UNIVERSITY OF PIRAEUS

DEPARTMENT OF BANKING & FINANCIAL MANAGEMENT

MSc IN BANKING AND FINANCE

MASTER THESIS

GINI COEFFICIENT AND INFLATION RATE

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PIRAEUS, 2017

Summary

The aim of this thesis is to study the effect of income inequality on **inflation rate** in countries of OECD. I analyze the effect of income inequality, measured by the **Gini coefficient**, on inflation with a panel dataset comprised of **29 OECD** countries over the period **2004 - 2013**. The dataset was obtained from OECD statistics database and Eurostat database and include independent variables that were found statistically important from previous surveys as well as the Gini coefficient. The dependent variable is the Annual Inflation measured by **CPI**. We use several regressions to test this association. One for the entire set of data and four other for countries with low and high Gini coefficient and for high and low GDP Growth. With the help of regression analysis, I find evidence supporting the view that **there is not a correlation** between those two variables for any regression, while the other inflation determinants are generally in accordance with previous results.

Key Words

Inflation, Income Inequality, Gini Coefficient, CPI, OECD

Chapters

Chapter 1: Introduction

“ Inflation is always and everywhere a monetary phenomenon in the sense that it is and can be produced only by a more rapid increase in the quantity of money than in output”

Milton Friedman

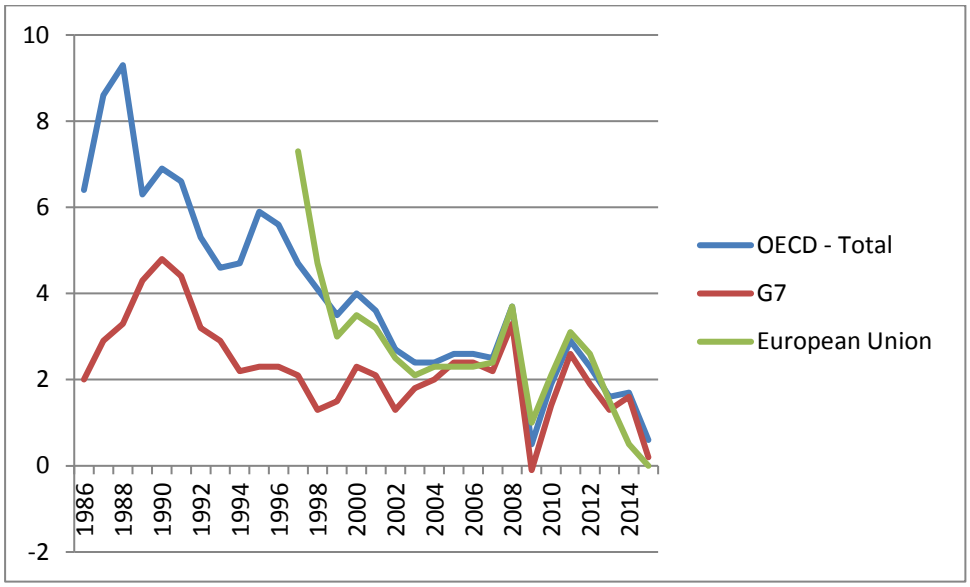
1.1 Motivation

Inflation has been one of the most major variables that governments take into consideration when they have to take decisions. Inflation has been connected with the rise of the prices, and the consequent reduction of the purchasing power of wages and savings. A lot of studies over the years have tried to shed light on this phenomenon however different surveys have led to different opinions. This implies that inflation is not such an easy phenomenon to explain theoretically but rather it reflects the complexity of our economic life. As a result, understanding it is major for us to confront it and achieve long term prosperity.

But what exactly affects the inflation rate? Modern economic theories generally agree to the statement of M. Friedman that inflation is always and everywhere a monetary phenomenon. Does a statement like this holds even nowadays or the complexity of the economic life has changed it radically? The diagram below can help in our understanding of the various powers, economic or not, that can affect inflation.

Diagram 1:

CPI from 1986 to 2015 for OECD, G7, European Union



As we can see in the diagram, the past years from 1986 to 2015 there has been a downwards trend for inflation rate as it is measured by CPI. In the diagram we can see the progress of inflation rate for OECD, for the G7 countries and the European Union. As we can notice all three of these units are "walking" on a similar pace. Especially after 2000 they seem to converge and follow each other. The reason behind this co-movement is apparent. The globalization that occurred since the 1990's, the internet revolution and the vast communications revolution has led to a more global economy with higher interdependencies. Of course this has come with a price in the face of the many crises that occurred the past years with the most recent that of 2007 being the most severe and destructive since the Great Depression.

The several crises that occurred the last decades have brought to the surface several factors that have been responsible one way or another for the instability of inflation. One of these factors, that this thesis will try to unravel, is income inequality. Income inequality is the unequal distribution of income across the various across the various members of the society. Income inequality is often presented as the percentage of income to a percentage of population. Income inequality is different among countries and many variables may be responsible for it like age, sex, religion etc. The phenomenon of increasing inequality and the destructive effects for a

country's economy is an issue of major debate among economists and politicians for its causes and the ways it can be moderated.

Many papers have highlighted the usefulness of reducing income inequality for a country's growth. Income inequality can function in different ways and affect all the aspects of our lives negatively. First of all, income inequality demotivates people to invest in their own education since they think that it doesn't worth the effort. This lowers productivity of workforce leading to a growth dampening. In addition, income inequality often causes social tensions in the form of property crimes, strikes and political chaos that ultimately lead to a decline of production, reduction of foreign investments and economic recession. Finally, redistribution policies affect the performance of a government since they retain money collected by taxes that could be used for other activities, like investment, which in the long run may benefit the economy more.

As many researchers have already found inflation has a negative effect on the welfare of people. However, it does not affect all people the same way. Poor people are more vulnerable than rich, due to the fact that they do not have access to financial markets that easily and keep most of their wealth in cash. This is expected to have a negative effect on income distribution and inequality. But what if inflation is nothing more than the result of income inequality itself? Doesn't that mean that governments should be more concerned about income inequality? Taking into account the importance of price stabilization it is not surprising for researchers to try and find various ways to affect the inflation rate.

There has been a great deal of metrics used to measure inequality. These metrics include the Gini coefficient, the Theil index and the Hoover index. Following a large bibliography concerning the income inequality we have decided to use the Gini index since it has the most benefits both in terms of understanding and is quite suitable to compare cross country evidence.

1.2 Purpose and Research objectives

The aim of the study is to investigate the relationship between inflation rate and income inequality, as measured by Gini coefficient.

Question: In order to accomplish the objectives of the research, the ultimate research question are:

- "Is there a relationship between inflation rate and income inequality?"
- "Is there a different effect depending on inequality and income level?"

Through this research we will be able to answer to questions such as: Why is it important to define an inflation-inequality correlation? How does that change our insights towards the economy and the policies that governments should follow? Is it important for our understanding of the economy or is it much ado about nothing?

The finding of a correlation between these two variables may lead to a change of the way we see inflation and income inequality. We usually consider income inequality as the result of the economic policy that a government follows and we never think of it as a possible cause of it. Also we consider inflation as a monetary phenomenon while maybe we shouldn't. Except of the way we define these two variables the finding of such a correlation leads to a serious rethinking of the government's policies. Such a correlation means that governments and central banks should take into consideration income inequality when they think of monetary policy.

This thesis aims at establishing income inequality as a major factor able to explain economic phenomenon like inflation. Its originality lies to the fact that it tries to link two variables in a way that few others have tried before. Thus, while most researchers have tried to examine the impact of monetary policy on income inequality this study will examine the opposite relationship.

The thesis's sample consists of 32 OECD countries and the period that will be examined is 10 years from 2004 to 2013. This thesis will try to examine if income inequality, measured by Gini coefficient, has any correlation with the inflation rate. This will be examined for all countries but we will take into consideration the common elements of the countries like their geographical position, their income classification etc. For this reason we will separate them in sub-samples and for the econometric part we will use Gretl statistical package.

The rest of the thesis is organized as follows. Section 2 introduces us to the theoretical part of the thesis where the two main variables of the survey will be introduced, inflation and Gini coefficient. Next, in Section 3 we will make a review of

the literature that will be used throughout the thesis. Section 4, consists of the empirical part where we will examine the possible correlation and finally Section 5 concludes.

Chapter 2: Theoretical Review and Definitions

2.1 The GINI Coefficient

The Gini coefficient also mentioned as Gini index was developed by an Italian statistician Corrado Gini and was first mentioned in his 1912 paper Variability and Mutability. The Gini coefficient is an indicator which represents how income is distributed among a nation's residents. Thus, it is a measure of income inequality.

The Gini coefficient may vary from 0, which represents total equality, to 1, which represents total inequality. However, values above 1 may occur if some persons represent negative contribution to the total (negative income). This is an extreme case that is quite unlikely to happen. In order to calculate the Gini coefficient two measurements are needed the cumulative population and the cumulative share of income.

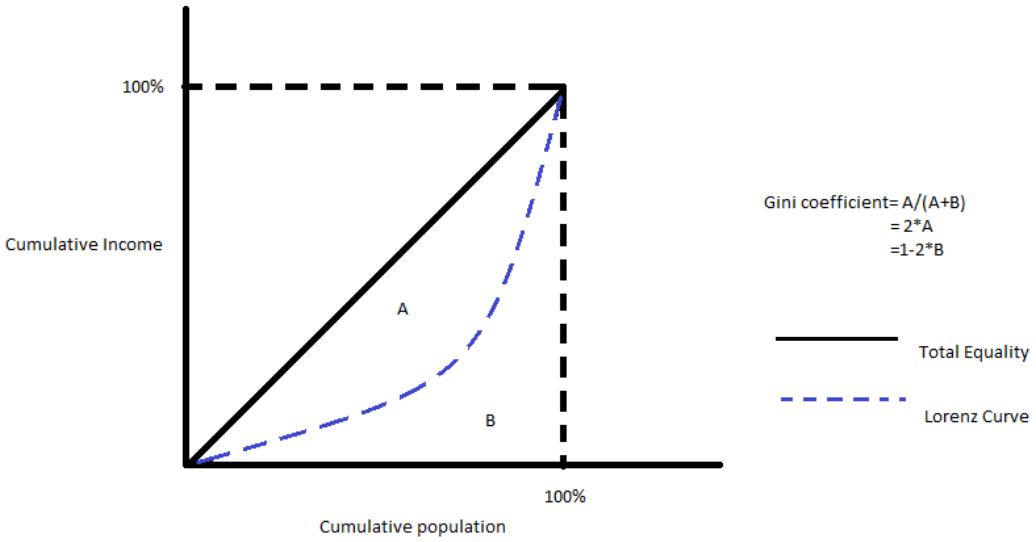
It should be stated here that Gini coefficient does not measure a country's wealth, but rather helps define the gap between the poor and the rich. That means that a developed and an undeveloped country may have the same Gini coefficient as long as they have similar distribution policies.

2.1.2 Mathematical Computation of Gini coefficient

In order to define the Gini coefficient mathematically we should first see what the Lorenz curve is. A Lorenz curve is a graph showing how much Y% of the total income or wealth is in the hands of the bottom X% of people. The line at 45 degrees represents total equality. The Lorenz curve then is skewing towards the (0, 0) point of a Cartesian coordinate system. The more skewed the curve is, the more inequality we face. The Gini coefficient can be thought as the area that lies between the line at the 45 degrees and the Lorenz curve, or as we can see in the Graph below, by the area A.

Diagram 2:

Gini coefficient and the Lorenz curve



An alternative approach to calculate Gini coefficient would be to consider the income distribution as a continuous distribution function p(x) where p(x)*dx is the fraction of the population with income x to x + dx. Then the Gini coefficient is half of the relative mean absolute difference.

$$G=\frac{1}{2*\mu}\int_{-\infty}^{\infty}\int_{-\infty}^{\infty}p(x)*p(y)*|x-y|*dx*dy$$

Where μ is the mean of the distribution $\mu=\int_{-\infty}^{\infty}x*p(x)*dx$ and the lower limits of integration may be replaced by zero when incomes are zero.

Alternate expressions

The Gini coefficient can sometimes be calculated without referring back to the Lorenz curve. For a population uniform on the values y_i, (taking y to mean a household's income), i=1 to n, indexed is non - decreasing order ($y_i \leq y_{i+1}$).

$$G=\frac{1}{n}*(n+1-2*(\frac{\sum(v+1-i)*yi}{\sum yi})) \quad (1.1)$$

Or

$$G = \frac{2\sum i*yi}{n*\sum yi} - \frac{n+1}{n} \quad (1.2)$$

2.1.3 Gini coefficient on market and disposable income

There are several ways to calculate the Gini coefficient but here we will examine only two of them.

Gini coefficient on market income

For this calculation the income before taxes and transfers is being used. It measures income inequality without taking into consideration the effect of redistributive policies of the government through taxes and transfers.

Gini coefficient on disposable income

In order to calculate this index the income after taxes and transfers is being used. This index, takes into consideration the effects of taxes and transfers.

Having a high or low Gini on market income doesn't necessarily mean that the gini coefficient on disposable income will be the same. That means that countries with high or low Gini on market income may be in fact different from those who have a high or low Gini on disposable income. For example for OECD countries although Italy has the highest Gini coefficient on market income, Mexico has the highest on disposable income. That happens because of the different redistributive policies of each country. Although, caution is recommended when using Gini coefficient to compare different countries the above discussion may seem quite useful when we have to quantify and evaluate differences in welfare and compensation policies and philosophies.

2.1.4 Other uses of Gini coefficient

While Gini coefficient usually refers to income inequality, it is quite broad and can also cover several fields of research. For example, scholars have constructed gini

coefficients for education, sociology, health science, ecology, engineering and agriculture.

Gini coefficient of education

This index measures the unequivalence in education for a given population. It is used to forsee the trends in social development through educational attainment over time.

Gini coefficient of opportunity

Opportunity Gini coefficient, which resembles with income Gini index, estimates the inequality of opportunity. Based on Amartya Sen's suggestion that inequality coefficients of social development should act as the amelioration of the people's choices and capabilities, rather than on the process of reducing income inequality. According to a review of Kovacevic, opportunity Gini index explains that the coefficient estimates how well a society supports its citizens to become accomplished in life where the success is based on a person's choices, achievements and gifts, not his background defined by a set of predetermined circumstances at birth, (such as, gender, race, etc) and circumstances beyond the control of that individual.

2.1.5 Features and Limitations in the use of Gini coefficient

Features of Gini coefficient

The Gini coefficient has some advantages that make it really useful for measuring inequalities. First of all it can be interpreted as a ratio something that makes it quite easy for anybody to understand. Also it can be used in order to compare different groups within the same country, such as by age, gender, ethnic groups etc. as well as to compare diverse countries. In addition to that, it can be used to see how income distribution changed over time since it is independent of absolute incomes. Gini coefficient fulfills four major principles:

1. Anonymity: it does not matter who the high and low earners are.

2. Scale independence: the Gini coefficient is not influenced by the size of the economy, the way it is measured, or the economy of the country on average.
3. Population independence: we do not estimate how large the population of the country is.
4. Transfer principle: if income (less than the difference), is transferred from a rich person to a poor person the final distribution is more equal.

Limitations of Gini Coefficient

Although, Gini coefficient may be simple and easy to construct this simplicity is also one of its greatest weaknesses. Gini coefficient is a relative measure of income inequality. That means that it cannot measure absolute wealth distribution and caution should be considered in its interpretation. It is possible for a country to have an increasing Gini coefficient while people in poverty becoming less and less. Changes in Gini coefficients may occur not only because of redistribution which is a de facto reduction of income inequality but also because of major demographic and social changes. Such examples are baby booms, aging populations, increased divorce rates, emigration and immigration etc. Furthermore, Gini coefficients may be the same for two countries but this does not show whether basic necessities are accessible for residents of both countries. That means that Gini index is not a measure of the wealth of a country and should not be considered as such in any way.

As was mentioned before, Gini index based on wealth may be really different compared to the Gini index based on disposable income. This may be due to differences in redistributive policies of each country or different stages in their life. Wealthy countries may indicate a low disposable income Gini coefficient while at the same time having a big wealth Gini coefficient indicating extremely unequal wealth distribution.

Sometimes there are difficulties in comparing income distributions among countries due to different benefits systems. For instance, some countries recompense in the form of money in addition to others that give food stamps, which may not be counted as income in the Lorenz curve and therefore not taken into account in the Gini coefficient. In addition Gini coefficient will yield different results when applied to individuals rather than households. When different populations are not weighed

with consistent definitions, comparison is not accurate. There is also a downward bias for countries with small population or diverse economies since they tend to report a low Gini coefficient. A similar bias exists over age. Increases in the proportion of young and old will affect Gini coefficient simply because older people have more wealth than younger people.

The Lorenz curve may underestimate the current extent of inequality if richer households are capable of using income more conveniently than lower income households. From another angle, measured inequality may be the result of approximately efficient use of household incomes.

2.2 INFLATION

In economics inflation refers to the general rise of prices of goods which is responsible for the loss of value of a currency. As a result, with the same amount of money we can buy fewer products as a result of inflation. Inflation can be attributed to both demand and supply, although it is generally acceptable that it is being caused due to excess supply of money. One of the most notable indices to measure inflation is the Consumer Product Index (CPI).

Inflation has both advantages and disadvantages for the economy. On the one hand, it affects all the aspects of economic life, discourages investment, diminishes the quantity of products in circulation, keeps interest rates above zero and reduces unemployment. Nowadays, most economists agree to the maintenance of inflation to a stable low level, although this may vary across countries according the central bank's strategy.

The opposite of inflation is called deflation and refers to the general reduction of prices of goods. Deflation is considered even more serious than excess inflation or hyperinflation due to the deflationary spiral phenomenon. This phenomenon may occur when inflation is really low or negative. Consumers expect that prices will fall even further so they stop buying goods and postpone continually their purchases. This has catastrophic effects on the economy and it is even more difficult for a country to get away from.

The history of inflation goes back lots of centuries. Even when gold was being used for transactions, governments had the privilege of melting down gold coins, mix them up with other metals and reuse them with the same nominal value. That way they could earn a lot through seigniorage. However, as the quantity of these coins was being increased and the value of each coin lowered, consumers would need a greater amount of money in order to make the same purchases as before. As a result, these goods would experience a rise on their prices.

During the 15th and 17th century large amounts of gold and silver coming from the rich and unexploited mines of the New World has been infused to Europe. Demographic reasons like the depopulation of various diseases that hit Europe played an important role in the rise of inflation. Economists have categorized three factors that are responsible for the rise and fall of the prices of goods:

1. Change of cost of goods
2. Change in the price of money
3. Currency depreciation

The adoption of fiat currency caused huge variations in money supply. As a result many countries experienced hyperinflation incidents.

There are lots of concepts linked to inflation: deflation – a general reduction of the prices, hyperinflation – the extreme rising of prices stagflation – a combination of high inflation and high unemployment and asset price inflation which refers to the rise of the prices of financial assets but without the prices of goods to rise too.

There are many possible ways to measure price inflation. A lot of indices have been used, each one for a different purpose. Some of the most used indices are Consumer Price Index, GDP Deflator and the Retails Price Index. Those indices can also describe inflation in a narrower set of assets excluding for example the prices of energy or food the prices of whom tend to have greater variations.

The inflation rate is being calculated as the percentage change in one of the above indices. When measuring inflation we should be very cautious. Inflation measuring requires that we should isolate the effects of better quality or performance on prices and exclude them. Also a single rise of a good's price is not able to lift inflation so it rising refers to the rise of price of a basket of goods. This basket is

representative of the goods that each household is using and it is quite extensive. The products that are being included in the basket are not constant but they rather change across time in order to reflect better the different consumer preferences. This way, old products disappear and new are being added, the quality is being improves and the preferences change. All these effects change the basket across time.

When measuring inflation a season adjustment should be always considered. For example heating costs are rising during colder periods so the price of oil is rising too. This does not reflect inflation pressure though. As was mentioned before, the inflation rising has many effects on economy both good and bad. However, it does not affect everyone in the same way. For example those people who own property are being benefitted since their property is increasing in value. However, those seeking to acquire it will have to pay more for it. Also people with fixed interest debts will also benefit since the real interest rates fall as inflation rises and that means that they will save money. For that reason lenders often charge a premium over the existing interest rate in order to protect their money. On the other hand when inflation is rising above a certain level the companies find it difficult to budget, they cease to invest and save and turn to other ways of earning money by exploiting currency inflation.

2.2.1 The quantity Theory

One of the many theoretical models of inflation that is generally quite accurate and accepted is the quantity theory of inflation. This theoretical model emphasizes money supply as the main reason behind inflation. The quantity theory is being summarized in the equation below:

$$M*V_T = \sum(pi * qi) = P^T*q \quad (1.3)$$

where M is the total amount of money in circulation

V is the transactions velocity of money

p_i, q_i are the price and quantity of transaction respectively

Another model which focuses on money demand instead, is the Cambridge equation or Cambridge approach. The respective equation for this model is as follows:

$$M^d = k*P*Y \quad (1.4)$$

Where M^d is the money demand

k is the

P, Y is the price and quantity of transaction respectively

This approach argues that not all money will be used for transactions but some of them are held for liquidity reasons. In equilibrium M^d = M, Y is exogenous and k fixed the above equation is the same as the one from the quantity theory where V = 1/K.

2.2.2 The Kaynesian view

According to Keynesian economics inflation is a phenomenon that isn't directly affected by money supply but us the outcome of pressures in the economy that are being expressed in the form of high prices. The Keynesian view distinguishes three types of inflation.

Demand-pull inflation

It is caused due to an increase in aggregate demand caused by an increase in private or government spending. This kind of inflation promotes growth through a multiplying procedure that stimulates investment and expansion.

Cost-push inflation

This type of inflation is caused because of a sudden drop in aggregate supply, which may be due to increased production costs or even natural disasters. Usually, the cost of oil is linked to this kind of inflation since it is being used in every kind of production process.

Built-in inflation

This kind if inflation is linked to expectation and the price/wage spiral. The price/wage spiral represents a circle process where wage increases cause a corresponding increase in prices, which causes the wages to increase even more in a never ending circle.

Money supply can also affect price levels however, unlike monetarists, Keynesian economists emphasize more to the role of aggregate demand in determining inflation. Another concept of note, is the one that links the prices of goods to unemployment. This theory also known as Philips curve suggests that a tradeoff between these two variables exist. That means that a certain level of inflation is necessary in order to reduce unemployment. This theory while seemed to explain the inflation incidents in 1960s failed to do the same for 1970s when high inflation and economic recession (stagflation) coexisted. Finally another Keynesian model suggests that an optimal GDP level exists where the economy functions at its full potential. If GDP exceeds this point then built-in inflation starts to occur. On the other hand if GDP falls below this threshold inflation will decrease as suppliers cut their prices to fill excess capacity.

2.2.3 Control over inflation

Monetary policy

Governments use a variety of tools in order to keep inflation in target. It should be stated here that there is not a standard inflation rate, but it adapts to the policy the government chooses. Usually the ideal inflation rate is considered to be between 2% and 6% annually. Central banks increase or decrease interests rates to affect money supply. This way it is able to control inflation. This is generally called as monetary policy.

Gold standard

The gold standard was a system where each unit of currency corresponded to a fixed amount of gold. Although the currency itself didn't have any value it was acceptable for transactions because it could be converted into gold. This system was abandoned after the adoption of Bretton – Woods system. Under the gold standard the inflation rate would be determined by the growth rate of the supply of gold relative to total output.

Wage and Price controls

Another system that was used in order to tame inflation was the control of wages and prices. This system was more successful during war periods. However, in any other period it was implemented it was quickly abandoned due to the wrong signals it could give to the market. The wage and price controls lead to good shortages and discourage future investment and it would be better imposed only for a limited time. Modern economists are not in favor of price controls and advice to liberalize prices since the economy can adjust and abandon unprofitable economic activity.

Next we would like to present how income inequality and inflation has changed for OECD countries from 1980s driven mainly by globalization and economic integration.

New technologies and new transportation have played a major role in the economy nowadays. Globalization, although is not a new phenomenon, is pushed forward especially after 1980s and the discovery of internet which helped lower the cost of communication and transportation tremendously leading to a truly global economy. Globalization has also caused many reforms in a country's economy through the growth of imports and exports and trade agreements. Globalization had a serious impact on inflation. Since 1980s and the Internet discovery global inflation has dropped considerably as we can also see in the diagram below. In addition the volatility of inflation has also dropped leading to more stable inflation expectations. Even developing countries where inflation rates are traditionally higher, seem to experience a considerable reduction in their inflation rates.

Globalization can affect inflation rates in several ways both directly and indirectly. The most obvious way is the change of imports prices. Low cost countries

can produce products which may have a comparative advantage in the world trade. This leads all countries to lower their prices in order to compete them. Import prices affect domestic inflation since producers often buy the cheap raw materials that they need for production leading to disinflation pressures.

Globalization has also a labor market effect. The increase of labor supply puts pressure on wages so many industries may choose to produce in countries with cheap labor. Globalization has also lowered the power of labor unions in OECD which can also affect directly the labor wage and inflation. Globalization has also promoted competition among different firms. Consumers may find products from all over the world so that puts pressure to the producers to keep the advantage by lowering their prices or trying to find ways through technological inventions which also have a role to play in disinflation pressures.

Liberalization has made access to capital markets easier. The massive growth of Foreign Direct Investment (FDI) has increased even more capital mobility putting pressure in costs. Last but not least inflation is directly linked to exchange rates. A depreciation of a local currency may affect inflation rate when the devaluation passes through prices.

2.2.4 Notable Hyperinflation and Deflation episodes

Hyperinflation episodes

Hyperinflationary episodes have been a common phenomenon for all countries before and after the adoption of fiat currency. I now present some of the most notable episodes throughout the years.

Austria

The aftermath of World War I left Austrian Republic a lot smaller than before with many people working in the public sector and all State enterprises bankrupt. In 1922 inflation reached 1426% while from 1914 to 1923 CPI had experienced a rise of 11.836 units.

China

China was the first country to implement fiat currency and the first to experience hyperinflation. Paper currency was being used for trade because of its convenience so its demand rose. The Yuan Dynasty during the 13th and 14th century was the first to print money to finance their wars while much later the Republic of China experienced hyperinflationary incidents from 1948-1949 with a peak rate of 5070%.

France

France also experienced hyperinflationary pressures during the French Revolution and until Napoleon replace it with the franc. The highest inflation rate that has been recorded was 304% from 1795 to 1796.

Germany

The Weimar Republic had experienced one of the most serious inflationary incidents in history. By 1922, the value of money in gold had fallen to £20 million from £300 million. As a result the central bank responded with a massive printing of notes driving the mark to devaluate even faster. During 1922 and 1923 the Weimar Republic experienced a peak inflation rate of 29.525%.

Greece

During the German-Italian occupation hyperinflation, based on psychological factors, led to a never before seen increase in prices. The fear of goods shortages, the sustainment of the occupation forces and the reduction of exports led the Bank of Greece to type more and more drachmas. As a result, from1941 to 1946 Greece suffered from hyperinflation even at a rate of $3x10^{10}$%.

Hungary

The political instability between 1919 and 1924 in Hungary led the country in the hands of hyperinflation. The levy on bank deposits led to the mistrust of banks by the public and a severe reduction in the amount of currency in circulation. However between 1945 and 1946 Hungary experienced the most severe inflation recorded. After the replacement of the national currency with another one created for tax and

postal payments the inflation rate hiked to a maximum of 1,9 quadrillion percent until it was replaced by another currency, the forint.

Soviet Union

Soviet Russia experienced a hyperinflation period starting from the early days of the Bolshevik Revolution until 1922 and the introduction of the new currency, chervonets. Between 1921 and 1922 the inflation rate reached 213%.

Zimbabwe

One of the most recent examples of hyperinflationary economy is that of Zimbabwe. A combination of a program for land reform aiming at black natives, disrupted food production and reduction of exports led the Reserve Bank to print more and more notes. As a result the local currency the Zimbabwean dollar was forced to four denominations of its value until 2009, when the dollar was abandoned in favor of using only foreign currencies. The highest inflation rate was recorded in 2008 and was about 7.96 billion %.

Deflation incidents

Apart from hyperinflation incidents a lot of deflation incidents have also occurred.

Japan

The most significant incident of the recent years occurred in Japan. Deflation started in 1990s. The central bank tried to apply quantitative easing but couldn't achieve its goal. There were many reasons behind the deflation incident. The aging population and the strict policy of the bank of Japan towards high inflation were some of these reasons. Companies had taken loans in order to invest in real estate. However when prices of real estate dropped they couldn't pay back their loans leaving both themselves and the banking sector vulnerable. People were so afraid of a possible bank collapse that they preferred to invest in treasury bonds instead of saving. Last but not least, Japan imported many cheap goods and raw materials from other countries especially China. In order to compete them domestic producers reduced their prices contributing in the deflationary spiral even more.

United States

United States have experienced four deflationary periods through history. The first and the most severe were during 1818-1821 when the prices fell by 50%. A credit contraction caused by a crisis in England forced the central bank to also contract its lending. The price of agricultural products fell by 50% until its recovery in 1830s.

In figure 2 the statistics of Gini index and inflation (CPI) are shown graphically for each country. We can see that inflation is steadily decreasing for most countries while at the same time income inequality provides mixed results with most of the countries increasing income inequality.

Chapter 3: Literature Review

3.1 The classical economist view for income distribution
The Pareto criterion

A major issue under consideration is what is the criterion that the distribution of income should be based on? Which distribution of income may be considered optimal? One of the most famous classical economists, V. Pareto defined a distribution optimal with a simple statement: a distribution is optimal if no change can ameliorate one's position without harming another. This criterion does not examine who is the one that benefits from the change but rather considers a community as a single entity which benefits from each member that is benefitted. It should be stated that the Pareto criterion does not evaluate the distribution of income or wealth in an economy but rather the efficient function of an economy. That happens because according to the Pareto criterion, no redistribution leads to a better situation since it would benefit some members of the society but it would worsen the position of others. The Pareto criterion helps to evaluate if the means of production are efficiently distributed without any waste. The classical view for the economy believes that the perfect competition leads to an optimal Pareto distribution.

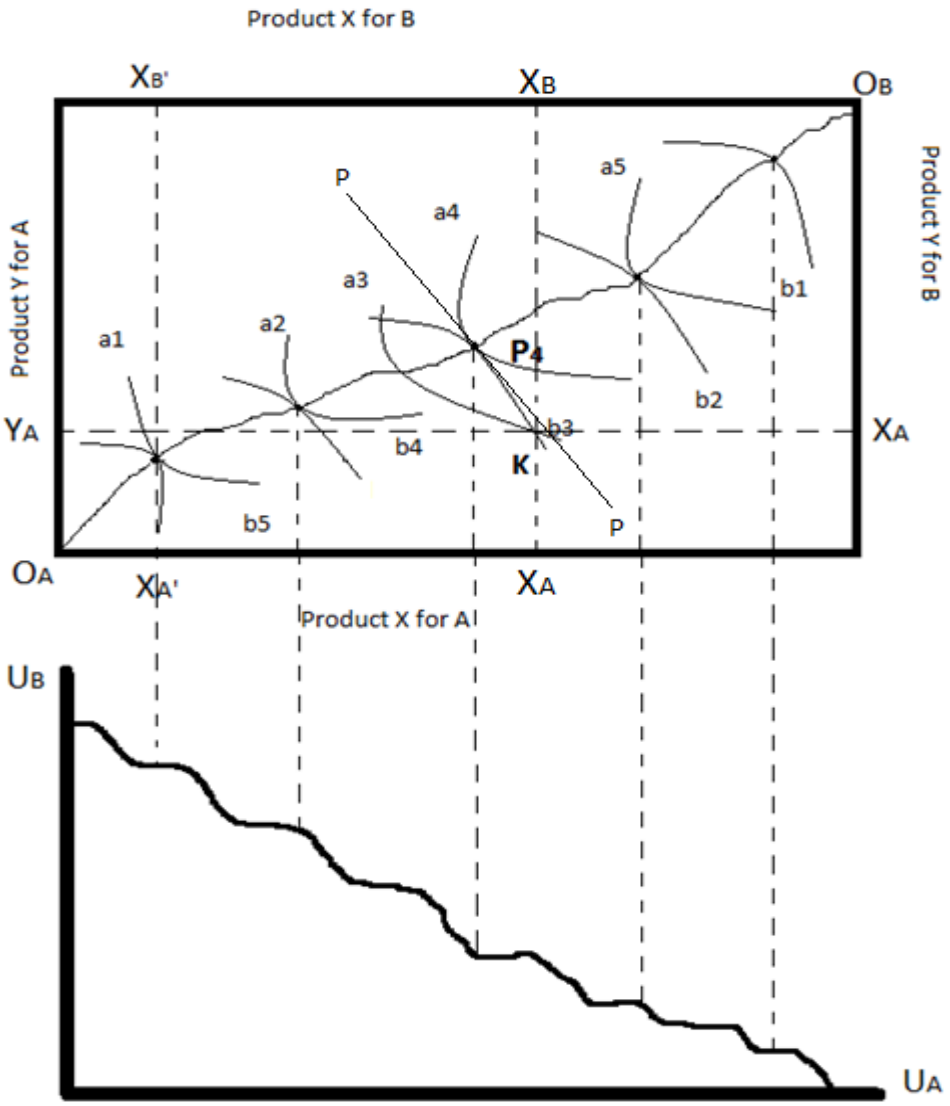
In order for an economy to function efficiently the criterion of the optimal Pareto distribution must be in force in both the product market and the market of means of production as well as the entire economic system.

Optimization in product trading

A distribution of the goods produced in an economy is optimal if and only if none other distribution would increase the satisfaction of one or more households without decreasing another's. We can determine this optimal distribution by using a box diagram. For simplicity, we consider than in an economy only two goods are being produced, X and Y, and there are only two consumers, A and B, with different preferences towards the two products.

Diagram 3:

The Pareto criterion for product trading optimization



The vertical axis of the box diagram represents the absolute stable quantity of product Y which is measured on the right axis for A and on the left for B. The horizontal axis depicts the absolute stable quantity of product X, which is measured for consumer A on the downwards axis and on the upwards axis for consumer B. The preferences of each consumer are depicted by their respective indifference curves a1, a2 etc. which start from the lower left angle for consumer A. As it is well known the slope on each point of the curve depicts different quantities of the two products which give the respective consumer the same utility. The slope, shows how much of the product X the consumer is willing to give up in order to obtain more from the product Y, which will grant him the same amount of utility. It is the marginal rate of

substitution. While moving from left to up and right the indifference curves indicate higher levels of utility. As for B, his respective indifference curves are depicted by curves b1, b2 etc. which start from the far up right angle and proceed to the far down left angle. Once again the slopes on each indifference curve indicates the marginal rate of substitution for consumer B.

Each spot in our diagram represents a possible distribution of products X and Y for the two consumers. Since there are infinite spots there are also infinite possible distributions. The question is whether an optimal distribution exists and how can we find it. Suppose that the optimal distribution exists at spot K. Onto this spot consumer A has a quantity OaXa for product X and OaYa for product Y. Acquiring these quantities consumer A has a utility which is depicted by the indifference curve a3. On the other side consumer B has a quantity of ObXb for product X and ObYb for product Y. The utility for consumer B is depicted by the indifference curve b4. However this distribution is not optimal. There is another spot which would give more utility for one of the consumers without worsening the position of the other. This spot is P4. As we can see, the exchange of goods between A and B could ameliorate the position of consumer A while leaving the position of consumer B the same. As a result the total prosperity for the whole economy is being increased. The same may result from a movement from spot K to spot P3. At this spot the position of consumer B is being improved since he gets more utility by the indifference curve b5 without worsening the position of A. The spots P3 and P4 are optimal according to the Pareto criterion. No one can obtain more without worsening the position of the other. These spots are optimal Pareto spots.

For each optimal Pareto spot two indifference curves are being osculated, one for each consumer. That means that at these spots there is the same slope and the marginal rates of substitution for the two consumers coincide. As we can see in order to have an optimal Pareto distribution the equation below is a necessary condition.

$$MRS^{A}_{XY}=MRS^{B}_{XY} \quad (1.5)$$

Taking a closer look at the box diagram we can observe that there are many such spots where the marginal rates of substitution are equal. That means that they are all optimal spots. By linking all of these spots we get a line known as a conflict curve. Each one of these spots indicates the maximum level of utility that a consumer can

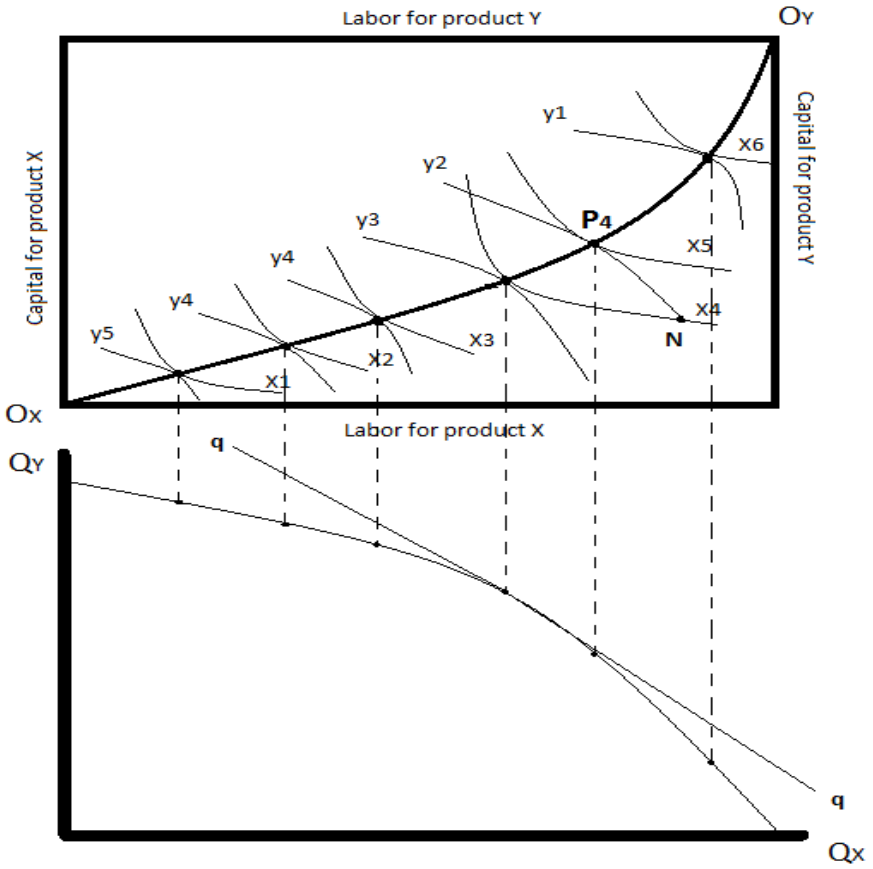
take, given the utility of the other consumer. This way, we can obtain a diagram which on the horizontal axis depicts the utility of the consumer A on the vertical axis the utility of the consumer B. This curve is known as utility – possibility frontier. All the spots on this curve are Pareto optimal spots. As for the spot where this procedure will end up, depends on the bargaining power of each trader which is being decided by their economic power.

Optimization in production

The same logic applies to the production of the goods. In the production, a position is optimal if no redistribution of the limited means of production would increase even by one unit the production of a product without reducing the production of another. Once again the box diagram will help us define the optimal point. Suppose, that in the economy only two products are being produced, X and Y each one by using two means of production, labor E and capital K.

Diagram 4:

The Pareto criterion for production optimization



The vertical axis of the diagram represent the quantity of K which is required for the X product at the right and the left product at the left, while the horizontal axis represents the amount of labor L which is needed for the X product on the bottom axis and for the Y axis on the top axis. The curves of equal product x1, x2, x3 etc. which start from the down and left corner and progress to the up and right corner depict higher levels of production for the product Y. Each point on a curve shows the different amount of K and E necessary to produce a given amount of the product that the curve depicts. The slope on each point of the curve indicates the marginal rate of technical substitution (MRTS) which shows the quantity which a mean of production may substitute a unit of the other without changing the level of production for the other product.

Each point depicts a different distribution of K and L and since there are infinite points there are infinite distributions. Suppose that the distribution is the one at point N where X3 and Y3 is produced. This distribution is not optimal though since with the same amount of means of production more units of one of the products could be produced without having to reduce the quantity of the other. For example, if the distribution was at point P4, the amount of X produced increases from X3 to X4 while the production of Y remains the same (Y3). The opposite could happen too. Increase the amount of Y from Y3 to Y4 at the P3 point and the amount of X produced remains the same (X3). Even if the distribution changes between the P3 and P4 points the production for both products will increase. Thus, these distributions are once again optimal. As we can clearly see on at the optimal level of production an equal production curve of one product osculates with the respective curve of the other product. That means that both have equal slopes and the same MRTS. Thus, a necessary condition for optimization is:

$$MRTS^{A}_{XY} = MRTS^{B}_{XY} \quad (1.6)$$

It should be stated here that optimal points exist whenever a curve osculates to the other product's curve. That means that the curve O_X O_Y depicts all the optimal points. This way, we can generate a diagram with the amount of X produced on the horizontal axis and the amount of Y produced on the vertical axis with all the optimal levels of production for these products. The curve generated is called the curve of production possibilities. Every point below this curve is possible but not optimal

while every point above the curve is desirable but not possible. Only the points onto the curve are both optimal and possible. The slope on each point of the curve represents the minimum possible amount of a product which is necessary to be sacrificed in order to free means of production that will be used in the production of the other product. This is called the marginal rate of transformation (MRT). This sacrificed amount of the product for the sake of production of the other is the marginal cost of the second in terms of the first. That's why the marginal rate of transformation is equal to the marginal rate of the two products.

$$\mathrm{MRT}_{XY}=\frac{MCx}{MCy} \quad (1.7)$$

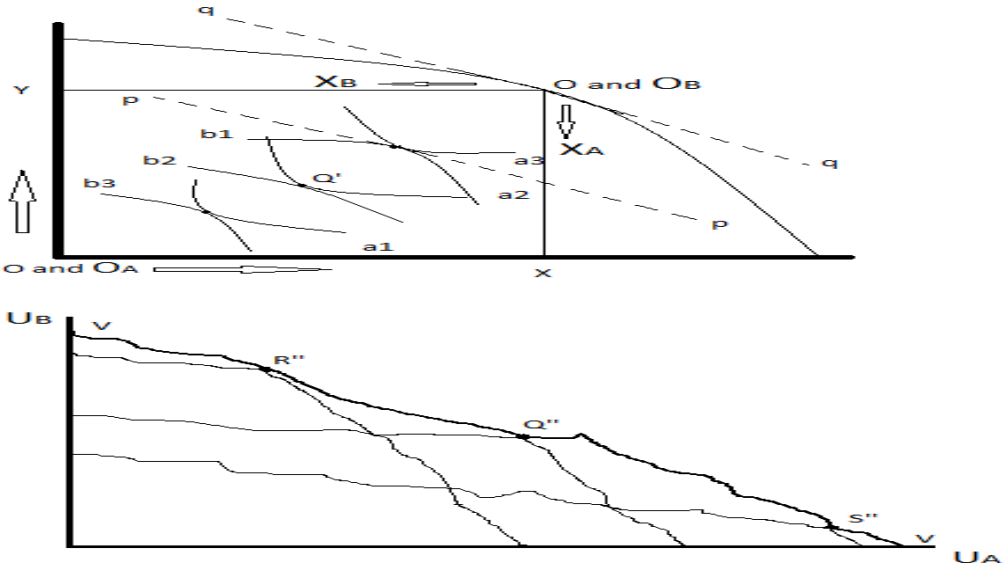
Combining the production optimization with the consumption optimization we generate the optimization for the entire economy. The marginal rate of substitution (MRS) for the pair of products from the production side should be equal with the marginal rate of transformation (MRT) of the products from the production side.

$$\mathrm{MRS}^{A}_{XY} = \mathrm{MRS}^{B}_{XY} = \mathrm{MRT}_{XY} = \frac{MCx}{MCy} \quad (1.8)$$

This optimization condition of the entire economy can be easily comprehended through a box diagram, as shown below.

Diagram 5

Pareto criterion for the economy effectiveness



The diagram above depicts the curve of production possibilities TT'. Choosing a point onto the curve let's say the point Q. The total amounts of the product X and Y produces are OX and OY respectively. These amounts are available for distribution between A and B. Drawing a vertical and horizontal line towards the Y and X axis we obtain the limits of the box diagram. The preferences of A are depicted by a1, a2, a3 etc. while for B by b1, b2, b3 etc. The curve O_A O_B shows optimal levels of trade between A and B, where the marginal rate of substitution for the one is equal to the other. From all these possible distributions the one that the economy is in balance is the point Q'. At this level the marginal rate of substitution of A is equal with the one of B and equal to the marginal rate of transformation since the slopes are the same. As we did before we can extract a curve of utility possibilities. This curve is UqUq. Although all these points are optimal from a consumption perspective only Q'' is optimal from both a consumption and production perspective. This way we can generate many such curves. By lining all the dual optimization points we get a new curve named the big curve of utility possibilities. All the points of the curve demonstrate equilibrium to both the consumption and the production sector. At these levels the economy functions effectively.

The mechanism of prices helps in the optimal distribution of the means of production and as a result contributes also in the distribution of income among households. This is happening because households dispose their means of production in order to receive compensation in the form of money. Every household receives compensation equal to the amount of means of production at its disposal as well as the prices that are being determined for them in the market. The prices of the goods are not shaped in the market in order to achieve a fair or optimal income distribution but rather to achieve an optimal means of production distribution. In perfect competition economies, the distribution of income should not present big inequalities.

3.2 Other theoretical approaches

The first approach is relevant to economic populism. According to this approach economic policies are in line with growth and income distribution rather than the risks of inflation, thus providing fertile ground for inflationary pressures. Populist policies which emphasize redistribution and price control end up being

ineffective for domestic demand and the economy at whole since the depletion of foreign reserves and speculative attacks lead inevitably to currency devaluation and inflationary pressures.

Another approach linking inequality and inflation is the so-called "wars of attrition" model. This approach suggests that conflict among several sociopolitical groups about how to share the burden of a fiscal adjustment may lead to the delay of revenue collection and thus to an inefficient tax system, relying as a result heavily on inflation tax.

3.3 Empirical Literature Review

The income inequality-growth association

Income inequality has become more and more important the last decade. Many papers try to unravel the connection with other economic variables, as well as its major effect in policymaking.

Cingano (2014) found that income inequality has a negative impact on economic growth using data for OECD countries for the past 30 years, stating also the fact that by not giving the opportunity to lower layers of income distribution to invest is one of the main reasons behind this hampering of growth. He also found that redistributive policies for inequality reduction had no effect on growth. Petersen (2015) found similar results contradicting the belief of previous papers that inequality promotes growth. He found that an inverse U shaped relationship exists between the two. According to him more inequality first promotes growth through performance and investing incentives but there is a threshold after which inequality reduces growth, stating also that lots of countries have exceeded this threshold. Era Dabla-Norris (2015) found a positive correlation too, suggesting that policymakers should pay more attention to middle and lower classes. Walsh and Yu (2012) divided inflation into two categories: food inflation and non-food inflation. They tried to examine whether these two types of inflation affect income inequality differently. Using an international sample of countries, including India, they found that not-food inflation is associated positively with income inequality while non-food inflation is

associated with declining income inequality. For the Indian data they separate urban and rural inequality and found that non-food inflation increases income inequality in both urban and rural areas. However food inflation is ambiguous for urban inequality but strongly negatively associated with income inequality for rural areas.

The income inequality-inflation association

Apart from the relationship between economic growth and income inequality, another one is major too, the correlation between income inequality and inflation. Too much effort has been put the past years in order to define the correlation between income inequality and inflation, although they seem to be quite conflicting. Bulir (2001) found that inflation has in fact a major negative impact on inequality. The reduction of inflation from hyperinflationary levels significantly lowers income inequality but for low inflation countries had minor benefits. Thalassinos et al. (2012) found empirical results that contribute to the positive relationship between inequality and inflation by using data from 13 EU countries for a period of 10 years between 2000 and 2009. On the other hand, Al-Marhubi (2000) used indicators of central bank independence and political instability, the openness of the economy, the level of economic development, the degree of urbanization as well as the Gini coefficient for 53 countries. He reported, a positive correlation between the two, although the association was not economically important. This suggests that even though there seems to be a positive relationship that does not mean that redistributive policies will automatically lower inflation. Heer and Süssmuth (2003) find empirical results to support these results too. Finally, Ho-Yin Yue (2011) reported that there is no empirical evidence to support that inflation is related to income distribution in Korea.

The inflation – income inequality association

Income inequality has rarely been used as an explanatory variable for the various phenomenon of our economy. Since the 1970s income concentration has increased dramatically in the US and several other nations. This has led to an increasing number of literature list with the effect of inequality being present. Specifically, Albanesi (2002) stated that inflation hurts low income households more

than the rich. She implies that inflation is positively related to income inequality and that through this relationship a conflicting game between the two is what determines the fiscal and monetary policy of a country. The weakening of the bargaining power of poorer people due to the increase of income inequality is what paves the way towards increased inflation rate and lower taxation, a policy that according to Albanesi hurts poor people more.

Bhattacharya et al. (2002) support that no central bank is in fact independent, but it faces the control and pressure of each elected government. They employed a standard over-lapping generation's model by taking two occasions, an economy with money as the sole asset and an economy with cash and a fixed real return asset. In the first occasion they found that governments rely mostly on seignior age as income inequality increases but in the second occasion the relationship between inflation and income inequality becomes non monotonic and that the inflation rate decreases as income inequality rises. They also found that in economies with high inequality inflation cannot be in equilibria so an independent central bank would benefit them the most.

Dolmas et al. (1997) examine the link between inflation and inequality, inserting the element of central bank independence and the "level" of democracy. They find that in democratic nations where the independence of the central bank is absent, high levels of income inequality lead to higher average inflation. Something like that though does not hold for non-democratic nations. They also suggest that this relationship between these two variables is causal and the direction of it is from inequality to inflation.

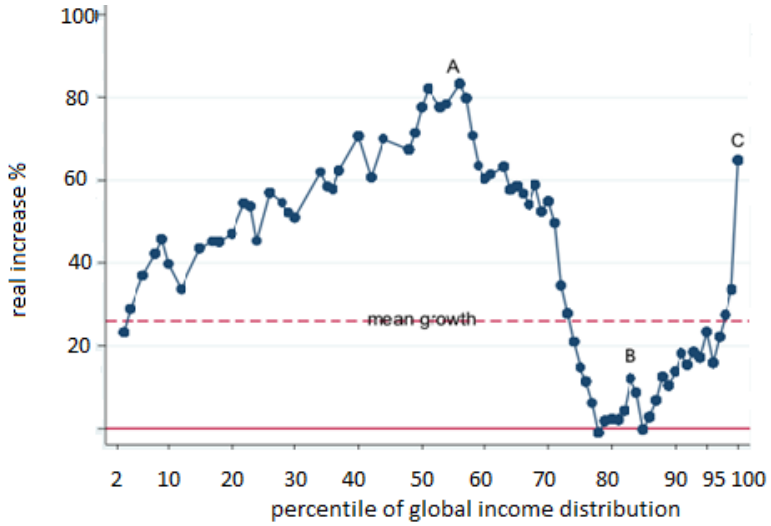
Crowe (2004) uses a simplified overlapping generation's framework and suggests that the inequality measure has a quantitatively significant positive effect on inflation. Desai et al. (2002) found that income inequality and the level of democratic constitutions in each country affect inflation differently. In countries with a Gini coefficient below 40, democracy helps diminish inflationary experiences. However, above this threshold, the effect seems to be reversed.

Income Elephant

A very useful graph which can help us perceive how wealth distribution has changed the recent years is a diagram named income elephant because of its shape. This graph was published by the economist Branko Milanovic in a 2012 World Bank working paper and attempts to show the effects of globalization on income redistribution from 1998 to 2008.

Diagram 6

Income elephant



The graph depicts on the horizontal axis the percentage of global income distribution while on the vertical axis the real increase of their respective incomes. It actually represents the real increase of incomes for every percentile of world income distribution. Income is measured in 2005 international dollars and individuals are ranked by their real household per capita income.

The graph is being separated into three categories A, b and C. According to the graph, the biggest loser of the last (arithmos) years has been the upper middle class which lies between 75th and 90th percentile of the global distribution (category B). This percentile not only saw their income being stable but also in some cases being reduced. According to Millanovic, this class refers to residents of Latin America and ex-communist countries. On the other side, the winners of globalization

have been those who reside onto the global median as well as those who represent the top 1% of the world income distribution who earned the most out of all.

As was mentioned before, Millanovic wanted to relate the income redistribution with globalization. In this thesis, we wanted to give more attention on how global inflation has changed in accordance with the Diagram 1. Diagram 1 provides a first image on how global inflation has changed between 1986 and 2015. The Consumer Product Index (CPI) has been used to represent the global inflation rate. As we can see in the graph, CPI steadily reduced during the aforementioned period. This makes us wonder: does income redistribution of the recent years has also affected global inflation?

3.4 Inflation determinants

Lots of papers try to unravel which are the main factors behind inflation. Anfofum et al. (2015) surveyed Nigeria and found empirical results to support that inflation variations is one of the major factors behind the country's retard economic growth. They used data for the period 1986-2011 and found that exchange rate, fiscal deficit and agriculture output are the main determinants of inflation in Nigeria. Andersson et al. (2009) examined the differences in inflation in EU countries for the period 1999-2006. They found that these differentials are due to the differences in business cycles, changes in market regulation of each country and persistence of inflation. However, external factors like the nominal effective exchange rate did not play a significant role.

Kazi and Munshi (2012) examined inflation in Bangladesh using data for the period from 1978 to 2010. The study concluded that GDP, broad money, government expenditure and imports has a positive effect while government revenue and exports had a negative impact in the long run. Kandil and Morsy (2009) showed that inflation pressures in GCC (Gulf Cooperation Council) have increased. Using a model of domestic and external factors found evidence that inflation in major trading partners, oil revenues, government spending and exchange rate depreciation are behind the inflation rising during 1970-2007 period. Mihailov et al. (2011) examine external and domestic inflation drivers in 12 new EU member countries based on the Philips curve.

They found that domestic variables are what drive inflation for large countries while external variables are mostly relevant with smaller countries.

Chapter 4: Empirics

4.1 Discussion of the data

The data used in this study is obtained from two of the most comprehensive datasets, the OECD statistics library and the Eurostat database. We are going to use variables that have been found to relate with inflation both from a political economy view as well as from the empirical results of previous papers. As stated before income inequality data are extremely difficult to find and even though the data collected derive from reliable databases it can still be questioned.

The model we want to examine is:

$$CPI_{i,t} = a_0 + \mathbf{b*Gini_{i,t}} + c_i*Elderly_{i,t} + d_i*TaxRevenues_{i,t} + f_i*Employment_{i,t} + g_i*DebtGDP_{i,t} + h_i*GdpGrowth_{i,t} + j_i*Econ.Openness_{i,t} + k_i* ExchangeRate_{i,t} + e_{it}$$

Table 1:

The variables

Gini	Annual Gini index
Old	Elderly People as a percentage of total population
Tax	Annual Tax Revenues
Employ	Annual Employment Rate
Debt	Annual %Debt of GDP
Growth	Annual GDP Growth Rate
Economic Openness	Annual (imports+exports)/GDP
Exchange Rate	Annual Exchange rate
CPI	Annual Inflation including food and energy costs

Gini Coefficient

The Gini coefficient is the variable used in the thesis to measure income inequality. As stated before the impact of income inequality on inflation is quite controversial since there aren't enough empirical results to back one or the other theory. In this thesis we expect to find a negative correlation. This is based upon the fact that when income inequality falls the goods produced are accessible for more people. That increases their demand and may lead to increasing prices and inflationary pressures. The data were obtained by the OECD statistics database and the Eurostat database for countries which lacked some elements and refers to the Gini coefficient after transfers and redistribution facilitations.

Tax

This variable refers to the Tax Revenues as an equivalent in dollars for each country. The data were obtained by the OECD statistics. In the previous chapters it was stated that governments may finance fiscal deficits in two ways, by tax or by inflationary finance. As a result we expect to find a negative correlation between tax and inflation since the ability of a government to collect money from tax will make it preferable than inflationary financing and vice versa.

Elderly People

This variable was used by Bhattacharya et al. (2002) in order to capture the demographic differences and the resultant bias toward redistribution. As a result we expect to find a positive correlation according to the existing literature. The data were obtained by the OECD statistics database and refer to the percentage of elderly people above 65 years old as a percentage of total population.

Employment

In our point of view we expect to find a positive relationship between employment and inflation. When employment rises more people have access to goods increasing their demand. This, once again, results in higher prices and inflationary pressures. The data were once again obtained by OECD statistics database.

Debt as a percentage of GDP

According to the political economy view high debt is related to increasing inflation. The empirical results of Latin America and pre-Soviet Union countries suggest that increasing debt is related to inflationary pressures. As a result we expect to find a positive correlation between these two variables. The data were obtained by the OECD statistics database.

GDP Growth rate

GDP growth is a variable with many implications over inflation. Typically GDP growth is associated with increasing inflation. Many incidents can back up this theory like producing more at the same or higher price or produce less at a much higher price. All these implications are connected with aggregated demand so they affect inflation. Our experience has showed that GDP Growth may coexist with both high and low inflationary pressures. For this thesis we expect to find a positive correlation. The data were obtained by the OECD statistics dataset.

Economic openness

Traditionally economic openness is associated with lower inflation. Imports from foreign countries increase competition and that leads the native producers to lower their costs in order to keep a comparative advantage. However in our study we follow Hardouvelis (1992) and Karras (1999) and expect to find a positive correlation

since openness diminishes the ability of central banks to affect output and instead increase inflation.

Exchange rate

The exchange rate is a variable that is said to be highly correlated with inflation. Some economists say that inflation is the precursor of an imminent currency devaluation. For this thesis we expect to find a positive correlation for these two variables. The data were obtained from the OECD statistics database.

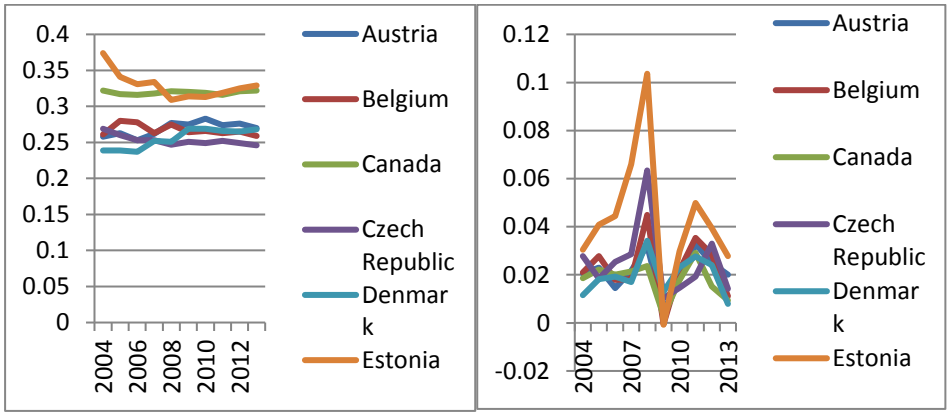
CPI Inflation

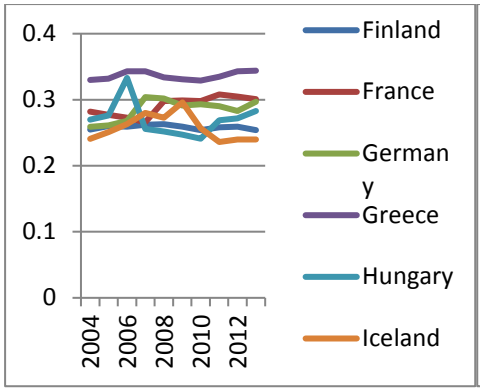
The inflation rate is our dependent variable. It is measured by CPI one of the most used indices when it comes to inflation. There are lots of different variations of CPI but for this thesis we employed CPI including food and energy costs.

The first thing to do before the econometric part of the thesis is to present a diagrammatic depicture of the main variables under examination, the Gini coefficient and the inflation rate for the countries of our sample, and try to extract as more as possible conclusions.

Diagram 7

Inflation and Gini coefficient for the Countries under examination from 2004 to 2013

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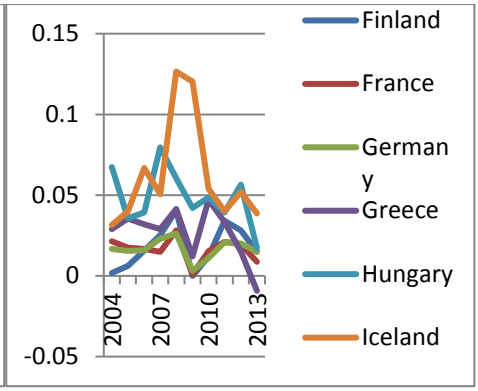
Iceland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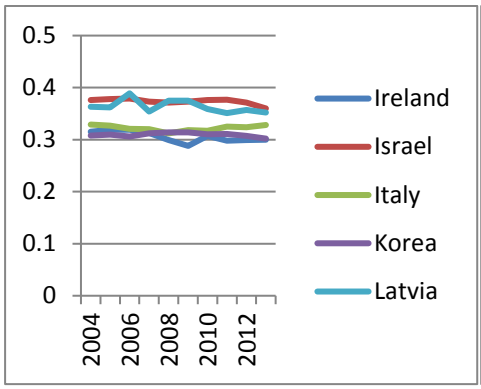
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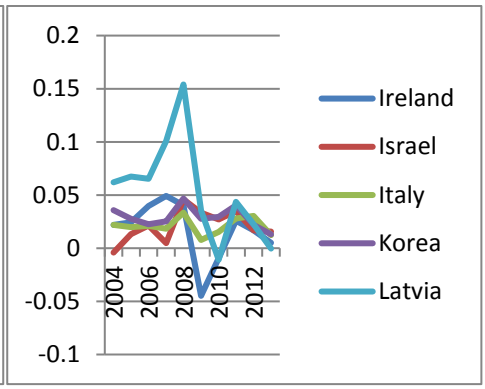
Italy
Korea
Latvia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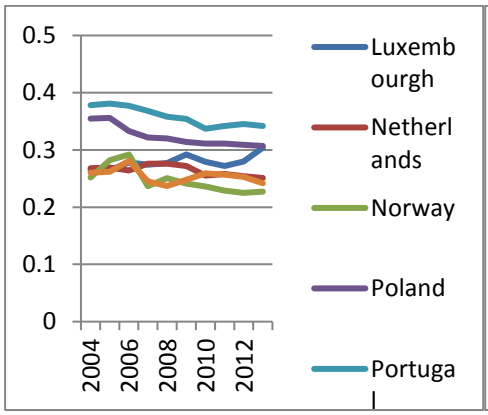
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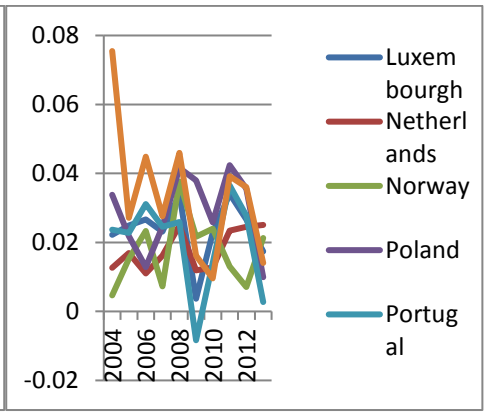
Portugal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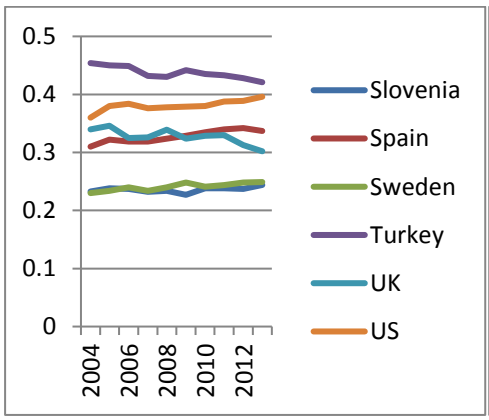
Portugal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2012
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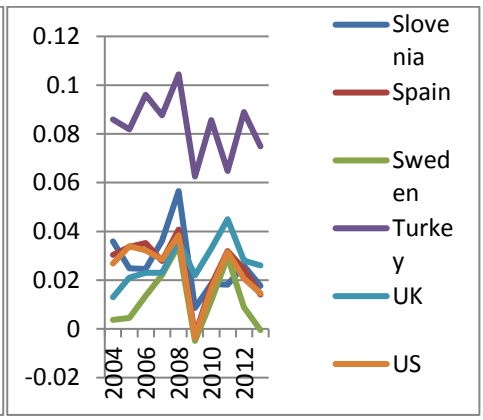
Sweden
Turkey
UK
US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0.06
0.04
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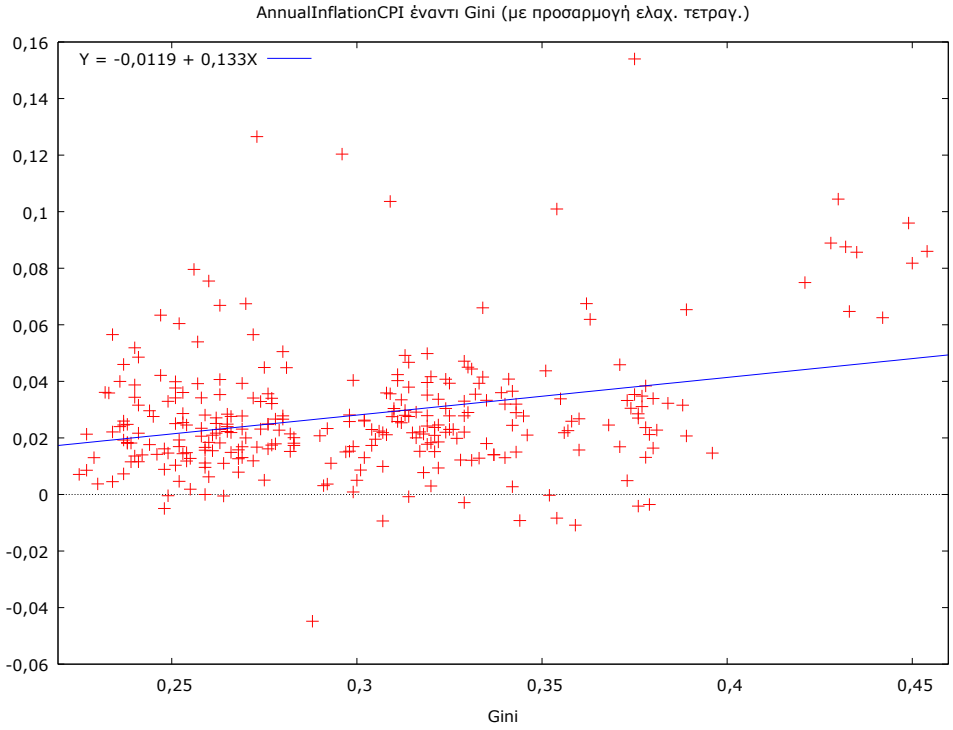
2004
2006
2008
2010
2012
Slovenia
Spain
Sweden
Turkey
UK
US

As we can clearly see, the inflation rate for each country is steadily decreasing for the timespan we are examining. As for the Gini coefficient we observe that it is generally steady with little variation among these years. The results are mixed with some of the countries presenting a downwards trend while others present a steady upwards trend. The next thing is to intuitively explore whether a correlation may be clear. For this reason we employ a dispersion diagram

Diagram 8

Inflation Gini coefficient scatter plot



Once again the results are mixed. While there seems to be some kind of relation this is not completely clear and not so powerful too. In order to determine whether a relationship exists we have to employ econometric methods.

4.2 Empirical results

For the econometric part of this thesis we are going to use Gretl statistical package. First we quote the descriptive statistics as well as a correlation matrix of our variables.

Table 2
Descriptive - Summary Statistics

Variable	**Average**	**Median**	**Min**	**Max**
AnnualInflationCPI	0,0282622	0,02433	-0,0448186	0,154003
D_Gini	0,301436	0,299	0,225	0,454
D_Tax	377441	140713	3764	4,28E+06
D_ElderlyTotal	0,153317	0,15945	0,0669	0,2127
D_Employment	0,653328	0,6534	0	0,8515
D_DebtGDP	0,673672	0,6115	0,072	1,788
D_GDP Growth	0,018986	0,021223	-0,143325	0,118894
D_Econ Openness	0,675192	0,635367	0,164146	2,14905
D_Exchange Rate	50,1033	0,804619	0,499748	1274,95
Variable	**St. Deviation**	**C.V.**	**Assymetry**	**Kurtosis**
AnnualInflationCPI	0,0226197	0,800351	1,7919	5,98844
D_Gini	0,0502342	0,16665	0,707433	0,0421547
D_Tax	704503	1,86653	3,64558	14,2937
D_ElderlyTotal	0,0312105	0,203568	-0,665575	0,183821
D_Employment	0,0848223	0,129831	-1,7066	11,3016
D_DebtGDP	0,33016	0,49009	0,399634	-0,337503
D_GDP Growth	0,0378998	1,99619	-0,727678	2,09253
D_Econ Openness	0,348932	0,51679	1,39066	3,24638
D_Exchange Rate	201,999	4,03166	4,87116	22,769

Table 3

Variables Correlation Matrix

	Annual Inflation	**Gini**	**Tax**	**Elderly people**	**Employment**	**DebtGDP**	**GDPGrowth**	**Economic openess**	**Exchange rate**
Annual Inflation	1	0,2957	-0,1279	-0,3111	-0,1470	-0,2156	0,2234	0,0153	0,0610
Gini		1	0,2937	-0,3292	-0,4286	0,1454	0,0984	-0,3177	-0,0109
Tax			1	0,0435	0.0765	0,3218	-0,0720	-0,3037	-0,0609
Elderly people				1	0,1268	0,2786	-0,3243	0,2740	-0,2955
Employment					1	-0,1083	-0,0113	0,1018	-0,0391
Debt GDP						1	-0,3537	0,0207	-0,1941
GDPGrowth							1	-0,0460	0,0848
Economic openess								1	-0,0468
Exchange rate									1

As we can see none of our variables present strong correlation with each other since none of them exceeds the 50% rate, thus avoiding the multicollinearity effect. Furthermore, many of our variables are generally stable since the CV is quite low for most of them.

After inserting our data the first thing to do is to test for unit roots. Usually in panel data the Levin-Lin-Chu test (LLC) is being used however since our sample is referring to a rather small timespan we consider the Augmented Dickey-Fuller test as the most appropriate to test for unit roots. When p-value for each cross section is above 10% then we cannot reject the zero hypothesis that unit root exist. As we can

see in the table below all of our variables present unit roots. We will present the p-values for CPI only and the rest can be found in the Appendix.

Table 4

CPI Cross section unit roots (p-values)

Austria	0,0037	Ireland	0,2466		
Belgium	0,0083	Israel	0,9403		
Canada	0,0204	Italy	0,0867		
Czech Republic	0,4741	Korea	0,5648		
Denmark	0,5824	Latvia	0,3006	Spain	0,3936
Estonia	0,3210	Luxembourgh	0,2182	Sweden	0,1264
Finland	0,1074	Netherlands	0,0652	Turkey	0,7508
France	0,1393	Norway	0,7045	UK	0,0613
Germany	0,0898	Poland	0,6019	US	0,3279
Greece	0,9497	Portugal	0,1654		
Hungary	0,3772	Slovak	0,4944		
Iceland	0,7656	Slovenia	0,3905		

In order to correct unit root we are using first differences for all of our variables. This way our model is transformed in the one below:

$$\Delta(CPI_{i,t}) = a_0 + \mathbf{b_i*\Delta(Gini_{i,t})} + c_i*\Delta(Elderly_{i,t}) + d_i*\Delta(Tax_{i,t}) + f_i*\Delta(Employment_{i,t}) + g_i*\Delta(DebtGDP_{i,t}) + h_i*\Delta(GdpGrowth_{i,t}) + j_i*\Delta(Econ.Openness_{i,t}) + k_i*\Delta(ExchangeRate_{i,t}) + e_{it}$$

After correcting unit roots we want to assess whether we should use a fixed or a random effect model. In order to test for that, we are going to use a Haussman test. First we have to construct our model using the option of random effects. The null hypothesis is that the coefficients obtained are consistent with random effects. Since the p-value is below 10% we can reject the null hypothesis. That means that we should use a fixed effect model.

Following the methodology and data description, the next step is to present our empirical results. First we use a set of all the countries to extract a broader conclusion and to examine whether a correlation between the two variables exists. Table 1 summarizes our findings:

Table 5

Initial Results

D_AnnualInflationCPI		
	Coefficient	P value
Constant	−0,00450814	0,0008 ***
D_Gini	0,0571981	0,7439
D_Tax	2,50417e-08	0,1374
D_ElderlyTotal	−0,878253	0,2080
D_Employment	0,0300370	0,4567
D_DebtGDP	0,0208425	0,4798
D_GDP Growth	−0,00586884	0,8508
D_Econ Openness	0,138950	1,90e-07 ***
D_Exchange Rate	0,000106223	0,0367 **
R^2	0,473	
Observations Number	232	

Notes: The dependent variable is the CPI Annual Inflation Rate. The explanatory variables are the first differences of : the Gini index, annual Tax Revenues, %Elderly out of Total Population, %Employment, %Debt/GDP, %GDP Growth, Economic Openness, Annual Exchange Rate, Annual Inflation(t-1)

* significant at the 10 % level

** significant at the 5 % level

*** significant at the 1 % level.

As we can see the model that we chose has very little explanatory power since only Economic Openness and Exchange rate is statistically significant at the 1% level. For that reason we decide to use another variable which according to the previous literature plays an important role in the determination of the current level of inflation. Thus, we add the autoregressive factor Annual Inflation CPI with one time lag. By adding this variable the model under examination is:

$$\Delta(CPI_{i,t}) = a_0 + \mathbf{b_i*\Delta(Gini_{i,t})} + c_i*\Delta(Elderly_{i,t}) + d_i*\Delta(TaxRevenues_{i,t}) + f_i*\Delta(Employment_{i,t}) + g_i*\Delta(DebtGDP_{i,t}) + h_i*\Delta(GdpGrowth_{i,t}) + j_i*\Delta(Econ.Openness_{i,t}) + k_i*\Delta(ExchangeRate_{i,t}) + \mathbf{l_i*\Delta(CPI_{i,t-1})} + e_{it}$$

We now present the results after the addition of the auto regressive variable in our equation

Table 6

The entire set of Data Results

D_AnnualInflationCPI		
	Coefficient	P value
Constant	−0,00397998	0,0018 ***
D_Gini	0,0909286	0,6753
D_Tax	1,24108e-08	0,4748
D_ElderlyTotal	−1,04492	0,1717
D_Employment	0,474125	0,0107 **
D_DebtGDP	0,0340478	0,2711
D_GDP Growth	−0,114017	0,0020 ***
D_Econ Openness	0,115122	1,60e-07 ***
D_Exchange Rate	0,000117655	0,0179 **
D_AnnualInflationCPI -1	−0,323655	7,16e-06 ***
R^2	0,473	
Observations Number	232	

Notes: The dependent variable is the CPI Annual Inflation Rate. The explanatory variables are the first differences of : the Gini index, annual Tax Revenues, %Elderly out of Total Population, %Employment, %Debt/GDP, %GDP Growth, Economic Openness, Annual Exchange Rate, Annual Inflation(t-1)

* significant at the 10 % level

** significant at the 5 % level

*** significant at the 1 % level.

The effect of Gini coefficient on inflation is neither found economically or statistically important at a 10% level. This is opposite with the results of previous literature who found a positive or a non-monotonic correlation between the two. As for the other variables Tax Revenues, the percentage of Elderly people and the Debt/GDP ratio are not found statistically important in order to hypothesize that they

can affect inflation rate. On the other hand, employment, Economic Openness and exchange rates report a positive coefficient that is significant at the 1% and 5% level according to previous surveys (Kazi and Munshi 2012). Exchange rate although seems to be statistically significant it isn't economically significant since the respective coefficient is almost zero. This result is contrary to other authors' results ho report it as a major driver of inflation (Anfofum et. al 2015). As for the other variables GDP Growth rate and the past inflation rate seem to have both a statistical significance and a negative impact on the inflation rate. Adjusted R^2 is quite big and that means that our model is quite satisfactory in terms of explanatory power.

The next step to test whether Gini coefficient has any relationship with inflation rate is to separate the countries under examination in two ways:

1. In Countries with Low and High Gini coefficients
2. In Countries with Low and High Growth rate

By categorizing the countries in such a way we try to find a possible relationship between these three variables: inflation, income inequality and GDP growth rate. This way we are going to decide if income inequality plays a role depending on these different factors. In order to do that, we have estimated the average Gini and the average GDP growth for each country for the years under examination. Then we computed an Average Gini coefficient and an average GDP Growth for all the countries and we categorized them.

Table 7
Separation according to Gini coefficient and GDP Growth

Country	Avg(Gini)
Slovenia	0,2358
Sweden	0,2408
Norway	0,2472
Czech Republic	0,2529
Slovak	0,2544
Denmark	0,2555
Iceland	0,2577

Country	Avg(GDP Growth)
Greece	-0,0153
Italy	-0,0028
Portugal	-0,0012
Spain	0,0067
Denmark	0,0087
Hungary	0,0109
Netherlands	0,0110

Finland	0,2583
Netherlands	0,2643
Belgium	0,2674
Austria	0,2691
Hungary	0,2699
Luxembourgh	0,2786
Germany	0,2848
France	0,2907
Ireland	0,3057
Korea	0,3093
Canada	0,3192
Italy	0,3221
Poland	0,3238
UK	0,3274
Spain	0,3277
Estonia	0,3289
Greece	0,3364
Portugal	0,3582
Latvia	0,3637
Israel	0,3734
US	0,3810
Turkey	0,4374
Average	**0,3014**

France	0,0111
Finland	0,0117
UK	0,0122
Germany	0,0130
Slovenia	0,0145
Belgium	0,0146
Austria	0,0151
Ireland	0,0151
Norway	0,0159
US	0,0165
Sweden	0,0189
Canada	0,0192
Czech Republic	0,0246
Luxembourgh	0,0269
Iceland	0,0277
Estonia	0,0290
Latvia	0,0322
Korea	0,0383
Poland	0,0405
Slovak	0,0424
Israel	0,0426
Turkey	0,0494
Average	**0,0189**

After separating the high Gini countries from the low Gini countries we are ready to test the model again for the 15 countries with the lowest and the 14 counties with the highest average gini coefficient of our sample.

Table 8

High Gini Results

D_AnnualInflationCPI		
	Coefficient	P value
Constant	−0,00753183	(0,0140) **
D_Gini	−0,00753183	(0,5658)
D_Tax	−0,170512	(0,9402)
D_ElderlyTotal	1,46119e-09	(0,9379)
D_Employment	0,0917765	(0,0300) **
D_DebtGDP	0,411927	(0,8243)
D_GDP Growth	−0,140847	(0,0007) ***
D_Econ Openness	0,172688	(0,0001) ***
D_Exchange Rate	0,000109871	(1,62e-05) ***
D_AnnualInflationCPI -1	−0,363178	(0,0044) ***
R^2 0,59		
Observations number 104		

Notes: The dependent variable is the CPI Annual Inflation Rate. The explanatory variables are the first differences of : the Gini index, annual Tax Revenues, %Elderly out of Total Population, %Employment, %Debt/GDP, %GDP Growth, Economic Openness, Annual Exchange Rate, Annual Inflation(t-1)

* significant at the 10 % level

** significant at the 5 % level

*** significant at the 1 % level.

For the countries with a high Gini coefficient the Gini index itself does not seem to be statistically significant at a 10% level. The autoregressive term is once again significant and economically powerful enough for the determination of the current inflation rate. Employment and economic openness have also been found to have a strong positive linkage with inflation in time t. On the other hand GDP growth has a moderate negative effect, although statistically significant at a 1% level, while exchange rate has a positive but economically non-significant effect on the current inflation rate.

Table 9

Low Gini Results

D_AnnualInflationCPI		
	Coefficient	P value
Constant	−0,00349180	0,0010 ***
D_Gini	0,0605939	0,8151
D_Tax	1,53226e-08	0,6482
D_ElderlyTotal	−1,66787	0,0561 *
D_Employment	0,455476	0,1035
D_DebtGDP	0,0744931	0,0131 **
D_GDP Growth	−0,0494766	0,3457
D_Econ Openness	0,101125	4,32e-05 ***
D_Exchange Rate	0,000761993	0,2349
D_AnnualInflationCPI -1	−0,214800	0,0265 **
R^2 0,46		
Observations number 128		

Notes: The dependent variable is the CPI Annual Inflation Rate. The explanatory variables are the first differences of : the Gini index, annual Tax Revenues, %Elderly out of Total Population, %Employment, %Debt/GDP, %GDP Growth, Economic Openness, Annual Exchange Rate, Annual Inflation(t-1)

* significant at the 10 % level

** significant at the 5 % level

*** significant at the 1 % level.

Concerning Low Gini countries Gini coefficient is once again insignificant at a 10% level while the autoregressive factor is found again statistically significant at a 5% level although it loses some of its economic significance. The interesting part is that of the other variables. The variable that represents Elderly people is found for the first time statistically significant at a 10% level and with a really strong negative economic impact. The result is opposite with Bhattacharya et al. (2002), who found a statistically insignificant and positive correlation. Economic openness once again is found significant at a 1% level with a moderate explanatory power. Finally Debt as a percentage of GDP is also found significant at a 5% level indicating a positive correlation.

Next we use the same approach in order to distinguish the low from the high growth countries. We now present the results of this procedure:

Table 10

High Growth Results

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D_AnnualInflationCPI		
	Coefficient	P value
Constant	−0,00502134	0,0500 **
D_Gini	0,249537	0,5794
D_Tax	1,46399e-07	0,5951
D_ElderlyTotal	−3,22281	0,0089 ***
D_Employment	0,603601	0,0213 **
D_DebtGDP	0,0783940	0,1813
D_GDP Growth	−0,132179	0,0054 ***
D_Econ Openness	0,130479	0,0040 ***
D_Exchange Rate	0,000153524	0,0929 *
D_AnnualInflationCPI -1	−0,296341	0,0122 **
R^2	0,49	
Observations Number	88	

Notes: The dependent variable is the CPI Annual Inflation Rate. The explanatory variables are the first differences of : the Gini index, annual Tax Revenues, %Elderly out of Total Population, %Employment, %Debt/GDP, %GDP Growth, Economic Openness, Annual Exchange Rate, Annual Inflation(t-1)

* significant at the 10 % level

** significant at the 5 % level

*** significant at the 1 % level.

Once again Gini index is found statistically insignificant at the 10% level. For the first time the autoregressive variable loses weight concerning its statistical significance while the variable for Elderly people is significant at the 1% level. As for the other variables, Employment, GDP Growth and Economic Openness are once again significant and in accordance with the results we expected. Finally the exchange rate is again statistically significant at a 5% level however its economic significance is really low.

Table 11

Low Growth Results

D_AnnualInflationCPI		
	Coefficient	P value
Constant	−0,00365367	0,0239 **
D_Gini	0,0162925	0,9446
D_Tax	1,05524e-08	0,4552
D_ElderlyTotal	−0,0634116	0,9250
D_Employment	0,404461	0,0777 *
D_DebtGDP	−0,0721031	0,6233
D_GDP Growth	−0,0721031	0,2237
D_Econ Openness	0,0985393	4,59e-05 ***
D_Exchange Rate	−8,32370e-05	0,6903
D_AnnualInflationCPI -1	−0,350190	0,0013 ***
R^2	0,51	
Observations Number	144	

Notes: The dependent variable is the CPI Annual Inflation Rate. The explanatory variables are the first differences of : the Gini index, annual Tax Revenues, %Elderly out of Total Population, %Employment, %Debt/GDP, %GDP Growth, Economic Openness, Annual Exchange Rate, Annual Inflation(t-1)

* significant at the 10 % level

** significant at the 5 % level

*** significant at the 1 % level.

Once again the Gini coefficient seems to be statistically insignificant. That means that there isn't a special effect depending on growth rate for the Gini coefficient. As for the other variables for the countries with high growth levels only Tax and Debt as a percentage of GDP seem to be insignificant. For the first time the percentage of Elderly people is significant at 1% level while exchange rate loses some of its previous significance. Concerning the countries with low growth rate only economic openness and the past level of inflation rate seems to be significant at 1% level while employment is significant at a 10% level.

Even though we have not found empirical evidence to support that income inequality affects inflation rates we were able to see that different factors play a role

in the determination of inflation rate when we separate them the way we did. Income inequality is found statistically insignificant for all the regressions above. Taking into consideration the drawbacks in the use of Gini coefficients for comparing different countries it may be optimal to use another estimate of income inequality to explore the inflation and income inequality association. Unfortunately, the fact that we could not find a correlation between the two variables does not allow for major insights towards the policies that a government or a central bank should follow.

Chapter 5: Conclusion

This thesis is trying to explore whether a correlation between income inequality and inflation exists. To be more specific we tried to explore whether Gini coefficient affects CPI. To explore this association we used a set of variables that were used before according to the literature list. The entire set of countries under examination consisted of 29 OECD countries for a time span of 10 years, between 2004 and 2013. We used a fixed effect panel data approach and used 5 regressions one for the entire data set and the other four for high and low Gini countries and for high and low GDP Growth countries to determine the relationship. However income inequality, measured by Gini coefficient, does not appear to be statistically significant and have any correlation with inflation rate.

Even though we could not find any evidence regarding the inflation and income inequality association we were able to verify the fact that inflation is a complicated variable which is impacted by different factors for each country. The comparison of different countries by using the Gini index may not be the optimal way so a possible suggestion for future research would be to consider a time series approach and isolate the factors that affect inflation rate for each country or even use a different measure of income inequality.

Appendix

Table 12:

Dickey Fuller Test for unit root p-values

	Gini	**Tax**	**Elderly**	**Employment**	**Debt**	**GDP Growth**	**Econ Openness**
Austria	0.9440	0.5773	0.4626	0.7009	0.1130	0.2162	0.1450
Belgium	0.000	0.5496	0.9983	0.8965	0.0778	0.1208	0.6637
Canada	0.0871	0.0380	1.0000	0.3245	0.4234	0.6916	0.2698
Czech Republic	0.1023	0.8289	0.9989	0.3545	0.5720	0.5157	0.1108
Denmark	0.9401	0.6512	0.0000	0.2809	0.4362	0.8216	0.3907
Estonia	0.9483	0.1844	0.0000	0.0826	0.0470	0.3182	0.1533
Finland	0.5818	0.4565	0.9067	0.1948	0.4015	0.2401	0.2495
France	0.4351	0.4919	0.9986	0.5477	0.0383	0.3803	0.2308
Germany	0.5845	0.5442	0.4487	0.2365	0.3427	0.1880	0.2774
Greece	0.0236	0.8733	0.0000	0.0783	0.0000	0.6190	0.1980
Hungary	0.8306	0.6082	0.7390	0.6892	0.6483	0.9024	0.3093
Iceland	0.7716	0.5503	0.1160	0.5693	0.9011	0.8233	0.1865
Ireland	0.7906	0.0891	0.0000	0.2738	0.1234	0.7559	0.0347
Israel	0.0483	0.0511	0.9976	0.8638	0.000	0.0078	0.1891
Italy	0.9212	0.5680	0.0554	0.2469	0.4716	0.2011	0.0573
Korea	0.9927	0.0530	0.1151	0.7853	0.2647	0.0324	0.0667
Latvia	0.0116	0.1874	0.9976	0.0595	0.1951	0.3062	0.2910
Luxembourgh	0.0848	0.7233	0.9440	0.0297	0.1948	0.1819	0.3730
Netherlands	0.8345	0.7338	0.9932	0.4673	0.0231	0.1805	0.3426
Norway	0.0319	0.1712	0.0000	0.1143	0.1504	0.8015	0.4729
Poland	0.0000	0.6627	0.1706	0.3424	0.3081	0.0000	0.3821
Portugal	0.9058	0.7649	0.9219	0.9575	0.9892	0.0001	0.4856
Slovak	0.3797	0.6533	0.0000	0.1980	0.5343	0.3088	0.2248
Slovenia	0.9441	0.8451	0.8710	0.6378	0.9872	0.2904	0.1648
Spain	0.3558	0.2558	0.9900	0.1877	0.7030	0.4304	0.1193

Sweden	0.0001	0.1556	0.9900	0.1569	0.6050	0.3581	0.0044
Turkey	0.4417	0.1557	0.9656	0.7929	0.4368	0.4891	0.2608
UK	0.3400	0.0485	0.8181	0.8090	0.1352	0.7832	0.1479
US	0.7301	0.6848	0.9995	0.2255	0.0966	0.8565	0.2867

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Table

Diagram