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Exchange rate as an unconventional tool of monetary expansion on the example of The Czech Republic

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Declaration on word of honor

I declare on word of honor that I independently elaborated the diploma thesis "**Exchange rate as an unconventional tool of monetary expansion**" and listed all used literature and the background material in the enclosed list of literature.

In ………….. day ………..…..

Acknowledgements

Abstrakt

Nedávná krize a ekonomická recese způsobila v mnoha zemích problémy s poklesem inflace a celkové zpomalení hospodářského růstu. Úrokové míry centrálních bank se ocitly v tzv. nulové dolní mezi (ZLB). Tato práce popisuje situaci deflace, ZLB a pasti likvidity. Tyto podmínky donutily cetrální banky k využívání alternativních nástrojů. Hlavním cílem této práce je zhodnotit využití kurzových intervencí, jako nekonvenčního nástroje v malé otevřené ekonomice s režimem cílování inflace, reprezentované Českou republikou. V praktické části práce zkoumá využití dalších možných nestandardních nástrojů v České republice a poskytuje důvody pro rozhodnutí České národní banky. Analýza ukazuje složitost problému a přináší důkazy o tom, že kurzový závazek nebyl plně promítnut do požadované úrovně cen. Nástroj by mohl vést k očekávanému dopadu, ale účinek je ovlivněn faktory, které nemá centrální banka žádný vliv. Účinek cesty k ovlivnění inflace, kterou zvolila Česká národní banka se prokáže až v horizontu několika let, po ukončení kurzového závazku.

Abstracts

Recent crisis and economic recession caused in many countries problems with drop in inflation and overall downturn in economic growth. The Central Banks found themselves in so called zero lower bound. This thesis describes the situation of deflation, zero lower bound and liquidity trap. These conditions called for the use of alternative monetary policy tools. The main goal of the thesis is to evaluate the use of foreign exchange rate intervention as unconventional tool in a small open economy with inflation targeting regime represented by the Czech Republic in the analytic part. Thesis examines other non-standard instruments and provides reasons for the Czech National Bank decision. The analysis shows the complexity of the issue and provides the evidence that exchange rate commitment was not displayed to the desired price level. The tool could lead to expected repercussion, but the effect is impacted by factors, which Central Bank cannot control. The effect of the CB way to fight the decreasing inflation will be better shown after the CB exit from the commitment.

Contents

1 Introduction

The Economy has suffered since the big crises in 2008 happened. During a process of recovery, when countries were fighting with sluggish growth another stroked of economy weakening has appeared in 2012 and 2013, as shown in United Nation booklet "World Economic Situation and Prospects"[1]. This negatively affected employment, household income and consumption, corporate profits and investment. Central banks (CB) have been looking for effective way to stable the economy. For a long time CBs where lowering the main interest rate in order to support the economic growth, investments, consumption and to encourage the economy to reach stabilized price level. However nowadays the interest rate policy is no more efficient, due to the fact that rates have already reached the lowest point possible and some of them are even in a negative numbers. These days' CBs are searching for a new programs and ways to control and manage their monetary policies. The most discussed tools that have been proactively used within the monetary policies of leading or small open economies are quantitative easing and exchange rate intervention.

 In a recent history economist and analyst worry about a potential deflation. The inflation was very low and in some cases was pushing prices down. The origin of deflation may have begun in the simultaneous small foreign and nation demand. Society is saving more money instead investing it, which drags the interest rate even lower. If economy works in a regime of liquidity surplus and needs further easing of monetary policy, but there is no rooms for the interest rate to go down, the standard tool of monetary policy doesn't work. Economies were very close to fall in to so call "deflation trap" and could have experienced "saving paradox ".[2]

This thesis aims to analyses situation in small open economic with the focus on the Czech Republic, the effectiveness of alternative tool used for boosting the economy and avoiding potential risk of deflation. Thesis centers the foreign exchange intervention (later FX intervention) tool, which concerns using CBs foreign currency reserves that are one of the biggest item on an active site in a

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[1] *World Economic Situation and Prospects 2014* [online]. New York: United Nations, 2014 [cit. 2015-05-12]. ISBN 978-92-1-109168-0. Available: http://www.un.org/en/development/desa/policy/wesp/wesp_current/wesp2014.pdf

[2] Also referred to as Paradox of Thrift was recognized by John Maynard Keynes. The idea behind this paradox is that the spending of society benefits to all, since one individual's expenses is another one's income. Therefore the trend of saving rather than spending, causes collective damage. Firm's profit decrease and are forced to lay off employees. More about Deflation trap later in the thesis.

CB´s balance sheet, to influence the exchange rate, competitiveness of economy, financial stability and indirectly the interest rate and inflation. Literature has been discussing using FX intervention already with the example of Japan, when McCallum[3] argued, that CBs in open economy can reach real and inflation stability by depreciating of its exchange rate. Authors such as Svensson[4] and Stone and col.[5] also deal with unconventional monetary policy using exchange rate while achieving low limit of interest rates.

2 Inflation Targeting

In the recent years countries around the world has experienced changes in the implementation of monetary policy, its strategies and tactics. Since the 1980s there have been significant trends in efforts to focus on the stability of prices, reduction of inflation and increase of independency of CBs. CBs began to operate with a new regime "inflation targeting" and thus more or less abandoned the category of money supply and demand.[6]

The first CB, which implemented this mechanism in the year 1990, was Reserve Bank of New Zealand. This was achieved by the Reserve Bank of New Zealand Act of 1989 appointing the independence of CB and established single objective for the monetary policy.[7] After the approach, number of countries both developed (Canada, Sweden, and Switzerland) and developing (Brazil, Chile, and Czech Republic) followed the New Zealand's ambitious adaptation of a new monetary. The theoretical background of inflation targeting was presented by new Keynesian economics in the form of so-called "A new consensus".[8]

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[3] MCCALLUM, Bennett T. *Theoretical analysis regarding a zero lower bound on nominal interest rates*. National bureau of economic research, 2000.

[4] SVENSSON, Lars EO. *The zero bound in an open economy: A foolproof way of escaping from a liquidity trap*. National Bureau of Economic Research, 2000.

[5] STONE, M., K. FUJITA, AND K. ISHI (2011): "*Should Unconventional Balance Sheet Policies be Added to the Central Bank Toolkit? A Review of the Experience So Far*." IMF Working Paper No. 145.

[6] KORDA, Jan: Komparace nového konsensu jako teoretického rámce cílování inflace s postkeynesovskou ekonomií. *Politická ekonomie,* 2010, 58.1: 92-104.

[7] SVENSSON, Lars EO. Inflation targeting: should it be modeled as an instrument rule or a targeting rule?. *European Economic Review*, 2002, 46.4: 771-780.

[8] GONÇALVES, Carlos Eduardo S.; SALLES, João M. Inflation targeting in emerging economies: What do the data say?. *Journal of Development Economics*, 2008, 85.1: 312-318.

As Bernanke and Mishkin state in their article : " *this approach is characterized, as the name suggests, by the announcement of official target range for the inflation rate at one or more horizons, and by explicit acknowledgment that low and stable inflation is the overriding goal of monetary policy.*" Authors also mention other key features of the regime such as the importance of communication with the public and increase responsibility of CBs to meet the set inflation target.[9]

The core idea behind this approach is the effect in the change of key interest rate[10], which in this regime represents the main and only instrument of the CB to change the price level through the various links on the economy. These links have impact on the ultimate objective - price stability and the success of monetary policy.

This chapter will introduce the simplified structural model of inflation targeting in respect with the thesis main focus on the small-open economy. The function relations are mainly taken from textbook of the authors Mandel and Tomšík. [11]

2.1 Functional relations

As briefly mention above, inflation targeting is characterized by the CB´s effort to meet the previously set inflation target. This is achieved by managing the short term interest rate of certain CB, which represents the operational criterion. There is no intermediate criterion and the CB uses number of inflation indicators.

Mandel and Tomšík firstly explain inflation targeting in a reduced form with the help of two functional equations: [12]

1)   Central bank´s reaction function

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[9] BERNANKE, Ben S.; MISHKIN, Frederic S. Inflation targeting: a new framework for monetary policy?. National Bureau of Economic Research, 1997.

[10] For example ČNB uses Repo rate as the key interest rate, however the specific definition depends on the instrumentation of the certain Central Bank.

[11] MANDEL, Martin a Vladimír TOMŠÍK. Monetární ekonomie v malé otevřené ekonomice. 2., rozš. vyd. Praha: Management Press, 2008, 367 s. ISBN 978-80-7261-185-0.

[12] MANDEL, Martin a Vladimír TOMŠÍK. Monetární ekonomie v malé otevřené ekonomice. 2., rozš. vyd. Praha: Management Press, 2008, 367 s. ISBN 978-80-7261-185-0.

$$\text{repo}_t - \text{repo}_E = f\,(\,P_t\,(\,p_{t+1}\,) - p^T{}_{t+1}),\tag{1}$$

where :

$p^T{}_{t+1}$: inflation target in the year t+1

$P_t\,(\,p_{t+1}\,)$: inflation prognosis in the year t for year t+1

repo_t : Short- term operative interest rate in the year t

repo_E : Short- term operative equilibrium interest rate

2)   Inflation prognosis

$$P_t\,(\,p_{t+1}\,) = f(\,x_{t,1}\ldots x_{t,n}),\tag{2}$$

$x_{t,1}\ldots x_{t,n}$ represent different exogenous explanatory variables for the inflation prognosis.

As those two function relations imply, inflation targeting process covers the setting of inflation target, creation of prognoses (conditional or unconditional)[13] as well as the operative management of short-term interest rate of the CB.

In order to influence inflation in the desired direction the CB changes its operational short-term interest rate. This adjustment should cause changes in the market short-term interest rate which should result in inflation correction. Described process can be identified as the traditional transmission mechanism.

Different exchange rate regimes could be undertaken by countries, however studies found that financially open countries with inflation targeting regimes are likely to profit more from exchange rate flexibility, resulting in long-term growth. Growing financial openness of countries necessitate the exchange rate to be flexible. There are few reasons that supports the statement. Firstly, flexibility of the exchange rate could play a role, when domestic prices have been set and the

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[13] More about inflation prognoses in: SKOREPA, Michal; KOTLAN, Viktor. Inflation Projections in Inflation Targeting: To Forecast or to Simulate?. 2002.

nominal rigidities could occur. Exchange rate would be in this case a price variable to absorb shocks. As it will be discussed later, exchange rate is one of the channels of monetary policy transmission. Free movement reinforces this channel, improving policy effectiveness. Policy under the inflation targeting, thus can pay more attention on domestic shocks.

In the inflation targeting, short-term interest rate is managed in the present time usually by open market operations. The CB, however, can choose any available tool to implement its monetary policy.[14] Developed countries commonly use the indirect instruments of monetary policy, which act globally on the entire banking sector.[15] CNB in order to influence the interest rate also uses the open market operations and buys (sells) securities[16] from domestic commercial banks in the domestic currency. If the price, interest rate, is announced in advance, the CB intends to change the short-term interest rates. Purchasing of securities by central banks leads to increase in demand and decrease in their prices, and so drop in short-term interest rate. With the sales of securities the result is opposite. Another effect of these operations is the impact on liquidity of commercial banks.

2.2 Transmission mechanisms

CBs don't have a direct way to influence the final monetary goals. Instead CB use different tools[17] to firstly effect operative criteria and secondly, in many transmission mechanisms, also stimulate so called intermediate criteria. This process should in the end result in anticipated impact on final monetary target. Ravenna defines transmission mechanism as a chain of causal relations, which CB uses to reach the monetary policy target.[18]

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[14] Operations in the open market, discount instruments and foreign exchange intervention or direct instruments such as change in reserves requirement, liquidity rules and others

[15] REVENDA, Zbyněk. Centrální bankovnictví. 2., rozš. vyd. Praha: *Management Press*, 2001, 782 s. ISBN 80-7261-051-1.

[16] The Government or CB securities.

[17] Central banks 4 most used and traditional tools are: Open market operation, Exchange rate intervantion, Reserves requirements and discount rate.

[18] REVENDA, Zbyněk. Peněžní ekonomie a bankovnictví. Vyd. 4. Praha: *Management Press*, 2008, 627 s. ISBN 978-80-7261-132-4.

Due to the fact that this thesis is primarily directed towards inflation targeting in small open economy, the considered main CB´s tool will be interest rate and its effects on assets prices, exchange rate, consumption and the whole economy.

Monetary policies identify several fundamental monetary transmissive channels:

1) Assets price channel
2) Exchange rate channel
3) Interest rate channel
4) Credit channel

This chapter's goal is to briefly characterize above mentioned channels with the closer focused on exchange rate channel. It is also important to mention the assumption of open economy and real interest rate.

Figure 1 Transmission mechanisms
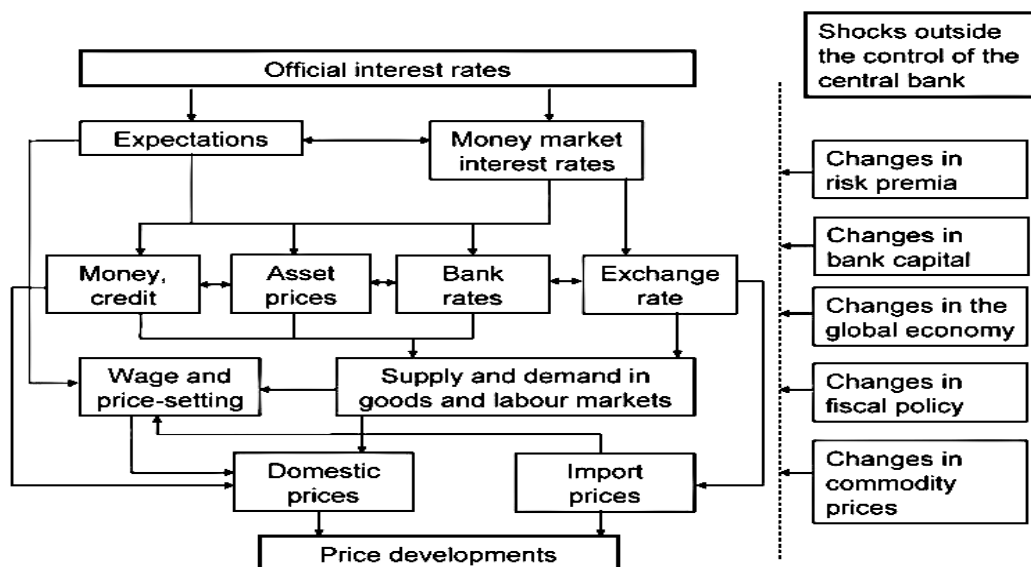
Source: *Transmission mechanism of monetary policy.* EUROPEAN CENTRAL BANK *[online]. [cit.2015-11-07].*

2.2.1 Assets price channel

Monetary policy influences the fluctuations of asset's prices, which have important effects on the aggregate economy. Transmission assets price channel includes tenure instruments denominated in domestic currency. Mishkin in his article divides the impact of monetary policy on assets prices to three types:

1) Stock market effects on investment
2) Firm balance-sheet effects
3) Household wealth and liquidity effects. [19]

For the next parts of thesis the author will consider the example of monetary expansion. This means CB is lowering interest rate (IR_{CB}).

As for stock market effect Mishki uses Tobin's q[20] (q) to explain why companies can invest (I) more when this indicator is high. In order to fully understand this mechanism it's important to explain how monetary policy can effect stock prices. One way to illustrate the influence is through price of bonds. Lower interest rate makes bonds unattractive and demand for stocks increases along with their prices (P_s). Firms are therefore able to issue stocks and sell them for far more in relations to cost of facilities and equipment, which firms want to purchase. Higher prices of stocks relative to replacement cost of capital rises Tobin´s q and encourages investments of firms, which boosts up the output (Y) as well as influences the inflation (π). [21]

$$\downarrow IR_{CB} \rightarrow \uparrow P_s \rightarrow \uparrow q \rightarrow \uparrow I \rightarrow \uparrow Y \rightarrow \uparrow \pi \qquad\qquad (3)$$

Another way how monetary policy and its impact on price of stocks influences the output is through credit market and the existing information asymmetry. It is called the "balance sheet channel". In summary, when expansionary monetary policy is implemented and price of stocks elevate, firms with a lower net worth (NW) become more valuable. Banks and other lenders are more likely to

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[19] MISHKIN, Frederic S. *Monetary policy strategy: lessons from the crisis*. National Bureau of Economic Research, 2011.

[20] Defined as the market value of firms divided by the replacement cost of capital.

[21] Alternative mechanism can be described through lower cost of capital , for more see MISHKIN, Frederic S. *Monetary policy strategy: lessons from the crisis*. National Bureau of Economic Research, 2011.

provide loans (L) to those firms do to reduction of adverse selection and moral hazard issue[22]. Higher lending leads to more investments (I). The transmission can be viewed as bellow. However, the effect of Tobin´s q on investments can be disputable. Due to reduction of adverse selection and moral hazard decrease of investment can occur, when the market value of a firm rises. This is caused by the lower need to take on riskier projects.

$$\downarrow IR_{CB} \rightarrow \uparrow P_s \rightarrow \uparrow NW \rightarrow \uparrow L \rightarrow \uparrow I \rightarrow \uparrow Y \rightarrow \uparrow \pi \qquad (4)$$

Similar relation can be linked on household's spending. There are two ways to follow the transmission. The first one is through liquidity of households. Consumer tend to hold more of liquid assets (stocks, bonds etc.) , when expectation financial crises, instead of buying durable and illiquid assets (houses, cars etc.). When prices (P_{fa}) of stocks go up, consumers feel safer and are willing to spend more money on long-lasting assets (C_d). Below is the potential scenario of mentioned transmission mechanism. Mishkin also talks about second effect, the effect on household´s wealth, when prices of stocks rise. Due to the fact that stocks are a component of financial resources of households, thus the wealth increases along it the spending. Transmission through households also brings potential inconclusive in the result. People may decide to save their additional funds instead of spending them.

$$\downarrow IR_{CB} \rightarrow \uparrow P_{fa} \rightarrow \downarrow \text{ possibility of financial harm} \rightarrow \uparrow C_d \rightarrow \uparrow Y \rightarrow \uparrow \pi \qquad (5)$$

This mechanism is considered as one of the least justifiable, due to the potential rebuttable causality mentioned above.

2.2.2 Interest rates channel

Interest rate channel could be considered as a core transmission channel for inflation targeting. Lowering the core CB´s interest rate (IR_{CB}), which represents the expansionary monetary policy

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[22] Moral hazard is a problem connected with debt and equity contracts arising from the debtor's motivation to take very risky investments and the owners' failure to guarantee that managers will perform and behave in the owners' interest.

(M), decreases interest rate (IR_D) costs for firms and households. Firm's investments (I) and household's spending (C) as well as output rises (Y_D) together with the domestic inflation (π_D).

$$\downarrow IR_{CB} \rightarrow \uparrow M \rightarrow \downarrow IR_D \rightarrow \uparrow I, \uparrow C \rightarrow \uparrow Y_D \rightarrow \uparrow \pi_D \tag{6}$$

This thesis will be later discussing monetary policy under so called zero lower bound (ZLB), when nominal CB interest rates reaches its lowest point and CB cannot use its standard tool. However in this section it's worth mentioning the effect of expectation and its impact on inflation.

Expansionary monetary policy traditionally leads to the expectation of higher future price level (P_e), considering rational economical agents. Hence future price level determines the expected future inflation (πe). The nominal interest rates stay the same, but the real rates decrease.

$$\uparrow M \rightarrow \uparrow P_e \rightarrow \uparrow \pi_e \rightarrow \downarrow IR_D \rightarrow \uparrow I \rightarrow \uparrow Y_D \rightarrow \uparrow \pi_D \tag{7}$$

Thus this channel could be in non-standard conditions problematic, due to the possibility of putting the economy in so called liquidity trap.

2.2.3 Credit channel

The effectiveness of credit channel is determined by the role of banks within the financial system and credit market. The crucial characteristic of commercial banks as main credit institution and its privilege to receive liquidity from CB or within the intra-bank market and distributes the liquidity to those without this access through loans.[23] The effectiveness of credit transmission mechanism could be impaired by the willingness of economic subjects accept loans and the increasing attractiveness of non- bank loan providers.

So called "balance sheet" effect was already discussed above, when describing asset price channel. In this section the transmission can be modified with the focus on a firm risk aversion. Moving the interest rates down (IR), lowers the cost of capital of firms. The net worth increases as well as the price of stocks (P_e), and business owners become less risk averse (R_f) leading to volume rise of

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[23] Usually small and medium businesses

loans (L) and growth of investments (I), output (Y) and inflation (π). The overview of the channel can be typified[24]:

$$\downarrow IR_{CB} \rightarrow \uparrow P_e \rightarrow \downarrow R_f \rightarrow \uparrow BL \rightarrow \uparrow I \rightarrow \uparrow Y_D \rightarrow \uparrow \pi_D \qquad (8)$$

2.2.4 Exchange rate channel

In small open economy, fluctuation of exchange rate can have a strong impact on inflation. The depreciations could end up in the rise of inflation due to the effect of higher import prices of goods, which directly enter the consumer basket and increase the inflation prices. Other reason may be the switch in domestic demand[25] as well as foreign demand, when people start buying more of the local goods, effecting the price, export and thus the output. Prices may be also increased by effect from the supply site, when producers may raise the prices, due to the higher prices of alternative foreign goods.

The core theoretical idea behind exchange rate transmission channel (considering expansive monetary policy) is based on supply of money through monetary base and the change in interest rate, the topic of uncovered interest rate policy will be discussed later in this thesis.

Mishkin divides the effects of exchange rate on economy in to two:

1) Effect on net exports
2) Effect on balance sheets

The growing importance of internalization and interdependency of economics has been on the horizon for a long time. Exchange rate and it´s fluctuation is putting a lot of pressure on household´s, firm´s and government´s decisions. Especially in open-market economy with flexible exchange rates the attention is turned on to the monetary policy reaction and effects on exchange rate.

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[24] MUKHERJEE, Sanchita; BHATTACHARYA, Rina. Inflation targeting and monetary policy transmission mechanisms in emerging market economies. IMF Working Papers, 2011, 1-27.
[25] Also called the subtitution effect.

In open-market economy the expansionary monetary policy can have major impact on export and thus the output.[26] The expansionary policy, when CB lowers its interest rate leads to the higher supply of local currency, which decreases the domestic interest rate (IR_D). Due to lower return compared to foreign interest rates, domestic deposit become unappealing for investors and local currency starts to flow out of the country.[27] The currency supply of the national currency on the Foreign Exchange Market raises and currency depreciates (E).[28] Domestic goods become cheaper abroad and compare to foreign imports. The result of depreciation is the increase of net exports (NX) causing bigger aggregate spending (Y), which leads to rise in inflation (π_D). The schema is as follows:

$$\downarrow IR_{CB} \rightarrow \downarrow IR_D \rightarrow \downarrow E \rightarrow \uparrow NX \rightarrow \uparrow Y_D \rightarrow \uparrow \pi_D \qquad\qquad (9)$$

In this context, Marshall-Lerner condition could be important for the assumption that depreciation causes the increase in net export. This condition uses price elasticity of exports and imports to indicate the rule, which states that depreciation of the domestic currency will lead to an increase in net exports (its value) only if the sum of the price elasticities of exports and imports is greater than one. If the sum of these elasticities is less than one, depreciation will lead to a reduction in net imports.[29]

Monetary expansion of CB in this case puts additional, cut-rate liquidity in to economy[30], creating higher demand for liquidity for commercial banks. However above mentioned mechanism doesn't have to occur. Especially considering highly liquid inter-bank market, such as the Czech Republic, where banks have enough free reserves in addition to minimum required reserves and the economy is in the stagnating phase. Banks would have to face supplementary interest rate costs, due to a lack of investments during the domestic economical inactivity and target foreign investors. This

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[26] It is clear this is not the case when fix exchage rates are applied in the economy.
[27] The reaction would also depend on other factors such as transaction cost ect.
[28] The actuall exchange rate, using indirect quotation, goes up, but due to consistency and better understanding lower Exchange rate will be viewed as $\downarrow E$.
[29] MANDEL, Martin a Vladimír TOMŠÍK. Monetární ekonomie v malé otevřené ekonomice. 2., rozš. vyd. Praha: *Management Press*, 2008, 367 s. ISBN 978-80-7261-185-0.
[30] Due to higher export. Increase in export leads to future appriciation of the local currency.

mechanism also presupposes rational domestic financiers, which due to lower interest rate will end up investing abroad.[31]In this scenario, more effective way with the impact on inflation would be direct exchange rate intervention, which would result in more certain depreciation of the currency and brought up inflation.

Mishkin describes the Exchange rate effect on balance sheet, as the effect on financial and nonfinancial firms caused by domestic debt denominated in foreign currency. He also mentions, that emerging countries should be especially careful, because high foreign debt and depreciation of domestic currency can result in negative outcome on demand.[32] The monetary expansion (M) and the increase in interest rate (IR) leading to depreciation (E) can lower the net worth of firms and households, whose debt is denominated in foreign currency. Using the recalculation of liabilities by depreciated exchange rate, the liabilities increase, on the other hand assets are usually recorded in domestic currency and the value is stable. Domestic firms and household than become less creditable and above mention adverse selection and moral hazard can cause decrease in lending (L). [33] Lower lending and investment result in lower economical outcome (Y). The mechanism can be presented as below:

$$\downarrow IR_{CB} \rightarrow \downarrow E \rightarrow \downarrow NW \rightarrow \downarrow L \rightarrow \downarrow I \rightarrow \downarrow Y \tag{10}$$

2.3 The limits of inflation targeting

This chapter will focus on limits in conventional monetary policy in reaction to crises. CBs are getting into a situation where you cannot have interest rates lower and classical (conventional) monetary policy already has no more room for easing monetary conditions – known as Zero level bound (ZLB).

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[31] No creditibility of domestic country or other factors can play a role.

[32] MISHKIN, Frederic S. *Monetary policy strategy: lessons from the crisis*. National Bureau of Economic Research, 2011.

[33] This can lead to even bigger probelm when financial institutions , such as domaectic banks, have great froreign loans and are pushed from both sides of balace sheet. The liabilities increase due to higher debt and assets decrease due to firms and household not being able to pay-back their loans.

Achieving ZLB is probably the main difficulty of nowadays monetary policymakers, but definitely not the only one. The reasons for turning to non-standard measures can be triggered by disorders or dysfunctions of the financial system caused by a crisis of CB´s creditability. Another problem is the disruption of transmission mechanism in the ineffectiveness of interest rate or credit channel. During the financial crises the financial market conditions turn and the change can have significant role in the shift in transmission channels of monetary policy.

2.3.1 Zero lower bound

Before the Japan experience with ZLB during the 1990s, economists' didn't put too much significance in to this topic and the issue was ignored almost completely. They thought the ZLB could arise in any economy with a low inflation target, however constraint will be short-lasting and the potential incidences very rare. For example authors Reifschnieder and Williams[34] in their study assess the regularity and length of ZLB on the Federal Reserve's macro econometric model and found, that in the case of standard monetary policy rule, represented by Taylor's role[35] and the inflation target set on 2 percent, the ZLB would afflict about 5 percent of the time and constrains would last about one year.

The Japan's experience during the 1990s, as well as those in the EU and US in the aftershock of the crisis, put this topic in a spot light and coerced researchers to review their opinion. The world crises in 2008 raised a whole new chapter in the history of monetary policy. Initial reactions of the world's major CBs in an effort to improve the consequences of the crisis was a sharp reduction in key interest rates up to a level of technical zero, at which tariffs persist until today. Noticeable decline in interest rates among European Central Bank (ECB), Federal Reserve's Bank (FED) and Czech National Bank (CNB) can be seen in the figure 2 below.

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[34] REIFSCHNEIDER, David; WILLIAMS, John C. Three lessons for monetary policy in a low-inflation era. *Journal of Money, Credit and Banking*, 2000, 936-966.
[35] Rule specifies how much the central bank should modify the nominal interest rate in reaction to shift in inflation, output, or other economic conditions: $IR = R + w \, (\pi - \pi^{target}) + w \, (Y - Y^{pot})$
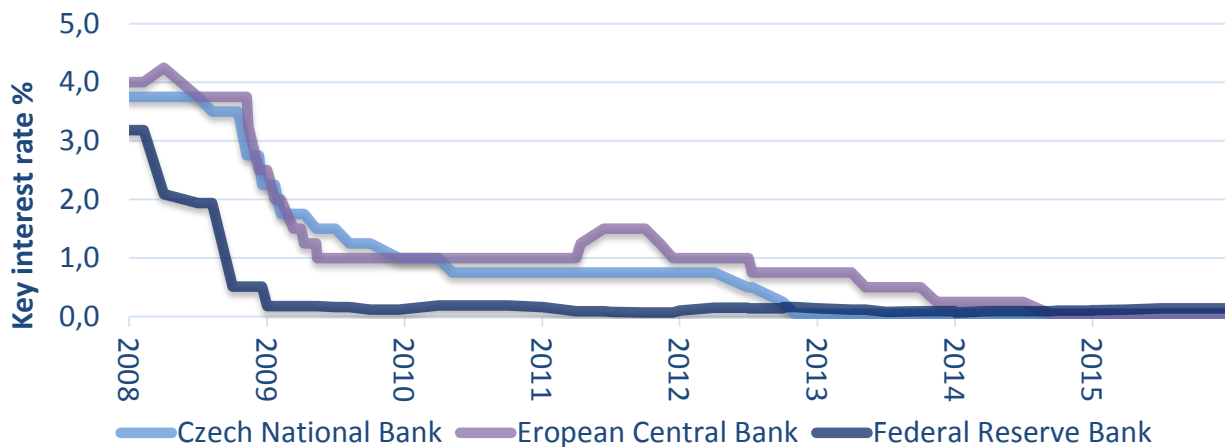
As the graph (figure 2) shows, FED as the first one, in response to the substandard (subprime) mortgages crisis, started to cut policy rates. Conversely, ECB's key interest rate increased slightly, until the fall of 2008, when after the collapse of Lehman Brothers the crisis fully erupted as well as the panic in global financial markets. It was obvious that other economies will hit a significant economic downturn. First to hit the zero ground was FED, its interest rate are since 2008 targeted in the interval 0-0, 25%. A bit different development can be observed in the Eurozone. In the first half of 2011, the base interest rate twice increased by a quarter percentage point to a total of 1,5%. The reason was a slight recovery of some economies, and thus the presence of higher inflation expectations. After four months, however, the main rate of the ECB lowered again. In September 2014, ECB key interest rate is reduced to 0, 05%. The Development of the key CB interest rate in the Czech Republic showed a very similar trend as in the aforesaid CBs. As a result of the global financial and economic crisis CNB responded complete exhaustion of its main monetary policy tool, while gradually reduced interest rates to a technical zero (0, 05%) at the end of 2012.

Ben S. Bernanke[36] pointed out: " *Should the nominal rate hit zero, the real short-term interest rate—at that point equal to the negative of prevailing inflation expectations—may be higher than*

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[36] BERNANKE, Ben S., et al. Deflation: Making sure 'it'doesn't happen here. *Remarks before the National Economists Club, Washington, DC*, 2002, 21.

the rate needed to ensure stable prices and the full utilization of resources." This may, thus call for the use of alternative and unconventional tools to ease monetary policy.
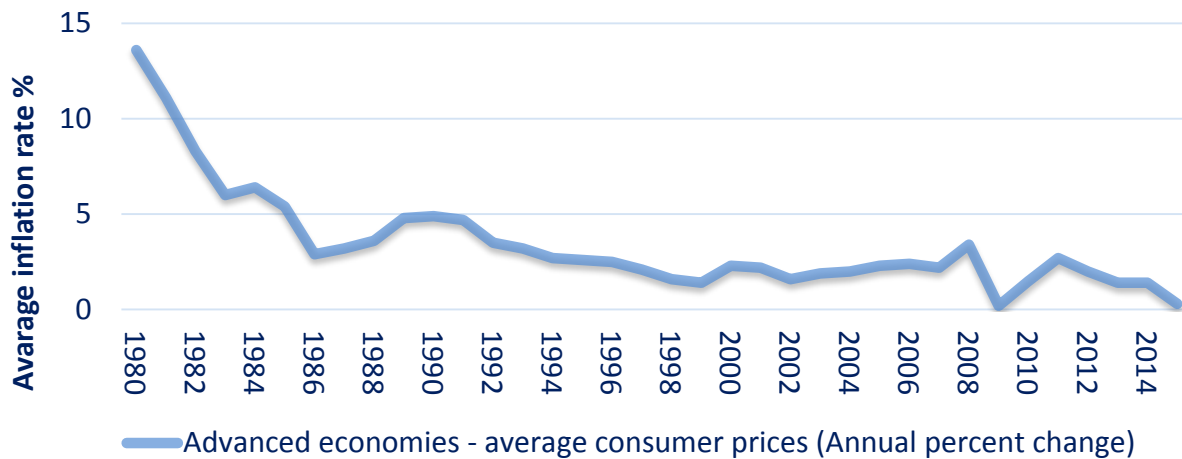
2.3.2 Deflation

In recent years there has been a worry in several countries[37] of spreading deflation and its deepening, due to the sharp slowdown in economic growth caused by financial crises and overall economic depression. Long prognoses showed low inflation rates and its fall possibly to even zero limits in the future. Figure 3 represents average inflation within economies, which International Monetary Fund considers as advanced.[38] Graph indicates, that inflation hasn't been so low for decades. Inflation decline could be viewed as beneficial in term of resource allocation[39] and decrease of uncertainty. However, low inflation or even deflation could cause very dangerous situation, when negative shocks to demand or supply could prolong and worsen the recession.[40] CB, then has to lower interest rate to arouse the economy. In such state negative interest rate may be necessary, and CB incline to use unconventional tools. This could lead to liquidity trap and extend the recession as well as deflation. With deflation, nominal interest rate at zero percent could still indicate higher real interest rate, than the one economy required for its healing from recession and the over indebtedness.

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[37] Central banks in Japan, China and other Asion countries,USA, Switzerland as well as the Czech Republic had to fight low inflation. Even ECB lowerd it interest rate in the hope of inflation increase.
[38] Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong SAR, Iceland, Ireland, Israel, Italy, Japan, Korea, Republic of, Latvia, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, San Marino, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Taiwan Province of China, United Kingdom, United States.
[39] This mainly means, that the real burden of debt in a situation of deflation is increasing, which in over-indebted economy causes a drop in demand and recession.

Economic literature provides two definition of deflation. The first one focuses on the price level in economy and its measured by the Consumer Price Index or GDP deflator. As Rogoff states in the study of International Monetary Fund: „*Deflation is defined as a sustained decline in an aggregate measure of prices such as the consumer price index or the GDP deflator. One or two quarters of price declines, while technically constituting deflation, would not be worrying. However, even mild but continuous deflation could be a cause for concern, as it may increase economic uncertainties, distort resource allocation, entail distributional consequences, and lead to subpar growth performance.*"[41]

Austrian school offers alternative explanation of deflation. They associate deflation solely with the unsatisfactory money supply. They also reject the above mention deflation recording on the base of fall in the price level measured by price indexes. In their opinion price indexes are artificially created abstractions, which are not able to affect the perception of price movements by individuals.

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[41] Rogoff, K. aj. (2003): *Deflation: Determinants, Risks and Policy Options – Findings of an Interdepartment Task Force.* Washington, D. C., International Monetary Fund, 2003.

It's necessary to point out that not all changes in prices can be identified as inflation and deflation. Revenda, in his paper, emphasizes the importance of long and continuous change in price in order to consider it as inflation or deflation. The shift in prices can be also caused by for example modification in taxes and deregulation, which is only fitful change. He also mentions the limiting effect of adequate money emission. Without sufficient money supply will prices eventually stop rising. However, there are no limits for the down- fall of prices in the terms of money supply, thus prices can go down, without necessarily fall in the money supply. [42]

Deflation could be divided by two basic situation, reflecting the effect on economy growth.

1) Bad deflation

2) Good deflation

Bad deflation represents the situation of decline in demand for goods and services, and is referred to as negative demand shock. Usually is associated with excessive restrictive monetary and fiscal policy, with a significant and longer lasting decline in asset prices, domestic recession or the recession and deflationary developments in the country's major trading partners as well as debt-relief of key sectors of the economy resulting in decline of consumption and investment. On the other hand second situation characterized as Good deflation, occurs when with the growth of the amount of goods to be produced, adequate escalation in money supply is not realized. In this context, we are talking about positive supply shock, which is associated with technological innovation leading to significant growth in labor productivity. Decrease in production costs may, in these cases, not only reimburse for the price decay, but it can also be a source of upward of profits following by the induced production growth. [43] The graphs bellow describe the two types of deflation using the AD-AS model. In this case inflation changes are substituted by price level, in order to display the changes in inflation and its decrease leading to deflation.

[42] REVENDA, Zbyněk. *Příspěvek k inflaci a deflaci v současné tržní ekonomice.* Finance a úvěr, 2004, 54, 7-8, 335-353.

[43] BORDO, M. D. – LANDON LANE, J. – REDISH, A. Good versus Bad Deflation: Lessons from the Gold Standard Era, Cambridge, National Bureau of Economic Research, 2004.

Figure 4 Deflation in AD-AS model
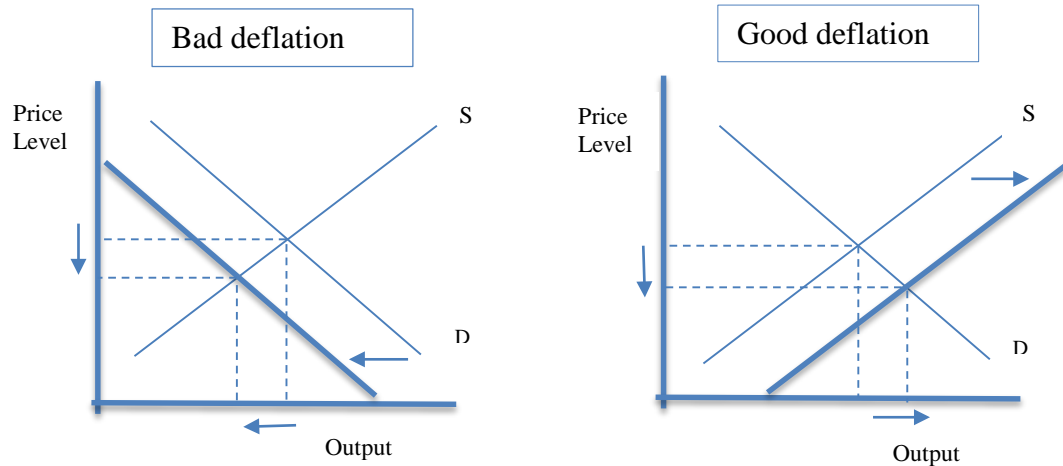
Source: *own processing of graph*

Revenda summarizes main factors, which question deflation as a healthy stage of economy:

1) Asymmetry development of prices, wages and capital market

2) Redistribution effect

3) Price stability and monetary policy of CB

The first set of factors could be easily described. The drop in prices, considering stable economic conditions (no positive supply shock exists), leads to accretion of real wages, transfers etc. This would result in the rise of unemployment and would have negative impact on state budget. Wages are downward almost inflexible, making fall in price level even bigger problem, when productivity must suffer even bigger increase accordingly to the upsurge of real wages. Decline in prices has a significant repercussion on capital market. Along with the stock prices the wealth of stock owns drops. Investors reduce their spending and negative atmosphere on capital markets prevails. Similar tendencies can be seen on the real-estate market. Asymmetry can be also noticed on the prices of loans, when the interest rates have the nominal limit the zero point.

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Redistribution constitute the transfer of wealth from some groups of economic entities in favor of other group of economic individuals. Redistribution of wealth causes substandard behavior primary of risk averse economic entities, causing ineffective allocation of resources. Redistribution also explains, why some entities can be oriented pro-inflation/ deflation. For example, real value of state debt increases with deflation, for that reason governments have interest in inflation. Debtors also take interest in inflation, on the other hand deflation could lead to problem with paying off their loans. During deflation the nominal interest rates tumble, but the real interest rates increase. Due to the zero limit of nominal rates, the threat of real interest rates escalating above acceptable level menace. And the monetary tool, short interest rate, is completely ineffective. Unbearable situation could in the end result in "credit-crunch". Debtors, which are not able to pay back their loans could cause the drop in providing loans by banks, due to necessity of banks to write off bad debts. Certainly reduction in loans has major impact on investment and consumption, employment and over all the economic output.

Other important effect related to deflation is the preferences of money-holding prior to consumption with the expectation of additional decrease in prices. Preference in holding money and not spending them influences the profits of businesses. Furthermore, demand shrinkage leaves some of the inventories on the stock and prices may again fall. In literature we can find the term "deflation cycle", which is putting above mention factors together and explains the loop of price decline. Deflation cycle starts when economic individuals include the decline in prices to their expectations and begin to postpone consumption. As mentioned above, fall in demand cases even greater decline in prices and real wages grow. Businesses are forced to downsizings, which could again limit the demand.
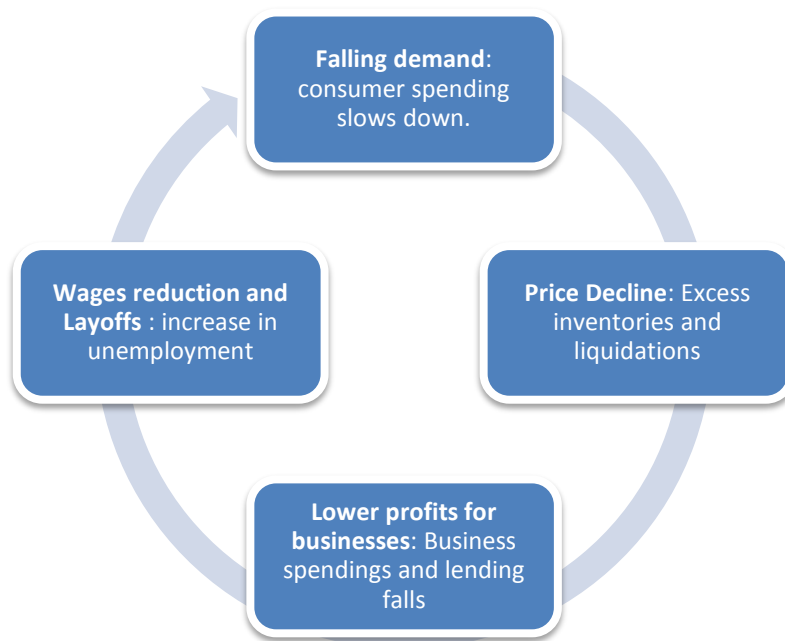
Source: *own processing of figure*

On the base of historical research authors of the study found, that deflation could enter the economy without previous warning and quite fast and could lead to major economic shocks. Therefore it is advanced to adopt resolute and energetic measures that would help to overcome deflation as quickly as possible. Besides the traditional, such as interest rate cuts along the yield curve, or the use of fiscal measures to support aggregate demand it is also recommended buying other asset classes or to extend the classify action of acceptable collateral. [44]

In conclusion in a deflationary surroundings, a nominal interest rate close to zero does not prevent the risk that real interest rates are too high for the well-being of the economy.

2.3.3 Liquidity trap

Significant indicator in Czech economy and the problem, when economy hits the ZLB, is the satiation of liquidity. Private sector starts to be apathetic in the choice of holding Treasury bills or

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[44] ROGOFF, K. aj. *Deflation: Determinants, Risks and Policy Options – Findings of an Interdepartment Task Force.* Washington, D. C., International Monetary Fund, 2003.

money. Asset prices are so high and the rate of return so low that businesses expect a decline in prices and rising interest rates in the future. Money demand has an infinitely, high sensitivity to changes in interest rates. This situation is characterized in the IS-LM model by horizontal curve LM. Interest rate channel loses effectively in order to limit deflationary pressures and increased output. Keynes argues that situations, where liquidity will be infinitely high, may occur. Monetary authority loses control over the level of interest rates, because any increase in the money supply does not affect output or prices. [45] If the real interest rate continues to be too high, when combining liquidity trap and deflation, the economy may fall in to deeper recession and prolong deflation.[46]

This statement, however, applies only in the case if the CB is unable to ease monetary policy by any of the other possible transmission channels.[47]Define liquidity trap just as a situation in which all the channels of monetary transmission are blocked. The claim of a liquidity trap would only apply in the case, when the nominal interest rates management of CB would be the only available monetary transmission channel. ZLB is necessary but not sufficient condition for a continuation of a liquidity trap

3   Non-traditional tools

Traditional CB's tools classification is divided in to so called market (non-direct), including the CB interest rate and non-market (direct) tools, such as for example credit contingents or the liquidity rules. Conventional measures are usually described as the tools used by CB, when normal condition exist and higher principles of independence and transparency endure. Financial stress has disrupted the normal monetary transmission and additional tools had to be used, in order to influence the financial stability as the central policy objective.

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[45] WROBLOWSKÝ, Tomáš. *Past likvidity, Keynesuv efekt a fiskální stimulace jako lék na soucasnou krizi*. Teoretické a praktické aspekty veřejných financí. Praha, 2014.

[46] SVENSSON, Lars EO. *Escaping from a liquidity trap and deflation: The foolproof way and others*. National Bureau of Economic Research, 2003.

[47] BUITER, Willem H. Buiter a Nikolaos Panigirtzoglou PANIGIRTZOGLOU. *Liquidity Traps: How to Avoid Them and How to Escape Them*. Cambridge: NATIONAL BUREAU OF ECONOMIC RESEARCH, 1999.

At the present time, there has been a shift in the meaning and non-standard instruments began to be looked upon as the CB tools aiming at directly to influence the process of financial markets (e.g. distribution of liquidity etc.). Many studies have been completed about the classification and description of unconventional CB tools. For Example study written by Cecioni, Ferrero and Secchi[48] offers distinction between conventional and unconventional tools based on the purpose of the tool - a non-standard measures are those that are trying to correct faults of monetary policy transmission mechanism and measures to stimulate the economic activity after reaching the ZLB. IMF[49] also delivers classification of unconventional measures divided to three areas:

1) Liquidity easing
2) Credit easing
3) Quantitative easing [50]

Kotaro Ishi, Mark Stone, and Etienne B. Yehoue provide also similar taxative list of unconventional[51]. Bernanke and Reinhart discuss three alternative views on the issues. These alternatives contain either determining the expectations of the public about future settings of the policy rate; quantitative easing projected as the increasing in the size of the CB's balance sheet beyond the level needed to established the short-term policy rate at zero and changing the arrangement of the CB's balance sheet in order to influence the relative supplies of securities held by the public.[52] Klíma and Komárek[53] also discuss the position of so called forward guidance in the new monetary policy.

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[48] CECIONI, Martina; FERRERO, Giuseppe; SECCHI, Alessandro. Unconventional monetary policy in theory and in practice. *Bank of Italy Occasional Paper*, 2011, 102.
[49] IMF. 2010. Central Banking Lessons from the Crisis. Monetary and Capital Markets Department, International Monetary Fund, 2010.
[50] ZAMRAZILOVÁ, Eva. Měnová politika: krátkodobá stabilizace versus dlouhodobá rizika. *Politická ekonomie*, 2014, 1: 3.
[51] YEHOUE, Etienne B.; STONE, Mark; ISHI, Kotaro. Unconventional central bank measures for emerging economies. *IMF working papers, 2009, 1-42.*
[52] BERNANKE, Ben; REINHART, Vincent; SACK, Brian. Monetary policy alternatives at the zero bound: An empirical assessment. *Brookings papers on economic activity*, 2004, 2004.2: 1-100.
[53] *Globální ekonomický výhled: Leden 2014*. Česká národní banka. Praha, 2014.

3.1 Forward guidance

Forward guidance is the CB's communication strategy, which aims to provide information to markets and the public on the future conduct of monetary policy, especially on the future trajectory of the short-term interest rate or another (different) instruments of monetary policy. Market participant's expectations about the forthcoming path of short-term rates play important role for the monetary transmission mechanism. The belief that low short-term interest rate will be preserved will encourage financial market participants to offer lower long-term bond yields and increase the prices of equities.

Studies has achieve resilient result that influencing the interest rate expectations of the public is fundamentally the one tool that central bankers have that can be applied not only under normal circumstances, but also when economy is under ZLB. However the real factors must be considered, when assessing the effect of communication to find out if the CB impact have a chance to really influence public expectations and change their behavior.

However, forward guidance cannot be considered as independent instrument of monetary policy, due to the fact that announcements by a CB will be taken by the public only if the CB has a demonstrated history records of conveying on its stated promises. Communication can be supportive in reaching a smaller gap between the policy expectations of the public and the plans of the CB.[54]

There are many papers, which study the effects of the Bank of Japan's Zero Interest Rate Policy and majority of them conclude the policy to be successful at influencing expectations. Czech National Bank is known for being very transparent and open to public. For the support of inflation expectation and use of unconventional monetary tool CNB also used massive forward guidance before intervene on the exchange market starting in September 2012. An analyses on this verbal tool will be conducted, in order to find out if the instrument was in the situation of Czech Republic effective.

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[54] BERNANKE, Ben; REINHART, Vincent; SACK, Brian. Monetary policy alternatives at the zero bound: An empirical assessment. *Brookings papers on economic activity*, 2004, 2004.2: 1-100.

3.2 Liquidity easing

The main difference between the standard liquidity easing measures [55] and non-standard liquidity providing, is the focus of CB´s non- standard operations not only on money market, but also on much larger spectrum of financial markets.

As described in the study of Yehoue, Stone and Ishi[56], the domestic liquidity easing concentrations on stabilizing vital markets and reconstructing the monetary transmission. Authors also describe three key way used to achieve the goal. CB can direct the injections of liquidity into the entire financial market, by relaxing collateral requirements, extending the duration of liquidity providing instruments or expanding access to CB´s liquidity facilities. Another way to rise the banks liquidity is by providing loans to banks at longer maturities, against collateral which contains assets from the market that is momentarily damaged. Thus the yield curve over the period in which the operations are conducted is directly influenced. CB could use direct instruments such as lowering the reserves requirements and changing the liquidity frameworks as well special credit facilities.

Authors provide also description of foreign exchange easing. Measures defined require the source of currency reserves, which could be more difficult to access. Foreign exchange liquidity injection by CB to domestic currency market in order to ease the liquidity stress.[57] Other instrument used to provide foreign liquidity is the cross-central bank currency swap arrangements.

3.3 Credit easing

Credit easing is specific for the fact that CB changes the composition of the balance sheet. CB buys less liquid and riskier assets instead of the commonly used government bonds. The primary purpose of such operations is pumping risky and less liquid assets from the financial system, and thus allowing the use of safer instruments to cover refinancing needs. Choice of assets is then mainly

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[55] Conditional tools are market operations during normal circumstances and lender of last resort.
[56] YEHOUE, Etienne B.; STONE, Mark; ISHI, Kotaro. Unconventional central bank measures for emerging economies. *IMF working papers*, 2009, 1-42.
[57] The main difference between foreign intervention and foreign exchange liquidity providing is the ability of CB direct the liquiditz to key financial institutions.

focused according to specific market sectors that have been damaged by the crisis, or on the once, where the financial distrust persists. The main focus is to affect the risk spread through assets, among those whose markets are mostly weakened and those that are more operational. When comparing to quantitative easing, we can find another modification apart from the above mentioned, that CB concentrates on the risk. Credit easing can normally be used when the short-term nominal interest rate are not constrained by the ZLB, whereas quantitative easing ought to be conducted particularly when the interest rate cannot lower and is at or close to zero . However, both operations aim at increasing the size of the central bank balance sheet and therefore expanding its monetary liabilities[58]

3.4 Quantitative easing

Quantitative easing is an activity of CB that leads to a deliberate increase in size of CB's balance sheet due to the rise in the standard non-risk assets. CB purchases risk-free quality assets with long maturity. These are primarily government bonds. It can be generally said that vary in size, but not the balance sheet composition. Purchase is provided by the creation of new reserves, which increases liquidity in the financial system.

When using quantitative and qualitative easing the CB is trying to "squeeze" long-term interest rates. Lower interest rates further stimulates investment, increases consumption and inflation expectations. It also have a significant effect on the public budget deficit, which is financed by this policy and reduces the cost of financing public debt. Assuming imperfect substitution between the assets of different degrees of liquidity and profitability, CB increases the demand for the asset, when buying the assets of different risk and return and thus increases its price. Upsurge in the money supply changes the optimal portfolio of assets held by households and firms, which then tries to rebalance the composition of the optimal portfolio in exchange newly released money for non-cash assets. Because the amount of assets in the financial sector is stable, the effort of

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[58] YEHOUE, Etienne B.; STONE, Mark; ISHI, Kotaro. Unconventional central bank measures for emerging economies. *IMF working papers*, 2009, 1-42.

economic entities to reinstitute the optimal mix of assets is pushing the assets prices up and thereby decreases their profitability.[59]

4 Exchange rate intervention

One of the activities that CB provides with respect to the involvement of the domestic economy in international relations, are foreign exchange operations. Those operations can be presented as the operations with foreign exchange reserves, foreign exchange regulation and foreign loans.

This thesis focuses on the foreign exchange reserves and its regulation by CB. Foreign exchange reserves are the central bank's one of the main assets. Reserves are one of the available tools used by the CB to intervene on the foreign exchange market to influence the exchange rate. Foreign exchange reserves are primarily securities issued by the CB on foreign markets or are received in the form of loans or other credit instruments from banks operating abroad, mostly from the CBs or international monetary institutions. CB are often involved in the regulation of foreign exchange reserves. That includes monitoring and inspecting rules for banking and non-banking entities in the area of foreign exchange. This means to regulate the movement of foreign capital, convertibility of the national currency and the exchange rate for the domestic currency. The movement of foreign capital in the modern market economy is very liberal. Liberal environment of the capital flow should result in improved capital allocation and it has an effect on reducing the interest rates. Convertibility of the national currency is to simplify the expression of the economic strength of the country. It is certainly a need to ensure the conditions. Basically we could divided exchange rates accordingly to the regulation of the exchange rate into regulated and unregulated.

1) Unregulated exchange rate (free floating) is created and predisposed by supply and demand. Unregulated exchange rate is often more volatile.
2) Exchange rates regulated by the CB, in particular by FX interventions. It consists of CB buying or selling foreign currencies for domestic currency in order to reach a level of local

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[59] BERNANKE, Ben; REINHART, Vincent; SACK, Brian. Monetary policy alternatives at the zero bound: An empirical assessment. *Brookings papers on economic activity*, 2004, 2004.2: 1-100.

currency that the CB has set in the form of devaluation/depreciation (managed floating) or revaluation/appreciation (Fixed regime). [60]

And thus, FX intervention as a monetary tool is commonly used by CB operating in the regime of fixed exchange rate and sometimes allowed in the so called managed floating regime. The use of FX interventions in the inflation targeting regime, or the regime of free floating exchange rate, in order to meet the inflation target is not common.[61]

Direct[62] FX interventions under normal conditions are used by CB as a monetary policy instrument, CB defines the volume of interventions in the foreign exchange market, while the impact on the exchange rate is uncertain and depends on the specific market circumstances. The direction of intervention is obvious, but the extent of this shift is unclear. CB purchase of foreign currency for the domestic currency increases demand for foreign currency on the foreign exchange market, the domestic currency will depreciate or its appreciation is slowed down. On the other hand, if CB sells foreign currency, the local currency is effected in the opposite way. There are bounds to extend and ability of CB to appreciate its currency, since it will always hold at most a restricted stock of foreign exchange reserves. But depreciation embraces no economic limit to the upward movement. CB thus acts as another trader on the foreign exchange market and with its activities affect the relationship between supply and demand in the foreign exchange market. Other method of action apart from CB defending the volume of the domestic currency, is declaration of a specific level of the exchange rate, which CB wants to achieve. Selection and possible announcement of a specific commitment to maintaining the level of the exchange rate - CB intervenes in the foreign exchange market to such extent, that the desired change in the exchange rate actually occurs.

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[60] VIDLÁK, Vojtěch. Vliv monetární politiky České národní banky na výnosnost vkladových produktů bank působících v České republice a její ekonomické dopady. 2015.

[61] Based on the impossible trinity law, it is not possible to have at the same time a fixed exchange rate, free capital mobility and independent monetary policy.

[62] Direct intervention happen, when the central bank is entering the foreign exchange market and actively buys or sells the home currency. For indirect intervention may be considered CB operation that are indirectly reflected in the exchange rate development throught other transmissive channels, such as the management of interest rates.

FX intervention can be divided into non-sterilized and sterilized. In the case of unsterilized FX interventions the volume of the monetary base changes. If we look at the commercial banks reserves, the CB purchases of foreign currencies lead to increase of bank reserves and selling foreign currency has opposite result on the banks reserves. The increase of reserves and thus the liquidity of commercial banks pushes down short-term interest rates, this is of course only under normal conditions without the ZLB. [63] If the CB wants to avoid the effect of interventions on interest rates, foreign exchange purchases may be sterilized by means of open market operations by selling securities for domestic currency. Sterilized intervention but then have a weaker effect on the exchange rate.

Most CBs using inflation targeting, as it will be explained later in the thesis, including ČNB, operate in a managed/free floating exchange rate, these banks intervene on the foreign exchange market only exceptionally or not at all. So in the first glance, ČNB use of the exchange rate in 2013 may seem like using the standard tools of monetary policy. We should though focus on the purpose and form of the announcement of acquiring asymmetric exchange rate commitment. ČNB pledged to intervene only if the rate was below its announced level and in the situation of ZLB, this decision is considered as unconventional monetary policy measures.

4.1 Uncovered interest rate parity

Investors expected return on investment should not differ no matter where he invests. In case the parity doesn't hold and investing depends on the location, arbitration should exist to equalize short-term excess. According to the theory of uncovered interest rate parity (UIP), the interest rate differential between two countries should be prognosticator of the modification in the exchange rate among them. Investor directly calculates the future exchange rate as a known value. However, the certainty of the future rate generally does not apply and therefore can be added to the UIP formula in the form of expectations. This means that if a currency is better remunerated, it should depreciates over time. Due to uncovered interest parity the purchase of foreign currency by CB

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[63] REVENDA, Zbyněk. Centrální bankovnictví. Praha: *Management Press*, 2011. ISBN 978-80-7261-230-7, 239.

does not need to lead to a depreciation of the domestic exchange rate. This fact is further enhanced by the ZLB.[64]

Uncovered interest rate parity is considered a short-term condition for equilibrium of exchange rate. Investors in the financial market is constantly comparing expected revenue between domestic and foreign assets and invest in assets with higher expected return. When comparing the returns of the two assets, investors move their money into countries with higher expected rate of return. Increased demand for the currency but also enhances its value and thus reduces the profit of the asset until the return of two assets is equal. The formula for UIP could be written as follows[65]:

$$E(S_{t+1}) = S_t \frac{1+IR^d}{1+IR^f} \qquad (11)$$

E (S_{t+1}): Expected exchange rate in t+1
S_t : Exchange rate in the time t
IR   : short-term interest rate, domestic (d) or in foreign country (f)

Logarithmic expression of the equation can be used when we experience low interest rates:

$$E(S_{t+1}) - S_t = IR^d - IR^f \qquad (12)$$

The form of the equation shows the interest differential of domestic and foreign interest rates, the right side demonstrations the expected future change of the domestic exchange rate. A key role in shaping the equilibrium value of the exchange rate in the short-term play the speculative arbitration rules. CB must be consistent with the uncovered interest parity rule in order to ensure successful intervention.[66]

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[64] CHINN, Menzie D.; ZHANG, Yi. *Uncovered Interest Parity and Monetary Policy Near and Far from the Zero Lower Bound*. National Bureau of Economic Research, 2015.
[65] The equation assumes perfect substitution between domestic and foreign assets.
[66] BOHATEC, Martin Bohatec. *MĚNOVÁ POLITIKA ČNB V SITUACI ZERO LOWER BOUND*. Praha, 2015. Diploma thesis.

4.2 Intervention under Inflation targeting

Technically, inflation targeting countries should display a relatively flexible exchange rate regime assuming that the core objective of monetary policy is price stability. In the year 2014 30 countries[67] reported using floating exchange rate regime, however in some cases with the coexistence of management of the exchange rate. Several inflation targeting countries do intervene irregularly, especially during the recent crisis.[68]

Number of coutries

■ Free floating ■ Floating and other managed arrangement ■ Crawl-like arrangement
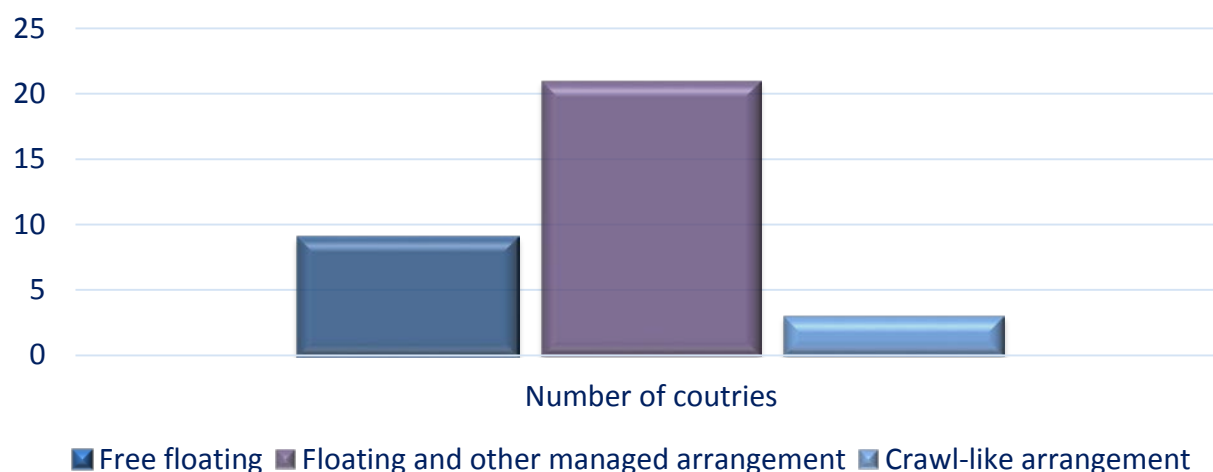
Source: *IMF AREAER (2014), own processing*

As Lukas Menkhoff[69] states, FX intervention seems to be used more in emerging market countries. It is partially reflection of structural features of those economies, which frequently partake on excessive exchange rate volatility and its effects on the real economy. Immature and imperfect financial markets also indicate that hedging against exchange rate risk is more expensive and in

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[67]TOMŠÍK, Vladimír Tomšík a Jan Vlček VLČEK. *Devizové intervence a jejich konzistence s cílováním inflace: Srovnání měnové politiky České republiky, Izraele a Švýcarska* [online]. Praha: Česká Národní Banka, 2015 [cit. 2015-11-12]. Available: https://www.cnb.cz/cs/verejnost/pro_media/clanky_rozhovory/media_2015/cl_15_150317_tomsik_bankovnictvi.html

[68] Brazil in October 2008, Chile in January 2011, Indonesia in October/November 2008, Israel in 2008–09, Mexico in 2009, New Zealand in 2007, Poland in April 2010 and from September 2011 to December 2011, South Korea in 2008–09, and Switzerland since 2009

[69] MENKHOFF, Lukas. Foreign exchange intervention in emerging markets: a survey of empirical studies. *The World Economy*, 2013, 36.9: 1187-1208.

some cases could be impossible. And thus the costs of exchange rate volatility can be considerable for individuals and for the whole economy. Some countries use intervention in order to support their export and artificially weaken their currencies, this could be a big problem when it comes to international relationships and policy.

Menkhoff also gives few reasons for the assumption, that FX intervention in emerging market countries might be more effective than in advanced countries:

1) The size of intervention compare to market turnover inclines to be greater.
2) The presence of some form of capital controls restricting entrance to international capital markets gives CB in these countries better power in the market.
3) Lower level of complexity of the local market along with severe reporting requirements provides CB with a bigger informational advantage.

Most studies evaluating the effect of past exchange rate interventions determines that interventions are able to slow down the nominal appreciation. However, these effects are rather short. The ability of interventions to influence the exchange rate level is assessed as relatively small. [70]

Fatum and Pedersen[71] in their paper based on sterilized intervention of Danish Central Bank discovered, that interventions influences the value of exchange rate only when the intervention is consistent with the monetary policy. This could rationalize the practice of using exchange rate intervention as a tool when interest rate loses the ability to influence the inflation expectations.

4.2.1 Intervention transmission canals

If CB uses intervention it is necessary to address the transmissions from conducted interventions to change of exchange rate. The important attributes for effective intervention is not only above mentioned consistency of intervention direction with fundamentals, monetary and fiscal policy, but

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[70] MENKHOFF, Lukas. Foreign exchange intervention in emerging markets: a survey of empirical studies. *The World Economy*, 2013, 36.9: 1187-1208.
[71] FATUM, Rasmus; PEDERSEN, Jesper. Real-time effects of central bank interventions in the euro market. 2007.

Menkhoff[54] also illustrates that particularly successful are surprising and powerful interventions. Other significant attribute is the CB reputation.

Generally, the transmission is divided in to channels[72]:

1) The interest rate channel
2) Portfolio channel
3) The expectations channel or signaling channel
4) The coordination channel

At the ZLB the interest rate channel is practically bolted. The rise of liquidity supply does not lead to a substantial decay in interest rates, which may limit the effectiveness of interventions. Given, that the effect of intervention on the domestic money supply is offset, the issue is, how sterilized intervention can affect exchange rates. The total impact of foreign exchange interventions on exchange rate is, in the case of achieving the ZLB, based on other channels especially the signaling and coordination channel[73]. As it will be described later, in this context the Svenssons approach to exchange rate tool, which is based on explicit exchange rate commitment seems more fitting than a the McCallum method using basically standard foreign exchange intervention.

Investors invest in the assets between numerous countries on the foundation of their relative estimated returns in order to balance their portfolio. In the portfolio balance channel, the assumption that local and foreign possessions are perfect substitutes doesn't hold. The exchange rate changes in order to affect the domestic price of foreign bonds and their anticipated return. For example, a rise in the supply of Czech-denominated assets compare to the supply of euro-denominated assets requires a decrease in the relative price of Czech-denominated assets. Assumption of imperfect substitution between domestic and foreign assets implies the existence risk premium, which can be distinct as the estimated additional revenue from domestic versus

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[72] CAVUSOGLU, Nevin. Exchange rates and the effectiveness of actual and oral official interventions: a survey on findings, issues and policy implications. *Global Economy Journal*, 2010, 10.4.
[73] See the Figure 7

foreign assets. Risk premiums are, could be caused by the volatility of exchange rates, political instability and intensity of the external debt of the country. When the UIP conditions don't hold.

Sterilized intervention can theoretically be effective, despite the perfect substitutability, through the signaling or expectations channel. The channel uses the change in expectations regarding future shift in exchange rate moving variables. The idea is that entities can vision exchange rate intervention as an indication about the future position of policy. The effect arises due to the modification of exchange rate expectations of private agents in responds to either the swing in future CB activities or shift in their opinion about the effect of CB certain actions. For instance, the announcement that the CB is prepared to buy certain financial assets, can encourage investor's confidence in the asset, reduce the risk premium and thereby stimulate business activity. In order to build CB credibility the rules must be as transparent as possible.

It is supposed that robust and sustained imbalances of the exchange rate are caused by a coordination lapses among agents. Endorsed intervention might be used as a coordinating signal, reassuring traders to participate in stabilizing speculation. The coordination of numerous signals is rather to persuade speculators than the signaled policy is credible to an individual signal. As Sarno and Taylor[74] are implying, sterilized official intervention coordination could help the CB with lower reputation. If the exchange rate finds it-self in trend situation it becomes harder for an individual trader to challenge the market. Authors also suggest, that the official intervention in the context of coordinating channel may be effective, because it might organize the "smart money" agents to enter the market simultaneously.

Cavusoglu[75] revised the studies that examine the effectiveness of interventions. As shown in the figure 7, his foundlings were, that interventions have a substantial short-term effect on exchange rates primarily through the signaling and coordination channels. It is also mentioned, that just few studies have offered indication that interventions have been effective in the long-run. Main policy recommendations based on these studies implies, that the effective use of FX intervention by the

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[74] TAYLOR, Mark P.; SARNO, Lucio. Official intervention in the foreign exchange market: is it effective, and, if so, how does it work?. 2001.
[75] CAVUSOGLU, Nevin. Exchange rates and the effectiveness of actual and oral official interventions: a survey on findings, issues and policy implications. *Global Economy Journal*, 2010, 10.4.

CB should be conducted openly, transparently and public communicate the desired level or change in the exchange rate, which is to be achieve.

Figure 7 Effectiveness of intervention projected in studies
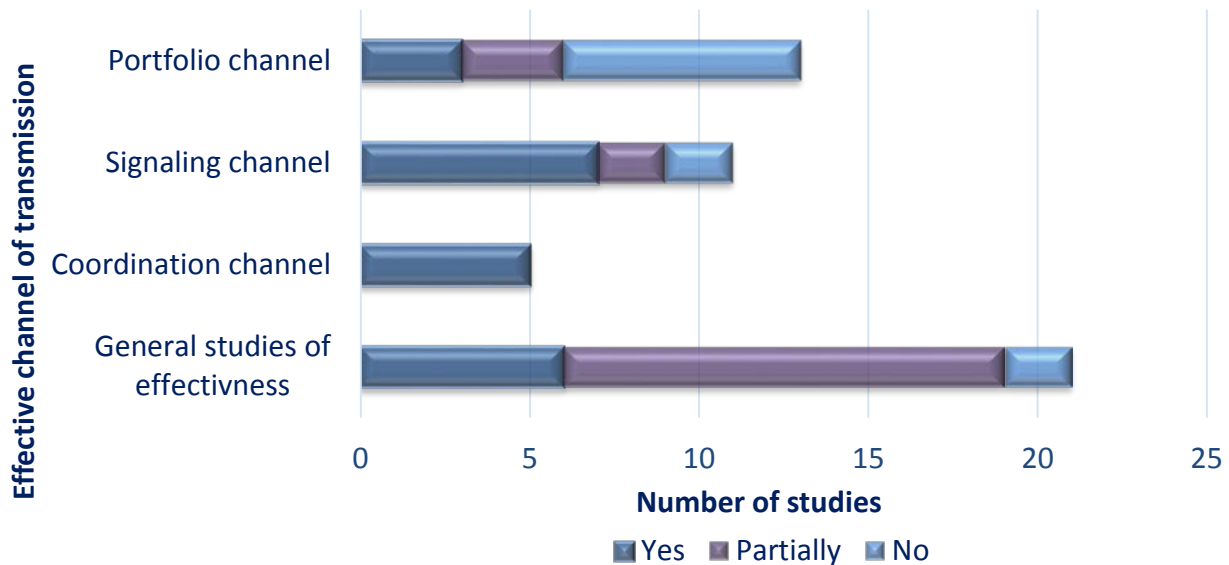
Source: LÍZAL (2013), *own processing*

4.2.2 Exchange rate pass-through

Numerous canals have been discussed explaining management of the nominal exchange rate by developing countries, which are using inflation targeting. Starting with import dependent countries and positive correlation of exchange rate pass-through and economic openness, variations of the exchange rate could have significant macroeconomic inferences for the real economy. Other so called "fear of floating" as described in the study by Christian Ebeke and Armand Fouejieu Azangue [76] can be demonstrated in the setting of financial stability targets in emerging countries. Ebeke and Azangue give examples of countries with greater share of public debt denominated in foreign currency or a bigger part of foreign investors in the national debt market. Those countries

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[76] EBEKE, Christian; FOUEJIEU, Armand. Inflation Targeting and Exchange Rate Regimes in Emerging Markets. 2015.

could be in a bigger risk, when a higher fluctuation of exchange rate occurs. Authors found that emerging countries, which adopted inflation targeting, have on average relatively more flexible exchange rate regime than other developing countries. Results showed that macroeconomic features (import dependency, share of public and private assets/liabilities in foreign currencies) diminish the degree of exchange rate flexibility. However study also states that, more-developed financial system and a transparency contribute to higher flexibility.

It's necessary, before starting to use exchange rate intervention, to assess the exchange rate pass-through on prices in the economy and thus inflation. In the typical inflation-targeting rule, an exchange rate shock spreads with the help of import prices; this channel transmits the shock almost immediately. Other canals are usually called as indirect canals; exchange rate eventually impacts real volumes of imports and exports, which is therefore a source of changes in the rate of growth, earnings and employment and thus the rise in inflation. Indirect channel, through which in some time an increase in the domestic price level occurs, is also the rise in prices of domestic goods that for its production need imported inputs or intermediate products. Another indirect channel could be the changes in spending, where prices of imports also modification the relative prices of other good resulting in shift in demand from foreign to domestic goods. It is important to distinguish the supply and demand inflation. A typical example of supply inflation is the increase in prices due to increase in the price of production inputs (materials, energy and capital), the call for wage increase is in place and that drives the inflation even further. This type of inflation will not drive the economic growth, on the other hand inflation that originated from the demand. Growth in demand will cause short-term steady growth in output beyond the level of potential output and the price level. However, in the long term only leads to inflation.

The pace of the pass-through of weakened exchange rate depends on the size and openness of the economy. The smaller and more open is the economy, the faster the change in the nominal exchange rate is fully reflected in the price level. Also the bigger the share of imported goods on domestic consumption, the greater the change in the nominal exchange rate effect on households and the real wages.

There has been studies[77], which quantified the exchange rate pass-through to inflation using data from the Czech Republic. The pass-through of exchange rate on inflation is measured in percentage as a response to a 1% of the exchange rate shock. The transmission of deviations in the exchange rate to inflation was found to be less than 100% of the shock. Babecká-Kucharčuková[78] explained this incompleteness of pass-through by the price rigidity, mark-up and pricing-to-market strategies. As well as so called menu costs and the costs of delivery and transportation. Babecká-Kucharčuková performed own simulation using date from the Czech Republic. The founding can be seen in the Figure

8. Noticeably, the best result on pass-through have import prices (0.70%). The smallest reaction to the shock is initiate from the consumer prices. Study also confirmed the length to complete transmission, which is estimated from 4 to 6 months.[79]

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[77] BENEŠ, Jaromír, et al. The Quarterly Projection Model and its Properties. 2003. HOLUB, Tomáš, et al. Causes of deviations from the CNB's inflation targets: an empirical analysis. *Czech Journal of Economics and Finance (Finance a uver)*, 2008, 58.09-10: 425-433. KORHONEN, Iikka; WACHTEL, Paul. A note on exchange rate pass-through in CIS countries. *Research in International Business and Finance*, 2006, 20.2: 215-226 and others.

[78] BABECKÁ-KUCHARČUKOVÁ, Oxana, et al. *What We Know About Monetary Policy Transmission in the Czech Republic: Collection of Empirical Results*. Czech National Bank, Research Department, 2013.

[79] BABECKÁ-KUCHARČUKOVÁ, Oxana, et al. *What We Know About Monetary Policy Transmission in the Czech Republic: Collection of Empirical Results*. Czech National Bank, Research Department, 2013.

Figure 8 Exchange rate pass-through (Czech Republic, appriciation shock by 1%)
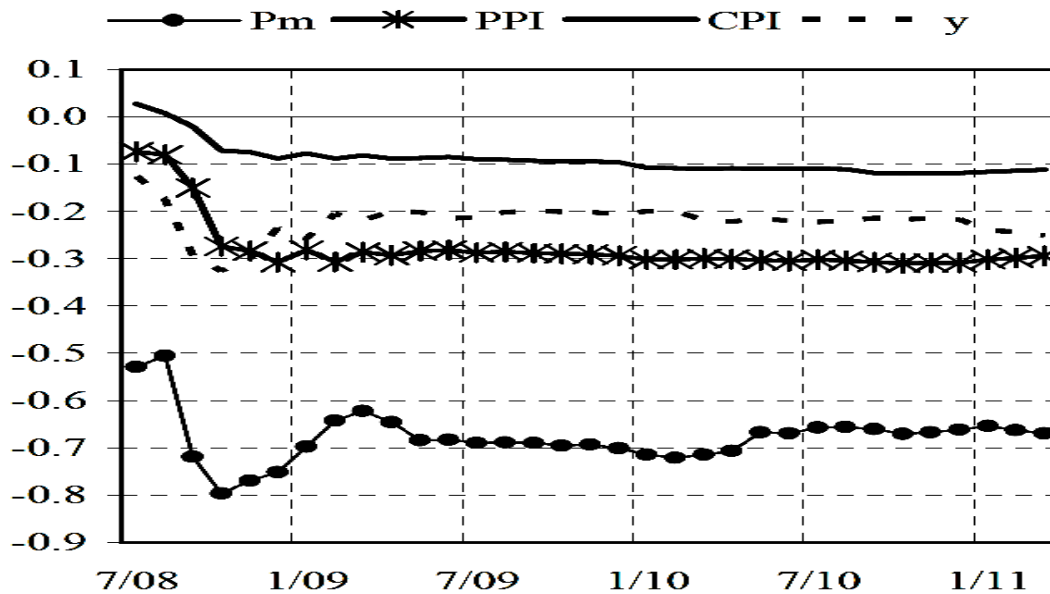
Source: BABECKÁ-KUCHARČUKOVÁ (2013), *own processing*

Pm : import prices
PPI : producer prices
CPI : consumer prices
y   : index of industrial production

During the standard times, the CB tries to responds to exchange rate depreciation by raising nominal interest rates, thus diminishing exchange rate effect on the economy. In the situation, where interest rates are at their lower limit and the weakening of the exchange rate is being done deliberately in order to increase inflation, such a reaction in interest rates of the CB does not occur and the pass-through to inflation and the real economy is bigger. In addition we should not forget the effect of foreign interest rates, which also impact the efficiency of interventions according to UIP. The simulations conducted [80] demonstrates, that with increasing time period of ZLB the impact of the depreciation to inflation increases and the stimulatory effect of the decline in real interest rates on the consumption and investment rises.[81] In addition using the exchange rate as an instrument of

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[80] using the prediction model g3, which has been used by ČNB since 2008.
[81] LÍZAL, Lubomír; SCHWARZ, Jiří. Foreign exchange interventions as an (un) conventional monetary policy tool. *BIS Paper*, 2013, 73i.

monetary policy at the ZLB is meaningful to the public, reachable and therefore credible commitment to a rise in the price level. Inflationary expectations of economic agents are increased, which reduces the real interest rates and leads to rise in household's consumption and investment activity.[82] The problem may be that this situation will increase the costs of borrowers to repay debt and rise the expenses to firms having foreign inputs.

4.3 Theories

The authors McCallum[83]and Svensson[84] could be considered as creators of one of the major and most cited works including an open economy and the possibility to use the exchange rate as unconventional monetary tool.

4.3.1 McCallum's monetary rule

McCallum[85] provides, in his paper, a possible solution to situation when the economy is in a liquidity trap, and the standard interest rate instrument is powerless. Considering, that monetary policy can use transmission channel involving foreign exchange in order to stabilize the economy. He adopts the assumption of open economy with low inflation or the level of output below its natural rate, as well as the basic assumptions of New Keynesian economy such as imperfect competition in markets, short-term price and wages rigidities and rational expectations of agents. Via the (IS - LM) mathematical model argues the use of FX intervention as an instrument of expansionary monetary policies to weakening currency, which will stabilize the price level and close the negative output gap .

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[82] Reaserch and policz noted3 CNB

[83] MCCALLUM, Bennett T. *Theoretical analysis regarding a zero lower bound on nominal interest rates*. National bureau of economic research, 2000; MCCALLUM, Bennett T. *Inflation targeting and the liquidity trap*. National Bureau of Economic Research, 2001.

[84] SVENSSON, Lars EO. *The zero bound in an open economy: A foolproof way of escaping from a liquidity trap*. National Bureau of Economic Research, 2000; SVENSSON, Lars EO. *Escaping from a liquidity trap and deflation: The foolproof way and others*. National Bureau of Economic Research, 2003.

[85] MCCALLUM, Bennett T. *Inflation targeting and the liquidity trap*. National Bureau of Economic Research, 2001.

McCallum works with so called Taylor rule[86] on which bases he designs the rule with exchange rate as an instrument that CB should in his opinion undertake under the liquidity trap. The equation could be specified as follows:

$$S_t - S_{t-1} = k_0 - k_1 (E_{t-1}\Delta p_t - \pi^t) - k_2 E_{t-1} y_g + e_t \ [87] \qquad (13)$$

$S_{t,t-1}$: exchange rate in time t, t-1
$E_{t-1}\Delta p_t$: expected price level change
π^t : inflation target
$E_{t-1} y_g$: expected gap of output from the potential value of output, $y_{g=} y_t - y_t^{pot}$
e_t : shock component, also referred to as white noise
k_0 : constant set as the average real interest rate
$k_{1,2}$: equation coefficients, where $k_1 > 0$ and $k_2 \geq 0$
$S_t > S_{t-1}$: Nominal depreciation

As the relation (13) implicates, in the situation of low inflation and/or expected negative gap of output, the left site of the balance must increase and the ΔS_t represents nominal depreciation. McCallum considers the ΔS_t only as a CB´s operation criteria, which is achieved by using other tools such as open market purchases. In the efforts to weaken the domestic currency, the purchases of foreign assets as basically unlimited, since CB can cover the purchase with newly created money almost indefinitely. Interventions, if not sterilized, further increase the money supply and inflation expectation. In the short term, the anticipated stiffness in domestic price level and the nominal exchange rate depreciation weakens the real exchange rate. Depreciation of the real exchange rate then effects the foreign and domestic demand resulting in increased net exports.[88] Using simulation the study found, that with the increase of inflation target coefficient (k_1) leads to inflation stabilization. Also rise in the output gap target constant (k_2) diminishes the volatility of the output gap. Proposing that the policy rule coefficient is significant for inflation and output gap

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[86] It offers "recommendations" for CB how to modify the short-term interest rates when economic situation shifts in order tostabilize the economy and inflation. The formula: $IR = R + w_1 (p_{t+1} - pT_{t+1}) + w_2 (y_t - y_t^{pot})$.
[87] Please notice the different notation compare to first chaptor.
[88] Net expor equals to the value of export minus the value of import of certain coutry.

stabilization under the liquidity trap.[89] The problem is that study doesn't specifically states what causes the rise in the coefficients.

McCallum[90] uses macroeconomic structure of an open-economy IS curve function (logarithmic form) under ZLB or liquidity trap, in order to explain the effect:

$$y_t = E_t y_{t+1} + a_0 + a_1(IR - E_t \Delta p_{t+1}) + a_2 \, E_t[l_1(\Delta S_t - \Delta p_t) + l_2(y_t - y_{t-1})] + e_t \qquad (14)$$

$$E_t \Delta nx_{t+1} = E_t[l_1(\Delta S_t - \Delta p_t) + l_2(y_t - y_{t-1})] \qquad (15)$$

y_t : output
p_t : the price level
nx_t: net exports
S_t : the domestic price of foreign exchange
IR : nominal short-term interest rate under liquidity trap

$a_1 < 0$, $a_2 > 0$ and $l_1 > 0$, $l_2 < 0$

Equation nx_t (15) characterizes the impact output change and relative prices on net export, where $S_t - p_t$[91] symbolizes the real exchange rate in the logarithmic form. As could be deduced from the relations (14) (15), when the ΔS_t increases (import goods are becoming relatively more expensive), the domestic products are preferred by the public and net export due to reduced imports rises. Also higher output encourages the exports, which also have positive effect on the net exports.

The real exchange rate is weakened until the change in the nominal exchange rate using the exchange rate intervention will fully "soak" into domestic price levels and the economic agents fully adjust their prices.

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[89] For more detailed information please refere to: MCCALLUM, Bennett T. *Theoretical analysis regarding a zero lower bound on nominal interest rates*. National bureau of economic research, 2000.
[90] MCCALLUM, Bennett T. *Theoretical analysis regarding a zero lower bound on nominal interest rates*. National bureau of economic research, 2000.
[91] The foreign prices and income are considered to be constant constant

The theory is criticized[92] for the fact that the UIP relations is not included. McCallum explains this fact on the existence of the risk premium, which he believes is linked to the relative volume of outer local and foreign nominal unresolved obligations. In other words, it is supposed that national and foreign possessions are not perfect substitutes. This implies, that his proposal relies largely on the portfolio balance effect, which as mentioned above is by many studies refer to a weak relation. Additionally, McCallum does not include the calculation of the required volume of international intervention in order to depreciate the currency.

4.3.2 Svensson´s „Foolproof Way"

When other potential solutions for the situation of ZLB and monetary policy remain ambiguous about the effectiveness, Lars E.O. Svensson is certain of his offer and call the proposed actions the "Foolproof Way". He argues mainly, that other studies depend too much on the portfolio channel. His proposal on the escape from the ZLB puts primary attention to change in private sector expectations about future developments of the exchange rate. CB commits to unlimited intervention in order to weaken the exchange rate to the desired level. A precondition for successful design is that not the economy is open to foreign trade.

As Svenssons states in his own paper[93]: "*Current domestic inflation and output are predetermined, and only future domestic inflation and output can be affected by monetary-policy actions. Furthermore, it is not the current real exchange rate and current long real rate but the expected future real exchange rate and the expected future real interest rate that are of importance for private-sector decisions.*"

The key premises of the transmission are[94]:

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[92] SVENSSON, Lars EO. *Escaping from a liquidity trap and deflation: The foolproof way and others*. National Bureau of Economic Research, 2003.

[93] SVENSSON, Lars EO. *The zero bound in an open economy: A foolproof way of escaping from a liquidity trap*. National Bureau of Economic Research, 2000, p. 7

[94] SVENSSON, Lars EO. *The zero bound in an open economy: A foolproof way of escaping from a liquidity trap*. National Bureau of Economic Research, 2000.

1) Domestic inflation is positively influenced by the agent's expectations of future inflation and marginal cost of production, these costs, such as wages and material costs, depends positively on the output gap and the exchange rate.

2) Domestic inflation and rising inflation of imported goods effect the Consumer Price Index in the same direction. The actual growth in import price is caused by the depreciation of the domestic currency.

3) The real interest rate through the aggregate demand negatively impacts the output gap, on the other hand output gap has opposite reaction (positively depends on) the real exchange rate (via the growth of net exports).

4) Long-term real interest rate have positive responds to the expected short-term nominal interest rates, which is controlled by the CB and the negative impact on future domestic inflation.

The real exchange rate has been already mentioned in previous section, there is more direct was to express the relation (logarithmic) and interpret the CPI inflation:

$$RR_t = S_t + p_t^f - p_t^d \tag{16}$$

$$\pi_{t,CPI} = \pi_t + \alpha\,(RR_t - RR_{t-1}) = (1-\alpha)\pi_t + \alpha\,\pi_t^f \tag{17}$$

RR_t : real exchange rate
S_t : nominal exchange rate
p_t : foreign (f) and domestic (d) price level
$\pi_{t,CPI}$: CPI inflation
α : portion of imported goods in the CPI
π_t^f : domestic-currency inflation of imported foreign goods

It's also worth to recap the well-known Fisher´s equation of real interest rate, since the 4th condition is capturing this relation, but only in words:

$$R_t = IR_t - E_t\pi_{t+1} \tag{18}$$

R_t : short real interest rate
IR_t : short nominal interest rate

$E_t\pi_{t+1}$: expected inflation

Due to the ZLB the short nominal interest rates equals to zero. According to the equation (18), in the situation of deflation (negative inflation), the real interest rate is positive. The rise in real interest rates under stated assumptions has a harmful effect on output. In the case of ZLB, the real interest rate is too high for stabilizing inflation close to the target and the real economy. The economy remains in recession and the output gap is negative. The need of further easing by CB is necessary.

Svensson[95] proposes to follow 3 steps:

1) To declare a regime of inflation targeting with escalating trajectory in price level, which is higher than the current level. Targeting the price level is preferred by the author, due to the longer- term targeting compare to inflating targeting. Price level targeting is more suitable for its important influence on the development of continuing inflation expectations.

2) Have the intention to weaken the domestic currency and exchange rate will be fixed to a crawling (progressively debilitating) level. The CB undertakes to intervene in order to weaken the exchange rate with unlimited range. So that after the devaluation of the nominal exchange rate, the short-term[96] level of real exchange rate was devaluated compared to its steady state.

3) And finally proclaim, that the commitment to maintain the exchange rate will be abandoned after the achievement of the desired growth level of prices and monetary policy will return to its standard instrument, short-term interest rates.

Svensson defines the transmission and effects of the above mention actions. Since it's possible for the CB to devalue the currency and fix the exchange rate at a target consistent with original real depreciation, the private sector believes in the credibility of the CB move and expects the peg to hold. In consistency with the UIP (12), CB must increase the short nominal interest rate, leading

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[95] SVENSSON, Lars EO. *The zero bound in an open economy: A foolproof way of escaping from a liquidity trap.* National Bureau of Economic Research, 2000.
[96] Short-term interest rate isconsidered, due to the assumption of sticky prices and so initially the real and nominal Exchange rate move 1:1.

the economy out of the trap. However, the real rate drops, the decline in real interest rates increases current consumption and cuts down the saving rate. Since the UIP must hold and real interest rates are lower.[97]The economy is therefore stimulated by the real depreciation, decrease in real interest rate as well as the upturn of expected future inflation. Svensson stresses that the success of the implementation of the temporary fixed exchange is based on the role UIP and above all influencing the private sector expectations. Thus he highlights the signaling channel, which appears to be a preferable solution.

There are, however, two important alarms about Svensson's suggestion. The first arising question is about the consistency of expectations with the theory, would it obey in the assumed manner. Other concern considers the situation of global crisis, the depreciation might recover demand in the domestic country, but at the expense of demand in other countries with equally problematic economic settings.[98]

5   Czech experience

In this part the focus will be targeting Czech national Bank (CNB) and its use of exchange rate interventions as a tool out of deflation under ZLB. This section of the thesis tries to evaluate the effectiveness and effect of the intervention on the economy and the main initial purpose – increase the inflation expectation and start up the economy. Since there is very limited room for comparison[99] with historic experience the attention will be mainly on CNB and the situation before the use of unconventional monetary tool and the state of the economy after 2 years (2015) from the intervention and declaration to maintain announced exchange rate floor (27 CZK/EUR).

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[97] As Svensson states , the rise in infation expectations is higer than the increase in the nominal rate. SVENSSON, Lars EO. *The zero bound in an open economy: A foolproof way of escaping from a liquidity trap*. National Bureau of Economic Research, 2000.p.25

[98] ALICHI, Ali, et al. *Frontiers of Monetary Policymaking*. International Monetary Fund, 2015.

[99] The situation experiencing ZLB and deflation in other coutries such as Japan, ECB or USA cannot be fully credible for comparismet since the conditions (highly liquid small open economy with economic entities largly in debt, but deposits still overrulling the loans) and state of economy is different.

The main objective of the CNB is maintaining price stability. By achieving and maintaining price stability, the CNB contributes to creation of conditions for sustainable economic growth. Within the Czech economy CNB holds a number of functions for instance; provides banking services for the state and the public sector, determines the monetary policy or performs foreign exchange supervision.[100]The turning point for the CNB was the year 1998, when it passes - after significant problems in previous years related primarily to unfavorable development of the balance of payment, which resulted in speculative attacks on the Czech crown – the Inflation targeting regime. CNB has long been one of the most transparent central banks, with the announced 2% target of inflation since January 2010. The Czech Republic encountered a continued period of economic recession[101], which was consequences of the overall euro crisis. Thus, CNB brought down repo rate to the "technical" zero point (0,05%) by November 2012. CNB needed another tool to ease the economy.

5.1 The decision for exchange rate interventions

CB had been decreasing its interest rate since the crises in 2008 hit the economy (figure 2). Fall in interest rates was the reaction to strong fall in prices as well as GDP. Due to the long expansionary monetary policy, the interest rates reached the ZLB level in 2012. However according to CNB deflationary pressures remain and the economy didn't seem to be recovering. This all suggested the need for further easing. CNB announced to use exchange rate as an instrument of monetary policy in a situation of zero interest rates.

5.1.1 Situation before interventions

Economic development of the Czech Republic, as a small open economy, is due to especially its central geographical location, similar production functions and trade relations synchronized with the economic growth of the European Union (EU). With that said, since the crises hit EU in 2008 the Czech GDP was also affected. The manufacturing was especially effected by the decline in

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[100] Revenda (2008) provides the whole list of CNB functions, REVENDA, Zbyněk. Peněžní ekonomie a bankovnictví. Vyd. 4. Praha: *Management Press,* 2008, 627 s. ISBN 978-80-7261-132-4.
[101] Including six quarters of negative GDP growth in 2011-13

foreign demand. High share of industrial production effected the decline in GDP. Figure 9 shows[102] the almost identical GDP trend of EU and the Czech Republic, as also seen in the graph, countries after a short woke up from the recession another decline came in the years 2012 and 2013 since the debt crisis in the Eurozone began.
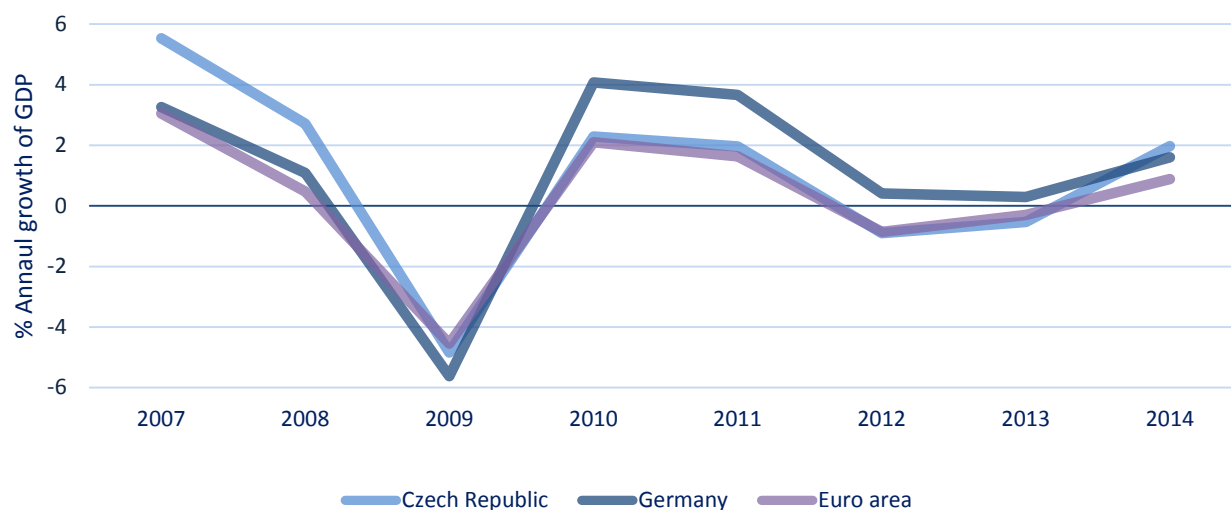
The Czech GDP was effected by the decline in foreign demand, but as the Figure 9 implicates and we can deduct by the, main trade partner, German economy is that Czech GDP didn't reach the growth of Czech neighbors[103] and thus, the decay of domestic demand has also a major role in weakening the economy. This assumption confirms also the figure 10, which contains annual data about the composition of Czech GDP, when the base year is 2007.[104] It is clear that the second economic downturn occurred mainly due to the decline in investment activity resulting in a drop in gross fixed capital formation and the decrease in household's consumption, which could be associated with the need of debt reliefs of companies and households credit restrictions. GDP was

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[102] Germeny is also included as the main influencer and trader of the Czech Republic.
[103] Including Poland, Slovakia and Austria.
[104] This year was chosen on purpose, since it was a year before crises.

actually mainly supported by the net export component, which indicates that national dement was mostly the reason for the weakening of the economy.
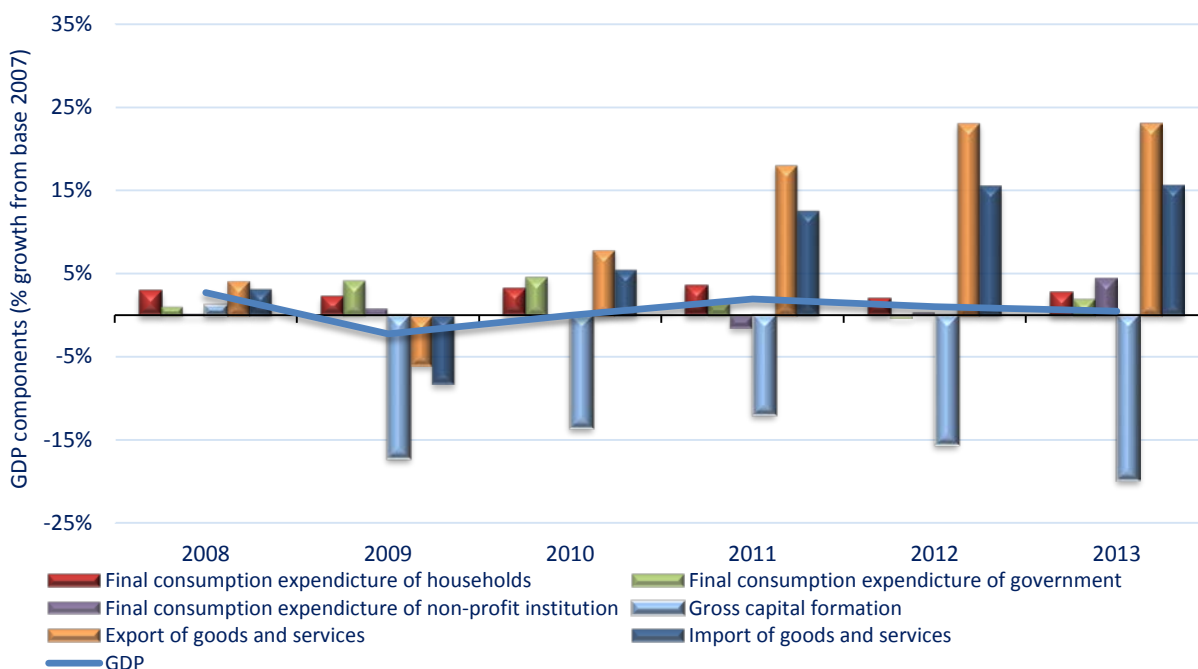
Source: CNB, *own processing*

The output gap, as mentioned in the theoretical part, is the difference between the potential outcome and the actual one and could provide information on the existence or absence of demand pressures in the economy. If both, the potential and the actual, outputs are the same (gap = 0), it is expected that the prices in the economy won't be effected , however in the case of negative gap, one could suspect the deflation pressures[105] on price could occur and inflation drops down.

Franta and col. [106] states that the estimated negative output gap in the first half of 2013 was from 2 to 4% depending on the method used.[107]

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[105] The disinflationary developments in the economy could be driven by favorable factors, the supply.
[106] FRANTA, Michal, et al. *The Exchange Rate as an Instrument at Zero Interest Rates: The Case of the Czech Republic*. Czech National Bank, Research Department, 2014.
[107] There are different methods used for calculating output gap such as, production function, Kalman filetr or HP filter

Figure 14 Unemployment rate

Czech Republic — Euro area — Germany

Figure 13 Index of wages

Nominal wages Index — Real wages Index
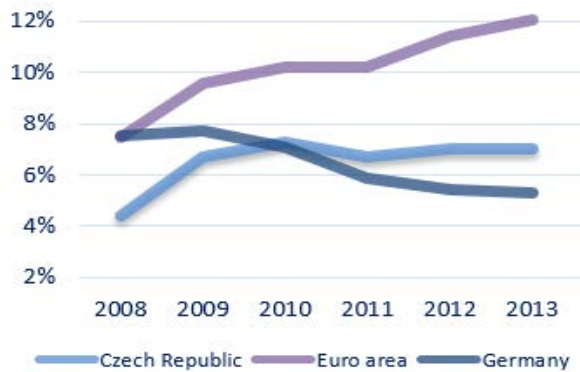
Figure 12 Inflation rate

CNB target

Inflation rate (CPI) — Monetary-policy inflation
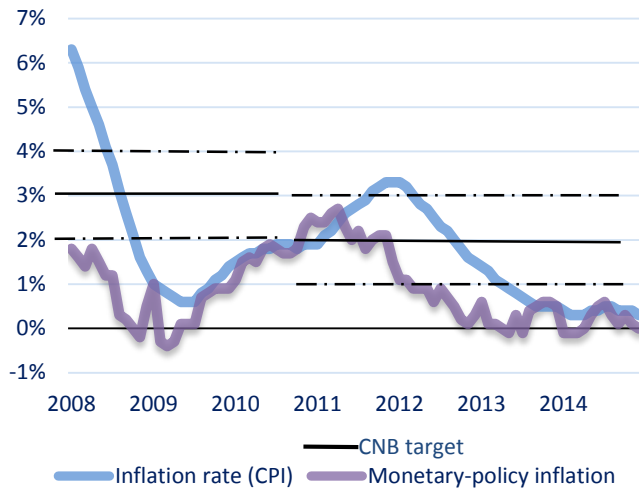
Figure 11 Components of inflation

Fuels — Grocery (including alcohol and tabacco)
Indirect taxes — Regulated prices
Adjusted inflation without fuels — Monetary-policy inflation
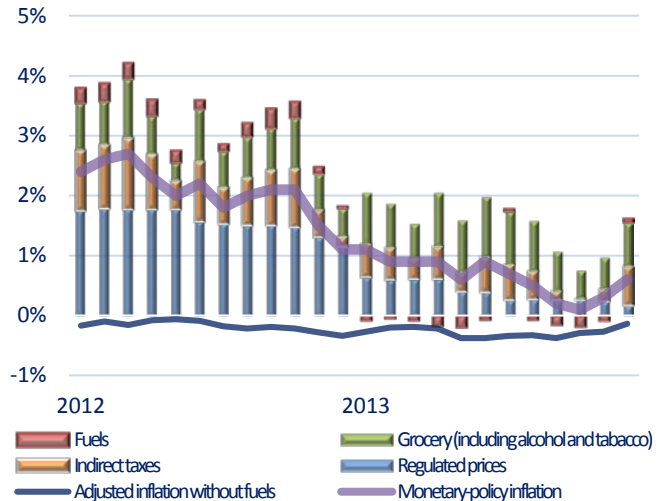
Source: TWB,CNB, *own processing*

Figures 11-14 display the decline in domestic prices[108], unemployment and wages, these effects together with restrictive fiscal policy and drop in domestic demand in represented years, leads to thinking about the consequences. As described above in the theoretical part, this situation seems to be a nice textbook example of deflationary pressures. Figure 12 and 14 signifies the deteriorating situation on the labor market compare to EU. Unemployment rate increased, however the rate fluctuates around 7 percent value since 2009. Figure 13 and 11 clearly picture the inflation

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[108] At the beginning of 2012 the CPI increased sharply and remained above the 3% limit of the tolerance band almost throughout the whole year. However, this increase was mainly due to an increase in VAT rate by 4%.

behavior of monetary-policy inflation, which is adjusted for the primary impact of tax changes.[109] This CNB relevant inflation fell down even to below 0% level. The adjusted inflation excluding fuel prices[110], has been negative since 2009. Since the targeted value of CPI inflation by CNB is 2%, this situation shown in figure 12, when the inflation is approaching 0%, is far from standard. In the most part, figure 11 visibly emphasizes, that the downside pressures were dragged by the regulatory prices. These include electricity prices, for many producers main input. deflationary pressures were, thus not only the result of declining in demand, but also to a large extent, the decline in the energy, telecommunications and other prices, so in principle shifts the supply function down.

In agreement with the constitutional mandate of the CNB to maintain price stability in the Czech economy, is expressed in the inflation target of 2%, CNB started to react against the lower prognoses of inflation easing the economy by lowering down the repo rate (main monetary short-term interest rate). As grasped in Figure 2, rates had taken down since 2008 and in the fall of 2012 interest rate hit the "technical" zero level, after the Bank Board meeting in November 2012. At this time Board announced (partial forward guidance) that rates will be held down until significant increase in inflationary pressures arises. In 2013 inflation continued with declining trend, since the economic downturn sustained. The board started to vote for the use of exchange rate intervention in their August and September meeting on the base of releasing the 2013 report on inflation III, the use at that point was not accepted, but its probability increased. The IV report on inflation in the year 2013 was especially important since it commented on the prognoses of inflation reaching 0% level at the beginning of 2014 and the monetary-policy relevant inflation being shortly negative, this state was according to the report, thanks to economic recovery and accelerating growth in producer prices abroad, supposed to improve by the end of 2014/beginning of 2015 when the prognoses climes up to 2%. The most warning scenario was about the dramatic need of substantial decrease of interest rates to negative values even in the interbank market. Franta and col.[111] in

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[109] CNB in its inflation targeting regime had set exemption, when CNB is not required to correctiong prices. This especially involves the supply shocks.Thus when deciding on monetary policy is adjusted CPI (monetary-policy) inflation more relevant.

[110] CPI adjusted for seasonal factors, the effect of changes in regulated prices, the effect of tax adjustments and other administrative measures to price change.

[111] FRANTA, Michal, et al. *The Exchange Rate as an Instrument at Zero Interest Rates: The Case of the Czech Republic*. Czech National Bank, Research Department, 2014.

connection with this prognoses highlight, that with the presence of the nominal ZLB, negative real interest rates can be achieved only through expressively positive inflation expectations. As a result of the further easing and economy under ZLB, CNB in the report on inflation presents prognoses of prepared alternative scenario that measures the effects of the use of the Czech crown exchange rate as an instrument of monetary policy easing. In below figures 15 and 16 the CNB comparasent of standard and alternative (exchnage rate) scenerio is displaied. The dashed line represents the use of unconventional tool and its eefect on interest rate and inflation with the confidence interval from 30% to 90%.

Figure 15 3M PRIBOR- standard and alternative scenario   Figure 16 Inflation - standard and alternative scenario
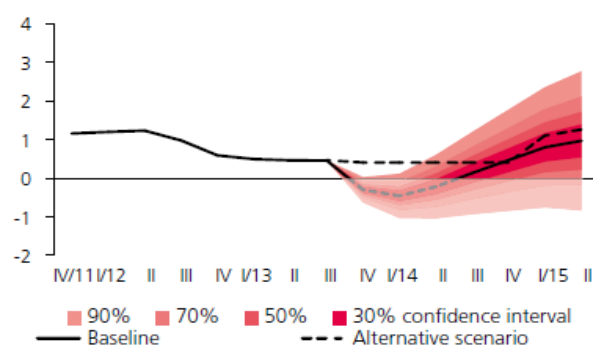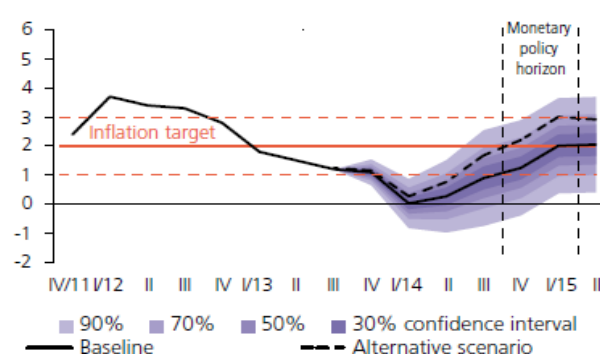
Source: CNB, INFLATION REPORT IV/2013, *own processing*

Also informs that on the Board meeting on November 7, 2013 Board decided to start using the exchange rate as an additional tool easing of monetary conditions. CNB announced that is prepared to intervene in the foreign exchange market in order to maintain the exchange rate close to the level of 27 CZK / EUR.

5.1.2 Reasons for exchange rate interventions

CNB since the announcement, that is ready to weaken the exchange rate of Czech crown in order to woken up the economy and further ease the monetary policy by unconventional tool, has been a target of many criticisms about the use and choice of the instrument. This section will provide some explanation on the different types of alternative instruments and the CNB exchange rate choice.

As mentioned above CNB is required to react on adverse development in stability of prices, even though there are some exception, CNB excluded the possibility of stand-by policy. As a first

alternative tool for CNB to consider for influencing the economy and easing the monetary conditions was lowering the interest rate (in the case of CNB the repo rate) to negative value, hence use a standard tool in the regime of inflation targeting. The main argument, which ruled out the use of negative rates, we certain legal constraints that define penalty interest as a multiple of discount or repo rate. With the outcome of absurd situations in which borrowers in default would instead of paying fines receive money.

 After the crisis most economies have been stroke by a heavy lack of liquidity and a subsequent credit crunch, the Czech banking sector is characterized by long-term surplus in. Free bank liquidity could be in characterized by the repo tenders amounts, because banks deposited their excess liquidity in the CNB. We can see the excessive liquidity in the bank system within the figure 17. CNB tries to drain the extra liquidity from commercial banks through repo tenders, or the deposit facility. In addition, since 2008 the volume of provided loans increase in value, however their share in total deposits declines, this could as well implicates the growing saving rate. This has to some extent implies an increase in domestic savings in response to the economic crisis. Liquidity situation as well as low long-term government bond yield didn't seem to be in consistency with quantitative easing.

Figure 3 Withdrawal of liquidity from banks
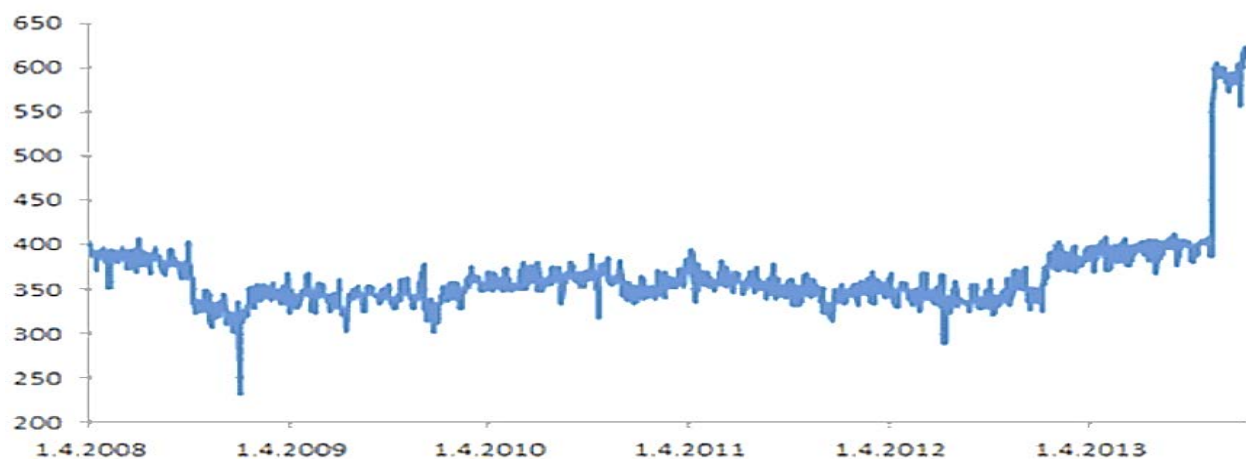
Source: TOMŠÍK (2014)

Due to absence in significant volume in corporate, similar risk bonds, as well as inadequate conditions of bonds market in the Czech Republic, the qualitative easing and implementing unconventional tool under such circumstances is also not possible.[112]

Other, above discussed non-standard tool is „forward guidance". CNB communicated its inclination towards the usage of exchange rate intervention as unconventional monetary tool, and thus at first tried to weaken the exchange rate by verbal interventions. There is a discussion on the extent of this unconventional tool on the economy, markets and public. The opponents say that the communication to implement the exchange rate as an alternative instrument before their actual usage, was weak. Even opinion, that interventions were unexpected, appeared. On the other hand, some argue that the CNB communication contributed to a decline in long-term interest rates in fall 2012, after the decision to reduce the limit interest rate for two-week repo operations to 0,25%. The first note towards the unconventional tool usage within the CB Board meeting was September 27, 2012 after which ž other meeting occur until year after, CNB decided unanimously that is ready to intervene, the Board meeting took place on November 7 , 2013. During the 7 other Board meetings CNB proactively discussed and took action in order to influence the opinions of market and public about easing the policy and prepare them on the possibility of exchange rate intervention.

Figure 18 CZK/EUR and its % change
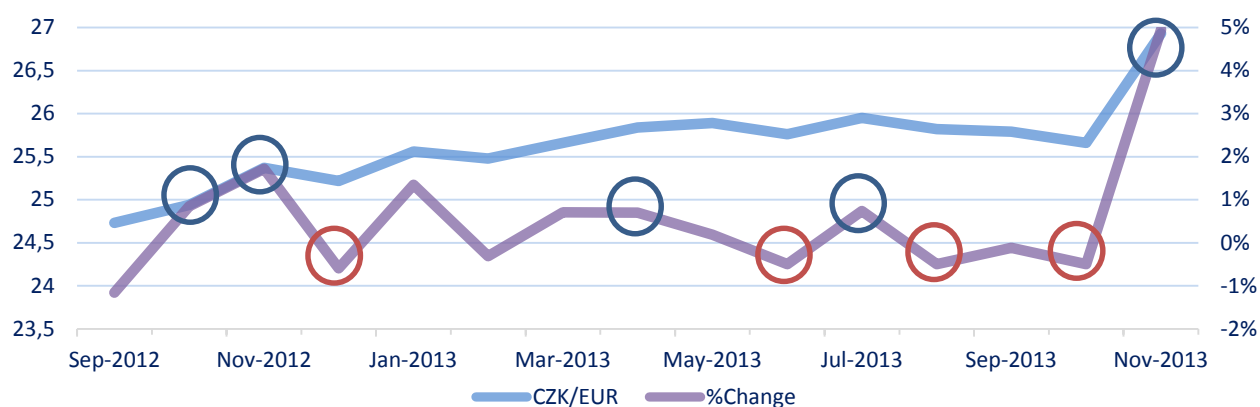
Source: CNB, *own processing*

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[112] Franta states that only mortgages bonds would be available. FRANTA, Michal, et al. *The Exchange Rate as an Instrument at Zero Interest Rates: The Case of the Czech Republic*. Czech National Bank, Research Department, 2014.

Looking at the exchange rate fluctuation, we can assume that some reaction after meeting is visible. From September 2012 to May 2013 Czech koruna depreciated against the euro significantly. The question is to what extent this was due to verbal interventions and how due to recession. For a more accurate assessment, whether individual sessions influenced the exchange rate, the percentage change of the Czech crown against the euro is calculated. The after meeting reactions are circled in the figure 18 (red circle represents appreciation of crown and blue depreciation). The biggest depreciation, is recorded after Board meeting in November 2012. At this meeting the Board agreed to cut the main monetary policy rates (repo) to zero level, therefore the change can be attributed to interest rate parity and not to verbal intervention. One would considered the last 2 meetings as the most influential, when it comes to verbal interventions. In those two meetings Board voted for using the exchange rate intervention to ease the monetary policy, but the proposal was rejected. In contrast, during the last two meetings the exchange rate strengthened. Last circle in figure 18 represents the introduction of the exchange rate commitment in November 2013 and is a proof that verbal interventions were not enough.

Considering the conditions of the Czech Republic as a small open economy, use of the exchange rate as an alternative monetary policy instruments was a relevant choice, especially due to the high economic openness presented in significant export orientation. The effort was to stimulate demand for domestic production and reduce the savings rate. CNB favored using exchange rate directly and chose unlimited intervention as an action in order to reach the level of the exchange rate, which will be consistent with the inflation target. Another way would be to use a defined volume of interventions. CNB believed that intervention with defined volume would have only small liquidity impact directly linked to their volume of interventions, they were also skeptical about the inability to identify ex ante quantity of intervention to influence the exchange rate and guarantee an adequate effect on inflation.[113] CNB publicly declared asymmetric commitment to hold the exchange rate at a level close to 27 CZK / EUR, and so will prevent pressures on appreciation, however movements above the intervention level will be left without response. Considering the Svensson`s or

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[113] FRANTA, Michal, et al. *The Exchange Rate as an Instrument at Zero Interest Rates: The Case of the Czech Republic*. Czech National Bank, Research Department, 2014.

McCallum`s scenario of easing the monetary conditions under ZLB, as described in the chapter 4, the CNB approach inclined more towards the "foolproof way" described by Svensson. McCallum tactic uses standard intervention, which CNB excluded for the reasons mentioned above. In consistency with Svennson, CNB in order to effect exchange rate by foreign exchange intervention relies mainly on exploiting the signaling transmission effect. However CNB doesn't follow the "foolproof way" in all means, the main difference compared to Svensson recommendations can be seen on the use of one time decline and asymmetric commitment. Svensson on the other hand, uses the crawling peg exchange rate regime as a way out.

5.2 CNB – alternative tool projection

In order for CNB to decide about its next step in easing the economy, the Board in November 2013 introduced and communicated the four scenarios of future monetary policy and its effect on the economy. CNB included the baseline scenario, which expected future decline in interest rate, leading the interest rate to negative values. This scenario was only hypothetical. CNB also investigated the policy in which the interest rates stay the same. This is the passive scenario, which had two faces depending one included external exchange rate appreciation shock. Alternative scenario, weakening of exchange rate close to 27 CZK/EUR and leaving the interest rates on the ZLB, was projected to appropriately ease the economy.

According the figure 19, the inflation was, due to the decline in exchange rate, supposed to rise. The impact was firstly on the import prices and later the exchange rate weakening was expected to wake up the domestic demand that would majorly influencing the rise of prices. Looking at the Figure 19, the inflation in the first quarter of 2015 reaches the highest value above the 2% target. The depreciation supports the country competitiveness. Growth in competitiveness would bring more profit to firms, which gives them motivation to invest more, as well as hire more employees and influences wages.[114]

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[114] FRANTA, Michal, et al. *The Exchange Rate as an Instrument at Zero Interest Rates: The Case of the Czech Republic*. Czech National Bank, Research Department, 2014.

Figure 19 Possible scenarios comparison in 2013
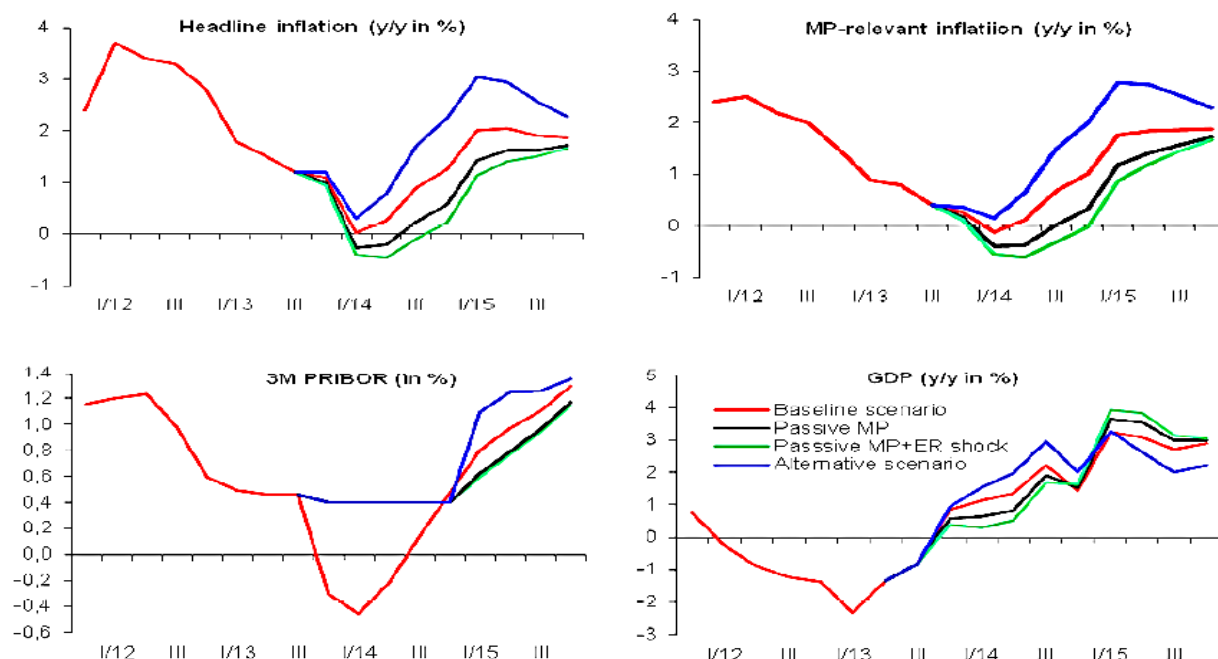
Source: FRANTA (2014)
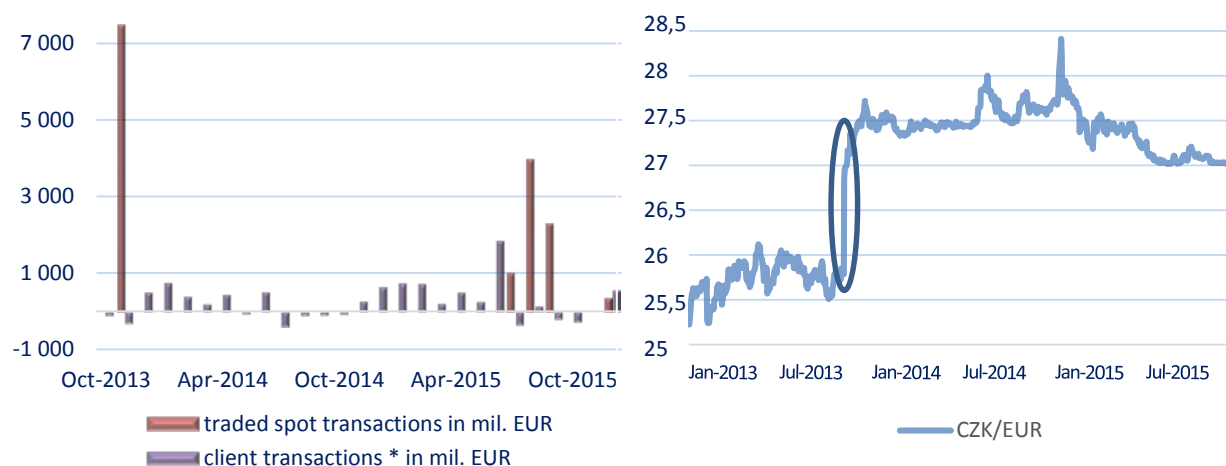
5.3 Exchange rate

Since 1997, when the Czech Republic moved from fixed to floating exchange rate regime, the CNB has intervened mostly against appreciation of the crown three times.[115] The effectiveness of past interventions could be a hint in the examination of the present once, but Czech Republic has never experienced ZLB and the historic intervention coexisted with the interest rate tool of monetary policy. The literature shows evidence of statistical, but small impact of past intervention on exchange rate.[116] Recently the most discussed interventions were the ones from November 7, 2013, when CNB directly intervened and weakened the Czech crown to nearly 27 CZK / EUR. According to published statistics of CNB, the purchase on the spot market of the euro reached to 7.499 billion

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[115] In February and July 1998, October 1999 to March 2000, October 2001 to September 2002.
[116] GALATI, Gabriele; DISYATAT, Piti. *The effectiveness of foreign exchange intervention in emerging market countries: evidence from the Czech koruna*. Bank for International Settlements, 2005.

euro (Figure 20). This meant a significant reduction in the supply of euro on the domestic market, leading to rise in the price of euro (appreciation) and thus depreciation of the Czech currency.

Figure 4 CNB transaction on the forex market and ita impact on exchange rate

Source: CNB, *own processing*

The exchange rate seemed to be stable, without the need for further intervention and the exchange rate commitment, supported by the declared determination of CNB to intervene in the case of appreciation of the crown, began to be trustworthy. However, starting with the end of 2014 and continuing to the beginning of 2015 the crown started to appreciate. The appreciation could be attributed to the economic growth, the fuel price fall and partially also to the inflow of EU subsidy as in figure 20 could be seen in the CNB client transactions.

Also it's important to mention, that crown was at the turn of November and December strengthened by speculation on further action by the ECB. The current monetary policy of the CNB is greatly influenced and could be complicated by the unconventional monetary policy of the ECB, which during the meeting on December 3, 2015 adopted a decision on the continuation of the bonds purchase program worth 60 billion euros per month, this should last at least till March 2017. Also the deposit facility interest were reduced on December 9, 2015 from -0,20% to -0,30%. As can be seen in figure 21, the interest rate differential has increased, which in consistency with the UIP, suggests the future appreciation of the currency.

Figure 5 3M PRIBOR,EURIBOR and its interest rate differential
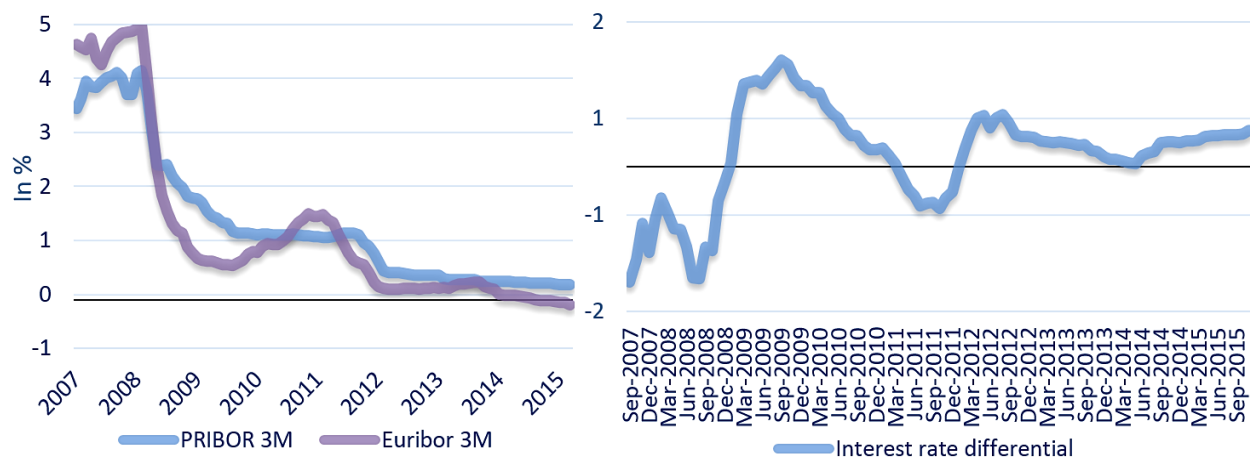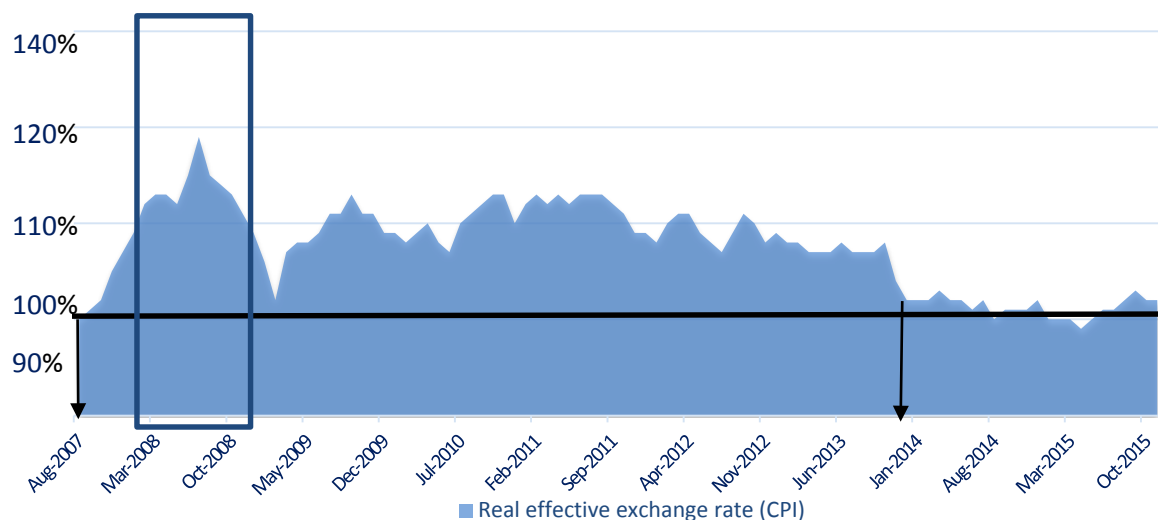

Source: TWB, *own processing*

Appreciation brought CNB to fulfil their commitment and in the year 2015 intervened against the appreciation. During July, August, September and November carried out a purchase of around 7, 4 billion euro (Figure 20).

The performance of the Czech economy and the monetary policy in the euro area, in my opinion will push the crown towards the level of 27 crowns per euro in 2016 and the CNB will have to continue to intervene against the appreciation. On Dec. 16, 2015, CNB at its Board meeting noted that will not stop using the exchange rate as an instrument of monetary policy before the end of 2016.

In order to examine the real appreciation or depreciation and understand the CNB decision better, we have to pay attention to real exchange rate. It can be observe in figure 22, where the real effective exchange rate is expressed through CPI. The appreciation of the real effective exchange rate is based on the year 2007, which represents 100 % (right axes). In other words the real effective exchange rate is one of the indicators of international competitiveness of the country and is generally understood as various levels of relative prices or costs expressed in a certain currency. In this respect, rates with values above 100% signify a downward trend in the country's

competitiveness relative to the base period, whereas rate below 100% means rising competitiveness of the country relative to the base period. Choosing 2007 as a base is not random, but as the last year before crises not effected by it, we can say that getting back to that point will be a good. In the figure 22 is clearly pictured the long-term development of the real effective exchange rate. The year 2008, highlighted in the graph below, is marked by high volatility of exchange rate at the beginning of the crisis and through the whole crises is consistently stronger than in the pre-crisis year. Accordingly to Lubomír Lízal[117] the real effective exchange rate at the beginning of the crises stabilized at a level systematically stronger and worked in the direction of tightening monetary conditions. This was compensate in the systematic reduction of interest rates (figure 21).

Figure 6 Real effective exchange rate

Real effective exchange rate (CPI)

Source: CNB, *own processing*

As mentioned above, the ECB and other CB will continue in reducing interest rates and easing monetary policy, causing decrease in the interest rate differential and thus tightening the monetary conditions. The down-turn in foreign price levels has effected real effective exchange rate, since it's based their difference (CPI). And thus same level of nominal exchange rate may correspond to a lower trajectory of domestic prices. Setting limits for the movement of the nominal exchange rate

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[117] LÍZAL, Lubomír. *Nadhodnocená, nebo podhodnocená koruna?* [online]. Praha: Česká Národní Banka, 2015 [cit. 2015-11-12]. Available: https://www.cnb.cz/cs/o_cnb/blog_cnb/prispevky/lizal_20150311.html

is not equivalent to targeting the price level. The exchange rate commitment seams then as rational decision in order to have situation under control, so not only relaxing the monetary terms, but also assure that due to easing the monetary policy abroad the conditions will not be tightened in the Czech Republic. Figure 22 provides information, that the crown is going back to the state that was before crisis and is even more depreciated, which does ease the conditions on the market.

I believe, that FX interventions will be needed even in early 2017, due to above mention reasons, and the Czech interest rates with the influence of the ECB policy, will go up only slowly.

5.4 Inflation

In order to assess the effectiveness of the used non-standard tool we need to look at the main reason for the weakening of the exchange rate. The core intention of it all was that CNB was worried about the deflation pressures and wanted to return inflation to 2% target and thus fulfill its purpose. We can therefore say, inflation can serve as an important parameter in evaluation the success of the tool.

When CB in 2013 prognoses the inflation with the consideration of using the alternative tool, its projection for 2015 was rather optimistic. The inflation according to the initial forecasts should have reached by the first quarter of 2015 3%. So we can see, in the graph below (figure 23) that the overall inflation never reached the targeted value and CPI even decreased throughout the whole period from November 2013 to the October 2015.[118] We can then either assume that this overshoot of inflation prognoses was intended and CNB wanted to influence the expectation of inflation. On the other hand it can imply that monetary policy has not been eased enough and the commitment should had been set at even lower level or the inflation is effected by other factors, which are out of the CNB control. In 2015 some debates about the shift in the level of the exchange rate commitment has occur, especially within the decrease in inflation and its expectation and oil prices (figure 24). This situation, is assumed to be the positive shock (supply deflation) and CNB decided

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[118] The last available statistical data.

not to react and rather maintain its commitments for longer period of time. Reaction should be considered if deflation continues in the long run causing decline in domestic demand. However setting the commitment to even lower target could rise a problem in the foreign exchange market, when it's crucial to estimate the reaction and acceptability of the new level by speculators.
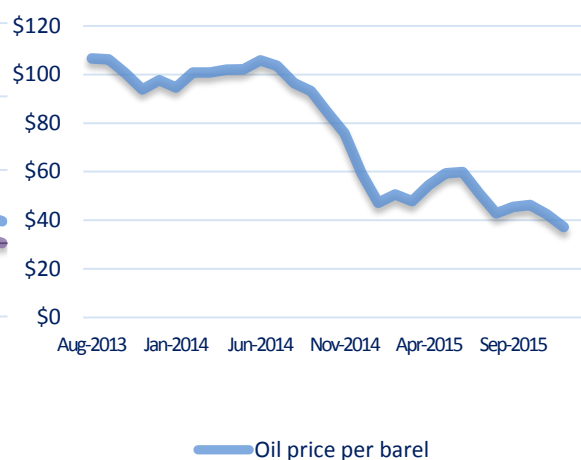
Following the Monetary-policy inflation, the course jumbs and never reaches 1% . From November 2014, it almost copies the development of oil prices (figure 24). The increase is prognoses by the CNB, but inflation is not expected to reach the target level throughout the whole year 2016.

Figure 7 Inflation 2013-2015

Inflation rate (CPI) — Monetary-policy inflation — CNB target

Figure 24 Oil prices

Oil price per barel
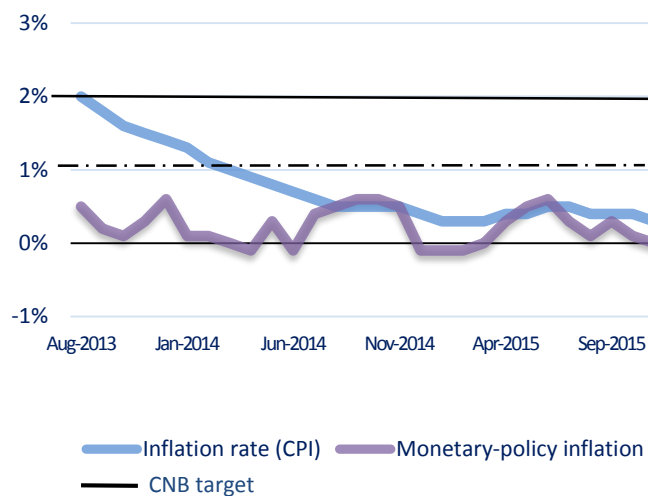
Source: CNB, *own processing*

Source: FED, *own processing*

During the year 2014 the drop in prices was mainly a result of fall in regulated prices, electricity and gas prices fell as well as the fees in health care system. Other cause was the overall cut in inflation within EU area. The EU industrial producer prices, which have direct relevance to the development of Czech import price is clearly declining, in a much larger degree than predicted in November 2013. A global significant slump in oil prices and the prices of food were registered at the beginning of 2015. The decline in oil prices could be contributed to a new technologies and high supply of the commodity. On the other hand, good harvests and the restriction on international trade in Russia donated to fall in food prices. This statement can be backed by figure 25 and it

could explain the decline in inflation at the start of 2015. As mentioned above, this represents positive stimuli to the economy, reducing costs and expenditure and thus leads to revenue real wages growth.

Figure 25 Components of inflation 2013-2015
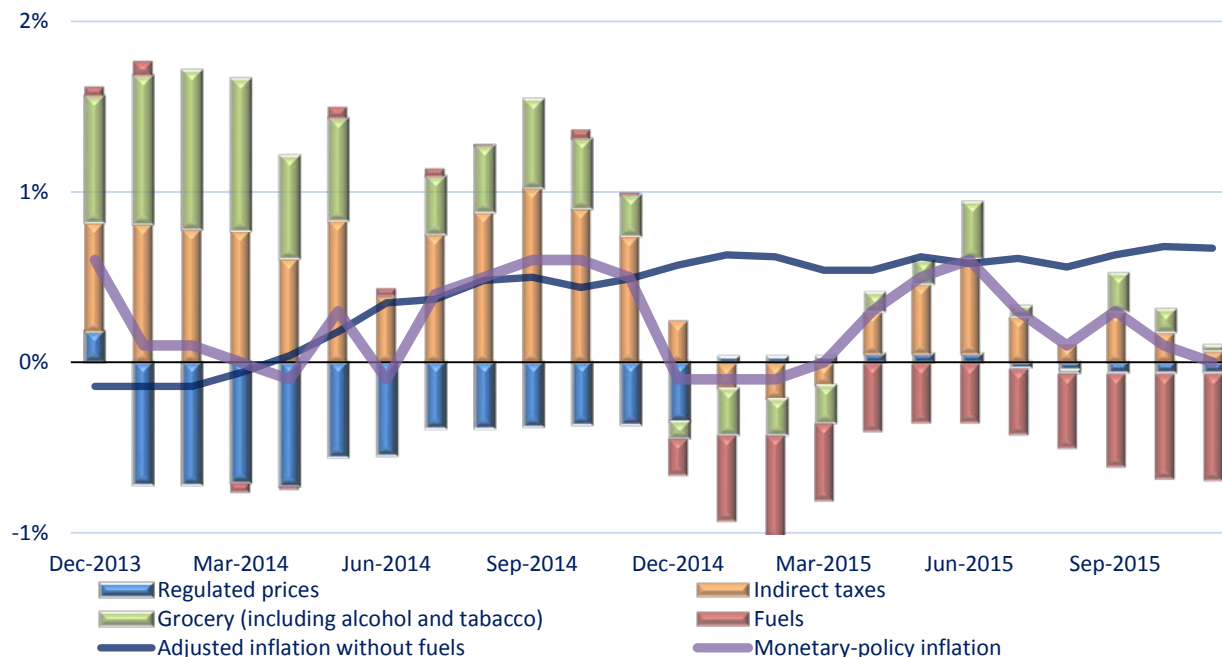
Source: CNB, *own processing*

The above mentioned factors are external the actual impact of the crown weakening is reflected in the prices adjusted inflation excluding fuel prices. The adjusted inflation (figure 25) is slowly increasing. The effect on different prices and thus the exchange rate effect can be seen in figure 26. After the intervention the direct effect of import prices was very clear, which corresponds with the effect on export prices. The demand effects of inflation is visible from the beginning of 2015, however the rise in consumer prices can be also attributed to the recovery in economic activity and wage growth. The inflation is still influenced by sharp decrease in foreign producer prices.
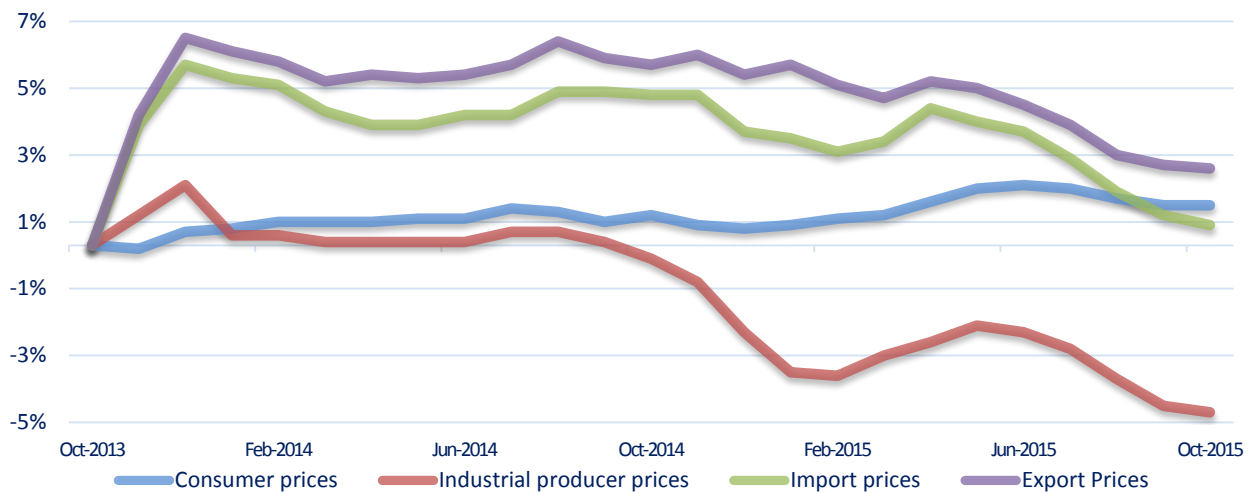
5.5 Real economy fundaments PB

The real economic growth racketed at the end of 2013. Also economic activity in 2014 was above the predicted level, in November 2013. After a long period of downward phase, this could be the economic recovery stage. Positive GDP growth, reflected a decline in unemployment and upward pressure on nominal and real wages. 2015 is also a positive year. The annual growth was positively affected by all the GDP components (figure 27). Noticeable is especially the gross capital formation, which negative values compared to 2007 has rapidly decreased and so the investments increased. Also the household consumption increased significantly. Another high value components is the government expenditure, expansionary fiscal policy, the government spending accelerated especially due to government investments financed mainly from EU sources. It's predicted that in the year 2016 the government spending will be mainly influenced by the rise in compensation due to the increase of wages of state employees. Another factor of the high growth is the monetary policy which is easing condition in the economy as well as the low oil prices.

Figure 9 GDP components compared to 2007
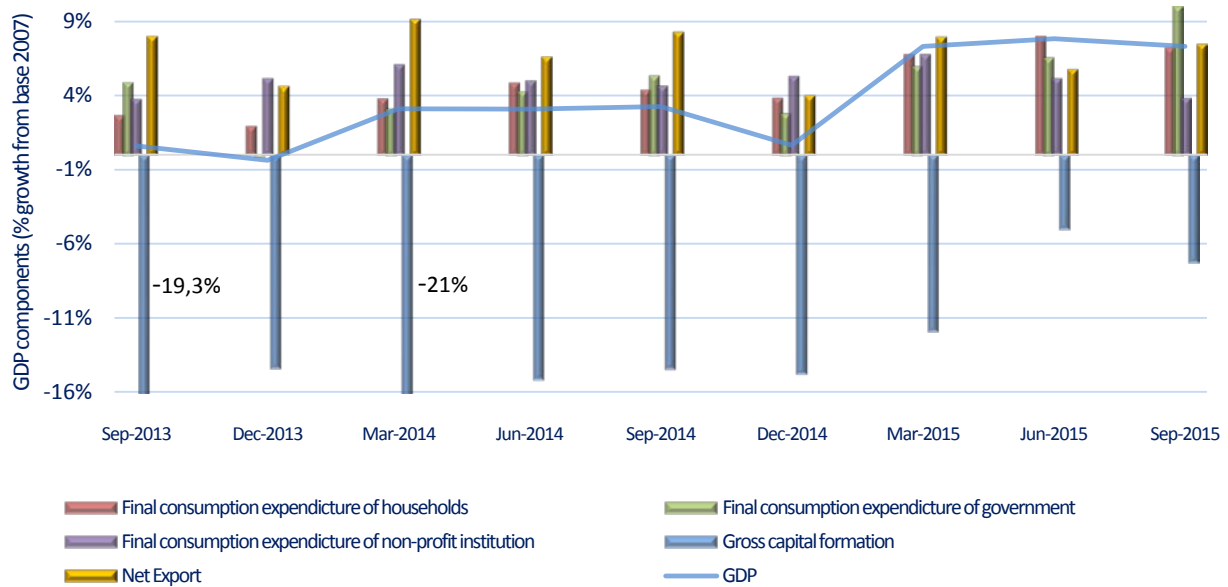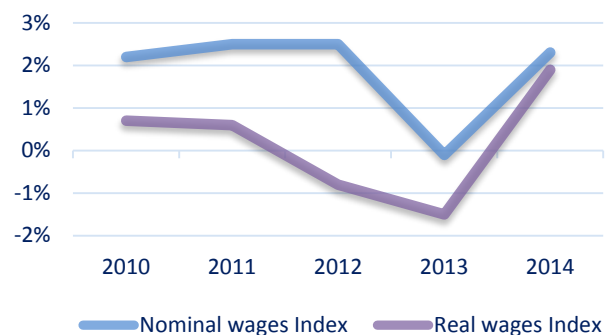

Source: CNB, *own processing*

Rapid domestic economic growth, as mentioned above, has positive effect in improving the situation on the labor market. The general unemployment rate in 2015 decreased further (figure 28). Nominal wages in the second quarter of 2015 increased by 2.9%. In the third quarter, the forecast expects a further acceleration, to 3.4%.
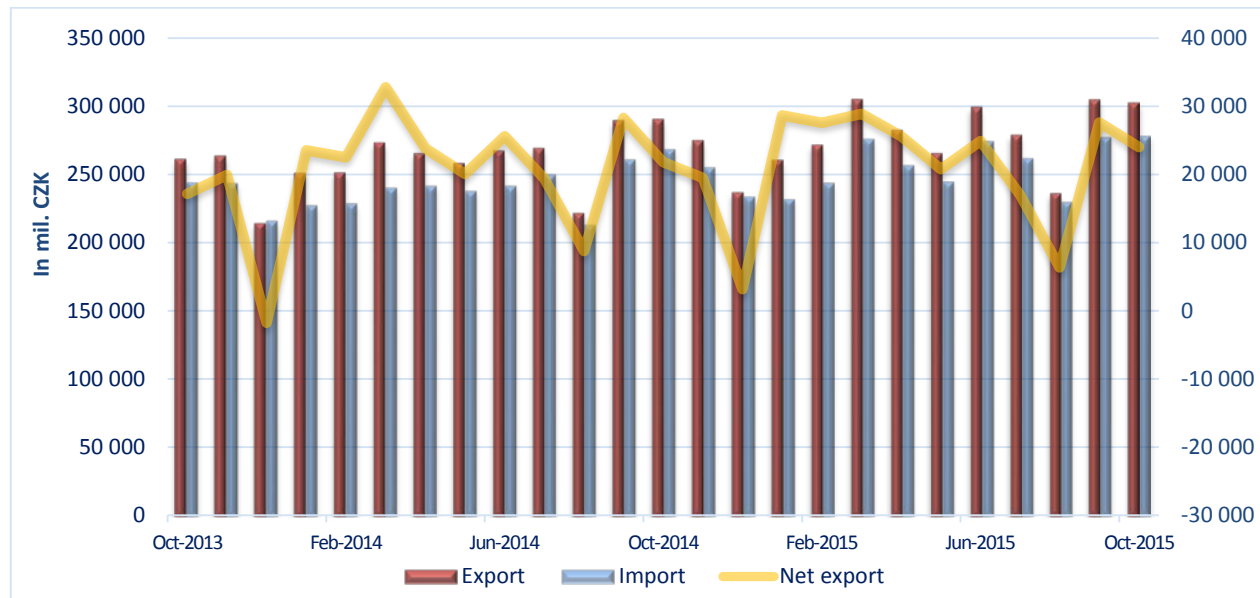
Figure 28 Unemployment rate 2012-2015
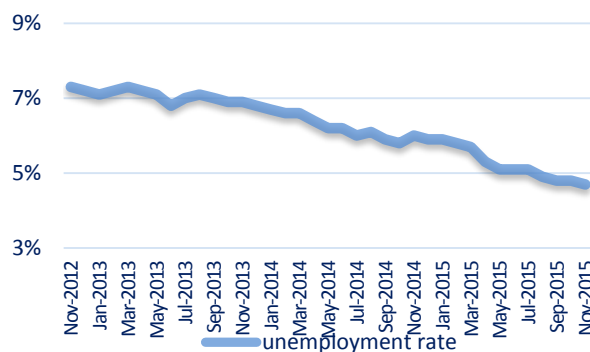
Figure 29 Index of wages 2010-2014

Source: TWB, *own processing*

Source: CNB, *own processing*

Figure 30 Net export

High nominal growth rate of exports in the first two quarters of 2014 confirm that the weaker exchange rate has the expected positive impact of the Czech export companies both through growth in export prices (figure 26) and the real growth of exports, which is supported by the economic recovery in the euro area. In 2015, net exports have, despite of increasing foreign demand, on average negative contribution, due to the increase in consumer goods and machinery imports, which implies strong growth in domestic demand. In summary, for the whole year 2015 contribute of net export to annual GDP growth was negative.

6 Conclusion

Due to the economic downturn in the years 2012 and 2013, CB completely exhausted the main monetary policy tool, the interest rate and found itself in the unfamiliar situation of ZLB. Due to continues recession and fear of deflation, the CB decided to use one of the unconventional tools, the exchange rate to ease the conditions. When CB announced its intention to depreciate the exchange rate, the decision was accompanied by heated debates, both professional and general public.

This thesis aims to describe and evaluate the effects of using foreign exchange rate as unconventional monetary tool. The first chapter very briefly defines, the rather new monetary policy based on inflation targeting system, were the central goal is put on price stability, which the CB achieves by controlling their policy interest rates. In this part of the thesis, the main transmission channels are presented, where in the standard condition, interest rate channel could be considered as a core one. Recent crisis and the fall of inflation led in some countries to the fear of deflation. CB started to worry about the occurrence of deflation cycle and liquidity trap. CBs reacted on the adverse economic situation by lowering the interest rate until the very last moment, many of them reached the ZLB. The thesis characterizes these conditions in more detail within the chapter 2. Because of exhaustion of interest rate and a need of further easing, most of the world's major CB had to extent their instrument portfolio with nonstandard tools for additional monetary easing. This thesis presents the alternative instruments to which CBs inclined, when the interest rates reached the technical zero. One of the most commented is quantitative easing, the thesis offers description also on other tools based on the purchase of bonds and credit easing. Another often applied tool is forward guidance, which is based on communication of the CB with the general public about the future moves in order to influence the expectation. The chapter 4 focuses on exchange rate intervention. This chapter is important for the later macroeconomic analysis of the Czech experience with the exchange rate unconventional tool, since it describes the transmission channels through which the intervention effect the exchange rate as well as the pass-through canals from exchange rate to inflation. Import prices are defined as the direct channel of past-through with immediate impact other main channel are the domestic and foreign demand and the effect on export

prices. Last part of the thesis is pursued to the main theories, McCallum's and Svensson´s, based on exchange rate. Svenssons approach to exchange rate tool, seems to be more appropriate than the McCallum, since he highlights the importance of signaling channel and uses the exchange rate directly.

Practical part of the thesis examines the CNB use of asymmetric exchange rate commitment in order to influence the inflation in the Czech Republic under ZLB. The thesis provides reasoning for the exchange rate instrument choice of CNB. The situation of the Czech Republic was quite unique as a small open economy with high liquidity in financial system, shallow bond market and legal issues, which limited the range of available instruments. The examination of CNB first intention to influence the inflation, verbal intervention, was not verified to be efficient, however during the period of CB communication, the exchange rate suffered a decline. CNB approached is closer to previously mentioned Svennsons theory also called "Foolproof Way". Since it uses exchange rate directly and emphasizes the signaling channel. Analysis inspected economical situation before the intervention and after focusing on effect on exchange rate, inflation and GDP. The commitment in 2013 appeared to become credible and the desired level of exchange rate was achieved fast and stay above the limiting level until the end of 2014. 2015 brought slight appreciation to the exchange rate resulting in additional intervention of CNB. This was mainly attributed to the further ECB monetary easing policy, decline in oil prices and overall domestic inflation as well as EU and better economic activity than it was predicted. Looking at the main target of our attention, inflation, the prediction in 2013 was far higher than the reality, the drop in inflation is mainly caused by prices of fuel, which represents positive shock. The adjusted inflation is increasing as well as GDP, so interventions have the potential to have the desired impact, but there are many other influences, which complicates the CNB situation.

Due to short time horizon from the announcement of intervention and especially its permanent use the conclusion on the assessment on the depreciation cannot be definite. An appropriate extension of this work could be make, when more and longer data is available, when the monetary loosening is fully reflected in the examined variables.

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