Dipartimento di Scienze Politiche *International Economics*

DRIVERS OF LONG-RUN INTEREST RATES AND THE CURRENT ACCOUNT

RELATORE
Prof. Giuseppe De Arcangelis

Sofia Poggi
629382

CORRELATORE
Prof. Eloisa Campioni

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Abstract

Nowadays, the fall of (real) long-term interest rates is becoming one of the most "burning issue" of the global economy. The absence of an economic recovery is largely connected to real long-term interest rates close to zero and current account imbalances. The aim of the thesis is to analyze the main drivers that affect interest rates and current account imbalances. The thesis proposes an econometric methodology to assess future development in interest rates, estimating a panel dataset of 28 EU countries over a period of 21 years, from 1995 to 2015. The explanatory variables considered encompass most of the determinants discussed in literature and confirm the explanatory power of most of them. From an overall point of view, the estimations are complemented with projections over T+10 horizon.

1 Introduction

Real long-term interest rates have been declining from the 1980s and 1990s in the main advanced economies. Low interest rates have strong implications for the conduct of monetary and fiscal policies, for business strategy plans of financial institutions and much more for households and business. Thus, it is essential for policymakers to understand how interest rates are determined and identify the factors that have driven down real bond yields. Three broad explanations have been put forward: the role of monetary policy at home and abroad; the imbalances between desired savings and investments being significantly affected by demographic changes; or the imbalances between the demand and supply of safe assets.

In addition, after the global financial crisis, global imbalances increased moderately in 2015 due to a reconfiguration of current accounts and exchange rates. Firstly, the shift in 2015 was driven by the upturn in advanced economies, the fall in commodity prices, and the external conditions for emerging markets. In addition, adjustments of exchange rates have a leading role, as a matter of fact, the USD appreciated and the euro and the yen consequently depreciated; moreover, the suddenly growth of China and the depreciation pressure of Ems countries have led global economy towards a saving glut scenario, that has contributed to the decline of interest rates.

This thesis intends to collect available estimates of future long-term interest rates (over the T+10 horizon), complement them with own estimations and projections on a panel dataset of 28 EU countries, and provide an overview of the drivers and macro consequences of a low interest rate environment (LIRE) and current account. Some authors, such as Rachel and Smith, affirmed that the secular trend looks like to persist. They suggest as well that the global neutral real rate may settle at or slightly below 1% over the medium to long-run.

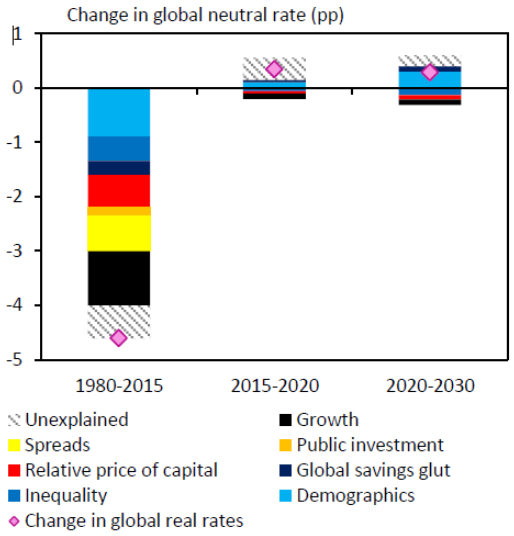
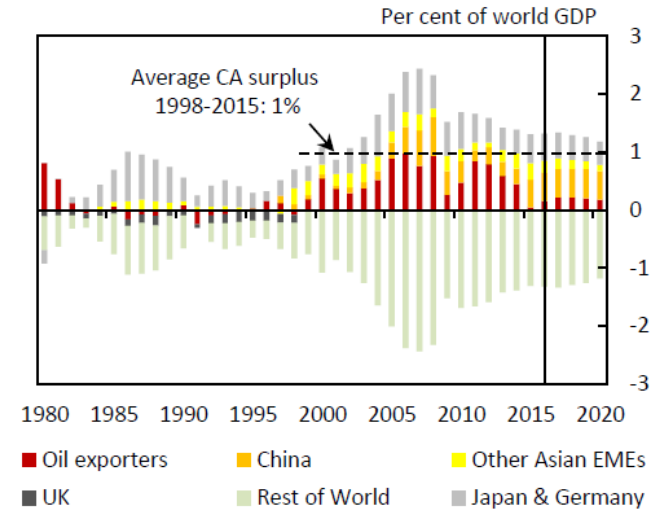


Figure 1 - Drivers of global real interest rate

In relation to current account imbalances, the IMF forecast for global imbalances suggests a gradual reverse of the EM saving glut in the future. This signifies the persistence of high current surplus in EMEs in the near future.



Sources: IMF and Authors' calculations

Figure 2 - Global Imbalances

The aim of this work is to improve the common understanding of the drivers of the long-run interest rate, which is an important determinant of the equilibrium across countries (current account imbalances) and, hence, an important input for the appropriate monetary policy stance.

2 Objectives and Scope

The crisis of 2007 has been an important common factor in the business cycle, financial markets dynamics and monetary policy conduct of several advanced economies.

2.1 Context

In a world characterized by a high degree of interdependence, one country's monetary policy may have strong implications on other countries' economies. **The financial crisis of 2007-2008 lays down its origin in global macroeconomic imbalances as well as in the failures of the financial system's management and supervision**. Around 20 years ago, excessive monetary easing, led by the Fed, has expanded money supply in emerging economies, making their central banks lower domestic interest rates, and creating bubbles at home. Consequently, emerging countries started to purchase US assets, originating bubbles in the US as well. Trade imbalances generated a global saving glut, providing cheap liquidity to the US market. One relevant example is the case of China and Asian economies, where a big surplus of savings in China and other emerging economies so called "Asian Tigers" was financing the American debt.

In addition, **trade imbalances are typically adjusted by relative currency exchange**. On one hand, currencies of countries with trade surplus should appreciate vis-à-vis currencies of countries with trade deficit, therefore making export less competitive and increasing consumption, investment in addition to imports. On the other hand, currencies of countries with trade deficit should depreciate vis-à-vis currencies of countries with trade surplus, therefore making import more expensive and export more competitive. Capital flow started in US during an extended period of low interest rates, from 2003 to 2005 and during a period of current near-zero interest rate policy from 2008.

In the aftermath of the global financial crisis, **real long-term interest rates have reached very low levels**. As policy rates approached and, ultimately, got stuck at their effective lower bounds, central banks' balance sheet adopted interest rates as the main policy instrument. When the global economy is under conditions in which monetary policy loses its power because the nominal interest rate is essentially zero and the quantity of money becomes irrelevant, it is possible to affirm that the economy is in the so-called "*liquidity trap*". A liquidity trap may be defined as a situation in which **conventional monetary policies have become ineffective**, because injecting monetary base into the economy has no effect: as a matter of fact, monetary base and bonds are viewed by the private sector as perfect substitutes. Indeed, **unconventional monetary policies such as the QE have been embarked on to counter the risk of economic and financial instability**.

Furthermore, because of the collapse of the financial system, the banking industry has suddenly changed. What has changed most with respect to the past decade is its **regulation**: banks have been asked to prove their ability to withstand crises, **capital requirements** have become far more demanding, and new rules for leverage and

liquidity have been introduced. Revised international rules, known as Basel 3, have forced banks to reinforce their solidity, adding equity and convertible debt to their balance-sheets. R**eturn on equity** have been lower than before the crisis. The increasing of the equity base trough expansionary and unconventional monetary policies pushed interest rates to very-low levels which have been followed up by big purchase of government bonds and other assets. The QE aimed at helping banks make funding cheaper and bosting economies, but lower rates and flat yield curves eventually compressed interest margins and profits. Moreover, the **financial sector reputation** dramatically dropped after the crisis.

2.1.1 Banking system timeframe[1]

The financial system scenario has changed a lot since its birth. Several rules and interventions have been made to shape the financial system and adjust the general instability during the years. Twenty years ago, the British government gave **the Bank of England the freedom to autonomously set interest rates**. That decision strongly raised the authority and purchasing power of central bankers together with the possibility of buying assets, targeting exchange rates and managing the economic cycle. At the beginning, central banks were created to enhance the financial power of governments to pursue several goals: **stabilizing currencies, fighting inflation, coordinating policies with other countries and reviving economies**. **The 19th century saw the emergence of another responsibility for central banks: the crisis management.** Only during the second world war, central banks resumed their initial role: keeping interest rates low and ensuring that governments could borrow to finance military spending. After this period, banks became more independent. **From the 1990s to the early 2000s, there has been a period of low inflation and economic stability**. Suddenly after, there was a rapid rise of assets prices and interest rates. When **the credit bubble burst in 2007 and 2008**, central banks were forced to take extraordinary measures, pushing rates down to zero and creating money to buy bonds and reduce long term yields. **The year 2010 marks an important time for consumers' protection and regulation supervision: the Dodd- Frank act.** It was introduced to provide the America's Federal Reserve with the authority to ensure financial stability. From this point in time, with short term rates approaching the zero-lower bound in late 2008 and early 2009, the Federal Reserve, the Bank of Japan, the Bank of England and the European Central Bank began to pursue **unconventional monetary policies – including forms of quantitative easing (QE)**. However, the first quantitative easing experiment finds its root in the dramatic situation of faltering growth that the Bank of Japan had to face in 2001. After having proceeded with several open-market operations, aimed at lowering the overnight interest rates down to the near-zero level (as targeted by the Japanese Overnight Call Rate), Japan's monetary operations started focusing on the outstanding balance of current accounts of commercial banks.

[1] This section is based on the article of the Economist 2017"- "The history of central banks", week April 29th – May 6th; pp 35-38.

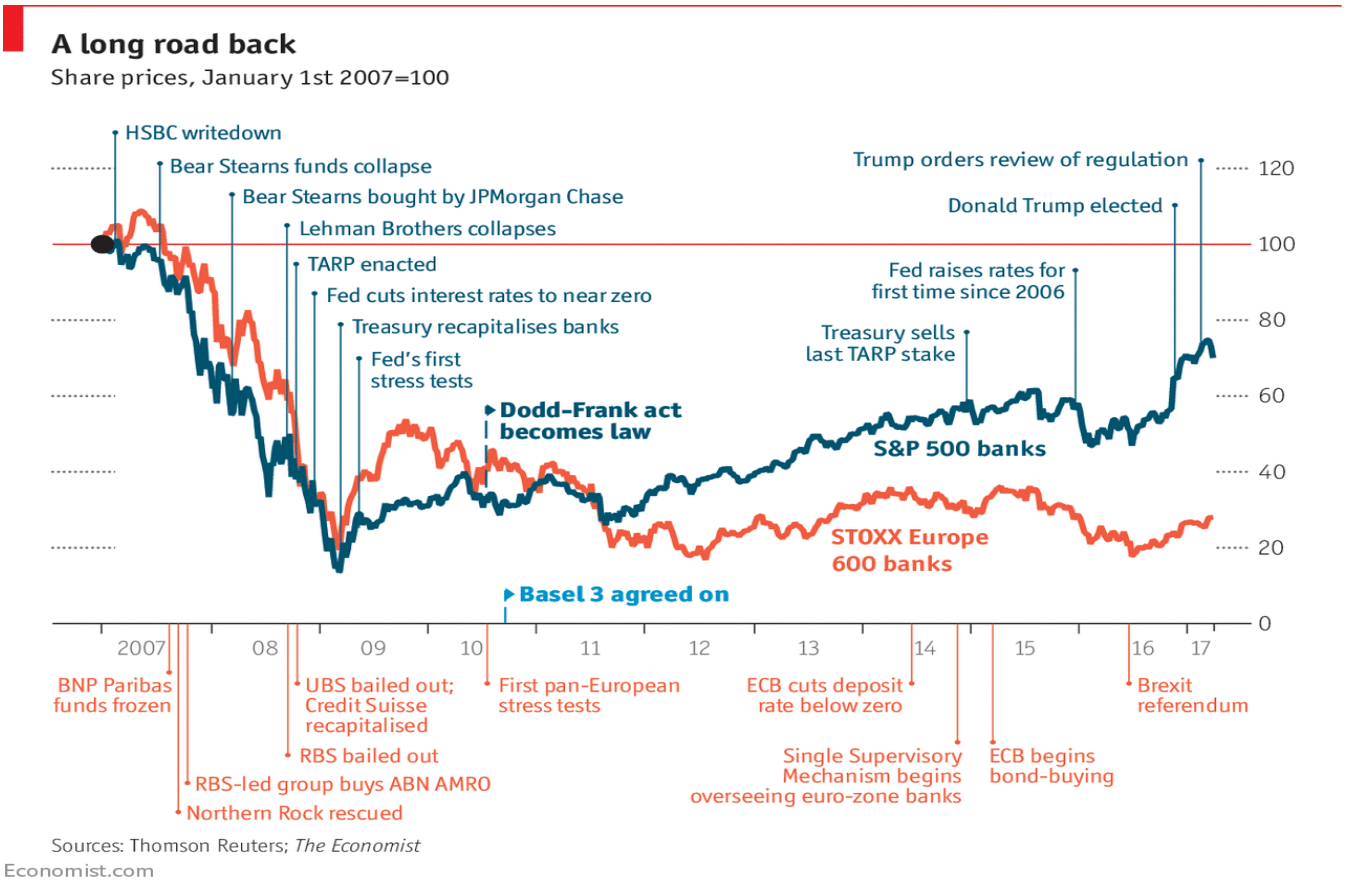


Figure 2 - A long road back

Japan's QE program took longer than expected to show its results. In 2008, in the middle of the "Lehman economic turmoil", the Federal Reserve announced its plan to launch quantitative easing measures in the US. **The policy of large-scale assets purchases made by the Fed since 2009 can be divided in three different rounds: QE1, QE2, QE3**. Over the period between March 2009 and January 2010, while the Federal Reserve was in the middle of its QE1 plan, after several unsuccessful attempts to the steer the economy out of the credit crunch, also the Bank of England released its first quantitative easing, a monetary measure taken to stimulate consumption and meet the 2% inflation target. **The last Bank that started a QE program was the European Central Bank.** Since the creation of the euro in 1999, one of the primary objectives of the European Central Bank has been the maintenance of price stability throughout a dramatic series of economic upheavals. In order to keep inflation rates close to the target percentage, during the financial crisis, the ECB responded with a medium-term-oriented monetary policy. After a first approach with a program of credit support (principally made of several LTROs and covered bond and ABS purchases), in 2010 the ECB announced the Securities Markets Programme, carried out in the euro public and private debt security markets to provide liquidity to their frailest segments. It was the fear of a deflationary spiral that, in January 2015, finally lead the ECB to unleash its first quantitative easing plan, intended to last until September 2016 extendable until the restoration of acceptable inflation rates. Nowadays, the exit of United Kingdom from the EU and Donald Trump election

have shaken the global stability again. What do we expect form the future? And, above all, what will affect global economy?

2.2 Objectives

The challenge of my thesis is to figure out a suitable econometric approach to assess future developments of interest rates as well as analyse the macroeconomic impact of central banks' balance sheet policies in a crisis period when interest rates reach the zero-lower bound. Nowadays, the fall of (real) long-term interest rates is becoming one of the most "burning issue" of the global economy. The absence of an economic recovery is largely connected to real long-term interest rates close to zero. Today, several research institutes, such as OECD, IMF and the European Commission, have already started addressing the issue.

The thesis proposes a simple econometric methodology to replicate the research 'studies carried out by others, implementing and taking in consideration new variables, updated data collection and statistical analysis. The aim of the thesis is to analyse the main drivers that affect interest rates and current account.

The key issue in assessing **long-run fiscal sustainability** is the future trend of the differential between the interest rate paid to service government debt and the growth rate of the economy. From an overall point of view, it is essential for policymakers to understand how interest rates are determined and identify the factors that have driven down real bond yields. This is the reason why different proxy connected with different economic area have been tested. The model estimation concern 28 States of the European economy, and all data have been gathered and transformed to make series as long as possible.

The analysis intends to specifically assess:

1. The variables affecting the long run interest rates and the current account and their explanatory power. Estimating a panel regression model with year data from EU 28 countries over the historical period before and after crisis (1980 – 2016).
2. On the basis of results, make projections on t+10 and to evaluate how fast interest rates are likely to return to more normal levels.

The assessment has been performed through the analysis of several institutional papers, in particular the work has been inspired on the OECD paper "Explaining the interest-Rate-Growth Differential Underlying Government Debt Dynamics" (Turner and Spinelli, 2011), subsequently used in their long-term growth scenarios (Johansson et al., 2013), and at the IMF to explain the persistence of negative IRGD in emerging and low-income countries (Escolano et al., 2011).

3 Methodology

Many factors affect interest rates and current accounts imbalances. On the one hand, there are those that favour a substantial increase in interest rates in the medium-term, inter alia, high and rising debt levels in advanced economies, ageing populations, and further financial deepening in emerging market economies, which should reduce their borrowing constraints and thereby their net savings. On the other hand, other factors work in the opposite direction, namely the long-lasting negative effects of the global financial crisis, and the trend decline in the relative price of investment goods. There are many authors who have analysed this vast field. For this reason, I conducted the analysis of my thesis taking in consideration several papers, following the main literature guidelines.

The paper follows this **methodology** and it comprises three main section:

1. **Analysis and reviewing of literature texts**: the first section analyses all papers and theories on several economic aspects that are considered the main drivers of equilibrium long-term interest rates and current account.
2. **Model creation and variables description**: on the basis of theories, time series on a set of 10 variables have been created or transformed by dataset stemming from European Commission or other main institutional bodies, to test the statistical validity and correlation.
3. **Empirical analysis of results**: as an outcome, the estimation of panel error correlation model, the results stemming from the model creation, and the robustness of data, combined with projections.

The analysis takes also in consideration the as-is evaluation of the global economy. As a matter of fact, the unconventional monetary policies have a big impact on the trend of interest rates. For this reason, a part of the thesis is focus on the impact and implications of a huge injection of monetary base and on the expenditure for health, pensions and education. However, at the end of our analysis we will understand that the last variable will be not significant for the prediction of LTI.

In conclusion, the work will suggest any potential improvement in order to predict how and when the long interest rates will recover and the current account imbalances gradually unwind.

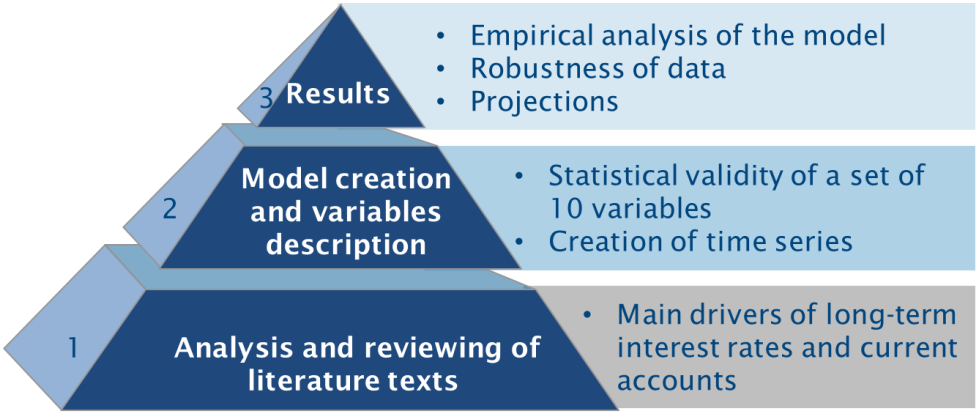


Figure 3 - Methodology

The thesis project is born in collaboration with the European Commission, C2-Fiscal sustainability unit, where I did a curriculum internship. Unit C2 is required to produce an annual report on fiscal policy trends. Research on interest rates drivers was part of my contribution. The majority of sources taken in consideration are documents produced by the European Commission itself, and the majority of data gathered to create the model series are contained in the Commission's confidential dataset called "Ameco".

The spirit and the main mission of the European Institutions is the experimentation of new models based on economic theories to improve European policies. As a matter of fact, the project is the experimentation and evaluation of aggregates of existent variables combined in different ways for different time period, with the intent to test their statistical validity.

3.1 Analysis and review of literature texts

The first section analyses all papers and theories on several economic aspects linked to nominal interest rates and current account. The study of long-term interest rates is always addressed in accordance with the principles of two mainstreams:

A. **Secular stagnation**: this theory affirms that although there is a lot of variation across countries, the presence of a discernible common trend suggests global factors are at work (Summer 2014). The theory of secular stagnation brings out the possibility that depression may become the normal condition of the economy" (Harry, Seymour E. 1943). Secular stagnation hypothesis comprises the following main topics:

Global real interest Rate: the follow of the real interest rates is symptomatic of a fall in global *neutral* rate**.** The global natural rate is determined by:

1. **Expectations of global trend growth:** such as expectations on global labour supply growth due to *demographic* forces and *technological* frontier, may cause global growth to slow by up 1 pp over the next decades.
2. **Preferences for savings and investments**: shift in the balance of desired savings and investments appear quantitatively even more important than changes in growth expectations.

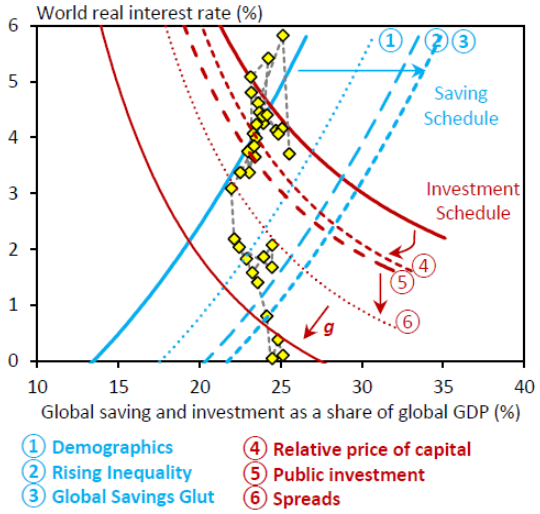


Figure 4 - Quantifying shifts in desired savings &investments

B. **Financial cycle**: this theory focusses on interactions between perceptions of value and risk, attitudes towards risk and financing constraints, which translate into booms followed by busts. These interactions can amplify economic fluctuations and possibly lead to serious financial distress and economic dislocations. This analytical definition is closely tied to the increasingly popular concept of the "procyclicality" of the financial system (Borio et al (2001), Danielsson et al (2004), Kashyap and Stein (2004), Brunnermeier et al (2009), Adrian and Shin (2010)).

Fiscal cycle hypothesis is focused on the following main topics:

1. **Credit cycle**
2. **Property prices**

This theory is in opposition with the common theory of business cycle and strictly connected with financial crises.

In addition to secular stagnation and fiscal cycle hypothesis**, current account imbalances** have been considered as a fundamental element to fully outline evolutions of long run interest rates. The key drivers of global imbalances are

1. **The asymmetric recovery and associated monetary policies in systemic advanced economies**
2. **The sharp drop in commodity prices (especially oil)**
3. **External financial conditions for Ems in part related to China' rebalancing process and prospects of monetary policy normalization of US**
4. **Global External Adjustment**

Moreover, an in-depth analysis has been carried out in relation to the policy implications of permanently low real interest rates:

- **Unconventional monetary policy instruments such as Quantitative Easing (QE)**

It seemed important to underline the role of QE programs as a further driven of the falling of long interest rates. The huge injection of monetary base has been considered as an important element for the model.

The aim of this section is to select, on the basis of literature opinion, the main variables affecting long interest rates and current account and test them for the creation of the model.

3.2 Model and series description

What has been done in order to create a simple econometric model was to decide on a set of 10 explanatory variables based on all papers investigated, such as OECD, IMF, Central Banks, EC papers and finding of relevant drivers of interest rates. Then data have been gathered for a panel of 28 EU countries ensuring necessary transformations.[2] Ten series of proxy connected to the 10 variables have been created. For each one, it will be explained all transformations and method that have been applied to create series and from where all data have been picked up.

3.3 Empirical Analysis

The following section presents the main results together with robustness checks and projections of the model. Commonly, economic series must be differenced before the assumption of stationarity can be presumed to hold. For this reason, I will divide my empirical analysis in this following step:

- Firstly, we carry out panel unit root tests with intercept and trend (Levin, Lin & Chu t* and Breitung t-stat) and level of integration. It is possible to choose to conduct the unit root on the **level**, on **firts difference**, or **second difference** of series. Panel data can have stationarity at different level.
- Secondly, we test stationarity of my regression using a panel least square method;
- Thirdly, we test the ECM residuals and residual correlation.
- Fourthly, we **capture long run relationship and short run dynamics.**
- Finally, we make projections for forecast LTI a t+10.

[2] Appendix 1 it is possible to find all variables transformations

4 Literature review

4.1 Mainstream

After 2 World War, nominal interest rates were above zero and according with Milton Friedman and Anna Swartz (Krugman) the experience of Depression of 1930s was cause by monetary contraction and that the Fed could have prevented it. Substantially, they believed that liquidity trap is not possible but it has happened and to the world's economy from 1990s (for instance, Japanese economy is stagnant since 1991).

The real natural rate of interest which used to be as high as 3.5% in 1990s has fallen to 1% or lower; with changes in the drivers unlikely to turn around quickly, the global equilibrium real rate may settle at slightly below 1% over the medium-long run. In 2009 the Commission together with Member States have postulated that the long-term interest rate would coverage to 5% in nominal terms (3% in real terms) for all countries by the T+10 horizon, staying constant thereafter. In the meantime, however the macroeconomic environment has been changing: long – term interest rates have continued their strong global downward trend began in the 1990[3](Gros 2016, Rachel and Smith 2015) inflation in the EA and EU has reached dismal levels and total public and private debt in major economies has increased by more than 20 pp to about 300% of GDP and though more sluggish lately, its expansion pace is still above the corresponding rate of economic growth (FT - Satyajit Das – 2016). In a context, the EC interest rate assumptions appear overvalued. While the outlook on interest rates must be combined with that on growth to gauge the impact on debt accumulation, the interest rates' role is a crucial one.

Low level of interest rates plays a key role in the nowadays debate for two reasons:

1. First, if real rates are low in normal times, adverse macroeconomic shocks are more likely to require negative real rates to restore a full-employment investment-savings balance.
2. Second, low nominal and real interest rates undermine financial stability.

Until today, expectations about future interest rate behaviour have been predicted using two main approaches, as follows:

1. **Secular Stagnation:** a "low for long" scenario argues that interest rates have declined permanently for **structural reasons on both the demand and supply side** (Ministere de l' economie 2016). The factors shaping preferences for savings and investment have changed, shifting the savings and investment curves and leading to a drop in the global inflation-adjusted natural rate of interest of 450bps over the past 40 years (Rachel and Smith 2015). Total factor productivity, demographic developments and

[3] the real natural rate of interest which used to be as high as 3.5% in the 1990s has fallen to 1% or lower; with changes in the drivers unlikely to turn around quickly, the global equilibrium real rate may settle at slightly below 1% over the medium-long run.

rising inequality are a few of the factors behind the excess supply of savings over investment (Rachel and Smith 2015). With changes in the drivers unlikely to turn around quickly, the global equilibrium real rate may settle at slightly below 1% over the medium-long run (Borio2012).

2. **Financial cycle:** a "back to normal scenario" argues that the current triggers of low interest rates are cyclical (temporary) and mainly linked to the financial cycle (Borio 2012). In this vein, real interest rates declined in response to the recession induced by the global financial crisis, as overly optimistic expectations on future income and revenues and excessively permissive regulation went into reverse[4], leading to an increase in aggregate savings and to a deleveraging process. With the "debt super-cycle" having now turned negative, interest rates would remain low for an extensive period as deleveraging is a long and persistent process[5].

4.1.1 Secular Stagnation

The term "secular stagnation" was coined by *Alvin Hansen* in his 1938 American Economic Association presidential address, "Economic Progress and Declining Population Growth." Writing in the latter stages of the Great Depression, Hansen argued that, because of apparent slowdowns in **population growth** and the pace of **technological advance**, firms were unlikely to see much reason to invest in new capital goods. He concluded that tepid investment spending, together with subdued consumption by households, lead to less demand for capital and a lower interest rate.

Larry Summers recently resurrected this idea in his November 2013 speech to the IMF Forum – fleshing out his thinking in a February 2014 speech to the National Association for Business Economics (Summers 2014). Summers thinks that Hansen's prediction was not wrong, just premature. For many reasons—including the contemporary decline in population growth, the reduced capital intensity of our leading industries (think Facebook versus steel-making), and the falling relative prices of capital goods—Larry sees Hansen's prediction of limited investment in new capital goods and an economy that chronically fails to reach full employment as relevant today. If the returns to capital today are very low, then the real interest rate needed to achieve full employment (the equilibrium real interest rate). The recent pattern of slow economic growth, low inflation, and low real interest rates motivates and is consistent with the secular stagnation hypothesis.

Larry Summers' *secular stagnation hypothesis* holds that achieving these three goals simultaneously may prove very difficult. For thinking about an economy's future growth, it is important to analyse:

A. **Output gap**: that is the deviation of actual growth rate from its potential growth rate.

[4] The self-reinforcing interactions between perceptions of value and risk, attitudes towards risk, and financing constraints can give rise to booms followed by busts (Borio, 2012 and Lo and Rogoff, 2015).

[5] Borio (2012) shows that peaks in the financial cycle tend to coincide with episodes of systemic financial distress and that financial cycles tend to be longer than business cycles.

The *potential growth* rate is focused on the Solow-Romer factors – growth may be low since the long-run potential growth rate has fallen. From Gordon point of view there are four main reason for slow future growth for the US:

1. Demography: The population is stagnant; life expectancy is increasing rapidly.
2. Education: The mass education revolution is complete, no further increase in the average US education level is to be expected.
3. Inequality: The raising share of the top 10% of the income distribution has deprived the middle class of income growth since 1980.
4. Public debt: The gloomy outlook for public debt makes current public services unsustainable.

The **Output gap** or **GDP gap**, is a Keynesian concept, growth may be low since it is below its long-run potential growth rate. This ware Summers' 2013 remarks: "Macroeconomic policy as currently structured and operated may have difficulty maintaining a posture of full employment and production at potential", he writes, "and if these goals are attained there is likely to be a price paid in terms of financial stability." In short, Secular Stagnation may force policymakers to choose between sluggish growth and bubbles.

In addition, long-lasting source of excess savings – and one that is particularly relevant to European nations like Ireland and Spain – is the 'balance-sheet recession' notion stressed by Richard Koo. When a debt-financed bubble bursts, firms and households simultaneously attempt to pay down their debt. While sensible at the individual level, the result is a lack of aggregate demand. If the new savings fail to find new investment opportunities, GDP may fall and Keynes's paradox-of-thrift can worsen balance sheets, thus prolonging the recession.[6](Baldwin R)

4.1.2 Fiscal Cycle

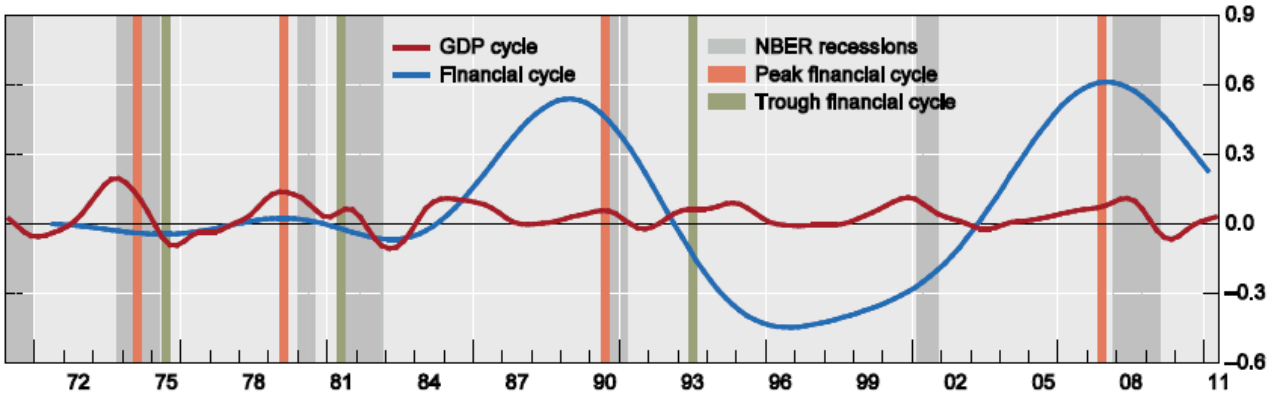
The definition of the financial cycle is quite debated. According with the majority of economists it will entails all self-reinforcing interactions between perceptions of value and risk, attitudes towards risk and financing constraints, which translate into booms followed by busts. These interactions can amplify economic fluctuations and possibly financial crises and economic imbalances. This analytical definition is strictly linked to the popular concept of the "procyclicality" of the financial system (e.g., Bormio et al (2001), Danielson et al (2004), Kashyap and Stein (2004), Brunner Meier et al (2009), Adrian and Shin (2010)). Arguably, *the most parsimonious description of the financial cycle is in terms of credit and property prices* (Drachmann et al (2012)). These variables tend to co-vary rather closely with each other, especially at low frequencies, confirming the importance of credit in the financing of construction and the purchase of property.
Financial cycle has several main characteristics:

[6] VOX EU – Baldwin R.

Firstly, the most interesting analysis is to value is to observe the interaction between this two sets of variables:

- Credit cycle (financial constrains)
- Property price (perception of value and risks)

Secondly, *the financial cycle has a much lower frequency than the traditional business cycle* (Drachmann et al (2012)). As traditionally measured, the business cycle involves frequencies from 1 to 8 years. By contrast, the average length of the financial cycle in a sample of seven industrialized countries since the 1960s has been around 16 years.



Orange and green bars indicate peaks and troughs of the financial cycle measured by the combined behaviour of the component series (credit, the credit to GDP ratio and house prices) using the turning-point method. The blue line traces the financial cycle measured as the average of the medium-term cycle in the component series using frequency-based filters. The red line traces the GDP cycle identified by the traditional shorter-term frequency filter used to measure the business cycle.

Source: Drehmann et al (2012).

Figure 5 - Financial cycle

Thirdly, *peaks in the financial cycle are closely associated with systemic banking crises* (henceforth "financial crises" for short). In the sample of seven industrialized countries thesisd above, all the financial crises with domestic origin (i.e., those that do not stem from losses on cross border exposures) occur at, or close to, the peak of the financial cycle.

The close link between the financial cycle and financial crises underlies the **fourth** empirical feature: *it is possible to measure the build-up of risk of financial crises in real time with good accuracy*. Specifically, the most promising leading indicators of financial crises are based on simultaneous positive deviations (or "gaps") of the ratio of (private sector) credit-to- GDP and asset prices, especially property prices, from historical norms (Bormio and Drachmann (2009), Alessi and Detken (2009)).

The length and amplitude of the financial cycle are no constants of nature, of course; they *depend on the policy regimes in place*.[7] Three factors seem to be especially important: the financial regime, the monetary regime

[7] This underlines a critical point: the financial cycle as defined in this essay should not be considered a recurrent, regular feature of the economy, which *inevitably* unfolds in a specific way (ie, a regular and stationary process). Rather, it is a tendency for a set of

and the real-economy regime (Bormio and Lowe (2002), Bormio (2007)). Financial liberalization weakens financing constraints, supporting the full self reinforcing interplay between perceptions of value and risk, risk attitudes and funding conditions. A monetary policy regime narrowly focused on controlling near-term inflation removes the need to tighten policy when financial booms take hold against the backdrop of low and stable inflation. And major positive supply side developments, such as those associated with the globalization of the real side of the economy, provide plenty of fuel for financial booms: they raise growth potential and hence the scope for credit and asset price booms while at the same time putting downward pressure on inflation, thereby constraining the room for monetary policy tightening (Bormio 2012).

variables to evolve in a specific way responding to the economic environment and policies within it. The key to this cycle is that the boom sets the basis for, or causes, the subsequent bust.

4.2 The drivers of equilibrium long-term real interest rates and current account

Two perspectives could help define the drivers of long-term real interest rates. A broader one considers funding sources more generally looking at the global **natural level of interest rate that derives from a given savings – investment relationship**. A stricter perspective sees $r\,{}_{t}^{LT}$ as **the equilibrium price of borrowing on the bond market.**

4.2.1 Global real interest rate

The global neutral real rate affects country specific equilibrium policy rates or R* (defined as the real rate that would deliver policymakers' objectives in the medium-term). According with Rachel and Smith, the global neutral rate it is considered as an anchor for equilibrium rates in countries that import and export a lot, it means that are keen on the idea to be economically open.

However, there are many reason that can lead global real rate to deviate from the long-run equilibrium (neutral) Rate, most of them are due to cyclical factors. Beyond cyclicality the other bunch of hypothesis is that market measures of global real rates based on long-term bond yields have been affected by low short-term interest rates i.e. 'global rates are low because monetary policy is loose'. But as Broadbent (2014) and Bernanke (2015) have pointed out, this view of the world is quite difficult to be correct as the fall in actual real interest rates has occurred in a moment of contained inflation with little sign of demand growth. Indeed, global growth and inflation have been normal, despite interest rates being very low. Monetary policy is not the caus of the fall in long-term rates. Laubach and Williams (2003) perform an exercise for the US and find that US R* has declined by around 450bps since the 1960s, and by around 300bps since the 1980s. The authors suggest that secular trends related to changes in trend growth and shifts in saving an investment preferences are responsible for this decline – not monetary policy(Rachel and Smith 2015)

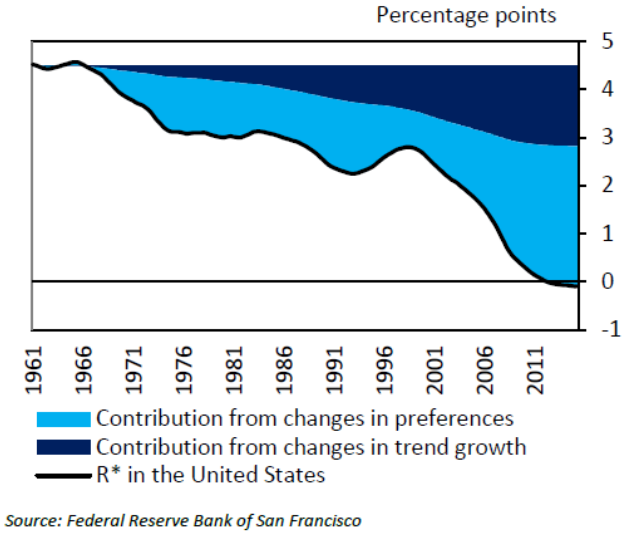


Figure 6 - Laubach - Williams estimates of the equilibrium real interest rate in the US

In addition, global Real rate relates to two types of elements:

1. **Global factors**: it comprises persistent headwinds that can take several years or even decades to subside and short run global cycle factors (level of confidence).
2. **Country- specific factors**: it comprises country- specific structural factors (such as demography, rate of productivity growth and education), country specific cyclical factors and headwinds and country-specific policy- stance.

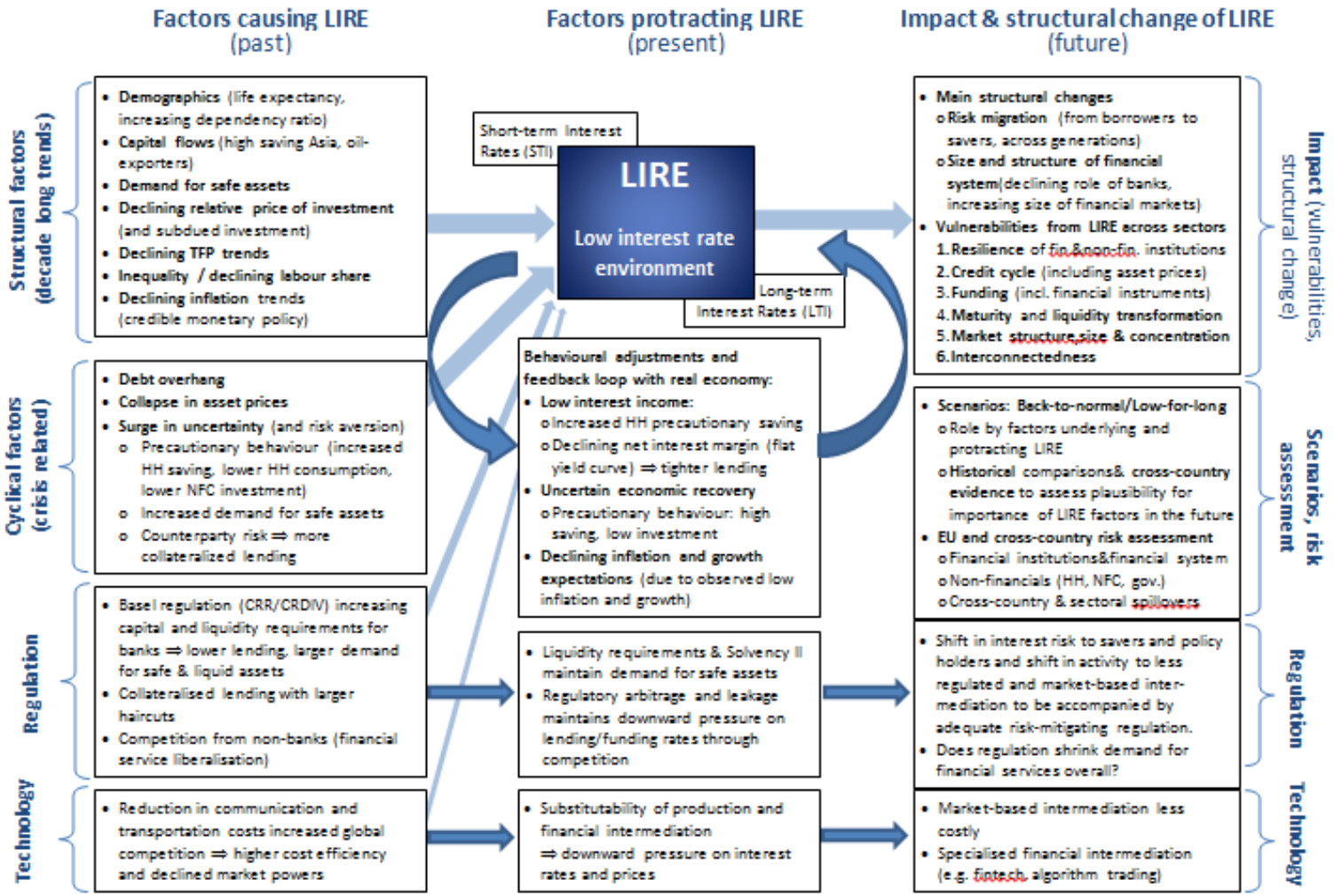
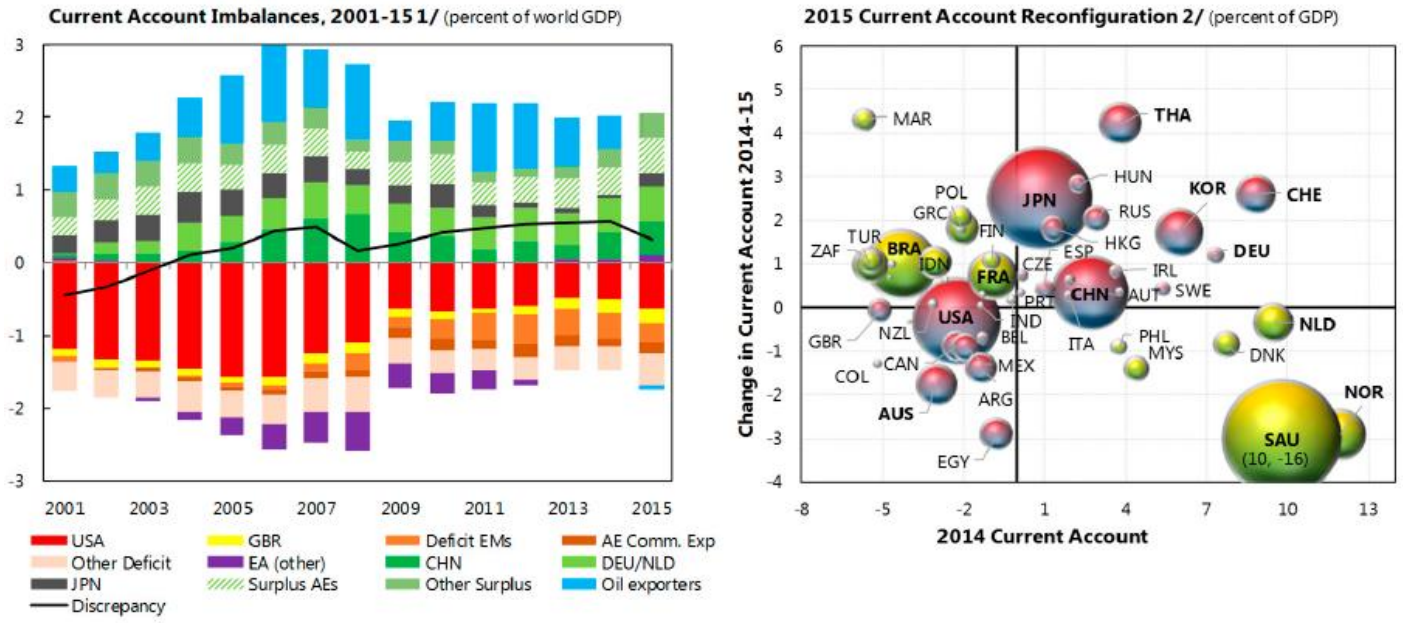


Figure 7 - Factors related to low interest rate environment

Source: ESRB 2016 based on the Joint ATC/ASC/FSC Task Force on "Macroprudential Issues and Structural Change in a Low Interest Rate Environment".

4.2.2 Global imbalances

In 2015, global current account imbalances increased moderately. The huge increase of global imbalances was led by some economies such as Japan's current account surpluses, the euro area and China and increasing deficit in United States. Surplus also grew in many economies such as Korea, Sweden, Switzerland, Singapore, Hong Kong that were principally commodity- importing and deficit increased in some commodity exporting advanced economies such as Australia, Canada. This widening was partly counterbalanced by reduced surplus of large oil-exporting countries, most noticeably Saudi Arabia and Norway, that became a large deficit as well as narrowing deficits in key Ems (Brazil, Indonesia, South Africa, Turkey).



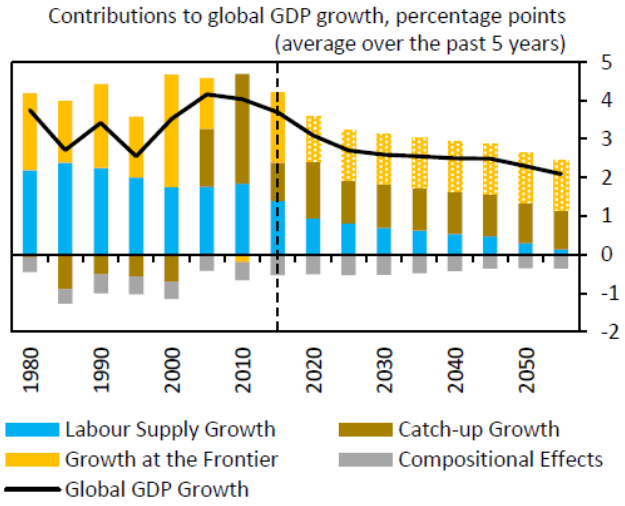
Sources: World Economic Outlook and IMF staff calculations.
1/Surplus AEs: Korea, Hong Kong SAR, Singapore, Sweden, Switzerland, Taiwan POC; AE Commodity Exporters: Australia, Canada, New Zealand; Deficit EMs: Brazil, India, Indonesia, Mexico, South Africa, Turkey; Oil Exporters: WEO definition plus Norway.
2/ Red (green) bubbles indicate widening (narrowing) of imbalances. Bubble sizes are proportional to the change in current account, in percent of world GDP (i.e., contributions to reconfiguration of global imbalances).

Figure 8 - Evolution and Reconfiguration of Global Current Account Imbalances 2001-15

Real exchanges rate movements accompanied the reconfiguration of current accounts. During 2015**,** we assisted to the depreciated in nominal terms of many countries vis-à-vis the U.S. dollar leading to a sharp appreciation of the latter in real effective terms, as well as of currencies closely linked to it. Closely tied to the USD, China's currency also appreciated sharply in real terms. The euro and the yen depreciated significantly both in nominal and real terms, as well as currencies of many commodity-exporting economies (e.g. Australia, Brazil, Canada, Russia). These sharp currency movements during 2015 occurred were originated to other already imbalances from previous years, and contributed in different degrees to recent current account dynamics (IMF 2014).

4.3 The drivers of real interest rates from the angle of interbank market equilibrium

Nowadays, interest rates across world are low. The causes of this situation are to be found in many factors. Firstly, the changes in growth rates are due to four main motivations: demographic rates, achievement of a good educational level, lowering labor supply, and slowing down technological advances. Moreover, the changes of the investment equation due to the disequilibrium of the balance of payments of the various countries contributed to the fall of interest rate. Considering the global situation of economies, governments decided to consider and implement non-conventional policy instruments such as the QE.



	1980 to 2015	2015 to 2030
Change in Global Growth	0.0pp	0 to -1.5pp
Labour Supply Growth	-0.8	0 to -0.5
Catch-Up Growth:	+1.0	-
Growth at the frontier:	-0.2	0 to -1.0
Educational plateau	-0.2	0 to -0.2
Inequality	0.0	0 to -0.6
Fiscal	+0.2	0 to -0.2
Technological progress	-0.2	-

Sources: TED, US Conference Board, IMF, UN and Authors' calculations

Notes: Global growth is expressed in constant PPP-weighted 1990 dollars. The grey 'compositional effect' bars in the chart show the impact on average global per capita incomes of having high population growth in low-income countries.

Figure 9 - Drivers of long interest rates

Let's analyses each driver deeply, looking at literature papers and motivations of why that is and what may happen going forward.

4.3.1 Growth and interest rates

Trend growth is the most commonly cited reason for the decline in real interest rates. This reason is in line with Alvin Hansen's secular stagnation hypothesis. He argued that because of apparent slowdowns in **population growth** and the pace of **technological advance**, firms were unlikely to see much reason to invest in new capital goods. He concluded that tepid investment spending, together with subdued consumption by households, lead to less demand for capital and a lower interest rate.

The two main components of trend growth are:

1. Productivity growth
2. Population growth

Evidence of this statement derives from Ramsey's framework. (Figure 10).

'Neoclassical' formulation: $r^* = q/\sigma + \theta + (\alpha \cdot n)$

Where:

r^*	Real interest rate consistent with inflation at target and zero output gap in the long-run
σ	Household's inter-temporal elasticity of substitution in consumption (preference for smoothed consumption)
q	Rate of labour-augmenting technological change
θ	Household's rate of time preference (patience)
n	Rate of population growth
α	Coefficient on the rate of population growth[(a)]

[(a)] The infinite horizon representative agent Ramsey model does not include population growth in the steady state real rate formulation. But there may be good reasons to include it (e.g. see Baker, Delong and Krugman, 2005).

Figure 10 - Ramsey Framework

Intuitively, **productivity growth** (***q***) is positively related to real interest rates in the model. The Ramsey-rationale for this is that weaker productivity growth reduces household's expected future income, meaning households must save more to sustain consumption in the future. Higher saving then translates to a higher rate of capital accumulation, which leads to a higher capital-to-output ratio in the long-run and a lower marginal product of capital. Since the real interest rate in the model equals the marginal product of capital, real rates also fall.[8] But what is perhaps more interesting about the Ramsey framework is that the mapping from productivity growth to real rates depends on household preferences for smoothed consumption over their lifecycle (σ).[9]

For what concern **population growth** and interest rates their relationship is less obvious and more complex. According to Ramsey, population growth should not be considered as a driver of low interest rates, he claims in fact that "there are infinitely lived households who do not grow in number, only in size". On the opposite is Hansen's opinion, he emphasized the important role of population growth as confirmed by baker, Delong and Krugman (2005) and Baker. If we consider the Solow model, labour and capita are considered complementary. So, slower population growth means fewer workers available to work on machine as well as a reduction of marginal product of capitals, pushing down interest rate. A practical example is Japan's population has fallen by nearly one million, according to new statistics – the first decline since official census records began in the 1920s.

[8] (Rachel and Smith 2015), a shift in household savings is just one mechanism by which productivity changes could feed through to real interest rates. An alternative channel is that weaker productivity growth could affect firms' investment intentions. Weaker productivity growth will mean a lower rate of return and mean firms are less willing to invest at a given interest rate.

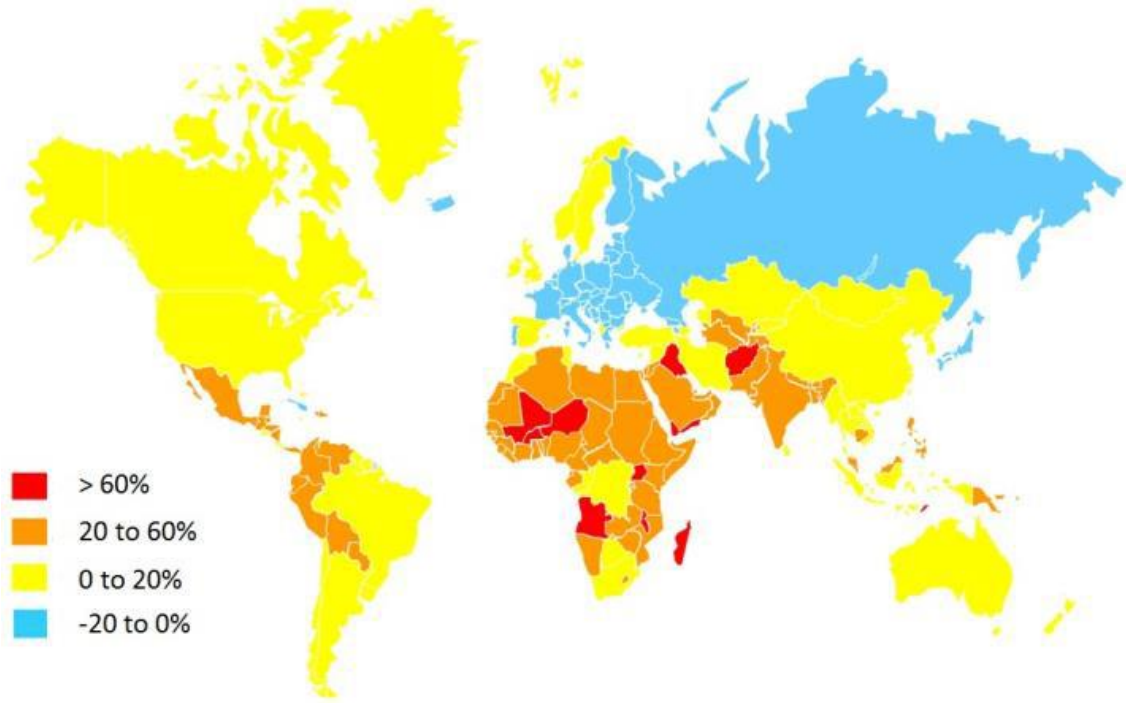
[9] (Rachel and Smith 2015), the other household time preference parameter, θ (household's degree of patience) can also affect real rates. The rationale is that more patient households are willing to defer more consumption today for a given rate of return in order to consume more in the future (low θ). Put differently, patient households are more willing to save, which results in a lower real interest rate.

It is possible to distinguish productivity growth between:

A. Growth at technological frontier (driven by invention)
B. Growth driven by those countries converging to the frontier (catch-up)

4.3.2 Demographic Growth

For what concern demographic growth, **the post war years has been driven by demographic boom**. The increasing health standards, the falling of mortality rates and the economic boom in advanced economies were the mains reason of population growth. In relation to emerging countries, most of them are still adding tens of millions of people to the global population each year. On the other hand, other countries as Japan and Western Europe are in decline. For instance, Japan's population has fallen by nearly one million, according to new statistics – the first decline since official census records began in the 1920s. In the near past, the country lost 947,345 people – more than the population of San Francisco – between 2010 and 2015.



Source: UN Population Projections
Thesiss: Working-age population is defined crudely as those aged 20-64

Figure 11 - Population growth from 2010 to 2025

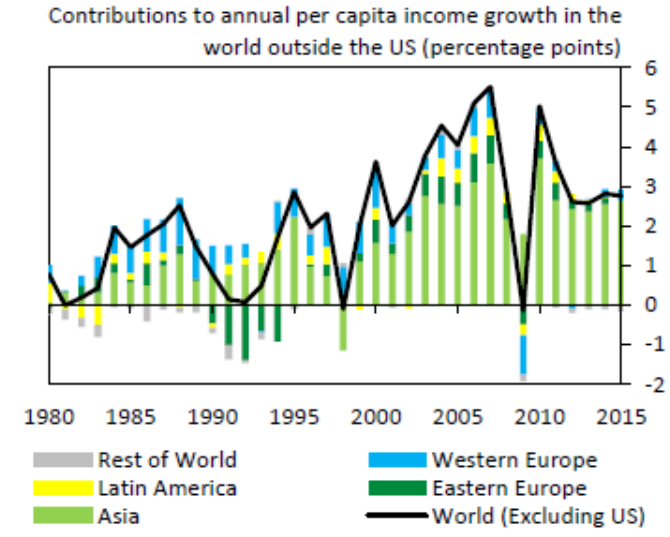
In addition, according to the UN, the global population should continue to expand from 7 billion to just under 10 billion by 2025. In relation to demographic growth is important to distinguish between:

- Growth of the total population ad growth of the labour force
- Growth of the population and capital accumulation

Population growth can affect interest rates by directly affecting labour supply growth, but population growth can have a wider impact on trend growth than that, as a matter of fact, according to *Kuznets*' theory there are many links between population growth and per capita GDP growth. **He echoes Hansen by linking the rate of capital accumulation to labour supply** – arguing that to maintain output per worker, more capital would be required to support a larger workforce. So, **rapid population growth should also increase capital accumulation and hence growth**. Demographic growth can also have a dual role, from one side, could still have an impact on real rates through productivity because population growth can lead to higher productivity growth, it means young workers, new adopters of new product, technology innovations. Otherwise, there are several cons to Kuznets' theory such as: scarcity of resources can be a constraint.

Catch up growth

For what concern emerging economies, **productivity catch up** can have a key role in economic growth. The catch up scenario is based on the theory of convergence and it means that poorer economies tend to grow more rapidly than wealthier economies, all economies in time will converge in terms of per capita income. In other words, the poorer economies will literally "catch-up" to the more robust economies. The typical example of this theory is the case of China, that has started to growth faster that other world economies since 1980s. The country's GDP has grown by an average of 10% in the last 30 years, turning China from a backward agricultural economy to world economic power.



Sources: Conference Board TED (2013) and IMF WEO (April 2015)

Notes: Figures are PPP weighted and refer to real GDP expressed in constant 1990-US Dollars.

Figure 12 - Catch up growth since 1980s

However, even if the catch-up growth tended to increase over the period, **the catch- up growth could not be a key driver of the interest rates decline.**

According to Rachel and Smith point of view, it is possible to predict that "If all countries caught up to US per capita income levels it would increase the level of world GDP by 270% i.e. world GDP would be almost four times the size it is now. In growth rate space, if this convergence occurred over a reasonable period (20-200 years), it would add around 130pp to global growth spread out over the convergence period. So, if all countries caught up to the US by the year 2100, it would add 1.5pp to global growth on average each year (130pp divided by 85 years), while if it took until the year 2200 it would add 0.7pp to growth each year (relative to a base case with no catch-up). Full convergence takes place by around the middle of the 22nd Century" (Rachel and Smith 2015)

4.4.3 Education, Inequality and Public indebtedness

Looking ahead, (Gordon 2014) argued that several factors can attempt to hold back US growth:

1. **The pace of educational attainment**: the major constrain in relation to education is that college education is extremely expensive. Most American families are forced to be indebted to provide education for their children, in fact the difference between earnings and the cost of education is enormous for most them. There are several reasons to affirm that the rate of human capital accumulation will decline in the future. To maintain the same level of education would be necessary to find more innovative educational solutions, focusing on the quality of education not quantity. (Jorgenson and Vu 2010), who estimate that human capital's contribution to US growth fell by 0.1-0.2pp since 1995. Put another way, ***the slowing pace of educational attainment may have pushed down growth at the technological frontier by up to 0.2pp.***
2. **Rising Inequality**: According to Cingano (2010), rising inequality is one of the main driver of slower growth. On the one hand, inequality may boost growth by incentivizing individuals to work harder and take more risks. Richer individuals also tend to have higher saving rates, so if savings are used for productive investment that too can boost growth. But rising inequality can also harm growth. Three channels are frequently highlighted in the literature:
    - Endogenous fiscal policy – Rising inequality may reduce the incentives for businesses to invest, as inequality could lead voters to insist on higher rates of corporate taxation and regulation.
    - Under-investment in human capital – With wealth increasingly concentrated among the economic elite and with limited access to credit for the less well off, lower-income households may be unable to afford higher education resulting in less human capital accumulation.
    - Less demand for innovation – If the adoption of advanced technologies depends on a minimum amount of domestic demand, inequality can reduce the incentives to innovate as the propensity to consume of the population will fall as inequality rises. This latter channel is an example of inequality having a persistent impact on demand, which then affects the supply side of the economy.

It is possible to imagine that there is an overlap between rising inequality and slowing educational attainment. According to literature, rising equality can bring human capital accumulation to slow and vice versa. What seems more credible and connected is that rising inequality may have resulted in a significant increase in global savings, which have put downward pressure on real interest rates.

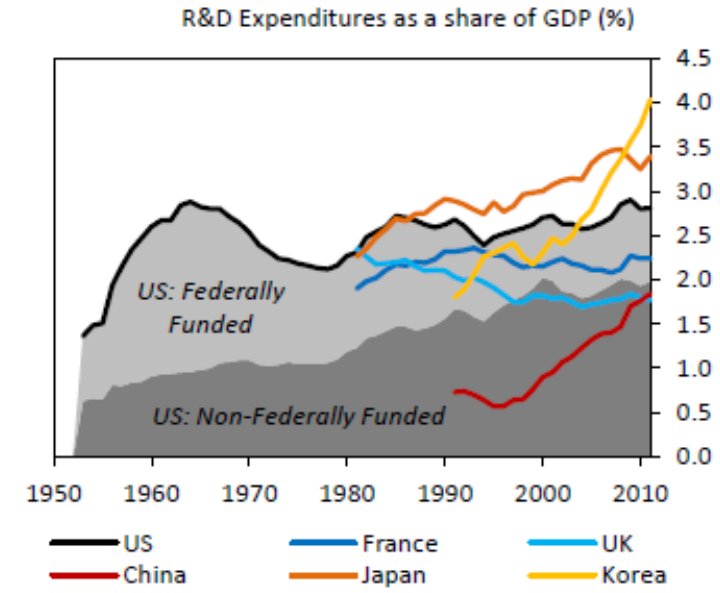
A. **Public indebtedness:** if we shift our point of view from supply side to demand side, another factor that could foster growth is long term fiscal expansion. Looking ahead, the argument is that with debt levels already at high levels there is limited scope for further fiscal expansion to continue to support growth – hence growth will be weaker in the future than it has been.

4.3.4 Innovation and technical progress

When we think about the future, the most important topics in economics is technology. (Fernald and Jones 2014) created a framework on which factors influence innovation. Their accounting model states that technical progress is defined by an ideas production function that depends on two inputs:

A. The stocks of ideas
B. The rate of return on innovation (how much output each idea generates)

Stock of ideas: a higher number of people doing research means that more funding is available as well as more ideas born. From Fernald and Jones's point of view, the number of research is linked to the size of labour supply. **However, they demonstrated that even if demographic growth decline and the number of research reduce, the flow of new ideas could still maintain, if a huge amount of national income is reserved to R&D.** In recent years awareness of the importance of research has led to a sharp increase in investment, in fact there are good reason to think that this trend could continue or even accelerate in the future. Firstly, because most of investments are carried out by private entities so the fear of cuts in public spending do not concern research. Second, emerging economies such as China and Asian tigers, have increased rapidly R&D investments, shifting the frontier of technologies and pushing advanced economies to invest more on it. Thirdly, the number of self-made investors has raised and it incentives big companies to spend time on R&D as it seems a profitable strategy.



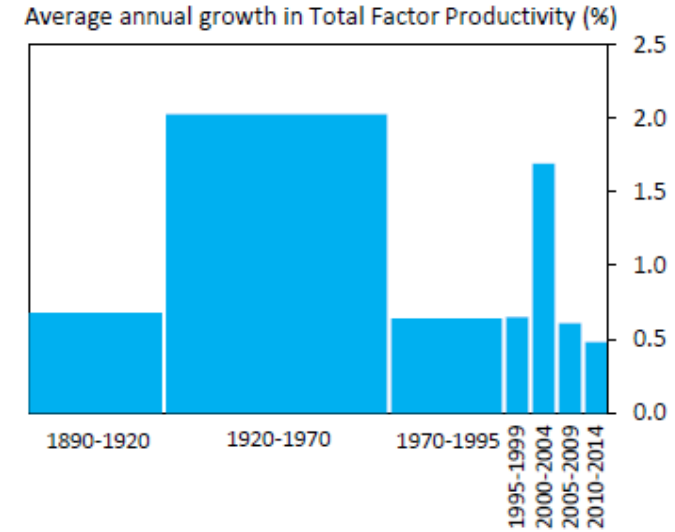
Source: NSF Science & Engineering Indicators 2014

Figure 13 - R&D spending in the world

The rate of return on innovation: this section answer to the following question: How effective those ideas will be in boosting output? Having a glance at the past, if we consider US TFP growth, Fernand and Jones has estimated that history is characterised by a series of "innovation waves" rather than a steady raise in productivity (Fernand and Jones 2014). However, Gordon states that US TFP is characterised by two distinct innovation waves:

1. The second industrial revolution
2. ICT revolution (1990s to 2000s)

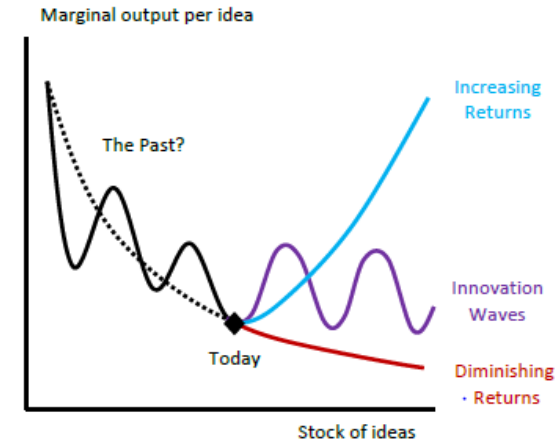
Gordons affirmed that only during these moments the productivity growth was unusually high, after the returned to their standard value.



Source: Gordon (2014)

Figure 14 - USA TFP Growth

Nowadays, there are several opinions on the future trend of technology. Some visions are more **optimistic** such as (Brynjolfsson &McAfee 2014) that "seem to largely agree with Gordon's characterisation of the history of US innovation up until the ICT boom, but they take a very different view about the recent productivity slowdown and the direction of travel going forward. They argue that new technologies are often disruptive and take time to be fully integrated into production processes. Indeed, they thesis that a productivity paradox was also a feature of the second industrial revolution – electricity was first introduced to American factories in the 1890s but it took 20 years for the benefits to show up in labour productivity growth. They argue the same is happening now – the 'second machine age' (or digital revolution) started back in the 1970s, but only started to show up in the productivity statistics during the ICT boom of the late 1990s. The more recent productivity slowdown is therefore just a sign of growing pains as production processes adjust to the new technologies. And, just as was the case in the electrification era, productivity will soon accelerate rapidly. Moreover, productivity could rise exponentially(Kurzweil 2015) because of positive feedback; the results of one stage are used to create the next stage .It means that computers will overtake humans in their ability to innovate. Some opinions are more **pessimistic** because suggest the returns to innovation are in decline (red line, Figure 10). One argument, highlighted by Summers (2013), focuses on shifts in employment between sectors and differences in productivity levels. Some sectors like manufacturing, extraction and ICT have the highest level of labour productivity. However, the high demand for health care and social services, implicate a high number of workforces. Nevertheless, is not fully possible to automate health care services and it means that they tend to have lower output levels per workers, pulling down average productivity per worker. In addition, what Gordon states is that "the low hanging fruit has already been picked"(Gordon 2010) it means that the pick of technology has been achieved in 20th century and cannot be repeated.



Source: Adapted from Fernald and Jones (2014)

Figure 15 - Returns to innovation

From an overall point of view, it is possible to affirm that TFP growth has not slowed and is not responsible for the falling of interest rates because it observed that technical progress will continue even growth at frontier will be weaker.

4.3.5 Saving – investment preferences

Global growth changes can partially explain the secular decline of interest rates and trade imbalances of current account. It seems reasonable to affirm that the main factor affecting global interest, mainly after post war period, is the **shifting in time preferences, it entail all decisions on consumption spending. The analysis is focused on intertemporal decisions in relation to savings- investments framework. It is important for the analysis to pay attention on the desired savings and investments.**

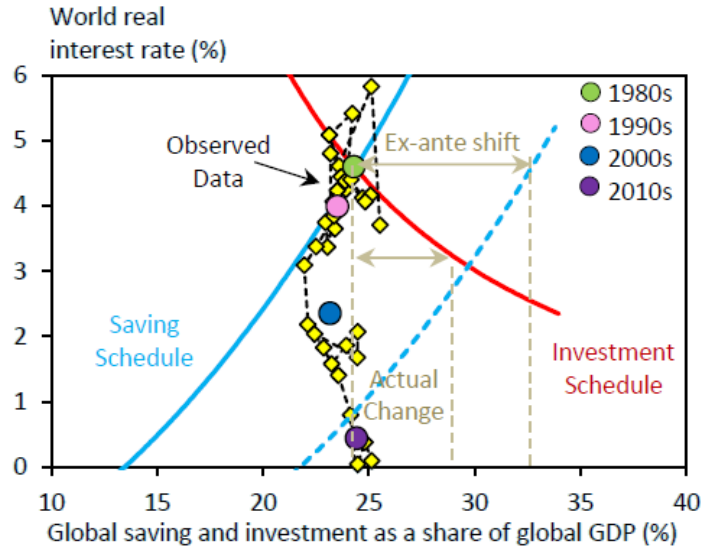
The S-I relationship explain that if the interest rates raise, the desired savings will tend to rise as well. Savings and interest rate are positively correlated, as a matter of fact, the return on money deposited in bank is higher and people prefer to save rather than invest. On the other hand, if the interest rates raise, the investment tend to fall because it became costlier to invest. As opposite, if the interest rates decrease, the desired investment raise. Investing become more convenient rather than keep money in bank with a lower rate. If we imagine living in a close economy, with no import or export relation with the rest of the world, actual savings and investment will always be equal by identity. In this work, it is important the slope of the equation, in other words, the sensitivity and the factors that push people to prefer to save or investing.

Is not possible to estimate the sensitivity of S-I slope, for this reason we can only rely on existing estimation stemming from the literature. Several authors have made time-series correlation, as it is reported form table below. However, it is robust to take an average of available estimates form the literature, so for the **elasticity of savings it is suggest an elasticity of 0.5.**

Author of study:	Elasticity
Blinder (1975)	0.03
Boskin (1978)	0.4
Carlino (1982)	0
Carlino & Defina (1983)	0
Gylfason (1981)	0.3
Heien (1972)	1.8
Howrey & Hymans (1978)	0
Summers (1982)	1.3
Taylor (1971)	0.8
Wright (1967)	0.2
Average:	***0.5***

Figure 16 - Literature estimates of savings' elasticity

In relation to the elasticity of investment, it has been taken the value -0.7. It is a value between -0.5 and -1, and it rely on more recent studies (Guiso et al, 2002, Gilchrist & Zakrajsek, 2007 and Ellis and Price, 2003). This makes investment more sensitive respect to savings, and the reason is the drop in relative price of capital goods. Considering the data and the figure below, it is possible to states that that despite the 450bps fall in global real rates, global savings and investment have remained stable as a share of global GDP over the past 30 years. It seems that that either savings or investment are insensitive to changes in real rates (one of the curves is vertical). However, it is reasonable to think that both curves must have shifted. So, let's understand which factors have caused the shift of curves and to what extent.



Sources: IMF, King & Low (2014) and Authors' calculations

Figure 17 - S-I framework

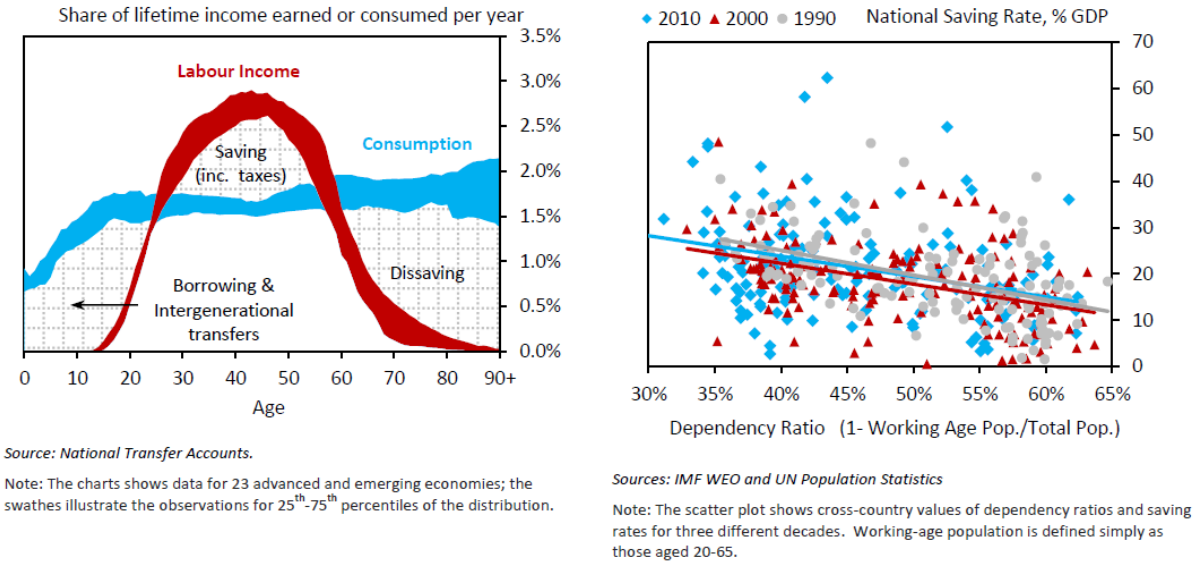
Factors affecting savings

Three are the main secular trends affecting savings:

1. Demographic structure of the global population
2. Rising inequality
3. Preferences shift by emerging market (the EM saving glut)

Demographics

The life-cycle hypothesis suggests that inside population structure **the part of people that tend to save more is the working age population**.



Source: National Transfer Accounts.

Note: The charts shows data for 23 advanced and emerging economies; the swathes illustrate the observations for 25th-75th percentiles of the distribution.

Sources: IMF WEO and UN Population Statistics

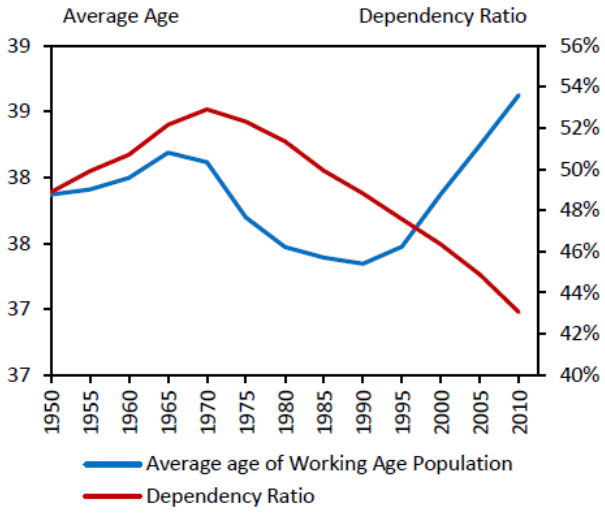
Note: The scatter plot shows cross-country values of dependency ratios and saving rates for three different decades. Working-age population is defined simply as those aged 20-65.

Figure 18 - Savings rate and dependency ratio

Considering cross sectional data, the relationship between the **dependency ratio** (the proportion of the population not of working age) and national savings rates is negative.

From IMF studies[10], has been estimated that every 1pp fall in the dependency ratio translates to around a 0.5pp rise in national saving rates. As a matter of fact, over the past 30 years the portion of dependents (does not of working age) has fallen from 50% to 42%. In opposition to the common idea that the proportion of old-age dependents rise, the fall of the portion of young dependents has more than offset this effect.

[10] IMF WEO and UN Population Statistics

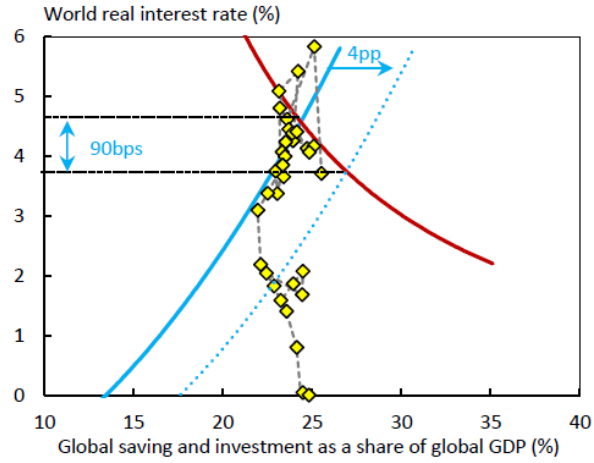


Source: UN population projections

Notes: The dependency ratio is defined as the proportion of the global population that are not of working age (working age = 20-65 years old)

Figure 19 - Dependency ratio

Figure 15 shows that the average age of the world's working population has risen from 37.5 to 39 between 1980 and 2015.So, due to changes in the composition of the global population has been observed a shift the desired saving schedule. **Overall, demographic forces, which have reduced the number of dependents per worker, are likely to have pushed up on desired saving rates, accounting for around 90bps of the fall in global real rates and 4pp raise for desired savings**.

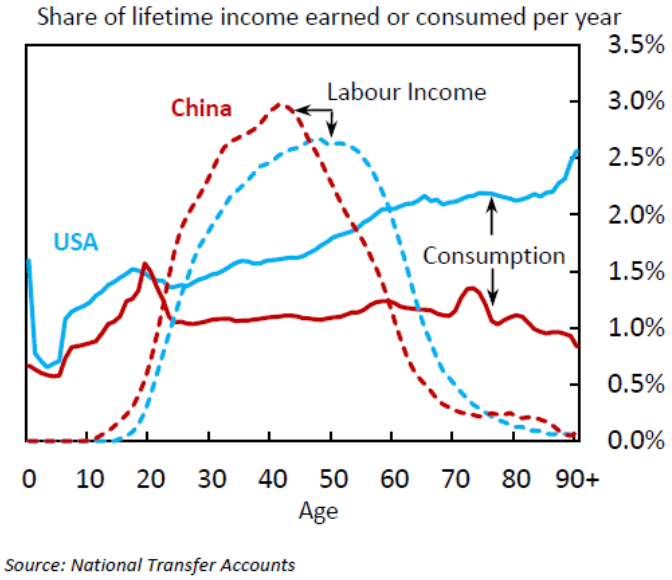


Sources: IMF and King & Low, 2014 and Authors' calculations

Figure 20 - Changes of global population

Looking ahead, the dependency ratio should stop falling because has been observed a raise of share of global population entering retirement age. However, the reversal is not certain. Considering the OECD statistic, the average retirement should reach 67 in 2030, it also means that people will be keener on saving instead of investing, to embark on a longer retirement. In addition, it is proved that old dependents have lower saving respect to young dependents, because they spend a lot of money in healthcare in the last years of life. There

are exceptional cases, such as China or other developing countries were the patter is flatter respect to other countries.



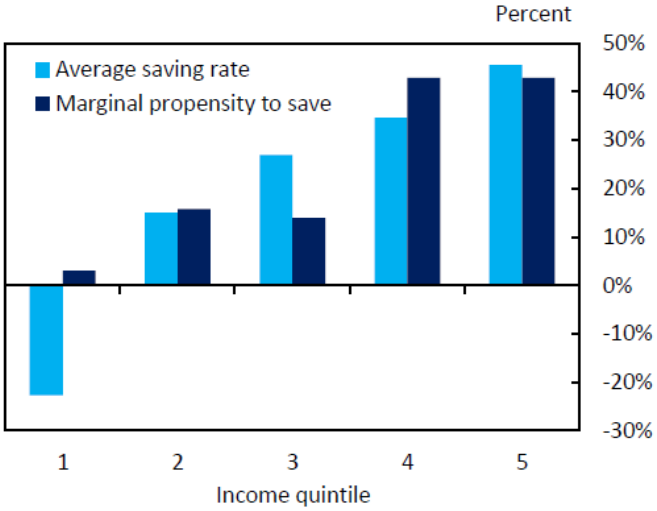
Source: National Transfer Accounts

Figure 21 - Consumption- Income pattern of US and China

In conclusion, the impact of desired saving over the future is uncertain, it is quite possible that the demographic effect on interest rates will reverse in 20 years. Quantitatively likely to be about half that of the downward drag on real rates over the past 20 years.

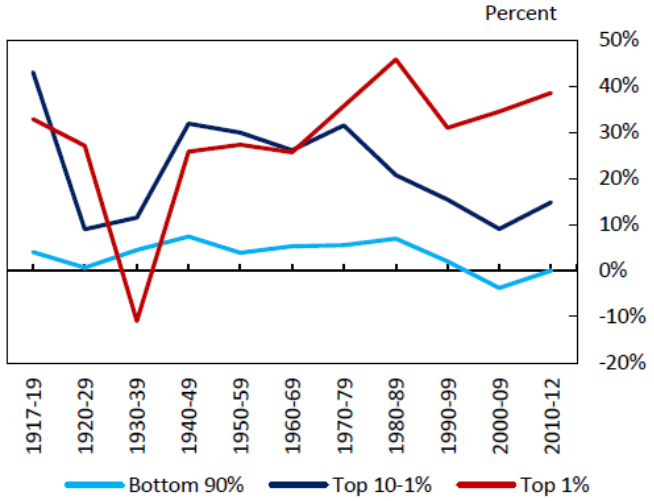
Inequality

According to literature (Dynan et al (2004)) the average saving rates and marginal propensities to save tend to rise with the level of income. This is confirmed by more recent evidence: for example, (Cynamon and Fazzari (2014)) show that the richest 5% save much more than the rest (with saving rates around 3 times as high), and give a long-run perspective on the high saving rates of the wealthy (Saez and Zucman (2014)). Since 1980, in US, has been observed that the richest fifth of the population increased their income by 7 pp with a change of the desired saving as well. According to Dynan approach, depending on which level of quintiles of the population we take in consideration, the level of desired savings increase.



Source: Dynan et al (2004)

Note: Estimates are for the US.

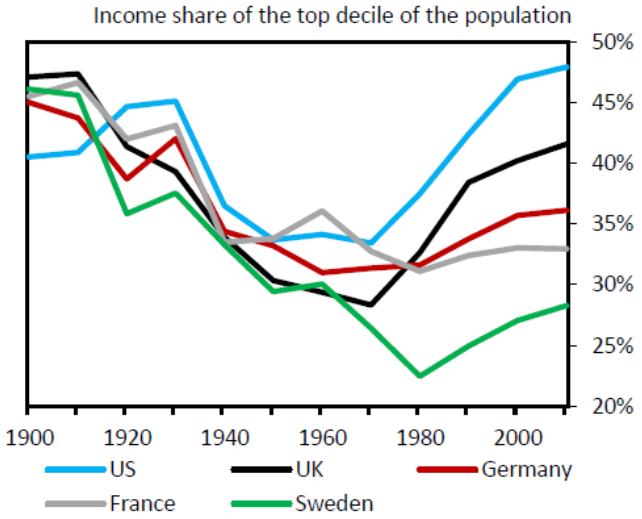


Source: Saez and Zucman (2014)

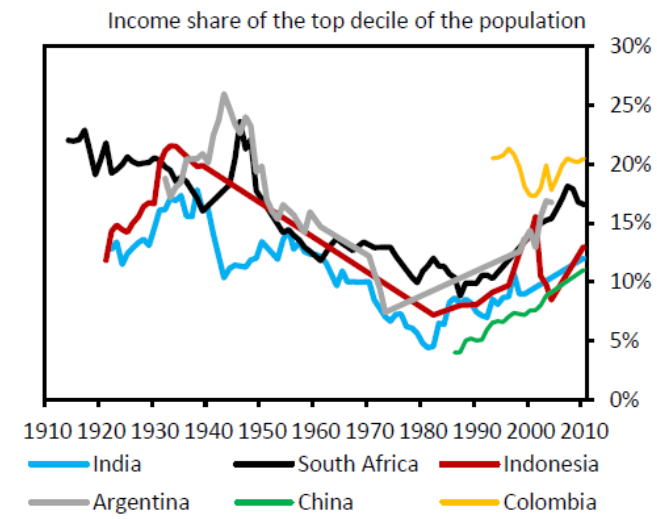
Note: Estimates are for the US

Figure 22 - Inequality and savings

However, since 1980 inequality between countries has fallen because of emerging economies such as Asia, that have rapidly growth in the last years reaching advanced economies. Moreover, there are some cases, such as Asia again, in which the pace of saving raised even if their economy observed very low income.



Source: Piketty (2014)



Source: Piketty (2014)

Figure 23 - Income inequality in advanced and emerging economies

In addition, there are other factors that it is reasonable to think that are responsible for the falling of interest rates:

a) **Capital income**: capital income gains have raised while labour income gains have fallen and this push up desired savings.

b) **Inequality between countries:** inequality between countries has fallen. Thanks to the convergence movement of emerging countries differences are reducing with advanced economies. Since 2000,

saving rates in emerging markets have increased above those in advanced economies. This means that faster income growth in EMEs may have raised global desired savings (Buiter 2015).

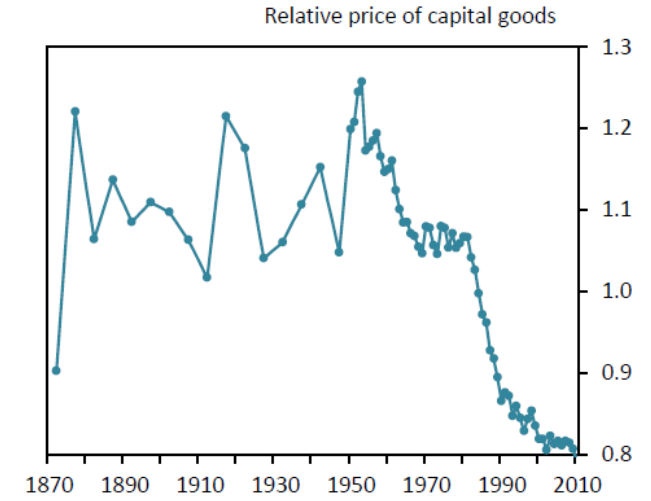
The future of inequality between countries may continue to fall. However, the future of within-country inequality will ultimately depend on policy (Piketty and Saez) 2005. Piketty and Saez point out that "*inequality does not follow a deterministic process. In a sense, both Marx and Kuznets were wrong. There are powerful forces pushing alternately in the direction of rising or shrinking inequality. Which one dominates depends on the institutions and policies that societies choose to adopt."*

Labor income inequality is more likely to continue rising because is based on the race between technology and education. Nowadays, education is very expansive and is more difficult to obtain a high skilled level of education due to the raise of supply of skilled labor as well as the raise of demand for skilled labor due to technological progress. So, the most skilled labor people earn much more respect to the other, as they are sought- after- skills.

Factors affecting investment

Over the past thirty years the ratio S-I has remained constant it means that investment schedule has shifted as well as savings schedule. The three main trends that have shifted the investment curve are:

1. **The decline in relative price of capital goods**: it means the 30% decline in the relative of capital goods. So, investment cost less and it is possible to increase the volume of investment but this effect cannot offset the negative impact on interest rates.



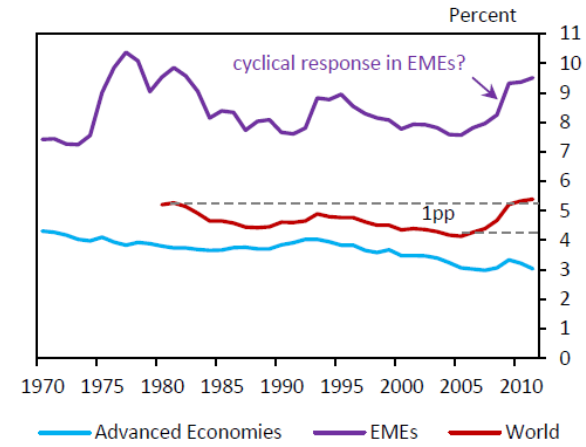
Source: Eichengreen (2015).

Note: Data show the relative price of capital goods compared with consumption goods for 11-now advanced countries.

Figure 24 - Price of capital goods

From an overall point of view, it is reasonable to affirm that in future we assist to a further decline in the relative price of capital goods that will contribute to lower rates even if less sharply respect to past years.

2. **Low public investment projects:** the global investment to GDP ratio has shifted around 1 pp between 1980 to 2007 due to a decline of public investment. The reason why public investments have declined is strictly connected to political views and the strong polarization of politics that created a strong sense of dispersion. On the other hand, emerging economies have observed a raise in public investments such as China. This effect is expected to be reverse.



Source: IMF (2014b)

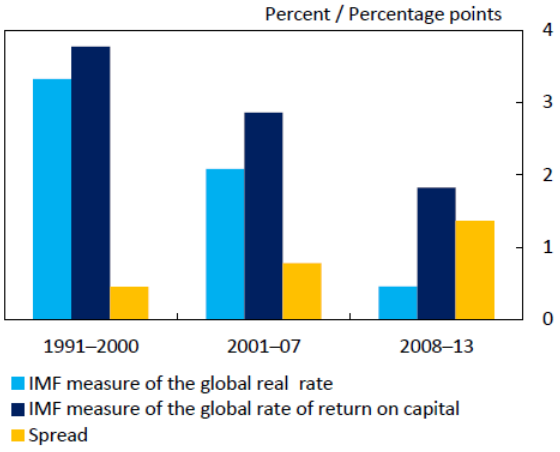
Figure 25 - Public Investment

3. **Spread increase between the risk-free rate and the return on capital:** the spread has risen over time, and shifted the investment down. The risk-free rate has fallen and it has induced people to save less. Empirically, there is no one measure of the spread tested between the rate of return on capital and the risk-free rate, so the IMF has considered a range of measures:

- Bank credit spreads: The difference between bank deposit and lending rates;
- Fixed income spreads: The difference between yields on corporate and government bonds;
- Equity market spreads: Earning yields minus government bond yield.

From IMF data, the average weighted measures of these three elements has been constructed for the world and has shown that the rate of return on capital has diminished since 1990s and the risk-free rate has diminished but as much as the risk-free rate, so form an overall point of view, the spread has increased.

Smith and Rachel assume that will not be further impact from spread on global risk-free rate in the future.



Sources: IMF (2014a) and Authors' calculations

Figure 26 - IMF measure of spread

4.4 Drivers of the current account imbalances

Since 1980, Asian economies have acted as precursor to what would become the global saving glut scenario. Many Asian emerging countries decided to increase the foreign exchange reserves to counterbalance the probable risk of capital outflow. Since 2015, the world was passing through a moment of global imbalances. Some countries observed a trade surplus thanks to their competitiveness exports; other countries were in trade deficit with a consequent capital outflow. When the dollar appreciates sharply and Chinese uncertainties gained prominence during the second half 2015, these factors became important and the main drivers of global imbalances:

1. **The asymmetric recovery and associated monetary policies in systemic advanced economies**
2. **The sharp drop in commodity prices (especially oil)**
3. **External financial conditions for Ems in part related to China' rebalancing process and prospects of monetary policy normalization of US**.
4. **Global external adjustments**

When the international crisis set in and the effects of the accumulated imbalances bore fully on Member States, the pressing need to rebalance became the main driving agent in many economies, sometimes regarding market pressure. However, the economic context was notoriously unfavourable in the years following the crisis because of negative or low growth, financial sector volatility, increased external surplus in stronger EU economies and worsening labour condition. In 2015 the need for rebalancing pressures became more strong but elevated level of indebtedness represented a serious obstacle to recover. However, large current account deficit has adjusted to more balanced position while large current account surplus persists.

4.4.1 Asymmetric recovery in systemic economies

From 1980 to 2016, exchange rates incur in different movements of volatility in several countries. In 2015the dollar and pound currency strongly recover leading US dollar strengthening and weakening of euro and yen. Therefore, US observed current account deficit and the euro area and Japan a big surplus, supported by large trade gains as well. In addition, the renminbi currency appreciated offsetting the China's surplus. In addition, a slow recovery has taken place for yen and sterling in late 2015.

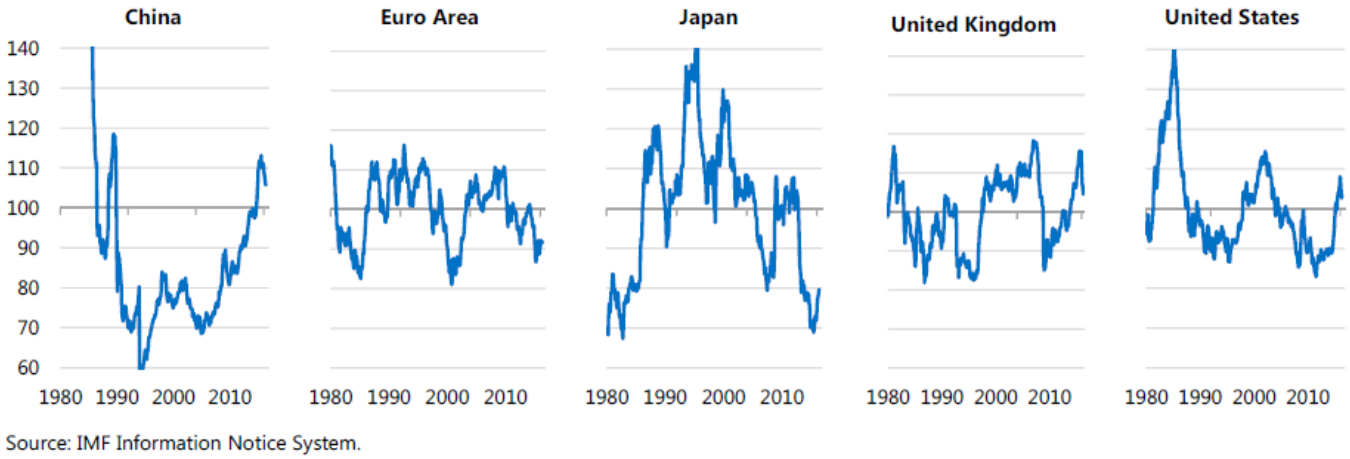


Figure 27 - Real Effective Exchange Rate from 1980 to 2016

4.4.2 Commodity price decline

The fall of commodity price have redistributive effects among world. Has been observed a "significant income transfer from heavily oil exporters such as Russia and Saudi Arabia to net commodity importer such as US, China, Japan and Germany (IMF 2014). Moreover, the decline of the price of oil has affected also the countries exporting commodity with surplus and countries importing commodity with deficits (US and UK). So, the exporters such as Canada, Mexico and Australia were in deficits while China, euro area and Japan and Korea in surplus.

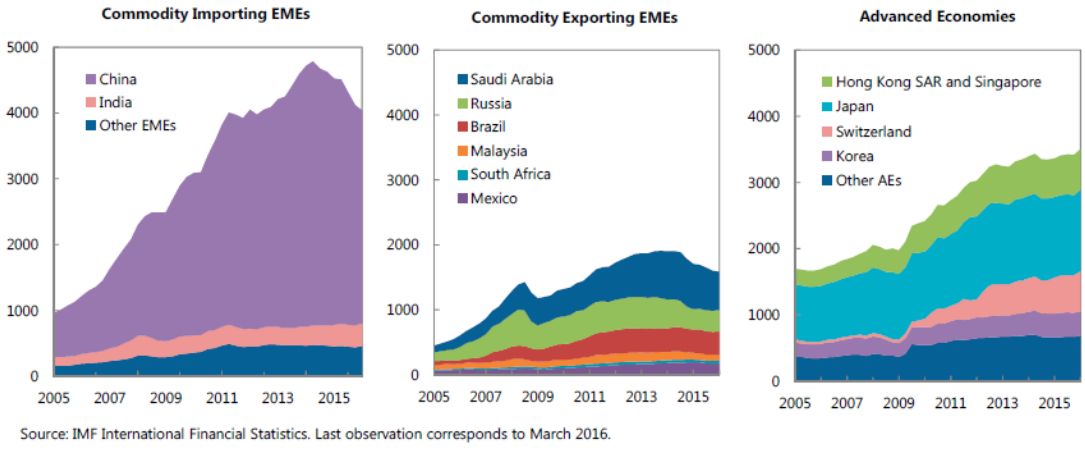


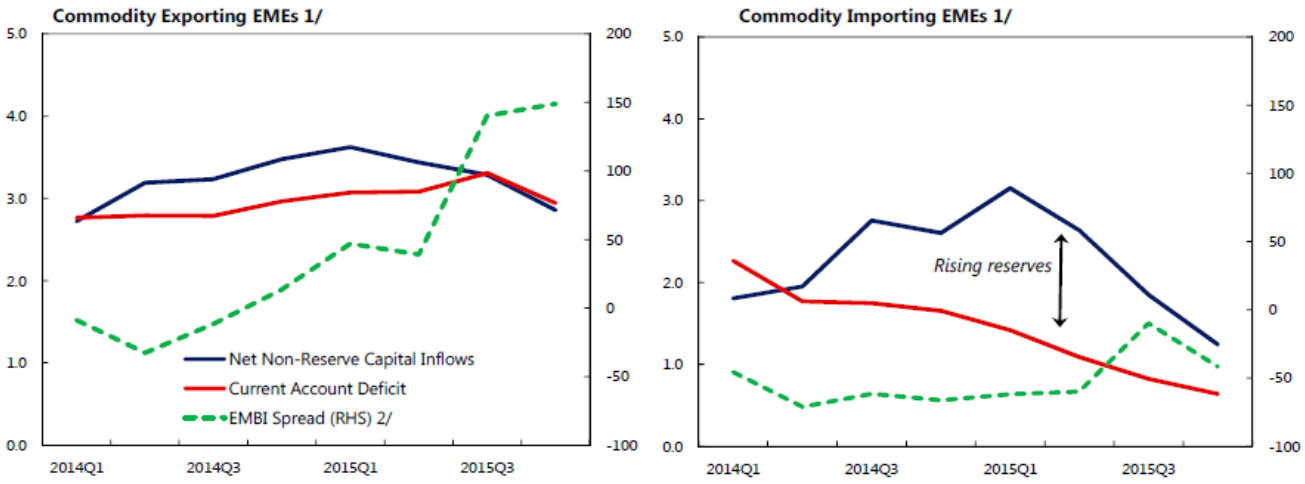
Figure 28 - Selected economies

The aim of exchange rate adjustment is to counterbalance resources and currency's value in both commodity exporters and importers, as countries with depreciating currencies observed a stronger response of net export volumes with the notable exception of Saudi Arabia and other smaller but heavy oil exporting countries with pegs, most commodity exporters observed an important weakening of their currencies. Meanwhile, commodity importers' currencies tended to appreciate (or depreciate less), with the notable exceptions of the euro area and Japan"(IMF 2014).

4.4.3 Tighter external financing conditions for emerging markets

External financing conditions for Ems are partially linked with China rebalancing process and US monetary policy program of normalization.

- Many EM ***commodity exporters*** incurred in a big increase in external **financing costs** offset by a little slowdown in net inflows, reflecting the negative terms of trade shock. Reserve use among this group was generally limited, with the key exception of Saudi Arabia (and other peggers) who drew on their foreign asset holdings to finance rising current account deficits and private capital outflows. In Russia, the sharp downward demand adjustment and a slowdown in private outflows prevented further decline in official reserves.
- Meanwhile, many EM **commodity importers saw a strong reduction in net private inflows** and only a moderate increase in spreads, because of the reduction of demand for financing. An important actor was China, where, despite a higher surplus, the intensification of private outflows (both from foreign and domestic sources), led to sizable reduction in official foreign assets and a tighter enforcement of capital flow management measures.

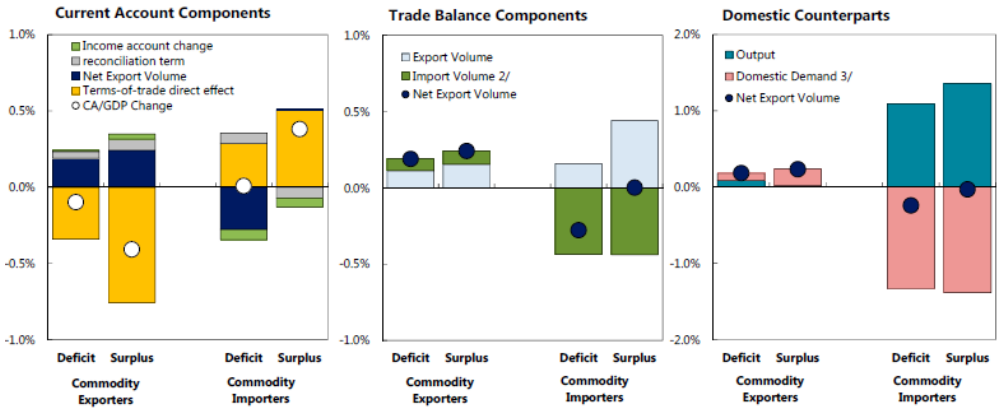


Sources: Haver Analytics; Bloomberg; IMF, World Economic Outlook; IMF, Balance of Payment Statistics; and IMF staff calculations.
1/ Commodity exporters include Argentina, Brazil, Chile, Colombia, Egypt, Malaysia, Mexico, Morocco, Peru, South Africa, Sri Lanka. Commodity importers include Costa Rica, Guatemala, Hungary, India, Indonesia, Pakistan, Philippines, Poland, Thailand, Turkey, Uruguay. GDP weighted averages are reported. Other countries not reported due to data limitations. Russia is excluded as 2014-15 dynamics mostly reflect idiosyncratic geopolitical factors.
2/ EMBI sovereign spreads relative to January 2014 level.

Figure 29 - External Financing Conditions for EMs

4.4.4 Global External Adjustment

Among commodity importers terms of trade income gains were accompanied by weakening net trade volumes. On aggregate, deficit commodity importers spent a large share of the income gains, while surplus importers saved most of the windfall. Has been observed a recovery of currencies of large deficit countries such as US and UK in comparison to the large surplus economies such as Japan and the euro area. “The latter registered such a big surplus because of the depreciation of their currencies. Fiscal policy played a limited role in the global imbalances. The exertional case in China where the fiscal stimulus supported domestic demand and contained the expansion of the current account surplus from terms of trade income gains. Among commodity exporters the main factor was the fall of commodity price that lead to weak current accounts” (IMF2014).



Sources: IMF International Financial Statistics, and IMF staff estimates.
1/ Deficit and surplus countries are classified based on CA balance in 2014. AE exclude USA, GBR, JPN, EA countries; EMEs exclude CHN, SAU, RUS. See Appendix I for technical details on the current account decomposition.
2/ A negative import contribution to the net trade volume implies an expansion of imports.
3/ A negative domestic demand contribution to the net trade volume implies an expansion of domestic demand.

Figure 30 - External Adjustment

4.5 The drivers of real interest rates from the angle of bond market equilibrium and asset pricing

Defining funding sources more narrowly as debt securities and looking at the government bonds market and its equilibrium provides a useful framework to analyse and project medium and long–term interest rates.

In this framework, the (risk and) term structure of interest rates known as the yield curve is based on an asset pricing model whereby the yield to maturity (YTM) [11] is the discount rate at which the bond price is calculated as present value of all expected future cash flows.

Strictly speaking, in the investors' asset pricing process two main considerations underpin the differences in yield or interest rates: **Risk,** depending in turn on three factors (risk premium reflecting default risk, liquidity and tax considerations) and **term to maturity.**

More broadly, however, the full constellation of drivers of bond demand and supply implicitly affects interest rates. Since the economic cycle affects a variety of these drivers (e.g. wealth, risk, investment opportunities etc.) the effect of expansions and recessions on interest rates is theoretically ambiguous. Yet, evidence shows that interest rates rise in an expansion and decline in a recession.

Factors affecting the demand and supply for bonds

(sign in parenthesis indicates the relationship between the respective driver and bond demand and supply)

Bond Demand:

- Price (deflated) (-),
- Expected inflation (-)
- Expected rate of return on other real assets e.g. stock market (-),

  → expected real return on bonds demanded relative to other assets
- Risk (-)
- Investor wealth (including propensity to save) (+)
- Liquidity (+)

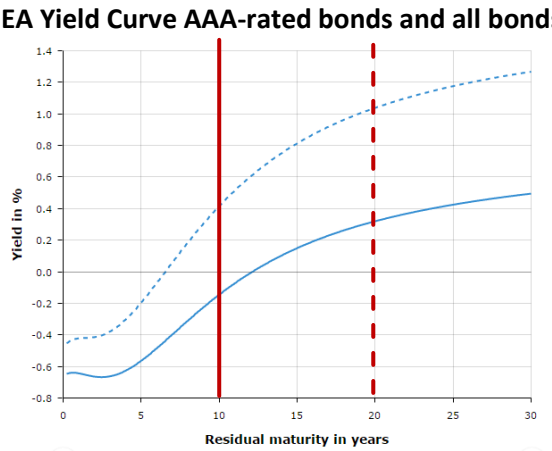
Bond Supply:

- Price (deflated) (+),
- Expected inflation (+)

  → expected real cost of borrowing via bonds (+)
- Expected profitability of the issuer's investment opportunities (+)
- Budget deficit (+)

Figure 31 - Factors affecting government bonds

[11] the best proxy for the nominal interbank interest rate; it often differs from the bond's rate of return or the coupon rate (when the coupon rate is less or more than its YTM, the bond is, respectively, selling at a discount or at a premium; if the coupon rate is equal to its YTM, the bond is selling at par).



Source: ECB

Thesis: EA Yield Curve on 11 Aug 2016

The dashed line indicates the spot rate based on all government bonds; the solid line on AAA-rated bonds only.

Figure 32 - EA Yield Curve

This is consistent with the fact that yield curves are symptomatically inverted ahead of a recession.

The EA yield curve is therefore an extremely valuable source of information both about the future path of both nominal interest rate and inflation. This curve, which is currently flat or moderately upward sloping (Figure 32) indicates that yields on all government bonds (interest rates) are not expected to increase over the next 2-3-year horizon and that inflation is also predicted to remain low. As for AAA bonds, the 5-year horizon YC is dip shaped, pointing at the fact that yields on these bonds are still expected to be further depressed by flight to safety before starting to rise.

4.5.1 The role of term premia

This section relies on the idea that long term rates derives from spot rates on long-term government bond yields. The latest are influenced by term premia. In principle, part of the long-term decline in real rates seen in recent decades could be driven by a fall in term premia, rather than just a decline in expected future interest rates as King and Low affirmed[12]. Since the 1980s there have been sizeable shifts in monetary policy regimes around the world, which arguably have lowered uncertainty about future policy rates and brought term premia down. The IMF[13] point out that many of these regime shifts occurred in the 1980s and early 1990s. there are several factors that have affected term premia over the past thirty years – such as those that have driven an increase in demand for safe assets relative to supply.

Over the past thirty years (particularly since the global financial crisis), there have been significant changes to the demand for and supply of government bonds that could have affected long-term yields. Five factors

[12] King and Low 2014

[13] IMF 2014

have been particularly thesisworthy – two on the supply side and three on the demand side:

A. Rising public debt issuance (*supply of safe assets*);
B. A deterioration in fiscal positions and credit ratings since the crisis (*supply*)
C. A sustained decline in safe-asset holdings by commercial banks before the crisis (*demand*), which has reversed since the crisis due to stricter financial regulatory standards (*demand*);
D. Central bank asset purchases – quantitative easing (*demand*)
E. Increased demand for advanced economy debt assets from overseas, particularly EMEs (*demand*)

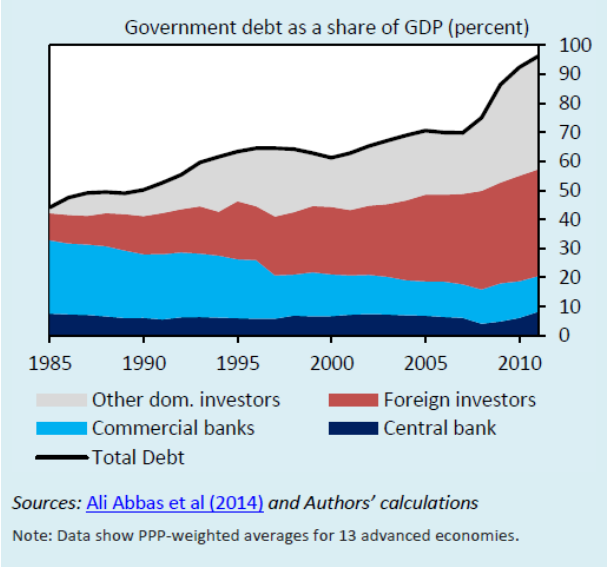


Figure 33 - Government debt changes in advanced economies

From **supply side**, it has been pointed out that the amount of government debt issues by advanced economies has increased since 1895[14] (Figure 33).

From **demand side**, demand for commercial banks had been in decline, on the other hand a large raise from foreign investors, particularly form emerging markets offset the previous decline. Many emerging market government chose to accumulate foreign currency reserves as a form of liquidity insurance.

4.5.2 Monetary policy - asset purchase program

In the last couple of years, the euro area has experienced a very sluggish pace of economic recovery with inflation very low and aggregate demand especially investment remain weak. The ECB has pushed policy rates to the zero lower bond ZLB and launched a whole series of unconventional measures, mainly **balance sheet policies.**

Monetary policies can affect market liquidity in various way, as global central bank's monetary policies have taken an increasingly "unconventional turn, through large-scale asset purchase (quantitative easing) and

[14] Ali Abbas et al 2014

forward guidance, the picture became more complicated. **Quantitative easing** is likely to improve market functioning and liquidity by increasing demand for the securities that the central bank purchases, thus reducing search frictions that prevent investors from funding potential counterparties and the downside risk of holding the target securities. Since the crisis, demand for safe assets from both commercial banks and central banks has increased significantly. Commercial banks have faced a raft of regulatory reforms under Basel III, which require them to hold permanently higher liquidity buffers, often in the form of high-quality government debt. In addition, the world's major central banks have engaged in asset purchases to provide monetary stimulus.

In the UK, the Bank of England's £200bn of asset purchases between March 2009 and January 2010 were estimated to have lowered ten-year UK government bond yields by around 100 basis points (Joyce et al, 2011). In addition, the current stream of asset purchases by the ECB and Bank of Japan is sufficiently large to absorb all net new debt issued by governments in advanced economies. These effects are likely to have put downward pressure on government bond yields since the crisis. However, while the effect of stricter regulatory standards on commercial banks is likely to be permanent, the effect of central bank asset purchases is a cyclical response and may unwind as advanced economies recover.

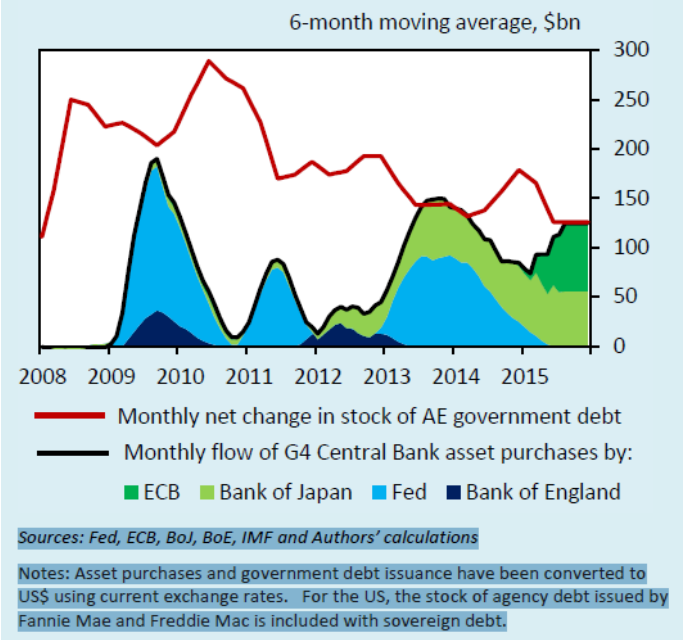


Figure 34 - Central bank asset purchases and flow of debt

From ECB analysis [15] the APP programmed produced significant effects upon announcement, on 22 January 2015. Second, such effects are estimated to persist for several months and, more specifically, for approximately if in the case of standard monetary policy announcements.

[15] The ECB' asset purchase programme: an early assessment Sept 2016

In terms of transmission channels, this evidence is consistent with two aspects of an asset valuation" (or portfolio rebalancing") channel: the reduction of duration risk and the bank capital relief.

The duration risk channel posits that the bond risk premium is increasing in the exposure of bond holders to the risk of unexpected future changes in policy interest rates. Long-duration bonds are riskier, because they are more sensitive to interest rate risk. By reducing private sector holdings of such bonds, central bank purchases should reduce exposure to duration risk and thus lead to a decline in yields. Prima facie, the evidence is consistent with this hypothesis: the fall in yields after the programmed announcement is larger, the longer the maturity of bonds.

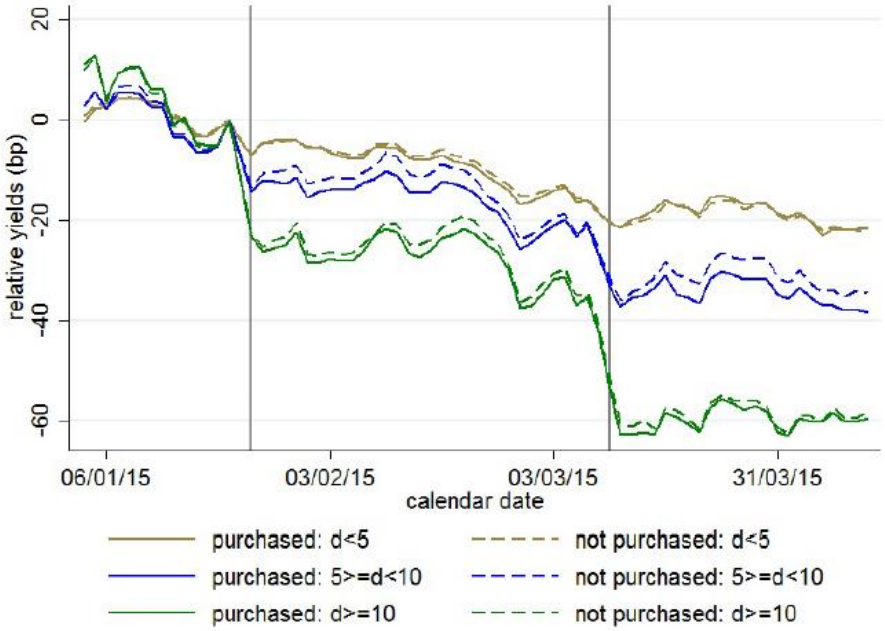


Figure 35 - APP announcement and bond yield

The capital relief channel suggests that the higher prices of sovereign bonds induced by the APP should benefit banks through the ensuing increased valuation of their bonds holdings.

This mechanism is dubbed capital relief channel, because it is akin to a capital injection. ECB paper shows that the equity prices of banks holding a larger portfolio share of government bonds benefited more from the increase in bond prices. The empirical evidence is also consistent with the signaling" channel. After the announcement of the programme, market expectations of future short-term interest rates edged down, while inflation expectations tended to increase. This combined effect suggests that the downward shift in the yield curve did not react a worsening outlook for inflation and GDP growth.

Finally, the evidence suggests that the introduction of the APP helped the ECB guide long-term inflation expectations closer to its price stability objective. Movements in long-term inflation expectations may be due to private sectors uncertainty about the length of the horizon over which price stability will be restored. This uncertainty can produce deviations of long term inflation expectations from levels consistent with the central banks objective.

4.6 Estimates of future long term-real interest rates – a summary of recent literature

Although the theoretical and empirical literature has recently abounded in discussions of interest and growth rate perspectives, precise estimates of these variables at different horizons are scarce. A set of estimates for $r\,{}_{t}^{LT}$, g_r, and inflation are extracted in Figure 36. The large differences in estimates observed in some cases can be explained by the variety of approaches and methodologies used by the studies underpinning these findings and which correspond to the different strands of thought presented in the previous section.

Rachel and Smith 2015 use a growth accounting framework to analyse various trends potentially affecting global growth and a saving-investment framework to illustrate shifts in these variables' schedules and thus changes in the global interest rate. Both results are based on a sample covering both emerging and advanced economies.

Favero and Galasso 2015 estimate a model of mortality, the Lee-Carter model, running panel seemingly unrelated regressions on fifteen European countries[16]. Using demographic based projections, they conclude that these countries would experience for the next twenty years lower long-run potential growth, but a reversion of real interest rates to their historical mean. Within this framework, the large influence of elderly and insiders on the political process allocating public resources would most likely lead to the older generations, rather than the younger ones, benefiting from these macroeconomic adjustments. Since different policy recipes have different intellectual and academic backgrounds but also different redistributive consequences, it is expected that ageing countries lean more towards macroeconomic adjustments, whereas younger nations support more structural reforms.

Aksoy *et al.*2015 simulate the effects of demographic transitions with a panel VAR from 20 OECD countries for 1970-2007 (annual data) using as key macro variables (growth, investment and savings ratios, hour, inflation, real rates, etc.) and age group shares (and oil prices) as exogenous variables[17]. Increases in the shares of the "dependent" cohorts (young and old) tend to have a negative long-run effect on all real variables (output, hours, investment, saving, real rates) and a positive effect on inflation.

[16] of which 13 EU (AT, BE, DK, ES, FI, FR, UK, DE, IE, IT, NL, PT, SE) plus NO and CH.
[17] Baseline specification has homogenous VAR-X coefficients but heterogeneous intercepts across the panel.

The ESRB 2016 report models two scenarios using an (unbalanced) panel VAR for EU-28 [18, 19,20,21] to derive the long-term projections for a set of macroeconomic variables[22] in the EU countries, including short- and long-term interest rates *i)* a "Low for long" (LfL) scenario whereby TFP growth is assumed to be equal to zero along the 2015-25 horizon for all the EU countries and demographic factors (i.e. population growth and the dependency ratio) are assumed to follow the projections of the European Commission) nominal short- and long-term interest rates remain low; *ii)* a "Back to normal" (BtN) assuming that TFP growth and long-term interest rates move back to pre-crisis (2000-2006) average levels, population growth follows the EC projections and dependency ratio paths are set halfway between flat and the EC outlook; short-term interest rates are lifted up to match the average of pre-crisis GDP and investment growth at EU level; long-term rates would move back to 2000-2006 averages by the end of the horizon (2025). These assumptions reflect the rationale that demographic factors would behave somewhat more favourably than under the LfL scenario with respect to dependency ratios, that TFP growth would strengthen and hence interest rates would return to higher levels. All in all, most relevant results are the following: the estimated coefficients of long-term rates imply a positive effect on real activity variables and asset prices; the signs of the coefficients on short-term interest rates are the opposite, which means that if short-term rates are lifted up, ceteris paribus, real activity will be dampened; dependency ratios play a significant role: the effects on TFP, real GDP, consumption and investment growth are all negative and statistically significant.

The EC 2014[23] estimates panel regressions based on two panels – one covering 27 EU MS plus the US and another covering 14 EU Member States plus the US and using OECD methodology[24]. The central aspect of the methodology is that an equation with a limited number of countries is used to estimate a "trajectory benchmark" for interest rates to which all member's states are assumed to converge. The results show a period

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[18] See "A panel VARX for the EU28 to study the implications of the low interest rate environment" by Marco Gross (DG Macroprudential Policy and Financial Stability, DIV Macro-Financial Linkages, ECB). For a survey of the methodology see Canova and Ciccarelli (2013).

[19] The model is estimated using a GLM which takes proper account of possible cross-country residual correlation. All model variables (except interest rates) are normalized by their historical standard deviations in order to better account for cross-country differences in a model in which the coefficients are assumed to be identical across countries.

[20] In order to keep the estimation feasible, the coefficients of the equations are assumed to be identical across countries. In this sense, the model captures average effects; heterogeneity across countries and variables is taken into account by the fixed effects which capture the difference relative to the average effect. In order to assess which structural factors are more relevant for macroeconomic outcomes the model was used to conduct a set of counterfactuals. TFP and dependency ratios were separately shocked at country level, with shocks being permanent by assumption. The shocks were calibrated to one standard deviation of the historical series of TFP growth and changes in dependency ratios.

[21] Caveats: *i)* the linear model cannot deal with non-linearities, which can be important if agents' and institutions modify their behaviour in a LIRE. ii) the model is estimated over a sample that does not include a period of prolonged low interest rates.

[22] The endogenous variables are: TFP, real GDP and its deflator, real investment and its deflator, real consumption and its deflator, nominal long-term (10-year maturity) and short-term interest rates (1-year maturity), the unemployment rate, nominal residential property prices, nominal equity prices and savings ratios. The exogenous variables are population growth and a dependency ratio, which is defined as the share of the population aged less than 15 and more than 64 relative to the population aged 15-64. Annual data over the period 1990-2015 are taken from the EC AMECO database. Residential property and equity prices are sourced from ECB databases.

[23] See thesis "An econometric methodology to project interest rates in the long term". J. Medeiros

[24] E*conomic and financial integration has increased sufficiently during the past three decades or so for real rates [and IRGD] to be determined largely by common factors* (WEO, 2014).

of negative r-g for all of the second half of the current decade (2015-2020) – in line with IMF – meaning that although real interest rates r and the cost of capital are likely to raise moderately in the medium term from current levels, they are likely to remain relatively low in the medium term, even when output gaps are eventually closed. The driving forces of the interest rate- growth rate differential (IRGD: r-g) are the variability and level of inflation, the yield curve and the output gap. These results are also consistent with the EC's QUEST model[25] whereby projections assume that TFP growth has persistently declined since 2009 and that dependency ratios will worsen over the coming decade, as described in the EC 2015 Ageing Report. **Lower TFP growth and a higher dependency ratio would lead to a large and persistent decline in the nominal short-term interest rate**. Considering only the decline in TFP growth, the short-term rate would return to baseline by 2025, whereas conditioning only on the increase in the dependency ratio, it would remain persistently low, as the real interest rate, due to higher savings and lower consumption.

[25] The model is a two-region open-economy setup of the euro area and the rest of the world. In each region, there are two types of households: liquidity-constrained and intertemporally optimising Ricardian households. The only rate is a short-term one. The increase in the dependency ratio is modelled as an increase in the population share of non-participants in the labour market. WS1 thank Werner Roeger, Marco Ratto, Jan in't Veld, Lukas Vogel, Beatrice Pataracchia and Romanos Priftis for their help and support.

Estimates of Selected Variables at T+10 (2025)

T+10 Estimates [1]	Rachel and Smith 2015	Favero and Galasso 2015	Aksoy et al. 2015	ESRB 2016 LfL	ESRB 2016 BtN	EC 2014 (JM)	EC 2016 DSA projections	EC 2016 YC estimates
r_{LT} (%)	1.0 [2]	0.0 to 6.0 [3]	- 1.6 [4]	0.5	3.8	3.4 [5]	3.0	0.8 [8]
g_r (%)	2.2 [2]	-0.1 to 0.2 [3]	0.7 [4]	1.4	2.0	n.a.	1.3 [6] 0.2 to 3.5 [7]	n.a.
r-g (%)	- 1.2	- 0.5 to 5.9 [3]	-2.3	-0.9	1.8	- 1.2 to 1.5	1.7 - 0.5 to 2.8 [7]	n.a.
¶ (%)	n.a.	n.a.	n.a.(?)	0.7	1.3	n.a.	2	1.8 [8]

Sources: studies referred and own calculations using ECB, ESTAT, Bloomberg

Figure 36 - Estimates of Different Studies

Thesiss:

[1] r_{LT} refers to the medium-long term 10 years' real interest rate, normally corresponding to secondary market government bond yields minus annual (twelve-month) consumer price inflation; g_r is real GDP growth rate, y-o-y, unless otherwise specified. ¶ represents inflation measured by the CPI deflator

[2] global values; approximate values based on graphs

[3] r_{LT}, gr and r-g are min, max values for the 13 EU countries covered (AT, BE, DK, ES, FI, FR, UK, DE, IE, IT, NL, PT, SE) approximate values based on graphs; g_r in 2025 (i.e.2024-2025 % change) based on real GDP per capita 2009-2025 % change assumed to occur linearly over 16 years. Country specific variables are available.

[4] r_{LT} and gr refer to values for core Europe (DE,FR,IT,ES) calculated, respectively, as the annual r_{LT} in 2015 - x and annual g in 2015 - y; where x and y converge linearly from 0% to 4.0% and from 0% to 1.5%, respectively, between 2015-2030; r_{LT} is derived as the average i_{LT} for DE,FR,IT,ES in 2015 (i.e. 1.197%, source ECB) – the HICP inflation for DE,FR,IT,ES in 2015 (0.125%, source ESTAT) - x; gr is calculated as the average gr for DE,FR,IT,ES in 2015 (i.e. 1.725%. source ESTAT) - y; the interpolated values for x and y in 2025 are 2.6% and 1% respectively (these values also correspond to the graphs in VOX article).

[5] EU28 median

[6] EU28 mean in 2025

[7] min-max values of the EU28 distribution in 2025

[8] r_{LT} computed as the difference between i_{LT} and inflation; ¶ calculated from inflation swaps, Bloomberg; i_{LT} calculated from the spot YC for the EA, all bonds ECB;

5 Empirical Analysis

At this point in time, the observation of low long interest rate phenomenon and inquiry concerning its causes has been carried out, as well as the formulation of hypotheses with generalized explanations for the phenomenon. Now, **in order to assess the relative importance of the various explanations discussed in the previous section and prove the validity of hypotheses (i.e. confirm them if true, refute them if false), we create and test an annual panel regression for 28 EU countries mostly covering the periods 1995 -2015**.

Firstly, this section reports the results of the OECD and EC papers, that have been carried out previously on interest rates growth differentials. Then, the work moves forward to the estimation of a panel error correction model (ECM) on a set of 10 explanatory variables, ensuring necessary transformations. The process of collecting data took a lot of time in order to make sensitive and robust data set. Finally, the preferred equation has been used for making projections.

5.1 Research studies carried out by others

The key issue in assessing long-run **fiscal sustainability is the future trend of the differential between the interest rate paid to service government debt and the growth rate of the economy.** Persistently low real rates have far reaching implications for the conduct of monetary and fiscal policies, business models of financial institutions and more broadly households and businesses. Thus, it is essential for policymakers to understand how interest rates are determined and identify the factors that have driven down real bond yields. This is the reason why this thesis wants to test different proxy connected with different economic area. The initial idea was to replicate a study conducted in the European Commission on the base of the OECD paper No 919 "Explaining the Interest Rates Growth Differential Underlying Government Debt Dynamics". Then, **the main intent was to extend the time series period, in order to test a longer and update dataset.**

5.1.1 OECD model

Considering the OECD model**, Turner and Spinelli,** affirmed that the key issue in assessing long-run fiscal sustainability is the future trend of the differential between the interest rate paid to service government debt and the growth rate of the economy. From 1980s and 1990s, the interest rate growth differential fell from almost 2.5% percentage points to about zero, between these periods.

The main reasons for the lower interest rate differential environment, that typically prevailed over much of the pre-crisis 2000s, are:

1. Uncertainty surrounding the volatility of inflation that has contributed to a fall of IRGD **between ¾ or 1 percentage point.**

2. Low short term, partially in response about the severity of the downturn and the risks of deflation following the sharp fall in equity prices at the end of the 1990s.
3. "Global savings Glut" originating from Asian emerging markets and oil exporters with an estimated effect of reducing the IRGD during 2000s by **around 1¼ to 1 ½ percentage points**.
4. Fiscal sovereign risk premium associated with increased government indebtedness, which for many countries has increased substantially in the wake of the crisis. **Each percentage point increase in the gross government debt-to GDP ratio above 75% of GDP leads to an increase in the differential of 4 basis points.**
5. EMU introduction, led to a marked convergence of long term interest rates among member countries so masking the effect of individual country characteristics such as indebtedness.

The IRGD is important to understand long run fiscal sustainability because higher interest rates imply higher interests' payments to service government debt. More formally, the importance of the interest rates-rates growth differential can be seen from the government budget identity:

$$\Delta Debt_t = -pb_t + (i_t - g_t)Debt_{t-1}$$

The variables taken in consideration were:

1. **Nominal potential GDP growth** is used in place of Actual Gdp growth
2. The **interest rate** used in the analysis is that on **10-year government bonds** which differs from the concept of the implicit interest rates on NET government debt used in the budget identity. OECD takes in consideration this because there is greater heterogeneity in the size of the composition of government assets holdings across countries. Interest rate, in budget identity, is **the average** implicit interest rates paid on **all debt which will differ from the interests' rates on new issues of government debt.**
3. Inflation uncertainty calculated as the **GDP Deflator of 5-year standard deviation**;
4. **Sum of combined current account surplus of asian emerging markets and oil exporters**, as a percentage of world GDP from 1980 to 2010;
5. **Slope of the yield curve** for the period 1980-2010;
6. **OECD countries for which gross government debt exceeds 75% of GDP** from 2007 to 2013.
7. **EMU time dummy** not extended beyond 2008.

The data are related to 23 OECD member's countries over the period of 1980-2010, the equation is the following:

IRGD: β0 + β1*SD5(GDP deflator) + β2*yield + β3* Global Saving Glut + β4 Dummy Debt75 + β5 Dummy (irl DEU- g) $_t$.

5.1.2 EC model

Considering the EC model, form a **theoretical perspective**, there are several strong points related to the differential growth rate. Firstly, **the output gap and the yield curve have been considered relevant on the impact of cyclical conditions on the IRGD**. Secondly, for the development of the financial system (or financial repression) the IRDG can be controlled using a number of proxy variables, such as inflation and private credit ratio. In addition, in a general equilibrium framework, it could be used to account for "excessive" public indebtedness by considering an interest rate premium on high debt countries; Moreover, world aggregate excessive savings can affect interest rates (Bernanke's (2005, 2007) "savings glut" effect); and, explicitly considers the strong autoregressive behaviour of interest rates.

As for OECD methodology, EC states that the IRGD plays a central role in the dynamics of public debt. However, there are some differences respect to the OECD model. The EC panel regressions cover 27 EU MS plus the US, while the latter covers 14 EU MS plus the US[26]. The equation with a limited number of countries is used to estimate a "trajectory benchmark" for interest rates to which all MS are assumed to converge. In addition, the interest rate-growth differential (IRGD) used in this thesis is the difference between the long-term interest rate and the **actual nominal GDP growth rate**, using EC-ECFIN's Ameco macroeconomic database. Turner and Spinelli (2011) prefers using potential nominal GDP in place of actual nominal GDP in order to reduce the volatility associated with cyclical fluctuations.

Panel regressions are **unbalanced**, including for each country the longer time span of data available, mostly covering the period **1980-2013**

The EC **use a fix core of 4 explanatory variables**

1. **Gdp deflator**
2. **Yield curve**
3. **Output gap**
4. **Gdp inflation**

Plus:

5. **Saving glut**
6. **g: actual nominal GDP growth rate**
7. **Dum 2209-2013*Debt>75: the effect of the crisis due to excessive debt.**

However, after several tests, they preferred not to include the proxy of financial repression such as private credit because they were not retained because they were not statistically significant and it would be hazardous

[26] EU14: AT BE DE DK ES FI FR IT NL PT SE UK IE EL. The larger panel includes a number of countries for which very few observations are available, mostly MS that acceded to the EU in 2014 or after.

to build exogenous paths for them to be used in the projections. Moreover, an explanatory variable measuring the impact of the general government debt-to-GDP ratio in excess of 75% on the IRGD was included in most panel regressions ($Debt > 75$). Although results on the excessive debt variable are mostly correctly signed, they are not always statistically significant. So, the equation for the model is the following:

IRGD: β0 + β1*SD5(GDP deflator) + β2*yieldi,t + β3* outputgap + β4* π + β5*Dummy(2009-2013) Debt75.

5.2 Panel Error Correction Model EU 28

This section illustrates the error correction methodology for assessing the importance and impact of long- run interest rates determinants. **The set of regression is based on a balanced cross section panel of annual data (1995 to 2015) from 28 EU Member States to estimate long run interest rates on 10 explanatory variables. All variables are expressed in nominal values.** The explanatory variables considered encompass most of the determinants discussed in literature:

Table 1 - Explanatory Variables EU 28

#	Variables	Code
1	**Nominal interest rates**	ILN
2	**Output gap**	OG
3	**Government Debt ratio**	GvD
4	**Yield Curve**	YC
5	**Cost of ageing**	CoA
6	**Current Account balance**	CA
7	**Private Sector Credit Flow**	PsCr
8	**Eurostoxx 600**	Stxx
9	**US long term interest rates**	fLTI
10	**ECB balance Sheet**	ECB_BS
11	**ECB MRO**	MRO

The Stxx and ECB_BS series have been transformed in logarithmic functions variable while all other series remained in levels because the relative data were either interest rates or % of GDP. These determinants can be categorized into 7 groups:

1. Growth
2. Risk
3. Government Debt
4. Generosity of Social Protection System
5. Financial Market
6. Saving-Investment imbalances: demographics and supply and demand for financing
7. Monetary policy: conventional and unconventional measures

Table 2 - Areas of investigation

#	Economic Area	Code
1	**Dependent variable**	ILN
2	**Growth**	OG
3	**Government Debt**	GvD
4	**Risk**	YC
5	**Generosity of Social Protection System**	CoA
6	**Generosity of Social Protection System**	BR
7	**Saving-Investment imbalances**	CA
8	**Saving-Investment imbalances**	PsCr
9	**Financial Market**	Stxx
10	**Financial Market**	fLTI
11	**Monetary policy**	ECB_BS
12	**Monetary policy**	MRO

The data used in this work cover 28 EU member States from 1995 to 2015:

Table 3 - Member States regression

#	States	Code
1	**Belgium**	BE
2	**Bulgaria**	BG
3	**Czech Republic**	CZ
4	**Denmark**	DK
5	**Germany**	DE
6	**Estonia**	EE
7	**Ireland**	IE
8	**Greece**	EL
9	**Spain**	ES

#	States	Code
10	**France**	FR
11	**Croatia**	HR
12	**Italy**	IT
13	**Cyprus**	CY
14	**Latvia**	LV
15	**Lithuania**	LT
16	**Luxembourg**	LU
17	**Hungary**	HU
18	**Malta**	MT
19	**Netherland**	NL
20	**Austria**	AT
21	**Poland**	PL
22	**Portugal**	PT
23	**Romania**	RO
24	**Slovenia**	SI
25	**Slovakia**	SK
26	**Finland**	FI
27	**Sweden**	SE
28	**United Kingdom**	UK

Not all States series show uniformity of data, there are some gaps in certain series. See Appendix 1 for each variables and country 'series transformation.

ECM – Model specification (general formula)

$$\Delta LTI_t = \alpha_0 + \beta_1 \Delta OG_t + \beta_2 \Delta fLTI_t + \beta_3 \Delta MRO_{t-1} + \beta_4 \Delta ECB\_bs_t + \beta_5 \Delta Stxx_{t-1} + \beta_6 \Delta YC_t + \beta_7 \Delta CoA_t + \beta_8 \Delta GvD_t + \beta_9 \Delta CA_t + \beta_{10} \Delta PsCr_t + \alpha_1 LTI_{t-1} + \alpha_2 OG_{t-1} + \alpha_3 fLTI_{t-1} + \alpha_4 MRO_{t-1} + \alpha_5 ECB\_bs_{t-1} + \alpha_6 Stxx_{t-1} + \alpha_7 YC_{t-1} + \alpha_8 CoA_{t-1} + \alpha_9 GvD_{t-1} + \alpha_{10} CA_{t-1} + \alpha_{11} PsCr_{t-1} + \eta \quad \textbf{(1)}$$

5.3 Results

This section presents five sets of results in order to prove stationarity of time series selected. We decide to use an error correction model (ECM) because we selected economic **time series** variables that commonly have a long-run stochastic trend, also known as **cointegration**. ECMs are a theoretically-driven approach useful for estimating both short-term and long-term effects of one time series on another. The term error-correction relates to the fact that last-periods deviation from a long-run equilibrium, the *error*, influences its short-run dynamics. Thus, ECMs directly estimate the speed at which a dependent variable returns to equilibrium after a change in other variables.

Commonly, economic series must be differentiated before the assumption of stationarity can be presumed to hold. **Before running formal stationarity tests[27], it is often useful to look at how the series behave when plotted.** Cointegration is necessary to test whether they have an evident trend in levels, whether they revert to a zero mean in 1st differences or whether they look totally erratic, case in which they very likely have a unit root or on a random walk. If series presents unit root, it is necessary to determine the order of integration.

1. The first section presents **stationarity and panel unit root tests with intercept and trend** (Levin, Lin & Chu t* and Breitung t-stat);
2. The second section presents **stationarity** tests in individual cross-section and combined cross-section;
3. The third and fourth section present **the ECM residual and residual correlation;**
4. The fifth section presents the **long and short run elasticities**

[27] The regression analysis of time series necessarily uses past data to quantify the historically observed relationships. If the future is like the past, then these relationships can be used for forecasts. However, if the future differs fundamentally from the past, then these relationships may not be a reliable guide for the future. In the context of temporal regression, the idea that historically observed relations can be generalized to the future is formalized by the concept of stationarity. **Stationarity** requires that the future is like the past, at least in the probabilistic sense.

5.3.1 Panel Unit root test (Levin, Lin & Chu t* and Breitung t-stat)

There is a substantial difference between a series that can be represented by stationary oscillations around a trend and a series that has non-stationary oscillations around a trend. Trend means the persistent of a long-term movement of a variable over time. Many economic series have evident long-term growth profiles.

Each series have been staggered for differentiation**.** The integration process can be defined as I (1), I (2) depending on the amount of times it needs to be differentiated. To be sure that the results are correct, it is important to test model of unit root test in order to determine the order of integration of variables.

To test the order of integration we used two models:

1. **Levin, Lin & Chu t**
2. **Breitung t-stat**

The Levin–Lin–Chu (2002), Harris–Tzavalis (1999), Breitung (2000; Breitung and Das 2005), Im–Pesaran–Shin (2003), and Fisher-type (Choi 2001) **tests affirm as the null hypothesis, that all the panels contain a unit root**. **The panel-based unit root test proposed from them, allows for individual-specific intercepts and time trends**. In their paper called "Unit root tests in panel data; asymptotic and finite-sample properties, they have developed a procedure utilizing pooled cross-section time series data to test the null hypothesis that each individual time series contains a unit root against the alternative hypothesis that each time series is stationary. As both the cross-section and time series dimensions of the panel grow large, the panel unit root test statistic has a limiting normal distribution.

The null hypothesis of the Levin Lin & Chu & Breitung test is:

$$H_0: p_i = 1$$

$$H_1: -1 < p_i = p < 1$$

It means that the null hypothesis affirms the existence of a common unit root, while the alternative hyphotesis affirms that the series are stationary.

Considering the results in Table 1, the Levin, Lin & Chu test and Breitung tests reject the null hypnosis of a unit root. In each case, the **p- value is higher than Statistic.**

Moreover, it means that **all variables series are stationary or stationary around a trend.**

Table 4 - Panel unit root test - Levin, Lin & Chu t* & Breitung t-stat

	Method	Statistic	Level**	Statistic	1st** difference,	Statistic	2nd** difference
LTI	Levin, Lin & Chu t	**-0.34556**	**0.3648**	**-7.99266**	**0.0000**		
	Breitung t-stat	**-6.16649**	**0.0000**	**-3.42490**	**0.0003**		
OG	Levin, Lin & Chu t*	-5.62075	0.0000				
	Breitung t-stat	-5.58295	0.0000				
GvD	Levin, Lin & Chu t*	**-3.12226**	**0.0009**	**-0.65980**	**0.2547**	**-4.03911**	**0.0000**
	Breitung t-stat	**2.60002**	**0.9953**	**-1.56282**	**0.0590**	**-4.52884**	**0.0000**
YC	Levin, Lin & Chu t*	-4.99067	0.0000				
	Breitung t-stat	-3.87403	0.0001				
CoA	Levin, Lin & Chu t*	-8.52691	0.0000				
	Breitung t-stat	-4.20630	0.0000				
CA	Levin, Lin & Chu t*	**-0.17047**	**0.4323**	**-8.84901**	**0.0000**		
	Breitung t-stat	**0.39666**	**0.6542**	**-6.36181**	**0.0000**		
PsCr	Levin, Lin & Chu t*	-4.82332	0.0000				
	Breitung t-stat	-3.94290	0.0000				
Stxx	Levin, Lin & Chu t*	-9.37189	0.0000				
	Breitung t-stat	-8.68526	0.0000				
fLTI	Levin, Lin & Chu t*	-14.2014	0.0000				
	Breitung t-stat	-16.0473	0.0000				
ECB_BS	Levin, Lin & Chu t*	**-1.48136**	**0.0693**	**-11.1278**	**0.0000**		
	Breitung t-stat	**-3.06384**	**0.0011**	**-11.4311**	**0.0000**		
MRO	Levin, Lin & Chu t*	-10.7260	0.0000				
	Breitung t-stat	-12.4990	0.0000				

****, **, * = statistical significance at the 1%, 5% and 10% level respectively*

In addition, analysing the results of panel unit root tests, it is observed that the order of integration of variables are different. The dependent variable is integrated at l(0), according to Breitung t-stat or l (1) according to Levin, Lin & Chu test**.** On the other hand, Current Account variable is integrated at l (1), both tests are different form zero for l (0) while are zero for first differentiation. The order of integration of the majority of variables (Cost of ageing, foreign long-term interest rates, Stxx 600, MRO, Output Gap, Private Sector credit and Yield curve) is l (0), while for ECB_BS variable the order of integration is probably l (0) because as it possible to

observe from Breitung t-stat, levels marginally fail the second test. The Breitung t-stat is 0.0011. Finally, the order of integration of the variable Government debt is I (2), both levels and 1st difference pass only one test.

5.3.2 Least Square panel estimation results

The second step is to estimate the stationarity of the regression using the **ordinary least squares method**. If the regression is not spurious as determined by test criteria described above, **Ordinary least squares** will not only be valid, but in fact super **consistent** (Stock, 1987).

Table 5 - Least Square estimates

Least Square	t-Statistic	Probability**
LTI(-1)	35.67029	0.0000
OG(-1)	3.811705	0.0002
GvD(-1)	-6741163	0.0000
YC(-1)	-2.635844	0.0086
CoA(-1)	1.996976	0.0463
CA(-1)	-4.503075	0.0000
PsCr(-1)	3.798865	0.0002
LStxx(-1)	-1.124803	0.2612
fLTI(-1)	16.02481	0.0000
LECB_BS(-1)	-12.67719	0.0000
MRO(-1)	11.14605	0.0000

****, **, * = statistical significance at the 1%, 5% and 10% level respectively*

The tests results show that the null hypothesis of non-stationarity for the variables should be reject and accepting the alternatives hypothesis because the p- value is 0. Furthermore, it means that variables series are all stationary.

5.3.3 Analysis of ECM residuals

At this point in time, it is important to test if there is a linear combination between explanatory variables that does not have a stochastic trend, it means that whether they are cointegrated. One simple way is to see if the residuals from the cointegrating relation are stationary.

Dickey–Fuller test (ADF)

To tests the residual stationarity, we use an augmented **Dickey–Fuller test (ADF)**:

$$H_0: \delta_i = 0$$
$$H_1: \delta < 0$$

It means that under the null hypothesis the Y_t is a stochastic trend under the alternative hypothesis Y_t is stationary. Another unit root test, in statistics is **the Phillips–Perron (PP**) test (named after Peter C. B. Phillips and Pierre Perron) That is, it is used in time series analysis to test the null hypothesis that a time series is integrated of order 1. It builds on the Dickey–Fuller test of the null hypothesis and like the augmented Dickey–Fuller test, the Phillips–Perron test addresses the issue that the process generating data for might have a higher order of autocorrelation than is admitted in the test equation—making endogenous and thus invalidating the Dickey–Fuller t-test. The augmented Dickey–Fuller test addresses this issue by introducing lags as regressors in the test equation, the Phillips–Perron test makes a non-parametric correction to the t-test statistic. The test is robust with respect to unspecified autocorrelation and heteroscedasticity in the disturbance process of the test equation. Philips-Perron test presents several advantages, one is that it is *non-parametric*, i.e. it does not require to select the level of serial correlation as in ADF. It means that it considers the same estimation scheme as in DF test, but corrects the statistic to conduct for autocorrelations and heteroscedasticity (HAC type corrections).

On the other hand, PP test have also many disadvantages such as that it is based on asymptotic theory. Indeed, it works well only in large samples not related to financial time series data. And, at the same time, it also shares disadvantages of ADF tests: sensitivity to structural breaks, poor small sample power too often resulting in unit root conclusions

In our regression residuals are stationary, as it possible to observe from Table 2. Probabilities stemming from several methods, ADF, PP, Levin, Lin & Chu t, Breitung t-stat are all zero. It means that is possible to reject the null hypothesis of non-stationarity of residuals.

Table 6 - Residuals stationarity

Method	Statistic	Prob**
Im, Pesaran and Shin W-stat	-12.3439	0.0000
ADF	253.115	0.0000
PP	728.203	0.0000
Levin, Lin & Chu t	-12.5914	0.0000
Breitung t-stat	-7.02846	0.0000

****, **, * = statistical significance at the 1%, 5% and 10% level respectively*

5.3.4 Information criteria for autocorrelation

Autocorrelation, also known as **serial correlation**, means the degree of similarity between a given time series and a lagged version of itself over successive time intervals. The traditional test for the presence of first-order autocorrelation is the Durbin–Watson statistic or, if the explanatory variables include a lagged dependent variable, Durbin's statistic.

Durbin Watson test

The Durbin Watson test is the first known test to verify the presence of error autocorrelation. The classic hypotheses states that E (εiεj / X) = 0 for ≠ j. The DW test verifies the presence of correlation in the error term. Historical series are the most frequent tests in which every statistical unit is observed repeatedly over time, and t is used as the index of observations. In this case, when there is a possible correlation between residuals εt and ε t-1, we talk about autocorrelation or serial correlation. But even in cross-section data there may be correlation between the contiguous unit errors it means that there is a special correlation. This model applies only when the regression model has intercepts but most important when serial correlation is of first order and there is no lagged response between repressors.

The DW statistic works as follow: when the tests observe a positive autocorrelation, it means that DW is equal to 0, when we observe a negative autocorrelation is because DW is equal to 4 and the preferred case is when DW is equal to 2 because it means that there is no correlation.

In addition to DW there are several other models to deal with delays such as:

Statistic F

It is an approach that involves starting a model with many delays and performing a series of tests on the final delay. The problem with that model is that it often produces too large models.

BIC

An alternative to avoid problems connected too large models is to use the Bayesian information criterion (BIC) or Schwarz criterion (also SBC, SBIC). This test is applicate on a finite set of models; the model with the lowest BIC is preferred. It is partially linked to the likelihood function and it is closely related to the Akaike information criterion (AIC). In order to increase the likelihood is possible to add parameters, but doing so may result in overfitting. Both BIC and AIC attempt to resolve this problem by introducing a penalty term for the number of parameters in the model. Gideon E. Schwarz and published in a 1978 paper developing the BIC model.

AIC

The Akaike information criterion (AIC) informed on the quality of statistical models for a given set of data. On the given data, AIC estimates the quality of each model, relative to each of the other models. It means that

AIC provides a means for model selection. AIC is based on information theory: when a given model is used to represent the process that generates the data it offers a relative estimate of the information lost. Indeed, it deals with the trade-off between the goodness of fit of the model and the complexity of the model. AIC does not provide a test of a model in the sense of testing a null hypothesis, so it can tell nothing about the quality of the model in an absolute sense.

5.3.4 ECM specification choice

According with the above criteria, we decided that the preferred ECM regression tested is the following:

$$\Delta LTI_t = \alpha_0 + \beta_1 \Delta OG_t + \beta_2 \Delta fLTI_t + \beta_3 \Delta MRO_{t-1} + \beta_4 \Delta ECB\_bs_t + \beta_5 \Delta Stxx_{t-1} + \beta_6 \Delta CoA_t + \beta_7 \Delta GvD_t + \beta_8 \Delta CA_t + \alpha_1 LTI_{t-1} + \alpha_2 OG_{t-1} + \alpha_3 fLTI_{t-1} + \alpha_4 MRO_{t-1} + \alpha_5 ECB\_bs_{t-1} + \alpha_6 Stxx_{t-1} + \alpha_7 CoA_{t-1} + \alpha_8 GvD_{t-1} + \alpha_9 CA_{t-1} + \eta \quad \textbf{(2)}$$

The preferred regression is the one that keep out the Yield curve and the private sector flow variables. Considering the results gathered from the tests, we preferred to choose the proposal 1 for several reasons.

All variables (only for reference)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.817858	2.099233	1.818692	0.0696
D(OG)	-0.075939	0.027486	-2.762863	0.0060
D(FLTI)	0.299443	0.153829	1.946599	0.0522
D(MRO)	0.878303	0.105101	8.356744	0.0000
D(LECB_BS)	0.650935	0.405579	1.604953	0.1092
D(LSTXX)	-1.652595	0.608173	-2.717310	0.0068
D(YC)	0.557839	0.032072	17.39354	0.0000
D(COA)	0.035651	0.046009	0.774881	0.4388
D(GVD)	0.011958	0.008249	1.449608	0.1479
D(CA)	0.126027	0.017708	7.117018	0.0000
D(PSCR)	0.004615	0.003060	1.507987	0.1323
LTI(-1)	-0.275948	0.023596	-11.69487	0.0000
OG(-1)	0.012652	0.020838	0.607137	0.5441
FLTI(-1)	0.163100	0.150009	1.087267	0.2775
MRO(-1)	0.098403	0.133492	0.737149	0.4614
LECB_BS(-1)	0.031940	0.243968	0.130919	0.8959
LSTXX(-1)	-0.585210	0.304233	-1.923561	0.0550
YC(-1)	0.132803	0.025800	5.147433	0.0000
COA(-1)	-0.023965	0.009080	-2.639384	0.0086
GVD(-1)	0.001647	0.001367	1.204775	0.2289
CA(-1)	-0.027888	0.008868	-3.144877	0.0018
PSCR(-1)	0.006049	0.004265	1.418186	0.1568

R-squared	0.698214	Mean dependent var	-0.388619
Adjusted R-squared	0.684100	S.D. dependent var	1.399247
S.E. of regression	0.786447	Akaike info criterion	2.403000
Sum squared resid	277.7060	Schwarz criterion	2.597070
Log likelihood	-543.9066	Hannan-Quinn criter.	2.479346
F-statistic	49.46721	Durbin-Watson stat	2.162100
Prob(F-statistic)	0.000000		

Proposal 1: Without YC, no PsCr

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.715868	2.541809	1.068478	0.2858
D(OG)	-0.168523	0.030854	-5.461871	0.0000
D(FLTI)	0.863171	0.175264	4.924971	0.0000
D(MRO)	0.566631	0.126903	4.465071	0.0000
D(LECB_BS)	2.310939	0.481997	4.794505	0.0000
D(LSTXX)	-2.468269	0.741286	-3.329713	0.0009
D(COA)	0.055927	0.053473	1.045896	0.2961
D(GVD)	0.020810	0.010031	2.074606	0.0385
D(CA)	0.084347	0.020617	4.091056	0.0000
LTI(-1)	-0.291961	0.026216	-11.13693	0.0000
OG(-1)	-0.050864	0.022845	-2.226468	0.0264
FLTI(-1)	0.374548	0.176777	2.118757	0.0346
MRO(-1)	0.023973	0.164475	0.145755	0.8842
LECB_BS(-1)	0.272186	0.292164	0.931621	0.3520
LSTXX(-1)	-0.600768	0.362163	-1.658836	0.0978
COA(-1)	-0.029500	0.011149	-2.645909	0.0084
GVD(-1)	0.002652	0.001606	1.651124	0.0993
CA(-1)	-0.040911	0.010837	-3.775113	0.0002

R-squared	0.465795	Mean dependent var	-0.406139
Adjusted R-squared	0.447883	S.D. dependent var	1.377600
S.E. of regression	1.023620	Akaike info criterion	2.918252
Sum squared resid	531.2334	Schwarz criterion	3.064425
Log likelihood	-748.0411	Hannan-Quinn criter.	2.975490
F-statistic	26.00436	Durbin-Watson stat	2.050282
Prob(F-statistic)	0.000000		

Figure 37 - ECM specification choice

Here there are the speciation for each regression tested. Three commonly used statistics in multiple regression are the standard error, R^2 and R^2 are correct. All three statistics measure the goodness with which the LS estimate in a panel regression model describes or adapts to data.

The panel regression with **all variables** presents a good **R- square value: 0.6982**. On the other hand, may presents potential serial correlation. While considering the Panel Least Square, **Proposal 1**, the one without PsCr and YC variables, it is possible to affirm that there is no serial correlation because **the Durbin Watson test is equal to 2**. In addition, the *n* variables taken in consideration are fewer respect to the previous one.

The regression, proposal 1, presents all EC residual stationary and cointegrated. The variable yield curve is significant in all specifications, for short al long term equilibrium, maybe because (ILN) the long-term interest rates and yield curve are codetermined. The YC= ILN – IST. On the other hand, due to the presence of yield curve variable in the regression, the R-square has less explanatory power (**0.46579**) respect to the regression with all variables.

5.3.5 Short and long-term elasticities of coefficients

Using our preferred equation, we calculate the elasticities of variables for short and long run equilibrium; calculating the elasticity is necessary to understand how and in which measure variables impact on the dependent variables. It is well- known that the elasticity of coefficient indicates the percentage change that will occur in one variable (y) when another variable changes one percent.

Elasticity: (%change in y) / (%change in x)

In our regression, there is short and long run equilibrium as indicated by the statistically significant coefficient of error correction term. The results of ECM indicate that there is both short and long run equilibrium in the system. The error correction term α_1, is equal to -0,292, it describes the adjustment speed at which the long interest rates return towards equilibrium. It is important identify the short run equilibrium elasticity and the long run equilibrium elasticity because of estimated coefficient' meanings.

In order to better understand sign of coefficient is important to outline that In the Short run term equation's signs can be interpreted as they appear in the Table 7 while in the Long Run Term, the meaning of signs is different, as a matter of fact, by factoring out the negative coefficient of the EC term, it means that "–" with "+" as they appear in the ECMs above means that variables move in the same direction; on the other hand, "–" with "–" means opposite direction.

Table 7 - Short and Long run elasticities equilibrium

	Long run equilibrium equation – Error Correction Term (α_1 not factored out)			
Driver	**Coefficient**	**Estimated parameter**	**p-value**	**Long run elasticity of tax base with respect to GDP (level logs)*[28]**
OG	α_2	- 0.051**	0.026	- 0.18
fLTI	α_3	0.375**	0.035	1.28
MRO	α_4	0.024	0.884	Not signific
ECB_bs	α_5	0.272	0.352	Not signific
Stxx	α_6	- 0.601*	0.098	- 2.06
CoA	α_7	0.030***	0.008	0.30
GvD	α_8	0.003*	0.099	0.10
CA	α_9	- 0.041***	0.000	- 0.14
	Coefficient of the Error Correction Term	**Estimated parameter**	**p-value**	**Adjustment speed towards equilibrium**
	α_1	- 0.292***	0.000	0.292
	Short run equilibrium equation			
Driver	**Coefficient**	**Estimated parameter**	**p-value**	**Short run elasticity of tax base with respect to GDP (level logs)***
OG	β_1	- 0.169***	0.000	- 0.17
fLTI	β_2	0.863***	0.000	0.86
MRO	β_3	0.567***	0.000	0.57
ECB_bs	β_4	2.311***	0.000	2.31
Stxx	β_5	- 2.468***	0.009	- 2.47
CoA	β_6	0.056	0.296	Not signific
GvD	β_7	0.020**	0.036	0.02
CA	β_8	0.084***	0.000	0.08

***, **, * = statistical significance at the 1%, 5% and 10% level respectively

As it possible to observe from Table 7, the estimates coefficients are almost significant, in **the short run** monetary policies variables are significant at 99% level, while the government debt is significant at 95% level. The only variable that is not significant is the (CoA) cost of ageing, the estimated parameter is 0,056. In addition, all signs are correct as expected from literature, as a matter of fact an increase of 1pp in output gap generates a small decrease of 0.17 pp in long interest rate. In the same direction, an increase of 1 pp of balance sheet generates a decrease of about 2.47pp of long interest rates, the expected sign is different form the one obtained. On the other hand, an increase of foreign interest rates generates an increase of 0.86 pp of domestic long interest rate, as well as an increase of 1pp of the interest rate of main refinancing operation generates an increase of 0.57 of the long interest rate, in fact according to the Taylor rule - in the short term the monetary policy variable (MRO of our panel, i_t in the Taylor rule) should evolves one to one in line with the natural

[28] The elasticity of tax revenue with respect to GDP is set to 1 (a_{ty} = 1.0). This is consistent with the assumption of Claus et al. (2006), which was based on the estimations in Girouard and Andre (2005).

nominal rate of interest ($\pi_t + r_t^*$). Finally, the case of Current account variable is quite controversial and complex, as well as in the long run, it seems that the CA and LTI should move in the same direction.

In **the long run**, monetary policies variables are not significant, the MRO estimated parameter: 0.024 and ECB-BS estimate parameter: 0.272. Cost of ageing and current account balance are significant at 99% level, in fact as the long run elasticity coefficient reveals current account imbalances have a strong impact on the long interest rate, according to literature an increase of 1% of current account surplus correspond to a larger excess of saving over investment which is symptomatic of a fall of long interest rates (-0.14). Moreover, 1 pp increase in the cost of ageing CoA (that reflects demographics changes) generates an increase of 0.30pp in long interest rates. Nevertheless, the positive sign of the coefficient of the constant term is not consistent with the theoretical effect we would expect. An increase of CoA expenditure is generally associated to a phenomenon of ageing population. This phenomenon currently determines forward looking agents to save more, lowering the interest rates, particularly in years approaching retirement.

In addition, output gap (OG) and foreign interest rates (flti) are significant at 95% level and the sign agree with our expectations, according to literature 1 pp increase in output gap generates a decrease of 0.18 pp in long interest rates as well as 1 pp increase of foreign interest rates generates an increase of 1.28pp of LTI. Finally, STxx and Gvd are statistically significant at 90% level. An increase of government debt is associated to an increase of long interest rates of 0.10 pp. On the other hand, an increase of Stoxx index should raise the long interest rates (2.06). In long term, there is no arbitrage between stocks and bonds so higher return on the stock market (an alternative investment) lowers the demand for government bonds and thereby raise the long-term interest rates. In our regression sign of Stxx is in contrast with our expectations.

The explanatory variable of yield curve (YC) and private credit flow (PsCr) are not included in our preferred equation to project interest rates because linking interest rates to yield curve and private sector credit flow could easily generate a negative feedback loop.

Form an overall point of view results say that in long term, the Long-term interest rates respond negatively to the Output gap, Stxx index and Current account imbalances and positively to the Cost of ageing and Government Debt. While in the short term, the long-term interest rates respond negatively to the Output Gap and Stoxx index and positively to all the other significant variables in the Short-term equation.

5.4 Robustness of Regression

From an overall point of view, in the ECM model observed have been used series of different orders of integration, cointegrated because ECM residuals are stationary. The error correction term observed has the right sign and size: **α_1 is -0.292.** It is well- known that the error correction term to be good is expected to be between -1 and 0.

Proposal 1

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.715868	2.541809	1.068478	0.2858
D(OG)	-0.168523	0.030854	-5.461871	0.0000
D(FLTI)	0.863171	0.175264	4.924971	0.0000
D(MRO)	0.566631	0.126903	4.465071	0.0000
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D(COA)	0.055927	0.053473	1.045896	0.2961
D(GVD)	0.020810	0.010031	2.074606	0.0385
D(CA)	0.084347	0.020617	4.091056	0.0000
LTI(-1)	-0.291961	0.026216	-11.13693	0.0000
OG(-1)	-0.050864	0.022845	-2.226468	0.0264
FLTI(-1)	0.374548	0.176777	2.118757	0.0346
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COA(-1)	-0.029500	0.011149	-2.645909	0.0084
GVD(-1)	0.002652	0.001606	1.651124	0.0993
CA(-1)	-0.040911	0.010837	-3.775113	0.0002

R-squared	0.465795	Mean dependent var	-0.406139
Adjusted R-squared	0.447883	S.D. dependent var	1.377600
S.E. of regression	1.023620	Akaike info criterion	2.918252
Sum squared resid	531.2334	Schwarz criterion	3.064425
Log likelihood	-748.0411	Hannan-Quinn criter.	2.975490
F-statistic	26.00436	Durbin-Watson stat	2.050282
Prob(F-statistic)	0.000000		

Figure 38 - Best regression

The preferred regression presents several strength, the Durbin Watson test is close to **2** it means there is no serial correlation, moreover data set is well-modelled by a normal distribution and the regression chosen presents fewer n to estimate compared to other specifications tested;

In addition, monetary policy variables are significant in the Short run term but not in the long run term and in long run term, from data observed, it possible to affirm that variables have the right sign, expect for the Stxx variables that has the wrong sign (-2.06%); Furthermore, in the Short run term the Cost of ageing is not significant, and does it make sense because the cost of expenditure is considered a long-term variable as it represents demographic changes. Finally, the ECM proposal 1 has an acceptable explanatory variable, the R-square is **0.46579. The signs of coefficient estimates conform to results in the literature and previous estimates.** Results are overall significant and in accordance with existing evidence.

5.5 Projections

Underlying series for projections of long-term value of interest rate

If the assumptions about future trends actually occur, a **projection** indicates what the future changes would be. These assumptions are often based on the patterns of series, in particular according with change or transformations which have previously occurred. A projection is not making a prediction or forecast about what is going to happen, it is indicating what would happen if the assumptions which underpin the projection actually occur.

Table 8 - Table of projects assumptions

Variables	Assumptions
Public debt (gvd)	Winter forecasts 2017
Output gap (og)	Winter forecasts 2017
Current account (ca)	Last value (2015)
Stock index (stxx)	Last value (2015)
ECB Balance sheet (ecbbs)	Last value (2015)
ECB interest rate (mro)	Growth rate of US interest rate (as 2 series are correlated)
US interest rate	T+10 (2027) = 3.2 (based on yield curve) Linear interpolation between 2015 and 2027
Cost of ageing (CoA)	AR 2015 (growth rate)

5.5.1 Forecast

Our preferred equation is used to project interest rates up to 2025. Considering the assumption (Table 8) made for the exogenous variables for the EU 28 members, the forecast suggest that the trend of output gap, public debt and current account should remain stable, at the same level of today. For what concerned monetary policy and financial variables, graphs show that the Stoxx index and European central bank balance sheet might be at the same amount as today.

The interesting forecast is the **US interest rates that should consistently increase, reaching 3/3.5 % points in the next decade.** This value is in accordance with the latest restrictive monetary policies, embraced by the FED. On the other hand, according with Rachel and Smith prediction, the ECB interest rates would remain below the 1% over the medium- long run and considering our projections would not be any reverse in current account imbalances (Figure 41) as IMF forecast for global imbalances suggests. Finally, the cost of ageing should shortly increase for all member states. The following graphs show the evolution trends of explanatory variables.

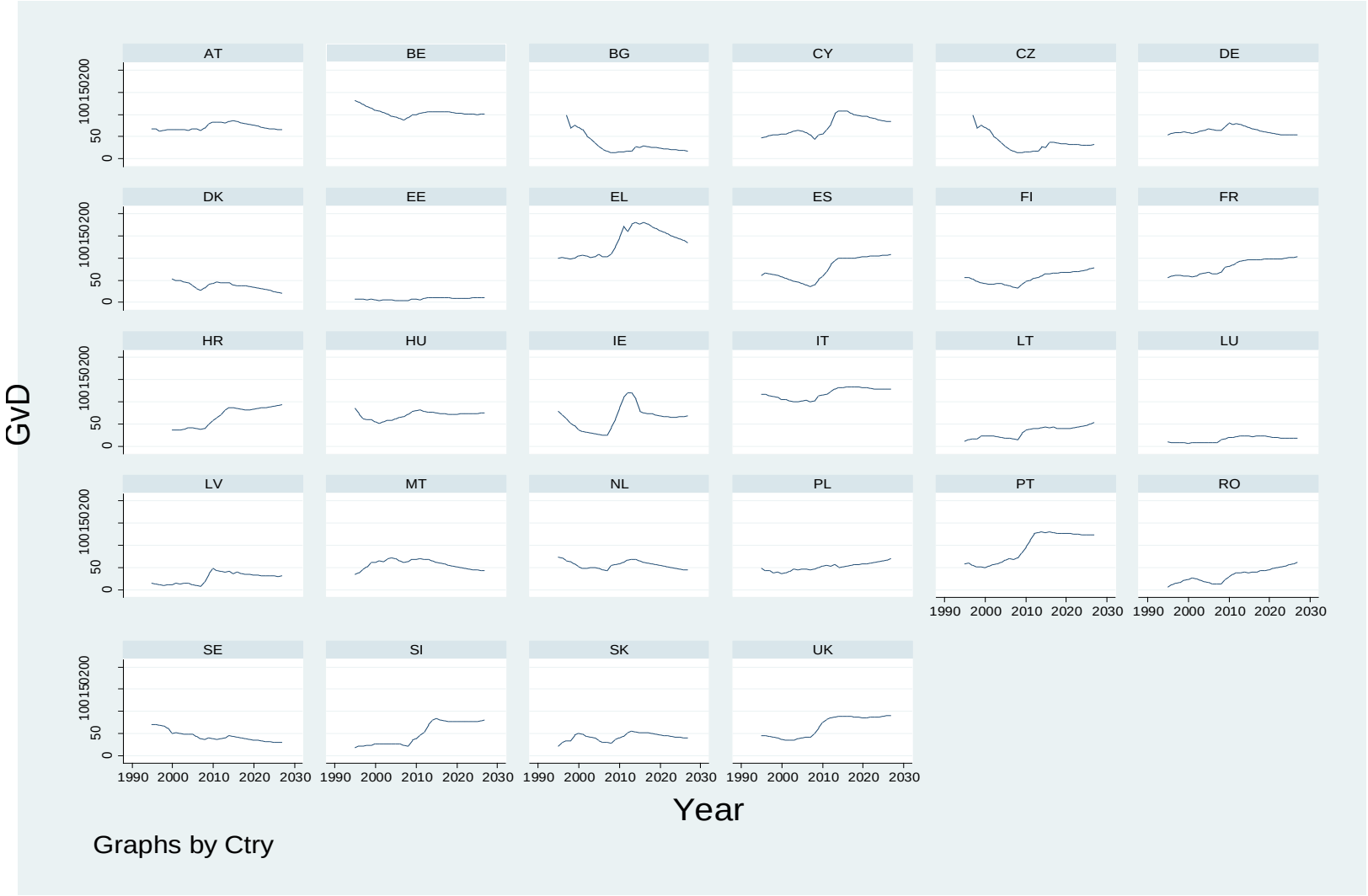


Figure 39 - Public Debt projection

Figure 40 - Output Gap projection

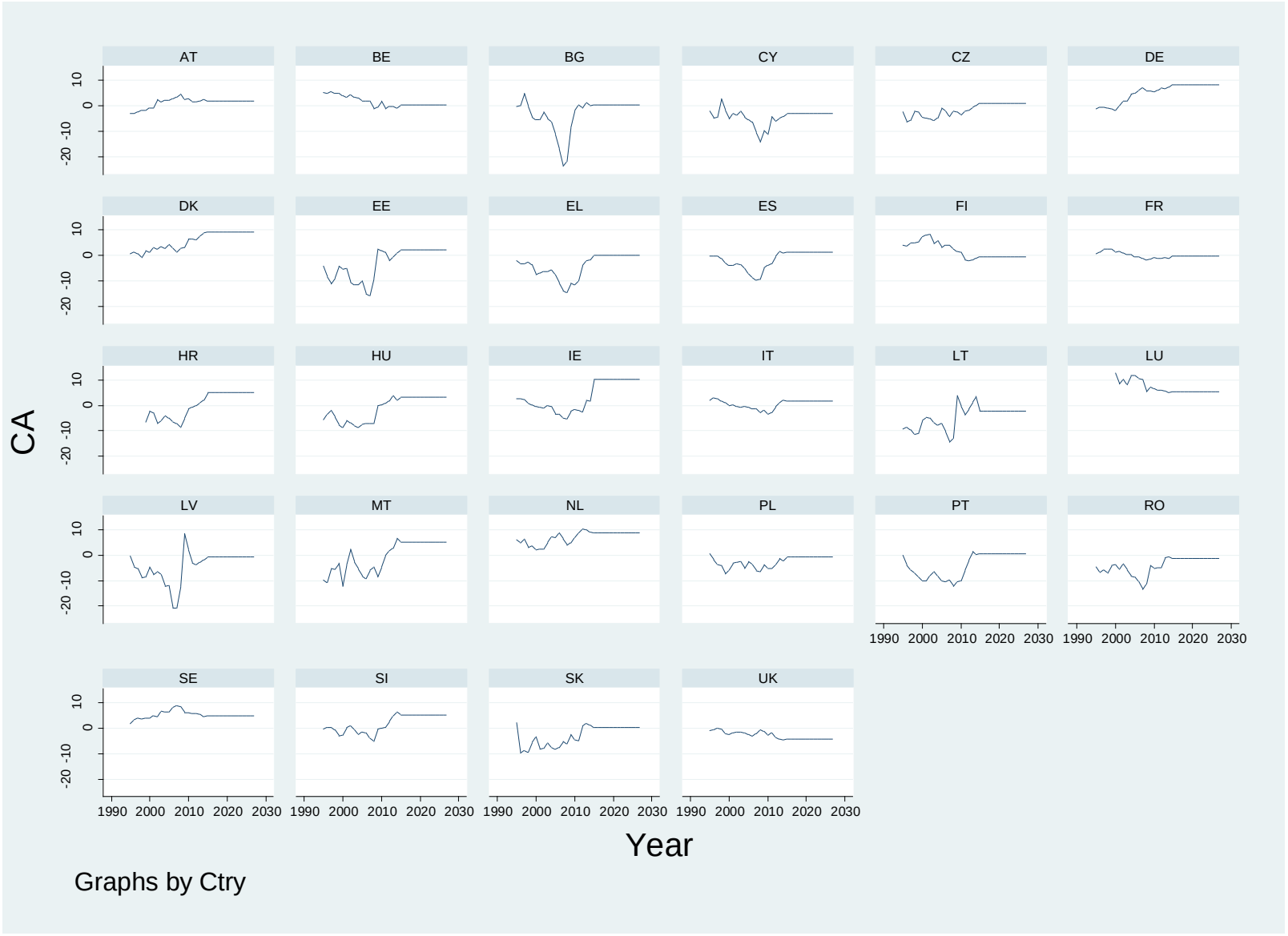


Figure 41 - Current Account projection

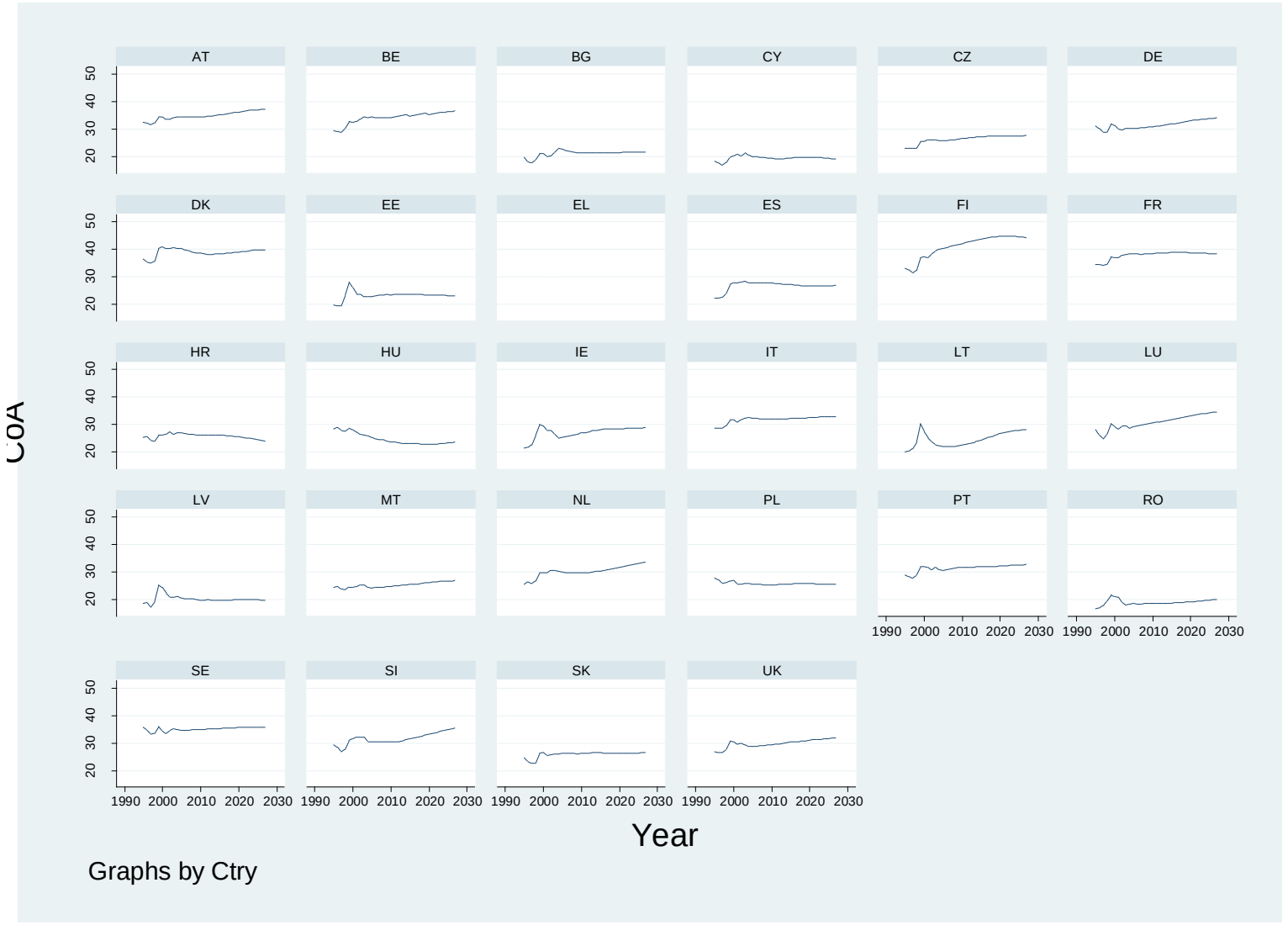


Figure 42 - Cost of Ageing projection

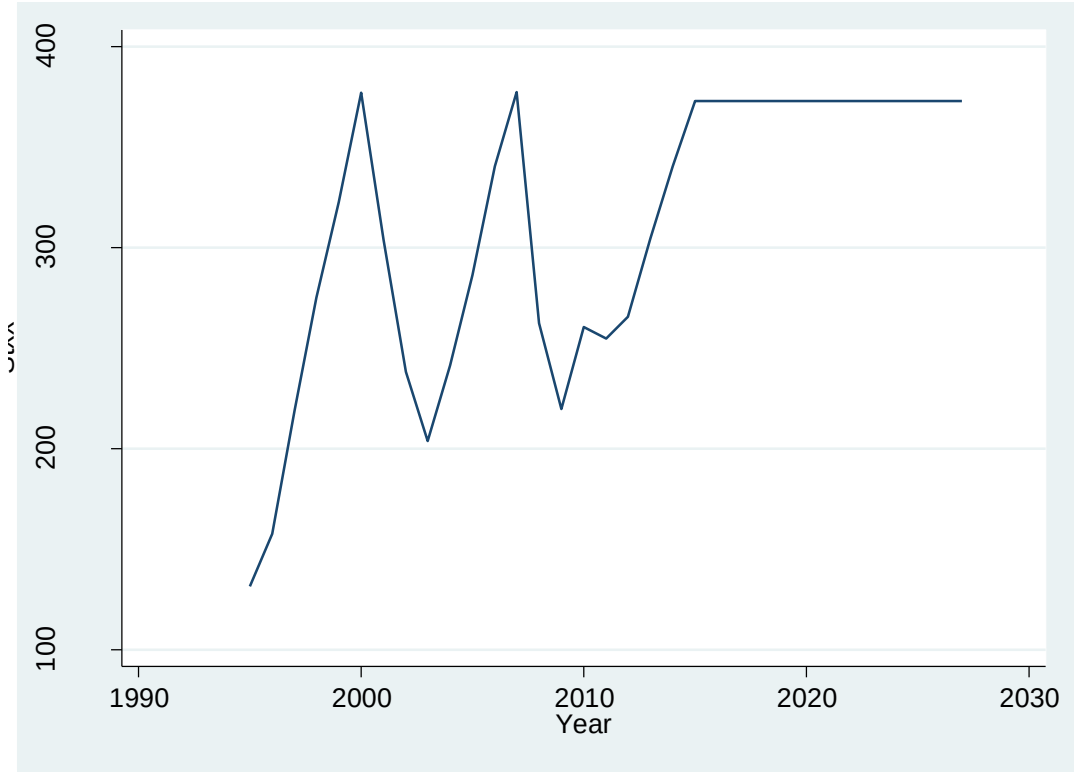


Figure 43 - STxx Projection

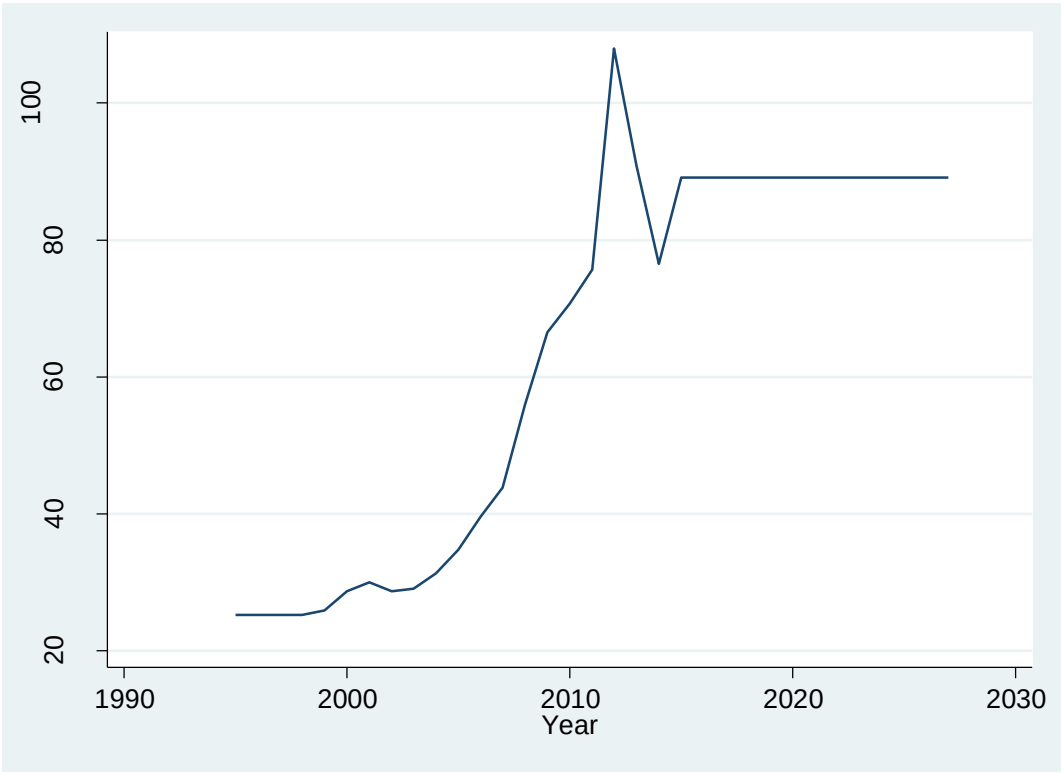


Figure 44 - ECB-BS projections

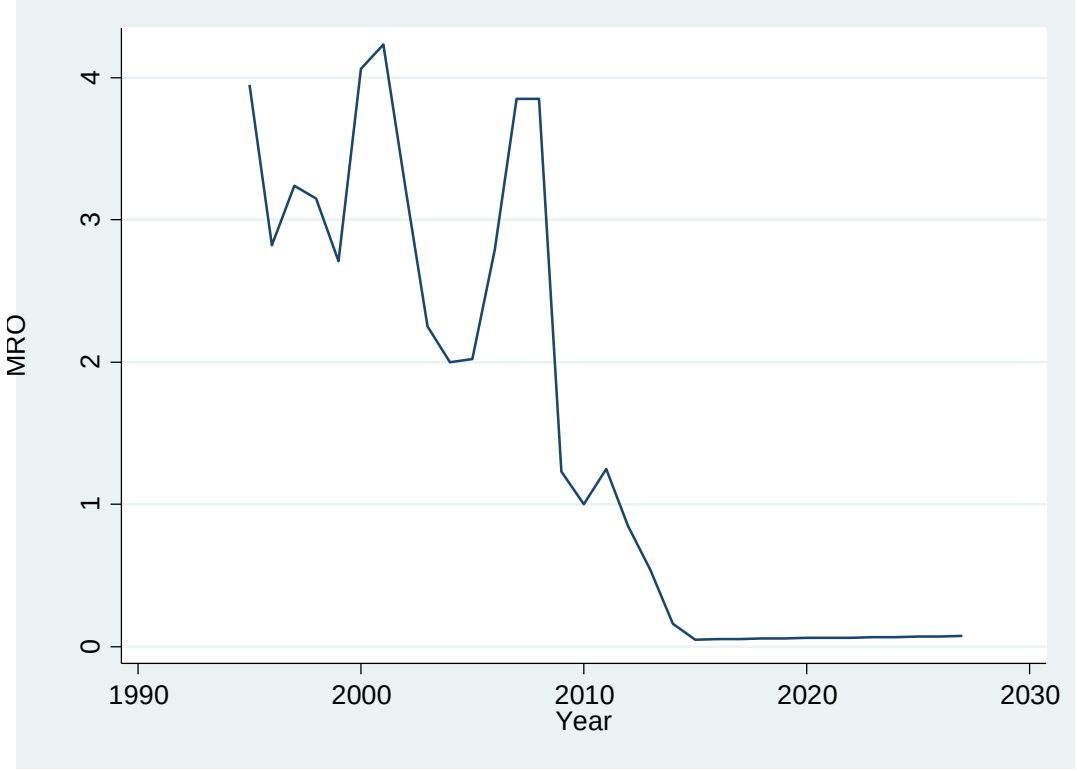


Figure 45 - ECB interest rate projections

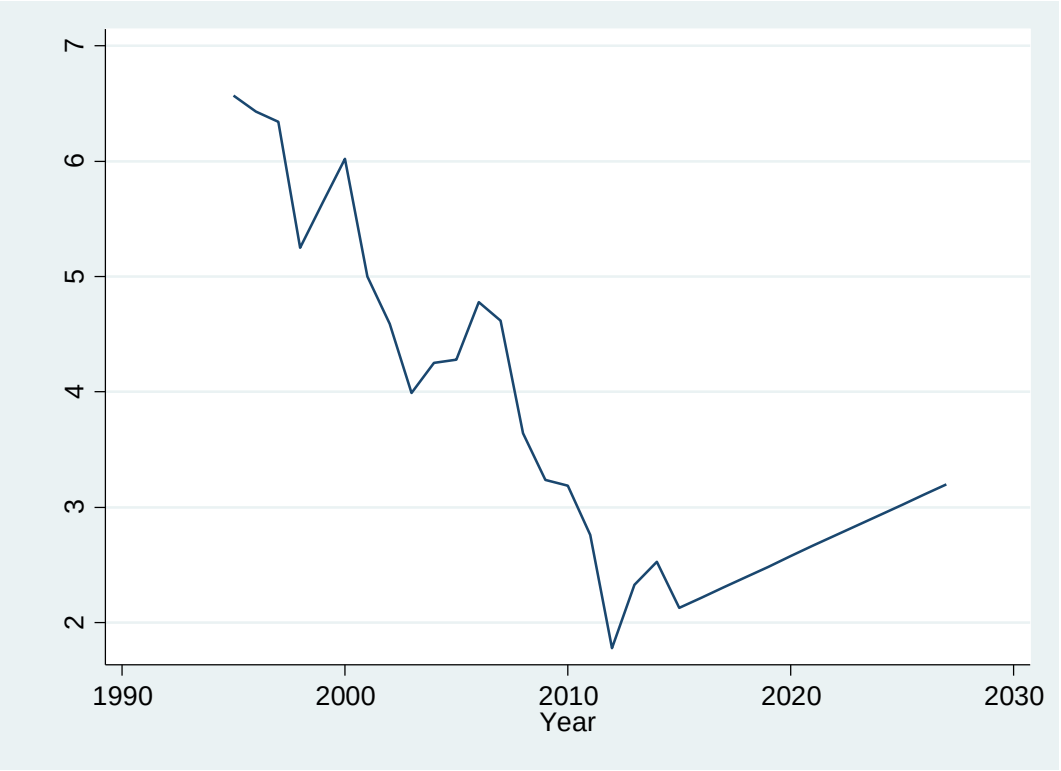


Figure 46 - US interest rates projection

6 Conclusion and Way Forward

A low interest rate environment (LIRE) and current account imbalances have broad implications for the real economy as well as for fiscal, monetary and prudential policy.

In **the real economy** including households, non-financial corporations and government LIRE and CA imbalances impact directly investment and consumption decisions. This impact depends on LIRE´s and CA's persistence and on the interaction of three types of effects[29]: *i)* an *Intertemporal substitution effect* whereby the non-financial private sector borrows today in order to finance consumption and investment, leading to a reduction of saving and increases the prices of financial assets (asset price misalignments); *ii)* a *portfolio substitution effect* driving savers move towards riskier assets in search for yield [30] and, potentially *iii)* a *competitiveness effect* observable to the extent LIRE is not global and generates real exchange rate effects affecting competitiveness. If LIRE is protracted, the positive effect on (current) aggregate demand via intertemporal substitution is smaller and the negative effect on savers is larger.

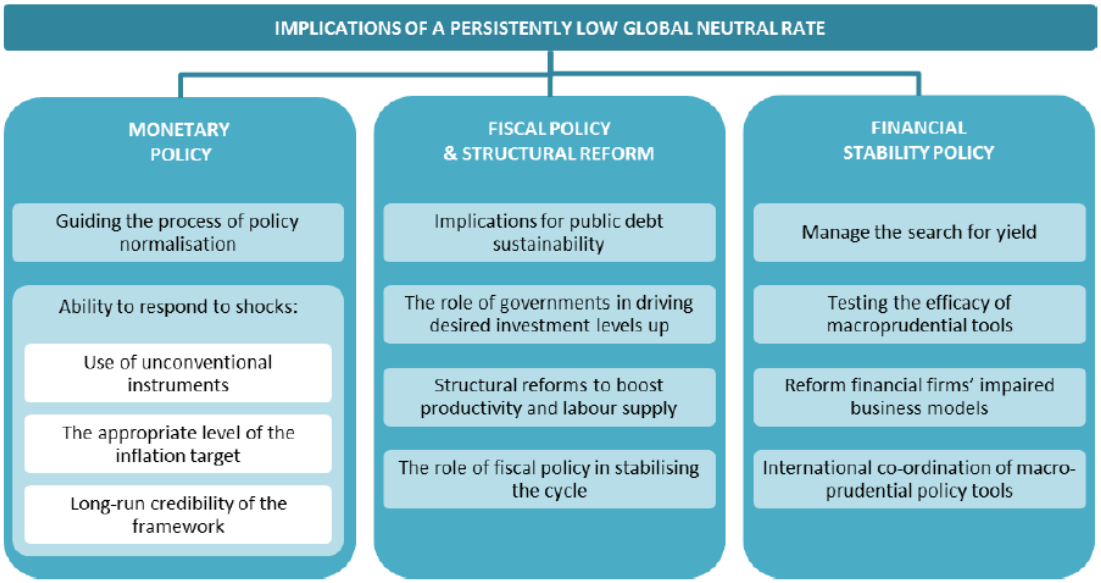


Figure 47 - Implications

A qualitative assessment and the results of the quantitative exercise suggest that the risks for the real economy, with implications for financial stability, arising from a low interest rate environment appear to be limited. An important caveat is that developments in the real economy are heterogeneous across EU member countries, and for this reason, risks are heterogeneous too. This also reflects differences in the economic and financial

29 ESRB 2016

30 This effect is may not be so clearly spelled out; uncertainty and the perspective of a protracted LIRE may determine the real sector to postpone its investment decisions and save instead

structure of the economies and in the macroeconomic consequences of the global financial and sovereign debt crises[31].

The severity of LIRE however depends on the drivers that trigger down the interest rates and may lead to imbalances in residential and commercial real estate markets in some countries. This build-up arises via distortions, imperfections and constraints such as money illusion, myopic behaviour and moral hazard, and zero lower bound of interest rates which is associated to LIRE.[32].

From a **fiscal perspective,** low interest rates are favourable to countries with high public debt but low growth is not, so what appears crucial is whether and for how long the two phenomena would be interlinked and likely to develop into a secular stagnation scenario. Economic growth has in this context a double entry: low growth raises the burden of interest rate expenditure flows (and thereby that of debt stocks] through both a numerator (r-g) and a denominator effect in the ratio, it simultaneously bears on SPB flows via automatic stabilisers, thereby implicitly affecting debt stocks through numerator effect[33].

Moreover, the extent to which countries with high public debt benefit from a low interest rate environment depends on the debt maturity profile, the proportion of outstanding debt to be rolled over in the coming years/under low interest rate conditions and a country's access to markets. For countries with reduced debt to GDP ratios on the other hand, low interest rates may represent a pull to use fiscal space and conduct expansionary fiscal policies, thus leading to new debt issuance.

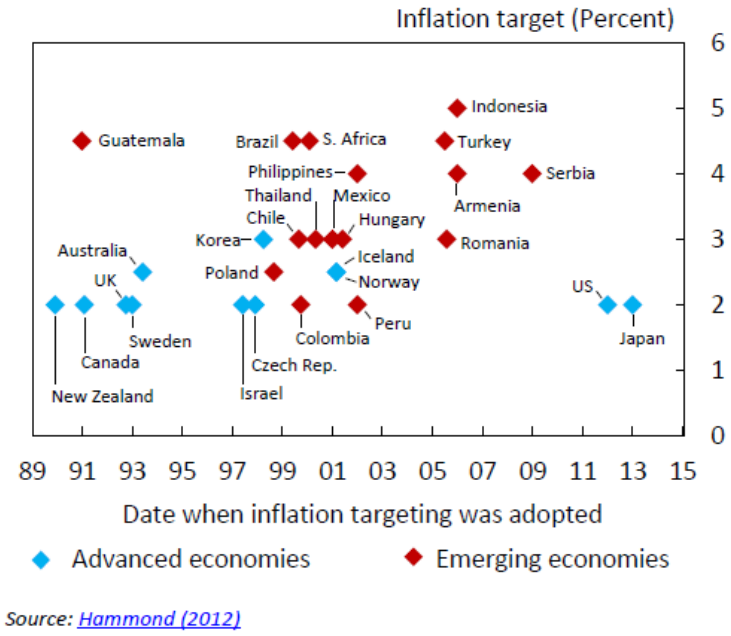
For all countries in general the low interest rate environment and the corresponding flattening of the yield curve may provide incentives for active debt management including average debt maturity lengthening - low cost of maintaining debt. LIRE and CA imbalances may also provide incentives to change the composition of public debt towards variable rate issuance to the extent that governments are myopic and focus only on the short-term gains that a lower cost of funding may provide[34].

Considering the above, a set of principles for good practices in a low interest environment[35] would include: assessing windfalls from low interest rates; making prudent forecasts of the interest burden; and particularly to spending these windfalls wisely, preferably on debt reduction; if windfalls are put to use on public investment, governments should make sure that this investment has a positive net return.

For **monetary policy,** a few considerations stand out. Firstly, if the (long-term) global equilibrium real rate is at or slightly below 1%, then for countries with a 2% inflation target, equilibrium nominal interest rates in individual countries may eventually settle at or below 3% – considerably lower than the historic norm.

31 ESRB 2016
32 ESRB 2016
33 See DSM 2016 Annex A7
34 C1 thesis 2015, ESRB 2016
35 Eurogroup 5 October 2015

Another consideration is whether **a 2% inflation target remains appropriate**. This debate is not new: it featured prominently in Blanchard et al (2010) and has been discussed more recently by Haldane (2015) along with other potential solutions to the low rates dilemma. Policymakers could risk losing credibility if existing monetary policy tools are found to be insufficient to stabilize the business cycle. In the face of adverse shocks, central banks may therefore be more likely to run up against the zero-lower bound on nominal interest rates, requiring the use of unconventional policy instruments such as quantitative easing (QE) more often. However, uncertainties over the transmission of QE and concerns over the size of central bank balance sheets might limit the use of such tools in the future. For large adverse shocks, fiscal policy may therefore need to bear more of the burden of business-cycle management[36].



Source: Hammond (2012)

Figure 48 - Inflation target

Secondly, the fact that drivers of (low) long-term real rates are essentially global means that central banks have a more limited scope in influencing them in one country or jurisdiction[37] (in this case in a Taylor rule perspective only the growth component of short-term interest rates would be idiosyncratic); the ECB's "forward guidance" i.e. its commitment to keep rates low for an extended period reflects LIRE and has so far contributed to a modest credit expansion to both households and firms favourable to growth as well as inflation and deposit rate cuts have amplified the impact of ECB asset purchases intended to spur markets and the economy[38]. Yet, policy difficulties lie ahead with QE and low bond yields reinforcing each other and with many forced bond buyers making that a true price formation role on the bond market is lost[39].

36 Rachel and Smith 2015

37 Gros, D. 2016 "Ultra-low or Negative Yields on Euro-Area Long-term Bonds: Causes an Implications for Monetary Policy", CEPS Working Document no 426. Sept 2016

38 Jobst, A. and Lin, H. (2016) - The ECB's Negative Rate Policy Has Been Effective but Faces Limits IMFdirect

39 The Economist 2016 Who's Scary Now

Thirdly, monetary-prudential trade-offs are in sight as the ECB has limited room for further substantial policy rate cuts without hurting the profitability of banks. Lower bank profitability and equity prices could pressure banks with slender capital buffers to reduce lending, especially those with high levels of troubled loans. From this perspective QE (asset purchase) would be the solution looking ahead, but this has to be weighed in the wider monetary – prudential – fiscal trade-off mentioned before (whereby low bond yields spiralling from QE increase debt incentives).

Last, a low growth low interest rate environment with high debt overhang entails that central banks become a stakeholder of structural reforms; this is the case because the latter are means to mitigate threats from LIRE to the sustainability of the social market economy which is the environment in which monetary policy operates[40].

On the **macro-prudential side**, the **financial stability** risks associated to the low for long scenario are threefold: i) first round (direct) effects including profitability and solvency pressures for financial, weakening the resilience and affecting the sustainability of some financial sectors, ii) higher sensitivity to market shocks due to growing competition from non-bank sectors and accelerated transition to a more market-based structure and iii) second round (indirect) effects such as increased risk taking in the financial markets beyond risk – bearing capacities.

The first-round effects of FL interest rates would be an environment with reduced net interest income and no loan growth due to low economic activity (detrimental for banks and other financial institutions, in particular insurance, DB and DC occupational pension funds, fund management companies and investment funds. While banks themselves are on a thin line mitigating the squeeze on profitability[41] and fighting persistent balance sheet weakness, guaranteed–return life insurers and DB pension funds' business model could be particularly affected and rendered unviable[42]. Evidence shows[43] that the insurance and pension sectors have already been

40 Cœuré Benoît, 2016 "Structural reforms on the way to a complete Economic and Monetary Union", Speech by Member of the Executive Board of the ECB at the International Conference on Structural Reforms in Advanced Economies, Hertie School of Governance, Berlin,17 June 2016

41 Banks have managed this so far with higher lending volumes, lower interest expenses, capital gains from investments, lower risk provisioning, small increases in fees and commissions, as well as savings from cost cutting, (Rostagno and others, 2016), but there are clearly limits to such mitigation measures. Moreover, the challenges to negative rates play out differently across banks from different EA countries for at least two reasons (Jobst and Lin 2016). First, since the ECB charges interest only on excess liquidity, the charge is greater in those countries where banks hold large excess reserves, these being generally countries with substantial current account surpluses vis-à-vis other EA members. At the same time, banks' ability to generate interest revenues for each euro of assets has suffered because their reliance on a wide deposit base has prevented them from cutting the interest paid for customer deposits as much as that charged for loans (the latter has fallen for many banks as in several large economies loans are typically indexed to the policy rate - "variable rate loans" – see Annex 3 Chart 3). Banks in these countries face reduced margins not just on new lending, but also on existing loans, as discussed in the IMF's April issue of the GFSR. (Jobst and Lin 2016

42 In some member states, low interest rates have also put the profitability of non-life insurers under pressure as a low interest rate environment makes it more difficult to compensate losses (in markets with intense competition) with income from high investment returns

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lowering or overall removing longer-term guarantees on returns and moving towards services similar to the asset management business model, offering more unit-linked products.[44]

Moreover, in a situation whereby defined-benefit pension funds become unviable, possibly simultaneously to the guaranteed-return life insurance, policies to allocate the cost would need to be contemplated, given the social importance of these sectors and the fact that the policy holders may not be in a position to bear the whole cost of such risks materialising. It cannot be excluded that some of the costs related to materialisation of these risks in the low interest rate environment would be borne by younger scheme members, for example via reductions in pension benefits of the young generation (see evidence from the EIOPA IORP stress test 2015, showing that younger pension beneficiaries face larger losses in the low interest rate environment than the older ones) or via state balance sheets, which are additionally under pressure due to weak growth (consequence for public[45].

In terms of the transition to market based funding, growing credit intermediation by non-banking institutions would benefit the real sector via alternative sources of finance but would affect banks by higher costs in terms of capital requirements, deleveraging needs, forbearance on outstanding loans as well as it would lead to an expansion of the shadow banking sector.

Second round effects derived from the former would be an excessive relaxation of credit standards, increase in the search for yield, incentives to forbear and hold NPLs extended at high interest rates since new lending is at lower rates, build up leverage beyond risk bearing capacities, lead to an accumulation of risky assets including fuelled demand for real estate, (i.e. increased risk taking) which may trigger asset revaluation.

The financial stability risks in a back to normal scenario are less substantial and basically derive from activities undertaken during the low interest rate environment - e.g. lending at low fixed rates and accumulation of higher-risk assets.

To address risk from prolonged low-interest rate environment in particular regarding solutions to increase resilience of insurance and pension fund companies the review of the regulatory framework (Solvency II) is already underway.

44 For detailed evidence, see ESRB 2016 Technical Documentation, Section C. While in some countries this trend has been already long under way, the low interest rate environment currently affects countries with a still relatively high level of guarantees on outstanding contracts.

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Appendix 1- Data Description

Transformations

Dependent variable: LONG-TERM INTEREST RATES (NOMINAL)

Source	Ameco (EC database)
Link	13 Monetary variables→ 03 Interest rates→ ILN
Code	**ILN**
Time series	From 1995 to 2015
Unit	Percentage of gross domestic product at current prices
Break Point	2000/2005
Transformation	Before 2000/2005 series have been extended backwards using the growth rates of EU countries for which data is available for those years.

Growth

Output gap (OG): gap between actual and potential GDP at constant market prices (Actual GDP-Potential GDP)/Potential GDP * 100. Different from the one in the OECD model that is the potential nominal GDP.

Source	Ameco (EC database)
Link	06 Domestic product →05 Potential gross domestic product at constant price→ OUTPUT GAP
Code	**AVGDGP**
Time series	From 1995 to 2015
Unit	Percentage of potential gross domestic product
Base year	2010
Transformation	**None**

Government Debt

Government Debt Ratio (GvD): General government consolidated gross debt - Excessive deficit procedure (based on ESA 2010), Percentage of gross domestic product at current prices.

Source	Ameco (EC database)
Link	18 GROSS PUBLIC DEBT→ 01 BASED ON ESA 2010
Code	**UDGG**
Time series	From 1995 to 2015

Unit	Percentage of gross domestic product (GDP)
Base year	2010
Transformation	**None**

Risk

Yield curve (YC): ILN – ISN

Source	Ameco (EC database)
Link	**13 Monetary policy→ Interest rates→ Yield curve**
Code	**IYN**
Time series	Some series from 1970 to 2015, some from 1995 to 2015 (almost East countries)
Unit	Percentage of gross domestic product (GDP)
Base year	2010
Transformation	To extend the yield series of some countries especially East Countries such as BG, CK, EE, HR, CY, LV, LT, LU, HU, MT, PL, RO, SI, SK i used Germany values, for gap years from 1995.

Generosity of Social Protection System

Cost of Ageing: Sum of Health Care and Long-Term care, Pensions, Social Protection, and Education expenditure

Source	Eurostat database + AR Expenditure
Link	http://ec.europa.eu/eurostat/data/database
Code	General government expenditure by function (COFOG) [gov_10a_exp]
Time series	From 1995 to 2025
Unit	Percentage of gross domestic product (GDP)
Base year	2010
Break Point	2014
Transformation	CoA series is the combination of COFGO series from 1995 to 2014 and AR data from 2015 to 2025. To overlap series, I calculated the growth of the latest series multiplied by the value of the last year (2014) of the previous series. We sum up the expenditure of HC, LT, Education and Pension all together to create one series for each country.

Benefit Ratio: the ratio between the average pension benefit and the economy-wide average wage

Source	2015 Ageing Report

Link	http://ec.europa.eu/economy_finance/publications/european_economy/2015/pdf/ee3_en.pdf
Code	**BR**
Time series	From 2000 to 2060
Unit	Percentage of gross domestic product (GDP)

Saving-Investment imbalances: demographics and supply and demand for financing

Current account balance (CA): Current account, main components, net balance - annual data, % of GDP (tipsbp11)

Source	Eurostat database
Link	http://ec.europa.eu/eurostat/data/database
Code	tipsbp11
Time series	From 1995 to 2025
Unit	Percentage of gross domestic product (GDP)
Base year	2010
Break Point	2009
Transformation	Missing Data going back to 2009, have been imputed from CAB New February. The CAB new February file is a transformation as well. We took Eurostat **quarterly data** of Current Account in million euros, then we sum the quarterly data to have annual data and divide them for GDP. Finally, we imputed annual data as percentage of GDP from 1995 to 2009. For missing data, such as Belgium previous years we take growth rate of annual data to calculate and fill in backwards years. .

Private Sector Credit Flow (PsCr): debt securities by sectors, consolidated - % of GDP

At the beginning, I took the data form Eurostat, there I made the sum of Debt Securities and Loans respectively for: S11: Non-financial corporations, S14: household and S15 non-profit institutions serving holdings then I found more recent data on EC platform.

Source	Ecfin-internal platform
Link	http://s-ecfin web/directorates/db/u1/data/scoreboard_data/sb.html? SUBJECT=SB_B1H_PRIVCRED_CO&SBSERIESTYPE=indic&FREQ=A&xml=xml/sb_latest.xml&startyear=0&
Code	PsCr

Time series	From 1995 to 2025
Unit	Percentage of gross domestic product (GDP)
Base year	2010

Financial Market

Eurostoxx 600 (Stxx): is a stock index of European stocks designed by STOXX Ltd.. This index has a fixed number of 600 components, among them large companies capitalized among 18 European countries, covering approximately 90% of the free-float market capitalization of the European stock market(not limited to the Eurozone).

Source	Bloomberg
Link	Bloomberg
Code	**Stxx**
Time series	From 1986 to 2017.
Unit	Index
Base year	2010
Transformation	Last value of each year and then average for each year**.**

US long term interest rate (nominal) (ltfI): 10 years' bond interest rate

Source	Bloomberg
Link	Bloomberg
Code	**United States 10Y**
Time series	From 1990 to 2017.
Unit	Percentage of gross domestic product (GDP)
Base year	2010
Transformation	Last value of each year and then average for each year**.**

Monetary policy: conventional and unconventional measures

ECB MRO (MRO): The interest rate on the **main refinancing operations** (MROs), which normally provide the bulk of liquidity to the banking system. The Euro system may execute its tenders in the form of fixed rate or variable rate tenders.

Source	ECB + Deutsche Bundesbank Euro-system statistics

Link	http://www.ecb.europa.eu/stats/policy_and_exchange_rates/key_ecb_interest_rates/html/index.en.html + https://www.bundesbank.de/Navigation/EN/Statistics/Time_series_databases/Money_and_capital_markets/money_and_capital_markets_list_node.html?listId=www_s510_mb02
Code	Main Refinancing operations + BBK01.SU0112_FLAGS
Time series	From 1995 to 2015.
Unit	Percentage of gross domestic product (GDP)
Base year	2010
Break Point	1999
Transformation	Sum of fixed rate + minimum bid rate. Average for each year. Annual data. To extend the series back to 1995 for those countries with more recent values, I took the discount rate of Germany before 1999. Moreover, to extend series back to 1995, we made the average of the sum of average of discount rate and Lombard rate. Linking the two series through the growth rate of the oldest one.

German policy Rate: discount rate and Lombard rate

Source	Deutsche Bundesbank Euro-system statistics
Link	https://www.bundesbank.de/Navigation/EN/Statistics/Time_series_databases/Money_and_capital_markets/money_and_capital_markets_list_node.html?listId=www_s510_mb02
Code	BBK01.SU0112_FLAGS + BBK01.SU0113
Time series	From 1987 to 2015.
Unit	Percentage of gross domestic product at current prices
Base year	2010
Transformation	Annual average and growth rate to extend the series back to 1995 form 1999

Balance Sheet: Index Total Assets/ Liabilities (ECB BS): Euro area (changing composition), Euro system reporting sector - Total assets/liabilities, all currencies combined - World not allocated (geographically) counterpart.

Source	ECB- STATISTICAL DATA WAREHOUSE

Link	Data Source in SDW: http://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=123.ILM.W.U2.C.T000000.Z5.Z01
Code	ILM.W.U2. C. T000000.Z5. Z01
Time series	from 1998 to 2017
Unit	Index
Base year	2010
Transformation	Index with base year 2010. Average of all week values in order to have one value for each year. Annual data. Years 1995-1997 before ECB creation are imputed with the 1998 value to reflect that these do not make a difference in terms of unconventional monetary policy.

Appendix 2 – ECM panel estimates results

Panel unit root estimates

Panel unit root test: Summary
Series: LTI
Date: 03/29/17 Time: 15:10
Sample: 1995 2015
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.34556	0.3648	28	532
Breitung t-stat	-6.16649	0.0000	28	504

Panel unit root test: Summary
Series: D(LTI)
Date: 03/29/17 Time: 15:06
Sample: 1995 2015
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-7.99266	0.0000	28	504
Breitung t-stat	-3.42490	0.0003	28	476

Figure 49 - LTI unit root test

Panel unit root test: Summary
Series: CA
Date: 03/29/17 Time: 15:50
Sample: 1995 2015
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.17047	0.4323	28	523
Breitung t-stat	0.39666	0.6542	28	495

Panel unit root test: Summary
Series: D(CA)
Date: 03/29/17 Time: 15:53
Sample: 1995 2015
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-8.84901	0.0000	28	495
Breitung t-stat	-6.36181	0.0000	28	467

Figure 50 - CA unit root test

Panel unit root test: Summary
Series: COA
Date: 03/29/17 Time: 16:13
Sample: 1995 2015
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-8.52691	0.0000	28	532
Breitung t-stat	-4.20630	0.0000	28	504

Panel unit root test: Summary
Series: FLTI
Date: 03/29/17 Time: 16:18
Sample: 1995 2015
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-14.2014	0.0000	28	532
Breitung t-stat	-16.0473	0.0000	28	504

Figure 51 - Cost of ageing and foreign long- interest rate panel unit root tests

Panel unit root test: Summary
Series: LSTXX
Date: 03/29/17 Time: 16:25
Sample: 1995 2015
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-9.37189	0.0000	28	532
Breitung t-stat	-8.68526	0.0000	28	504

Panel unit root test: Summary
Series: MRO
Date: 03/29/17 Time: 16:27
Sample: 1995 2015
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-10.7260	0.0000	28	532
Breitung t-stat	-12.4990	0.0000	28	504

Figure 52 - Stoxx and MRO panel unit root tests

Panel unit root test: Summary
Series: OG
Date: 03/29/17 Time: 16:27
Sample: 1995 2015
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-5.62075	0.0000	28	509
Breitung t-stat	-5.58295	0.0000	28	481

Panel unit root test: Summary
Series: PSCR
Date: 03/29/17 Time: 16:28
Sample: 1995 2015
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.82332	0.0000	28	466
Breitung t-stat	-3.94290	0.0000	28	438

Figure 53 - Output Gap & Private sector Credit unit root tests

Panel unit root test: Summary
Series: YC
Date: 03/29/17 Time: 16:40
Sample: 1995 2015
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.99067	0.0000	28	523
Breitung t-stat	-3.87403	0.0001	28	495

Figure 54 - Yield Curve unit root tests

Visual Stationarity tests

Explained variable (individual cross- sections) in levels:

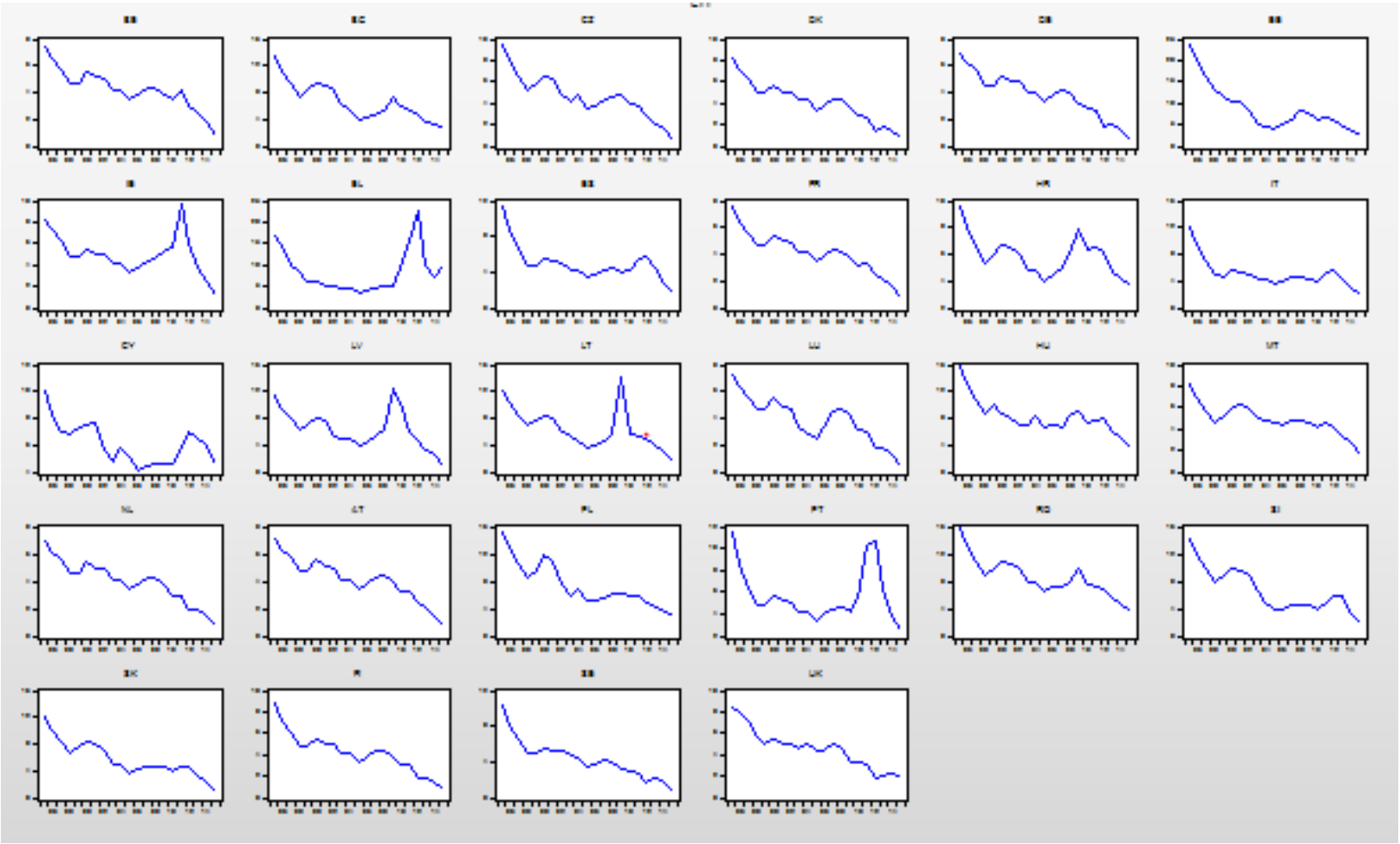


Figure 55 - Explained variables in level

Explained variable (individual cross- sections) in 1st difference

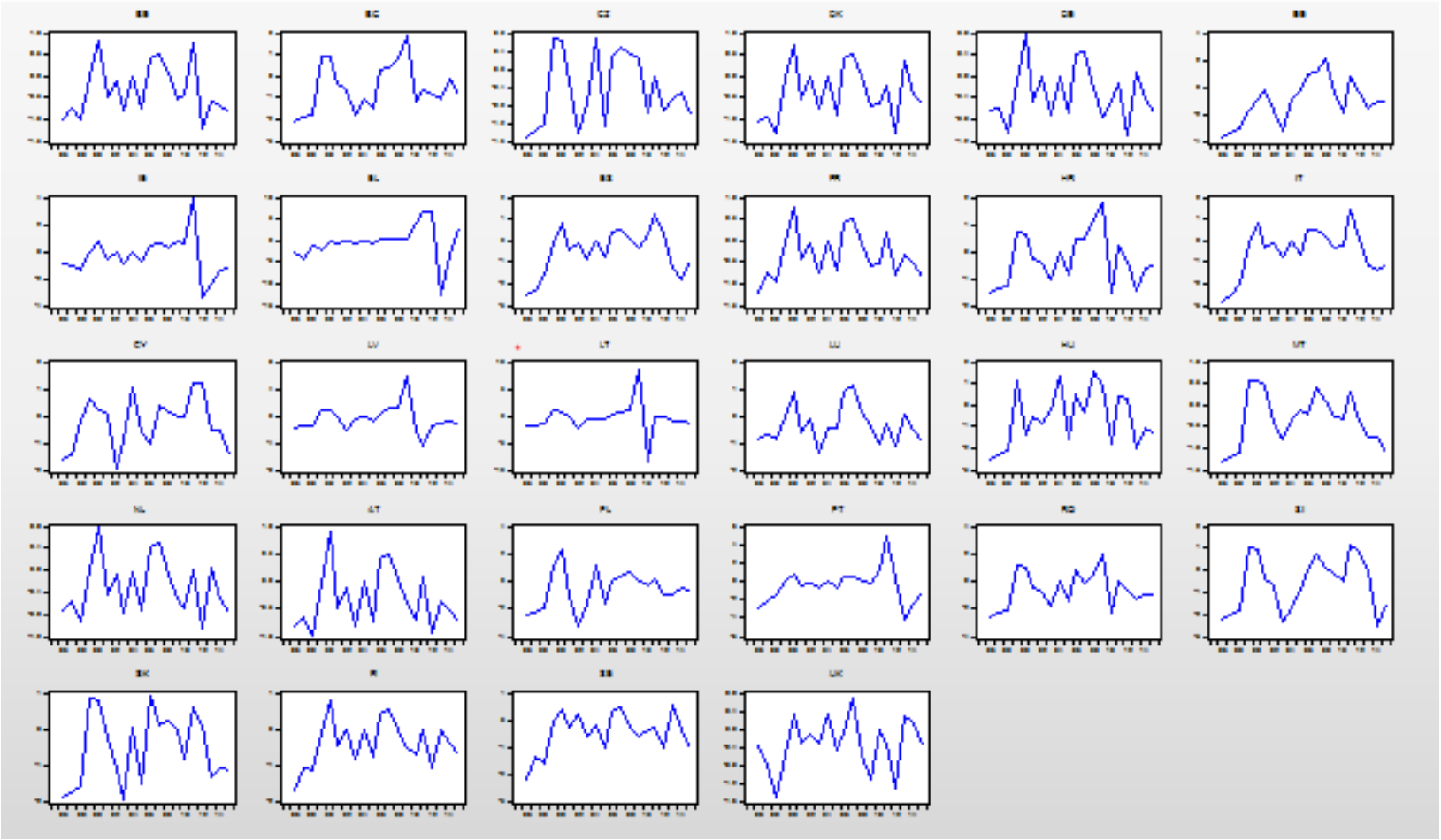


Figure 56 - Explained variable in 1st differences

Explanatory variables (combined cross- sections) in levels:

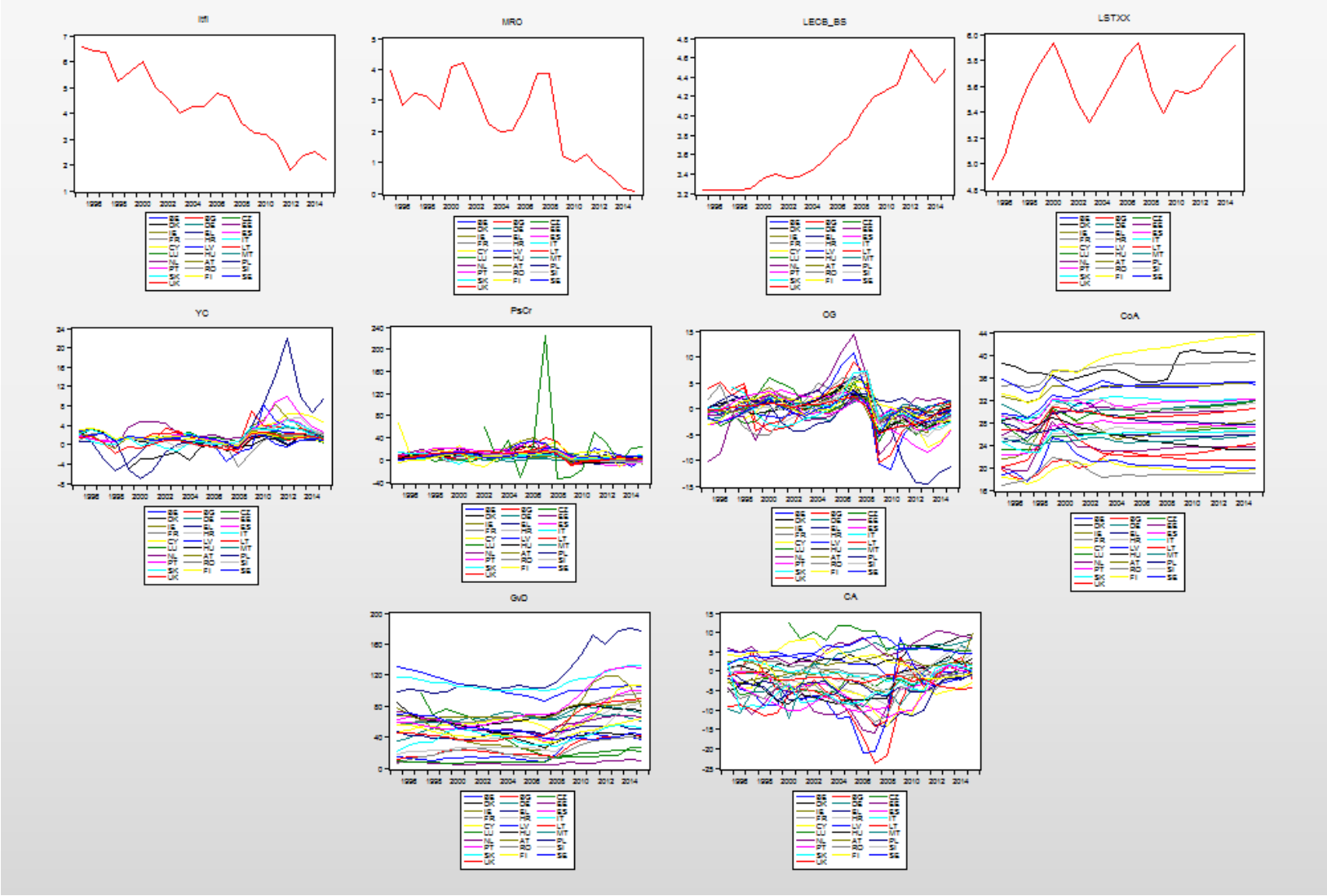


Figure 57 - Explanatory variables in level

Explanatory variables (combined cross- sections) in 1st difference:

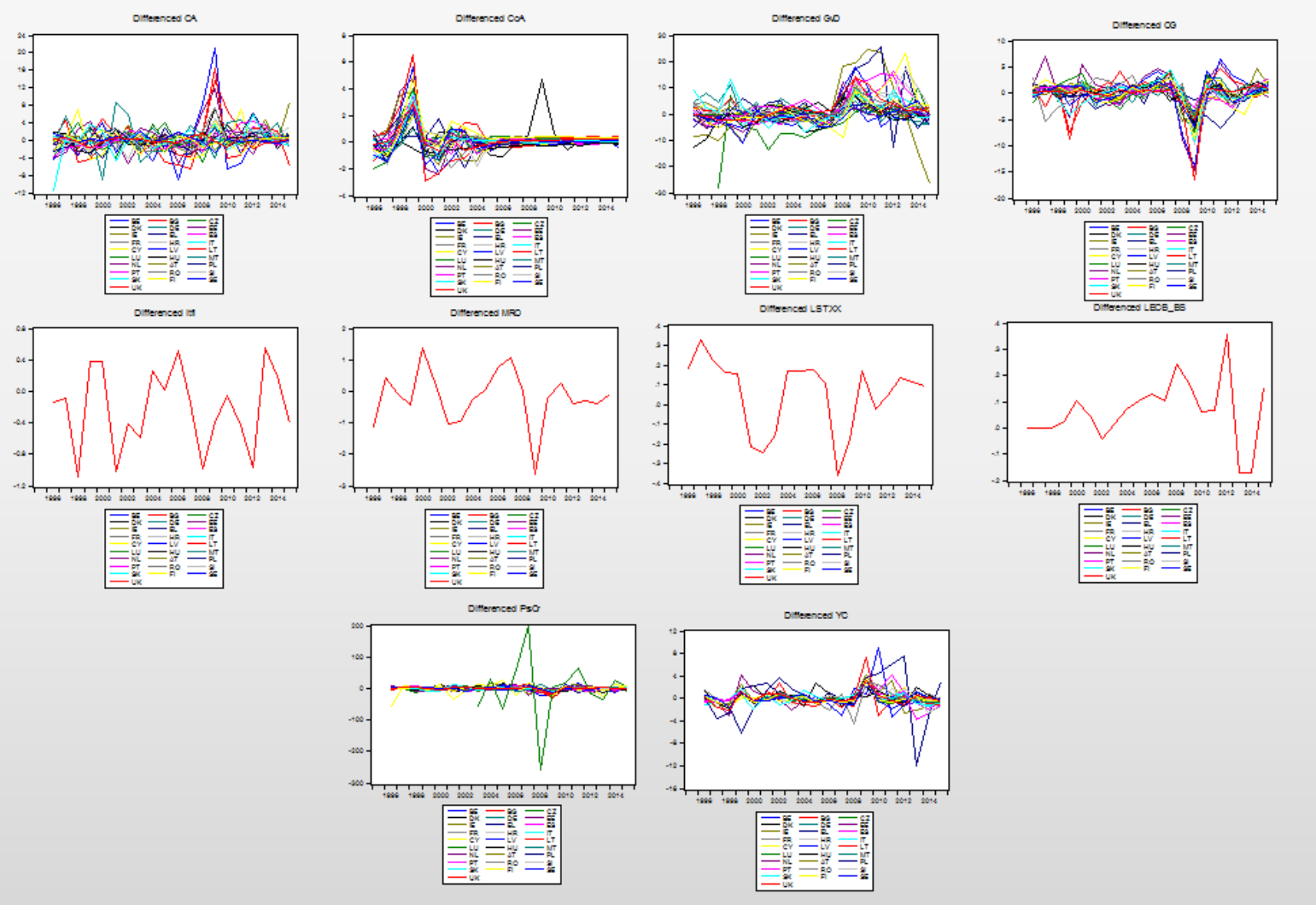


Figure 58 - Explanatory variables in 1st differences

Statistical Stationarity Test

Dependent Variable: LTI
Method: Panel Least Squares
Date: 03/29/17 Time: 14:45
Sample (adjusted): 1996 2015
Periods included: 20
Cross-sections included: 28
Total panel (balanced) observations: 560

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LTI(-1)	0.763646	0.021408	35.67029	0.0000
C	65.87595	21.35347	3.085023	0.0021
YEAR	-0.032398	0.010615	-3.052092	0.0024

R-squared	0.776230	Mean dependent var	5.287067
Adjusted R-squared	0.775427	S.D. dependent var	2.598400
S.E. of regression	1.231360	Akaike info criterion	3.259458
Sum squared resid	844.5499	Schwarz criterion	3.282644
Log likelihood	-909.6483	Hannan-Quinn criter.	3.268512
F-statistic	966.0825	Durbin-Watson stat	1.665120
Prob(F-statistic)	0.000000		

Dependent Variable: OG
Method: Panel Least Squares
Date: 03/29/17 Time: 15:35
Sample (adjusted): 1996 2015
Periods included: 20
Cross-sections included: 28
Total panel (unbalanced) observations: 537

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	136.0509	35.69292	3.811705	0.0002
OG(-1)	0.682472	0.030893	22.09123	0.0000
YEAR	-0.067863	0.017795	-3.813610	0.0002

R-squared	0.515761	Mean dependent var	-0.174556
Adjusted R-squared	0.513947	S.D. dependent var	3.237298
S.E. of regression	2.256963	Akaike info criterion	4.471488
Sum squared resid	2720.133	Schwarz criterion	4.495432
Log likelihood	-1197.595	Hannan-Quinn criter.	4.480855
F-statistic	284.3805	Durbin-Watson stat	1.563615
Prob(F-statistic)	0.000000		

Figure 59 - LTI & OG

Dependent Variable: FLTI
Method: Panel Least Squares
Date: 03/29/17 Time: 15:32
Sample (adjusted): 1996 2015
Periods included: 20
Cross-sections included: 28
Total panel (balanced) observations: 560

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	317.7480	19.82850	16.02481	0.0000
FLTI(-1)	0.304779	0.040514	7.522871	0.0000
YEAR	-0.157036	0.009803	-16.01890	0.0000

R-squared	0.910664	Mean dependent var	4.141185
Adjusted R-squared	0.910343	S.D. dependent var	1.380823
S.E. of regression	0.413457	Akaike info criterion	1.076817
Sum squared resid	95.21733	Schwarz criterion	1.100002
Log likelihood	-298.5086	Hannan-Quinn criter.	1.085870
F-statistic	2838.933	Durbin-Watson stat	1.850614
Prob(F-statistic)	0.000000		

Dependent Variable: MRO
Method: Panel Least Squares
Date: 03/29/17 Time: 15:33
Sample (adjusted): 1996 2015
Periods included: 20
Cross-sections included: 28
Total panel (balanced) observations: 560

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	179.5895	16.11239	11.14605	0.0000
MRO(-1)	0.512543	0.037131	13.80370	0.0000
YEAR	-0.089048	0.008000	-11.13083	0.0000

R-squared	0.686404	Mean dependent var	2.263748
Adjusted R-squared	0.685278	S.D. dependent var	1.298940
S.E. of regression	0.728707	Akaike info criterion	2.210253
Sum squared resid	295.7748	Schwarz criterion	2.233438
Log likelihood	-615.8709	Hannan-Quinn criter.	2.219306
F-statistic	609.5840	Durbin-Watson stat	1.535612
Prob(F-statistic)	0.000000		

Figure 60 - FLTI & MRO

Dependent Variable: PSCR
Method: Panel Least Squares
Date: 03/29/17 Time: 15:39
Sample (adjusted): 1996 2015
Periods included: 20
Cross-sections included: 28
Total panel (unbalanced) observations: 494

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	813.3550	214.1048	3.798865	0.0002
PSCR(-1)	0.165211	0.042941	3.847436	0.0001
YEAR	-0.402270	0.106687	-3.770550	0.0002

R-squared	0.065110	Mean dependent var	7.593725
Adjusted R-squared	0.061302	S.D. dependent var	13.44841
S.E. of regression	13.02968	Akaike info criterion	7.978391
Sum squared resid	83358.31	Schwarz criterion	8.003912
Log likelihood	-1967.663	Hannan-Quinn criter.	7.988411
F-statistic	17.09787	Durbin-Watson stat	2.047787
Prob(F-statistic)	0.000000		

Figure 61 – PsCr

Dependent Variable: LECB_BS
Method: Panel Least Squares
Date: 03/29/17 Time: 15:29
Sample (adjusted): 1996 2015
Periods included: 20
Cross-sections included: 28
Total panel (balanced) observations: 560

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-56.53446	4.459542	-12.67719	0.0000
LECB_BS(-1)	0.675257	0.027044	24.96861	0.0000
YEAR	0.028824	0.002271	12.69335	0.0000

R-squared	0.955298	Mean dependent var	3.785102
Adjusted R-squared	0.955138	S.D. dependent var	0.498211
S.E. of regression	0.105525	Akaike info criterion	-1.654401
Sum squared resid	6.202452	Schwarz criterion	-1.631215
Log likelihood	466.2322	Hannan-Quinn criter.	-1.645347
F-statistic	5951.672	Durbin-Watson stat	1.837870
Prob(F-statistic)	0.000000		

Dependent Variable: LSTXX
Method: Panel Least Squares
Date: 03/29/17 Time: 15:30
Sample (adjusted): 1996 2015
Periods included: 20
Cross-sections included: 28
Total panel (balanced) observations: 560

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.703111	2.403186	-1.124803	0.2612
LSTXX(-1)	0.595566	0.027039	22.02623	0.0000
YEAR	0.002496	0.001230	2.029466	0.0429

R-squared	0.542144	Mean dependent var	5.615602
Adjusted R-squared	0.540500	S.D. dependent var	0.221716
S.E. of regression	0.150293	Akaike info criterion	-0.947113
Sum squared resid	12.58156	Schwarz criterion	-0.923927
Log likelihood	268.1916	Hannan-Quinn criter.	-0.938059
F-statistic	329.7696	Durbin-Watson stat	1.242706
Prob(F-statistic)	0.000000		

Figure 62 - ECB_BS & LSTxx

Dependent Variable: YC
Method: Panel Least Squares
Date: 03/29/17 Time: 15:41
Sample (adjusted): 1996 2015
Periods included: 20
Cross-sections included: 28
Total panel (unbalanced) observations: 551

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-54.69592	20.75081	-2.635844	0.0086
YC(-1)	0.736474	0.029020	25.37853	0.0000
YEAR	0.027477	0.010352	2.654407	0.0082

R-squared	0.563099	Mean dependent var	1.570804
Adjusted R-squared	0.561504	S.D. dependent var	2.058795
S.E. of regression	1.363314	Akaike info criterion	3.463144
Sum squared resid	1018.527	Schwarz criterion	3.486620
Log likelihood	-951.0962	Hannan-Quinn criter.	3.472317
F-statistic	353.1437	Durbin-Watson stat	1.781739
Prob(F-statistic)	0.000000		

Dependent Variable: COA
Method: Panel Least Squares
Date: 03/29/17 Time: 15:22
Sample (adjusted): 1996 2015
Periods included: 20
Cross-sections included: 28
Total panel (balanced) observations: 560

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	28.08191	14.06222	1.996976	0.0463
COA(-1)	0.990986	0.007291	135.9125	0.0000
YEAR	-0.013809	0.007023	-1.966183	0.0498

R-squared	0.971050	Mean dependent var	28.28921
Adjusted R-squared	0.970946	S.D. dependent var	5.581577
S.E. of regression	0.951389	Akaike info criterion	2.743555
Sum squared resid	504.1632	Schwarz criterion	2.766740
Log likelihood	-765.1953	Hannan-Quinn criter.	2.752608
F-statistic	9341.603	Durbin-Watson stat	1.642618
Prob(F-statistic)	0.000000		

Figure 63 - YC and CoA

Dependent Variable: COA
Method: Panel Least Squares
Date: 03/29/17 Time: 15:22
Sample (adjusted): 1996 2015
Periods included: 20
Cross-sections included: 28
Total panel (balanced) observations: 560

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	28.08191	14.06222	1.996976	0.0463
COA(-1)	0.990986	0.007291	135.9125	0.0000
YEAR	-0.013809	0.007023	-1.966183	0.0498

R-squared	0.971050	Mean dependent var	28.28921
Adjusted R-squared	0.970946	S.D. dependent var	5.581577
S.E. of regression	0.951389	Akaike info criterion	2.743555
Sum squared resid	504.1632	Schwarz criterion	2.766740
Log likelihood	-765.1953	Hannan-Quinn criter.	2.752608
F-statistic	9341.603	Durbin-Watson stat	1.642618
Prob(F-statistic)	0.000000		

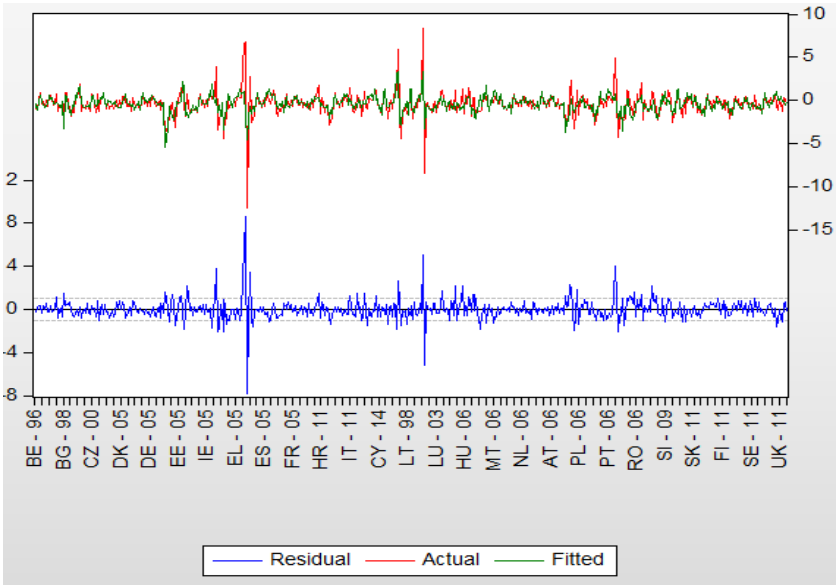
Dependent Variable: CA
Method: Panel Least Squares
Date: 03/29/17 Time: 15:21
Sample (adjusted): 1996 2015
Periods included: 20
Cross-sections included: 28
Total panel (unbalanced) observations: 551

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-173.2865	38.48181	-4.503075	0.0000
CA(-1)	0.881534	0.019724	44.69344	0.0000
YEAR	0.086366	0.019185	4.501712	0.0000

R-squared	0.791456	Mean dependent var	-1.609691
Adjusted R-squared	0.790695	S.D. dependent var	5.606453
S.E. of regression	2.564945	Akaike info criterion	4.727181
Sum squared resid	3605.261	Schwarz criterion	4.750657
Log likelihood	-1299.338	Hannan-Quinn criter.	4.736354
F-statistic	1039.872	Durbin-Watson stat	1.814611
Prob(F-statistic)	0.000000		

Figure 64 - GvD & CA

ECM residuals



Panel unit root test: Summary
Series: RESID_ECM_NOYC_NOPSCR
Date: 03/31/17 Time: 15:42
Sample: 1995 2015
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-14.0791	0.0000	28	469
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-12.3439	0.0000	28	469
ADF - Fisher Chi-square	253.115	0.0000	28	469
PP - Fisher Chi-square	728.203	0.0000	28	497

Panel unit root test: Summary
Series: RESID_ECM_NOYC_NOPSCR
Date: 03/31/17 Time: 15:43
Sample: 1995 2015
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-12.5914	0.0000	28	469
Breitung t-stat	-7.02846	0.0000	28	441

Figure 65 - ECM residuals

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Summary

Nowadays, the fall of (real) long-term interest rates is becoming one of the most "burning issue" of the global economy. The absence of an economic recovery is largely connected to real long-term interest rates close to zero and current account imbalances. The aim of the thesis is to analyze the main drivers that affect interest rates and current account imbalances and propose an econometric methodology to assess future development in interest rates, estimating a panel dataset of 28 EU countries over a period of 21 years, from 1995 to 2015. The explanatory variables considered encompass most of the determinants discussed in literature and confirm the explanatory power of most of them. From an overall point of view, the estimations are complemented with projections over T+10 horizon.

Introduction

Real long-term interest rates have been declining from the 1980s and 1990s in the main advanced economies. Low interest rates have strong implications for the conduct of monetary and fiscal policies, for business strategy plans of financial institutions and much more for households and business. Thus, it is essential for policymakers to understand how interest rates are determined and identify the factors that have driven down real bond yields. Three broad explanations have been put forward: the role of monetary policy at home and abroad; the imbalances between desired savings and investments being significantly affected by demographic changes; or the imbalances between the demand and supply of safe assets.

In addition, after the global financial crisis, global imbalances increased moderately in 2015 due to a reconfiguration of current accounts and exchange rates. Firstly, the shift in 2015 was driven by the upturn in advanced economies, the fall in commodity prices, and the external conditions for emerging markets. In addition, adjustments of exchange rates have a leading role, as a matter of fact, the USD appreciated and the euro and the yen consequently depreciated; moreover, the suddenly growth of China and the depreciation pressure of Ems countries have led global economy towards a saving glut scenario, that has contributed to the decline of interest rates.

Some authors, such as Rachel and Smith, affirmed that the secular trend looks like to persist. They suggest as well that the global neutral real rate may settle at or slightly below 1% over the medium to long-run. In relation to current account imbalances, the IMF forecast for global imbalances suggests a gradual reverse of the EM saving glut in the future. This signifies the persistence of high current surplus in EMEs in the near future.

The challenge of my thesis is to figure out a suitable econometric approach to assess future developments of interest rates as well as analyse the macroeconomic impact of central banks' balance sheet policies in a crisis period when interest rates reach the zero-lower bound. The thesis proposes a

simple econometric methodology to replicate the research 'studies carried out by others, implementing and taking in consideration new variables, updated data collection and statistical analysis.

The analysis intends to specifically assess:

3. The variables affecting the long run interest rates and the current account and their explanatory power by estimating a panel regression model with year data from EU 28 countries over the historical period before and after crisis (1980 – 2016).
4. On the basis of results, make projections on t+10 and to evaluate how fast interest rates are likely to return to more normal levels.

The assessment has been performed through the analysis of several institutional papers, in particular the work has been inspired on the OECD paper "Explaining the interest-Rate-Growth Differential Underlying Government Debt Dynamics" (Turner and Spinelli, 2011), subsequently used in their long-term growth scenarios (Johansson et al., 2013), and at the IMF to explain the persistence of negative IRGD in emerging and low-income countries (Escolano et al., 2011).

The paper follows this **methodology** and it comprises three main section:

4. **Analysis and reviewing of literature texts**: the first section analyses all papers and theories on several economic aspects that are considered the main drivers of equilibrium long-term interest rates and current account.
5. **Model creation and variables description**: on the basis of theories, time series on a set of 10 variables have been created or transformed by dataset stemming from European Commission or other main institutional bodies, to test the statistical validity and correlation.
6. **Empirical analysis of results**: as an outcome, the estimation of panel error correlation model, the results stemming from the model creation, and the robustness of data, combined with projections.

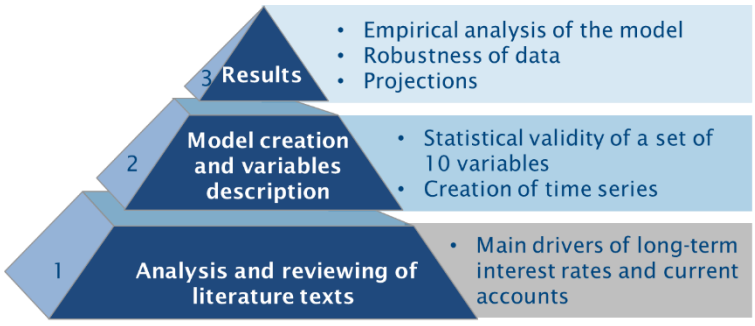

Figure 66 – Methodology

The thesis project is born in collaboration with the European Commission, C2-Fiscal sustainability unit, where I did a curriculum internship. Unit C2 is required to produce an annual report on fiscal policy trends. Research on interest rates drivers was part of my contribution. The majority of sources taken in consideration are

documents produced by the European Commission itself, and the majority of data gathered to create the model series are contained in the Commission's confidential dataset called "Ameco".

The first section analyses all papers and theories on several economic aspects linked to nominal interest rates and current account. The study of long-term interest rates is always addressed in accordance with the principles of two mainstreams:

C. **Secular stagnation**: this theory affirms that although there is a lot of variation across countries, the presence of a discernible common trend suggests global factors are at work.[46] The theory of secular stagnation brings out the possibility that depression may become the normal condition of the economy."[47]

D. **Financial cycle**: this theory focusses on interactions between perceptions of value and risk, attitudes towards risk and financing constraints, which translate into booms followed by busts. These interactions can amplify economic fluctuations and possibly lead to serious financial distress and economic dislocations. This analytical definition is closely tied to the increasingly popular concept of the "procyclicality" of the financial system[48].

In addition to secular stagnation and fiscal cycle hypothesis**, current account imbalances** have been considered as a fundamental element to fully outline evolutions of long run interest rates. Moreover, an in-depth analysis has been carried out in relation to the policy implications of permanently low real interest rates such as**: unconventional monetary policy instruments (Quantitative Easing)**

It seemed important to underline the role of QE programs as a further driven of the falling of long interest rates. The huge injection of monetary base has been considered as an important element for the model.

Secular stagnation hypothesis affirms that the follow of the real interest rates is determined by:

3. **Expectations of global trend growth:** such as expectations on global labour supply growth due to *demographic* forces and *technological* frontier, may cause global growth to slow by up 1 pp over the next decades.
4. **Preferences for savings and investments**: shift in the balance of desired savings and investments appear quantitatively even more important than changes in growth expectations

Many factors affect interest rates. On the one hand, there are those that **favor a substantial increase in interest rates in the medium-term**, such as high and rising debt levels in advanced economies, ageing populations, and further financial deepening in emerging market economies, which should reduce their borrowing

[46] Summers (2014)
[47] Harris, Seymour E. (1943). Postwar Economic Problems (PDF). New York, London: McGraw Hill Book Co. pp. 67–82<Chapter IV Secular Stagnation by Alan Sweezy.>
[48] eg, (Borio et al (2001), Danielsson et al (2004), Kashyap and Stein (2004), Brunnermeier et al (2009), Adrian and Shin (2010))

constraints and thereby their net savings. On the other hand, **other factors work in the opposite direction, for instance, t**he imbalance between the propensity to save rather than the propensity to invest. Summers (2014) suggests the causes are demand-side factors such as declining rates of population growth, cheaper capital goods and changes in the distribution of income. Alternatively, structural change and the reduction in the natural rate of interest could originate from secular stagnation on the supply side. For example, Gordon (2015) argues that sluggish trends in labor productivity caused by diminishing returns from the digital revolution contribute to this secular stagnation. In addition, Rogoff (2016) suggests that debt overhang has at least partly contributed to higher savings and weaker investment

In addition, there are many financial factors affecting the widening of long interest rates. The bond market equilibrium and the asset purchase programme has strongly contributed to the actual scenario. The perception of risk premium and yield curve maturity as well as financial constrains play a key role in determining interest rates. Moreover, the huge amount of government assets purchased such as quantitative easing strategy has generates a fall of long interest rates, as well.

Model and Series Creation

After retracing the observation of low long interest rate phenomenon and inquiry concerning its causes has, as well as the formulation of hypotheses with generalized explanations for the phenomenon. The analysis goes on with the model and series creation. **In order to assess the relative importance of the various explanations discussed in the previous section and prove the validity of hypotheses (i.e. confirm them if true, refute them if false), we create and test an annual panel regression for 28 EU countries mostly covering the periods 1995 -2015 using the error correction method (ECM).**

The initial idea was to replicate a study conducted in the European Commission on the base of the OECD paper No 919 "Explaining the Interest Rates Growth Differential Underlying Government Debt Dynamics". From OECD and EC works the key issue in assessing long-run fiscal sustainability is the future trend of the differential between the interest rate paid to service government debt and the growth rate of the economy.

Then we decided to use an error correction methodology for assessing the importance and impact of long- run interest rates determinants. The set of regression is based on a balanced cross section panel of annual data (1995 to 2015) from 28 EU Member States to estimate long run interest rates on 10 explanatory variables.
All variables are expressed in nominal values**.** The explanatory variables considered below encompass most of the determinants discussed in literature:

#	Variables	Code
1	**Nominal interest rates**	ILN
2	**Output gap**	OG

3	**Government Debt ratio**	GvD
4	**Yield Curve**	YC
5	**Cost of ageing**	CoA
6	**Current Account balance**	CA
7	**Private Sector Credit Flow**	PsCr
8	**Eurostoxx 600**	Stxx
9	**US long term interest rates**	fLTI
10	**ECB balance Sheet**	ECB_BS
11	**ECB MRO**	MRO

Table 9 - Explanatory variables

The Stxx and ECB_BS series have been transformed in logarithmic functions variable while all other series remained in levels because the relative data were either interest rates or % of GDP.

We decide to use an error correction model (ECM) because we selected economic **time series** variables that commonly have a long-run stochastic trend, also known as **cointegration**.

Before running formal stationarity tests, that is essential to test the validity of time series, economic series must be differentiated, it means test whether they have an evident trend in levels, whether they revert to a zero mean in 1st differences or whether they look totally erratic, case in which they very likely have a unit root or on a random walk. If series presents unit root, it is necessary to determine the order of integration.

To test the order of integration we used two models:

3. **Levin, Lin & Chu t**
4. **Breitung t-stat**
5. **The null hypothesis of the Levin Lin & Chu & Breitung test is:**

$$H_0: p_i = 1$$

$$H_1: -1 < p_i = p < 1$$

It means that the null hypothesis affirms the existence of a common unit root, while the alternative hypothesis affirms that the series are stationary.

Considering the results in Table 1, the Levin, Lin & Chu test and Breitung tests reject the null hypnosis of a unit root. In each case, the **p- value is > Statistic.**

Moreover, it means that **all variables series are stationary[49] or stationary around a trend.**

[49] **Stationarity** requires that the future is like the past, at least in the probabilistic sense

	Method	Statistic	Level**	Statistic	1st** difference,	Statistic	2nd** difference
LTI	Levin, Lin & Chu t	**-0.34556**	**0.3648**	**-7.99266**	**0.0000**		
	Breitung t-stat	**-6.16649**	**0.0000**	**-3.42490**	**0.0003**		
OG	Levin, Lin & Chu t*	-5.62075	0.0000				
	Breitung t-stat	-5.58295	0.0000				
GvD	Levin, Lin & Chu t*	**-3.12226**	**0.0009**	**-0.65980**	**0.2547**	**-4.03911**	**0.0000**
	Breitung t-stat	**2.60002**	**0.9953**	**-1.56282**	**0.0590**	**-4.52884**	**0.0000**
YC	Levin, Lin & Chu t*	-4.99067	0.0000				
	Breitung t-stat	-3.87403	0.0001				
CoA	Levin, Lin & Chu t*	-8.52691	0.0000				
	Breitung t-stat	-4.20630	0.0000				
CA	Levin, Lin & Chu t*	**-0.17047**	**0.4323**	**-8.84901**	**0.0000**		
	Breitung t-stat	**0.39666**	**0.6542**	**-6.36181**	**0.0000**		
PsCr	Levin, Lin & Chu t*	-4.82332	0.0000				
	Breitung t-stat	-3.94290	0.0000				
Stxx	Levin, Lin & Chu t*	-9.37189	0.0000				
	Breitung t-stat	-8.68526	0.0000				
fLTI	Levin, Lin & Chu t*	-14.2014	0.0000				
	Breitung t-stat	-16.0473	0.0000				
ECB_BS	Levin, Lin & Chu t*	**-1.48136**	**0.0693**	**-11.1278**	**0.0000**		
	Breitung t-stat	**-3.06384**	**0.0011**	**-11.4311**	**0.0000**		
MRO	Levin, Lin & Chu t*	-10.7260	0.0000				
	Breitung t-stat	-12.4990	0.0000				

****, **, * = statistical significance at the 1%, 5% and 10% level respectively*

Table 10 - Panel unit root tests

Secondly, it is important to test if there is a linear combination between explanatory variables that does not have a stochastic trend, it means that whether they are cointegrated. One simple way is to see if the residuals from the cointegrating relation are stationary.

Method	Statistic	Prob**
Im, Pesaran and Shin W-stat	-12.3439	0.0000
ADF	253.115	0.0000
PP	728.203	0.0000
Levin, Lin & Chu t	-12.5914	0.0000
Breitung t-stat	-7.02846	0.0000

****, **, * = statistical significance at the 1%, 5% and 10% level respectively*

Table 11 - ECM residuals

In our regression residuals are stationary, as it possible to observe from Table 2. Probabilities stemming from several methods, ADF, PP, Levin, Lin & Chu t, Breitung t-stat are all zero. It means that is possible to reject the null hypothesis of non-stationarity of residuals.

At this point in time, it is possible to test autocorrelation among series to choose the best combination of explanatory variables. The traditional test for the presence of first-order autocorrelation is the **Durbin–Watson** statistic or, if the explanatory variables include a lagged dependent variable, Durbin's statistic. **When the tests observe a positive autocorrelation, it means that DW is equal to 0, when we observe a negative autocorrelation is because DW is equal to 4 and the preferred case is when DW is equal to 2 because it means that there is no correlation**.

According with the above criteria, we decided that the preferred ECM regression tested is the following:

$$\Delta LTI_t = \alpha_0 + \beta_1 \Delta OG_t + \beta_2 \Delta fLTI_t + \beta_3 \Delta MRO_{t-1} + \beta_4 \Delta ECB\_bs_t + \beta_5 \Delta Stxx_{t-1} + \beta_6 \Delta CoA_t + \beta_7 \Delta GvD_t + \beta_8 \Delta CA_t + \alpha_1 LTI_{t-1} + \alpha_2 OG_{t-1} + \alpha_3 fLTI_{t-1} + \alpha_4 MRO_{t-1} + \alpha_5 ECB\_bs_{t-1} + \alpha_6 Stxx_{t-1} + \alpha_7 CoA_{t-1} + \alpha_8 GvD_{t-1} + \alpha_9 CA_{t-1} + \eta \quad \textbf{(2)}$$

The preferred regression is the one that keep out the Yield curve and the private sector flow variables. Considering the results gathered from the tests, we preferred to choose the proposal 1 for several reasons.

Proposal 1

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.715868	2.541809	1.068478	0.2858
D(OG)	-0.168523	0.030854	-5.461871	0.0000
D(FLTI)	0.863171	0.175264	4.924971	0.0000
D(MRO)	0.566631	0.126903	4.465071	0.0000
D(LECB_BS)	2.310939	0.481997	4.794505	0.0000
D(LSTXX)	-2.468269	0.741286	-3.329713	0.0009
D(COA)	0.055927	0.053473	1.045896	0.2961
D(GVD)	0.020810	0.010031	2.074606	0.0385
D(CA)	0.084347	0.020617	4.091056	0.0000
LTI(-1)	-0.291961	0.026216	-11.13693	0.0000
OG(-1)	-0.050864	0.022845	-2.226468	0.0264
FLTI(-1)	0.374548	0.176777	2.118757	0.0346
MRO(-1)	0.023973	0.164475	0.145755	0.8842
LECB_BS(-1)	0.272186	0.292164	0.931621	0.3520
LSTXX(-1)	-0.600768	0.362163	-1.658836	0.0978
COA(-1)	-0.029500	0.011149	-2.645909	0.0084
GVD(-1)	0.002652	0.001606	1.651124	0.0993
CA(-1)	-0.040911	0.010837	-3.775113	0.0002

R-squared	0.465795	Mean dependent var	-0.406139
Adjusted R-squared	0.447883	S.D. dependent var	1.377600
S.E. of regression	1.023620	Akaike info criterion	2.918252
Sum squared resid	531.2334	Schwarz criterion	3.064425
Log likelihood	-748.0411	Hannan-Quinn criter.	2.975490
F-statistic	26.00436	Durbin-Watson stat	2.050282
Prob(F-statistic)	0.000000		

Table 12 - Preferred ECM regression

The regression, proposal 1, presents all EC residual stationary and cointegrated. It is possible to affirm that there is no serial correlation because **the Durbin Watson test is equal to 2**. **Proposal 1**, the one without PsCr and YC variables, the variable yield curve is significant in all specifications, for short al long term equilibrium, maybe because (ILN) the long-term interest rates and yield curve are codetermined. The YC= ILN – IST. On the other hand, due to the presence of yield curve variable in the regression, the R-square has less explanatory power (**0.46579**) respect to the regression with all variables.

Using our preferred equation, we calculated the elasticities of variables for short and long run equilibrium; calculating the elasticity is necessary to understand how and in which measure variables impact on the dependent variables. Moreover, there is short and long run equilibrium as indicated by the statistically significant coefficient of error correction term.

	Long run equilibrium equation – Error Correction Term (α_1 not factored out)			
Driver	**Coefficient**	**Estimated parameter**	**p-value**	**Long run elasticity of tax base with respect to GDP (level logs)*[50]**
OG	α_2	- 0.051**	0.026	- 0.18
fLTI	α_3	0.375**	0.035	1.28
MRO	α_4	0.024	0.884	Not signific
ECB_bs	α_5	0.272	0.352	Not signific
Stxx	α_6	- 0.601*	0.098	- 2.06
CoA	α_7	0.030***	0.008	0.30
GvD	α_8	0.003*	0.099	0.10
CA	α_9	- 0.041***	0.000	- 0.14
	Coefficient of the Error Correction Term	**Estimated parameter**	**p-value**	**Adjustment speed towards equilibrium**
	α_1	- 0.292***	0.000	0.292
	Short run equilibrium equation			
Driver	**Coefficient**	**Estimated parameter**	**p-value**	**Short run elasticity of tax base with respect to GDP (level logs)***
OG	β_1	- 0.169***	0.000	- 0.17
fLTI	β_2	0.863***	0.000	0.86
MRO	β_3	0.567***	0.000	0.57
ECB_bs	β_4	2.311***	0.000	2.31
Stxx	β_5	- 2.468***	0.009	- 2.47
CoA	β_6	0.056	0.296	Not signific
GvD	β_7	0.020**	0.036	0.02
CA	β_8	0.084***	0.000	0.08

***, **, * = statistical significance at the 1%, 5% and 10% level respectively

Table 13 - Short and long run equilibrium elasticities

The results of ECM indicate that there is both short and long run equilibrium in the system. The **error correction term α_1**, is equal to **-0,292**, it describes the adjustment speed at which the long interest rates return towards equilibrium.

As it possible to observe from Table 7, the estimates coefficients are almost significant, in **the short run** monetary policies variables are significant at 99% level, while the government debt is significant at 95% level. The only variable that is not significant is the (CoA) cost of ageing, the estimated parameter is 0,056. In addition, all signs are correct as expected from literature, as a matter of fact an increase of 1pp in output gap generates a small decrease of 0.17 pp in long interest rate. In the same direction, an increase of 1 pp of balance sheet generates a decrease of about 2.47pp of long interest rates, the expected sign is different form the one obtained. On the other hand, an increase of foreign interest rates generates an increase of 0.86 pp of domestic long interest rate, as well as an increase of 1pp of the interest rate of main refinancing operation generates an

[50] The elasticity of tax revenue with respect to GDP is set to 1 (a_{ty} = 1.0). This is consistent with the assumption of Claus et al. (2006), which was based on the estimations in Girouard and Andre (2005).

increase of 0.57 of the long interest rate, in fact according to the Taylor rule - in the short term the monetary policy variable (MRO of our panel, i_t in the Taylor rule) should evolves one to one in line with the natural nominal rate of interest ($\pi_t + r_t^*$). Finally, the case of Current account variable is quite controversial and complex, as well as in the long run, it seems that the CA and LTI should move in the same direction.

In **the long run**, monetary policies variables are not significant, the MRO estimated parameter: 0.024 and ECB-BS estimate parameter: 0.272. Cost of ageing and current account balance are significant at 99% level, in fact as the long run elasticity coefficient reveals current account imbalances have a strong impact on the long interest rate, according to literature an increase of 1% of current account surplus correspond to a larger excess of saving over investment which is symptomatic of a fall of long interest rates (-0.14). Moreover, 1 pp increase in the cost of ageing CoA (that reflects demographics changes) generates an increase of 0.30pp in long interest rates. Nevertheless, the positive sign of the coefficient of the constant term is not consistent with the theoretical effect we would expect. An increase of CoA expenditure is generally associated to a phenomenon of ageing population. This phenomenon currently determines forward looking agents to save more, lowering the interest rates, particularly in years approaching retirement.

In addition, output gap (OG) and foreign interest rates (flti) are significant at 95% level and the sign agree with our expectations, according to literature 1 pp increase in output gap generates a decrease of 0.18 pp in long interest rates as well as 1 pp increase of foreign interest rates generates an increase of 1.28pp of LTI. Finally, STxx and Gvd are statistically significant at 90% level. An increase of government debt is associated to an increase of long interest rates of 0.10 pp. On the other hand, an increase of Stoxx index should raise the long interest rates (2.06). In long term, there is no arbitrage between stocks and bonds so higher return on the stock market (an alternative investment) lowers the demand for government bonds and thereby raise the long-term interest rates. In our regression sign of Stxx is in contrast with our expectations. The explanatory variable of yield curve (YC) and private credit flow (PsCr) are not included in our preferred equation to project interest rates because linking interest rates to yield curve and private sector credit flow could easily generate a negative feedback loop.

Form an overall point of view results say that in <u>long term</u>, the Long-term interest rates respond <u>negatively</u> to the Output gap, Stxx index and Current account imbalances and <u>positively</u> to the Cost of ageing and Government Debt. While in the <u>short term</u>, the long-term interest rates respond negatively

to the Output Gap and Stoxx index and positively to all the other significant variables in the Short-term equation.

The preferred regression presents several strength, the Durbin Watson test is close to **2** it means there is no serial correlation, moreover data set is well-modelled by a normal distribution and the regression chosen presents fewer n to estimate compared to other specifications tested;

In addition, monetary policy variables are significant in the Short run term but not in the long run term and in long run term, from data observed, it possible to affirm that variables have the right sign, expect for the Stxx variables that has the wrong sign (-2.06%); Furthermore, in the Short run term the Cost of ageing is not significant, and does it make sense because the cost of expenditure is considered a long-term variable as it represents demographic changes. Finally, the ECM proposal 1 has an acceptable explanatory variable, the R-square is **0.46579. The signs of coefficient estimates conform to results in the literature and previous estimates.** Results are overall significant and in accordance with existing evidence

Projections

Finally**,** our preferred equation is used to project interest rates up to 2025. The interesting forecast is the **US interest rates that should consistently increase, reaching 3/3.5 % points in the next decade.** This value is in accordance with the latest restrictive monetary policies, embraced by the FED. On the other hand, according with Rachel and Smith prediction, the ECB interest rates would remain below the 1% over the medium- long run and considering our projections would not be any reverse in current account imbalances (Figure 41) as IMF forecast for global imbalances suggests. Finally, the cost of ageing should shortly increase for all member states. The following graphs show the evolution trends of explanatory variables.

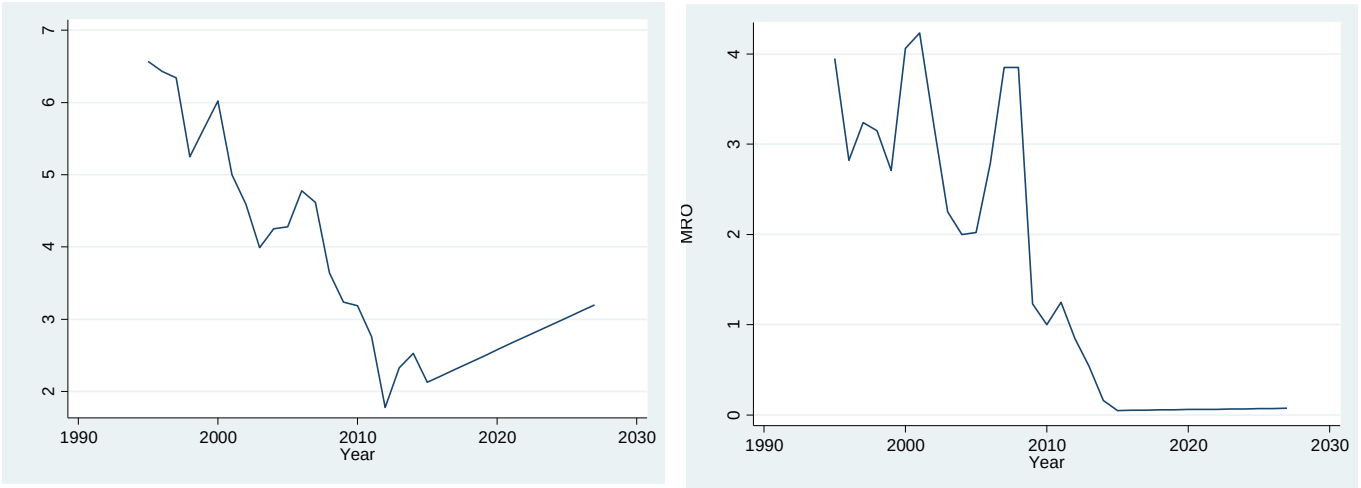

Figure 67 - US and EU interest rate projections

A low interest rate environment (LIRE) and current account imbalances have broad implications for the real economy as well as for fiscal, monetary and prudential policy. IF low level of interest rates is protracted, the positive effect on (current) aggregate demand via intertemporal substitution is smaller and the negative effect on savers is larger. The severity of LIRE however depends on the drivers that trigger down the interest rates such as changes in savings behavior.

From a **fiscal prospective**, low interest rates are favorable to countries with high public debt.

For **monetary policy,** a few considerations stand out. Firstly, if the (long-term) global equilibrium real rate is at or slightly below 1%, then for countries with a 2% inflation target, equilibrium nominal interest rates in individual countries may eventually settle at or below 3% – considerably lower than the historic norm. Policymakers could risk losing credibility if existing monetary policy tools are found to be insufficient to stabilize the business cycle, the uncertainties over the transmission of QE and concerns over the size of central bank balance sheets might limit the use of such tools in the future.

On the **macro-prudential side**, the **financial stability** risks associated to the low for long scenario are: i) direct effects including profitability and solvency pressures for financial, weakening the resilience and affecting the sustainability of some financial sectors, ii) higher sensitivity to market shocks due to growing competition from non-bank sectors and accelerated transition to a more market-based structure and iii) indirect effects such as increased risk taking in the financial markets beyond risk –bearing capacities.