University of Economics, Prague

Faculty of economics

Major field of study: Economic policy

DOES THE CONVERSION TO EURO RISES PRICES? AN EXPERIMENTAL STUDY FROM THE CZECH REPUBLIC

Master thesis

Author: Bc. Roman Bohumínský
Thesis supervisor: doc. Mgr. PhDr. Doctorandus
Silvester van Koten, M.A., Ph.D.
Year: 2015

Hereby, I declare that I wrote my graduation thesis by myself and I used the literature and other sources which are properly listed in the enclosed references.

Bc. Roman Bohumínský
In Prague, 15th May 2015

Acknowledgment

Abstract

In the euro area, the changeover to the euro was accompanied by fears of increases in prices by consumers. However, in most countries the changeover had barely any effect on inflation indices, but a significant effect on perceived inflation and even now people still believe that the price increase was more dramatic than it was in reality. This paper examines the situation in the Czech Republic, being one of the last countries in the EU which have not adapted the euro yet. I am especially interested in finding whether a changeover would lead to price increases even though Czech citizens have got plenty of time to indirectly familiarize with the euro currency. The analysis is based on a laboratory experiment. With this method I am studying the effects of transition to euro on consumer behavior. In addition, I compare the results (indirectly) with those of other European countries. Under the framework of posted price experiment, it can be concluded that, in the particular sample, the changeover to euro currency does in fact affect the outcome of trade at least temporarily. In this case, the changeover from CZK to EUR leads to elevation of prices and reduction of the traded quantities, especially right after the changeover. The main reason for this is that the producers (sellers) tried to exploit the changeover situation in order to increase their profits. All the presented results are significant at 5% level.

Abstrakt

Přechod na novou měnu euro byl v rámci celé eurozóny spojen s velkými obavami ohledně zvyšování cen. Nicméně, ve většině zemí přechod na euro neměl téměř žádný efekt na indexy měřící inflaci, měl však významný dopad na vnímanou inflaci a i nyní lidé stále věří, že zvýšení cen bylo dramatičtější než ve skutečnosti. Tato práce zkoumá situaci v rámci České Republiky, která je jednou z posledních zemí EU jež zatím neakceptovala euro jako svou domácí měnu. Zajímá mne zejména, zda ke zdražování dojde i v České republice až (pokud) příjme euro. Čeští občané měli dostatek času se s eurem seznámit alespoň nepřímo, a tedy nelze ex ante předpokládat identický dopad. Analýza je založena na laboratorním experimentu, s jehož pomocí zkoumám dopad reformy měny na chování spotřebitelů. Výsledky porovnávám (nepřímo) s jinými studiemi z EU. Ve zkoumaném vzorku mělo zavedení eura skutečně dopad na výsledky obchodování, alespoň dočasně. V daném případě přechod z českých korun na eura měl za následek nárust cen a propad ve zobchodovaném množství, zejména krátce po změně platidla. Hlavním důvodem byl ten fakt, že prodejci se snažili dané situace využít ve svůj prospěch za účelem zvýšení svých zisků. Všechny výsledky jsou platné na 5 % hladině významnosti.

JEL klasifikace: D43, D80, E31

Klíčová slova: vnímaná inflace, přechod na euro, Eurozóna

Content

Introduction

On the first of January 1999 the euro (€) was officially launched as an electronic currency in eleven states of European Union. Exactly three years after the introduction of electronic euro, the paper bills and coins started to circulate in these eleven states plus Greece, which joined in 2001. The majority of the European citizens believed that the long-term effects of this transition would be positive and would make up for the transition costs (Meier & Kirchler, 1998; Müller-Peters et al., 1998). Since then, the fear of substantial price increases connected with the currency changeover is still present in states which are not yet part of the Eurozone (EC, 2007). Interestingly, even consumers from the Eurozone states perceive that the introduction of euro did elevate prices (Stix, 2009).

However, at the time following the currency changeover, according to the official statistics, the inflation in the eurozone member states did not grow significantly, but in fact, in some states even decreased (Stix, 2009). There are, as will be presented below, some sectors of the economy, where the inflation rise was more dramatic. Nonetheless, the biggest rise was connected with perceived inflation. At the time of the changeover, perceived inflation started to differ significantly from recorded inflation. There are many factors which could be the cause of the hike in prices as well as in the perceived inflation, which was much higher than the officially recorded one and it is quite complicated to identify the main factors behind the increase in perceived inflation.

My main motivation for this thesis is to see, whether the euro changeover would have similar effects in the Czech Republic (most notably rise in perceived inflation) as in other eurozone member states or if the changeover effects would be in line with neoclassical economics theory - meaning that the currency used should not influence the outcome of the trade. The Czech Republic is quite an exception when it comes to euro adoption and hence deserves a closer look. The Czech approach is typical in a way that the introduction was postponed till a not specified date even though the Maastricht Convergence Criteria were almost met and also that Czech consumers are less willing to enter the Eurozone as time goes by (PORC, 2014). Together with the fact that Czech Republic is one of the last European Union countries which is not yet part of the Eurozone, along with the Czech National Banks recent EUR/CZK foreign exchange interventions, it makes it even harder to predict the outcome of the changeover in the Czech Republic.

In order to analyze the hypothetical situation of the adoption of euro in the Czech Republic, I decided to use instruments of the experimental economics. More precisely, I will simulate a computerized posted offer market experiment with currency changeover from Czech crowns to euros, to see, whether the outcome of trade would be different. The experiment is a unique in a way that it would be the first one to analyze currency changeover, with experimental approach, in the Czech Republic.[1]

The thesis is organized as follows: In chapter 1, I summarize the euro changeover effects on the inflation and perceived inflation and try to identify the leading factors behind the increased misperception. In chapter 2, I discuss the political and economic background behind the planned euro introduction in the Czech Republic. In chapter 3 I take a look at pros and cons of double auction and posted offer market experiments in order to select the more fitting one for the experimental design, which is described in the following chapter 4. In chapter 5, the summary statistics of the sample are described. In the next chapter 6, I present the changeover results with respect to the price, quantity and profit. And finally, in the last chapter 7, I summarize and evaluate the main aspects of this work.

---

[1] However, I am not aware of any experiments on similar topic with such aproach even worldwide.

1. Inflation and perceived inflation

1.1 Perceived inflation on the rise

As you can see in the Appendix 1, according to the Harmonised Indices of Consumer Prices (HICP), there is no clear evidence supporting the increase in inflation in Eurozone. However, there is a clear trend showing that perceived inflation did significantly grow. That is true even for Slovenia which has introduced the euro in 2007 and its citizens could have been more familiar with it by the time the conversion took place, but this is not the case. According to these data, the difference between measured inflation and perceived inflation started to be significant approximately at the time of the changeover.

What is more interesting is the fact that people still tend to perceive higher inflation even years after the transition as can be seen from the Appendix 1. Stix (2009) found, using Austrian data, that, even 2 years after the changeover, 50% of the consumers reported using mental legacy currency prices as a mental benchmark when making price comparisons. These results are consistent with those of the European Commission from 2005, reporting that 43% of the euro area citizens are still mentally calculating in legacy currencies when making exceptional purchases, while only 24% counted mainly in euro (EC, 2005). According to the European Commission (2001), before the euro conversion in the former 12 states, almost 70% of the population fears that this process will be connected with abuses and cheating. It seems as if the fears do not go away with time at all or very slightly, because in the same analysis from the year 2007, just three percent less of the new upcoming euro users reported same concerns. Hofmann et al. (2006) found that the consumers who had some kind of preconceptions about price increases before the conversion later experienced (perceived) higher inflation. The estimation error is strongly correlated with the magnitude of the preconceptions.

1.2 Sectorial inflation

There are, however, sectors where the changeover had a much more dramatic effect on price changes. In comparison with the official HICP the differences in prices pre and post euro are even in the units of percent. Hobijn (2006) states that ''Analyses by Eurostat, the European Commission's statistical service, indicate that the euro changeover led to some price increases in specific sectors, such as restaurants, cafes and hairdressers, but that the

overall effect on prices in the euro area was limited. For the all items Harmonized Index of Consumer Prices, the price increase most likely falls within the range 0.12 percent to 0.29 percent." One would think that the sectors, with the highest price increases, would be those with which consumers get in touch on a daily basis and hence consumers would perceive higher inflation, but this is not the case. In reality, according to the studies presented below, you can see that the changes were present also in not so expected and familiar areas.

One of the studies (Kooreman et al, 2004) examining the less frequently used parts of the economy is focusing on the development of the charity donations[2] in The Netherlands. The authors found in this quasi-natural experiment that the donations rose by 11.1% with regards to the year before currency changeover.[3] One year later, the levels were still elevated, but less considerably – by 5.1% relative to those in 2001. Prior to the changeover, the fluctuation of donations did more or less correlate with the inflation. What is also interesting is the fact that there was also change in the donated coins and notes leaning towards donation of money with higher real value.

Another study from that group is examining a very similar topic – church collections. Cannon & Cipriani (2006) analyzed the data from Italy[4] and Republic of Ireland[5]. In Italy the nominal collections rose by 11% while the income growth rate was 3% and in the Republic of Ireland the nominal collections rose by 13% and income by 10%. These results are robust with those of Kooreman et al (2004) as mentioned above.

Perhaps the best known study analyzing more familiar parts of the economy – restaurant sector to be more specific, is by Hobijn et al (2006). Differences in restaurant sector are not as vast as those in the charity. In the month following the euro switchover, the inflation in the whole euro area was 0.16%, but the inflation in the restaurant sector was 1.3%. There were even countries, such as Germany and the Netherlands, where the inflation in restaurant sector was higher than 2 and 3 percent respectively. In sharp contrast to this, EU countries not being a part of the euro area experienced restaurant sector inflation as low as 0.2%. Such discrepancy was without a doubt caused by some of the factors related to the

---

[2] The analyzed donations are those of the house-to-house collection using collecting boxes. Each year the collection takes place at the same period.
[3] The inflation after the changeover was 3.4%
[4] Roman Catholic churches.
[5] Anglican churches in the Republic of Ireland and mainland Europe.

currency changeover. The authors analyzed the situation with Dutch data and came to conclusion that the inflation spike which followed the adoption to euro is possible to interpret in the light of current economic theory. Their explanation is based on a fact that prices in this sector are very sticky and since the changeover date was well known, there was a plenty of restaurants which delayed otherwise usual re-pricing till the date of changeover, but then increased prices in a higher magnitude. This is also connected with higher menu costs than is typical for ordinary re-pricing, but according to Hobijn, it played only a minor role.

Similar results acquired Adriani et al (2009) when analyzing prices from the Michelin Red Guide[6] during the same period. They analyzed six EU states of which 3 adopted euro in the year 2002 – France, Germany, Italy and other 3 which did not – Denmark, Sweden and United Kingdom. Again, an unprecedentedly big difference was measured between prices in euro area and other EU restaurants. More interestingly, they have also found dramatic price discrepancy between the restaurants in the euro area and rest of the EU catering mainly for tourists. Difference in prices between these two groups raised by 5.8% mainly because of the price increases in euro area. As the outcome of this study suggest, the Eurozone really did experience dramatic price increase with redistributional effect in favor of the catering sector, but since there are striking differences even between the restaurants solely in the euro area, another factors than just simple rounding effect and delaying of the price adjustment have to be looked at.

1.3 Possible factors of misperception

"Two out of three eurozone consumers felt they were ripped off by retailers during the changeover to pricing in euros, according to the European Commission…. Germany, France and Netherlands were the countries with the highest percentage of people feeling cheated…" (Financial Times, 01.03.02)

The first two factors related to price changes during the changeover that come to mind are commission fees and menu costs. Commission fees are one of the few factors that should even cause a price drop, hence this factor could not be taken into account as being the main one. The second factor is menu costs. In this case, it could be viewed as a perfect example

---

[6] The guide provides information about restaurants according to consistent and rigorous criteria and as such was a handy dataset for the authors.

of an external shock to which sellers had to respond by changing their menus and that is of course connected with at least some costs. For example, the National Bank of Belgium organized a survey among businesses in 2002 and came to conclusion, that for the companies the least important factor for price increases during the changeover was in fact the menu costs. Yet still most of the 300 million EU citizens felt quite significant increase in inflation. For instance, in Germany the euro coins and notes were called as Teuro which comes from German "Teuer", meaning costly (Mastrobuoni, 2004).

There have been plenty of attempts to find the other most probable and significant factors which lead consumers to misperception. The very basic explanation could be that the consumers are simply rounding the prices and with each unit the error gets bigger. For example, in Italy the exchange rate at the time of conversion was 1,936.27 lire for one euro. For simplicity of calculation it could be rounded to 2 and hence create a bias of 3% in the perceived inflation as suggested by the Italian Statistical Institute (Istat). The rounding effect could in fact be present and most probably is present in most people's minds, but could not be used as a leading factor. As you can see from Appendix 3, there are countries, where the rounding goes the opposite direction and implies reduction in the perceived inflation. Since the perceived inflation reduction with respect to the euro changeover did not occur, this assumption has to be rejected.

Marques and Dehaene (2004) studied whether the buying frequency of consumer products had any particular effect on the swiftness of relearning prices. They studied this effect in Portugal and Austria and came to conclusion that the more frequently the item is bought, the more accurately its price is identified. Interestingly, at the time of the study[7], the level of accuracy was still not as high for the euro money as it was with the former currencies.[8] When comparing the goodness of estimation of prices, it should not be a surprise that there are differences among age groups. In a Finnish study (Aalto-Setälä & Raijas, 2003) the authors tested prices of different groceries with regard to perception of different age groups and found that the worst estimators are in the group above 50 years old. What is more interesting for purposes of this study is that, after the transition, the gaps between age groups did even increase.[9] Even the evaluation of adoption to euro is somehow problematic by most of the citizens. Many of them believe they have adapted well, but the results are

---

[7] Approximately two years after the euro transition.
[8] Unfortunately the two studies conducted by Marques and Dehaene (2004) were not incentivized and hence the results could be mixed.
[9] Price estimations were acquired via telephone interviews (1000 respondents) and the interviews were not incentivized.

not so convincing. In Ireland, for instance, some people had to convert prices into the old currency in order to get a clear grasp of the exact values even one year after the transition (Ranyard, Burgoyne, Saldanha, & Routh, 2005)[10]. When comparing different studies, the conclusion is that the best (or least wrong) estimators are in Germany and Austria. In Germany, when asked to estimate prices of a middle-sized car, the results were no different than those in Deutsche Marks (Mussweiler and Englich, 2003).[11]

Additional observed factor related to the "euro illusion" is somewhat closely connected with the rounding effect. The rounding error is related to the nominal value of the coins and notes, meaning, the lower the nominal value is, the higher noise it makes when rounding each additional decimal number or even the number on a whole. In addition to this, people tend to evaluate prices on the basis of their nominal representation rather than on its real value. The nominal value depends on the monetary unit of one currency relative to another currency or the exchange rate (Gamble, 2006). In appendix 3 (except for Irish Pound) the euro has a lower value than any other listed currency of the former states. The euro illusion phenomenon is in this aspect very similar to that of money illusion as described by Fisher (1928) and Shafir, Diamond, & Tversky (1997). However, in this case, consumers in general do overestimate prices expressed in high nominal value currencies and vice versa. There has been conducted plenty of laboratory experiments regarding this particular issue. In these experiments, nominal value affected buying and selling of shares (Svedsäter, Gamble, and Gärling (2006), also spending and even product choices were affected in a similar way (Raghubir and Srivastava (2002).

The expansion of the euro illusion connected with prices, could be of that related to the income or salaries. Perceptions of salaries by consumers are in this case as important. When the conversion to euro took place, not only prices converted in most cases to lower nominal euros, but also the income did. In such vein study conducted by Gamble, Gärling, Västfjäll, and Marell (2005) found that participants did fall under the illusion of different nominal values of prices and income. In this case, participants preferred to have their income paid out in high nominal value currencies and to pay for various products in currencies with low nominal value.[12] Similarly, German study by Jonas et al. (2002)

---

[10] The study was conducted via in-depth interviews and was not incentivised.
[11] Serious drawback of this study is in comparison of perception of prices of only one item and that the participants were asked whether they would like to participate in an experiment and then were asked to fill in questionnaire with minimal or none incentive.
[12] Note that the experiment was conducted in a fictious currencies and was not incentivised with respect to the results. Only show-up fee was paid out.

confirmed such behavior by linking this issue with willingness to drive different distances to work. Higher willingness to drive longer distances was connected with income in German marks, which has higher nominal value and euro having lower nominal value was for the participants not so "attractive" and was rewarded with lower willingness to drive long distances to work.[13]

2. The Czech Republic and introduction of euro

2.1 Political background

The Czech approach to the adoption of the euro currency is somewhat problematic and hence deserves a closer look. The euro conversion approach and approximate dates were laid out in official documents at the time when it was decided that the Czech Republic would become a part of the European Union. The first of these documents is called "The Czech Republic's Euro-area Accession Strategy". Mainly it formulates the benefits and risks connected with the entry into the Eurozone and also points out the related demands on domestic economic policy and desired functioning of particular markets. Regarding the targeted euro adoption date it is said that: "Presuming successful fulfilment of the Maastricht Convergence Criteria, including successful consolidation of public finances, the achievement of an adequate level of real convergence and reasonable progress with regard to structural reforms guaranteeing sufficient economic alignment with the countries of the EU, accession of the CZ to the Eurozone may be anticipated in 2009- 2010" Czech Governmnet & Czech National Bank (2003). The government opted for a „Big Bang Scenario" which ment a single-step introduction of cash and noncash euro.

However, with each additional year it became evident, that the tendencies to enter the ERM II and to adapt the euro were becoming less apparent. Since 2005 it became clear that the pro-euro approach was fading away as there was even recommendation to the government not to enter the ERM II mechanism, because the appropriate conditions were not created and in such circumstances it would not be beneficial for the economy to adopt the euro (Flek, 2013). The year 2006 brought full stop on attempts to join the euro area before 2010. Outcome of this Assessment was postponing of the entry date further beyond the year 2010 and future adoption date was not closely specified. Next year, to these

---

[13] 120 participants of the experiment were recruited from an introductory psychology class and again, participants were not incentivized.

reasons were added problems related to the public finance reform and flexibility of the Czech economy, which meant definitive end of all the attempts to join the euroarea (Helísek, 2013). Without having at least a partly set joining date, together with the crisis which sprung in the follow-up years, the efforts started to slow down dramatically.

2.2 Economic background

To get a better understanding of why the Czech Republic did follow such approach, it is useful to look at the situation of its peers which joined the euro area between 2007 and 2009. Namely it is (the entry year is in brackets): Cyprus (2008), Malta (2008), Slovakia (2009) and Slovenia (2007). As will be presented in the next paragraphs, the situation in these countries (including the Czech Republic) was very similar and even the fulfilment of the Maastricht Convergence Criteria did not differ much.

Table 1: Fulfilment of the Maastricht Convergence Criteria (2004)[14]

	Price stability	Government budgetary position (deficit, debt)	Long-term interest rates
Czech Rep.	Yes	No	Yes
Slovakia	No	No	Yes
Slovenia	No	Yes	Yes
Cyprus	Yes	No	Yes
Malta	No	No	Yes

Source: Ministry of Finance of the Czech Republic & the Czech National Bank (2004)

As you can see from the Table 1, the Czech economy did manage to fulfill all the criteria in 2004 except for the general government deficit, which was a problematic issue for the other countries as well (apart from Slovenia). The EU reacted to this situation with introduction of the excessive deficit procedure. In the CZ the general government deficit did in fact get smaller with each additional year and fulfilled the criteria, but it has to be noted that major role played the unexpectedly high economic growth of the pre-crisis years. Apart from the general government deficit, prior to the first proposed entry to the ERM II the CZ failed to meet the other criteria only once with only one criteria. It was in the year 2008, because the inflation was higher than allowed. The higher inflation in that year was not solely caused by economic forces, but also by a substantial rise in indirect taxes and administered prices (Flek, 2013).

---

[14] The criterion of exchange rate stability cannot be evaluated due to the absence of ERM II mechanism.

Later on, Czech National Bank (CNB) pointed out on a low economic alignment with Eurozone, meaning that the introduction of euro would not be beneficial to the Czech economy according to the theory of optimum currency areas as described by Mundell (1961). Two groups of factors were mainly analyzed – the similarity of cyclical and structural characteristics and the functioning of adjustment mechanics. Even though the CZ had in 2008 a standard of living comparable with the least developed countries of Eurozone, having the GDP per capita at 75% of the euro area average (Czech National Bank, 2008), it still had better starting position than Slovakia for instance and even the economic alignment was on a higher level than in Slovakia.

In the light of this information, it can be concluded, that the CZ would have no problem with fulfillment of the Maastricht Convergence Criteria, if the entry to the euro area was taken seriously and the entry to the ERM II would not have been postponed. In such hypothetical situation, even the change of taxes and prices in 2008 would perhaps be handled more carefully or postponed till the introduction of euro and hence every criterion would be met. The case of Slovakia having lower standards of living, lower economic development and lower success rate at fulfilling the criteria than the CZ, is a telling example of how much more the decision was politically than economic based in the CZ.

3. Double auction or posted offer market experiment?

Laboratory experimental research has been present in economics for almost 50 years. During that time, laboratory experiments have not only helped to test current economic theories, but also helped to study the implications of for the fields of regulation and public policy. Most of the early experiments were based on (oral) double auction method and in the year 1964 the first research paper applying experimental methods was released on posted prices markets. As will be demonstrated below, there is a quite a difference between these two markets (Smith, 1964). The paper was written by the Nobel Prize winner Vernon L. Smith and is entitled Effects of market organization on competitive equilibrium. Later on, experiments studying markets characterized with posted prices became more and more common. Perhaps the first research experiment with posted prices to have policy implications was conducted in the late 1970's and was later published by Hong and Plott (1982). There is an interesting fact connected with this research, as it has yielded opposite

results as were expected by the policy makers (sponsors) of this experiment and this was also the case for a lot of upcoming experiments.

The role of experimental economics has been to supply data where no other source of data exists. Main advantages of this experimental approach are simply the costs which are extremely low relative to costs of field experiments (Plott, 1986). Today, experiments are inseparable part of economics, but since there is being done so many of them and even in other research fields than economics, not all of them have proper qualities and added value. Perhaps the biggest problem today is that many studies are being done without incentivization of the tested subjects (economic agents) and hence these agents do not have sufficient motivation to put maximal effort into the experiment. This is especially true for most psychological studies. On the field of economics the situation is much more positive in this aspect.

3.1 Double auctions

Basic principle of double auctions requires both sides – sellers and buyers to be active in setting the price. In short, buyers tender bids to buy unit(s) of good(s) for the lowest price possible and sellers tender to sell unit(s) of good(s) for the highest price possible. Perhaps a good way to grasp a better understanding of this principle is to look at more exotic countries, where habitants use this principle on daily basis in a form of bargaining (haggling) or a similar conditions as are present on stock exchange trading floors. However, since it is called a double auction the outstanding (last) bid and offer are publicly displayed. After that, any buyer and seller is allowed to change his bid/offer to make himself better off. Only when there are no more changes the contract is made.

It is apparent that prices of the same good could differ dramatically. However, according to the experimental research, when repeated under ceteris paribus conditions, prices do not differ much, but more importantly are very close to the equilibrium price. What is also interesting is the fact that markets with such experimental setting exhibit an efficiency rate of 100 percent (except for the first few rounds, where the efficiency is very close to 100%) and prices equal marginal costs. Smith (1976) came to conclusion that double auctions have striking competitive tendencies in a sense that "no double auction trader needs to know anything about the valuation conditions of other traders, or have any understanding

or knowledge of market supply and demand conditions, or have any trading experience (although experience may speed convergence) or satisfy the quaint and irrelevant requirement of being a price taker" (every trader is a price maker in the double auction). As Holt (1993) notes, these statements were in fact proven and confirmed by at least a thousand market session in variety of designs.

3.2 Posted prices

Even though posted prices are much more common in the real economy, especially in developed countries, experiments with this principle are, as was mentioned above, used only few decades and are less common relative to double auctions. In the real economy this principle resembles with posting prices on price lists and menus and hence each customer therefore has only two options, either to accept or decline the offer without haggling. In a posted offer market experiments it is very similar. Each seller submits a price and all prices are publicly listed and cannot be changed by the seller for some fixed period. Sellers also assign particular quantities according to their set prices to maximize their profit. During this fixed trading period, buyers first approach sellers with lowest prices. After these sellers run out of stock, buyers move to next cheapest sellers and so on. Sellers are only allowed to change their prices before the next period starts. Since each seller has limited stocks, a random device is usually applied to determine orderly access for the buyers.

Experiments with posted prices setting exhibit lower efficiency levels. Efficiency in these markets is in the lower 90's of percent compared with 100 for the double auction experiments. Also, prices in this setting do not necessarily move towards the equilibrium price during the experimental periods and in fact could even deviate from it. The posted price institution induces an upward pressure on prices. It also exerts a downward pressure on efficiency. This signals a potential delicacy in the market's performance by showing how it can be influenced by subtle features of organization (Plott, 1986). As opposed to double auction conspiracies in posted price setting experiments tend to be more common and successful and as such allow for maintaining of higher prices.

Both of these two mentioned experimental methods have the same setting as can be seen in Figure 1. In this scenario, buyers are paying sellers for units of particular good in equivalent of real money and sellers are trying to sell as many units as possible with prices

above marginal costs and hence maximize their profit. At the end of the trading session, buyers are reselling the bought goods at fixed prices to the experimenter and earning profit. They are paid out in real money. It is similar for sellers, as they just trade in the virtual profits with the experimenter for the real money. It is important that the incentives (real money profits) are for the test subjects to keep.

Figure 1, structure of incentives in a laboratory market
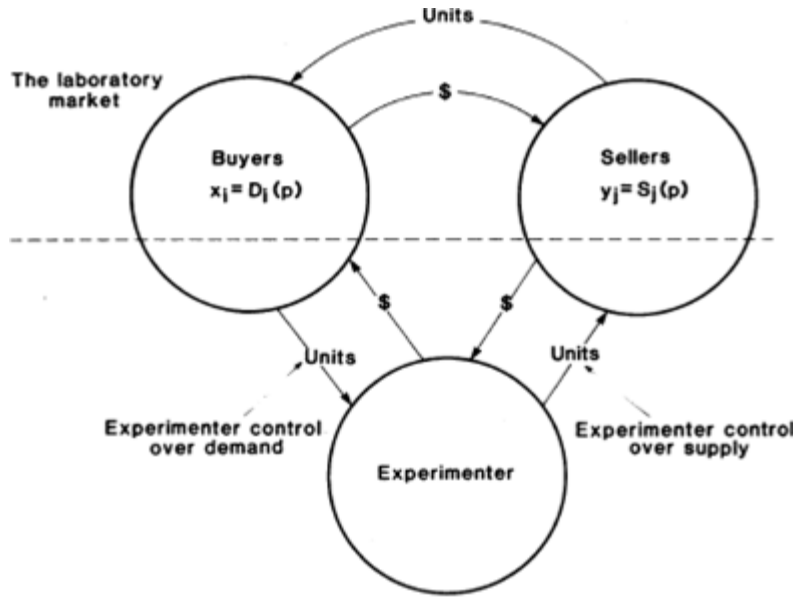
Source: Plott, 1986

In such laboratory setting, each buyer has a demand function denoted by equation 1 and each seller has a supply function denoted by equation 2.

$$x_i = D_i(p) \tag{1}$$
$$y_j = S_j(p) \tag{2}$$

Sum of all individual demand functions gives market demand and sum of all individual supply functions gives market supply. Under perfect competition, equation 3 should hold and the (experimental) market should be 100% efficient. Also earnings of all participants should be maximized.

$$\sum_i D_i(p) = \sum_j S_j(p) \tag{3}$$

4. Experimental design

In this section (4), I am going to present the hypotheses and also discuss the main influencing factors. In the following subsection I will present a design of the experiment and for better understanding I extend on this with subsection related to the equilibrium price and quantity. I also report quite detailed payment scheme in order to make the experimental subjects incentives clear. And finally, I discuss ways of how to modify (possibly improve) the course of the experiment.

4.1 Hypothesis

In the theoretical part, I looked closely at the situation of the former eurozone states and also those later acceding to see, if the currency changeover had any effect on prices and also on the amount of trade. I tried to identify main causes in the increase of perceived inflation as well. According to the neoclassical economic theory with homo oeconomicus assumptions, people should behave equally no matter what currency they use or what nominal value does the currency have. However, based on the findings acquired from other eurozone member states, as was shown above, there indeed was change in prices[15] and traded quantities[16]. Also, perceived inflation started to differ from common inflation indices (rise) and this occurred even in latter acceding states.

My main motivation is to see, whether the situation in the Czech Republic would be in line with the results predicted by the theory, or if the results will be similar to those from other eurozone states. Hence I am formulating following hypotheses:

H1: The average prices before and after the changeover are equal,
H2: The average quantities traded before and after the changeover are equal.

On the one hand, in the Czech Republic are factors, which could help minimize the deviations in prices and quantities, but on the other hand, there are factors which could cause the prices and quantities traded to deviate as in other eurozone states.

---

[15] As demonstrated by Hobijn (2006) and Adriani et al (2009).
[16] As an indirect proof of different traded quantities after the changeover, the findings of Kooreman et al (2004) and Cannon & Cipriani (2006) from quasinatural experiments can be used.

Perhaps the most powerful factor which could help minimize the deviations in the CZ is the relative recent stability of the Czech crown with respect to euro. By the end of the 2013, the Czech National Bank used foreign exchange interventions to depreciate the Czech crown, holding the exchange rate around 27 CZK/EUR. Since then, the exchange rate has been much more stable (see Figure 2) and hence people should be more aware of the current exchange rate and calculate prices more precisely. Also, the Czech citizens have had plenty of time to adapt at least indirectly to the euro, since each neighbor state (except for Poland) uses euro currency, but then again, time proved to be rather insignificant factor as was presented above.

Figure 2, exchange rate EUR/CZK
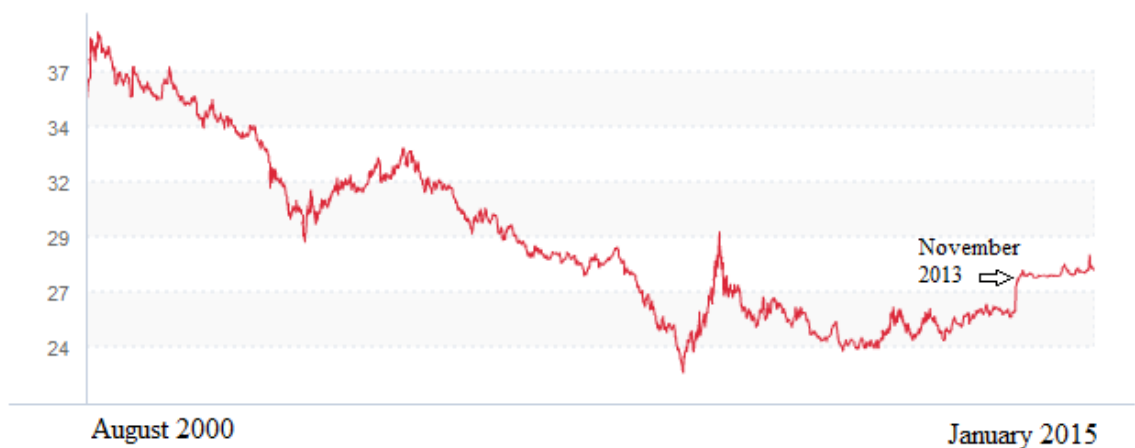
Source: penize.cz

One of the factors which could cause the deviations similar as in other eurozone states (or even stronger) is the standpoint of Czech citizens regarding the adoption of the euro currency. As can be seen from the Table 2, according to Public Opinion Research Centre, the number of citizens approving euro as legal tender is quite dramatically decreasing and with the current situation of overindebtedness in Eurozone, it is not very probable, that any rise in this number will be seen in nearest future. Another factor is that the Czech crown, as well as almost all pre-euro european currencies, has a higher nominal value than the euro and therefore people could fall under the euro illusion as it was described above.

Table 2, Citizens on adoption of euro *(percentage)*[17]

	4/2001	4/2010	4/2013	**4/2014**
For adoption	52	38	18	**19**
Against adoption	23	55	77	**76**

source: PORC

4.2 Design

To test the hypotheses, I decided that the best way to do this will be with incentivized laboratory experiment. I will be using a posted offer market design with 8 groups consisting of four sellers and four buyers and the trading will take place in 20 periods. The division of buyers and sellers will be completely random and each participant will be informed about her/his role right before the start of the experiment (after the instructions are read). Although the experiments by Ketcham, Smith and Williams (1984) were not studying the currency changeover effects, I will replicate their framework for comparison purposes – i.e. swiftness and degree of trending to the equilibrium, because such framework is commonly and widely used.

The currency used in the first part of the experiment will be the Czech crowns. After the first 10 trading periods pass, conditions will change and the currency used will switch to the euro (at a given exchange rate), while the division of buyers and sellers will remain the same. This is the zero treatment on which I will extend in the other treatments. A total of 4 treatments will be used. For the zero treatment I decided to keep things as simple as possible in order to eliminate any possible noises. The zero treatment will take place during one trading session consisting of 2 groups with 16 test subjects. My second treatment (treatment 1) is identical with the first one with the exception that part of the questionnaire regarding the inflation estimate will not be incentivized. The results should be identical as in the treatment zero, meaning that this setup should not make any difference in the trading.

Treatment 2 is different from the first one in a sense that buyers will still see values in the Czech crowns even after the changeover, while sellers are trading in euros. I decided to use such treatment in order to see whether the trading reaches different outcomes because of

---

[17] It has to be noted that although PORC is official Czech public institution, these results are based on surveys with approximately one thousand respondents which accounts to approximately 0,01 % of the population.

the information asymmetry which gives a slight advantage to buyers.[18] The trading will take place in one trading session consisting of 2 groups with 16 test subjects.

In order to replicate the situation during the changeover as much as possible, I will implement a steady increase in price fundamentals in the last (third) treatment, meaning that the price of the traded good will go up each period by 2% which is widely accepted as a "normal" inflation value as well as the current inflation target of the Czech National Bank. This particular treatment will be available only for 2 test groups also with 16 subjects. For readability reasons a Table 3 summarizing the experimental characteristics and treatments is added.

Table 3: Summary of the experiment

Number of periods	20
Number of groups in total	8
Number of participants in total	64
Treatment 0 (2 groups)	Currency changeover from CZK to EUR will take place at the end of period 10.
Treatment 1 (2 groups)	Identical as Treatment 0 except that the inflation estimation is not incentivized.
Treatment 2 (2 groups)	Same as treatment 1, but buyers see values in CZK even after the changeover.
Treatment 3 (2 groups)	Same as treatment 1, but during each period the inflation will rise by 2%.

## 4.3 Equilibrium price and quantity

In order to be able to read the results properly, first take a closer look at the trade equilibrium. Both buyers and sellers have preset costs (for sellers) and values (for buyers) so their profit could be calculated immediately and be paid out according to their results. These two variables have fixed values according to the number of units bought/sold. With each additional unit the marginal profit was lower in that particular period. When combined into supply and demand graph, with sellers being the supply side and buyers being the demand side, an equilibrium price in the interval between 25 and 27[19] and equilibrium number of traded units 4 per seller in each period is reached as can be seen in the Figure 3. The situation is slightly different for treatment number 3 since there was

---

[18] Of course, the information asymmetry is only present when the test subjects are not perfectly familiar with the euro and could fall under the euro illusion and hence this is the assumption.
[19] The precise equilibrium price is 26, but because in this case the variables cost and value are not continuous variables and units under cost/value of 26 were not available for trade, it can be generalized that the equilibrium price lies in this interval.

steady increase in prices by 2% in each period, hence the equilibrium price is slightly increasing in each round, but nevertheless for simplicity it can be said that this still holds.

Figure 3, Equilibrium price and quantity
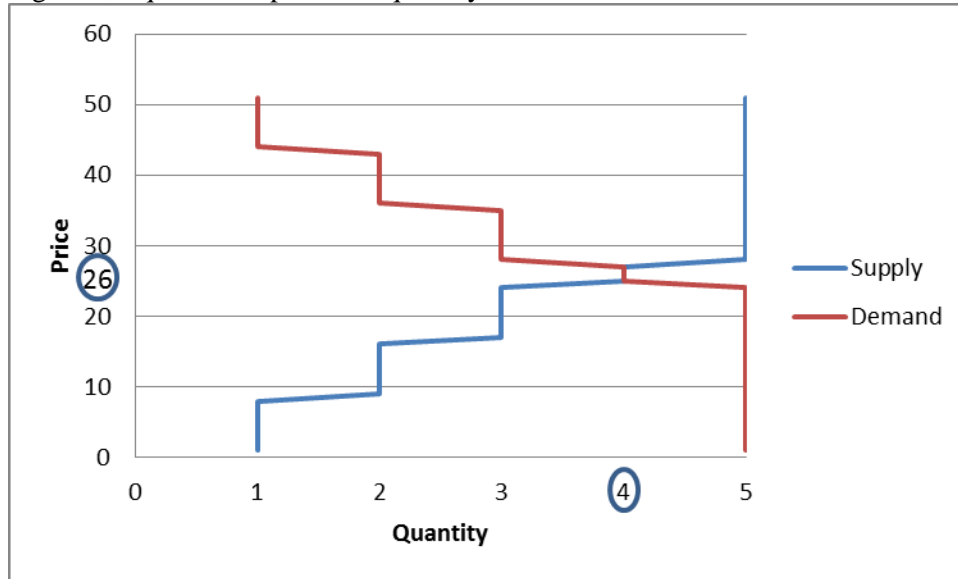
4.4 Payment

In order to follow the conventions of experimental economics (e.g., Hertwig & Ortmann 2001) and to get as realistic results as possible, all sessions of the experiment were incentivized. Test subjects were paid out according to their decision-making (i.e. profit in the experiment). The earnings of each participant were based on their earnings in four periods, which were drawn randomly at the end of the experiment. Two random periods were drawn before the changeover and two after the changeover – the exchange rate used for these two periods was 27,5 CZK/EUR as it was mentiond in the begining of the experiment. Participants also had a possibility to earn up to 100 CZK based on the accuracy of their inflation estimates.[20] Earnings from this particular item ranged from as low as 7 CZK to 97 CZK with an average of 82 CZK. Each subject also received a show-up fee of 50[21] CZK. A total of 18880[22] CZK was paid out, ranging from 150 CZK up to 400 CZK for the most succesful trader. Average amount paid out across all four sessions is 295 CZK.

---

[20] This option was not available for treatment 1, but it did not affect the outcomes.
[21] Participants of the sessions where the profits were lower than promised (250 CZK) were paid out a show-up fee 80 CZK in order to compensate for the lower earnings.
[22] This number does not include the payments for those who did not participate in the experiment, becase they were overcapacity, but still arrived on time.

The announced duration of the experiment was 1 hour. However, each session took approximately 75 minutes. Time needed to read the instructions was 20 minutes, the trading took 40 minutes and the remaining 15 minutes took the questionnaire along with the distribution of payments for the participants.

4.5 Thoughts for future research

There are few possibilities to modify the treatment even further and hopefully will find use in future studies. For example, it would be interesting to mix the trading periods with respect to the currencies used – either to have euro in all odd periods and Czech crowns in all even periods for both buyers and sellers, to see, whether higher volatility between periods occurs. Perhaps the most interesting treatment would be, if the sellers were given slightly better conditions (lower costs) after the euro changeover, to see, whether it was utilized for higher profits or not, because I expect that the price elasticity will be lower right after the changeover giving sellers possibility to exploit their buyers (at least temporarily).

This particular experiment, even with the treatments used and those discussed, could be also done as a double auction experiment. As I have mentioned above, I decided not to use this principle, because posted offer markets reflect the real world (especially retail) markets much butter. However, with this setting I could ex ante expect not only faster equilibrium convergence, but also change of a lower magnitude (if any) in the prices and quantities traded.

Although I had 64[23] test subjects, the size and the variety of the sample is quite a drawback. It is problematic, to say the least, to conclude any general statement based on such sample. The sample consisted only of university students studying in Prague. That way not only the age distribution, but also the educational and habitat distribution does not match the Czech Republic's attributes. It has to be noted that when approaching the results of this experiment, things such as cultural customs, traditions, beliefs etc. have to be taken into account as well. When (if) similar studies appear in different countries, the cross-

---

[23] In fact I had 80 test subjects, two more sessions were done as a pilot experiment, but since these were not incentivized, I decided not to use them.

country comparison should be made only with great caution because of the indirect differences between states and its citizens.

5. Sample description and summary statistics

The sample consists of 16 subjects in each session, totaling to 64 test subjects. Since each session had 20 trading periods and in each period every seller or buyer had a chance to trade at maximum 5 units, this gives a total of 6400[24] observations. All recruited test subjects are university students with average age of 22.9 years and with average net income almost 8500 CZK. 64% of all subjects are of Czech nationality and 26.5% are Slovak. Participants of Slovak nationality have got almost the same experience very recently, when in the 2009 the Slovak Republic adopted the euro currency, making them ex ante more familiar not only with the euro but also with the changeover situation.

Table 4, characteristics of the test subjects

	Mean	Std. Dev.	Min	Max	
Age	22.9063	2.0135	19	29	
Monthly net income (CZK)	8467.903	6701.246	0	40000	
Nationality	Czech: 42	Slovak: 17	Russian: 3	Ukrainian: 1	Georgian: 1

At the end of the experiment, I also asked the test subjects few general questions, to see, whether they have enjoyed it or if they have found it difficult. The answers show that the test subjects found it quite interesting, had no major problems with time required to complete their trades, but the difficulty could have been an issue for some subjects. On a 1 to 5 scale, the difficulty averages at 2.4, this means that the difficulty was viewed as "moderate", even though the experiment was very basic and intuitive. I think that the fact that the experiment was held in English could have alleviated the perceived difficulty at least slightly, because majority of the participants was Czech or Slovak.

A look at the exact times required to set prices by sellers and time required to buy units by buyers, at first sight it looks as if the available time was almost insufficient, because the number of participants using the whole provided time to finish their trade was very high.[25] However, according to the stated opinions of the experiment participants, the time required was not an issue. In this case, note, that participants had to click continue button in order to

---

[24] This is computed as follows: 64 test subjects * 20 periods * 5 units = 6400 obs.
[25] For sellers a total of 2579 units was bought at the time limit and for buyers a total of 1964 units was supplied.

end their trade, if not the timer kept running until the time ran out. It indicates that in the sample the number of subjects postponing the trade until the time ran out was quite high. Unfortunately, for future analysis I have to be very careful when interpreting relations with respect to time required.

Table 5, opinion on the experiment and time required

	Mean	Std. Dev.	Min	Max
Interesting	3.75	1.0309	1	5
Difficult	2.3906	1.1405	1	5
Enough time	3.5156	1.2991	1	5
Time required to set prices (sellers)	35.0931	11.0221	0	40
Time required to buy units (buyers)	27.8386	15.8051	0	40

Subjects from the sample are well used to euro currency. According to their answers, I can be said, that they use euro quite often, are very familiar with euro currency – no subject reported the lowest familiarity. As I have reported above, Slovak participants have higher preconditions to be using euro more often and also to be more familiar with it. It indeed showed in the answers, because in those two questions, all Slovak participants reported highest or second highest familiarity and the same goes for use of the euro.

What is most interesting is that the estimate of the current exchange rate CZK/EUR (from the time of the experiment) is on average very precise even though few subjects reported values which corresponds more with exchange rate which was present approximately one and a half year ago, but most of the outlying estimates are made by participants which are not from the Czech Republic.

Table 6, euro familiarity

	Mean	Std. Dev.	Min	Max
Often use euro	3.1875	1.19742	1	5
Familiarity with euro	4.1719	0.9111	2	5
Estimate of the current exchange rate CZK/EUR	27.3619	0.5504	25	28.2

Perhaps the most all-round and difficult question the participants were asked is to give a day precise estimate of the date when the Czech National Bank started its foreign exchange interventions in order to depreciate the Czech crown. What is interesting is that only one person reported the correct answer – 7.11.2013. However, when analyzed quarterly, as can be seen in the Figure 4 much more positive results yielding the highest number of answers in the correct quarter and year. Unfortunately it is quite problematic to draw any conclusion out of this, since I do not have a sample data from the broader population and

hence do not know whether the sample is more or less educated in this area than the general population.

Figure 4, Estimates of the intervention date
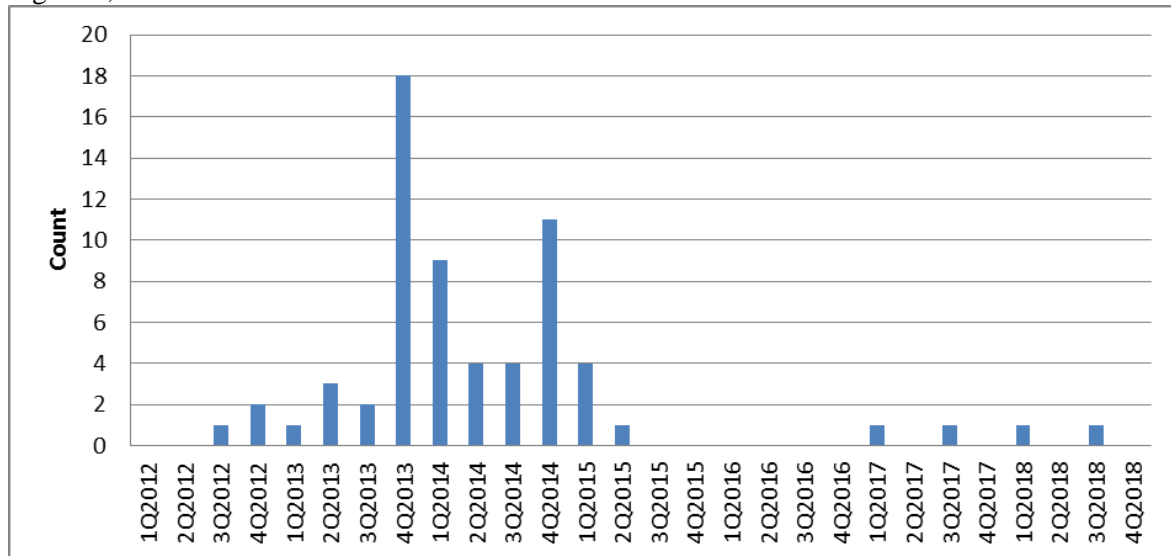
To expand on the questions related to the euro currency, I presented the participants also a set of questions to see their opinion on the situation after the changeover and their possible attitude. Most of the participants, 55 out of 64, believe that prices will change after the changeover. When asked to imagine themselves in a position of an entrepreneur and if they would change prices after the changeover, 36 subjects reported they would indeed change prices, while 34 subjects would increase prices, 21 would keep and only 2 would decrease. When compared those two questions, it shows indirect inconsistency with the answers, because 19 subjects would behave differently in the position of a price setter (entrepreneur). Interesting results yield the question whether the participants would welcome euro in the Czech Republic. The number of those who are "pro-euro" and "anti-euro" is the same in this sample, which is interesting, because the general public is much more "anti-euro" as can be seen for example from the Table 2.

Table 7, opinions on euro and changeover

Would you change prices after adoption of the euro?	Decrease: 2	Don't know: 7	Raise: 34	Keep: 21
Do you think the prices will rise after the changeover?	Don't know: 1	No: 8	Yes: 55	
Would you welcome euro in the CZ?	Don't know: 6	No: 29	Yes: 29	

Perhaps the most important table from this section is presented below – Table 8. The reason why it is the most important is, because in this table, finally some preliminary

results of the trading that took place during the experiment can be seen. Although it does not have any direct link to the changeover, it still gives a good starting point for reporting the results later on.

The first reported variable "Mean price of realized transactions" simply gives a mean price of those transactions that were proposed and accepted, in other words, where the trade was successful as opposed to the variable "Mean price of total offers" which reports not only the successful transactions but also only the proposed (without buyer). Mean price of realized transaction indeed falls is in the equilibrium range as I have defined it above and I can conclude that this experiment fulfilled the posted offer market criteria and it will be also presented graphically in the section Results. The number of observations in this case says that 3586 transactions were made, but keep in mind that this variable computes it for both sides – sellers and buyers and hence if only "one-way" transactions were taken into account, than the number is 3586/2 = 1793 as it is presented in the last variable "Number of total transactions". What is interesting is that the "Mean price of total offers" is on average lower than "Mean price of realized transactions", which is somewhat contra intuitive.

The variable "Number of total offers" says that on average in each group, in each treatment and in each period the total number of offers made by the sellers was almost 13.5 units. This means that on average each seller offered 3.37 units for trading, which is little below the predicted equilibrium offered units. The variable "Number of total transactions" could be read identically except for the fact that it shows only the successful transactions – those with a buyer. The equilibrium amount of units traded is in this case is even farther from the optimum. This is caused by the fact that the amount of traded units was more volatile across the whole trading. The volatility was mostly downward oriented and as can be seen from the "Max" column, not in a single period was the maximum (20) amount of units offered.

Table 8, Variables summary, averaged over groups, periods and treatments

	Mean	Std. Dev.	Min	Max	Observations
Mean price of realized transactions	26.5667	7.2285	4	59.95	3586
Mean price of total offers	21.8957	7.4864	0.825	124.4375	6400
Number of total offers	13.4813	2.3329	2	18	3200
Number of total transactions	11.7774	1.9604	2	16	1793
Realized profit - sellers	51.5827	15.1364	14	72.3075	625
Realized profit - buyers	44.1477	11.5256	8.4625	67.9688	625

If you take a look at the variables "Realized profit" for sellers and buyers, you can see right away, that sellers were more profitable in this case. This could be caused (among other factors) by the fact that sellers tried to take advantage of the currency changeover in order to increase their profits. I will look at this manner closer at the section results, in order to be able to draw any serious conclusion out of this. Note that the profit is also averaged over group, period and treatment, but in this case also per trader in order to get more meaningful values, hence the lower number of observations[26].

Table 9, Real and perceived inflation

Inflation	Real inflation	Inflation perception = estimation error in percents
Tr0	1.314926	-31.11764
Tr1	1.054499	-5.637391
Tr2	1.094632	-9.713185
Tr3	1.585023	-33.81485

The second column of Table 9 gives an overview of the real inflation that was present across the sample in period 1 to 20 with respect to the treatments. It has to be noted, that the rate of inflation is affected mainly by the prices selected in the first period – meaning that if the starting price was set low by the sellers, it then took more periods to reach the equilibrium price and also the difference between the equilibrium price and starting price was higher, resulting in higher inflation in that particular sample. It will be discussed more in the section Results.

---

[26] If I would compute the profit for each traded unit separately, I would arrive at the total number of observations 1793.

In the third column, you can see an inflation estimation error in percentage points. The test subjects were asked at the end of the experiment to give an estimate of the inflation in their trading session. According to the accuracy of their estimate, they had chance to earn some extra money (as described in the section Payment). The error was computed as a difference between the reported estimates of test subjects and the real inflation. You can see that the participants underestimated the inflation and this holds for all treatments. Keep in mind that in the treatment number 3 there was present 2% inflation in each period because the values were programmed to increase in such a way forcing the sellers to increase their prices in order to keep their profit.

Although all the estimation errors are calculated across the whole trading and not only focusing on the changeover period, still the results are very interesting. When compared for example with the statistics reported by Stix (2009) which indicate increased perceived inflation after the changeover which is indirectly saying that people tend to overestimate the inflation, also for example Duffy and Lunn (2009) is stating similar findings, in this sample the situation is opposite. The situation is not very clear in this area, because there is also big number of studies saying that people tend to underestimate the inflation (as this is the case of this sample) for example – Bates and Gabor (1986), Kemp (1991) and finally Alba, Bolton and Warlop (2003). According to the presented studies, the differences could most likely be linked to social background and social situation.

When these two reported indices are compared, it can be seen that there is positive relationship meaning that the higher the real inflation is, the higher the error is. The highest error is in the third treatment with 2% increase in prices each period. This is interesting, because participants were able to see the 2% increase in their costs and values. On the other hand, when compared the other three treatments, you can see that the difference between the real inflation and the error is smallest here and hence I can assume that the participants indeed noticed the 2% inflation and adjusted their estimates probably even more since they had this "anchoring point".

I ex ante expected that the error would be smallest in the second treatment since the buyers saw values in CZK even after the changeover. The error is indeed quite low in this case, but when compared with treatment 1, it is still higher. In light of this, I cannot accept the assumption that when the values are shown in CZK the estimation error is lower in this sample. In the following section, I will be analyzing whether in the sample the difference

in nominal and real values of the currencies played some role in the number of realized transactions.

Finally, I also tested for correlation between the preconceptions of price increase after the changeover and the perceived inflation. As I have reported in the theoretical part, Hofmann et al. (2006) found that there exists strong correlation between the magnitude of preconceptions and the estimation error. In order to find whether the correlation is present in this sample, I compared the reported inflation estimations along with the answers on question: Would you change prices after adoption of the euro? Do you think the prices will rise after the changeover?

Table 10, Correlation of estimations

	Inflation estimation
Would you change prices after adoption of the euro?	0,07025244
Do you think the prices will rise after the changeover?	0,011263973

From the Table 10, it is apparent, that in the sample the correlation is not present as opposed to the results of Hofmann et al. (2006). I believe the difference is caused mainly by using quite indirect[27] variables with very low variability especially in the available answers of the questions on the left side of the Table 10, hence the comparison is problematic.

---

[27] In this case, I am comparing „hypothetical" questions with the inflation perception in these trading sessions, because it is impossible to acquire real changeover data ex ante as opposed to the ex post study by Hofmann et al. (2006).

6. Results

In this section, I am going to look at how the currency changeover influenced the outcomes of trade. I am especially interested in the changes after period 11 as this "simulates" the situation closely following the currency changeover. For the statistical significance testing I will be using Wilcoxon signed-rank test. With this test, I will be comparing the pre and post changeover periods in order to see, whether it exhibits different sample means. I am going to look closely mainly at the statistics reported in Table 8, namely:

a) Mean price of all offers
b) Mean price of realized transactions
c) Total number of offers
d) Total number of realized transactions
e) Profit – computed for sellers and buyers separately

6.1 Mean price of total offers

In order to be best able to present the results, I first had to compute mean price of offers for each group and each treatment separately. The results of this are 8 variables as shown in the Figure 5. Of course, I had to calculate it also with respect to the trading periods (Y-axis) in order to get a nicely readable time series. The variable is the same as reported in the summary statistics. It contains mean price of all offers made by sellers, even those without a buyer. All graphical results for all variables will be presented in a similar way.

Figure 5, Mean price of total offers
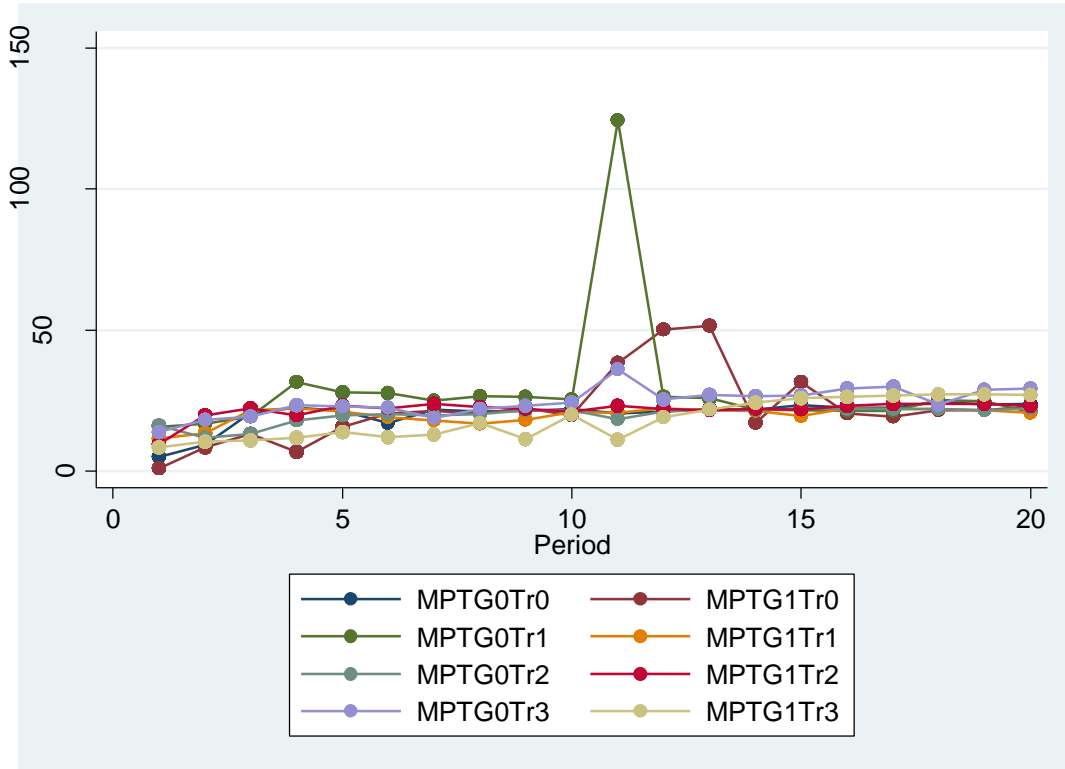
On a first sight, you can see that the mean price of total transactions is quite stable with few exceptions. The first major exception is from period 1 to 5, but this is typical for posted offer experiments, because it takes longer time to reach the equilibrium, but in this case, the equilibrium price was on average reached quite fast even for posted offer experiment standards. More interesting is the second major exception starting at the changeover period 11. The highest increase in prices occurred in group 0 under treatment 1, where the price jumped up almost five times. Apart from that, the price raised also in other two groups, but not in such extreme magnitude. The results suggest that the changeover from Czech crowns to euros really did change (elevate) the prices, but after three trading periods the situation was almost identical as before the changeover. In the next subsection I will present, whether the buyers accepted these new prices or not.

Table 11, Wilcoxon signed-rank test results for mean price of total offers

	Prices in original form	Prices averaged for each group
Period 10 - 11	0.0361	0.0000
Period 10 - 12	0.0000	0.0000
Period 10 - 13	0.0000	0.0000

Based on the results of Wilcoxon signed-rank test, as presented in the Table 11, it can clearly be seen that the mean price of total offers in this experiment did in fact got

influenced by the changeover in period 11. For purposes of this test, I decided to use period 10 as it is the last trading period in CZK and then compare it with period 11, 12 and 13 since these are the closest follow up periods. All three periods (11, 12, 13) when compared with period 10, exhibit statistical significance at the 5% significance level. In this case, I can easily reject the null hypothesis stating that both distributions are the same. I also run the comparison with averaged prices for each group, but the results are no different and I still reject the null hypothesis.

In this experimental setup there was minimal or no place for menu costs. Although Hobijn et al (2006) gives small credit to menu costs, it could still have had at least some effect during the changeover period. Thanks to the elimination of menu costs, it can be concluded that sellers acted only in a selfish – profit maximizing way. It is possible that this "exploiting" of customers was present during the past euro changeovers and could even be present in the Czech Republic once (if) it adopts the euro currency.

Figure 6, Number of times each price occurred
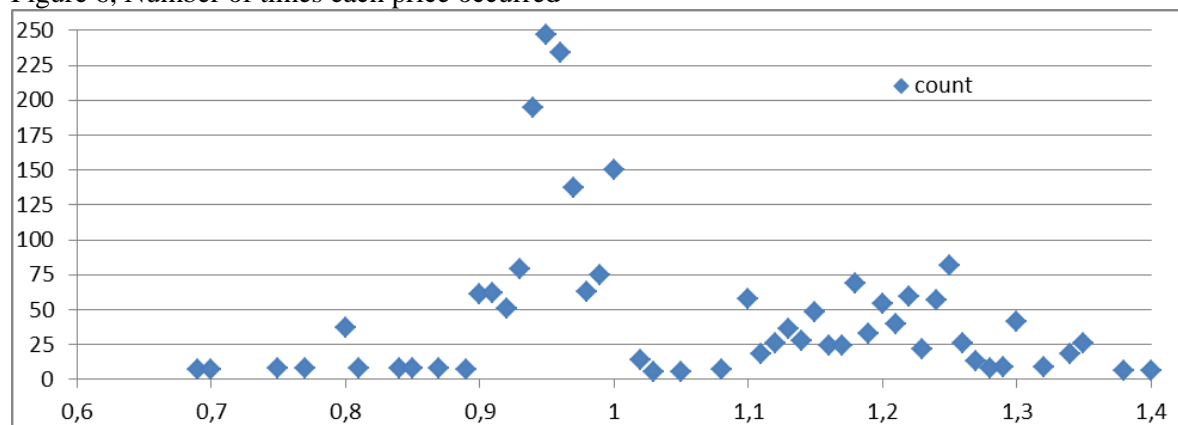
I was also interested in finding, whether the rounding effect would occur in this sample as well. For this purpose, I created Figure 6, which is showing count of how many times each price occurred in the second part of the trading (periods 11-20). On a Y-axis, the count is displayed and on X-axis the prices in EUR are displayed. I decided not to use the first half of the trading (periods 1-10) simply because all prices in CZK were set as whole numbers.

Simply by looking at the values with only one decimal number and also values with two decimal numbers, but the second decimal number being 5, it is noticeable that there are "spikes" of such prices. The situation is similar with the outlier values, which are not

displayed in the graph.[28] The only major deviation is in the interval between 0.9 and 1, but since this is more or less equilibrium interval, it is understandable. Subjects in the sample indeed preferred to use "nice" numbers most probably in order to make the exchange rate easily computable. Based on these findings, I can conclude that the rounding results are in line with those of Istat (2003) as discussed in the theoretical part.

6.2 Mean price of realized transactions

Since the mean price of realized transactions exhibits lower outlier values (hence the scale on Y-axis is lower) it looks graphically as if the volatility is higher in this variable, especially in the first few trading periods. However, regarding reaching the average equilibrium price, the situation is very similar to the one presented above. In fact, apart from the group 0 under treatment 1, once the prices reach the equilibrium, they become very stable, even during the time of the changeover.

When compared with the results of the mean price of total offers, it is obvious that buyers (apart from that one particular group) denied overpriced offers. I can summarize that in the sample, sellers tried to exploit the currency changeover by increasing the prices in order to make higher profit, but buyers boycotted such offers. Keep in mind that participants from each group and each treatment did not know the situation in other groups and treatments and hence acted only with the knowledge of their costs/values and also with the knowledge of the prior prices.

---

[28] Please note, that, for readability reasons of the graphical output, I have eliminated outlying values from 0 to 0.6 and also from 1.5 to 30.

Figure 7, Mean price of realized transactions
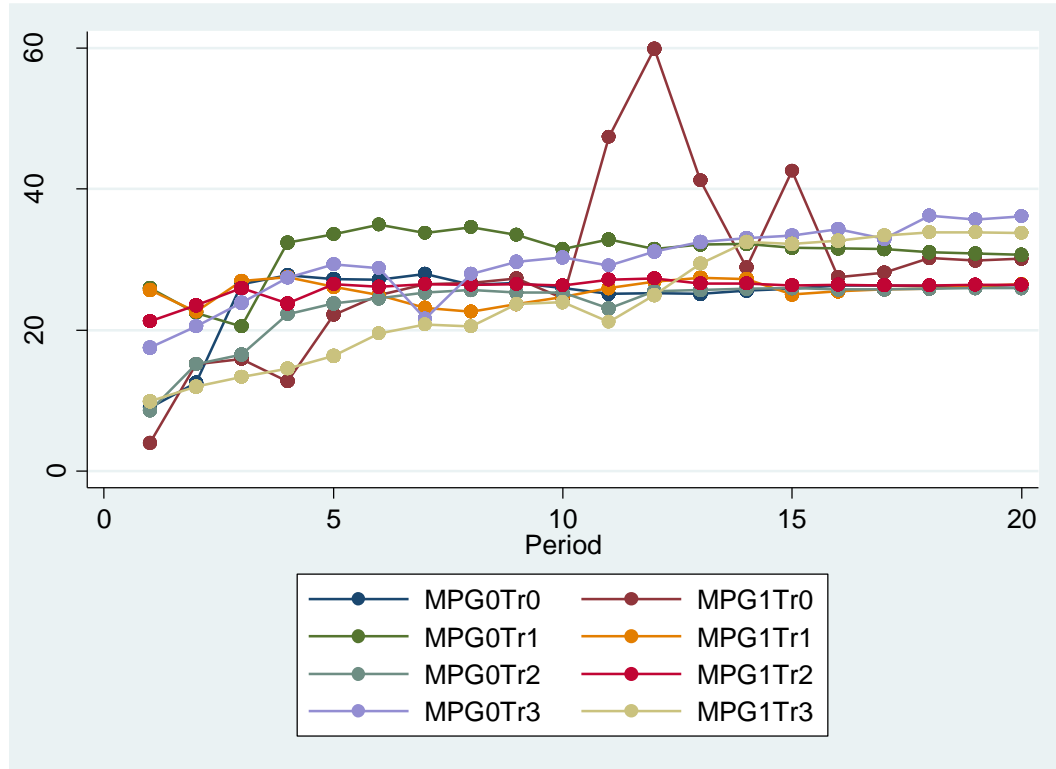
The results of Wilcoxon signed rank test are very similar to those presented for mean price of all transactions. In this case, the significance levels are just slightly over 1% and on the 5% significance level, the null hypothesis can again be confidently rejected.

Table 12, Wilcoxon signed-rank test results for mean price of realized transactions

	Prices in original form	Prices averaged for each group
Period 10 - 11	0.0147	0.0055
Period 10 - 12	0.0007	0.0007
Period 10 - 13	0.0000	0.0000

6.3 Total number of offers

Total number of offers is clearly more volatile across the whole trading. The number of offered units is lower than what the equilibrium predicts, as was described in the summary statistics. The volume of offers seems not to be affected by the changeover. Sellers, in this case, did not try to exploit the changeover period by offering solely higher or lower number of units, but again, even just from the graphical output, it is possible to notice at least slight diversion from the equilibrium path.

Figure 8, Total number of offers
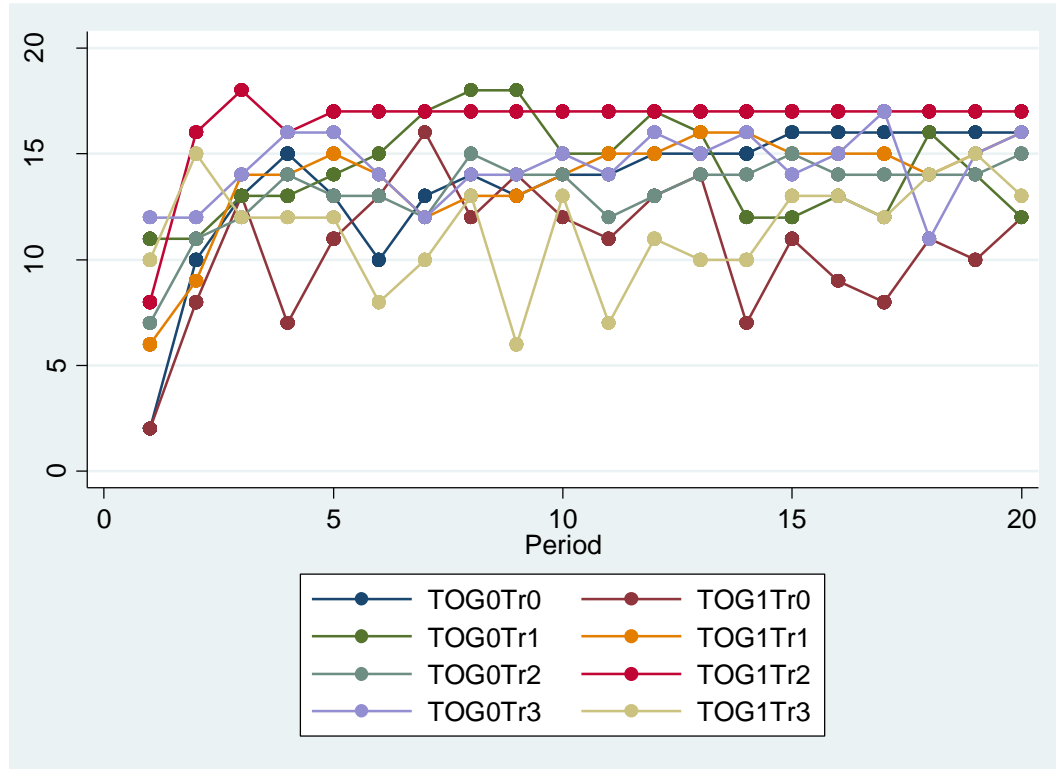
It can be seen that the difference in the total number of offers in pre and post changeover, across the monitored trading periods, is statistically significant even at the 1% level. In this case, it is problematic to give credits solely to the changeover since the volatility is present across the whole trading and hence the volatility alone could cause the statistical significance. I have to be cautious with rejecting the null hypothesis as a result of the introduction of EUR. For clearer significance test results it is necessary to look at them also in line with the statistical significance results for the variable total number of realized transactions.

Table 13, Wilcoxon signed-rank test results for total number of offers

	Offers in original form	Offers averaged for each group
Period 10 - 11	0.0000	0.0000
Period 10 - 12	0.0000	0.0000
Period 10 - 13	0.0000	0.0000

The treatment number two (buyers still see values in CZK) was implemented mainly in order to see, whether there would be any difference in the outcome – both in prices and quantity, so I can compare results when different currencies were used. The main point was to find, if the participants did fall under the effect of euro illusion as described for example by Gamble (2006), as it is the currency with lower nominal value than CZK. In this setup,

it is almost impossible to report any outcome based solely on the graphical results, but again, thanks to Wilcoxon signed-rank test, I found that the nominal value of the currency played some role in this experiment. The statistical test was conducted on the same basis as all the tests reported here. In every option the difference between treatment 2 and all the other treatments is statistically significant at 1% level[29]. As I have reported in the theoretical part, the nominal value affected buying and selling of shares (Svedsäter, Gamble, and Gärling (2006), spending and even product choices (Raghubir and Srivastava (2002). The issue of the swiftness of relearning prices as discussed by Marques and Dehaene (2004) is negligible in my setting, since only one universal commodity was traded. On the question of euro illusion can be extended by saying that in this setting and within this sample, not even the traded subject (commodity) played major role, because the subject of trade was in this case unknown, nameless and not closely specified commodity.

6.4 Total number of realized transactions

The total number of realized transactions is obviously most volatile of the presented variables. Even the change in the changeover period is highest in this case. When compared with the total number of offers, a big drop in the changeover period can be seen. This is most probably because of the higher prices selected by sellers, which buyers did not accept, resulting in a drop in realized transactions.

---

[29] In fact, the results for all the options were 0.0000.

Figure 9, Total number of realized transactions
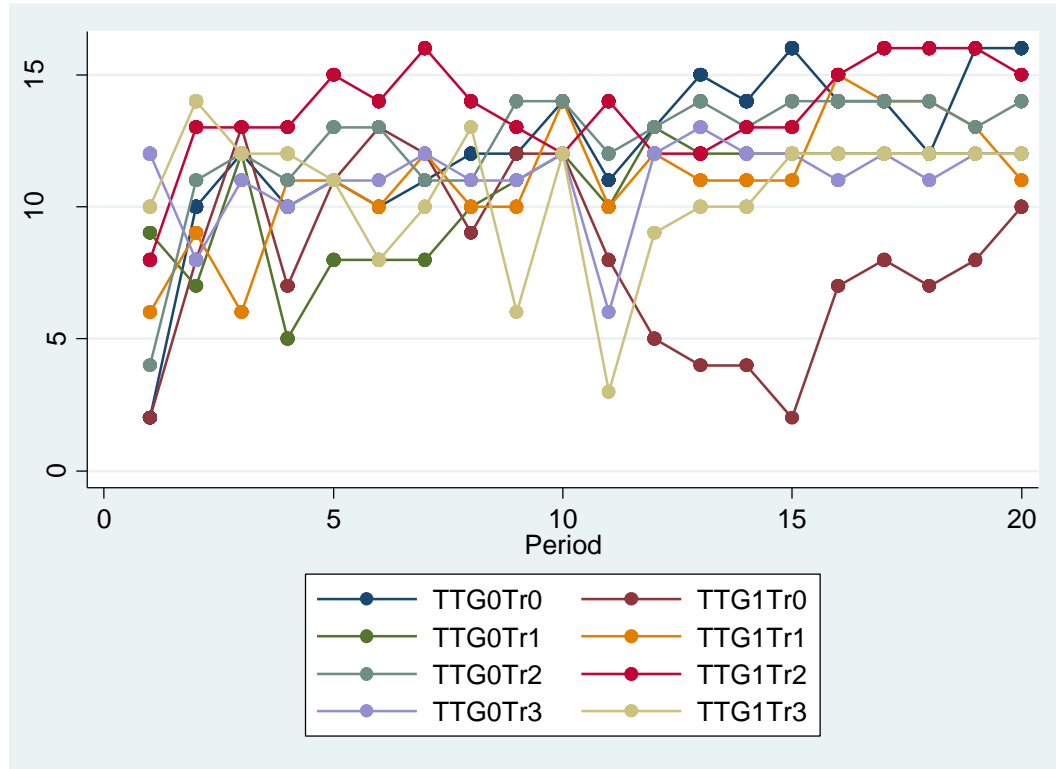
Simply by looking at the graphical output, it is not surprising that the difference in the monitored periods is statistically significant. In this case, again, even at the 1% levels. Even though there is a big volatility across the whole trading, the pattern present in the changeover period (11) is unique when compared with other periods. The null hypothesis here is easier to reject, especially for the period 11 with respect to the changeover effect. When compared with the previously reported variable total number of offers, I still cannot get any clearer results in spite of the fact that the variable realized number of offers is subset of the variable total number of offers, because it does not seem that the sellers did respond quantity-vise to the big drop of realized transactions in period 11.
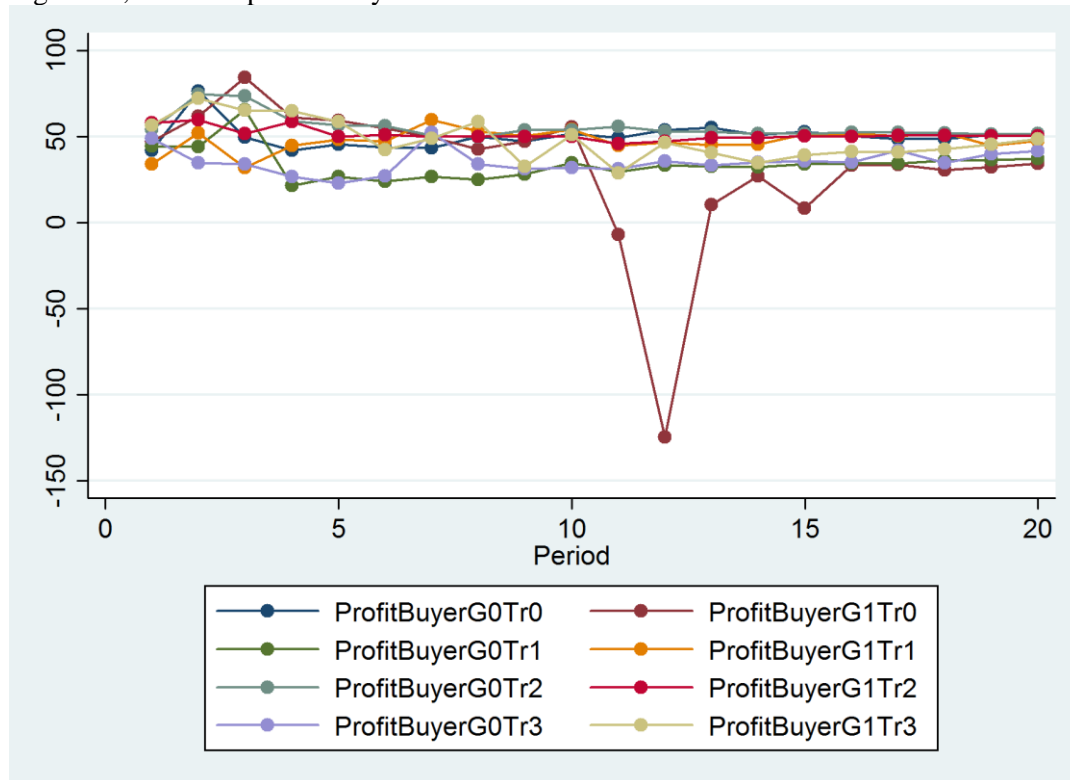
Table 14, Wilcoxon signed-rank test results for realized number of offers

	Offers in original form	Offers averaged for each group
Period 10 - 11	0.0000	0.0000
Period 10 - 12	0.0000	0.0000
Period 10 - 13	0.0000	0.0000

6.5.1 Profit – buyers

The realized profit of buyers follows very similar pattern as the graphical output of the variable mean price of total offers, except that the volatility is facing opposite directions. This is reasonable, because the higher the price is, the lower is the profit for buyers regardless of accepting the offer or not. As it goes with the variable mean price of total offers, in this case the trading becomes more or less stabilized after period 4. It looks as if after the changeover there is no dramatic change in the realized profit of buyers, with the exception of group 1 under treatment 0, because this group did not boycott the elevated prices, as can be seen in the Figure 7. Other than that, the buyers were most probably satisfied with their profit levels or the sellers set the prices and quantities in a way that simply did not allow the buyers to increase their earnings. But it can be concluded that buyers were not an easy "prey" for the sellers.

Figure 10, Realized profit – buyers

Even though the graphical output of this variable seems as if the changeover had almost no effect, the Wilcoxon signed-rank test results shows the opposite. It can be seen that once again results of all the examined periods are statistically significant even at the 1% level.

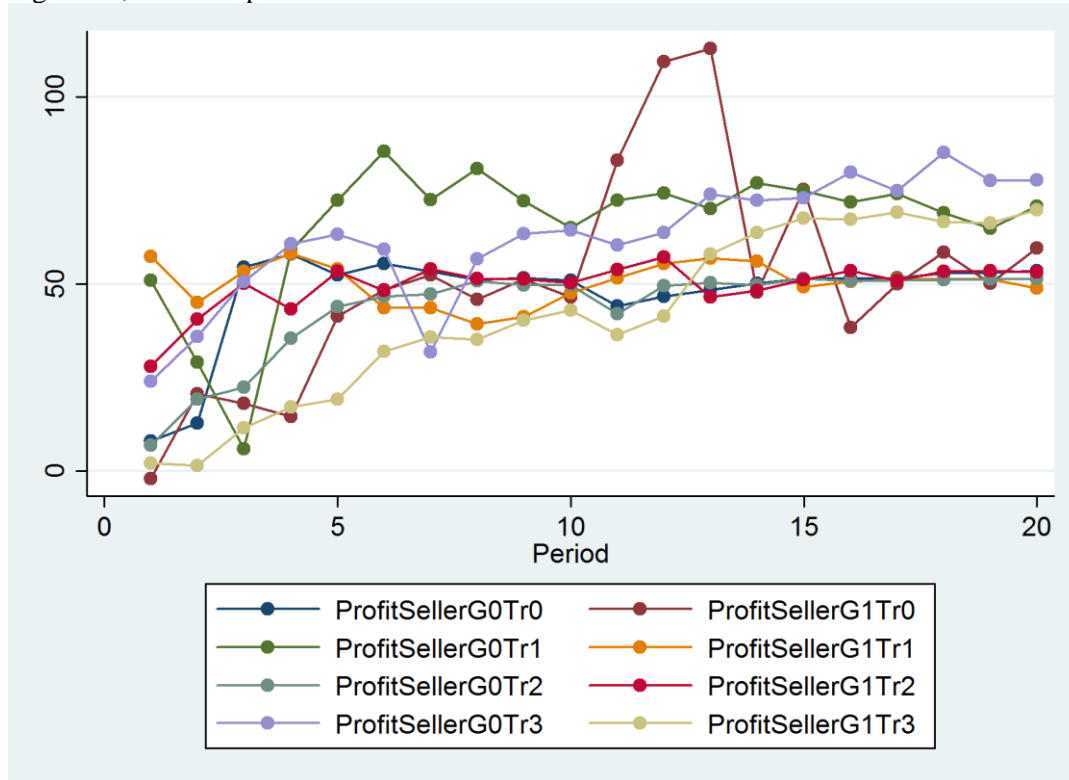Table 15, Wilcoxon signed-rank test results for realized profit of buyers

	Offers in original form	Offers averaged for each group
Period 10 - 11	0.0000	0.0000
Period 10 - 12	0.0000	0.0000
Period 10 - 13	0.0000	0.0000

6.5.2 Profit – sellers

The profit made by sellers is clearly less stable than the profit of buyers. It is hard to find any stable pattern in this graph except maybe for few groups (G0Tr0, G0Tr2 and G1Tr2) which provide more stable profit than the others. However, it can at least be seen that the difference between the highest realized profit and the lowest realized profit was smallest in the pre-changeover period 10. After the changeover, the profit started to differ once more and was not very stable (especially when compared with the profit of buyers) until the very last period.

The most important thing this variable tells is that not all the sellers were successful in the attempt to exploit the buyers by increasing their prices after the changeover. Few of the sellers even experienced a drop in their profits after the currency changeover. Unfortunately, I do not know of any studies to compare the results of the profit variables with, not even indirectly. That way I cannot conclude whether my results are normal or outlying.

Figure 11, Realized profit - sellers

The statistical significance test verifies the results for this variable, because all the results are statistically significant at the 1% levels. This is not a surprise especially when the volatility of this variable is taken into account.

Table 16, Wilcoxon signed-rank test results for realized profit of sellers

	Offers in original form	Offers averaged for each group
Period 10 - 11	0.0000	0.0000
Period 10 - 12	0.0000	0.0000
Period 10 - 13	0.0000	0.0000

6.6 Summary

Based on the development of prices and quantities, some interesting patterns worthy of commentary can be seen. In the sample, the change of currency indeed resulted in changes of the trade. Both of my original hypotheses (H1, H2) can be rejected with respect to the periods closely following the currency changeover. The fact that these changes resulted in the change of the realized profit, especially for sellers can be added to this. As I have presented above, all the reported results are statistically significant.

Since I have eliminated the possibility for menu costs and the need for relearning prices was minimal, I can conclude that some of the major effects influencing the trade in this

case were: rounding effect, euro illusion and perhaps the most important – selfish utility (profit) maximizing behavior.

The main thing that was affected by the changeover was the price. Sellers tried to take advantage of the currency changeover by raising their prices without any major adjustments of the number of offered units. However, not all the attempts were successful, because buyers (in most cases) were not accepting over-priced offers and this resulted in a drop of realized trades. The results of the profit variables indeed confirm it.

There is no clear winner in the "battle" between the sellers and buyers. Most of the buyers were not affected by the changeover profit-wise. On the other hand the changeover conditions set by the sellers did not allow the buyers to make themselves better off. The reason why the buyers did not experience a drop in their profits is most probably simply because they were well prepared for the changeover and hence did not accept the unfavorable offers. The situation is much more different for buyers. Even though they clearly attempted to take advantage of the changeover and probably realized this could be a good situation to increase their profits, not everyone was successful. From this point of view the buyers were more familiar with the new currency. Even though I can only guess, I am almost sure that there were some attempts to (or maybe just thoughts) form some kind of oligopolistic structure by the sellers, but since this experiment was conducted under perfect competition conditions these attempts were predestined to fail.

 The situation would most probably be different price-wise, quantity-wise and even profit-wise if some kind of cooperation would be implemented in the experimental framework, or changed altogether to a different type of competition. There is a lot of minor factors that could be changed in the experimental framework that would result in a major differences in the numbers, but the motivation of the traders to increase their utility (profit) would stay the same.

7. Conclusion

The main aim of this paper was to find, whether the possible future currency changeover in the Czech Republic from CZK to EUR would affect the real economy and prices. I decided to approach this issue using economics experiment. I organized a total of 4 incentivized experimental sessions with 64 participants. The whole experiment was conducted using the framework of posted offer pricing, where sellers set prices and quantity offered and buyers set the quantity they were willing to buy. Participants were also asked to fill out a questionnaire, which gave the possibility for analyzing even more issues along with better knowledge of the participants.

The results revealed that the currency changeover from CZK to EUR under the ceteris paribus experimental conditions did in fact affect the outcomes of the trade. Note that all the reported results are statistically significant at the 5% level, while most of them are significant even at the 1% levels. The mean price offered was definitely affected in the sample. The prices offered on average went up after the changeover, temporarily deviating from the equilibrium path. However, the mean price of realized transactions was not affected in such magnitude. The reason behind this is simply that the buyers rejected the overpriced offers of the sellers exploiting the changeover situation. Regarding the traded quantities, the amount of offered units was more or less not affected by the currency changeover, thus leading to the conclusion that sellers approached a strategy of price increase without modification of their supply. The number of realized transactions is, however, affected. Since the sellers tried to take advantage of the changeover by offering units for higher prices, and the buyers boycotted these overpriced offers, it is evident that the result of this had to be a temporary drop in the amount of realized transactions. Naturally, these changes (of prices and traded quantities) affected also the development of realized profits. The buyers profit was quite stable during the whole trading. There was only one group which deviated dramatically. In this group, the changeover led to a drop in profits of approximately 300%. Other than that, the buyers managed to keep very uniform profit levels. On the other hand, sellers' profit levels were unstable during the whole trading and the changeover made them unstable even more. As a result of this, some sellers experienced a decrease in their profits after the changeover, which is a consequence of reduction in trading which followed right after the changeover.

Moreover, most of the main contributing effects leading to the price increases connected with the changeover in the Eurozone were analyzed in this study as well. Thanks to the selected framework of the experiment, I was able to eliminate menu costs. Even though the menu costs account only for a small magnitude of deviations, as described by Hobijn et al (2006), it still was one of the most reasonable factors that could have justified for the price changes. Another factor which was analyzed and could have caused deviations was the rounding effect. The rounding effect indeed was present in my sample, as the participants preferred to use "nicer" rounded prices. This effect was widely present during the changeover period in the EU as discussed for example by Mastrobuoni (2004) and Istat (2003). And finally, since I have implemented the treatment number two (buyers still see values in CZK), I was able to test for the euro illusion effect (as described by Gamble, 2006), which was present in this sample as well. Thanks to the fact that the traded commodity was nameless and not closely specified, the participants could not have any prior assumptions regarding the price of the traded item and thus leading to minimization of external noises.

Unfortunately, as it is almost with all experimental studies, even this study had to face few limitations. The biggest drawback, I believe, is in the limited comparability of the results with different studies from different countries and hence I had to be very careful with concluding any general statements. Another limitation can be seen in the size of the dataset. Although the participants of the experiment were incentivized, adding more participants, especially from the broader population, would surely add to the explanatory power. I am hoping that this study will raise interest in the topic of euro changeover, especially in the Czech Republic, as it could help the Czech citizens to better prepare for the possible currency changeover and thus could help introduce smoother changeover.

References

Alba, Joseph W., Bolton, Lisa E. & Warlop, L. (2003). Consumers Perceptions of Price (Un)Fairness. Journal of Consumer Research, 29 (4), 474-491.

Adriani, F., Marini G., & Scaramozzino, P., 2009. The Inflationary Consequences of a Currency Changeover on the Catering Sector: Evidence from the Michelin Red Guide. Oxford Bulletin of Economics and Statistics, 71 (1), 113-133.

Aalto-Setälä, V., Raijas, A., 2003. Consumer price knowledge before and after the euro changeover. International Journal of Consumer Studies, 27 (3), 210-217.

Bates, John M., Gabor, A. (1986). Price Perception in Creeping Inflation: Report on an Enquiry. Journal of Economic Psychology, 7, 291–314.

Cannon, E., Cipriani, G. P. (2006). Euro-Illusion: A Natural Experiment. Journal of Money, Credit and Banking, 38 (5), 1391-1403.

Public Opinion Research Centre. Citizens on Adoption of Euro and Impacts of EU Membership on the Czech Republic - April 2014. Retrieved 11 February, 2015, http://cvvm.soc.cas.cz/en/international-relations/citizens-on-adoption-of-euro-and-impacts-of-eu-membership-on-the-czech-republic-april-2014

Czech Governmnet & Czech National Bank (2003). The Czech Republic's Euro-area Accession Strategy. Retrieved 10 November, 2014, http://www.cnb.cz/en/monetary_policy/inflation_reports/2003/2003_october/boxes_annexes/zpinflace_03_october_p.html

Czech National Bank. Analyses of the Czech Republic's Current Economic Alignment with the Euro Area (2008). Retrieved November 16, 2014, http://www.cnb.cz/en/monetary_policy/strategic_documents/download/analyses_of_alignment_2008.pdf.

Duffy, D., Lunn, Peter D. (2009). The Misperception of Inflation by Irish Consumers. The Economic and Social Review, 40 (2), 139-163.

EC, 2001. Euro attitudes (wave 6) — Eurozone. Conducted by EOS Gallup Europe upon the request of the European Commission in November 2001, Flash Eurobarometer Number 115.

EC, 2005. The euro, 4 years after the introduction of the banknotes and coins. Conducted by EOS Gallup Europe upon the request of the European Commission in October 2005, Flash Eurobarometer Number 175.

EC, 2007. Introduction of the euro in the New Member States. Conducted by EOS Gallup Europe upon the request of the European Commission in March–May 2007, Flash Eurobarometer Number 207.

Fisher, I. (1928). The money illusion. New York: Adelphi.

Flek, V. (2013). The Blundered Strategy of Euro Adoption in the Czech Republic: A "Pre-crisis" Retrospective. Review of Economic Perspectives, 13, 132-145.

Gamble, A. (2006). Euro illusion or the reverse? Effects of currency and income on evaluations of prices of consumer products. Journal of Economic Psychology, 27, 531–542.

Gamble, A., Gärling, T., Västfjäll, D., & Marell, A. (2005). Effects on consumer choice of the nominal representation of prices. Journal of Retailing and Consumer Services, 12, 307–406.

Hertwig, R., Ortmann, A. (2001). Experimental practices in economics: A methodological challenge for psychologists? Behavioral and Brain Sciences, 24, 383-451.

Helísek, M. (2013). How far along is euro adoption in the Czech Republic? Benefits for business still remain. Central European Business Review, 2.

Hobijn, B., Ravenna, F. & Tambalotti, A. (2006). Menu Costs at Work: Restaurant Prices and the Introduction of the Euro, The Quarterly Journal of Economics, 121, (3), 1103-1131.

Hofmann, E., Kamleitner, B., Kirchler, E. and Schulz-Hardt, S. (2006). Kaufkraftschwund nach der Wahrungsumstellung: Zur erwartungsgeleiteten Wahrnehmung des (T)Euro, forthcoming in Wirtschaftspsychologie.

Holt, Charles A. (1993). Industrial Organization: A Survey of Laboratory Research.

Hong, James T., Plott, Charles R. (1982). Rate Filing Policies for Inland Water Transportation: An Experimental Approach. The Bell Journal of Economics, 13 (1), 1-19.

Istat: L'inflazione percepita al 6% (8 October 2003), Corriere della Sera.

Jonas, E., Greitemeyer, T., Frey, D., & Schultz-Hardt, S. (2002). Psychological effects of the Euro-experimental research on the perception of salaries and price estimations. European Journal of Social Psychology, 32, 147-169.

Kemp, Simon (1991). Remembering and Dating Past Prices. Journal of Economic Psychology, 12, 431–455.

Ketcham, J., Smith, Vernon L., & Williams, Arlington W. (1984). A Comparions of Posted-Offer and Double-Auction Pricing Institutions. The Review of Economic Studies, 51 (4), 595-614.

Kooreman, P., Faber, Riemer P. & Hofmans, Heleen M. J. (2004). Charity Donations and the Euro Introduction: Some Quasi-Experimental Evidence on Money Illusion. Journal of Money, Credit and Banking, 36 (6), 1121-1124.

Marques, J. F., & Dehaene, S. (2004). Developing intuition for prices in euros: Rescaling or relearning prices? Journal of Experimental Psychology: Applied, 10, 148–155.

Mastrobuoni, G. (2004). The Effects of the Euro-Conversion on Prices and Price Perceptions. CEPS Working Paper, 101.

Meier, K., & Kirchler, E. (1998). Social representations of the euro in Austria. Journal of Economic Psychology, 19, 755–774.

Ministry of Finance of the Czech Republic & the Czech National Bank. Assessment of the Fulfilment of Maastricht Convergence Criteria and the Degree of Economic Alignment of the Czech Republic with the Euro Area (2004–2008). Retrieved November 11, 2014, from http://www.zavedenieura.cz/en/documents/fulfilment-of-maastricht-criteriaAppendixes

Müller-Peters, A., Pepermans, R., Kiell, G., Battaglia, N., Beckmann, S., Burgoyne, C., et al. (1998). Explaining attitudes towards the euro: Design of a cross-national study. Journal of Economic Psychology, 19, 663–680.

MUNDELL, R. A. (1961). A Theory of Optimum Currency Areas. American Economic Review, Vol. LI, No. 4, 509–517.

Mussweiler, T., & Englich, B. (2003). Adapting to the Euro: Evidence from bias reduction. Journal of Economic Psychology, 24, 285–292.

Penize.CZ. EUR exchange rate. Retrieved 11 February, 2015, http://www.penize.cz/kurzy-men/6596-euro

Plott, Charles R. (1986). Laboratory experiments in economics: the implications of posted-price institutions. Science, 232, 732-738.

Raghubir, P., & Srivastava, J. (2002). Effect of face value on product valuation in foreign currencies. Journal of Consumer Research, 29, 335–347.

Ranyard, R., Burgoyne, C., Saldanha, G., & Routh, D. A. (2005). A qualitative study of adaptation to the Euro in the republic of Ireland: 1. Attitudes, the "Euro Illusion" and the perception of prices. Journal of Community and Applied Social Psychology, 15, 95–107.

Shafir, E., Diamond, P., & Tversky, A. (1997). Money illusion. The Quarterly Journal of Economics, 112, 342–374.

Smith, Vernon L. (1964). Effect of market organization on competitive equilibrium. The Quarterly Journal of Economics, 78 (2), 181-201.

Smith, Vernon L. (1976). Bidding and Auctioning Institutions: Experimental Results," in Y. Amihud (ed.) Bidding and Auctioning for Procurement and Allocation, New York: New York University Press, 43-64.

Stix, H. (2009). Perceived inflation and the euro: Evidence from an Austrian survey. European Journal of Political Economy, 25, 547-561.

Survey on the Introduction of the Euro (2002), Press Release 6 March 2002, National Bank of Belgium, Brussels.

Svedsäter, H., Gamble, A., & Gärling, T. (2006). Money illusion in intuitive financial judgments: Influences of nominal representation of share prices. Journal of Socio-Economics.
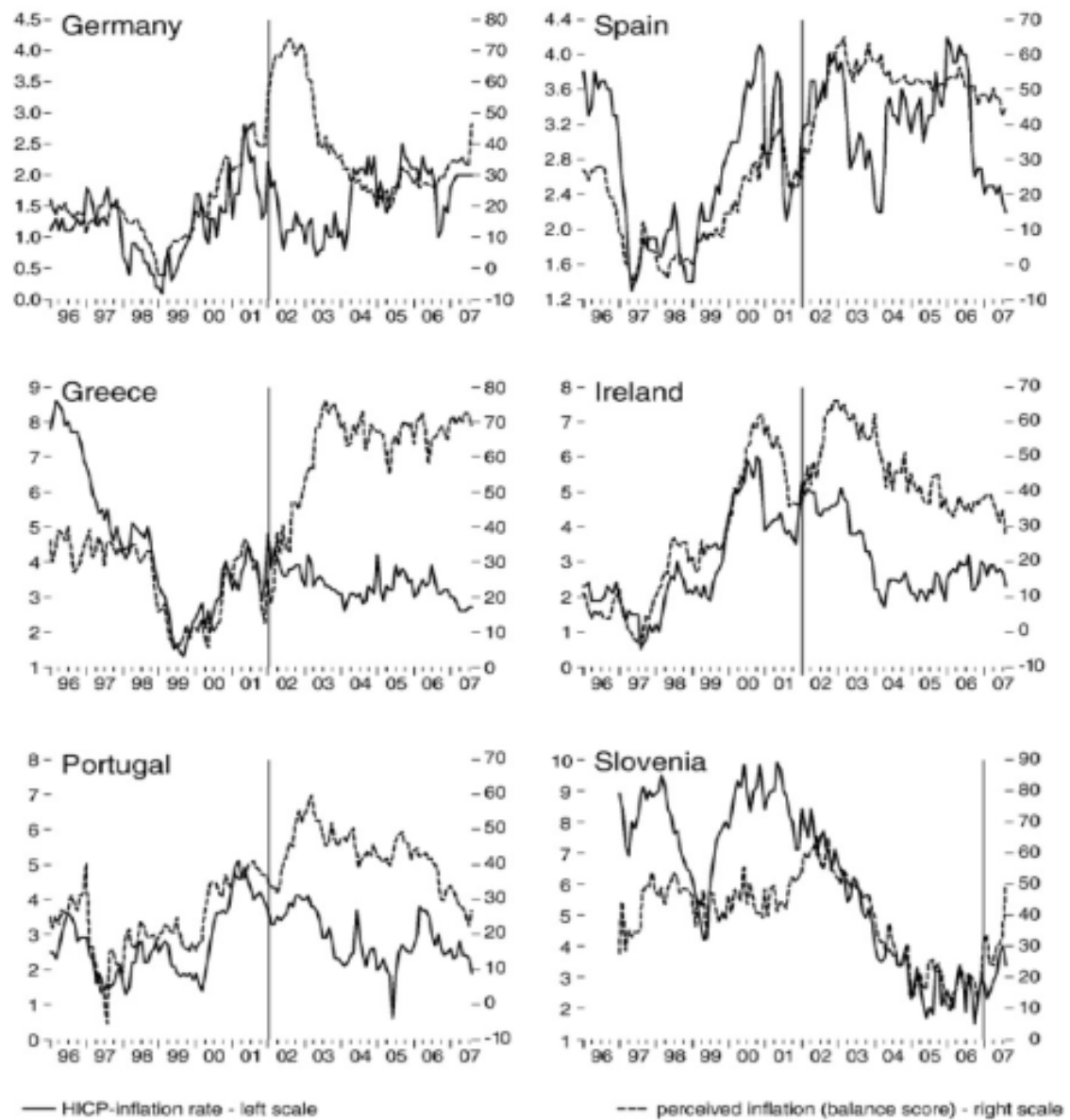
Appendix

Appendix 1: Perceived vs. real inflation in euro area, part 1
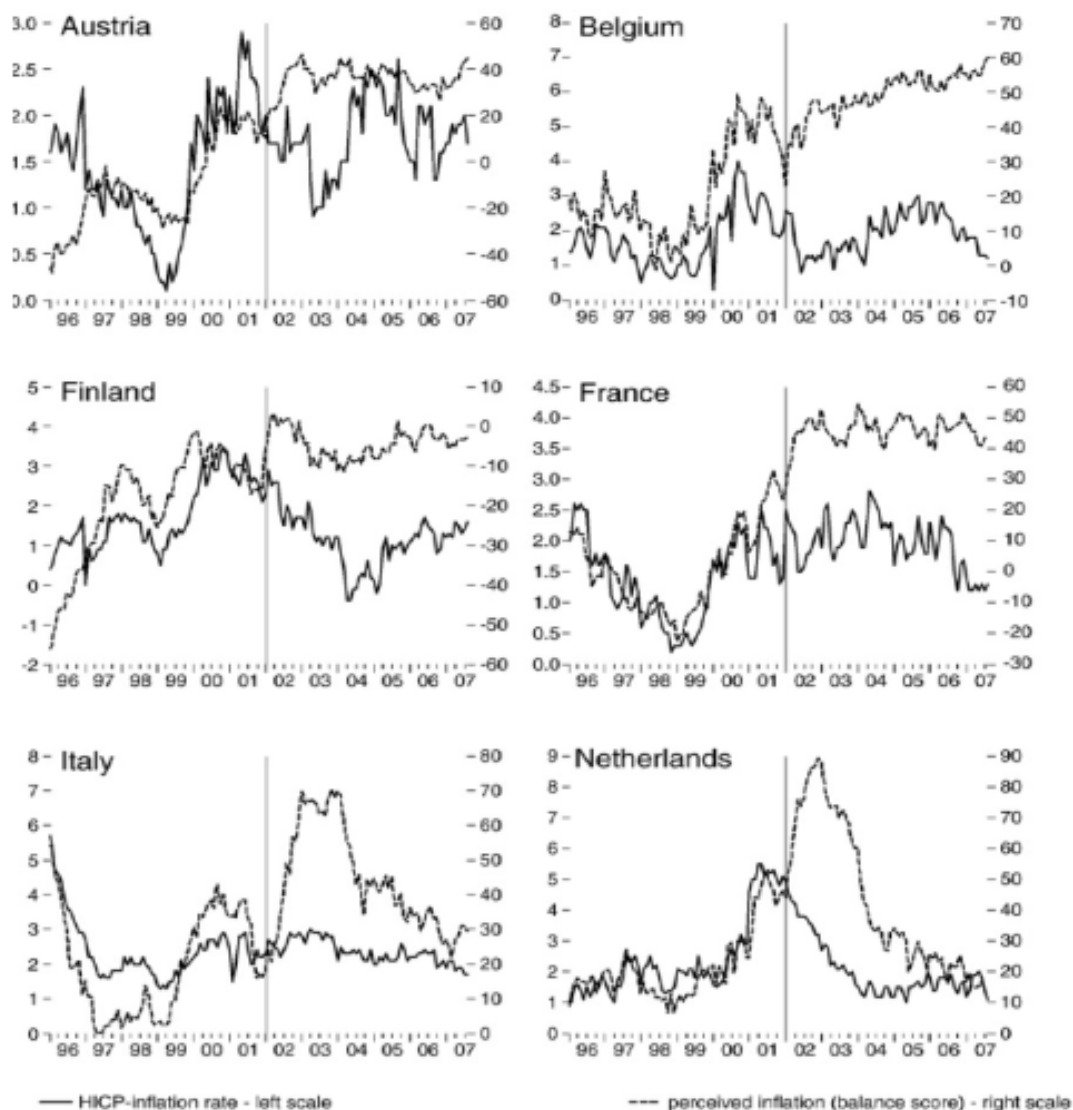
Source: Stix, 2009

Appendix 2: Perceived vs. real inflation in euro area, part 2

—— HICP-inflation rate - left scale   --- perceived inflation (balance score) - right scale

Source: Stix, 2009

Appendix 3: Euro counties and their exchange rates with the euro

Country	Exchange Rate	approx.	error
Belgium	40.34	40	0.8%
Germany	1.96	2	-2.2%
Greece	340.75	350	−2.6%
Spain	166.39	166.67	-0.2%
France	6.56	6.67	-1.7%
Ireland	0.79	0.8	-1.6%
Italy	1936.27	2000	-3.2%
Luxembourg	40.34	40	0.8%
Netherlands	2.20	2.2	0.2%
Austria	13.76	14	-1.7%
Portugal	200.48	200	0.2%
Finland	5.95	6	-0.9%

Source: Mastrobuoni, 2004