Charles University

Faculty of Social Sciences
Institute of Economic Studies

MASTER'S THESIS

The Relation Between the Euro Cash Changeover and the Perceived Inflation in the Baltic Countries

Author: **Bc. Előd Orosz**

Supervisor: **prof. Ing. Oldřich Dědek, CSc.**

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Declaration of Authorship

I hereby declare that I complied this thesis on my own under the leadership of my supervisior, using only the listed sources and literature. This thesis was not used to obtain another academic degree.

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Acknowledgments

Abstract

This thesis focuses on the effect of euro cash changeover on inflation perception, and its relation to the inflation measured by central banks or by national statistical offices. We present an analyses of inflation gap in Estonia, Latvia and Lithuania at the euro introduction and detect its determinants by econometric methods. We use Ordinary Least Squares, Random Effects Generalized Least Squares and Fixed Effects estimator. The thesis is divided into two main parts. The first part examines the theoretical background of perceived inflation and focuses at the phenomenon of increased inflation gap at the euro introduction. Second part contains an empirical study on inflation gap. We find out that perceived inflation in Baltic countries does not show such a divergence, as it was presented at the establishment of the Eurozone. Moreover, we find out that education and available income in general has a small, but evincible effect on inflation gap observed at euro introduction.

Bibliographic record

Abstrakt

Tato práce se zaměřuje na efekt zavedení společné euro měny na vnímanou inflaci a její vztah k inflaci měřené centrálními bankami nebo národními statistickými úřady. Představujeme zde analýzy inflačních mezer Estonska, Lotyšska a Litvy po zavedení eura a zjišťujeme její determinanty pomocí ekonometrických metod. Používáme běžnou metodu nejmenších čtverců (Ordinary Least Squares), náhodné efekty zobecněné metody nejmenších čtverců (Random Effects Generalized Least Squares) a odhad pevných faktorů (Fixed Effects). Práce je rozdělena do dvou hlavních částí. První část objasňuje teorii vnímané inflace a zaměřuje se na fenomén zvětšování inflační mezery po zavedení eura. Druhá část obsahuje empirickou studii inflační mezery. Zjistili jsme, že vnímaná inflace v Baltských zemích nevykazuje takové rozdílnosti, jak bylo prezentováno při vzniku eurozóny. Navíc jsme zjistili, že vzdělání a disponibilní příjem má malý, ale prokazatelný vliv na inflační mezeru pozorovanou po zavedení eura.

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Acronyms

BPI	Balanced Perceived Inflation
CB	Central Bank
CEE	Central and Eastern Europe
CPI	Consumer Price Index
ECB	European Central Bank
EMI	European Monetary Institue
EMU	European Monetary Unit
EU	European Union
ERM	European Exchange Rate Mechanism
FE	Fixed Effects
FED	Federal Reserve System
GDP	Gross Domestic Product
GLS	Generalized Least Squares
HICP	Harmonised Index of Consumer Prices
IMF	International Monetary Fund
IT	Information Technology
IPI	Index of Perceived Inflation
OLS	Ordinary Least Squares
RE	Random Effects
US	United States
USA	United States of America

Master's Thesis Proposal

Author	Bc. Előd Orosz
Supervisor	prof. Ing. Oldřich Dědek, CSc.
Proposed topic	The Relation Between the Euro Cash Changeover and the Perceived Inflation in the Baltic Countries

Motivation   This thesis will focus on the perceived inflation during the implementation of the euro in Estonia, Latvia and Lithuania. Consumer surveys frequently show a gap between perceived and factual inflation. This gap is widely discussed in academic research. There are many tendencies to get the perceived inflation closer to the factual one. To examine these tendencies we have to understand the bias of the perceptions. To achieve this goal, we have to detect the variables influencing the inflation perceptions. In accord with the previous experience which implied that during the euro cash changeover the lag between perceived and factual inflation is getting wider, the countries introducing the euro started to implement various rules, decreasing this negative effect. The effect is negative since it affects the behavior of the economic agents in a way which is not favorable for the economy.

Hypotheses

>   Hypothesis #1: In case of the Baltic countries we can observe a jump in perceived inflation around the euro cash changeover as it was observable at the initial euro area members at the introduction of the new currency.

>   Hypothesis #2: Thanks to the more sophisticated legislation before the introduction of the new currency, we expect that the jump in the gap between perceived and factual inflation was smaller, than in the case of initial euro area members in 2002.

>   Hypothesis #3: We expect, that the gap between the factual and the perceived inflation has an inverse relationship with the education and with the available income of the repsondent.

Methodology   The source of data about the inflation perception is a monthly dataset collected within the Joint Harmonized EU Program of Business and Consumer Surveys. As the main tool of my analysis I want to use the difference-in-differences method, which allows to examine the changes in the level of perceived inflation during the euro cash changeover and makes easier to treat the differences between the perceived and the actual inflation. The difference-in-differences method is usually calculating the effect of a treatment or event on an outcome by comparing the change over time in the outcome variable for the treatment group to the change over time for the control group. The treatment group is formed by the Baltic countries, i.e. Estonia, Latvia and Lithuania, while the control group contains other eurozone countries.

Expected Contribution   The main contribution of the thesis lies in the target group of countries we would like to examine. In the light of the result of the empirical analysis, the reader will be able to understand the impact of the euro changeover on perceived inflation more precisely in the Baltic countries, i.e. in Estonia, Latvia and Lithuania. Since all of these countries joined the eurozone in the last 4 years (2011, 2014 and 2015), the topic is still actual. The obtained results also can be useful at the decision-making process about the introduction of the euro in the Czech Republic. We expect to obtain results supporting the inverse relationship between education/available income and perceived inflation. Based on the result receiving from this research, we also will be able to compare the effectivity of the European legislation directed to decrease the jump of the perceived inflation during the euro changeover.

Outline

1. Introduction.

2. Literature review, examination of the theoretical background.

3. Measurement of perceived inflation.

4. Hypothesis and methodology.

5. Empirical part- description of the data and the model, analysis of the data.

6. Results

7. Conclusion

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Author   Supervisor

Chapter 1

Introduction

The Baltic countries, namely Estonia, Latvia and Lithuania introduced the euro between 2011 and 2015. Estonia was the 1st on 1 January 20011. Exactly 3 years later it was followed by Latvia, while the last one in the line was Lithuania, where euro was introduced a year after. For all the three countries, introduction of the euro meant not just a change of the legal tender, but much more. As it is known, Baltic countries were the part of the Soviet Union for 40 years during the second half of the 20th century. The public opinion about this period is quite negative, and there still exists fear from the return of Russian influence. Introduction of the common European currency for these countries was an important milestone of the breakup with the Soviet history, or rather on the way towards the European integration. By introducing the Euro, Baltic countries showed their ability to fulfill and sustain all macroeconomic indicators, which were required by Maastricht criteria.

The objective of this thesis is to determinate the effect of the introduction of the Euro on the inflation perception of the population in the Baltic countries and find a theoretical explanation behind processes in real economy. Moreover, a non-hidden goal is to compare our results by empirical findings on the data from countries where euro was introduced earlier.

Chapter 2 reviews the theoretical background of inflation perception and its relation to the inflation rate measured by Central Bank (CB)s. Analyses the effect of increase in perceived inflation on the real economy and the practical experiences with increased inflation perception. At the second part of the chapter the index of perceived inflation is presented in details. A separate paragraph deals with the cost of inflation misperception. It highlights the negative effect of the increased gap between real and perceived inflation on the

economic output.

In Chapter 3 are dedicated to the euro. In the first part of the chapter are presented the path to the creation of the euro as a single European currency. Next section presents the international role of the euro. At the second part of the chapter are discussed the common monetary policy under the leadership of the European Central Bank (ECB) and practical experiences of the Slovakian and Slovenian euro introduction.

Chapter 4 focuses on Baltic countries. The first section provides information about the economic background of the three examined countries. The next sections dealing with the process of the euro introduction at the Baltic countries separately. Our empirical findings are presented in the Chapter 5. We created a backward looking model to determine the effect of explanatory variables on perceived inflation in the Baltic countries. The bunch of explanatory variables was created based on previous academic papers dealing with the problem at the creation of the Eurozone e.g. Brachinger (2006) or Del Giovane & Sabbatini (2008).

For modelling the perceived inflation, we used several methods. Our basic method was OLS. In addition, we used alternative estimators to confirm our findings. We used Random Effects (RE) generalized least squares and Fixed Effects (FE) estimator to check the robustness of the results.

The last paragraph of the thesis is focusing on the effect of available income and education on inflation perception. However, detailed study of euro introductions inevitable side effects is beyond our scope, results obtained at the empirical part of the thesis should provide a useful guideline for future extension of the work.

Chapter 2

Theoretical Background of Inflation Perception

2.1 Actual versus Perceived Inflation

The difference between perceived and measured inflation is very important for the monetary policy. In the case of euro introduction, the increasing gap between measured and perceived inflation in medium term can boost the dissatisfaction with the euro and decrease its public acceptance. Other negative effects of the gap between perceived and measured inflation are the distorted prices and wages and a diminishing ability of producers and consumers to assess prices correctly, which can reduce price system's allocative efficiency (Del Giovane & Sabbatini 2005).

2.2 Estimation of Inflation Expectations

History showed, that expectation has a very important effect on the behavior of individuals, therefore for the whole economy. Expectancy theory points out, that in a certain cases individuals are motivated to act in certain way, chosen from a bunch of options just because of the expected result of the chosen behavior. If we want to examine the role of inflation perception or expectation more deeply, we have to pass the following steps. First we have to obtain the expected rate of inflation, after that we have to determine the factors influencing this rate and last but not least we should examine, if estimations have any significant influence on future inflation Brachinger (2006)

High level of inflation has a significant effect on the distribution of income.

Since we can observe a difference in the consumption of different social groups, therefore we could find such a difference among the inflation level, what the representatives of these social groups are perceiving. Inflation has numerous negative effect on economy. It is enough to mention the increased unpredictability of long term decisions, higher nominal interest rates. Moreover, inflation influence the distribution of income, by changing the real value of a long term nominal contracts.

It is a common phenomenon, that respondents of surveys focusing on perceived inflation are perceiving higher inflation rate, as the official one. It is not just the reason of respondent subjective decision making process, but also the reason of different input information. The explanation is, that the different social groups has consumer baskets composed differently. It means, that consumers with lower income are spending relatively more money for food and fundamental needs, why consumers with higher income spending relatively more for services and industrial products. Since the price different products changing differently, the perceived inflation rate will differ among respondents. Badarinza & Buchmann (2009)

2.3   Historical experiences with inflation perception

Possible differences between measured and perceived inflation rate were known among economists for several decades. We could find academic papers dealing with perceived inflation, focusing on some concrete country, like Jonung & Laidler (1988). Nevertheless, it became widely known after the establishment of the eurozone, especially after launching the euro in cash in 2002.

For better understanding of the phenomenon, we have to say some details about the introduction of the euro. The European Monetary Union was created in 1999, however the physical launch of coins and notes was realized just three years later in 1 January 2002. The exact method of currency changeover was chosen just few months before the definitive launch of the notes and coins, since there was a broad discussion among the policy makers about the optimal way of realization. There were three different approaches in a ring, i.e. the mounting wave, the big bang and the no compulsion, no prohibition scenario. All of the methods has its strengths and weaknesses. The method of euro changeover was decided at the Madrid summit of the European Council. The later successfully

applied big bang scenario was refused, due to the demanding technical and
psychological reasons. Euro introduction in first round affected more than
300 million people. The remaining two methods were similar in phasing out
transition into three phases. The difference among them was in the length of
the certain phases and among its relation to the contemporary usage of euro
and the national currency. As it was mentioned above, the physical coins and
notes were launched in 1 January 2002. Thanks to the satisfactory preparation,
the technical side of the introduction went without any significant problem. Till
the end of February of the given year, euro definitely took the place of national
currencies in the 12 founding countries. Dědek (2008).

Figure 2.1: Measured and Perceived Inflation Rate at the Eurozone
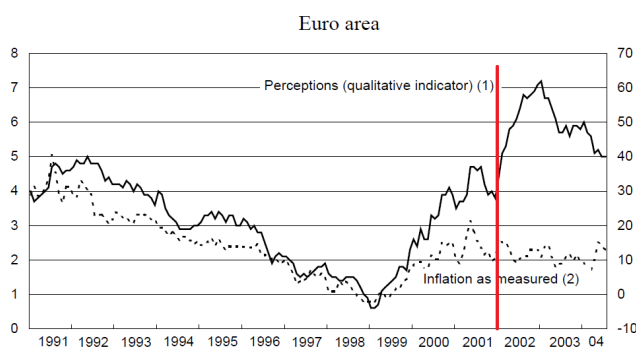
Source: Del Giovane & Sabbatini (2005) on European Commission and Eurostat.
(1) Qualitative indicator obtained as the percentage balance of responses to the monthly
consumer survey (right-hand scale). - (2) Twelwe-month rate of increase in the Harmonised
Index of Consumer Prices (HICP) (left-hand scale)

The general phenomenon in the newly formed Eurozone was, that while
increase in price level registered by national institutes of statistic was moderate,
a wide group of euro-area citizens perceived a significantly higher increase in
the price level. The gap between measured and perceived inflation rate reached
unprecedented extend in most of the eurozone countries. In some countries the
gap started to diminish few months after the introduction of the new currency,
although in Germany and in Italy it started do decrease in the second half
of 2003, resp. in the first months of 2004. See Figure A.1 The effect of such
an unexpected increase in perceived inflation is explained by several reason.
Del Giovane & Sabbatini (2005) emphasize the responsibility of the media in
Italy. The most straightforward example is, that during the process of the euro
changeover, the official data about price increase were repeatedly questioned.
There was another, at this time very popular hearsay in Italy, that companies

would like to convert prices from lira to euro on the rate of 1000, while the official conversion rate was almost the double, 1936.27 lire per euro.

Other explanation for increased inflation perception was the so called rounding error. As it was mentioned above, the official conversion rate for lira was 1936.27 lira per 1 euro. The official conversion rate in Germany was 1,95583 marks per one euro. Both exchange rate left enough space for rounding error. It is originated from the consumers limited ability to perform difficult mathematical computations without assistance. For increased perceived inflation it had a significant effect, since when consumers converted new nominal prices to the old ones, they used the conversion rate 2000.00 in Italy for Lira, and a 2.00 in Germany for mark. In practice, the simplified conversion method caused a 2.25% pseudo price increase in case of German mark and a 3.30% pseudo price increase in case of Italian lira. Exchange rate of all former national currecy is displayed at Table A.1

2.4 Theory of Inflation Perception

Brachinger (2006) developed a theory of inflation perception. The basics of this theory are provided by the Prospect Theory developed by Kahnemann and Tversky on individual decision-making under risk. Both of them were awarded the Nobel Prize in Economics for this theory. The theory of perceived inflation is characterized by three hypotheses. First hypotheses is about the perception of the price by consumers. In case of every good, consumer has a so called reference price which is specific to the given good. The consumer always observes the difference between the current and the reference price. If the reference price is higher, consumer takes the difference as a loss, if in contrary the current price is higher, takes it as a gain. Second hypotheses is about the evaluation of the losses and gains from the first hypotheses using a value function V, where losses are always evaluated higher than same gains. In practice it means, that consumers are more sensitive for rising prices than for decreasing ones. This judgement is made after every price change the consumer observes. In decision making theory this phenomenon is called loss aversion. Third hypotheses is about the influence of frequency of purchase to the inflation perception. If consumer meets with price increases more often, it will be easier for him to recall noticeable price increases when want to judge gains or losses. The effect of goods purchased every once in a while or goods obtained without

explicit purchasing action, e.g. its price is charged once a month such as mobile subscription, have a negligible effect on inflation perception.

Introduction of a new currency is always involved with some difficulties for the public. After the price conversion everybody has to memorize the new prices in Euro. The effectivity of this process is influenced by a variety of factors. Most of them is difficult to influence, however it seems to confirmed, that the speed of price learning process at a certain produkt is strongly correlated by the frequency of the purchase of a given good. Marques & Dehaene (2004) investigated the psychological mechanism behind this phenomenon. Del Giovane & Sabbatini (2005) discussed, that a possible explanation for the after changeover inflation gap between measured and perceived inflation could be, that at the first weeks and months after the changeover, frequently purchased goods are overrepresented in the valuation function of the consumers. Based on the possible negative effects of the gap between measured and perceived inflation it is very important to measure it somehow. The main source of information about perceived inflation in European Union (EU) countries is a monthly survey carried out by the European Commission within the framework of the Joint Harmonised EU Programme of Business and Consumer Survey. The survey contains two questions about the respondent's opinion on consumer prices. The first and the second question sound "How do you think that consumer prices developed over the last 12 months?" and "By comparison with the past 12 months, how do you expect that consumer prices will develop in the next 12 months?". Every respondent has to choose one of the following possible answers: risen a lot, risen moderately, risen slightly, stayed about the same or fallen.

Different methods were developed in the last few decades to quantify these survey data and estimate the yearly rate of perceived inflation. Most of these methods are based on empirically unsupported assumptions therefore most of them are highly unreliable. Within our possibilities we want to use more methods to quantify the survey results and compare the result received using these different methods.

2.5 Index of Perceived Inflation

Another concept for measuring the inflation perception called Index of Perceived Inflation (IPI) was introduced by Brachinger (2006). The main added value of the index is that it allows a direct measurement of yearly perceived

inflation rate without any survey, based only on directly or indirectly available official data.

The main goal of IPI is to measure, how consumer's decisions are influenced by inflation. Brachinger (2006) says, that consumers use a reference price to evaluate the actual price of every single good they are faced with. The valuation process is contains few very simple steps. Consumers compare the price of a given product with an own reference price created in the past, based on some previous experience. If the reference price is the higher one, consumer evaluates the price difference as a gain, while if the current price is the higher one, consumer evaluate it as a loss. Based on Branchinger's theory, consumers are much more sensitive to the loss than to the gain realized in such a situation. Moreover, consumers are much more sensitive for the price increase of a goods which they buy more frequently, even if these goods are responsible just for a small part of a consumer's expenditure.

$$IPI_L^{v,t} = \sum_{i:p_t(i)>p_v(i)} \left[C\frac{p_t(i)}{p_v(i)} - (C-1) \right] f_i^0 + \sum_{i:p_t(i)>p_v(i)} \frac{p_t(i)}{p_v(i)} f_i^0$$

Brachinger computed IPI inthe way described above. At Brachinger (2006) $C = 2$, which means that consumers are twice as sensitive to price increase than to price decrease. $P_t(i)$ and $P_v(i)$ are the current and the reference price of an examined product, while $f_i(0)$ desribes, how often the consumer purchasies the given good.

2.6 Inflation Perception in Practice

In general, it is true, that the perceived inflation takes higher values, than the measured one. Several explanations are exist. First of all, due to the loss aversion of the consumers, they are more sensitive to the price increases than to the price decreases Brachinger (2008).

There exists an empirical evidence Aucremanne *et al.* (2007), that in the founding countries of the eurozone there is a difference between perceived and measured inflation, a so-called inflation gap. In some academic works this gap is originated from the period of euro introduction, however these results we always have to take with some reserve. The reason is, that the comparison of two different index with different unit of measurement can not be 100 percently reliable. The ECB in relation with the inflation perception published a short list with the most probable explanation for higher perceived inflation. First of

all, it is very probable, that consumers always focus at prices which are growing actually, and nobody takes care about the prices which are staying unchanged. Moreover, goods which consumers buy more frequently, such as newspapers, tobacco or fuel prices have a more significant impact on perceived inflation. Here the means of payment does matter as well. Based on ECB, payments realized in cash influence perceived inflation more than cash-less payment e.g. utility prices, which are very often payed by direct debit. Differences in consumer baskets of citizens can cause some differences. While measured inflation is based on an average consumer basket data, on individual level it could be the source of distortion. E.g. if some people never use a car, or public transport, for them inflation pushed by growing fuel will be less significant, than for somebody who is using it on a daily basis.

In some cases, even the direct price change does not have to mean inflation. Increasing quality of the product, an adequate price increase leaves the level of inflation unchanged. If consumers want to deal with such a phenomenon correctly, they have to be very accurate and need to understand the product quite well. In lot of cases unfortunately consumers are not able to judge such a situation, which in practice could lead to the increasing inflation gap.

2.7 Cost of inflation misperception

One of the side-effects of the euro introduction is that after the establishment of the Eurozone and launching the euro in form of cash, citizens of the initial Eurozone countries overestimated the actual level of inflation. May be, that for some readers at the first reading the misperception of the inflation seems to be unimportant, however on aggregate level it could cause significant problems.

Long term inflation misperception could cause a decline in aggregate output. The decline in such a situation is a cumulative result of two separate phenomena. At first, people due to the supposed increase of prices are reducing spending. At second, appearing price uncertainty has a negative effect on consumers' confidence, causing the swift in the evaluation of own financial situation.

Most of the explanations, focusing on the negative impact s of inflation misperception, mentions the problem of non-rationality of consumers' decision making to a certain level. Making a hundred percent correct decisions assume a hundred percent rational decision making process. In practice it has to mean, that the consumer has to remember all prices, moreover at the case of currency

change-over have to be able to convert them correctly to the value in euro, and last compare them without mistake. Here we arrived also to the importance of the frequency, by which goods are purchased, which we discuss in a different topic. We could underestimate the overall influence of currency changeover on the citizens' everyday life. The usage of a new currency unit, and therefore the application of different nominal prices could cause complications in everybody's life, especially could be stressful for the people belonging to any disadvantaged group of the society. Stress, by which such an event is followed, could be understandable. Nevertheless, such an extent shift in consumer's decision, what researchers observed e.g. in Germany and Italy after the introduction of the euro, seem to be superfluous. For more details see Eife & Maier (2007).

Chapter 3

The Euro

3.1 The Path to the Euro

The dreams about creating an Economic and Monetary union are the same
age than creation of the EU, however the first steps were realized only in the
1970's after the failure of the Bretton Woods system with the so called "snake
in the tunnel". It was an effort within the European Economic Community
to eliminate large fluctuations between European currencies using a currency
band which meant an imperfect peg between the currencies of the Central
and Eastern Europe (CEE) countries. The success of the "currency snake"
was limited in long run, therefore a new plan was developed by the EU to
create an Economic and Monetary union. The creation of the Economic and
Monetary Union was developed in 3 stages. At the first by starting in 1990,
the cooperation between member states CB's got closer and capital movements
were liberalized. During this stage in 1992 the Treaty of Maastricht was signed,
where convergence criteria were laid down. These criteria are necessary to meet
any member state before entering to the third stage of the EMU. The four points
of the criteria are the following:

- Sustainable government finance, which means that the annual budget
  deficit has to be less than 3 % of the Gross Domestic Product (GDP),
  while government debt is not allowed to be more than 60% of the GDP.

- Inflation rate stability during a one-year reference period, when the in-
  flation is not allowed to be higher by more than 3 percentage point,
  compared to the average inflation at the the three countries with low-
  est inflation. Moreover, this inflation has to be realized in a sustainable
  manner.

- Exchange rate stability during a two-year reference period, when exchange rate has to stay in the exchange rate band defined during the second stage. It means the mandatory joining of the European Exchange Rate Mechanism (ERM).

- Interest rate convergence, which means in practice that during a one-year reference period the interest rate at the given country is not allowed to be higher by more than 2 percentage point, compared to the average of the three countries with the lowest interest rate.

At the second stage of the ERM, starting from 1994, the European Monetary Institue (EMI) was created. EMI was responsible for the coordination of the member state's monetary policy and for the preparation to the third stage of the European Monetary Unit (EMU). During the third stage in 1999, all the 11 member states' currency was pegged to the Euro, which started to exist as a real currency. Since this year, the ECB has been the institute responsible for the eurozone's monetary policy. The transition period had lasted three years before the introduction of actual euro notes and coins at January 2002 in 12 countries, complemented by Greece, who joined the third stage of the EMU at 2001. When Baltic countries joined the EU in 1 May 2004, they automatically joined the EMU. Since this time the fiscal situation was stable and the inflation was moderate in all the three countries, all of them joined the ERM II almost within one year from joining the EU. Estonia and Lithuania joined it in June 2004, while Latvia joined it in May 2005. All three currencies were pegged to the euro at a rate, which was not changed till the countries joined the Eurozone.

Table 3.1: National currencies before the euro

	Former Currency	1 euro	Euro introduction date
Estonia	Kroon	15.6466	1 January 2011
Latvia	Lats	0.702804	1 January 2014
Lithuania	Litas	3.45280	1 January 2015

Source: ECB.

For clarity we have to mention, that Estonian kroon was pegged to German mark since Estonia's independence in 1992 and it was later automatically changed to euro. The definitive exchange rate before joining the eurozone was fixed in July 2010. Latvia also used a fixed exchange rate system before joining the EU. The lat was pegged to the Special Drawing Rights, which are the cur-

rency of the possible claims at the International Monetary Fund (IMF). Lat's peg was switched to Euro in January 2005. Litas had an American dollar peg, which was changed to euro peg at February 2002. Dědek (2008)

3.2   International Role of the Euro

The creation of the euro was an important step forward not only for the EU members but for the whole world. As the national currencies were changed to euro in the majority of countries in EU, the euro started to be stronger and became one of the most important currencies of the world, being able to compete with United States (US) dollar. The introduction was a powerful stimulus for financial markets, and however US dollar remained the principal investment currency, its importance was decreased since the euro's existence. One of the main positive yield of countries joining the eurozone is the positive effect of trade expansion. Another main goal of joining the eurozone is to sustain the price stability and eliminate the inflation. The reason for that is , that only in a stable and well predictable economic environment can countries reach the high employment, the growth targets and sustain competitiveness DAVULIS (2014). Joining the eurozone for the Baltic countries at first meant the long term guaranteed price stability, i.e. the elimination of harmful inflation. euro was understood, as a milestone for the creation of a prosperous economic conditions, which could lead to a high employment rate and most of all to a sustainable development. Price stability is important to, since thanks to that individuals will be able to distinguish goods based on its prices, which is inevitable to become a conscious consumer.

Joining the eurozone means a joining of a monetary union. After the currency changeover, CB in general loses one of its most powerful toll to keep in hands the economy. It is true, that in general the member countries jointly create the common economic policy, and local national CB's have influence on the ECB's monetary policy, however based on the experiences of the last few years, it is far away from the situation, when in a so called "crisis" situation CB can protect the country's economy by monetary policy tools, which could be applicable within few hours. At this point we arrived to the most important current problem of the eurozone, that we unfortunately, due to its complexity, are unable to explain deep enough, nevertheless it has to mentioned. When in the beginning of 1960's Mundell (1961) published his theory about optimum currency area, he defined the most crucial criteria to create a successful cur-

rency area. One of Mundell's points was about the similarities of the business cycles of the participant. Unfortunately, due to its size and its unbalanced economy it is not fulfilled yet, in the case of EU. We can take a look at the case of Greece, or any other Mediterranean EU member countrie's economy and compare it with the performance or with the efficiency of Germany, or any other Northern European member countries. Another, until that time to the most of the countries almost unknown phenomenon is the deflation, which could be as dangerous, as the high inflation rate, since when deflation appears, individuals start to postpone their spendings, since they realize that they can buy more goods for it in the future. Under the deflationary pressure the effect of the monetary policy is unpredictable, since actors react in a different way than under a normal economic conditions.

3.3 Monetary Policy under the Leadership of the European Central Bank

In the last years before the introduction of the euro, all the three Baltic countries currencies were pegged to the euro, therefore the effect of the national Central Banks on monetary policy as well as on inflation was limited. After joining the eurozone, the countries started to be a part of the single monetary policy of the ECB. As it is declared in the Article 2 of the Statute of the ECB, the number one aim for ECB is to maintain price stability. Here we can find a relevant difference between the EU and other countries, e.g. the United States of America (USA). While for the Federal Reserve System (FED), the CB of the USA, the objectives are defined rather in pieces, focused at key topics as the optimal and sustainable employment and the economic performance. For the ECB price stability is the primary target, and all other activities are adjusted to fulfill this goal.

To the measurement of the price stability, ECB uses the HICP. The main tool for ECB to reach the inflation target, which is slightly below 2 % in medium term, is the interest rate. By the basic interest rate, ECB as any other CB determines the minimum cost of short term loans, which has an effect in market interest rates and on indirect way it affects inflation expectations of the market players. By the changes of basic interest rate, ECB can manage the appearing imbalances in the economy, first of all in price level, which is the most important in our case. In practice it means, that when the interest rate is going down, it

makes easier for market players to get money, therefore the amount of money in circulation increases. It has an effect on asset pricing thus on exchange rate too. Due to the increased amount of money in the economy, asset prices start to increase and at the same time exchange rate starts to go down. The process, mentioned above has a complex effect on real economy, since the effect of the interest rate change appears on commodity and labor pricing, and thanks to the shift of exchange rate, it appears also on the price of imported goods. Of course the monetary policy represents just one piece of the cake. There are other external factors influencing the price level, which are independent from the activities of the ECB, such is the fiscal policy, and any external shock on exchange rate or on commodity prices. Sauer & Sturm (2007).

The external factors had a significant effect during the euro changeover not just in the Baltic countries, but in any country where euro had been introduced before. If we want to demonstrate this phenomenon, it is enough to compare with the Slovenian case, where euro was introduced right before the European financial crisis started, when the economic growth was on its peak level, with the case of Slovakia, where euro was launched at the time when the first real economy impacts of financial crisis appeared, or with Estonia, where Euro was introduced during the culmination of the financial crisis.

3.4 Realization of Euro Cash Changeover in Slovakia and Slovenia

In Slovakia the euro cash change over was realized in the first two weeks of 2009 in a so called "big bang scenario". It means that in practice at the introduction of the euro the swift from the national currency to the euro was realized as fast as possible. Of course, before the establishment of the eurozone, there was an extensive discussion about the optimal manner of currency changeover. There were several possibilities from the gradual swift, with relatively long transmission period, to the changeover realized as fast as possible. The earlier empirical experiences showed, that the "big bang scenario" is the most effective from economical side, and at the same time it is the less painful for the citizens. In case of slovakian euro introduction it was 14 days. During this period a dual cash flow was presented in shops and everywhere, where cash is used. In these 14 days both currencies were possible to use for payment, however the change to the consumer had to be paid in euro. This process in all cases placed a

burden to the enterprises, however most of them was able to realize it without significant disruption. In the situations, where dual usage of currencies was impossible to realize, e.g. ATM's, ticket machines, coffee machines, the change-over was realized immediately during the first day of the transmission period. It was particularly important in case of ATMs. Suster *et al.* (2006). After the introduction of the euro, there was a 3 year period, when dual pricing was mandatory for all vendors.

The cash chang-over was realised in the same manner in Slovenia just two years earlier. We can observe just little differences, e.g. in the lenght of the mandatory dual pricing, which was in case of Slovenia significantly shorter, just 6 months after the introduction of the euro. Another difference was, that in Slovenia citizens had limited possibility to change remain tollars, the former national currency of Slovenia, to euro after the 14 days official transition period. Weyerstrass & Neck (2008)

Chapter 4

The Euro in the Baltic Countries

4.1 Economic Background of Baltic Countries

Baltic countries have several common basic features. All the three countries are very small in comparison to the GDP of the EU, very open in economic terms and in terms of foreign trade are strongly connected with the rest of the eurozone. Joining the EU in 2004, in all Baltic countries started a huge economic recovery. In the first years spent in the EU, GDP growth was around 10% thanks to the rapid development of electronic industry, Information Technology (IT) and constructions. In addition to the rapidly growing economy, the private public debt increased fastly after 2004 similarly to other CEE countries.

Figure 4.1: Real GDP Growth Rate

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
EU (28 countries)	3,6	1,9	1,1	1,1	2,1	1,6	3	2,6	0,1	-4,7	1,8	1,5	-0,7	-0,1	1,1
Estonia	6,4	6,8	6,8	8,1	7,2	10,1	11,1	8,5	-5	-14,6	2,7	8,6	5	2	2,4
Latvia	6,4	8,5	8,5	9,7	10,1	11,4	12,6	10,7	-2,1	-12,8	-0,8	7	6,1	5,3	3,3
Lithuania	3,3	6,7	6,9	10,2	7,4	7,8	9,1	12,4	3,7	-13,9	3,8	8,5	5,2	4,3	3,9
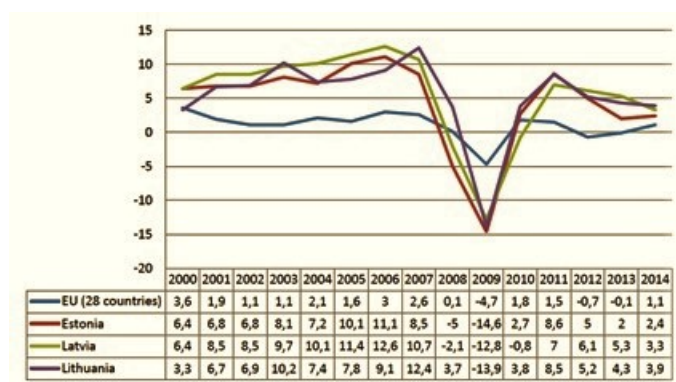
*Source:* Wrobel (2015) on Eurostat.

As it was usual during this period, significant part of the debt was nominated in foreign currency in all of these countries which caused a huge problem in difficult times starting from the second half of 2008. Due to the global economic turmoil, Baltic countries found themselves in a vicious circle. Firms

were unable to produce the same amount of products as during the economic prosperity, which caused increasing unemployment and decreasing export. This process took place very quickly, resulting a decrease of purchasing power and as a consequence, the demand on imported goods. These above mentioned unfavorable global economic conditions mixed with the local weaknesses caused a delayed euro introduction in all Baltic countries compared to the initial planning.

4.2 The Euro Adoption in Estonia and its effect on economy

Estonia fulfilled the Maastricht inflation criterion at the end of 2009 and budget criterion at the spring of 2010. The definitive decision about the introduction of the new currency was made on July 2010 by the Council of the EU. The euro was introduced in Estonia on 1 January 2011 at the same time in cash and non-cash circulation. Estonia was the 17th member of the Eurozone and the 5th from the countries which joined the EU in 2004. Moreover, Estonia is the first former Soviet Union member state which joined the Eurozone. At the first 14 days of the euro adoption a dual currency system was used, i.e. cash payments could be realized either in euro or in Estonian kroon. Bank of Estonia, the CB of the country realized an extensive information campaign during the year before the introduction. During that campaign all Estonians were broadly informed about the details of the currency changeover and about the practical aspects of the new currency.

The main goal of the above mentioned information program was to reduce the inflation pressure created by the currency changeover. The main tools of the project were the dual pricing and the sub-campaign called "the euro will not increase the price". Dual pricing meant in Estonian case, that all prices at stores had to be marked in the old and the new currency during that period starting half year before and lasting half year after the currency changeover. The sub-campaign was launched by the Estonian Chamber of Commerce and Industry to support fair price setting during and after the Euro changeover. It was voluntarily joined by more than 400 firms including the most important retail companies of the country Rõõm *et al.* (2014).

The government also acted in an exemplary manner in relation with taxes and benefits to decrease the inflation pressure. All the liabilities against the

state and benefits payed out from the budget were rounded in a way that was more favorable for the citizens. Based on information from ECB, 85 million euros were supplied in coins and 12 million pieces of banknotes were supplied during the euro changeover in Estonia.

However, Estonia is a small country, it has an important role in commerce due to its geographical location and historical connections. Its main partners are Finland and Russia. Of course the euro introduction has a more significant positive effect on the trade with Finland, nevertheless after joining the eurozone, new partners appeared from EU countries Jagelka (2013).

Since the introduction of the Euro passed more than 5 years, which is a period long enough, to draw some consequences. The fence has two sides, as usual. On the one hand, we have to take into account the difficulties by which the population and the government faced up in the first months, on the other hand are the medium and long term gains in corporate and government level. Of course these benefits on the end were enjoyed by the individuals.

4.3   The Euro Adoption in Latvia

Latvia was the only country who joined the eurozone in January 2014. It is the country's 4th currency in the last 25 years. The former currency of the country, lat was converted into euro at the official rate of 1,423 euro = 1 lat. Here we have to mention, that lat was one of the few currencies, which had higher nominal value than euro at the euro changeover in 2014. This influenced the inflation perception to a positive direction, since nominal prices in euro are higher, than were in lat. During the first two weeks of January both currencies were accepted as a legal tender, however all changes had to be given in euro. This period is intended to enable people to spend all their cash having in lat. After this transition period euro remained the only currency in usage. At the same time, banks had to change the lat to euro at the official exchange rate without any commission.

Similarly to Estonia, and to the other CEE countries introducing the euro, in Latvia was realized in a broad information campaign under the National Euro Changeover Plan. Information activities were focused on practical information and targeted to the general public, especially to socially excluded or otherwise disadvantaged social groups. As it is already known from Slovakia, an euro newspaper and a currency calculator was distributed in Latvia too, to make the price conversion easier to everybody. Moreover the Latvian Ministry of Finance

operated a green line for citizens, where it provided all practical information related to the euro.

As it was observable in Estonia, also in Latvia was launch a campaign called "Fair Euro Introducer" by private sector actors to maintain the transparency of the euro introduction and to set fair pricing in euro. Despite the extensive information campaign realized in Latvia before and during the currency changeover, a significant part of the citizens remained wary of the usage of the euro due to the difficulties in Estonia and due the volatile general economic situation. Cavallo *et al.* (2015)

4.4   The Euro Adoption in Lithuania

The Commission for the Coordination of the Adoption of the Euro in Lithuania was established in 2005. Its main goal was to implement the euro adoption in Lithuania. To meet the main target, a National Changeover Plan and a Public Information and Communication Strategy for the adoption of the euro were created. The most important goal of the strategy was to evolve a public awareness regarding the adoption of the euro and further effects. Before the introduction of the euro within the above mentioned strategy was launched an euro information campaign. The main parts of the information campaign were information leaflets called "Are you ready?", a mass media campaign and a conference about the euro. All of these tools were focused to the euro banknotes and coins, its security features, principles of conversion of accounts, balances, social payouts and to the methods have to check them. The European Council approved Lithuania's admission to the euro area on 23rd of July 2015. A month after the Lithuanian CB launched a "Fair euro introduction" campaign, which obligated to show all prices in Lithuania in both litas and euro until 30th of June 2015.

Lithuania joined the eurozone on 1st of January 2015. On that day euro replaced the former currency, litas, at the fixed exchange rate 1 euro = 3,45280 litas. As it is usual, on the first two weeks after the introduction of the euro a dual circulation period of litas and euro was existing. This transition period ended on 15th of January 2015. The banknotes and coins of the former currency were exchangeable in post offices until 1st of March 2015 and in banks until 30th of June 2015 without any additional commission. At the CB of Lithuania, the banknotes and coins of litas are exchangeable for an indefinite period. Rubio & Comunale (2016).

4.5   The Effect of Euro on Inflation Perception at the Establishment of the Eurozone

However, during the monetary unification in 1999 and in 2002, when euro was introduced in its physical reality, nobody expected, that it will have any significant influence on price level. The practice showed, that for most of the European citizens who were involved in the creation of the eurozone, had perceived the reality in a different way. (Giovanni Mastrobuoni, 2004). At this time, it seemed very simple. The national currencies were fixed against the EMU since 1999. Economists expected a simple numerical change of prices on the predefined exchange rate with some moderately significant impact, such as the negative effect of diminishing commission fees, or positive effect of menu cost. Based on data from Eurostat, during the first 6 months of 2002, HICP declined from 2,7% to 1,7%. As it was mentioned by the ECB, "Petrol, meat, vegetables and restaurant services are all good examples of items that are purchased more frequently".

The difficulties related with the inflation theory at the euro introduction are originated from the problem, that the time pattern of the euro's effect on inflation is still not clear. The shift from old currency to the new one mentally and in practice is a twofold, complex process. On the one hand, firms need time to acknowledge, how consumers are processing new prices. On the other hand, consumers are switching step by step from the national currency to the Euro. In the first part of the process they are converting the prices more and more precisely. When they proficiency is stable enough, and when they have already memorized some prices in euro, they will be able to compare prices in it. Döhring & Mordonu (2007).

Here we can find a significant difference between the euro introduction at the initial round and between the countries introducing the euro after 2007. At the initial round, regulations about dual pricing were not that well developed, therefore in some market segments it almost does not appeared. Moreover, the duration of the the transition period, when the using of dual pricing was obligated, almost does not existed, and even in a more favorable cases it was used just few months. In comparison, e.g. in Slovakia, dual pricing was obligated to every market actor for three years, and even 8 years after the currency changeover, it is possible to find prices on former Slovak crown.

Similarly, as with the dual pricing, we could find a huge difference between

the euro introduction at the initial members of the eurozone and at the countries, where euro was introduced later on.

While at the initial members, the inflation gap between measured and perceived inflation was an unexpected phenomenon, the countries introducing the euro later, had an opportunity to prepare for it based on the previous experiences of the founders and take measurements to protect the success of the euro introduction. These measurements were realized in two different levels. First of all, it was necessary to reduce as much of the direct price increase at the conversion. At the same time, it is important to prepare the general public to the phenomenon of the perceived inflation and about its possible negative effects by providing practical information. The concreate measurements realized at the Baltic countries will be discussed below.

Chapter 5

Empirical Part

5.1 Description of the Data

Our basic data set contains quarterly data of the 28 EU member countries since the first quarter of 1996 till the third quarter of 2015. 19 member states are currently (2016) in the eurozone, which came into existence on 1 January 1999 with the official launch of the euro, resp. on 1st January 2002 by the launch of physical coins and banknotes. Originally the eurozone had 11 members, but before coins and notes were introduced in 2002, Greece had joined the group additionally. In the last 14 years 7 additional countries started to use the euro as an official currency, including all the three Baltic countries. Since we are focusing on Baltic countries, the data from the rest of the EU countries are used only as a control group at the hypothesis #2. Our data set contains quarterly data due to the GDP growth. The rest of the included variables are on monthly basis.

The first part of our analysis is based on a research conducted data set collected by the European Commission about the inflation perception within the framework of the Joint Harmonized EU Programme of Business and Consumer Survey. The data are collected on monthly basis in all EU member countries in the same way by a telephone questionnaire on a representative sample. As it was mentioned above, the data are converted to quarterly. Two questions are asked about the past and the future inflation in every country. The first question is "How do you think that consumer prices developed over the last 12 months?" and the second question is "By comparison with the past 12 months, how do you expect that consumer prices will develop in the next 12 months?". Respondents may choose one of the following answers for both questions: risen

a lot (PP), risen moderately(P), risen slightly, stayed about the same (M), fallen (MM), don't know (N).

To receive expected inflation rate series, we need to make some assumptions. Our first assumption is that some fraction of the respondents - denoted by α_t - asked on the survey, are incapable to construct any opinion about future prices' while $1 - \alpha_t$ are able to construct and do so. Those, who are not able to form an opinion, are supposed to be ranked as "do not know", but they do not have to deplete this category in every case, therefore $0 < -\alpha_t, -N$.

The group of respondents, who are able to answer the question about future prices, are using a method containing two steps to answer it. First of all, one has to define its own consumer basket and after that has to find its own probability distribution of the percentage change of prices within this basket. Denote the percentage change in own price index by x and the subjective probability density function of x by $f_t(x)$, where t is the month during which the person was examined. Last but not least, we have to take into account, that there is an interval, where the respondent is not able to distinguish the price changes from zero. While at the answering of the given question we have to deal with prices and everybody is able to differentiate different prices and identify whether it is higher or lower, in case of price indices where respondents have to follow a bunch of prices, this threshold plays a significant role. Let's denote this threshold by δ which is equal to the just perceptible price change. For this definition is evident, that the interval of imperceptibility lies between $-\delta$ and $+\delta$.

In our case it is quite complicated to say anything about this threshold. Based on Weber's law, which states that the just noticeable difference between two stimuli depends on the magnitude of the stimuli. Unfortunately, this is one of the insufficiencies of the data set - answers are not differentiated among the consumers based on price sensibility. In practice it means, that some consumers valuate a 1% price increase as "significant", while for others even a 10% price increase is treated as negligible.

For our computation, we are using a balance of the relative frequency of the above mentioned answers by weighing them in the following way:

$$\boldsymbol{B = PP + 0,5P - 0,5M - MM} \tag{5.1}$$

From this equitation we can see, that the balance always has to be between -100 and +100. The first extreme means that all respondents answered that

the prices "fallen" over the last/next 12 months, while the other extreme says that everybody answered that the prices "risen" over the last/next 12 months. The indisputable plus of the survey is, that answers are divided into several subgroups based on different socio-economical features like the respondent's household income, occupation, education, age and sex. These subcategories allowed us to make our empirical research more detailed and compare evidences between subcategories in different countries. These subcategories could be helpful at the treatment of different price sensibilities of the consumers. Brachinger (2008).

To explain the changes in the perceived inflation, we used a wide range of explanatory variables. Our first variable is the HICP containing all items. It is designed for an international comparison of inflation. We expected that HICP would reflect the price changes most accurately for our purposes. Since inflation is in a close relationship with the GDP growth, we also included the GDP growth rate in our model. In our data set both the unadjusted and the adjusted GDP growth are included. The unadjusted data are based on market prices and are unadjusted neither seasonally nor based on calendar, while adjusted data are seasonally and calendar adjusted. We know that unemployment rate has an important effect on inflation, therefore we expected that data about unemployment rate could contain ineligible information to our model. As in the case of GDP growth, we have adjusted and unadjusted unemployment rate. Unadjusted unemployment rate is neither seasonally nor calendar adjusted, while adjusted unemployment rate is seasonally adjusted, however not calendar adjusted.

5.2   The Hypothesis

When we started to examine the perceived inflation in relation with the Euro cash changeover, our basic hypothesis was that during the introduction of the new currency, prices are increased inadequately, resp. in a hidden way by market players in order to achieve higher profit. Since we investigate the impact of Euro adoption on perceived inflation, our three basic hypotheses are the following.

- Hypothesis #1: In the case of Baltic countries we can observe a jump in perceived inflation around the Euro cash changeover as it was observable at the initial Euro area members at the introduction of the new currency.

- Hypothesis #2: Thanks to the more sophisticated legislation before the introduction of the new currency, we expect that the jump in the gap between perceived and factual inflation was smaller, than it was at the initial euro area members in 2002.

- Hypothesis #3: We expect, that the gap between the factual and the perceived inflation has an inverse relationship with the education and with the available income of the respondents.

5.2.1   Treatment Period

To measure the influence of the euro introduction in the Baltic countries, we are using a dummy variable called "euro dummy" to mark the treatment period when the new currency may have had an inflationary impact on prices. Since we can just guess, how long the euro introduction as a phenomenon influenced the consumers' perception before and after the factual date of the introduction, i.e. 1st of January of the given year, we used 5 different dummies to receive the most precise result. Of course we have to mention, that these dummies are not just about the consumer's perception, but also about the market player's reaction to the Euro. It is reasonable to assume, that some impacts of the euro are included in the prices long before the factual introduction of the euro and also the length of the treatment period could differ in different countries. Del Giovane & Sabbatini (2005).

To find the most appropriate treatment period, we use 5 different combinations. The first one contains 3 quarters before the date of introduction, and 3 quarters after the introduction. The second one contains 2 quarters before and 2 quarters after, while the third one contains just 1 before and 1 after the euro introduction. The fourth treatment period focuses on the inflation before the introduction, therefore it contains the last two quarters before the introduction, while the fifth treatment period focuses on the effects after the introduction, i.e. during the first and second quarters after the introduction.

5.3   Relation Between Measured and Perceived Inflation in the Baltic Countries

If we compare the time series of measured and perceived past inflation, the first prominent difference we can recognize, is that the perceived past inflation is

noisier than the measured one. It corresponds with the result found in other papers examining the inflation perception. The most probable reason is the fluctuation of respondents in the survey. (Carlson, Parkin 1975) We should expect that if we could ask the same group of people every month, the noise in the data should be limited, since the changes in the market basket of a given respondent from month to month have a continuous character. During the data analysis we also have to take into account the subjective evaluation mechanism of every single respondent. Due to the subjectivity of this mechanism, our data set also contains the differences between the respondents' valuation function. If we could collect data from the same respondents in every month, the results could be influenced only by the natural changes in the valuation function.

First of all, we want to see the level of perceived inflation in all three countries for the total population, based on the first question of the questionnaire which focuses for the last 12 month's inflation. Since the euro was introduced in a different year in all of these countries, we look at data from January 2009 in case of every country.

Figure 5.1: Inflation perception in Estonia

Source: Source: Author's collection based on European Council

In case of Estonia perceived inflation has a growing trend, however around the introduction of the euro we can see a brake. We checked the correlation between inflation perception and HICP, which was 0,96. It is the highest among the Baltic countries during the examined period. We also wanted to know, how well the HICP is able to explain the perceived inflation. In case of Estonia it was also very attractive. Using linear regression, we realized that $R^2 = 0,92$ and that HICP was strongly significant, which support our presumption based on the similarities of the shapes of the two graphs.

Figure 5.2: Inflation perception in Latvia
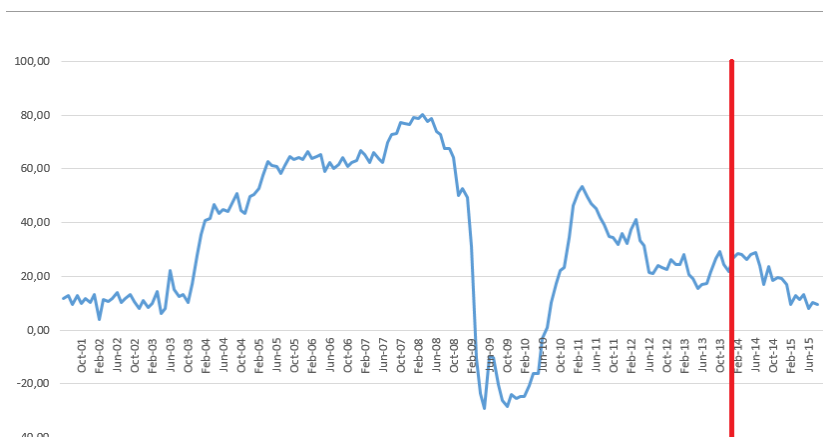
Source: Source: Author's collection based on European Council

We proceed similarly in case of Latvia and Lithuania. The correlation was the lowest in the case of Latvia, only 0,46 between HICP and perceived inflation. However, the HICP is still significant using linear regression, the R^2 is smaller, equals only 0,21. In Lithuania we also find a quite strong correlation, which was equal to 0,68 between HICP and perceived inflation. Accordingly, the R^2 was equal to 0,46. The significant difference in the level of correlation among HICP and perceived inflation is fascinating, since we know that the survey was made in the same manner in every country, and especially interesting, if we take into account that the Baltic countries are very similar from an economic and historic point of view.

Figure 5.3: Inflation perception in Lithuania
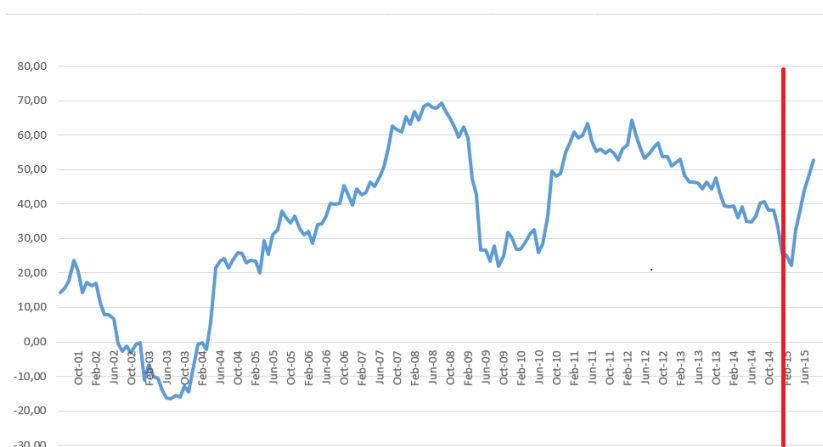
Source: Source: Author's collection based on European Council

5.4   Lenght of the Effect of Euro Introduction on Inflation Perception

Our first hypothesis focuses on jump in perceived inflation at the Baltic countries during the period of the currency changeover. We expect that it is detectable during the treatment period. First we threat the Baltic countries together as an unbalanced panel data, using OLS regression. Our explained variable was the index of perceived inflation described on the previous chapter, computed on the total population, while explanatory variables were adjusted unemployment and a dummy variable indicating the treatment period related to the Euro introduction.

OLS is the most straightforward method for estimating the parameters of a multiple linear regression. The parameters are computed by minimizing the sum of squared residual.

Unfortunately, the results what we received were quite disappointing, since none of the variables was significant even if we tried to include other available, potential explanatory variables in the model. Also R^2 was on a very low level.

5.4.1   Alternative Estimators

We looked for alternative estimation methods to be able to find empirical evidence related to the euro changeover. We tried using RE and FE estimator, however the results were similar to the above mentioned one, i.e. none of the variables were significant, therefore we decided to change the way how we looked for reasonable results.

Table 5.1: Inflation perception: Regression Results

	OLS	FE	RE
Adjusted Unemployment	-1.896	-2.37	-1.89
Eurodummy Q234123	-3.358	-1.68	-3.35
N	49	49	49
R^2	0.035	0.0621	0.0593
AIC	456.059	444.88	
BIC	461.73	450.559	

Note: *Statistically significant at the 10% level; **Statistically significant at the 5% level; ***Statistically significant at the 1% level; t-statistics are in parentheses.

We decided to examine the Baltic countries separately, in order to leave

more space to find some country specific effects. We had to realize, that the length of the significant treatment period differs among countries.

Our best model is presented in the first row, while a significance test for other variables are in the 2nd table. As we mentioned earlier, we chose 5 different treatment periods based on earlier academic papers written about perceived inflation (The euro changeover in Estonia: Tairi Room, Katri Urke), however our computations showed, that not all of them are suitable for our current purposes. Based on the results we received, we should assume, that related to our problematics there is no golden rule about the beginning and the end of the treatment period. In case of Estonia and Lithuania, the only significant treatment period was the one starting 3 quarters before the euro introduction and ending 3 quarters after it. None of the other treatment periods were significant in these 2 countries. In case of Latvia the results are a bit different, because the only significant treatment period dummy is the dummy denoting the 1st and the 2nd quarter after the Euro introduction.

Table 5.2: Inflation perception: OLS by country

	Estonia	Latvia	Lithuania
Adjusted Unemployment	-10.924^{***}	2.936^{***}	2.596^{**}
	(2.067)	(0.555)	(0.689)
Eurodummy Q234123	38.52^{**}		-8.332^{**}
	(12.1)		(3.228)
Eurodummy Q12		7.72^{**}	
		(3.276)	
N	16	15	18
R^2	0.700	0.7136	0.829
AIC	147.19	88.52	105.88
BIC	149.51	90.65	108.55
	09Q1-12Q4	12Q1-15Q3	11Q1-15Q2

Note: *Statistically significant at the 10% level; **Statistically significant at the 5% level; ***Statistically significant at the 1% level; t-statistics are in parentheses.

Treatment period dummy gave us a twofold result. In case of Estonia, where Euro was introduced in 2011, the treatment period dummy has a significant positive effect on perceived inflation. In case of Latvia, the effect is also positive, however its impact is moderated compared to Estonia. In Lithuania, which was the last country in the brunch where Euro was introduced, the effect of the introduction is against our expectations. The Euro dummy in this case has a significant negative effect on perceived inflation.

To be able to explain the different effects of the euro introduction in the Baltic countries, we have to examine the economic climate in these countries. As we know, the European debt crisis has been taking place in the EU since the end of 2009. The Baltic countries in relation with the rapid, but at this time unsustainable growth before the crisis, were even more affected, than the rest of the CEE countries. Furthermore, since there is a 4 year long time gap between Estonian and Lithuanian currency changeover, the intensity of the crisis was different in the Baltic countries during the euro introduction. In 2011, when Estonia introduced the common currency, the country's economy was close to the deepest point of the economic crisis. Later on, when Latvia and Lithuania were allowed to join the eurozone, the conjuncture was stronger and stronger. We expect that during the worst moments of the crisis, when the level of inflation was low or even deflationary power encouraged to hold cash and decrease purchases, the appearance of the euro increased the perceptions in such great heights. The deeper probable explanation behind this phenomenon could be, that as it was mentioned, before the introduction of the euro the inflation in Estonia was close to or even below zero, while consumers could have expected that if they had started to use the euro, it would have brought the inflation of the eurozone, i.e. import the inflation. When Latvia introduced the euro two years later, the difference between the inflation in Latvia and the inflation of the eurozone had a diminishing tendency, for which reason consumers did not fear the import of the eurozone inflation that much. The proceeding of this tendency caused, that when the time of the Euro introduction got closer, consumers perceived that it had a negative effect on inflation.

In general, we take that the economies of the Baltic countries are almost similar, and all economic interrelations have to work in a same manner in all of these countries. In contrary, as well at the adjusted unemployment, we can see that it has a quite similar influence on inflation perception in Latvia and Lithuania, while in Estonia even the sign of the coefficient is the opposite. It could be explained by the fact, that in the case of Estonia, the worst period of the crisis is included in the data set, while for the other two countries the data start after the culmination of the crisis.

When we started to work on the theoretical background of the model, we tried to find more explanatory variables related to perceived inflation, such as political part in power, wage-price controls, highly publicized wage settlements, and changes in indirect taxes. As it was observed few decades earlier by Carlos and Parkin, its effect was "trivial and insignificant".

5.5   How the Lagged Inflation Affects the Inflation Perception

We could expect, that lagged inflation would strongly affect the inflation perceptions, since consumer's information about current prices can never be completely up to date. The reason is, that nobody buys every single good on a daily basis. Literally spoken, every single good's effect on the level of perceived inflation is correlated with the frequency, by which consumers are buying it. The explanation is, that the consumer realizes the price of a given good most probably at the time when he buys it. From the academic works explaining perceived inflation, we know that for these reasons e.g. the price of newspapers, tobacco has a much stronger effect on perceived inflation, than e.g. the price change of real estates or any good what one purchases just few times during one's life. Brachinger (2008). In our data set inflation is lagged by 1 quarter.

Table 5.3: The effect of lagged inflation

	Estonia	Latvia	Lithuania
Adjusted Unemployment	−9.942***	2.965***	2.613**
	(1.469)	(0.604)	(0.682)
Lagged inflation	5466.784**	-85.912	514.91
	(1432.78)	(482.13)	(333.45)
Eurodummy Q234123	17.469		−8.502*
	(1.110)		(2.846)
Eurodummy Q12		7.864*	
		(3.510)	
N	16	15	18
R^2	0.864	0.715	0.894
AIC	136.480	90.481	101.612
BIC	139.570	93.314	105.173
	09Q1-12Q4	12Q1-15Q3	11Q1-15Q2

Note: *Statistically significant at the 10% level; **Statistically significant at the 5% level; ***Statistically significant at the 1% level; t-statistics are in parentheses.

We are unable to derive a general conclusion about the relation between the lagged inflation and the inflation perception. While the theory, that consumers are using information from the past sounds reasonable, the consumer's subjective evaluation function probably doesn't work in such a straightforward way. Estonia is the only Baltic country, where the impact of the lagged inflation is significant under the period we examined above. On the other hand, we can

see that in our extended model, the Eurodummy lost its significance. In case of Latvia, the lagged inflation was totally insignificant. Even the simple correlation between inflation perception and lagged inflation was too low, to be able to find any result which could be evaluable in the context. In Lithuania the effect of lagged inflation is not that clear. However, it does not have a significant effect on perceived inflation, the p-value is not that far from significance and the inclusion of lagged inflation in the regression makes the model more precise.

5.6   Effect of the Euro Introduction on Inflation Perception in Other Eurozone Countries

Now let's see the jump in perceived inflation in the countries, where Euro was introduced before the Baltic countries. We should divide these countries into two subcategories. First category contains countries introducing Euro in 1999, resp. physical coins and notes were introduced in these countries on 1 January 2002. Greece is included in this category, despite the fact that it introduced the currency 2 years later in 2001, but the national currency was replaced at the same time like in the rest of the initial Eurozone member countries.

The second group consists of Slovenia (2007), Cyprus and Malta (2008) and Slovakia (2009). In this group we should highlight the result from Slovenia and Slovakia due to the historical, economical and dimensional similarities. Our assumptions about these groups were the following. First of all, at the first group of countries we expected that the jump in perceived inflation would be higher, due to the lack of measures which tend to avoid the abuse of consumer prices. To explain the situation at the definitive launching of the Euro, we have to mention that perceived inflation as a phenomenon was known before the Euro changeover, nevertheless never before had such an extensive planned cash changeover happened in the history. Most of the problems discussed in this thesis, came into focus during or after this period.

As it is mentioned in the 2nd hypothesis, we expected that after the economists had started to focus on this problem, we expect that the "jump" in perceived inflation during the euro introduction ceteris paribus would have to be smaller, as a result of a more extensive, and in ideal case more effective preventive measures. For example the nowadays usual information campaign, the obligatory dual pricing, the transmission period, when both currencies are in circulation

or e.g. the voluntary declaration of market players about not to be abuse prices in relation with the currency changeover.

Table 5.4: Control group

	Slovenia	Cyprus	Malta	Slovakia	Slovakia (incl. time)
Adj. Un.	−21.830***	−5.790	−5.024	−5.199*	−11.534***
	(2.87)	(4.22)	(5.08)	(2.06)	(2.45)
Lagged inf.	1653.572*	124.463	213.19	2753.25	2255.796
	(795.68)	(418.08)	(166.86)	(1808.75)	(1345.99)
Eurodummy	−23.207***	3.891	−11.504*	-101.63	−16.069*
	(5.13)	(7.42)	(5.15)	(7.32)	(7.74)
Time					$2.411^{0.73}$
					0.73
N	16	16	16	16	16
R^2	0.887	0.298	0.339	0.708	0.854
AIC	122.03	125.88	113.239	124.361	112.220
BIC	125.12	128.98	113.239	124.361	116.084
	05Q1-08Q4	06Q1-09Q3	06Q1-09Q4	07Q1-10Q4	07Q1-10Q4

Note: *Statistically significant at the 10% level; **Statistically significant at the 5% level; ***Statistically significant at the 1% level; t-statistics are in parentheses.

We started with the second part of the control group, i.e. with countries which joined the eurozone after 2002, except the Baltic countries. The results are surprising, however not inexplicable. In case of Slovenia, we could say that our previous presumptions are fulfilled, at least on the level of explanatory variables. All of the these variables we used are significant, moreover the most important thing is that the Eurodummy is strongly significant. In the case of adjusted unemployment and lagged inflation, the sign of the coefficients coincides with our assumptions, however in the case of Eurodummy, which is strongly significant, the sign of the coefficient is exactly the opposite of what we excepted, i.e. the period around the introduction of the Euro had a significant negative effect on perceived inflation. If we examine the value of perceived inflation over the examined time period, we should say that in reality it was not the negative effect of the Euro introduction. Moreover we can see a huge jump in inflation perception during the last 6 quarters in the examined period. If we put this jump in context, we will see that it was probably the result of the culmination of the pre-crisis conjuncture.

Cyprus and Malta are a quite different story, than the rest of the eurozone.

In Cyprus none of the explanatory variables were significant. When we looked into the data, we realized that the only explanatory variable which had considerable impact on inflation perception is the adjusted unemployment rate. Its sign and coefficient is adequate. In our regression, which focuses only for the period around the euro introduction, it is insignificant, however if we use all available data from the Q3 of 2001 to the Q2 of 2015, the adjusted unemployment rate is strongly significant, and even if we do not use other explanatory variables, the $R^2=0.773$. One of the reasons behind the results could be that Cyprus is an island, the 2nd smallest country of the eurozone and after Malta. Due to the intensive tourism, euro was widely used in the country even before it became a legal tender in 2008, therefore for the local citizens it was familiar enough at the time of introduction and the official introduction of the euro did not infer such a spectacular change in the citizens' everyday life.

Slovakia shows more common attributes with Slovenia rather than with the above mentioned two island states. In our first regression, the R^2 was high enough in comparison with the results from earlier regressions, however none of the explanatory variables were significant, except the adjusted unemployment and even its significance was weak enough to be neglected. After we checked the possibilities, we decided to include a time variable in the model. By including the time variable, R^2 increased significantly, while at the same time Adjusted Unemployment and the Eurodummy indicating three quantiles before and three quantiles after the introduction of the euro, started to be significant.

In the first part of the control group are included all the countries, where euro coins and notes were introduced on 1st January 2002. The effect of the euro introduction on measured inflation was small enough in the countries, which started to use euro first in 2002. Based on the estimation of the Eurostat, the HICP inflation in the first month of the euro was 2.3%. The impact of the currency changeover is estimated between 0.12 and 0.29 percent points. The rest of the inflation was the reason of normal market processes. On the other hand, to calculate the exact impact of the new currency is impossible, since nobody was able to examine the related countries at the same period without the currency changeover. Therefore, we have to rely on estimations, which in every case includes some uncertainty (Eife, Coombs 2007). It is possible, that in overall level the measured inflation stayed on a "normal" level. However, in certain sectors, such as restauration, we could find a significant price increase. In the intensity of the price increases were differences among the countries, however it was observable in every country introducing the euro.

5.7 Comparison of Perceived Inflation by Measured One

The problems at the comparison of the perceived inflation with the one measured by CBs is not that straightforward as it seems at first sight. During the time we examined the literature about the topic, we had to realize that to find the right methodology would be crucial for the success of our study. As we know, the Balanced Perceived Inflation (BPI) calculated from the European Commission's Joint Harmonized Consumer Survey moves between - 100 and +100. On the contrary, in our target countries the inflation never left the interval between -5% and +10% during the period of our interest. Also there is significant difference between the variance of the two variables, therefore instead of a simple numerical comparison of the difference between the two variables, we need a more sophisticated tool. For our purposes difference-in-differences model seemed to be the most proper solution. It is a statistical and econometric technique used to mimic experimental research data using observation based ones. To draw up the basic theory behind the difference-in-differences method, we need two groups which we want to examine in two different time periods. The first group is manipulated by an impact in the second time period, while the second or so called control group is not influenced by such an impact neither in the first nor in the second period. If we control the same variables during the different time periods in both groups, the average gain from the control group is subtracted from the average gain of the treatment group, which enables us to eliminate biases caused by trends or by fundamental differences between the two groups. Imbens & Wooldridge (2007)

Here we have to mention, that difference-in-differences model is a suitable tool because of the characteristics of our basic data set. The IPI could be another proper way to examine the question, since it is an indicator of the inflation which "looks the inflation from the purchaser's perspective" (Brachinger 2008). Unfortunately, our current possibilities do not allow us to compute a proper IPI, therefore we have to be satisfied by the results received from BPI.

5.8 Influence of the Rounding Error on Inflation Perception

When we observe the effect of euro changeover on inflation perception, we have to examine the exchange rate used to convert national currency to euro, from the side of algebra. So called rounding error arises from the people's imperfect ability to convert prices from one currency to another without help or assistance because of its mathematical complexity. As it is usual, after the currency changeover people used to convert back prices defined in euro to the former currency unit. For these purposes dual pricing is a really thankful tool. First because people have time to get familiar with the new prices, since dual pricing is usually introduced few months before the changeover. Later, it is helpful when customers want to convert prices back to the former currency unit. The interesting question is that how often does a consumer face a situation when dual pricing is not available and have to convert prices from one currency to another. Ehrmann (2006) examined the growth of inflation during the euro changeover. He found that the jump in inflation is smaller in those countries, where the prices in euro were easily convertible to the former currency and was higher in those where the conversion rate was more complex.

Another interesting question is, that how much time does a consumer need for a 100% mental shift from one currency to another. Based on an empirical evidence, menthal shift could take even years Lunn & Duffy (2015). It is difficult to find exact data, however based on the present writer's own experience from Slovakia, in some extreme cases even seven years after the euro changeover, some people are converting the price denominated in euro to Slovak koruna to be able to make a more precise comparison or just emphasize the value. On the other side, we can declare with a high probability without any representative research, that the length of time needed to switch mentally from using one currency to another is in a direct relationship with the examined person's age and in an inverse relationship with its education.

5.9 How the Gap Between Measured and Perceived Inflation Differs Across Countries During the Euro Changeover

In our second hypothesis we expect, that the extent of the gap between measured and perceived inflation has an inverse relationship with the since the euro changeover, i.e. from 2002, when the first 12 members of the Eurozone started to use the euro. Our hypothesis was backed up by information about the effort of the ECB to decrease this gap by a various range of more and more sophisticated tools, from the extensive media campaign, through control during the introduction until the dual pricing and so on.

If we focus on the increased difference between measured and perceived inflation, i.e. the inflation misperception observed at the initial euro changeover in 2002, we should say that it was the result of an unsatisfactory regulation. We could think, that the ECB was unprepared for the euro introduction, although on the other hand we have to mention, that never before had such an extensive currency changeover happened in the history, especially not within such a short time.

The development in regulation of the euro introduction is easily observable in the countries, where euro was introduced later on. The Baltic countries are the right example, that inflation misperception is not a necessary side result of the euro introduction. To its appearance a complex conjunction of several external and internal factors is necessary. By eliminating the internal factors, the probability and the intensity of inflation misperception could be reduced significantly. Eife & Maier (2007).

5.10 Quantified Impact of Euro Introduction on Perceived Inflation

Since we started to work on the problem of euro induced perceived inflation, our aim was to quantify the change of perceived inflation caused by the introduction of the euro. It was a bit challenging, since we only had the type of data from Baltic countries where the impact of euro introduction was included, therefore we had to find the appropriate method to separate the external effects on consumers' inflation perception from the impact of euro. For this purpose

we decided to create an auxiliary data set, where we modelled the perceived inflation in the three Baltic countries without the introduction of the euro.

Our basic expectation was, that the perceived inflation in the examined country is correlated with the perceived inflation in neighboring countries. We choose the main business partners of the Baltic countries, which are Finland, Germany, Poland and Sweden. Of course, the Baltic countries are each other's main business partners, however we do not want to use data from one Baltic country to explain data from another, and vice versa. Based on the academic literature and on our previous experiences, we want to include other explanatory variables. We choose GDP growth of the examined country and changes in unemployment. Unfortunately, both of the variables had such a minor and insignificant effect on perceived inflation, that we decided to exclude them from our model. We used monthly data about inflation perception from Finland, Germany, Poland and Sweden. Two of them, Germany and Finland are a founding member of the Eurozone. Poland and Sweden are using its national currency till nowadays. All of the three Baltic countries realize a significant part of its international trade with the above mentioned four countries. Here we have to mention, that the Baltic countries are also in a close business relation with Russia, nevertheless we had no reliable data about inflation perception from Russia. Saboniene (2015)

We used an OLS method in all the three cases. For that reason, first we had to test, if the assumptions of OLS are fulfilled. To test homoscedasticity we used White-test, which revealed that we have to reject the null hypothesis about homoscedasticity. Based on OV-test, we should reject the null hypothesis about omitted variables in all the three cases as well. Since White-test is quite sensitive to normality, we used Shapiro-Wilk test for normality. We should reject the null hypothesis at all the three countries for every variable, i.e. reject the null hypothesis about the normal distribution of residual. For that reason, we tried to verify homoscedasticity by Breusch-Pagan-test. The advantage of Breusch-Pagan test is, that it is not that sensitive for the normality of the residuals. Based on Breusch-Pagan test, we do not have to reject the null hypothesis in case of Estonia, even if the result is not too convincing. In case of Latvia and Lithuania we had to reject homoscedasticity. Wooldridge (2015). In the light of the above presented test results, we have to handle the below presented results with a certain distance. The detailed results of the test are presented in Appendix A.

In case of Estonia, we used data from July 2001 to March 2010. It is true,

that Estonia introduced the euro just in January 2011, however we detected in the previous chapters, that euro introduction had a significant effect on perceived inflation during the period between April 2010 to September 2011, i.e. it started three quarters before the introduction of the euro, and lasted three quarters after the euro introduction. Here we have to mention, that at the previous chapters we used quarterly data, while now we are using monthly ones. We chose data for the initial regression in case of Latvia and Lithuania in the same way, i.e. till the beginning of the treatment period. The length of the treatment period is presented in the first part of this chapter. The results are presented below.

Table 5.5: Perceived inflation without the impact of the euro introduction

	Estonia	Latvia	Lithuania
Infl. Perc. Poland	0.853***	0.502***	0.966***
	(5.81)	(4.06)	9.97)
Infl. Perc. Finland.	1.738***	1.088***	0.975***
	(7.59)	(4.06)	(7.08)
Infl. Perc. Germany	0.328***	0.494***	−0.160***
	(2.72)	(3.32)	(-2.07)
Infl. Perc. Sweden	−1.427***	−1.097***	−0.170***
	(-8.72)	(-5.66)	(-1.69)
Intercept	−21.496***	−18.165***	10.041***
	(-2.27)	(-1.54)	(1.64)
N	105	150	153
R^2	0.697	0.426	0.7582
AIC	878.05	1356.83	1185.99
BIC	891.32	1371.89	1201.14
	Jul01-March10	Jul01-Dec13	Jul01-March14

Note: *Statistically significant at the 10% level; **Statistically significant at the 5% level; ***Statistically significant at the 1% level; t-statistics are in parentheses.

The perceived inflation in the above presented four countries are explaining the inflation perceptions in the Baltic countries quite well. R^2 are between 0.424 and 0.75, which is good enough. Moreover, all of the explanatory variables are strongly significant. Based on the results presented in the table above, we were able to model the value of inflation perception during the treatment period in the affected three countries. The calculated hypothetical values of perceived inflation without the impact of the euro changeover are presented

in the Appendix A. The results partially support our findings based on the dummy variable at the first part of the chapter.

In case of Estonia, the average difference between the survey based perceived inflation, and the values generated by our model, which was based on the perceived inflation in the above mention four countries, is 14.42 point during the treatment period. It means, that in average, during these 18 months the value of perceived inflation was 14.42 point higher. Based on our expectations, it was the result of the euro introduction.

In case of Latvia, the result is not that straightforward. Based on our model, the difference is negative. It means, that during the treatment period the perceived inflation was lower by 15.72 point. At the evaluation of the results from Latvia, we have to take into account, that in this country the treatment period is just 6 months, based on our previous regression results, while in the another two countries it is 18 months. Additionally, at the creation of the model, we had the lowest R^2 in case of Latvia, only 42% . In the other two countries it was significantly higher, around 70%, which may negatively influence the reliability of data about hypothetical inflation perception.

We can find the most significant positive difference in case of Lithuania, which is 38.30 points. Based on this model, during the treatment period the inflation perception was 38.30 points higher on average due to the euro introduction. Since at the creation of the variables for the hypothetical inflation perception the R^2 was 75%, and the observed difference is huge. To summarize the results of this method, we could say that there is a soft evidence that euro introduction had a positive impact on inflation perception at least in Estonia and Lithuania.

5.11 Shortcomings of Perceived Inflation Measurement

Since all the hypotheses are revolved around perceived inflation, we have to mention the possible shortcomings of the measurement used at the creation of the European Commission's data set. As it is written at the data description, a representative group of respondents are contacted every month in all EU member countries. Since the group of respondents is changing every month, the result is strongly influenced by the respondent's market basket. It is a subjective function by which one evaluates and react to price changes. Due

this subjectivity, the feasibility of the data set and the theory of perceived inflation in the current form both have limits. We should take these limits into account, if we want to create extensive conclusions.

5.12 Effect of Available Income and Education on Inflation Perception

Our third hypothesis is based on the suspicion, that education and available income has an effect on inflation perception. We expect, that available income has a significant effect on inflation perception, because we expect that people from a lower quartile of population based on available income are more sensible for price changes. Therefore the just perceptible expected price rise δ_t for these respondents has to be lower, which means that based on our assumptions, people with lower available income will react even for such a price increase positively, which will be imperceptible for people from higher income category. Another finding supporting our expectation was realized by Rõõm *et al.* (2014). They examined the relative price of goods and the impact of the euro changeover in Estonia and found, that the price increase of the relatively cheaper goods were more significant during the euro changeover. In case of education the explanation of our expectations is constructed in a similar manner. We expect that the lower level of education is correlated with lower income, therefore the citizen with lower education will be more sensitive for price changes and its just perceptible price change will be lower.

Chapter 6

Conclusion

Since the establishment of the eurozone, within the field of monetary policy the focus moved from measured inflation to the inflation perceived by the individuals. At the creation of the monetary policy in general, it is essential to know, how it will materialize after the implementation. To be able to evaluate the effect of a given policy, it is necessary to understand the underlying driving forces of perceptions and expectations on the level of the individuals. In case of inflation perception, we should divide the factors influencing inflation perception into two independent groups. First group contains the variables which are available on aggregate level, while the second group contains all variables which affect everybody on its individual level.

We have devoted a significant part of this thesis to the appearance of increased perceived inflation at the euro introduction in the Baltic countries. We used different methods to verify or hypotheses. At the first model we used a dummy variable to quantify the effect of euro changeover on the inflation perception. For that model, we hat to estimate the suitable treatment period. During the treatment period euro introduction had a significant value on perceived inflation. At our second model we used data about inflation perception from the main partners of Baltic countries. Based on these data, we were able to generate a hypothetical values of inflation perception in the Baltic countries, without the impact of euro introduction. We find out, that the introduction of the euro had a positive effect on inflation perception in Estonia and Lithuania.

At the last part, we also examined the effect of education and available income on inflation perception in the Baltic countries. Our expectation about the inverse relationship of the available income and education with inflation perception were fulfilled. Although the difference was modest.

Our suggestion for further extension of the work is to use other econometrical methods. The combinations of more sophisticated econometrical model with other significant explanatory variables could enhance the quality of the results significantly. For countries, where euro introduction is not realized yet, to find another explanatory variables of inflation perception should be an asset.

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Appendix A

Modelled values of perceived inflation

Table A.1: Exchange Rate Between the Euro and National Currencies

Currency	1 EUR =
Belgian franc	40.3399
Estonian kroon	15.6466
Finnish markka	5.94573
Irish pound	0.78756
Italian lira	1936.27
Cypriot pund	0.585274
Latvian lat	0.702804
Lithuanian litas	3.45280
Luxembourgish franc	40.3399
Maltese lira	0.429300
German mark	1.95583
Dutch guilder	2.20371
Portugal escudo	200.482
Austrian schilling	13.7603
Greek drachma	340.750
Slovak koruna	30.126
Slovenian tollar	239.640
Spanish peseta	166.386

Source:ECB.

Table A.2: Perceived inflation without the impact of the euro intro-
duction

	Estonia	Latvia	Lithuania
Infl. Perc. Poland	0.853***	0.502***	0.966***
	(5.81)	(4.06)	9.97)
Infl. Perc. Finland.	1.738***	1.088***	0.975***
	(7.59)	(4.06)	(7.08)
Infl. Perc. Germany	0.328***	0.494***	−0.160***
	(2.72)	(3.32)	(-2.07)
Infl. Perc. Sweden	−1.427***	−1.097***	−0.170***
	(-8.72)	(-5.66)	(-1.69)
Intercept	−21.496***	−18.165***	10.041***
	(-2.27)	(-1.54)	(1.64)
N	105	150	153
R^2	0.697	0.426	0.7582
AIC	878.05	1356.83	1185.99
BIC	891.32	1371.89	1201.14
	Jul01-March10	Jul01-Dec13	Jul01-March14

Note: *Statistically significant at the 10% level; **Statistically significant at the 5% level;
***Statistically significant at the 1% level; t-statistics are in parentheses.

Figure A.1: Measured and Perceived Inflation Rate in Italy
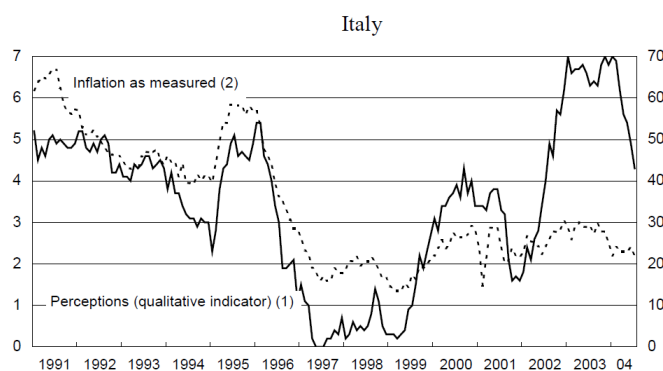
Source: Del Giovane & Sabbatini (2005) on European Commission and Eurostat.
(1) Qualitative indicator obtained as the percentage balance of responses to the monthly
consumer survey (right-hand scale). - (2) Twelwe-month rate of increase in the HICP (left-
hand scale)

Table A.3: Difference between measured and hypothetical perceived inflation in Estonia

	Perc. Infl. in Estonia	Modelled values	Difference
Apr 2010	6.50	-9.34	15.84
May 2010	10.81	-1.27	12.09
Jun 2010	25.37	2.01	23.36
Jul 2010	24.44	12.61	11.83
Aug 2010	30.31	8.44	21.87
Sep 2010	31.82	28.12	3.70
Oct 2010	50.75	31.33	19.42
Nov 2010	58.32	21.06	37.26
Dec 2010	61.12	29.35	31.76
Jan 2011	59.63	42.59	17.04
Feb 2011	54.70	43.93	10.76
Mar 2011	59.57	61.12	-1.55
Apr 2011	68.88	64.06	4.82
May 2011	75.20	59.89	15.31
Jun 2011	74.81	64.15	10.66
Jul 2011	73.63	69.03	4.60
Aug 2011	76.13	69.20	6.93
Sep 2011	75.63	61.85	13.78
Average			14,42

Source: author's own calculation

Table A.4: Difference between measured and hypothetical perceived inflation in Latvia

	Perc. Infl. in Latvia	Modelled values	Difference
Jan 2014	21.91	48.44	-26.53
Feb 2014	26.49	45.26	-18.77
Mar 2014	28.51	43.78	-15.27
Apr 2014	28.05	41.45	-13.40
May 2014	26.23	35.41	-9.18
Jun 2014	27.98	39.13	-11.15
Average			-15.72

Source: author's own calculation

Table A.5: Difference between measured and hypothetical perceived inflation in Lithuania

	Perc. Infl. inLithuania	Modelled values	Difference
Apr 2014	35,98	32,87	3.11
May 2014	39,13	27,12	12.01
Jun 2014	34,97	30,91	4.06
Jul 2014	34,86	33,41	1.45
Aug 2014	36,44	20,76	15.66
Sep 2014	40,21	16,77	23.44
Oct 2014	40,80	6,88	33.92
Nov 2014	38,16	4,52	33.64
Dec 2014	38,25	0,02	38.23
Jan 2015	33,26	0,15	33.11
Feb 2015	25,76	-20.67	46.43
Mar 2015	25,20	-22.47	47.67
Apr 2015	22,19	-24.28	46.47
May 2015	32,47	-25.47	57.94
Jun 2015	37,89	-27.31	65.20
Jul 2015	43,91	-26.83	70.74
Aug 2015	47,75	-25.95	73.70
Sep 2015	52,71	-29.86	82.57
Average			38,30

Source: author's own calculation

Appendix B

Empirical data

Empirical data, stata source codes and alternative specifications available upon request.