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Unconventional Monetary Policies and
their Impacts on Liquidity of Czech
Banking System

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Declaration

I hereby declare that the presented thesis “Unconventional Monetary Policies and their Impacts on Liquidity of Czech Banking System” is my own work and that I have properly cited all literature and other sources of information used when elaborating this master’s thesis.

In Prague on May 23, 2018

.....
Bc. Tomáš Panýr

I wish to express my sincere gratitude to Ing., Doc. Karel Brůna, Ph.D. for his patient guidance and useful critiques during the elaboration of this master's thesis. I am particularly grateful for his valuable and constructive suggestions which significantly increased the expertise of the research.

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Abstract

The master's thesis analyzes the current development of the monetary policy and the implementation of the unconventional monetary instruments by the central banks in response to the financial crisis and a subsequent liquidity trap. Attention is primarily focused on quantitative easing and foreign exchange interventions and their transmission mechanisms by which the monetary authorities seek to fulfill their primary objective in terms of price stability in a zero interest rate environment and a non-functioning standard interest rate transmission. The main objective of the thesis is to link the unconventional monetary policy and the liquidity of the banking system and to explain their close interaction. The analytical part focuses on a specific example of the Czech economy and the implementation of foreign exchange interventions by the Czech National Bank and their influence on the easing of monetary conditions and a further increase in the liquidity of the banking sector.

Keywords: unconventional monetary tools, transmission mechanisms, quantitative easing, foreign exchange interventions, excess liquidity, Czech National Bank

JEL classification: E31, E44, E52, E58, G32

Abstrakt

Diplomová práce analyzuje aktuální vývoj měnové politiky a zavádění nekonvenčních měnových nástrojů centrálními bankami v reakci na finanční krizi a následnou past likvidity. Pozornost je upřena primárně na kvantitativní uvolňování a devizové intervence a jejich transmisní mechanismy, pomocí kterých se měnové autority snaží naplňovat svůj primární cíl v podobě cenové stability v situaci nulových úrokových sazeb a nefunkční standardní úrokové transmise. Hlavním cílem práce je propojení nekonvenční měnové politiky a likvidity bankovního systému a vysvětlit jejich úzký vztah. Analytická část se zaměřuje na specifický příklad české ekonomiky a implementaci devizových intervencí Českou národní bankou a jejich vlivu na uvolnění měnových podmínek a další nárůst přebytečné likvidity bankovního sektoru.

Klíčová slova: nekonvenční měnové nástroje, transmisní mechanismy, kvantitativní uvolňování, devizové intervence, přebytek likvidity, Česká národní banka

JEL klasifikace: E31, E44, E52, E58, G32

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List of Abbreviations

A	Absorption	FR	Foreign Exchange Reserves
BCBS	Basel Committee on Banking Supervision	FX	Foreign Exchange
BoE	Bank of England	HLA	Highly Liquid Assets
BoJ	Bank of Japan	HQLA	High Quality Liquid Assets
CA	Current Account	G	Government Spending
CF	Credit Facility	I	Investments
CNB	Czech National Bank	ILAAP	Internal Liquidity Adequacy Assessment Processes
CUR	Currency in Circulation	KA	Capital Account
D_{DF}	Deposit Facility	LCR	Liquidity Coverage Ratio
D_{GOV}	Government Deposits	L_D	Liquidity Use
D_{OUTR}	Own Issues	L_{STR}	Liquidity Sterilization
D_{REPO}	Repurchase Agreement	L_S	Liquidity Demand
DI	Direct Investments	L_U	Liquidity Sterilization
EBA	European Banking Association	MFCR	Ministry of Finance of the Czech Republic
ECB	European Central Bank	MR	Minimum Reserves
EO	Errors and Omissions	NSFR	Net Stable Funding Ratio
ER	Excess Reserves	NX	Net Exports
FA	Financial Account	OI	Other Investments
FD	Financial Derivatives	OTHA	Other Assets
FED	Federal Reserve System	OTHL	Other Liabilities
		PI	Portfolio Investments

LIST OF ABBREVIATIONS

PIA	Primary Income Account	SEC_{OUTR}	Securities Held Outright
RE	Reserve Assets	SEC_{RREPO}	Reverse Repurchase Agreement
QE	Quantitative Easing	T	Taxes
S	Savings	Y	Income
SIA	Secondary Income Account	ZLB	Zero Lower Bound
SEC_{LF}	Collateral for Lending Facility		

Introduction

Over the last few years, unprecedented monetary instruments have occupied much of the attention of central banks of major advanced economies as the recent economic development has confronted central bankers with questions beyond the scope of the theory of standard monetary policy. Due to numerous structural macro and micro economy imbalances which resulted into a financial crisis and subsequently into the Great Recession, the major central banks to protect the financial system and support their economies responded with a significant loosening of monetary conditions. The gradual rates cuts and the resulting zero lower bound on nominal monetary interest rates got the central banks into a situation where it was no longer possible to further ease monetary conditions using the standard interest rate transmission.

In order to meet the objective of price stability, monetary authorities decided to include new unconventional instruments into their portfolio. Among these tools, quantitative easing and FX interventions gained a dominant position. Although the primary objective of these instruments was to avoid the threat of deflation, which was one of the main arguments of the monetary authorities in their accession to the further easing of monetary conditions, the unconventional policies had inevitable and vital impacts on many other economic aspects, including the liquidity of the banking systems.

The first goal of the research is to examine the consequences of the zero lower bound on the standard interest rate transmission used by the central banks in the inflation targeting regime and to explain why the alternative tools can result in restored inflation pressures. The thesis defines in detail transmission mechanisms of quantitative easing and FX interventions and points out to the differences between these two instruments and advantages they provide for different types of economies. In addition to the theoretical definition of individual instruments, the aim is also to provide alternative

and often very critical views that contradict the central bank arguments, both on deflation and on the implementation of individual unconventional instruments and their consequences. The second goal is to put into context monetary policy of the central bank and the liquidity of the banking system and to determine the effects of newly implemented non-standard monetary tools. To thoroughly analyze the impacts of FX interventions on the systemic excess of liquidity, the specific example of the Czech banking system was chosen.

The thesis strives to answer these two primary objectives in three chapters. The first chapter focuses on the recent changes in monetary policies and the dawn of the new unconventional tools. In the first section, the development and changes in global economies are shortly described. Subsequently, the origins of the unconventional tools and a situation of zero central banks' policy interest rates are explained. The third section then summarizes newly implemented unconventional tools and thoroughly defines their transmission mechanisms through which the central banks try to affect their primary goal of price stability.

The main objective of the second chapter is to put the central bank's monetary policy into context of the liquidity of the banking system. To achieve this goal, the first section firstly defines terms liquidity and liquidity risk from several perspectives. The second section then presents the short history of the regulation of liquidity risk and highlights the most important milestones. For a better understanding of the principles of liquidity risk management, the subsequent section provides an overview of the risk measurement options applied at individual banks. The last section focuses on the liquidity of the banking system, explains the reasons for the systemic deficit/surplus of liquidity and determines the tight connection of this area with the monetary policy of the central bank.

In the last chapter, after a brief introduction of main characteristics of the Czech financial system, the standard monetary tools and their relationship to the liquidity of the banking system are explained. The second section shows the macroeconomic development of the Czech economy over the last few years, and in the third one, the subsequent shift to the foreign exchange interventions is evaluated. The third section also strives to explain the influence of these monetary actions on the levels of interest rates in the individual segments of the financial market. The aim of the fourth section is to examine the impacts of FX interventions on the various determinants closely influencing excess liquidity of the Czech banking system. In the last section, the characteristics of the Czech financial system and its balance sheet are put into context with the effects of the monetary expansion of the CNB and the overall impact on the liquidity situation is assessed.

I

Theoretical part

1 Changes in conduct of monetary policy

In the aftermath of the financial crisis, global economy found itself in a situation that could hardly be spotted in the long history of a two-level banking system with a single monetary authority. Not only the globally most influential monetary authorities, the *Federal Reserve System* (FED) and the *European Central Bank* (ECB), had to prove, despite being no longer capable of achieving their goals with well-known standard monetary tools, they were still able to push economies towards the directions they are aiming to.

1.1 Development after credit crunch in 2008

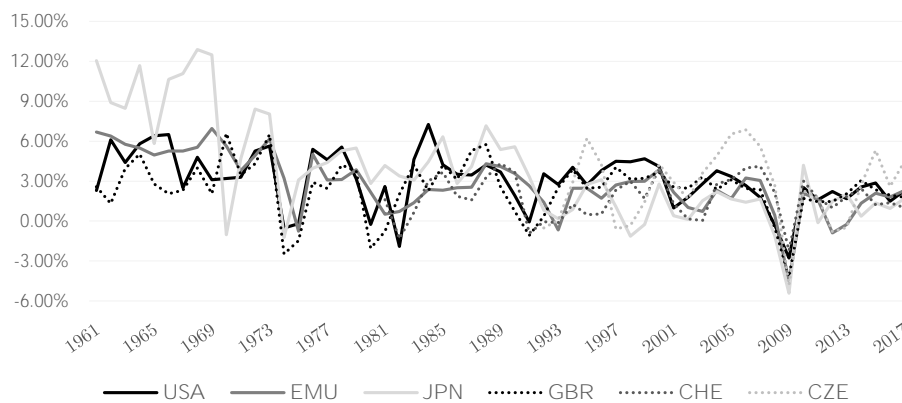
It was a combination of several factors including increasing public and private debts, worsening of competitiveness of many economies together with large flows of foreign capital and over-investment in a few asset classes, which resulted in global economic imbalances. The burst of the bubble of one of those classes - real estates - supported by excessive credit growth and credit agencies failures, was the last straw that escalated into the global financial crisis. With undermined confidence in the financial sector and huge bailouts provided by central governments to affected institutions, the global economy headed into a deep recession, which later earned the designation the Great Recession. One of the legacies of this crisis were new market conditions, the conditions that forced monetary authorities to implement new untraditional policies. The primary aim of these policies was to preserve financial stability and reinforce aggregate demand.

How deep and crucial this recession, which peaked with fall of Lehman Brothers, was in the context of economic growth is shown in Fig. 1.1. As

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well as in other figures in the first chapter, four global economic superpowers are included. Since the thesis directs its attention to the Czech Republic, the figures in this chapter are also extended by the countries which represent small open economies. In this thesis, the Czech Republic, and Switzerland serve as examples of these countries.

Fig. 1.1: GDP growth annual data 1961-2017



Source: World Bank, own processing

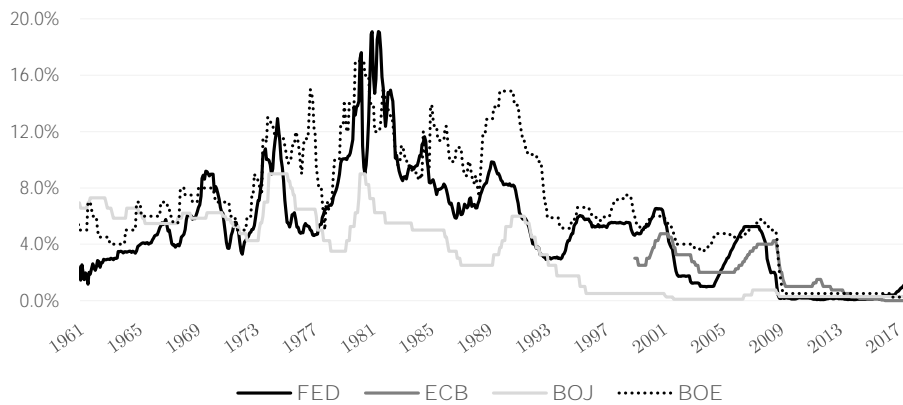
The United States of America, the euro area and Japan together with the United Kingdom and earlier mentioned small open economies, they all found themselves in deep crises starting in 2008. Fig. 1.1 shows synchronized steep decline in GDP which reached almost -6% in some of these areas in the deepest point of the crisis. The year 2008 represents by far the lowest point in the figure's monitored period that begins in early 60's. These huge but temporary drops in GDPs were an only direct consequence of several issues of global economies.

In the context of monetary policy, a more pressing issue, an issue that was also initiated by the global financial crisis, were inexorably declining interest rates (Fig. 1.2). While GDP remained in negative figures for nearly two years, abnormally low rates of major central banks have been present for almost a decade as central banks tried to support financial sector with liquidity and easing market conditions to avoid bankruptcies and enhance financial intermediary function. The year 2008 is the moment when interest rates began their falls to the unprecedentedly low levels.

Monetary authorities pushed their interest rates into unusual territories through successive reactions to the unfavorable economic situation. The FED took the first steps to ease the monetary policy. Because of the issue

of sub-prime mortgages, the FED lowered its rates from 5.25% in September 2007 to 1.5% in October 2008 in eight steps. Since the European authorities like the ECB and the *Bank of England* (BoE) did not expect any threat for the European financial sector from overseas' mortgage crisis, their policies kept tightening rather than easing market conditions until 2008. The Bank of England decreased its key interest rate in four steps from 5.75 to 4.5 in autumn 2008 and the ECB did not even start to cut its rates until the October 2008, when Lehman Brothers fell.

Fig. 1.2: Central bank's base interest rates 1961-2017



Source: FED, ECB, BoJ, BoE, own processing

After the fall of Lehman Brothers, steep cuts in interest rates got the FED's and the BoE's policy interest rates to or very close to a *zero lower bound* (ZLB). The FED's key interest rate was set to 0.25% at the end of 2008 and the Bank of England followed this direction with five cuts to jump from 4.5% to 0.5% in March 2009. The ECB's policy was not as aggressive as the previous two mentioned. Besides being the last bank which cut its rates, the ECB's key interest rate did not reach such low levels as the former ones. However, after the devastating October 2008, even the ECB started to cut the rates and in seven steps got as low as 1% in May 2009. The financial crisis left policy interest rates of all major central banks on the historically lowest levels.

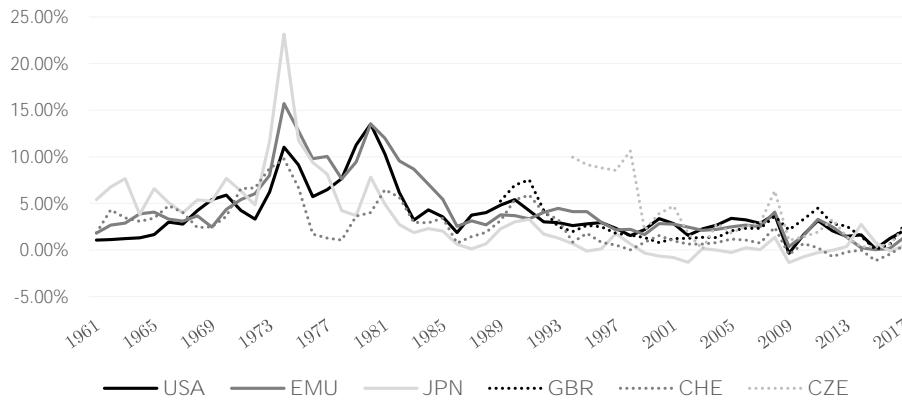
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1.2 Zero lower bound and transmission of monetary policy

In the last decade, inflation targeting has gained a privileged position in monetary policies of central banks around the world. This regime of monetary policy was first applied in New Zealand in 1989 and in the following years quickly received recognition from other monetary authorities as well. This theoretical concept of New Keynesians presumes endogeneity of the money stock and the monetary base and builds on the interest rate transmission. (Mandel and Tomšík, 2014).

In inflation targeting regime a monetary policy is ordinarily considered solely in terms of the choice of an operating target for a short-term nominal interest rate which directly affects short-term money market interest rates and subsequently and intermediately on long-term money market rates and finally on deposit and lending bank rates. Hence, the interest transmission mechanism is fundamentally dependent on the chosen operative criterion, i.e., the central bank's key interest rate.

Fig. 1.3: Inflation annual data 1961-2017



Source: World Bank, own processing

As mentioned already, ever since the financial crisis started to spread throughout the banking sector, central banks reacted with steep interest rates cuts. Primarily in order to ease monetary conditions and facilitate the financing of the banks affected by the crisis. It is a common policy that a central bank reacts to changes in the economic cycle and adjusts its interest rates accordingly, i.e., increasing the policy rates in times of peak of the economic cycle to prevent the economy from overheating and

inflation to soar and vice versa. However, Fig. 1.2 shows, that regardless of development in the economic cycle, interest rates remained in all-time lows for a very extended time. This phenomenon is indisputable when comparing Fig. 1.2 and Fig. 1.1. The situation experienced over the last few years is something central banks, except the specific example of *Bank of Japan* (BoJ), never had to react to.¹

As the financial crisis widened, individual central banks found themselves in a situation of zero or negative inflation. A situation of deflation is from the point of view of today's mainstream economics a phenomenon that a central bank should avoid and is inconsistent with a generally accepted target of price stability. One of the main arguments of this idea is that decline in the price level also leads to the shrinking incomes of corporates caused by decline in flexible prices of goods. Since the wages are rather rigid, soaring unemployment together with decreasing output is inevitable. (Krugman, 2010) Such an economy is consequently at risk of deflationary spiral.²

Despite this main argument of central banks against deflation and the frequently stressed threat that consumers and firms under conditions of price decline postpone or delay consumption and investment, economic theory does not have a clear and single view of deflation. Kovanda in Brůna et al. (2015), in his strongly critical article, questions the meaningfulness of "printing money", which is advocated mainly by Keynesians, and highlights numerous studies that contradict the recent policies of central banks. He concludes, that based on surveying data of seventeen deflationary periods over a hundred years, the only exception when deflation and a severe economic downturn seemed to have a connection, was the Great Depression in the 1930s. Other publications analyzing the history of deflation have the same conclusion and, moreover, often combine the decline in prices in the economy with economic growth. Another argument goes even further and suggests that too low interest rates set by central banks, driven by deflationary concerns, initiated an increase in money supply and subsequent excess liquidity on global markets which was one of the indisputable causes

¹Although not much attention was devoted to Japan, experience of this country goes far beyond the experience of other listed areas. While the FED, the ECB and the BoE had never had to fight extremely low inflation levels before, the BoJ experienced deflation multiple times in Japan's history. As Fig. 1.3 proves, Japan spent most of the times since the late 90's in an environment of declining prices. The issue of Japan is concerned, for example, in Bernanke, Reinhart, Sack (2004) or Krugman (1999).

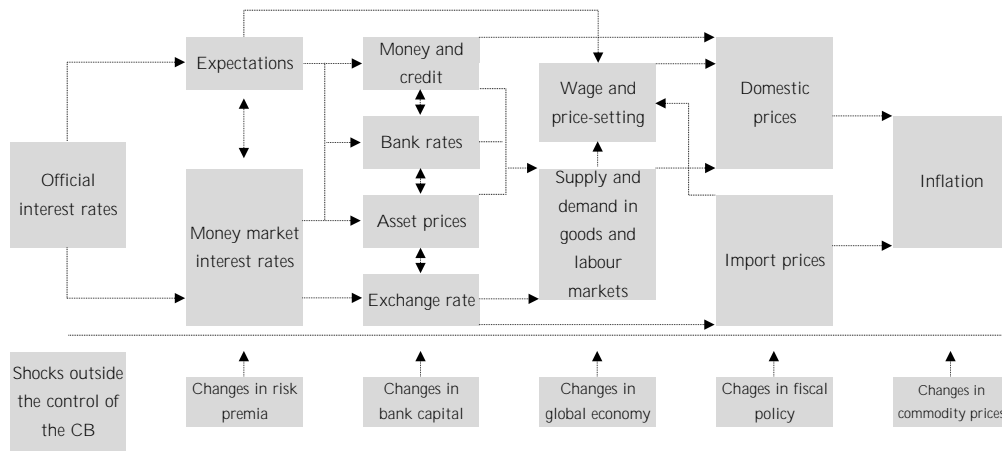
²Opinions on deflation vary across economic schools of thoughts, see, for example, Krugman (2010), Svensson (2003) Holub and Kral (2013), Klaus (2014) or Brůna et al. (2015).

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of the financial crisis. Kovadna's main argument is that there is no sufficient proof that the link between inflationary/deflationary expectations and the willingness of people to spend is strong and points out that consumers are more keen about their expected real income. In conjunction with the often-mentioned Lost Decade of Japanese economics, the author stresses demographic factors (namely the aging of the Japanese population) as the main reasons for persistent falling prices and the stagnant economy. Thus, he refers to supply-side causes of minimum economic growth rather than demand factors.

Despite that opinions on the phenomenon of deflation may differ, price stability is concurrently the main, if not the sole objective of most central banks in developed countries. Consequently, inflation with its long-term extremely low levels in combination with interest rates at historically lowest levels started to pose an unsolvable problem in a regime of a standard interest rate transmission mechanism, mainly due to high real interest rates in the situation of deflationary expectations.

Fig. 1.4: Transmission of standard monetary policy



Source: ECB, own processing

After another several successive rates cuts, the central banks reached the ZLB and essentially exhausted the room for further easing of monetary policy through conventional interest rate transmission. Unfortunately, the depth of the recession in many countries caused that Taylor rule would recommend negative nominal interest rates. The second problem appeared due to the issues with the solvency of many banks and consequent limited financial intermediation that resulted in a broken relationship between of-

ficial and market interest rates. (Joyce et al., 2012) In combination with limited efficiency of the credit channel present due to great financial uncertainty and notable deleveraging of private subjects, the central banks had to implement new *unconventional* instruments able to overcome shortcomings of contemporary monetary policy. (Zamrazilová, 2014)

The transmission mechanism of standard monetary policy is shown in Fig. 1.4. As central banks were not able to further favorably influence money market interest rates through their official interest rates and further ease market conditions in the zero lower bound situation, the inflation target started to become unattainable as real interest rates remained too high to support aggregate demand. The central banks could not effectively and positively influence markets, prices, economic subjects and consequently inflation. In such a situation, nor were the central banks able to affect the expectations of market participants that would be in line with the inflation target. The situation of the inefficient standard monetary transmission mechanism when conventional monetary policy cannot react in line with the Taylor rule to impact market rates in an expected way is referred to as “a trap of liquidity.” This topic is thoroughly described, for example, in Krugman (1999), Svensson (2003) or Joyce, Miles, Scott, and Vayanos (2012).

1.3 Unconventional tools and their transmission mechanisms

The issue of the binding ZLB constraint arises especially in the situation of subdued aggregate demand. In order to stabilize the economy close to its potential and to avoid disinflationary pressures, the economy requires significantly negative real interest rates. If monetary conditions are not eased sufficiently, the economy then plunges deeper into the negative output gap, which further pushes inflation below the central bank’s target. Low inflation is not high enough to push long-term real interest rates to desirably low levels which subsequently leads to negative expectations and the further increasing negative output gap. In the worst case scenario, mainly stressed by the central banks, such a situation can escalate into a deflationary spiral.

Due to the ZLB on nominal interest rates, the only way to decrease long-term real interest rates and support subdued aggregate demand is to lower long-term nominal interest rates or sufficiently increase inflation expectations. A central bank conducting standard monetary policy does not have long-term interest rates under its direct control, as it primarily

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operates on the money market with short-term securities. Thus, long-term interest rates are normally influenced only indirectly, primarily via money market interest rates. Consequently, in a situation of liquidity trap, an unconventional tool is required.

There have been numerous discussions regarding a definition of the instrument which qualifies for unconventional. As Zamrazilova (2014) pointed out, there has rarely been a need to define the term *unconventional* in the economic literature. Modern economic textbooks care more about standard and non-standard classification, which depends on whether the instrument is market or non-market oriented. Since there is no generally accepted definition, Zamrazilova (2014) summarizes multiple approaches that deal with this issue.

The first one defines unconventional measures as those that try to remedy the transmission mechanism failures of monetary policies once the economy achieved the ZLB. The second argument is based on the claim that monetary policy is primarily a macroeconomic policy while unconventional tools are strongly oriented towards individual segments or institutions.

Bini Smaghi (2009) classifies following three areas as unconventional tools:

- *endogenous (indirect) credit easing* - measures which provide liquidity to commercial banks against collateral,
- *credit easing* - measures aimed at the lack of liquidity and reduce spreads of non-banking financial market segments and
- *direct quantitative easing* - buying government bonds to reduce long-term risk-free rate.

A similar definition is also provided by the International Monetary Fund. (Zamrazilová, 2014)

- *liquidity easing* - lending of government bonds in exchange for illiquid securities,
- *credit easing* - buying private securities and
- *quantitative easing* - purchasing long-term government bonds or government guaranteed securities.

The alternative tools in the zero interest rates environment were also discussed, for example, in Bernanke, Reinhart, and Sack (2004) or Goodfriend

(2000). In the remainder of this chapter, various unconventional monetary policy instruments will be closely specified.

1.3.1 Forward guidance

Apart from unconventional open market operations, *forward guidance* gained a vital role in recent years. The meaning of this tool is clarified by The FED (2015, para. 1) as a situation when *central banks communicate regularly and frequently with the public about the state of the economy, the economic outlook, and the likely future course of monetary policy*. The importance of forward guidance grew significantly during the Great Recession and especially afterward when the effectiveness of the standard interest rate policy reached its limits, i.e., a zero lower bound.

The key research in the area of forward guidance has been led by Woodford (2012), who argues that policy accommodation can be provided even when the key interest rates are very close to zero levels. The accommodation is derived from a commitment of central bank to maintain interest rate at the ZLB considerably longer in the future than it would be expected under normal conditions. Such a commitment reduces expected central bank's interest rates and subsequently long-term nominal interest rates. The desired goal is to appropriately influence future inflation expectations and ultimately decrease real interest rates. Nevertheless, in the situation of low inflation and the ZLB the link between short-term central bank's interest rates and inflation expectations are substantially suppressed.

Over the last few years, the central banks used their communication channels in support of the non-standard policy measures and for assuring the public about the long-term effects of the set monetary policy. The popularity the forward guidance has recently gained is in contradiction to the past, when central banks rarely communicated their policy decisions in advance.

The ECB (2013) distinguishes among following types of forward guidance:

- *pure qualitative forward guidance* - no explicit end-date or numerical thresholds that provide information about the likely evolution of policy interest rates in the future, e.g., “*policy accommodation can be maintained for a considerable period*”,
- *qualitative forward guidance conditional on a narrative* - qualitative statements about the likely evolution of policy interest rates complemented by a description of a combination of macroeconomic con-

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ditions under which the monetary policy orientation is expected to prevail, e.g., “*until deflationary concerns would be dispelled*”

- *calendar-based forward guidance* - a conditional commitment based on the explicit date after which the stance of monetary policy is expected to change, e.g., “*conditional on the outlook for inflation, the target overnight rate can be expected to remain at its current level until the end of the second quarter of 2010*”,
- *outcome-based forward guidance* - with explicit numerical conditions or thresholds connected with economic variables.

The rhetoric of central bank may be a powerful tool; without any credibility, however, such an instrument would become powerless. Market participants need not only to understand the signs of the central bank but also trust them and not read them as a pessimistic signal. Thus, also the fulfillment of a statement or commentary made by a central bank is crucial to maintaining credibility, which makes forward guidance a sensitive and delicate tool. Consequently, the credibility of monetary authority is a necessary prerequisite for effective communication and successful implementing of monetary policy.

1.3.2 Quantitative easing

Joyce, Miles, Scott, and Vayanos (2012, p. 276) provide a general explanation of quantitative easing. They state that to carry out QE central banks expands its balance sheets by purchasing securities, such as government bonds, from private subjects, banks primarily. Such an action “*shifts the portfolio mix of assets held by the private sector who come to hold more claims on the central bank.*” The increase on the liability side of central bank’s balance sheet is likely to be in the form of greater reserves held by the banking system. Such activity increases liquidity in the financial system and at the same time the increases prices of the purchased assets and decreases their yield.

Similarly to standard interest transmission, QE is expected to stimulate the economy by decreasing market interest rates. The main difference between regular open market operations in the form of reverse repurchasing operations and quantitative easing is in the maturity of purchased assets

and volume of these purchases.³ While the former instrument is focused on short end of the yield curve; the later one is aiming at the longer end. Thus, a central bank conducting QE buys highly rated government bonds which are then held to maturity. In addition, QE tends to have higher potential than reverse repo operations. The main idea behind this practice is not only that purchasing bonds with longer maturity will lead to another lowering of the interest rates and increase inflationary pressures which could not be accomplished in times of the ZLB with standard monetary tools. The appealing option is also to stimulate the real economy, since lowering long term interest rates may result in a greater willingness of households and corporates to increase their borrowings from banks. This should be supported by the higher lending activity of commercial banks, which accumulated the funds for new loans in the form of the excess reserves due to the redemption of bonds from their portfolio by the central bank. Other factors positively influencing economy include higher investments and private consumption together with a weakened exchange rate which supports exporters and domestic consumption as consumers prefer local goods and services before more expensive foreign. These factors have to some degree potential to support aggregate demand and increase inflation expectations and consequently inflation itself.

Finally, under an assumption of the rational private sector which faces no credit restriction and perceive the government and central bank assets indistinguishable from its own, quantitative easing carried out by a central bank would be powerless. The same also applies to credit easing and is akin to the Ricardian Equivalence. (Joyce et al., 2012) However, such an assumption of perfect substitutability is highly unrealistic and questionable even in healthy market conditions. This assumption is further developed in the following section. The quantitative easing was implemented by all major banks including the FED, the ECB, and the BoE.

1.3.2.1 Channels of transmission

The channels defined in this chapter are summarized in Fig. 1.5. The amount of literature dealing with the topic of quantitative easing is currently very wide; therefore, it is possible to encounter other channels which are not discussed here or slightly different definitions of the ones presented in this thesis.

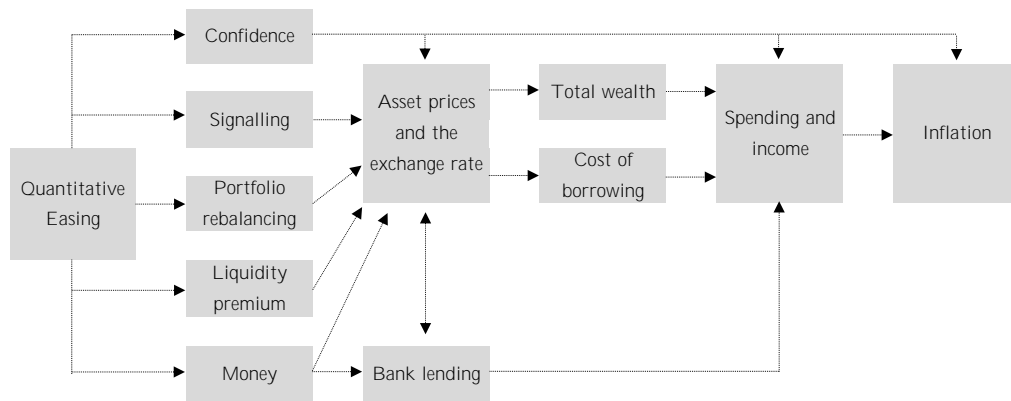
³Outright purchases are not in the history of monetary policy nothing exceptional. For example, the US Fed historically bought and sold U.S. Treasury bills into its balance sheet to impact short-term interest rates.

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QE tries to affect both long-term interest rates and inflation expectations. The frequently defined transmission channels of QE are:

- *portfolio rebalancing channel (asset valuation channel),*
- *reanchoring channel,*
- *signaling channel,*
- *liquidity channel, and*
- *banking loan channel.*

Fig. 1.5: Transmission of quantitative easing



Source: BoE, own processing

Portfolio rebalancing channel

The *portfolio rebalancing channel* also referred to as an *asset valuation channel* is often perceived as the essential channel through which QE operates. As Joyce, Miles, Scott, and Vayanos (2012) explain, this channel can work only if long-term government bonds and bank reserves are not assumed to be identical assets by the private sector. In such a situation, the economy would be in a liquidity trap, and this transmission mechanism would become inefficient and regardless of the quantity purchased no reduction in bond yields would happen. However, government bonds and bank reserves are not perfect substitutes even in the period of the ZLB. Joyce,

Miles, Scott, and Vayanos (2012) name two main reasons, one related to preferred habitats and the other one to the pricing of duration risk.

As a consequence, a central bank can affect asset prices and subsequently also actual investment decisions. In a situation when a central bank buys long-term government bonds from commercial banks it at the same time increases reserves held by these subjects. In case these bonds would be purchased from non-banks, most of the proceeds would end up in bank accounts as client deposits. Nevertheless, as an investor sells a long-term bond from its portfolio and replaces it with a bank deposit, a resulting change in duration may motivate him to invest in another long-term bond, presumably involving a higher risk than the original asset, which is available. As this would be a case of the majority institutional investors including pension funds, a central bank asset purchasing program focused primarily on government bonds would indirectly affect prices of other long-term assets traded on financial markets. This tends to reduce both the term and risk premium for all long-dated asset. (Joyce et al., 2012) With respect to the impacts on term premium components of longer-term yields, Christensen and Rudebusch (2012, p. 32) stress the relevance of the financial market structure and the nature of investors' preferred habitats. Hence, the effects of the same policy will be different in two countries where one has a highly liquid government bond market.

Andrade et al. (2012) offer a more detailed view when they define three channels that can be summarized under the general designation *portfolio rebalancing channel*. The first of these channels, *a duration channel*, is reflected in a reduction in the interest rate risks to investors investing in long-term bonds. Reduced risk can motivate long-term investors to buy the remaining ones of available bonds, despite the decline in their yields. The duration channel should be the strongest in the long-term bonds that are most exposed to interest rate risk. (Andrade et al., 2016) The second one, which is also discussed by Zamrazilova (2015), is *a scarcity channel*. This channel results in a rise in a price and decrease in yield due to massive purchases of specific bonds and requires a form of market segmentation. It suggests that certain securities will be demanded by central banks based on their characteristics. This component of the portfolio rebalancing channel would imply that central bank purchases affect prices only of those assets. The last of these channels, *a capital relief channel* suggests that the increase in asset prices that are accommodated by assets purchases generate a form of capital injection for leverage-constrained institutions. (Andrade et al., 2016)

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Signaling channel and reanchoring channel

Although both signaling and reanchoring channels are closely related and both emphasize the impact of QE on the future path of monetary policy and interest rates especially, they work through different mechanisms with different implications.

The *signaling channel* assumes that the central bank communicates successfully its future conditional policy and possesses better information than the rest of the market. For example, Christensen and Rudebusch (2012, p. 32) conclude that the FOMC announcements of bond purchases could have been interpreted as reinforcing this guidance and essentially providing a signal that the period of low funds rate levels will be even longer. Thus, an absencing or inadequate forward-looking policy guidance on interest rates may commensurately diminish signaling channel strength. The signaling channel is, therefore, akin to forward guidance and relies heavily on the communication of the central bank. (Andrade et al., 2016) In comparison to forward guidance, signaling effect should be understood as more credible, since large purchases of assets expose the central bank to the situation of possible losses if the short-term interest rates would rise.

The *reanchoring channel* emphasizes the effect of quantitative easing on long-term expectations. As Andrade et al. (2016) mention, the ECB's survey reveals that the announcement and conducting of QE have a supportive influence on the public expectations of fore-casted macroeconomic variables that are returning towards levels consistent with the ECB's ones, which are in line with targeted price stability. Consequently, the reanchoring channel positively influences uncertainty which results in deviations of these expectations by the private sector.

Liquidity channel

Christensen and Gillan (2018) propose that *the liquidity channel* influence prices of targeted assets as QE increases the bargaining power of sellers in the market for the purchased securities by a central bank. Hence, market participants are willing to accept a lower liquidity premium. The effectiveness of this channel is temporary and limited to the duration of the actual asset purchase program.

The authors describe this effect as similar to the one traditionally occurring on on-the-run Treasuries. Since on-the-run treasury are the most liquid, they typically trade at a slight premium; therefore, they yield a little less than their off-the-run counterparts. The price difference between on-the-run and off-the-run Treasuries is often referred to as the liquidity

premium.

In general, liquidity premiums should be rather small in deep and liquid government bond markets and higher in initially less liquid markets. Beside the market liquidity, several other aspects determine the strength of the liquidity channel. Among these factors are, for example, the actual amount purchased of a specific security or an asset class or the intensity of the purchases. The more intense the purchases are, the greater is the ability of QE to absorb negative liquidity shocks. As a consequence, the higher the previous factors, the higher the reduction in liquidity premiums. For example, the central bank's purchases of riskier and less liquid assets can result in lowering the price for risk as it improves the liquidity of these markets.

Banking loan channel

The last potential channel of QE discussed in this chapter is *the banking loan channel*. Butt, Churm, McMahon, Morotz, and Schanz (2018) understand the banking loan channel as a supplementary channel of monetary policy which results in a rise in lending activity of banks.

The higher loan supply is possible due to the increase in excess reserves which were accumulated during the actual QE and purchases of securities into the central bank's balance sheet. A bank has a few options how to allocate free resources. It can keep them in the central bank as a part of excess reserves, invest them into highly liquid assets or use them to finance loans to clients. Unfortunately, a bank is unable to force clients to take the credit; therefore, strength and importance of this channel, as compared to the portfolio rebalancing one, is rather weak and complementary.

1.3.2.2 Qualitative easing

QE is often complemented by decreasing quality of the securities bought during the central bank's purchases. Contrary to quantitative easing, qualitative easing does not change the size of the central bank's balance sheet but its structure. The balance sheet of the central bank thus experiences an increase in the riskier and less liquid assets and a decline in the risk-free and highly liquid debt securities. However, the practice of recent years shows that it is not common for the central bank to only change its balance sheet structure, while at the same time not increasing the total volume.

This situation is the often cited issue of the ECB because of the lowering quality of assets purchased and especially decreasing requirements on collateral accepted, also defined as a *collateral easing*. (Fiedler et al., 2016)

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Bini Smaghi (2009) mentioned at the beginning of this section describes this practice as a *credit easing*.

To conclude this part focused on quantitative and qualitative easing, the multiple channels of this unconventional monetary policy have to some degree potential to replace standard interest rate transmission in the situation of the ZLB. Changes in market yields and asset prices may make it easier for corporates and other economic subjects to raise funds during the eased credit conditions and consequently boost economic activity and generate capital gains for owners of these assets. This could subsequently result in higher private investments, consumption and wealth.

On the other side, QE has many critics among economists, since non-standard and unconventional monetary tools often fight the consequences of macroeconomic imbalances and are not aimed at the original causes of the issue. When focusing on the case of the eurozone, there are still numerous unsolved macroeconomic difficulties that pose untold threats to future. As Sinn (2013) points out, the essential problem of the eurozone is the different needs of southern economies in comparison with the northern ones, especially Germany. While Greece, Spain and Portugal fight deficits in their current account balances and need to devalue in real terms to restore their competitiveness, Germany enjoy massive surplus that is paid for with money created by the central banks of other eurozone countries. This idea is a further reference to the question of the appropriateness and acceptability of deflation.

The main problem, suggested by several economists, is that such an artificial lowering of market yields goes in hand with the secondary intentions of the ECB which are being carried out through QE. Instead of focusing on structural reforms and solving the originator of deflation threats, the ECB's purchases push down interest rates and reduce funding costs of the southern states of the eurozone and enable further debt financing of the economies where the capital would be reluctant to go voluntarily or at significantly higher price. Sinn's (2016) notion is that commercial banks throughout the eurozone ease the burden on the over-indebted eurozone countries and, in essence, restructure their debt. This reflection is in stark contrast to the rhetoric of the ECB as well as the assumption that the central bank should not finance governments, which in this case, albeit indirectly, is happening.

1.3.3 Foreign exchange interventions

Over the last few decades, a relevance of foreign exchange (FX) interventions in monetary policies of emerging and transition economies sub-

stantially increased. These economies are commonly connected with major changes in their banking systems' balance sheets as banks are the main counterparty in central bank transactions. The interest in FX interventions increased even more in the last few years as for the specific type of economies they began to represent one of the alternatives in the situation of the ZLB.

FX interventions were a frequently used tool of transition economies transforming from central to market economies as these countries used various fixed exchange rate regimes. The chosen form of the fixed exchange rate regime served as a nominal anchor with the intention to avoid extremely high inflation at the beginning of transformation processes. Together with increasing convertibility of domestic currencies and significant inflows of foreign capital, driven by positive interest rate differential and minimal exchange rate risk, the central banks accumulated FX reserves in order to maintain the exchange rates in predefined levels. As a result of FX interventions, these economies are characterized by a systemic surplus of liquidity in the banking sector due to the convergence processes and trend appreciation of the domestic currencies also by significant accounting losses of the central banks. (Brûna, 2010a)

Concerning the recent practice in the situation of the ZLB, FX interventions became the second alternative to be used as an unconventional monetary tool. While QE has a much greater potential to successfully ease monetary conditions and affect the price levels in an economy with very advanced capital markets, its effectiveness is limited in countries where capital and specifically bond markets are considerably less developed. The main advantage of FX interventions is the direct impact on the exchange rate that, in a small open economy, can have a direct impact on economic growth as well as the central bank's primary target of price stability.⁴

1.3.3.1 Types of FX interventions

From the point of view of economic theory, this tool can be used in multiple different ways. The types of FX interventions are:

- verbal,
- indirect,
- direct,

⁴This issue is further expanded in the third chapter.

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- sterilized,
- non-sterilized, and
- declaring the volume of currency used for interventions or
- declaring the lower/upper levels of the exchange rate.

In the case of verbal interventions, a central bank tries to affect the market participants through press releases and other public communication channels. The purpose is to make the exchange rate to behave in a certain way, without the central bank having to take any actual action. To conduct successful interventions and make currency to move in the manner intended, such a verbal intervention has to be transparent and credible.

Indirect FX interventions can be understood as a change in interest rate, tax and financial policies through which the FX price is affected. In connection with the monetary policy, transmission to currency exchange rate works through a change in central bank's key interest rate. As the key interest rate influences market rates in the economy, a rise in interest rates increases demand for domestic currency as a result of the enhanced attractiveness of local investment opportunities for foreign investors and speculators. The higher demand ultimately results in appreciative pressures. Additionally, given the way indirect interventions can operate, it is clear that in some cases it can also be a tool applied by government actions, and, thus, by fiscal policy. The current example of fiscal policy trying to act on the exchange rate is the recently increasing protectionism.

In contrast, direct interventions indicate the central bank entry to the market where it buys - counteracts appreciation or sells - act against the depreciation of the foreign currency. A central bank may choose between *sterilized* or *non-sterilized* interventions. In the case of the former one a central bank automatically eliminates the impact of currency purchases on the domestic money supply and money market interest rates through the issuance of alternative liabilities, e.g., short-term securities. The actual effectiveness of such a kind of interventions is often disputed. Simultaneously, successful implementation of sterilized interventions conflicts with *impossible trinity* which implies an inability to carry out active and independent monetary policy, free capital movement and regime of the fixed exchange rate at the same time and in the long run. Regarding non-sterilized interventions, a central bank does not try to minimize the impact on bank reserves and interest rates. As this can be understood as a classical definition of "sterilization," Gadanecz, Mehrotra, and Mohanty (2009, p. 1)

also refers to the modern version, where the sterilized interventions mean “adjusting the day-to-day supply of bank reserves to demand so that the short-term interest rate is maintained on or around the chosen policy path.”

While FX interventions with *declaring the volume of currency used for interventions* were used by Japan in its long history of fighting against deflation, the Czech Republic, and Switzerland chose the second type and declared only an upper bound of the exchange rate. The primary advantage of the announcement of explicit level for the exchange rate, is its easy and transparent interpretation for both, the professional and the general public due to virtually unlimited possibilities of the central bank to intervene against its currency and to maintain the fixed exchange rate. An issue occurs when the central bank intervenes against the depreciation of the domestic currency since FX interventions in this direction are limited by the volume of FX reserves.

1.3.3.2 Macroeconomic equilibrium in open economy

An open economy interacts with outside economies as it imports and exports goods and services and at the same time imports and exports capital. *The balance of payments*, which shows the interaction of the economy with foreign countries can be divided into the three main parts - *the current account* (CA), *the capital account* (KA) and *the financial account* (FA). While the importance of the capital account is rather complementary and for simplicity will be not taken into account in the next text and equations, the financial and the current accounts are crucial for the external equilibrium of the economy. Under the BPM6 standard, the balance sheet of payments provides the balance of the financial account and the balances of the current and the capital accounts on the line “net lending (+) / net borrowing (-).” As these two lines should be balanced, differences between balances that result from imperfections in source data are offset by the item *net errors and omissions* (EO) which can be calculated by Eq. 1.1.⁵

$$EO = FA - CA - KA \quad (1.1)$$

⁵Since the thesis works with the most recent BPM6 methodology, sign convention is consistent with national accounts manuals. In the current and the capital accounts, both credits and debits are reported with a positive sign. In the financial account, the positive number indicates both the growth of assets and liabilities and the negative number their decline. Balance items are calculated as credits minus debits or net acquisition of financial assets less net incurrence of liabilities. (Marková, 2017)

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Fig. 1.6: Balance of payments (BPM6)

	Credits	Debits	Balance
Current account	+	+	C-D
Goods and Services	+	+	C-D
Goods	+	+	C-D
Services	+	+	C-D
Primary Income	+	+	C-D
Secondary Income	+	+	C-D
Capital account	+	+	C-D
<i>Net lending (+) / net borrowing (-)</i>			C-D
	Net acquisition of financial assets	Net Incurrence of liabilities	Balance
Financial account	⬆(+)/⬇(-)	⬆(+)/⬇(-)	A-L
Direct investment	⬆(+)/⬇(-)	⬆(+)/⬇(-)	A-L
Portfolio investment	⬆(+)/⬇(-)	⬆(+)/⬇(-)	A-L
Financial derivatives	⬆(+)/⬇(-)	⬆(+)/⬇(-)	A-L
Other investment	⬆(+)/⬇(-)	⬆(+)/⬇(-)	A-L
Reserve assets	⬆(+)/⬇(-)		A
<i>Net lending (+) / net borrowing (-)</i>			A-L
Net errors and omissions			FA - CA - KA

Source: own processing

The *net exports* (NX) are the value of a country's exports of goods and services minus the value of its imports and can also be called *the trade balance*. Together with *the primary income account* (PIA) and *the secondary income account* (SIA), they constitute *the current account* of the balance sheet of payments. A transition economy in its early stage usually experiences a gradual change from a deficit of trade balance into its surplus. From the view of the balance of payments, this change is mainly driven by substantial inflows of *foreign direct investments* (DI) which allow the economy to finance technological development that otherwise could not be funded by insufficient domestic savings. However, while the inflows of foreign direct investments considerably facilitate the growth of the trade balance of infant transition economies, in the following years, it is characteristic that their reinvestments are diminishing and the country's PIA deficit deepens due to the outflow of dividends. Thus, the transition economies typically experience over an extended period current account deficits. Simultaneously, the significant deficit of the PIA often, with a certain time lag, results in the gradual deterioration of the country's net investment position. Additionally, the *portfolio investments* (PI) are another part of the financial account and are characterized by their high volatility and sensitivity to the eco-

conomic cycle and therefore do not provide a stable source of funding for a possible current account deficit. With the implementation of the new standard, FX reserves are kept under the reserve assets (RA) as a component of the FA. Other items entering FA are other investments (OI) and financial derivatives (FD).

Brūna (2010a)⁶ shows the relationship between accumulation of FX reserves by a central bank and macroeconomic equilibrium. In a small open economy, a trade balance can be expressed as a sum of differences between private savings (S) and investments (I) and the difference between government incomes (T) and expenditures (G) (Eq. 1.2). Eq. 1.3 shows absorption of an open economy which consists of the total demand for all goods and services by all domestic economic subjects. Absorption is equal to the sum of all domestically-produced goods consumed locally and all imports.

$$NX = (S - I) + (T - G) \quad (1.2)$$

$$A = Y - NX \quad (1.3)$$

Assuming no EO in the calculation and an insignificant role of KA, we can simplify Eq. 1.4 defining an equilibrium of the balance of payments. After putting each item of CA and FA into the equation, the identity Eq. 1.5 shows that in a transition economy RA can be used to finance the deficit of CA.

$$CA = FA \quad (1.4)$$

$$NX + PIA + SIA = DI + PI + FD + OI + RA \quad (1.5)$$

We can drop FD and OI from Eq. 1.5 assuming they are equal to zero to simplify the calculation further. We can then substitute Eq. 1.2 into Eq. 1.5 and Eq. 1.2 into Eq. 1.3. Consequently, the tight relation of the accumulation of foreign reserves to macroeconomic equilibrium and the economic policy of stabilization of absorption can be deduced. (Brūna, 2010a)

⁶The original article works with structure of the balance of payments set by BPM5, for the purposes of this thesis the equations were modified to reflect the newer standard BPM6.

$$RA = (S - I) + (T - G) + PIA + SIA - DI - PI \quad (1.6)$$

$$A = Y + PIA + SIA - DI - PI - RA \quad (1.7)$$

FX interventions are traditionally associated with the application of the fixed exchange rate regime and maintaining the domestic currency in pre-defined bands. FX reserves in the central bank's balance sheet allow to temporarily prevent the local currency from depreciation beyond the upper oscillatory band. Such a policy, however, is restricted by limited amounts of FX reserves which the central bank owns. In transition economies, depreciation of the domestic currency, against which the central bank acts in a fixed exchange rate regime, is typically a consequence of deficit of the current account which is not appropriately covered by inflows of foreign capital. (Brûna, 2010a) On the contrary, in the case of interventions against the trend strengthening of the currency, the central bank is not limited in volume as it buys foreign currency against the domestic one.

Brûna (2010a) summarizes that key factor in the accumulation of foreign reserves of transition economies are continuous pressures on the appreciation of the domestic currency. This happens in spite of ongoing deficits of current account due to the gradual improvement of the export performance and to the massive inflows of foreign capital primarily in the form of foreign direct investments.

1.3.3.3 FX interventions as alternative monetary tool

This instrument has recently gained notable attention as some central banks chose FX interventions as an alternative tool to escape a deflationary trap and to pursue price stability. These central banks decided to use the exchange rate as its main and temporary instrument and operative target at the same time. Only Japan, Switzerland and the Czech Republic used FX interventions as an alternative tool in the situation of the ZLB.

Regarding the recent practices of some open economies, the inflation targeting theory gives hardly any guidance on FX interventions as an alternative instrument. The inflation targeting assumes only indirect effects on exchange rate through interest rates and recommends no direct exchange rate management. Despite the often questioned functional transmission of FX interventions, free-floating is currently used by only about 20 countries, while either managed floating or other managed form of currency regime is used by the majority of countries. (Lizal and Schwarz, 2013)

Channels of transmission

As shown previously, in a small open economy, FX interventions have a strong potential to support economic growth and contribute to the growth of prices in the economy. Devalued domestic currency leads to an increase in imported inflation through higher prices of imported goods included in the consumer basket and represents the main channel which causes the rise in inflation. Secondary, as the imports happen to be relatively expansive in comparison with domestically produced goods and services, substitution of imports for domestic production may result in the increase in domestic consumption, which is in a situation of negative output gap suppressed. Similarly, a country which is heavily export-oriented may benefit from weaker currency as local goods become cheaper for non-residents which ultimately results in increased competitiveness of exporters. In a situation, when Marshall-Lerner condition⁷ is met, a currency devaluation or depreciation will result in a positive impact on the trade balance.

Conducting unsterilized interventions imminently expands bank reserves and results in downward pressures on the interbank rates. As Iwata and Wu (2012) object, such transmission is highly limited in a situation of the ZLB as domestic short-term debt securities and money become close to perfect substitutes. Therefore, FX interventions are required to operate via different channels to become effective. Distinguishing between sterilized and unsterilized interventions so loses its original purpose as all interventions can be treated as sterilized in the situation of the ZLB and purchases of foreign currency by the central bank cannot affect money supply and interest rates.

In addition to standard transmission of the exchange rate to interest rates, similarly to QE, concurrent economic theory proposes three main transmission channels through which FX interventions can affect economic subjects. These channels include:

- *portfolio rebalancing channel*,
- *coordination channel*, and
- *signaling channel*.

⁷The Marshall-Lerner condition states that, for a positive effects on the trade balance, the sum of the absolute values of the price elasticities of exports and imports of devalued/depreciated currency must be greater than 1.

Portfolio rebalancing channel

While the definition of the *portfolio rebalancing channel* remains the same as in the chapter dedicated to QE, the impact of this transmission in the case of FX interventions is frequently questioned. Since all interventions in the situation of zero interest rates become sterilized, potential of such interventions to affect private sector decisions and risk premium is very low. This channel stands and falls with the assumption of a perfect substitution of bonds and money. Also, the *portfolio rebalancing channel* is criticized that in the case of small-scale interventions low volumes are not sufficient to fully activate this transmission.

The liquidity obtained from FX interventions can be allocated to bonds or other asset classes and reduce their yields. However, the allocation to these assets is limited by the expected return of such an asset to domestic investors. in a situation where these assets offer zero or negative returns, in a situation where local entities have any other alternative to which they can invest their funds, the transmission channel cannot function.

On the other hand, for foreign currency speculators may even very low or negative yields of the bonds become potentially profitable speculation at sufficiently high expectations of appreciation of the given currency. These purchases then further push the market interest rates down and thus reduce the long-term real interest rates. The inability to prevent speculation on the appreciation of the domestic currency implies that central banks cannot risk announcing the exit of interventions in advance. Such information would lead to a serious increase in the speculative purchases of the given currency and the increased need to intervene by the central bank and thereby to a substantial increase in FX reserves in its balance sheet and the further issuance of liquidity to the banking system.

Coordination channel

The *coordination channel* expresses the general tendency of markets to converge their estimates towards the central bank's ones. This idea is further supported by the fact, that a credible prediction of the main economic indicators is one of the essential functions of central banks. The coordination channel was examined thoroughly by Reitz and Taylor (2007). They express an opinion that in a microstructure approach market makers adjust their expected levels of exchange rate if the order flow comes from informed traders. As central banks are expected to be informed traders, the coordination channel implies that official intervention should be capable of altering the exchange rate in the desired path. However, central banks often

conduct these trades anonymously; thus, it is not always easy to see the initiator of the deal.

Signaling channel

The *signaling channel* can be defined in a similar way as in the previous section. According to this channel, the information about possible future FX interventions constitute new information for market participants who reacts with changing their expectations.

In the case of the transmission channels of verbal interventions, Hába (2016) mainly stresses the significance of the *signaling channel* and *coordination channel*.⁸

The effectiveness of listed channels is frequently challenged, as theory suggests that only the signaling and the coordination channels have some but only short-lasting effects on exchange rates. Lizal and Schwarz (2013, p. 135) mention very short and questionable impacts of FX interventions against appreciation of Czech koruna taking place in periods of February - July 1998, October 1999 - March 2000, and October 2001 - September 2002. On the other hand, they express the conviction that such a policy can be effective “*when the direction of intervention is consistent with the monetary policy stance.*” This implies that FX interventions can be used under certain conditions to ease monetary policy further. To support these theses, Franta et al. (2014) show that in a situation of the ZLB an exchange rate shock to economy becomes significantly stronger, as interest rates cannot act in the opposite direction. There are two primary channels affecting inflation to increase. Import prices that push inflation higher and real interest rates that are nudged down and encourage the growth in the real economy. A strong role in this transmission can be attributed to signaling channel as these effects increases as the duration of the ZLB regime prolongs.

Similarly to QE, also FX interventions used as a temporary monetary tool have their adverse aspects. As a central bank intervenes against appreciation of its currency in order to advantage exporters and increase their competitiveness, increase prices of imports and support the economic growth and inflation, enlarging open FX position exposes the central bank to considerable currency risk. The trend appreciation of the domestic currency, which is sooner or later inevitable, may seriously jeopardize the coverage of currency in circulation and reserves of banks. Simultaneously,

⁸For successful interventions additional conditions must be fulfilled. These conditions are *irrational expectations*, *lack of a clear monetary policy rule* and *asymmetric information*. For more information see Hába (2016, p. 407)

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emerging negative financial result and the worsening loss of past periods can give rise to increasing political pressures that could severely undermine central bank's independence and credibility. (Brûna, 2010a) On the other hand, Jeanne and Svensson (2016) propose that a threat of future financial loss from the revaluation of foreign reserves represent a way to commit credible and sustainable rise in the price level as it motivates the central bank not to allow future domestic currency appreciation. Another unfavorable aspect is that artificial weakening of domestic currency inevitably favors exporters and does not force them to improve their products and compete on the market. This easing of competitive conditions subsequently keeps on the market such subjects that would not normally survive.

yska in Brûna et al. (2015, p. 47) calls the current situation “*a vicious circle of stagnation which lasts for more than 15 years.*” According to the author, the slow and moderate economic growth over the last few years is a consequence of previous bubbles in asset prices, which the central banks tried to resolve with even more stimulus, creating new ones in other asset classes. However, the rate of growth of the economies is steadily declining, and especially the recent recovery is extremely weak and slow.

2 Liquidity of single bank and banking system

Although the primary aim of unconventional monetary instruments was to meet the objective of price stability, these instruments have had a major impact on the entire banking system. While under standard conditions the banks are profoundly reliant on liquidity supplied by central bank, which holds for every single banking system, some of these systems currently violate this fundamental characteristic, especially those of developing and transition economies, as banking sectors operate in fundamental surplus of liquidity as a consequence of central banks non-standard behavior in the past. This is a direct result of multiple channels including entry of a central bank into the banking system, repurchase of banks' assets or FX interventions against the appreciation of the domestic currency. The purchases of foreign currency were driven primarily by a surplus balance of direct foreign investments or trade balance. The balance sheet of the central bank of such an economy is characterized by long FX position and notable amounts of excess reserves of commercial banks on the liability side. (Mandel and Tomšík, 2014)

A similar trend can be recently spotted also in developed countries. Because of the financial crisis, central banks support their banking systems via liquidity providing programs which put these entities in a situation where they place large volumes of excess reserves on central bank accounts. Some of the systems are gradually turning from the environment of liquidity deficit into a situation characterized by a long-term liquidity surplus. Contrary to the primarily FX interventions in transition economies, in the case of developed countries, it is a direct outcome of outright purchases of securities.

2.1 Liquidity and liquidity risk definitions

Vento and Ganga (2009) introduce three meanings of liquidity in financial markets. The first view expresses the capability of a bank to maintain a balance between cash inflows and outflows in future points in time. The second one shows the ability of an institution to convert an asset into cash without any time delay and financial loss. The third view describes the capability of an institution to raise additional resources on the wholesale, primarily unsecured interbank, financial markets.

Current economic literature distinguishes primarily between *funding liquidity* and *market liquidity*. While *funding liquidity* determines the bank's availability of borrowing to finance its assets and ability to pay at any moment its obligations that come due in the required form. *Market liquidity* refers to the liquidity of assets' markets and the ability of subjects to close their position without financial loss.

2.1.1 Funding liquidity risk

Drehmann and Nikolaou (2009, p. 10) define bank's funding liquidity as "*the ability to settle obligations with immediacy*" and consider a bank illiquid "*if it is unable to settle obligations in time.*" Funding liquidity is dependent on the uncertainty of future cash-flows and future prices of liquidity sources. Consequently, *funding liquidity risk* expresses "*the possibility that over a specific horizon the bank will become unable to settle obligations with immediacy*" (Drehmann and Nikolaou, 2009, p. 10). Similarly the BCBS (2008, p. 1) understands and defines liquidity of a bank as "*the ability of a bank to fund increases in assets and meet obligations as they come due, without incurring unacceptable losses.*"

Funding risk arises due to core activities of banks as financial intermediaries which ensure the flow of financial resources among financial market participants. In general, banks provide medium and long-term loans and fund themselves primarily with on-demand and short-term deposits. Thus, such financial institutions are engaged in the transformation of short-term liabilities into long-term assets and are necessarily exposed to funding liquidity risk.

A funding liquidity risk may be the case of meeting the request to withdraw money from client's account or to carry out payment from an account according to the client's order. An illiquid bank is unable to manage its liquidity position to cover the mismatch between upcoming outflows and inflows and therefore does not have enough free resources in such a volume to meet its outstanding liabilities. This may negatively and severely influence

the profitability and financial stability of the bank. Historically, funding ability of the bank is heavily tested in a situation associated with either significant outflows of deposits or with severely difficult financing conditions on the market. For example, under stressed scenarios, some of the markets are expected to be closed, and some types of funding will not be available. It is the case of unsecured wholesale funding which in a situation of financial distress, would fundamentally aggravate its allocation function. Subsequently, subjects which would rely on this form of resources would be severely exposed to funding risk.

2.1.2 Market liquidity risk

Santoso, Harun, Hidayat, Wonida (2010, p. 3) call market liquidity as “*liquidity in trading*” or “*asset liquidity*.” They define market liquidity as “*the asset’s ability to be transformed into another asset without loss of value*.” While the funding liquidity is related to the balance sheet of an individual bank, the market liquidity arises from the several market characteristics such as free entry, exit at zero cost and transparent information. These authors also refer to the Kyle’s (1985) assessment of the degree of liquidity. Kyle (1985, p. 3) derives the degree of liquidity of the market from its *tightness*, *depth*, and *resilience*. The tightness is measured with the bid-ask spread of assets, also defined as the cost of a reversal of position and also measures transaction costs. The market depth describes the size of the transaction required to change the price of the asset and the market resilience measures the speed of the prices to return to their equilibrium after a shock in the market. Vodová (2013) also adds term *intermediacy* that describes the speed with which transaction can be executed. To measure all these aspects detailed information on every transaction is needed.

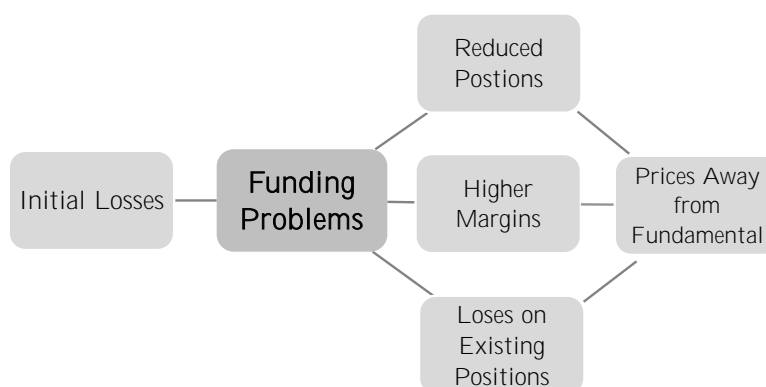
A market liquidity risk demonstrates a possibility that a bank will not be able to close its position at a market price due to insufficient demand. Vento and Ganga (2009, p. 80) defines this risk as a situation when an institution is not able to “*easily offset or eliminate a position without significantly affecting the market price because of inadequate market depth or market disruption*.”

Brunnermeier and Pedersen (2008) show that reduced funding ability of financial institutions profoundly affects market liquidity and leads to higher volatility. Such a situation happens when the lower availability of credit discourages traders from taking positions that would normally be funded by borrowed capital. Since these two variables are interdependent, also market liquidity, and market depth affect credit availability and consequently

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funding liquidity. This may be a case when a bank relies heavily on the interbank market which due to a shock stops to fulfill its function efficiently.

Fig. 2.1: Funding and Market Liquidity



Source: Vodová, own processing

2.2 Development of liquidity risk regulation

Because of great significance of financial system and its stability and due to the several factors including asymmetric information and negative externalities, banks are the objects of very strict regulation. In comparison with other risks, however, the history of the regulation of liquidity risk is relatively austere.

A maturity mismatch on both sides of the balance sheet, a combination of a large share of low liquid assets accompanied by a substantial volume of highly liquid liabilities are the crucial aspects of the banks' balance sheets. Other factors like a high degree of uncertainty of the banking business highly dependent on credibility and trust and unknown timing of the cash-flows including off-balance sheet positions only confirm the relevance of liquidity risk.

Another aspect that adds to the significance of liquidity risk is its interdependence on other risks. Vodová (2011) highlights that liquidity risk cannot be considered as an isolated risk but a risk that is heavily influenced by the additional financial risks banks undergo. Interconnection of individual risks that directly affect and are also affected by liquidity risk indicates Fig. 2.2

Fig. 2.2: Liquidity Risk



Source: Vodová, own processing

A typical example of the interdependence of banking risks with liquidity risk is a banking run where a bank facing reputational risks and distrust of the public has to face unexpected and excessive withdrawals from accounts.

The BCBS established a basic liquidity management approach based on liquidity inflow and outflow planning already in 1992 in *A Framework for Measuring and Managing Liquidity* and later updated by *Sound Practices for Managing Liquidity in Banking Organisations* in 2000. The principles presented in these documents have remained the basis for subsequent papers by which BCBS continued to improve *liquidity* and *liquidity risk* management. Nevertheless, the recommendations focused primarily on qualitative aspects of liquidity management also in Basel II and remained, in comparison to credit risk, at the edge of attention. The liquidity risk was captured only in the pillar 2 of the Basel II as a residual risk and banks were required to hold appropriate levels of capital with respect to its risk profile. (BCBS, 2004) With Basel III the emphasis was put on the ability to react to massive early withdrawals of short-term funds and generally to outflows of deposits and capability of mitigating liquidity risk. In order to be able to satisfy these claims, the bank has to hold a sufficient amount of cash or assets which can be converted to cash instantly. One of the most relevant indicators of such an ability is a stock of *highly liquid assets* (HLA) or *liquidity buffer*. An asset is said to be liquid if it can be quickly converted

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into cash with no or minimal impact on its price and minimum transaction costs.

Since liquidity of a bank is a continuously changing variable, the volume of liquid assets and operational liquidity need to be steered on a daily basis. The level of optimal liquidity that a bank needs depends on a number of factors and does not necessarily mean to possess the highest possible amount of highly liquid assets. Since the high liquidity feature is usually at the expense of returns, an approach to keep excess liquid assets could negatively affect the profitability of a bank.

During the crisis in 2008, the turmoils in financial markets engendered an increase of funding risk and a major decrease of market liquidity. The systemic liquidity shocks notably limited several intermediary functions of financial markets including allocation efficiency. The fact that the crisis that arose in one market within one country and subsequently paralyzed banking systems in other ones has shown that there were fundamental systemic problems which have been greatly underestimated by the regulator and banks themselves. As a consequence, the Great Recession revealed the weaknesses of the regulatory framework and has prompted a substantial increase in emphasis on liquidity risk.

The BCBS (2008) stresses paramount importance of effective and sound liquidity risk management that ensures a bank's ability to meet its all obligations. The BCBS (2008, p. 1) also emphasizes that "*a shortfall at a single institution can have system-wide repercussions.*" Basel III introduced new quantitative liquidity indicators including the *liquidity coverage ratio* (LCR) and the *net stable funding ratio* (NSFR).

Liquidity coverage ratio

The LCR (Eq. 2.1) is a ratio of highly liquid assets and net outflows that come due in 30 days. A bank should endeavor to hold such an amount of liquid assets to cover its calculated liquidity needs at within a horizon of one month. The LCR measures bank's resistance to a sudden stress situation predefined by the regulator and lasting for 30-days and measures a short-term liquidity position.

$$LCR = \frac{Highly\ Quality\ Liquid\ Assets}{Net\ Liquidity\ Outflows\ in\ 30\ Days} > 100\% \quad (2.1)$$

The banks have to hold at least 100% coverage of the net liquidity outflows for 30 days in the form of *high quality liquid assets* (HQLA). For

assets to be considered as HQLA they have to be easily and immediately converted into cash at little or no loss of value. Since the LCR represents a crisis scenario, this assumption must also hold in the distressed times. These assets must have the characteristics such as low risk, certainty of valuation, and low correlation with risky assets. The eligible HQLA are divided into the two classes. Level 1 assets include the most liquid items of the balance sheets including cash, CB reserves and receivables or claims guaranteed by central or governments or multilateral development banks and international organizations. All assets have to be assigned zero risk weight, and there are no restrictions on the total volume of Level 1 assets included in HQLA and no haircut has to be applied. Level 2 assets may contribute up to 40% of total HQLA, and Level 2B assets may not account for more than 15% of total volume of eligible assets. A 15% haircut is applied to the current market value of each Level 2A asset. These assets include mainly claims on or guaranteed by regional governments with a risk weight of 20% or high quality covered bonds which meet specific requirements. The remaining assets that satisfy conditions to qualify for HQLA are subject to a 50% haircut. Highly liquid and rated corporate debt securities and common equity shares may represent the assets included in Level 2B. (BCBS, 2013)

The indicator forms its assumptions on the logic that short-term and uninsured deposits are much more prone to early withdrawals and will not be rolled over in a crisis. Therefore, they are assigned with higher weights when calculating the LCR and some types of unsecured deposits, such as from a sophisticated financial counterparty, may receive a weight of up to 100%. On the other hand, deposits by retail customers are not expected to have such a high sensitivity to a crisis and are assigned the lowest run-off rates. A condition that a low weight can be awarded is that such a deposit *“is fully insured by an effective deposit insurance scheme or by a public guarantee that provides equivalent protection.”* The Basel Committee on Banking Supervision (2013, p. 27) For example, stable retail deposits usually receive a run-off factor of 5%.

To further tighten the predefined stress scenario the inflows must not exceed 75% of the calculated outflows. This assumption guarantees that the bank will have to face liquidity outflows and thus has to own sufficient stock of HQLA. The burden can be reduced by the preference of stable resources with longer maturities and receivables with shorter maturities.

Net stable funding ratio

On the contrary, the NSFR (Eq. 2.2) focuses on the whole balancing sheet and evaluates the structural and longer-term liquidity. It does so by

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comparing Available Stable Funding obtained from the liability side of the balance sheet and Required Stable Funding representing the assets. Similarly to the LCR, there are several different weights used in the calculation to distinguish and advantage some assets/liabilities over another. For example, retail customer deposits represent on aggregate a significantly more stable source of funding compared to deposits from financial institutions which is taken into account in the weights used.

$$NSFR = \frac{\text{Available Stable Funding}}{\text{Required Stable unding}} > 100\% \quad (2.2)$$

In addition to the LCR, the BCBS outlines other metrics to be used as consistent monitoring tools that should capture specific information related to a bank's cash flows, balance sheet structure and specific market indicators. The main aim of these metrics is to provide sufficient information to supervisors in order to assess the liquidity risk of a single bank. These metrics include contractual maturity mismatch, concentration of funding, Available unencumbered assets, LCR by significant currency and market-related monitoring tools. (BCBS, 2013)

Similarly to the BCBS, the European Banking Association (EBA) devoted a considerable amount of attention to liquidity and funding risks. *The Guidelines for common procedures and methodologies for the supervisory review and evaluation process (SREP)* represents an overarching and comprehensive document determining the policy of European regulation. Under this guideline, the European banking institutions should implement their own *Internal Liquidity Adequacy Assessment Processes (ILAAP)* ensuring comprehensive identification, measurement, management and adequate risk tolerance of liquidity risk. The areas the ILAAP should focus on primarily include liquidity and funding risk management framework, funding strategy, intra-day liquidity risk management, liquidity stress testing or liquidity contingency plan. (EBA, 2014)

It is apparent that the recent development strives to significantly increase the emphasis on liquidity risk management. The goal of the implementation of these new quantitative indicators is to enforce sound liquidity management practices and thereby increase banks' resilience to the liquidity risk and strengthen the whole banking system. The upgraded liquidity framework of Basel III thus aims to positively affect both micro and macro levels of financial markets.

2.3 Measurement of liquidity risk

Because of an increasing emphasis on liquidity risk, banking institutions make use of an overarching range of regulatory and internally developed liquidity measures. Along with the growth of a balance sheet of a bank and its product portfolio the complexity of calculation of liquidity indicators also increases. The main reasons behind the growing complexity are the increasing demands on data inputs and technical requirements. Bank has two main methods to measure the level of liquidity risk it undergoes: liquidity gap and liquidity ratios.

2.3.1 Stock indicators

Apart from the discussed and relatively infant required regulatory indicators, banks may also use other well-known balance sheet ratio indicators to analyze their liquidity situation. These ratios provide an instrument to quickly and easily calculate a basic liquidity indicator showing, for example, volume of highly liquid assets and short-term liabilities or structure of client deposits. Their construction also allows banks to follow the trends in bank liquidity. These are some of the liquidity ratios Vodová (2013) mentions.

Liquid assets to total assets

The liquid assets to total assets ratio gives information regarding the bank's ability to absorb liquidity shocks with its assets. It is the liquidity buffer that enters the numerator, whose function is to mitigate a possible runoff of short-term funding in the event of adverse market conditions. The opinion that the highest possible stock of highly liquid assets is not necessarily desirable was mentioned in the previous section.

Liquid assets to deposits and short-term borrowing

Compared to the previous one, the indicator *liquid assets to deposits* is of higher indicative value, as it is short-term funding, namely on-demand deposits without specified contractual maturities, which can be withdrawn from the bank at any time. As well as the liquid assets to total assets indicator reflects mainly the absorption capacity of the bank.

Loans to total assets/deposits

The loans to total assets ratio indicates what percentage of the assets of the bank is tied up in illiquid loans. As this ratio goes higher a bank

becomes less liquid. *The loans to deposits*

The simplicity of their calculation is, on the other hand, often accompanied by a low indicative value. These indicators provide only a static analysis, selects only a specific part of the balance sheet and often neglect the materiality of off-balance items. At the same time, some indicators also do not pay attention to the maturity of individual items, which is critical for proper bank liquidity management. Lastly, accounting data, which are often used as inputs, are also not appropriate for measuring the liquidity risk that arises from a mismatch of cash-flows.

2.3.2 Cash-flow indicators

In comparison with the stock indicators, the cash-flow indicators are very little standardized and are usually internally developed and unique for each banking institution. A type of liquidity gap may vary from a simple and static version counting only the contractual maturity of individual on-balance items to highly complex ones including off-balance and contingent liabilities. The advantage of more complex versions of liquidity gaps is that they allow a dynamic view by including various assumptions for cash-flow data. Bank's cash-flows can be divided into maturing products, the products that have contractually defined timing of cash flows, and non-maturing products that do not have a specific date when cash flows occur. (Džmuraňová, 2016) For the purpose of accurate calculation of timing of inflows and outflows, this timing is for on-demand products at least approximated.

Since balance sheet management is a dynamic process; it also requires a dynamic liquidity risk measurement. Dynamic liquidity gaps are one of the methods to capture the specifics of the individual institution and to provide better estimates of expected development of the cash-flows. One of the necessary conditions for the success of such a sound internal model is an accurate estimation of the timing of cash-flows for non-maturing products. Based on segmentation and its characteristics, every group of homogeneous on-demand deposits/loans (e.g., current accounts) has its own modeled *run-off profile*. For example, retail deposits should be by their nature considered more stable than corporate ones; thus, their estimated run-off profile would be substantially slower. The off-balance sheet items (e.g., credit cards and guarantees) are also products that do not have a clear outflow or inflow dates and therefore require similar approach. Other factors that complicates realistic cash-flow forecast may be *prepayments* of loans. Similarly, the *early withdrawals* of deposits represent the possibility of removal of funds from an investment before the expected maturity date and *roll-overs* assume the

probability that a specific item of the balance sheet will be renewed upon its maturity.

One specific example of liquidity gap is called *survival period analysis*. The survival period analysis measures bank's short and long-term liquidity, based on the selected maturity buckets. The Committee of European Banking Supervisors published guidelines that are determined by the CEBS's Advice on Liquidity Risk Management. These guidelines recommend several pillars which bank's liquidity risk management should be based on.⁹ Among others recommendations the utmost importance is put on liquidity buffers that should ensure the smooth functioning in times of stress when an institution has an urgent need to raise liquidity within a short time frame and regular funding sources are no longer available or do not provide enough liquidity.

Since the guidelines recommend to incorporate also stress scenarios, such a metric allows the bank to simulate the development of liquidity position in the unfavorable situation when the different types of financial markets are closed. The possibility of financing through various markets is gradually reduced (e.g., secured/unsecured, short-term/long-term) as a bank operates under stress conditions. The stress may have a form of idiosyncratic crisis, which is a situation when individual endogenous characteristic directly affect a bank or market crisis arising from exogenous macroeconomic and systemic factors affecting the entire sector.

As outlined in this section, measurement, and management of liquidity risk based on cash-flows indicators is considerably more comprehensive compared to simple balance sheet ratios and offers incomparably more options. However, cash-flow based indicators are somewhat more data intensive and are often dependent on a complicated forecast of inflows and outflows with dynamic versions including complex behavioral assumptions. While on the one hand, the estimated early withdrawals, roll-over and prepayments can provide a significantly more accurate estimate of the cash-flow mismatch, in the case of inaccurate estimates of these parameters the impact is the exact opposite.

⁹The first 18 recommendations are aimed at credit institutions to ensure adequate liquidity risk management. These recommendations focus on both regular and stressed times. The main pillars are diversification of funding resources, appropriate liquidity buffers, robust stress tests and regularly tested contingency funding plans.

2.4 Liquidity of banking system

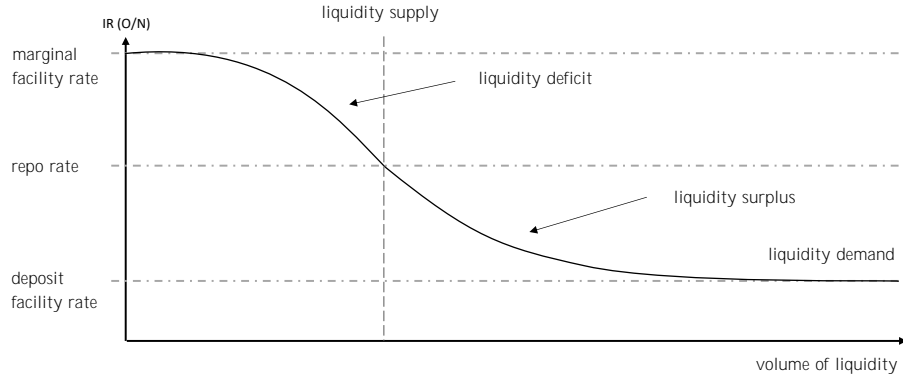
Banks have several different types of resources to finance their assets, and each bank should ensure that it can at any time be able to finance its assets with appropriate funding. Such resources can be short-term client deposits, interbank money market loans, securitization and during the past years also an increasing role of credit instruments offered by the central banks. However, while the deficit entities may demand liquidity on the secondary market from the entities with its surplus, the only entity that can supply liquidity to the whole banking system is the central bank. As Mandel and Tomšík (2014) point out, all mainstream economics schools of thoughts, including Keynesians, Post-Keynesians or monetarists, assume liquidity deficit of banking system in the long run. This fundamental imbalance is in line with the monetary policy steered with various forms of primarily short-term credits of the central bank.

2.4.1 Systemic deficit/surplus of liquidity

The equilibrium state of the supply of and the demand for liquidity is attained by the central bank in the use of standard monetary policy by open market operations and usually accompanied by automatic facilities. As the central banks seek to affect short-term money market interest rates through their transmission mechanisms, an essential prerequisite for successful transmission of the central bank base rate is the equalization of the liquidity demand and the supply in the banking system. Hence, for attainable implementation of the central bank's monetary policy, an ability to stabilize the price of the banking system liquidity is of paramount importance. For this reason, the central banks must possess such instruments which enable it to respond flexibly to the day-to-day volatility in the liquidity demand/supply and avoid adverse effects on short-term interest rates due to systemic liquidity shocks. (Brůna, 2010b) In a situation of insufficient liquidity, the liquidity demand would be larger than the supply, and the interbank rates would be pushed upwards as banks would try to place redundant liquidity in the money market. Conversely, a situation of the surplus of liquidity would push interbank rates downwards.

The discrepancy between demand and supply of liquidity is the result of liquidity shocks. An *individual* shock affects a single bank, while a *systemic* shock concerns the whole banking system. The individual shock may be associated, in particular, with reputational risk and subsequent bank run or concentration risk that may affect the liquidity risk on both sides of the balance sheet. As is the case of funding and market liquidity defined

Fig. 2.3: Supply of and demand for liquidity



Source: CNB, own processing

in Section 2.1, both shocks are highly interconnected, and although banks manage their liquidity position and financial risks individually, severe deterioration of market conditions may affect numerous entities at the same time and contribute to negative shocks for the whole banking system. A typical example of a systemic crisis of liquidity was the recent Great Recession when the lack of liquidity of individual systemically important banks escalated into the decline in confidence in the whole financial system. This distress was very closely linked to the credibility of individual banks and accompanied by freezing of the interbank market.

By its nature, every banking system operates in the fundamental deficit of liquidity. As Brûna (2010b, p. 18) refers, such a characteristic is a direct results of the “*specific position of the central bank in the domestic interbank payment system*” where the clearing accounts held with the central bank “*automatically imply the need of liquidity acquisition from the central bank.*” Due to the minimum required and precautionary reserves, the demand for liquidity tends to grow along with the growth of deposits in the banking system. The assumption that in the absence of the need to hold minimum or precautionary reserves the banking system would operate in the state of zero demand for liquidity is possible to refute by arguments that existing liquidity in the banking system cannot be considered a perfect substitute. The interbank transactions are bearing significantly higher credit risk, especially in a situation of crisis, and generally, require different collateral. Also, the recent experience associated with the Great Recession and subsequent rationing proved that the interbank market could very quickly cease to fulfill its functions.

2.4.2 Liquidity supply and demand

Brůna and Blahová (2016) describe systemic liquidity of the banking system by the series of equations. The first one denotes liquidity *use* (Eq. 2.3) that consists of *demand* (Eq. 2.4) and *sterilization* (Eq. 2.5) and the last one which describes the liquidity *supply* (Eq. 2.6). As pointed out earlier, a difference between the expected demand for liquidity and its actual available volume may cause an unexpected systemic shock. The central bank's balance sheet in the context of liquidity management is summarized in Fig. 2.4.

Fig. 2.4: Central bank balance sheet in context of liquidity

Assets	Liabilities
Autonomous factors	
	Currency in circulation
	Government deposits
	Excess reserves
Items connected with monetary policy instruments	
Foreign exchange reserves (foreign exchange interventions)	Minimum reserves
Securities (supplying open market operations)	Bank's deposits/securities issued by CB (withdrawing open market operations)
Securities (lending facility)	Bank's deposits (deposit facility)
Other Items	
Gold	Capital
Tangible and intangible assets	Retained profit/loss outstanding
Other assets	Other liabilities

Source: Brůna (2010b)

The demand for liquidity comprises of minimum reserves that banks are required to hold and excess precautionary reserves. In addition to the reserves, the volatile demand of clients for currency in circulation and balances on the state budget account are the autonomous factors which determine the total amount of liquidity demand from the banking system. The short-term development of the autonomous factors constitute the factors that the central bank has not under its control and are the main source of uncertainty in the liquidity demand.

Absorbing monetary policy instruments comprise sterilization of liquidity. These instruments include the withdrawal open market operations and the deposit facility. The liquidity demand and the liquidity sterilization together form the *use of liquidity* (Eq. 2.3) and are composed of the central bank's liability side of its balance sheet. (Brůna and Blahová, 2016)

$$L_U = L_D + L_{STR} \quad (2.3)$$

$$L_D = MR + ER + CUR + D_{GOV} \quad (2.4)$$

$$L_{STR} = D_{OUTR} + D_{REPO} + D_{DF} + OTHL \quad (2.5)$$

Where

L_U	= liquidity use
L_D	= liquidity demand
L_{STR}	= liquidity sterilization
CUR	= currency in circulation
D_{DF}	= deposit facility
D_{GOV}	= government deposits
D_{REPO}	= repurchasing operations
D_{OUTR}	= own issues
ER	= excess reserves
MR	= minimum reserves
$OTHL$	= other liabilities

On the contrary, the liquidity supply (Eq. 2.6) consists of the assets side of the central bank's balance sheet. These items include mainly FX reserves, credit facilities, securities held outright, securities received in reverse repurchasing operations and as collateral for the lending facility.

$$L_S = FR + CF + SEC_{OUTR} + SEC_{RREPO} + SEC_{LF} + OTHA \quad (2.6)$$

Where

L_S	= liquidity supply
CF	= credit facility
FR	= FX reserves
SEC_{LF}	= securities held as collateral for lending facility
SEC_{OUTR}	= securities held outright
SEC_{RREPO}	= reverse repurchase agreement
$OTHA$	= other assets

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Eq. 2.7 and Eq. 2.8 follow the previous text and define the long-term systemic deficit/excess of liquidity. If the central bank had previously provided liquidity to the banking sector through FX interventions or outright purchases of securities in such a volume that it resulted in its excess, the central bank is forced to absorb this liquidity through the sterilization instruments. Because banks have their accounts with central banks, there is no other option than that the issued liquidity will remain in those accounts. Therefore, all liquidity will by definition always stay with the central bank on the items constituting a demand for liquidity or through sterilization instruments, in the case of its excess.

$$FR + SEC_{OUTR} < MR + ER + CUR + D_{GOV} \quad (2.7)$$

$$FR + SEC_{OUTR} > MR + ER + CUR + D_{GOV} \quad (2.8)$$

Through the FX reserves, the central bank provides the banking system with liquidity until it sells foreign currency assets from its balance sheet. In the case of the outright purchases of securities, if the central bank does not reinvest these funds; the long-term liquidity is absorbed from the system with the maturity of the securities.

If the central bank has not delivered long-term liquidity to the banking sector through FX interventions or outright purchases of securities, such a system automatically operates in a deficit of liquidity. In this case, the central bank ensures sufficient liquidity with short-term instruments. At the same time, these instruments are being used to manage the short-term liquidity deficit/surplus of the banking system.

$$\begin{aligned} \Delta L_{STR} = & \Delta L_S - \Delta L_D = \\ & (\Delta FR + \Delta CF + \Delta SEC_{OUTR} + \Delta SEC_{RREPO} + \Delta SEC_{LF} + \Delta OTHA) - \\ & (\Delta MR + \Delta ER + \Delta CUR + \Delta D_{GOV}) \end{aligned} \quad (2.9)$$

$$\Delta L_{STR} = \Delta D_{OUTR} + \Delta D_{REPO} + \Delta D_{DF} + \Delta OTHL \quad (2.10)$$

Brůna and Blahová (2016) show that an unexpected systemic shock is a result of a mismatch between the predicted demand for liquidity and its actual supplied volume for a given day. This mismatch is reflected in

short-term net liquidity position Eq. 2.9 and such a shock corresponds to a discrepancy between expected and actual change in volume of currency in circulation, government deposits and minimum and excess reserves. In order to minimize these shocks and eliminate adverse effects on short-term money market interest rates the central bank has to be able to fully adopt the supply to these factors. In addition to minimum reserves, which grow together with increasing client deposits, currency in circulation presents the most influential autonomous factor.

$$\Delta L_S < \Delta L_D \quad (2.11)$$

$$\Delta L_S > \Delta L_D \quad (2.12)$$

From a short-term perspective, there may be a situation where the volume of liquidity is lower than the demand of banks, although this banking system experience long-term fundamental excess of liquidity. The banking system fluctuates between surplus and deficit regardless of its long-term systemic position. The short-term net liquidity position is characterized by the current imbalance between the liquidity supply offered by the central bank and the aggregated demand for liquidity from banks. Eq. 2.11 defines short-term liquidity deficit, while Eq. 2.12 shows short-term surplus.

If due to an error in the prediction of endogenous autonomous factors the demand for liquidity is lower than the supply, there is an increase in net liquidity sterilization as banks deposit this excess liquidity through sterilization instruments. In the case of short-term liquidity deficit, the opposite holds true. If there is insufficient liquidity from sterilization instruments, the banking system can obtain additional resources through the lending facility during the day. Consequently, a systemic liquidity shock influences a systemic liquidity position as well as inequality of supply and demand for liquidity is reflected in a change in the net volume of sterilized liquidity.

II

Analytical part

3 Foreign exchange interventions of Czech National Bank

The Czech banking sector, which dominates the Czech financial system with 80% of the sector's assets and greatly contributes to financial intermediation, is characterized by its high and long-term liquidity surplus. While the banking sector ordinarily operates in a situation of systemic liquidity deficit, the monetary policy of the small open transition economy resulted in high liquidity excess of the banking sector. Such a situation was a direct result of FX interventions of the *Czech National Bank* (CNB) conducted from the second half of the 1990s until October 2002 against the appreciation of the Czech koruna. This policy was used during the period of the fixed exchange rate and also afterward in the system of managed exchange rate regime. (Brůna, 2010b) The CNB later indirectly affected the exchange rate of koruna by conversion of EUR 6 billion received from government's privatization incomes and from 2004 to 2011 the CNB redeemed approximately EUR 7 billion from the EU funds. FX interventions were sterilized by the CNB through outright sales of CNB treasury bills and then by repo operations. (Mandel and Tomšík, 2014) In the case of the Czech Republic, excess liquidity was not significantly emitted by the rescue of individual banks.

3.1 Standard monetary tools of CNB

The CNB implements multiple instruments to manage liquidity situation of the Czech banking system. These instruments also set the CNB's policy interest rates which are used by the CNB to steer and stabilize short-term money market interest rates, namely the overnight rate and consequently to affect interest rates in the economy in general. The CNB's key interest rate serves as an operative criterion in the interest transmission mechanism

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through which the central banks targets inflation. The CNB was the first bank of the transition economies that adopted inflation targeting.

Due to the systemic liquidity surplus, the CNB almost does not have to supply¹⁰ liquidity to the banking system, and its primary task is to withdraw the liquidity on a regular basis with the standard monetary tools. The key instrument for the management of the banking system liquidity is open market operations. The CNB executes its main instrument in the form of the *two-week repo tenders* to withdraw the excess liquidity from the banks and to steer interest rates in the economy. In exchange for deposited liquidity surpluses, a bank receives central bank treasury bills as collateral. The tenders are being held three times a week at a variable rate in the form of the American auction procedure. The minimum acceptable volume is CZK 300 million and subsequent bids must be expressed as multiples of CZK 100 million. There are several other supplementary tools the CNB possesses including the 3-month repo tender. However, the use of these instruments is rather rare.

In addition to the open market operations, the CNB also uses automatic facilities. The Czech banks use primarily the *deposit facility* for depositing their excess liquidity overnight while the second one, the *marginal lending facility*, remains mostly out of their attention.¹¹ The role of the facilities is to provide the banks with the instruments which allow them to steer their deficit or surplus of liquidity at the end of the day. These facilities inherently set the upper and lower bounds for the movements of the overnight money market interest rate. Given that the central bank seeks to manage the liquidity of the banking sector primarily through its main instrument, the deposit and marginal lending facilities should have been of a complementary character.

Before every repo tender, the CNB predicts the actual supply of excess liquidity. The accuracy of this forecast plays a crucial role in the management of liquidity of the banking system and could significantly affect the subsequent real state of liquidity in the financial system. In the case this prediction turns out to be inaccurate, it results in an imbalance in the banking sector that cannot be solved via the interbank market. In this situation, banks would have to use the CNB's automatic facilities to manage their liquidity position. Since both the deposit and the Lombard rates are at standard monetary conditions punitive, these operations would be

¹⁰In 2008 the CNB introduced a regular liquidity-providing repo tender which use was limited, although having an important psychological effect. (Lizal and Schwarz, 2013)

¹¹Apart from these two facilities, the CNB also uses its intraday credit facility to ensure smoothly functioning interbank payment system.

financially disadvantageous to the banks compared to the standard repo tenders.

The last of the standard monetary tools the CNB uses are the minimum reserves. The role of the minimum reserves, which originally served as a monetary tool, shifted to the instrument that stabilizes the demand of the banking system for liquidity or the supply of surplus reserves. (Brůna, 2010b) The Czech banks are required to keep on their clearing accounts on average for the maintenance period 2% of primary deposits of non-bank entities whose maturity does not exceed two years. The maintenance period begins on the first Thursday of the month and ends on Wednesday before the first Thursday in the following month. Balances up to the required volume bears repo rate, the excess amount does not pay any interest. The usefulness of this instrument has fallen even further in the situation when central banks supply liquidity to their banking sectors through the tenders with full allotment.

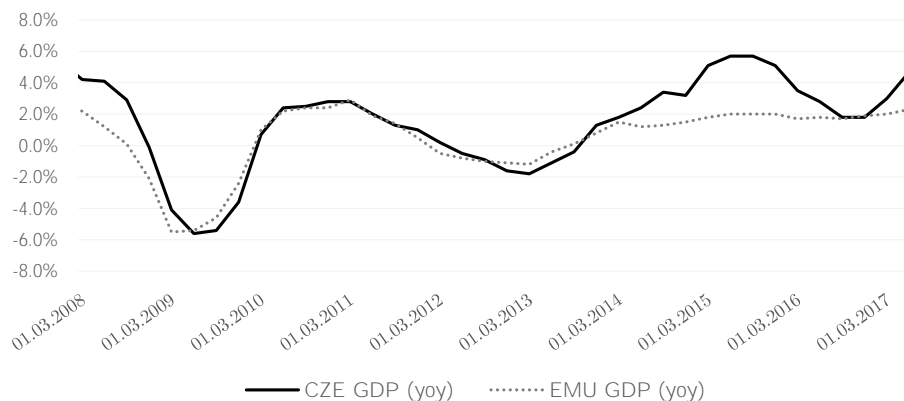
3.2 Macroeconomic development and influence of eurozone

The Czech Republic is a small open economy, which is due to its large pro-export-orientation heavily dependent on the current economic situation in the European Union and the eurozone especially. Fig. 3.1 shows the economic cycle of the Czech Republic and compares it to the eurozone. It is noticeable that the Czech cycle is strongly synchronized with the eurozone's one. As a consequence, the policy of the CNB is necessarily highly correlated to the policy of the ECB.

Due to the turmoil in financial markets and the overvalued koruna, the Czech economy found itself in a deep recession in 2009. (Vejmělek, 2014) As well as the rest of Europe, the Czech economy experienced a deep decline in the GDP in the year 2009 and only after seven quarters of moderate growth came back into another recession. Shortly after the outbreak of the Great Recession the inflation plummeted to extremely low levels for the first time. Despite the weak domestic demand, changes in indirect taxes, administrative prices and external factors including growing fuel prices resulted in an increasing trend in the CPI. The average annual inflation rate thus gradually increased between 2009 and 2012 and began declining at the end of 2012. However, the price development of the items in the consumer basket already started to decline in the final quarter of 2008. (Vejmělek, 2014) Therefore, even though the Czech CPI kept increasing

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Fig. 3.1: GDP growth of Czech Republic (yoy) 2008-2017

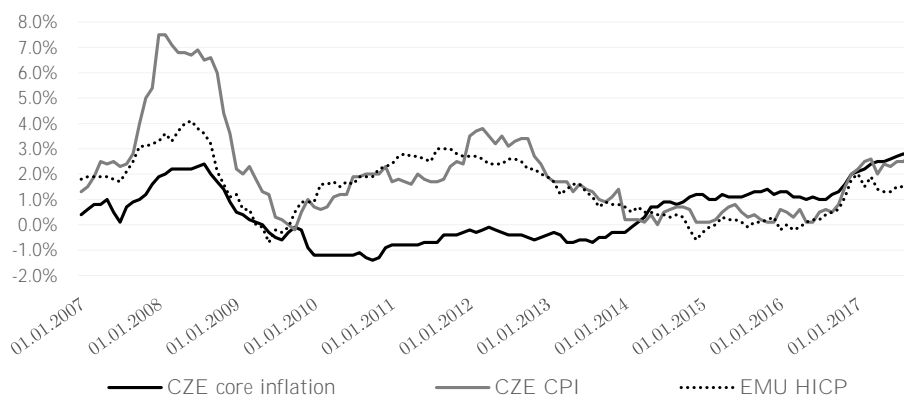


Source: CNB (ARAD), CZSO, own processing

until the end of 2012, the prices that the CNB has under control, i.e., core inflation, was in the negative territory already since mid-2009. (Holub and Král, 2013)

Both the CNB and the ECB have one primary objective which is to maintain price stability and conduct their monetary policies within the inflation targeting regime. While the ECB aims to maintain inflation rate below, but close to, 2% over the medium-term, the CNB targets the inflation of 2% that should not differ from this number by more than one percentage point on either side. Given these considerations, the situation presented in Fig. 3.2 was in both areas in 2009 highly unacceptable.

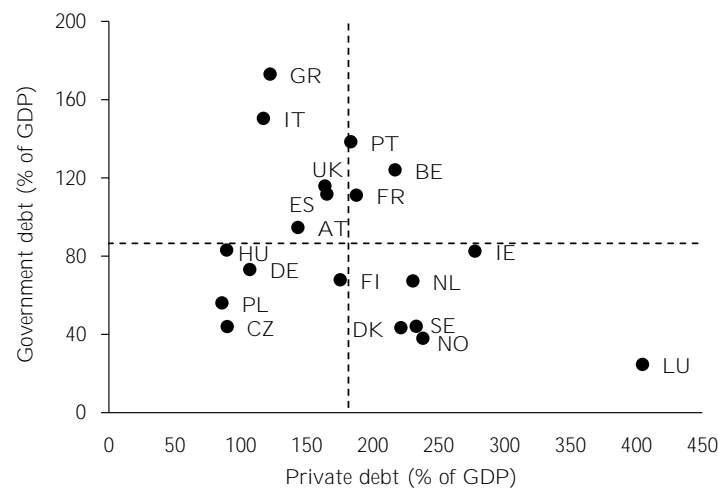
Fig. 3.2: CPI in Czech Republic 2007-2017



Source: CNB (ARAD), CZSO, own processing

The several difficulties that the euro area struggled and still struggles with resulted in the second recession in a very short period. The need for structural reforms and consolidation of public finances, very high indebtedness and weak banking sector were the major problems that resulted in the eurozone's debt crisis which escalated in 2012. Due to these difficulties and structural issues mainly of southern countries, inflation started to plunge again in the second half of 2012.

Fig. 3.3: Private and government debt in EU 2017 Q4



Source: CNB

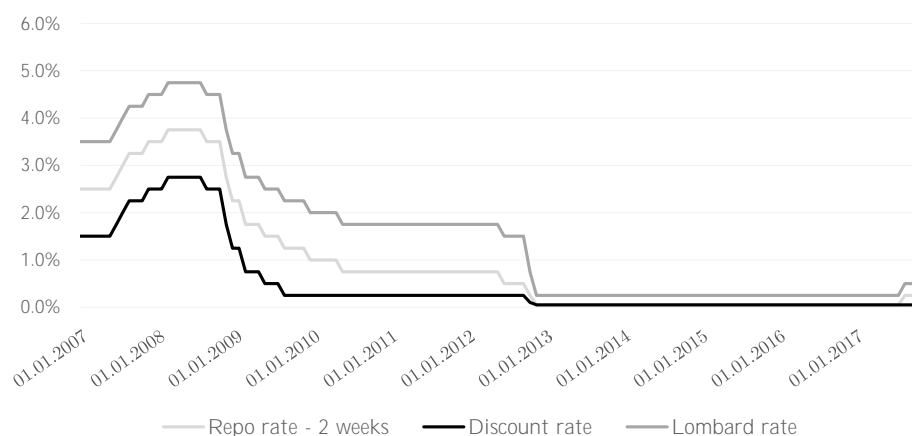
Fig. 3.3 illustrates that private and government debt of the Czech Republic is among the lowest in Europe and significantly below the average which is indicated by the dashed lines. Given its infant non-indebted economy, the Czech Republic was spared from macroeconomic and structural issues which particularly affected the south part of the euro area. Nevertheless, a small economy which is heavily export-oriented is dependent on the economic health of other countries and strongly influenced by a situation in an importing country.

The CNB started to slowly lower its policy interest rates already in August 2008. The first cut of 25 basis points concerning all three key interest rates, which slashed the rates from their peak values of 3.75%, 2.75% and 4.75%, was only the beginning of the upcoming successive dovish decisions by the board. The board of governors decided to cut its interest rates 6 times to the levels of 0.75% for the repo rate, 0.25% for the deposit rate

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and 1.75% for the Lombard rate in mid-2010. The development of these rates is shown in Fig. 3.4.

Fig. 3.4: CNB's policy interest rates 2007-2017



Source: CNB (ARAD), own processing

After a relatively calm period of no need to take any major monetary policy decisions and stable development of the CNB's policy interest rates, a base scenario prognosis of the CNB started to forecast increasing deflationary pressures again. It was pointed out that despite a very favorable situation concerning the CPI for a relatively long period, the core inflation was in the negative territory from mid-2009 until the end of 2014. Insufficient demand for loans, weak domestic demand for goods and continuing fiscal consolidation were the strongest among other factors that started to push also the fore-casted CPI below its target in 2012. This threat began to be apparent despite the fact that actual CPI still significantly exceeded 3% in the mid-2012. The continuing decline in inflationary pressures, which were further supported by imported low inflation from abroad resulted in ongoing cuts in the policy interest rates. On November 2012 the CNB decided to lower its interest rates for the last time to the levels of 0.05% for the deposit rate, 0.05% for the two-week repo rate and 0.25% for the Lombard rate.

With this decision, the CNB exhausted all room for any further interest rates cuts. Similarly to the other central banks, the CNB also reached a point where it was no longer possible to steer interest rates and target inflation with its standard tools. At the same time, actual inflation started to fall rapidly below the CNB's target. This was a major sign of the need

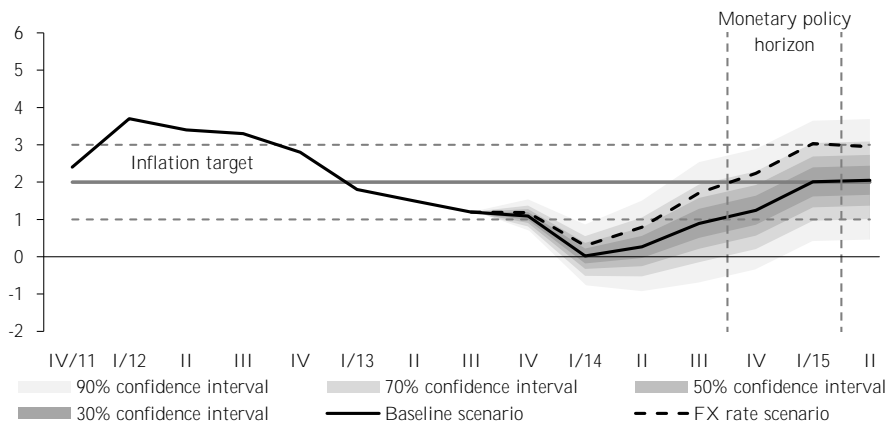
to introduce new, yet untested, monetary instruments.

3.3 Exchange rate commitment

In the first chapter, two main unconventional tools were introduced. Contrary to the Eurosystem or the FED, the CNB chose FX interventions before quantitative easing. There were several reasons for this decision. Contrary to the ECB, the CNB did not have to accede to any form of quantitative or credit easing to support its banking system. As the CNB did not need to implement any tools to reinforce the banking system with funding, the standard tools endured their role for considerably longer time. Another reason for choosing FX interventions is that the Czech capital market does not even come close to those in developed countries, since the majority of corporates and institutions finance themselves primarily through bank loans.

The main reason, however, was already outlined in the second section of this chapter and also in the first chapter of this thesis. The small open economy like the Czech one is heavily dependent on foreign trade and its export is closely related to the level of the exchange rate. Due to the openness of the Czech Republic, import prices have a considerable effect on the price level in the whole economy. While outright purchases would hardly found a place in the domestic financial market, FX interventions would immediately affect the majority of exporters and importers. (Lizal and Schwarz, 2013)

Fig. 3.5: CNB's prediction of inflation 2013 Q4



Source: CNB

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Given the increasing anti-inflationary pressures, on 7 November 2013 the CNB with immediate effect decided to implement automatic and unlimited FX interventions setting the one-sided exchange rate commitment. With this commitment, the CNB started to maintain the exchange rate close to the level of 27 CZK/EUR. This decision was driven by weak expectations of the monetary-policy relevant inflation development according to the baseline scenario of the contemporary forecast (Fig. 3.5). The scenario was consistent with a significant decline in market interest rates into the negative territory. Due to the ZLB on nominal interest rates, the CNB decided to ease monetary policy further using other instrument and to keep its interest rates at technical zero. (CNB, 2013) As the CNB entered the FX market on 7 November 2013, the Czech koruna depreciated slightly above the declared level of 27 CZK/EUR immediately.

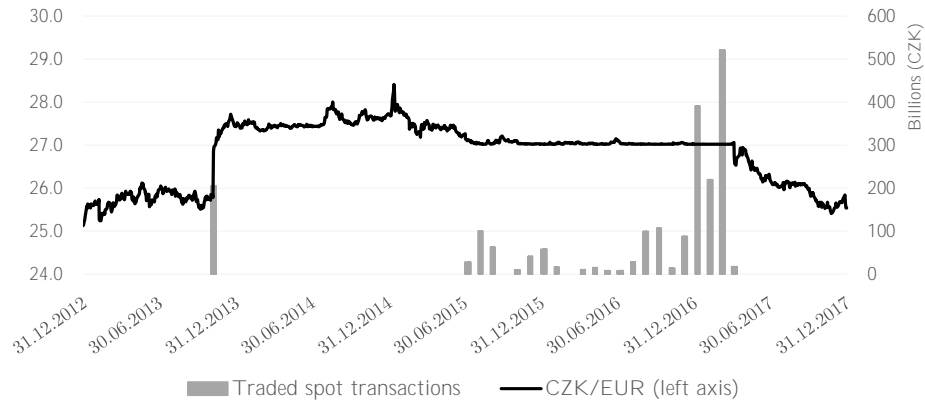
The decision-making prediction is presented in Fig. 3.5. The prediction shows that without implementing the exchange rate commitment, inflation would fall far below the inflation target to zero level and would only slowly return to the inflation target. On the other hand, an alternative scenario, which worked with further eased monetary conditions through the exchange rate, indicated a much more optimistic situation and a return to the target in the third quarter of 2014 and subsequent overshooting of inflation.

The actual entrance to the FX markets was preceded by long-term verbal interventions. Similarly to the public, who perceived koruna weakening negatively, also expert opinions on the implementation of interventions, particularly because of the threat of deflation which the CNB referred to, differed significantly.¹² The major assumptions of the successful interventions were a resulting increase in exports and subsequently in private consumption, which was declining for a few quarters already as households increased their savings and kept deferring their consumption based on the expectations of continuing price decline. (Tomsik, 2013) The key factors affecting inflationary expectations and inflation itself were expected inter-temporal and intra-temporal effects on consumption. While the inter-temporal substitution would result in a reduction in delaying consumption to the future and increase in spending today as economic subjects would expect higher future prices, the intra-temporal effects would result in a change in the composition of the current consumption due to the increased import prices which would lead to a higher preference of domestic goods.

How often and how much the CNB had to intervene is shown in Fig. 3.6. After the launch of the commitment, the CNB had to heavily intervene only during its very beginning in the amount of approximately CZK 200

¹²See, for example, Klaus (2014) or Holub and Král (2013).

Fig. 3.6: CNB's traded spot transactions 2013-2017



Source: CNB, own processing

billion and did not have to massively regulate the koruna's exchange rate in the following two years. The pressure of the inflows of speculative capital started to slowly increase in the second half of 2015. Fig. 3.6 indicates the increasing need to buy foreign currency in order to avoid the strengthening appreciation pressures. The second half of 2015 was also the moment from which the koruna was almost fixedly attached to the level of 27 CZK to EUR. The actual amount of the actively traded spot transactions during the period of the CNB's FX interventions reached CZK 2 053 billion.

The development in the last months of the exchange rate commitment can be explained by multiple factors. First of all, the sound economic growth, driven especially by higher exports which also contributed to the higher demand for the koruna, and the reviving domestic demand created conditions for the reasonable appreciation of the currency. However, the main reason for strong appreciation pressures was the imminent exit from the exchange rate commitment and growing speculative pressures motivated by increasing expectations of a significant appreciation of the koruna by foreign subjects.

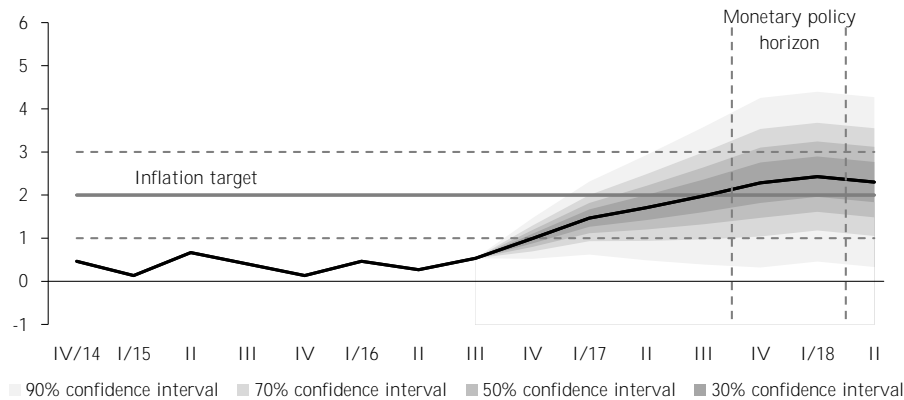
The CNB initially avoided setting a specific exit date and communicated repeatedly that *"the CNB is resolved to intervene in the FX market in such volumes and for such duration as needed to reach the desired exchange rate level and thereby smoothly fulfill the inflation target in the future."* (CNB 2013, para. 3) Despite this wording, the CNB at the beginning of the regime presented its first and as it turned out an overly optimistic estimate of the exit during 2015. However, given the persistent anti-inflationary cost-pushed shocks from abroad and deflationary risks in the eurozone, the

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commitment was repeatedly prolonged. Despite this argumentation used primarily by the CNB, as well as there were different opinions on the appropriateness of the implementation of FX interventions, there are also differences in views on the timing of the exit and its optimal communication and announcement. For example, core inflation indicated the possibility of terminating interventions considerably earlier (Fig. 3.2).

Virtually all forecasts in 2016 indicated a gradual increase in inflation and meeting the inflation target during 2017. Initially, the CNB communicated the expected end of FX interventions in 2016 and subsequently shifted the exit to the second half of 2016 and finally to the second quarter of 2017. The inflation forecast from November 2016 (Fig. 3.7) and the dynamics of the price levels clearly suggested that there were little reasons to further delay the exit.

Fig. 3.7: CNB's prediction of inflation 2016 Q4



Source: CNB

Postponing the termination of FX interventions and communicating the exit strategy are another of the frequently discussed aspects of the policy of the CNB. The CNB failed to exit in such a way as to avoid massive speculative attacks resulting from the expected appreciation of the domestic currency. It is questionable whether the central bank's patience waiting for the next inflation forecast and macroeconomic analyzes had any major reason in the situation of robust economic growth and almost zero unemployment. Fig. 3.6 proves that the bets on the approaching exit reached noticeably high volumes. These speculative attacks from the last months of the exchange rate commitment are at the same time the primary reason for a significant increase in excess liquidity of the Czech banking system.

On 6 April 2017 during its extraordinary board meeting the CNB decided to end the exchange rate commitment. This decision came into force immediately upon its announcement, and the koruna exchange rate started to move again according to market supply and demand on the FX market. The CNB made it clear that in case of excessive exchange rate movements it is ready to enter the market again and mitigate such fluctuations. Nevertheless, the catastrophic scenarios giving the example of the Swiss case with regard to the exit strategy predicting an extreme appreciation of koruna did not turn out to be correct. Despite a slight appreciation of the koruna in the day of the exit (Fig. 3.6), its subsequent development may be considered as a moderate and gradual strengthening.

3.3.1 Transmission to interest rates

Although the CNB was not able to steer interest rates in the economy through its policy interest rates and the two-week repo rate primarily as it would be a case in the ordinary course of business; this role has been taken over by FX interventions in recent years. The following text shows the impact of the unconventional tool through its transmission mechanisms on the levels of interest rates of the interbank, treasury-bill and government bonds markets.

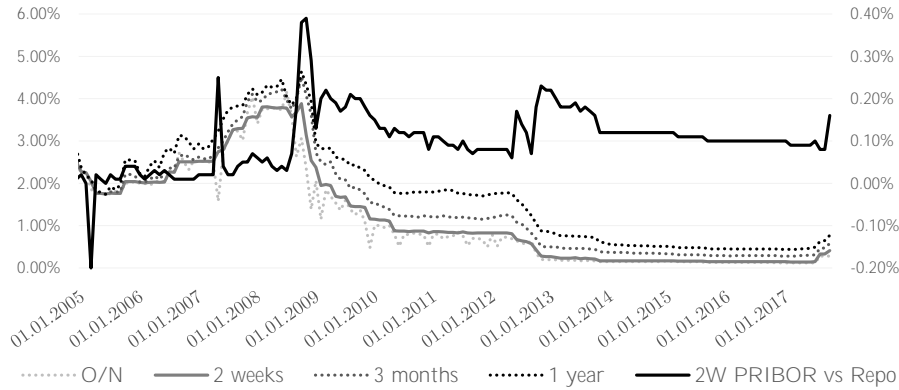
3.3.1.1 Interbank offered rates

Prague interbank offered rate (PRIBOR) and overnight tenor especially are the money market rates that the CNB under standard conditions aims to affect. Fig. 3.8 shows selected tenors of the Czech interbank rates with values on the left axis and a spread between the two-week PRIBOR and the two-week repo rate represented by the black curve with values displayed on the right axis.

While the spread of the two-week PRIBOR and the two-week repo rate was quite volatile shortly before the initiation of FX interventions, its value dropped to 12 basis points in November 2013 and remained almost identical until the end of the CNB's commitment. The two-week PRIBOR was at its lows before the CNB's first hike in August 2017. Nevertheless, the spread apparently did never get to the pre-crisis levels. It is a logical impact of the Great Recession, as money market rates started to include notable spreads capturing credit risk which was until then greatly neglected. Consequently, the money market became a rather expensive source of funding. However, the Czech banks do not finance themselves on the interbank market and, as will be discussed in the next chapter, do not even need to finance themselves

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Fig. 3.8: Prague interbank offered rate 2005-2017



Source: CNB (ARAD), own processing

in domestic currency via any alternative market and entirely rely on retail and corporate deposits.

The story is similar also to other tenors. For example, the 3-month PRIBOR decreased from 0.38% in November 2013 to 0.28% in March 2017. Hence, although a modest one, a fall in the money market rates over nearly four years of FX interventions is apparent. It is in contrast with statements that in a situation of the ZLB, FX interventions are always sterile and transmission of an exchange rate into money market yields is limited.

This can be attributed to several factors. First of all, the Czech money market is not highly liquid due to the excess liquidity of the banking sector. Since there are virtually no trades, an informative value of these rates, especially those with longer maturities, is highly doubtful. Fig. 3.8 indicates that the Czech banks reflect their expectations of movements in the central bank's policy interest rates (Fig. 3.4) and remain more or less stable during the period of consistent interest policy. The second reason can be attributed to a decline in the credit spread that banks add to interbank rates as a risk premium after the financial crisis.

3.3.1.2 Treasury bills and government bonds yields

Since the outbreak of the financial crisis, yields on bond markets have experienced an increase in volatility and, in particular, a sharp fall into negative values. Until the Great Recession, there was actually no spread in yields of countries which were part of the euro area. In fact, even a country outside the euro area like the Czech Republic enjoyed almost the same levels of long-term interest rates as the eurozone's superpowers. This

changed in 2008 and since then these spreads widened significantly. This aspect can be attributed to more conscious financial markets, which started to differentiate among the eurozone countries after enormous difficulties in Greece and subsequently in other southern economies, rather than to the non-standard monetary policies.

Nonetheless, the phenomenon that has its origin in the non-standard monetary instruments are a long-term declining trend of interest rates levels. It was a sequence of several events that pushed interest rates and yields to the historically lowest levels. Cutting the policy interest rates of the ECB to the zero levels was the starting point for setting this direction in Europe. This movement was supported by conducting the main refinancing operations at fixed rate tenders and the longer-term refinancing operations for even more extended periods at artificially low levels to ensure liquidity of the banking sector. A significant decrease can be spotted in the period of the announcement of initiation of the expanded asset purchase programme at the turn of 2014 and 2015. The reaction of markets could be, therefore, attributed to the signaling effect of QE affirming market participants in the long-term intention of the ECB to keep monetary policy loose. The extremely eased conditions and low interest rates in the euro area meant that originally Euro-investors started to look after alternative investments in different currencies.

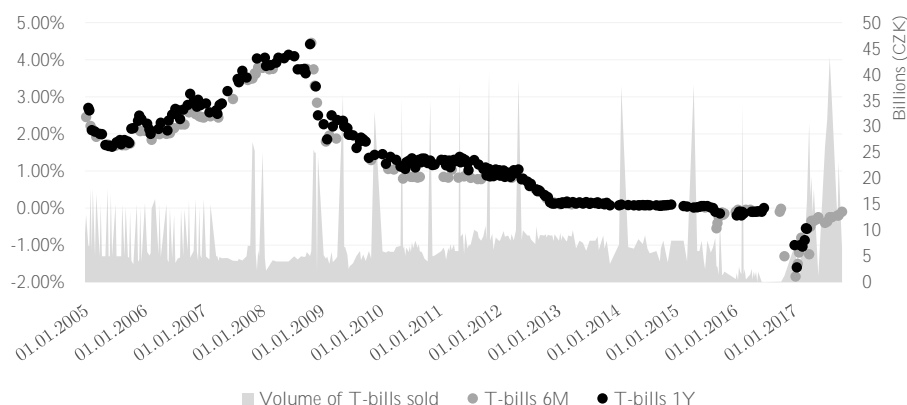
As a consequence, during the period of the exchange rate commitment, the volume of Czech government debt increased significantly in the hands of foreign investors. Due to an anticipation of the future appreciation of the koruna's exchange rate, foreign entities created large positions through derivative trades such as cross-currency swaps and FX swaps. This resulted in a distortion in the markets of these derivatives, whose price in koruna terms grew and their implied koruna yield went to more negative values. Simultaneously, other investors were attracted by debt instruments. (Sýrovátka, 2017)

Czech government *t-bills* are short-term money market securities with maturity up to 1 year, the face value of CZK 1 million and are being issued on a discounted basis. The Ministry of Finance of the Czech Republic (MFCR) issues treasury bills through the Dutch auction and only the primary dealers in Czech governments bonds are eligible to participate in this auction. Contrary to the interbank unsecured money market, the government securities traded on the same market responded significantly more intensively to the policy of the CNB.

The yields of the Czech t-bills started to decrease already during 2012 which was a moment when the CNB lowered its interest rates for the last time and started to use verbal interventions primarily. (Tomsik, 2013) Fig.

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Fig. 3.9: Average yields of Czech t-bills 2005-2017



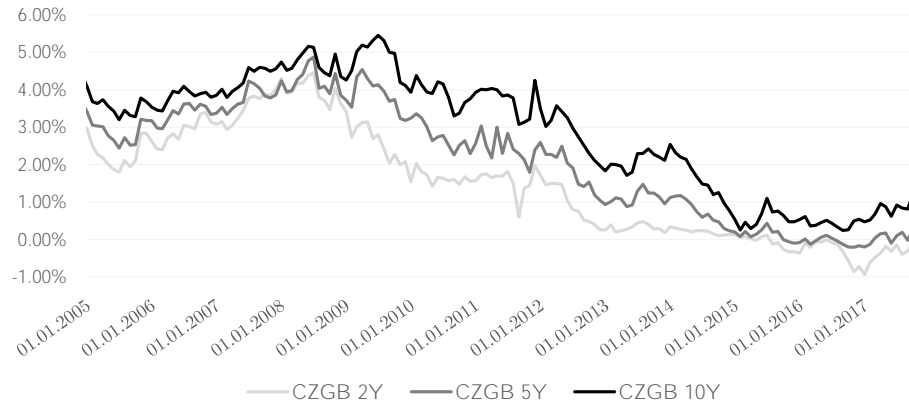
Source: CNB (ARAD), own processing

3.9 shows that despite the majority of issues had a maturity longer than six months, the yields of the Czech t-bills followed very closely the decrease of the CNB's repo rate. In the same year, the average yield this instrument offered was already lower than the lowest CNB key interest rate and started to offer zero interest in 2013. Subsequently, the yields got even further into the negative numbers due to the rising expectations of the end of the exchange rate commitment and the growing speculation on the subsequent strong appreciation of the Czech koruna.

The situation regarding the Czech government bonds, especially the ones concerning shorter maturities, was similar to the situation with the t-bills. The speculative capital inflows soared the prices of both the t-bills and the government bonds and knocked down the yields across all maturities these instruments offered. (Vejmělek, 2014) Fig. 3.10 indicates that similarly to other rates also the Czech government bonds yields were decreasing already from the end of 2008. A sharp fall of these yields continued even after the last cut in the CNB's interest rates at the end of 2012. Together with the initiation of the CNB's commitment the fall further gained momentum. For example, 10-year government bonds offered yields lower than 1% from the end of 2014, and 2-year bonds were yielding negative interest rates from mid-2015.

An explanation of such extremely low levels of both short-term and long-term debt of the emerging country with the rating mostly A+ from the major rating agencies is provided by Fig. 3.11. While the domestic banks started to diminish their holdings of the Czech debt since 2014, the proportion of the debt held by foreign entities has increased rapidly. The

Fig. 3.10: Average yield of Czech government bonds 2005-2017



Source: CNB (ARAD), own processing

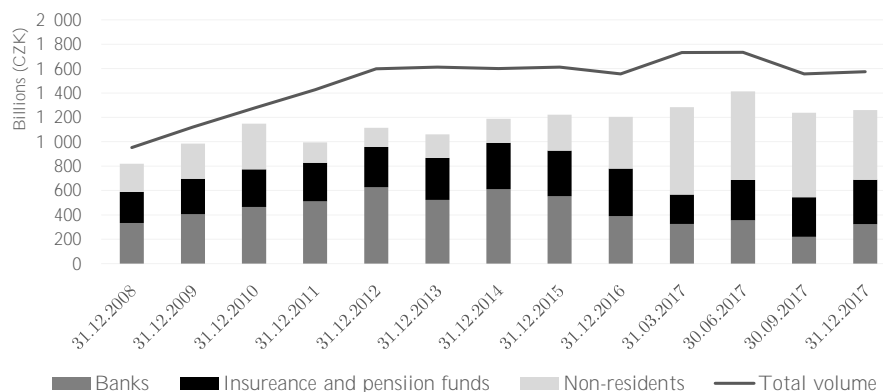
increase in the holdings of government bonds and their subsequent gradual decrease which occurred during 2017 is shown in greater detail.

The domestic banks themselves did not have any particular reason to accept negative yields even for a short period of time. The alternatives of the CNB's deposit facility and repurchasing operations ensuring very low but still positive yields of 0.05% for the past 5 years were simply more profitable and bore virtually no credit risk. This was not the case for non-resident subjects. In the environment of extraordinarily low yields in eurozone markets, mainly driven by quantitative easing of the ECB, they sought to place their funds in profitable operations. These investors and mostly speculators were willing to finance the Czech government debt and yet pay for it due to an expectation of the appreciation of the koruna sufficient enough to offset the negative returns from the instrument. Such an expectation provided an attractive but speculative profit even at a time when yields on these debt instruments moved to the negative numbers.

As a consequence, the yields of the Czech government bonds were traded at the historically lowest levels throughout the last months of the CNB's interventions. This factor prevailed at the shorter end of the yield curve as foreign investors participated mostly in primary auctions of these maturities. In consequence, domestic investors, mainly financial institutions, were forced to focus on purchasing of bonds with longer-maturities in order to receive positive returns. Syrovátka (2017) includes the favorable development of public budgets and the associated lower supply of bonds, low inflation and stable credit ratings of the Czech Republic as other factors that resulted in the shift of the yield curve to the lower levels.

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Fig. 3.11: Holders of Czech government bonds 2005-2017



Source: MFCR, own processing

The share of foreign investors in the auctions of the domestic government bonds increased gradually. As a result, non-residents increased their holdings to 42% of total CZK 1 732 billion of the issued bonds in March 2017 compared to the 12% of CZK 1 601 billion in 2014. This substantial increase was at the expense of domestic banks that reduced their holdings to 19% (42% for financial institutions in total) from 38% (65% for financial institutions in total) in 2014. The Czech government took advantage of the low returns and pre-funded its budget. Syrovátka (2017) calculates that in the first half of 2017 the MFCR issued bonds in the amount of nearly CZK 130 billion which was over 80% of the originally planned minimum domestic issue for that year. At the same time, the average time to maturity was shorter than five years as MF focused on shorter maturities as they yielded negative returns. After the termination of FX interventions, the yields recovered from the negative values as foreign investors started to slowly sell their koruna assets. This development was further supported by an improving outlook for economic activity in the euro area, rising inflation expectations and increasing US yields.

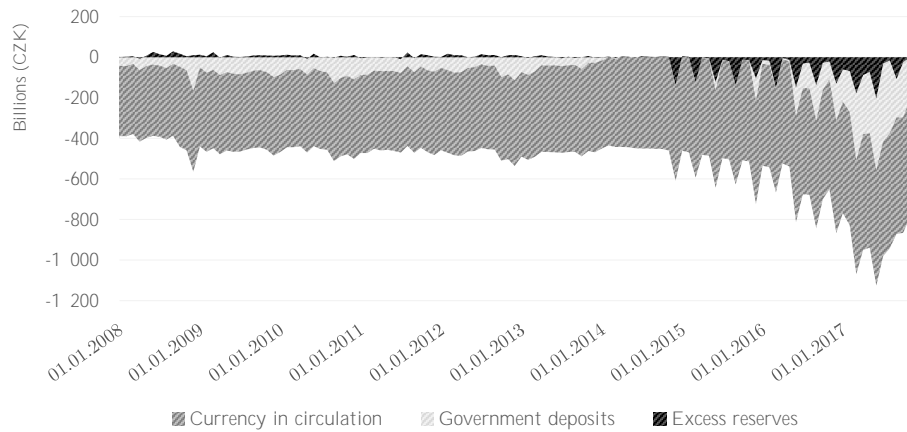
3.4 Management of liquidity of banking system

In the theoretical part, it was explained that an accumulation of FX reserves is one of the sources of a systemic excess of liquidity of banking sectors. Considering that the assets of the CNB are almost exclusively composed of FX reserves, the volume of FX interventions also corresponds to the increase in the liquidity supply. Since all liquidity, by definition, always

stays with the central bank, the issued non-cash liquidity went directly into the banks' reserves.

Fig. 3.12¹³ focuses on autonomous factors represented by excess reserves, government deposits and currency in circulation. While the development of currency in circulation remained stable, higher government deposits and partly also excess reserves led to the overall growth of the demand for liquidity in the banking sector. Although excess reserves do not exhibit a substantially increasing trend, they were considerably volatile during the second half of FX interventions. Other factors increasing the demand for liquidity were government deposits.¹⁴

Fig. 3.12: Liquidity of banking system - autonomous factors 2008-2017



Source: CNB (ARAD) , own calculation

Concerning excess reserves, it is apparent that the Czech banks historically maintained on their clearing accounts only on average such balances that exactly corresponded to the minimum reserve requirements. The volatility of excess reserves started to increase since 2015, and the Czech banks held on average approximately CZK 100 billion of excess reserves in April 2017 which stands for almost CZK 3 000 billion in cumulative amounts of reserves that bore no interest in that month. It is highly unusual, as the practice of the Czech banks was to reach in the last day of maintenance period zero volume of cumulated excess reserves. Due to the availability

¹³For better illustration the figures in this section analyzing autonomous factors, monetary instruments and demand for and supply of liquidity capture the liabilities of the central bank with a negative number.

¹⁴The reason for this increase will be discussed later in the text.

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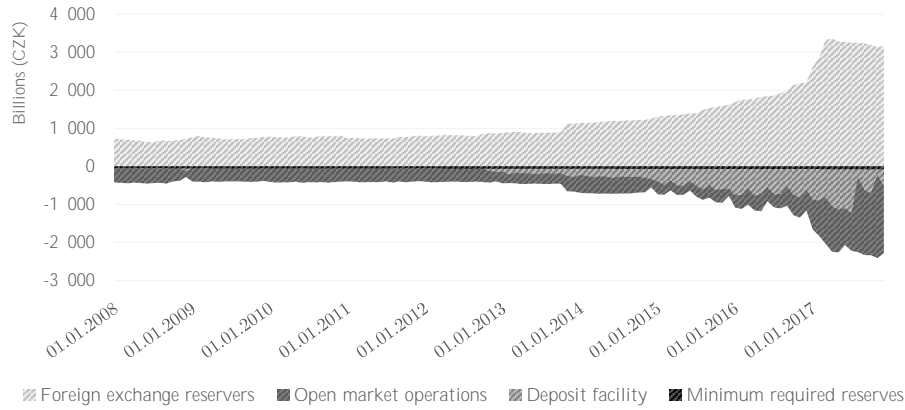
of the deposit facility yielding minimum but still positive interest¹⁵, it was unambiguously a more advantageous way of managing excess liquidity than keeping the reserves on clearing account. Whereas overnight balances on the clearing accounts bear the repo rate up to the required reserves level, balances above this level do not bear any interest. The increased volatility of excess reserves is apparent in the period of increased activity of the CNB on the FX market. This change in behavior can be hardly understood, one of the possible explanations may be unexpected inflows of speculative capital that were booked after the deadline for accessing the deposit facility. However, increased reserves imply further adverse pressures on a net interest margin and generally on the profitability of the commercial banks which was already strongly influenced by declining interest rates and excess liquidity placed at the CNB for minimum interest.

Unstable excess reserves imply that the use of sterilization instruments was changing. Fig. 3.13 indicates higher volatility of the use of the deposit facility and the repo operations and consequently also of liquidity kept on clearing accounts and reported as excess reserves. Historically, as a result of roaring credit activity which peaked in the autumn of 2008, the excess liquidity the CNB withdrew through repo operations on a regular basis was slowly decreasing from 2005 to 2008. From late 2008, the volume of sterilized liquidity fluctuated around the level of CZK 500 billion for following six years. This amount increased in the first week of FX interventions to CZK 651 billion by almost identical volume of the purchased euros by the CNB during the first days of the exchange rate commitment. The changes in the volumes of usage of the CNB's standard monetary instruments closely copy the amount of interventions conducted by the CNB presented in Fig. 3.6. At the end of the exchange rate commitment, the Czech banks deposited with the CNB approximately CZK 2 700 billion.

The same levels of the two of three policy interest rates turned the deposit facility, which under normal conditions only serves to fine-tune the liquidity position, into a widely used instrument for a long time. Compared to a period when there is at least a minimum spread between the deposit and the repo rate, the banks had no incentive to prefer the 2-week repo operation over the one-day deposit. With respect to the received yield, the banks were indifferent whether they put their money into the two-week repo or they left all the liquidity on their clearing accounts and use the deposit facility at the end of the day. Actually, with a bit of simplification, it can be said that eased monetary conditions made it easier for the banks to manage their operative liquidity on a daily basis.

¹⁵The deposit rate has been at the level of 0.05% since November 2, 2012.

Fig. 3.13: Liquidity of banking system - monetary instruments 2008-2017



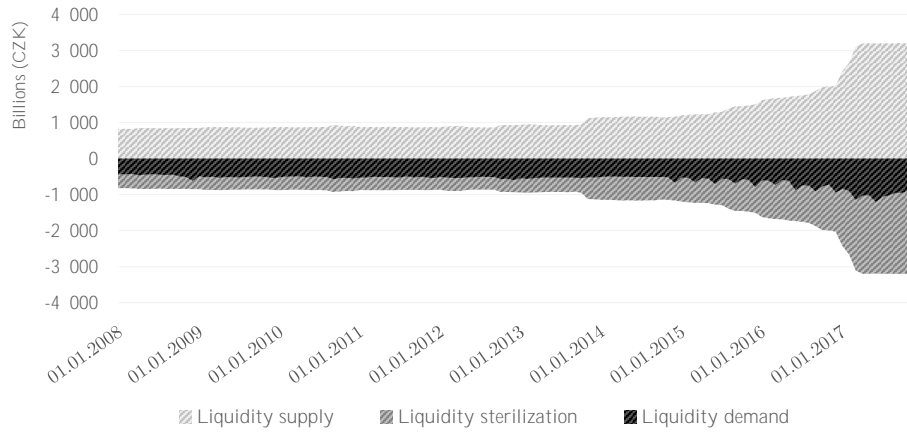
Source: CNB (ARAD) , own calculation

The overall demand for liquidity increased only marginally over the period under review, while the liquidity supply increased substantially as a result of FX interventions. Consequently, the excess supply resulted in the considerably higher volumes of sterilization. The Czech banking system is thus front-loaded with excess liquidity for many years ahead, which will inevitably increase the sterilization costs of the central bank. The only way to withdraw excess liquidity is the sale of FX reserves by the central bank. Such operations in large volumes, however, are highly unlikely since they would cause strong appreciation pressures on the level of the exchange rate and would be in contradiction with the standard interest rate transmission to which the CNB once again resumed after the termination of FX interventions.

The implications from this chapter suggest that the boost in excess liquidity is rather negative for the entire banking system as well as for individual banks, as they already faced liquidity surplus before the introduction of this unconventional monetary instrument. The exposures of the banking system to the central bank surged markedly. As banks have implemented strict credit limits, such a situation could pose a problem for some banks as the actual exposure could get into a conflict with the approved limit. Simultaneously, a rapid increase in excess reserves implies another adverse impact into the net interest margin. On the other hand, these reserves could come from deposits that were already negatively remunerated and could, therefore, yield some returns for the banks.

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Fig. 3.14: Liquidity demand and supply of banking system 2008-2017



Source: CNB (ARAD) , own calculation

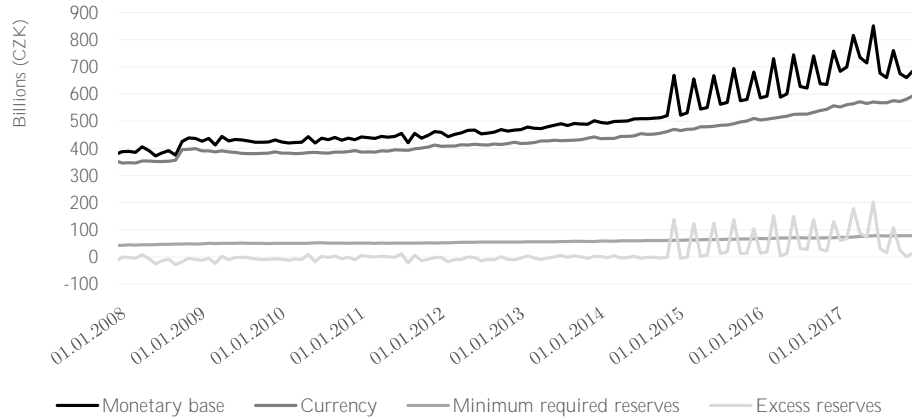
3.4.1 Monetary base and money supply

Two variables which are frequently monitored in connection with monetary policy are a monetary base and a money supply primarily. The monetary base reflects the central bank's relationships with other sectors of the economy. Therefore, the monetary base counterparts are external sector, government sector, banking sector and private sector. The development of the monetary base which consists of currency in circulation and reserves of commercial banks is presented in Fig. 3.15. In the context of monetary policy, the CNB never oversaw the monetary base because it chose to intervene to keep the exchange rate at a preset minimum level, eo ipso the volume of the monetary base was solely determined by the FX market.

The development of the monetary base follows the conclusions that come from the previous analysis of liquidity of the banking system. Although the monetary base reported according to a methodology of the CNB does not show any rapid increase during FX interventions, volatile excess reserves are also reflected in this indicator. Despite the immense increase in excess liquidity, since these reserves were immediately placed into the central bank through the repo operations and the deposit facility, they are not reported as a part of the monetary base which includes only required and excess reserves on clearing accounts and currency in circulation.

In spite of the rapid increase in excess liquidity, this increase did not imply any excessive money growth in the economy, as only one part of the monetary base - currency issued, i.e., the banknotes and coins in circulation is also calculated into the money supply. Additionally, the money supply

Fig. 3.15: Monetary base 2008-2017



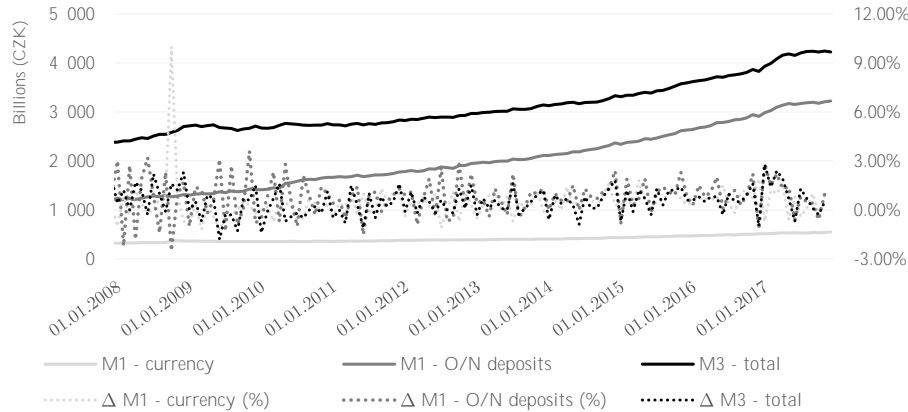
Source: CNB (ARAD), own processing

excludes both cash held in vaults and reserves placed at the central bank as these items are not actually circulating in the economy. It is a logical consequence of the assumption of endogeneity of money. The quantity of money in an economy is determined by endogenous economic variables and requirements of the real economy rather than autonomous decisions of the central bank. Similarly, in the standard interest rate transmission the CNB aims to have an effect on the price of money and at the same time manages liquidity of the banking system. The amount of money in the economy is therefore not a central bank monetary policy instrument. This is in line with Revenda (2014) who did not expect any substantial boost in the lending activity of banks and expressed an opinion that FX interventions will only affect reserves of the banks.

Regarding FX interventions, an immediate impact on the level of the money supply likewise cannot be affected by conversions of foreign currency deposits of residents into Czech koruna deposits, as the money supply (M3) already includes these deposits. Similarly, deposits of non-residents in the Czech currency generated by inflows of foreign capital and its conversion to the domestic currency have no effect, as deposits of non-residents are excluded from the money supply. It is another strong indication that FX interventions did not lead to an excessive credit growth as this would be reflected in a massively increasing M3 aggregate. Revenda (2014) adds that banking credit activity was hampered by several factors, among others increasing demands on banks' capital adequacy, tightening regulatory rules, lack of quality projects, production difficulties of corporates or pessimistic mood of consumers.

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Fig. 3.16: Money supply 2008-2017



Source: CNB (ARAD), own processing

As well as the CNB does not have any direct control of the monetary base, it also does not determinate the money supply. The CNB influences the money supply only indirectly through its transmission into interest rates, expectations and the subsequent growth of the economic cycle as a result of the easing of monetary conditions. The quantity of money in the economy then grows through the increased lending of the commercial banks. However, the recent data does not imply such an excess lending activity during and shortly after the exchange rate commitment. As indicated in Fig. 3.16, during FX interventions there was no meaningful increase in the money supply (M3). Compared to the pre-crisis period, currency in circulation is currently growing at approximately 8% per year, while before the crisis this growth was on average by 10% annually. (Král, 2016) In the Czech conditions, such a reaction of the banks could hardly be expected, as even before the initiation of FX interventions the Czech banking sector had a considerable surplus of liquidity.

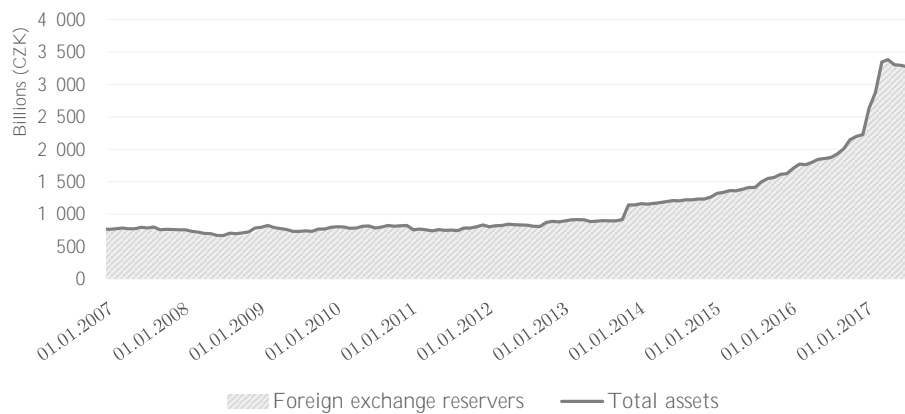
3.4.2 CNB's balance sheet and accounting loss

Since the paramount argument in favor of FX interventions was always price stability and fulfilling the inflation target, the impacts on the CNB's balance sheet could be referred to as a side effect. Despite this approach by the central bank, it is a fundamental prerequisite to access its balance sheet and evaluate the impacts on its structure and size. This assessment also summarizes the previous parts of this chapter.

The development of the amount of FX reserves held in the CNB's bal-

ance sheet is illustrated in Fig. 3.17. FX reserves account for 99% of total assets and therefore are the only item worth mentioning with regards to the asset side of the balance sheet. From November 2013 to April 2017 the amount of the FX reserves grew almost four times from the original amount of CZK 899 billion to CZK 3 360 billion at the end of the one-sided commitment. It is apparent that such massive purchases of foreign currency on the FX market emerging from August 2015 and escalating in the last few months of the commitment strongly influenced the size of the CNB's balance sheet.¹⁶

Fig. 3.17: CNB total assets 2007-2017



Source: CNB (ARAD), own processing

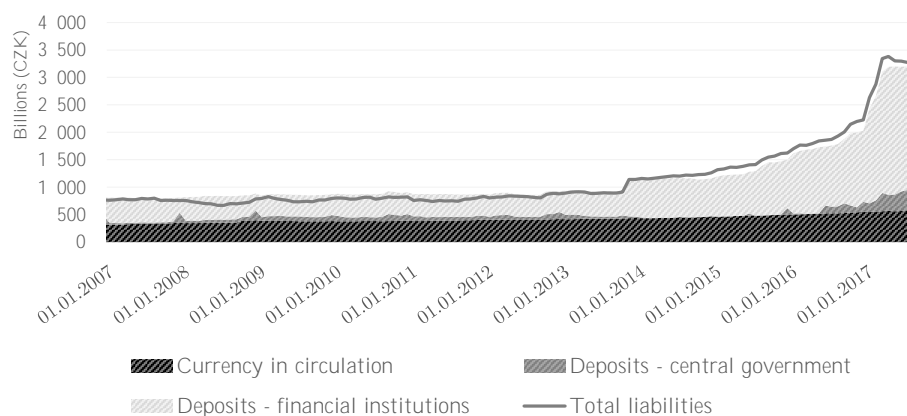
The reasons behind the original accumulation of FX reserves preceding the November 2013 was outlined in Chapter 1.3.3.2 and is inherently connected with FX interventions the CNB conducted in the second half of the 1990s against the appreciation of the Czech koruna. It is necessary to mention that such a practice is fundamentally different from FX interventions conducted in the period of the ZLB.

Compared to the asset side, a structure of liabilities is somewhat more varied. Fig. 3.18 presents the development of three main items. These items are *currency in circulation* and *deposits of financial institutions* and *central government*. Whereas the currency in circulation was experiencing the slow and steady growth, the other two items were of different kinds. Deposits of financial institutions started to growth observably with the initiation of the one-sided commitment. The increase reflects the development of bank reserves as described in the previous section.

¹⁶See Fig. 3.6 in Chapter 3.3.

3. FOREIGN EXCHANGE INTERVENTIONS OF CZECH NATIONAL BANK

Fig. 3.18: CNB total liabilities 2007-2017



Source: CNB (ARAD), own processing

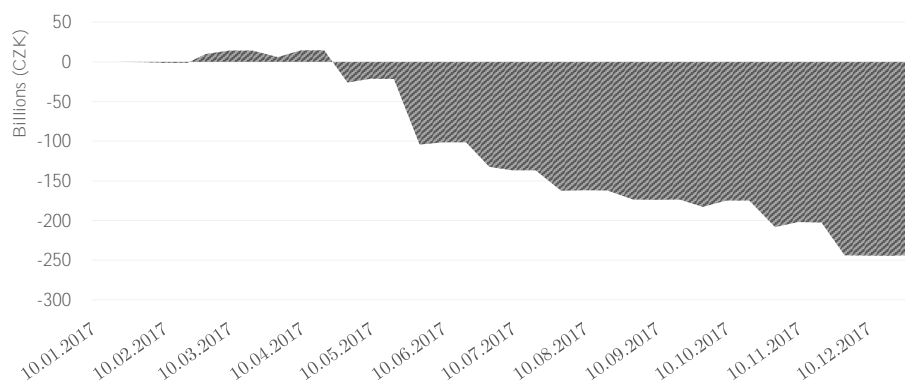
The reason behind the rise in the last of the items was driven by low and negative yields of debt securities of the Czech government. The negative interest rates of the Czech treasury bills and the short-term government bonds during 2016 and 2017 prompted the MFCR to take advantage of such market conditions and lower the Czech debt. Due to the high demand for koruna debt instruments, the MFCR borrowed in advance to replace its maturing bonds at a considerably lower price of the issued bonds. At the same, the volume of issued bonds was higher than needed to repay maturing issues and to finance government spending.

Since the Czech government did not have any particular use for these excess cash resources, among other things also due to reduced public sector investments, they were deposited on the current account at the central bank. In addition to the negative return on the sale of securities, the MFCR also earned a positive yield on these deposits. The MFCR thus joined other economic subjects that benefited from FX interventions at the expense of the CNB.

An explanation of why total liabilities in some parts of Fig. 3.18 are less than the sum of the three highlighted items is such that the CNB was at loss for most of the presented periods. This is due to exchange rate losses from accumulated FX reserves and subsequent systemic liquidity surplus, which leads to the need to withdraw excess liquidity for the price of the interest paid. The CNB's equity, which is not a part of the figure, was negative and thus reduced the overall volume of total liabilities.

CNB Ten-day Balance Sheet regularly presents the current development of the central bank balance sheet and allows a detailed view of changes

Fig. 3.19: CNB profit/loss for accounting period 2017



Source: CNB, own processing

in the volume of individual items. Fig. 3.19 focuses on the impact of FX interventions on the profitability of the central bank and reveals high financial costs of FX interventions. Although the bank recorded retained profits of CZK 46 billion from previous years and a profit from the current accounting period of approximately CZK 15 billion in March 2017, along with the abandonment of the commitment and gradual strengthening of the koruna, the CNB fell into a deep loss. The losses already wiped out the CNB's equity in the course of 2017 and forced the central bank to operate again in a situation of negative equity and the CNB's financial loss reached almost CZK 250 billion by the end of 2017. Given the enormous amount of accumulated reserves and the expected trend currency appreciation of the converging and growing economy, these losses can be expected to deepen further in the near future.

The issue of central bank profitability can be viewed from two perspectives. The first view is defended primarily by representatives of central banks and argues that the loss of a central bank is mainly an accounting issue that does not affect the functioning of the central bank or the banking system. On the other hand, the argument of the second group of economists argues that in economics there simply does not exist a concept of "harmless loss." From a perspective of the fiscal economy, it can be seen that losses resulting from a long FX position are necessarily the profits of those who are in the opposite position. Successful speculators thus earn profits at the expense of the central bank and consequently taxpayers as possible retained profits could improve the state budget.

Tomšík (2008, p. 64) argues that *"the CNB's economy is completely separate from the public budgets which is one of the signs of the central*

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bank's financial independence. Because taxpayers do not pay for this loss, there is no need for the public or the political sphere to worry about this issue." At the same time, he concludes that the current loss of the CNB will be eliminated in the future because of low interest-bearing liabilities, and relatively high returns on its assets. Although the CNB's balance sheet has actually managed to turn accumulated losses to profits for a short period, the recent monetary policy turned the accounting profit again to a significant loss, which will inevitably further deepen in the future. Due to the expected continued appreciation and low returns on secure assets to which the central bank invests, the mentioned profits are consequently possible in a very distant future.

Concerning the CNB's negative equity, Mandel et al. (2014) challenges the role of central bank losses and concludes that such losses cannot be considered fictitious accounting issue and have real monetary, income and demand impacts.¹⁷ His main point is that losses resulting from a long FX position and short credit position towards the domestic banking system are logically profits of entities in the opposite positions. Additional earnings from successful speculation will ultimately result in a rise in deposits and in the case of deposits of domestic entities in an increase in the money supply.

The author, on the example of restrictive monetary policy, states that while rising interest rates will in the standard interest rate transmission act restrictively via pressures on rising interest rates in the whole economy and subsequent appreciation of the exchange rate, central bank losses will act in the opposite direction. In an extreme situation, the central bank would lose control over inflation if the effect of the central bank's loss associated with currency appreciation and costs of sterilization would result in such inflationary pressures that would equal the originally intended anti-inflationary ones.

Similarly to the phenomenon of deflation, the profitability of central banks is another topic that the contemporary economics does not have a unified view. Although central bank autonomy is one of the fundamental characteristics of a credible central bank and central bankers often argue that the irrelevance of accounting profits is a key prerequisite for independence on central governments, it is questionable whether potential deep and long-term losses do not in effect pose a serious threat to this characteristic as the increasing loss can attract politicians' attention.

¹⁷For more detail see Mandel et al. (2014).

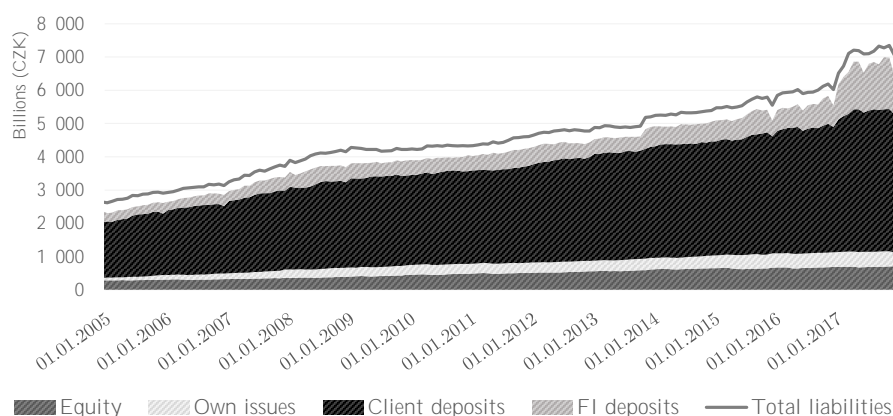
3.5 Balance sheet of Czech banking system

The relatively infant Czech banking sector changed significantly over the last 25 years. In its first phase, the banking sector was heavily focused on lending to corporates when credit exposure to this sector was close to 90%. The Czech banks' orientation changed along with the banking crisis in 1997, when the individual institutions did not escape to major downsizing of balance sheets and write-offs of bad loans. Following the subsequent restructuring of the banking sector, its balance sheet structure began to evolve towards the current situation. During this stressed period, foreign financial groups entered into capital structures of the Czech banks. Foreign shareholders currently own the vast majority of the Czech banks. The restructuring process was completed in 2001. (Tomšík, 2014)

The Czech banking system is characterized by its soundness, resilience, and high liquidity. The development of both the liquidity situation of the Czech banking system and the size and the structure of its balance sheet is closely related to the outcomes from Chapter 3.

The total balance sheet of the Czech banking system rose from CZK 4 916 billion in October 2013 to CZK 7 210 billion in April 2017. While for most of the period the balance sheet grew steadily and by the end of 2016 the total assets amounted to CZK 6 019 billion in the following three months this number jumped to CZK 7 106 billion. The increase of more than CZK 1 trillion during three months that culminated at the end of March 2017 corresponds to the CNB's increased need to intervene due to the influx of speculative capital (Fig. 3.6).

Fig. 3.20: Total liabilities of banking system 2005-2017

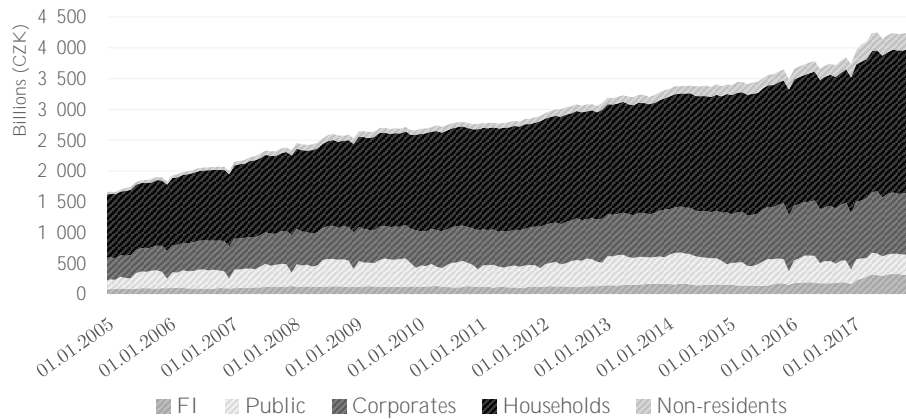


Source: CNB (ARAD), own processing

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The liabilities of the Czech banks show principally a stable development and most of the items from Fig. 3.20 do not require closer attention. Whereas client deposits, which include primarily retail and corporate accounts, have grown in a long-term and more or less in a stable manner independently of monetary policy, the situation of deposits from financial institutions is different. A slight increase in financial deposits is apparent already at the beginning of FX interventions. However, in the period of huge inflows of speculative capital in early 2017 the amount of financial deposits increased from CZK 647 billion at the end of 2016 to CZK 1 262 billion in March and to CZK 1 433 billion in April 2017.

Fig. 3.21: Structure of client deposits of banking system 2005-2017

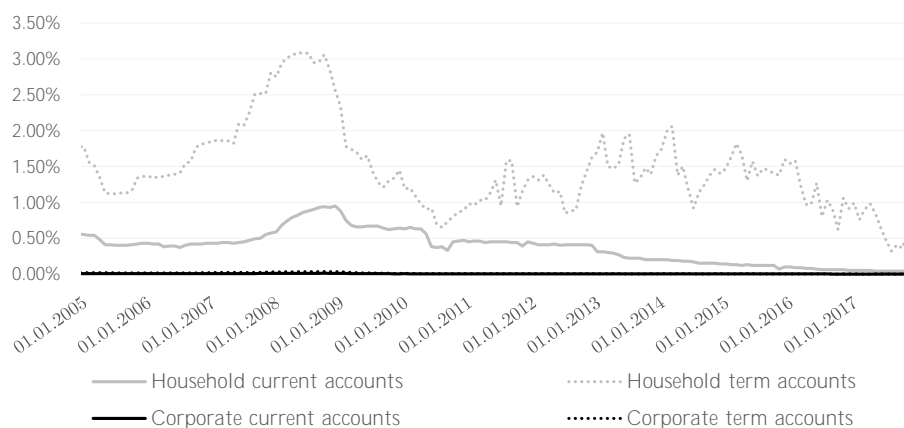


Source: CNB (ARAD), own processing

The structure of client deposits, which also contributed to the growth of the balance sheet, is displayed in greater detail in Fig. 3.21. In general, client deposits consist of deposits from financial and public institutions, corporates, households, and non-residents. These accounts are primarily of non-speculative character and, even the figure itself does not suggest any significant changes within the critical periods. The trend of clients deposit has been rising in the long run especially in the case of households. This increase is due to a combination of standard lending activities of the banks, deposit multiplication and economic development in extraordinarily loose monetary conditions.

Fig. 3.23 depicts the client deposit structure and shows another aspect of extraordinarily eased macroeconomic conditions. Decreasing interest rates, which were analyzed in the previous section, can also be observed with client funding. These levels of interest rates do not only influence incomes through

Fig. 3.22: Interest rates on CZK deposits - new business 2005-2017



Source: CNB (ARAD), own processing

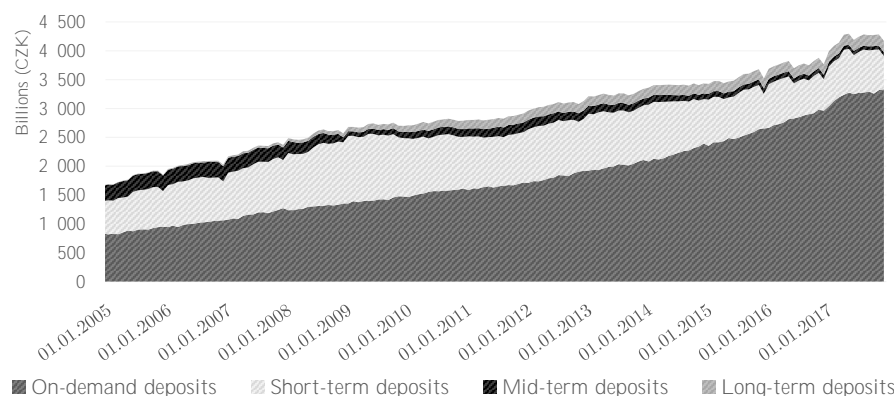
price of loans but also fundamentally affect the product composition of liabilities. The negligible returns that banks offer for both current and term accounts are not sufficient motivation for clients to opt for longer-term accounts. Fig. 3.22 shows a monthly development of interest rates the Czech banks offered to their clients regarding newly opened deposit accounts. For the last several years current accounts and corporate term accounts were yielding almost zero interest rates. In 2017 also household term accounts got closely to the zero rates.

The trend of growing current on-demand accounts is obvious while the volumes of short-term deposits with a maturity up to one year, mid-term deposits with a maturity longer than one year and shorter than five years and long-term deposits with a maturity exceeding five years are stagnating or rather decreasing in the course of the past ten years. Due to low spreads between these types of deposits, clients have no reason to prefer longer-term products before on-demand accounts. Also, the Czech banks have no reason to motivate their clients to invest in long-term deposits due to sufficient liquidity they possess.

In spite of a theoretically immediate maturity of current accounts and other products with a non-defined contractual maturity, the banks use special approaches for such on-demand deposits. (Džmuraňová, 2016) The banks use their internal models to estimate at least an approximate maturity of clients' current accounts, and only a small part of such deposits is actually expected to mature overnight. Nevertheless, the shortening of the fundings' maturity may represent a potential threat in the future, despite the fact that entities have, at least on an aggregate basis, sufficient amounts

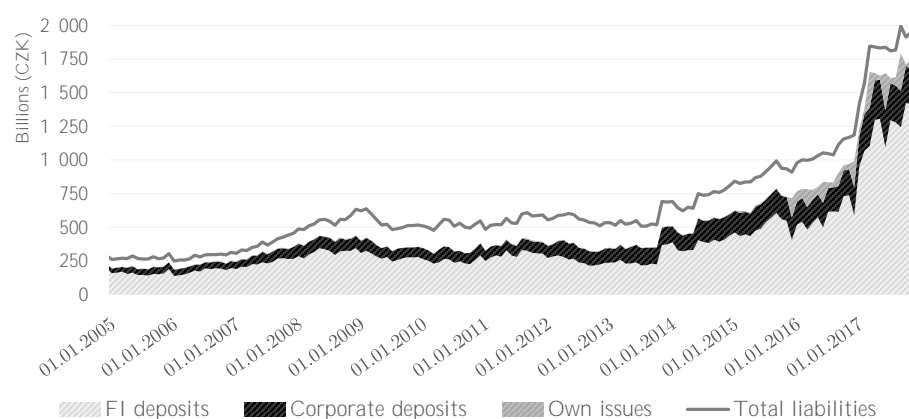
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Fig. 3.23: Maturity of client deposits of banking system 2005-2017



of funding. Except for the noticeably low volumes of term deposits, the own issues, another form of long-term stable funding with a fixed maturity, make up only a small part of the total liabilities and thus confirm that the Czech banks rely heavily on client deposits.

Fig. 3.24: Total liabilities (non-residents) of banking system 2005-2017

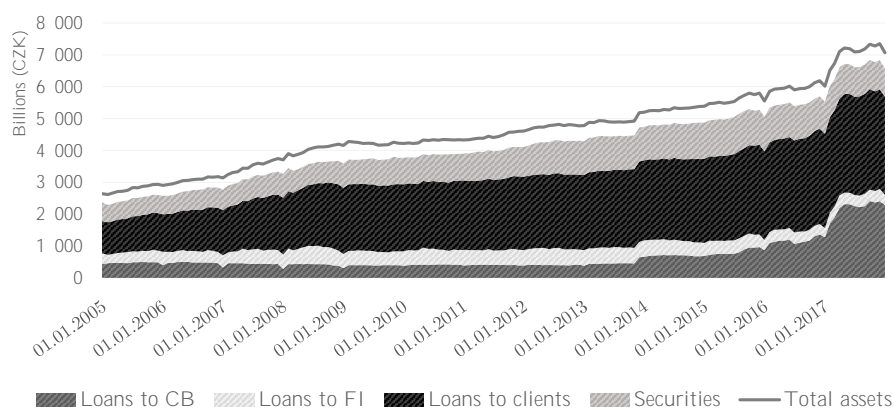


Except for investments in Czech government bonds, non-residents, especially large international banks, sought to profit on FX interventions also through short-term deposits. The total amount of liabilities from non-residents in Fig. 3.24 published by the CNB in its Monetary and financial statistics in the ARAD database offers a detailed view on the recent devel-

opment of liabilities held by non-residents.

The rise from CZK 518 billion in October 2013 to 1 839 in April 2017 is substantially composed of financial short-term accounts including money-market deposits. The item “own issues” reveals that non-residents invested their money also into the Czech money and capital market securities. Regrettably, it is not possible to distinguish long-term funding like covered bonds from short-term depository receipts using published aggregated data from the CNB. Thus, while the total balance sheet increased by the amount of CZK 2 300 billion during the period of interventions, non-residents’ short-term liabilities accounted for about CZK 1 300 billion.

Fig. 3.25: Total assets of banking system 2005-2017



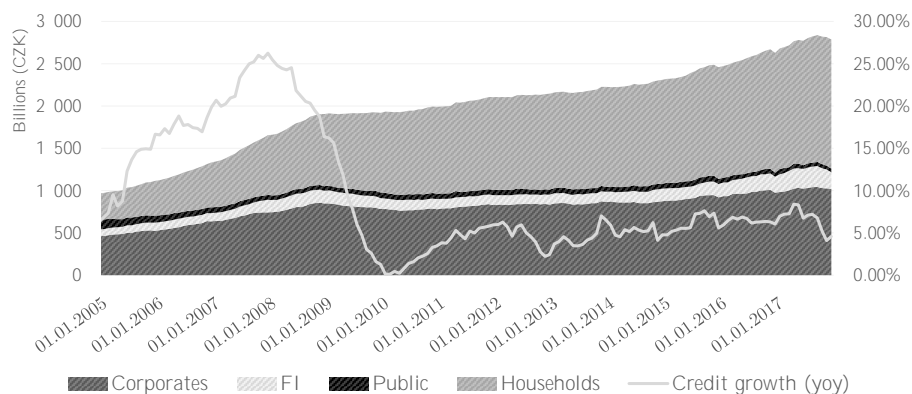
Source: CNB (ARAD), own processing

The majority of this hot money was even half a year after the end of FX interventions still part of the balance sheets of the domestic banks. This explains a moderate strengthening of the Czech koruna after the exit without any massive appreciation. Since the koruna remained strongly overbought, the Czech economy was not able to generate enough demand for the redemption of the Czech currency from speculators who relied on the significant strengthening of the currency after the CNB’s exit. (Dědek, 2017)

The use of these financial resources illustrates Fig. 3.25 representing the asset side of the system’s balance sheet. The slow and gradual growth in credit activity is starting to appear in the last few years. Nevertheless, such a moderate increase can be hardly attributed solely to interventions. In the monthly data analyzed in Fig. 3.26 there is no implication of excessive rise in credit activity due to both extremely low interest and FX interventions

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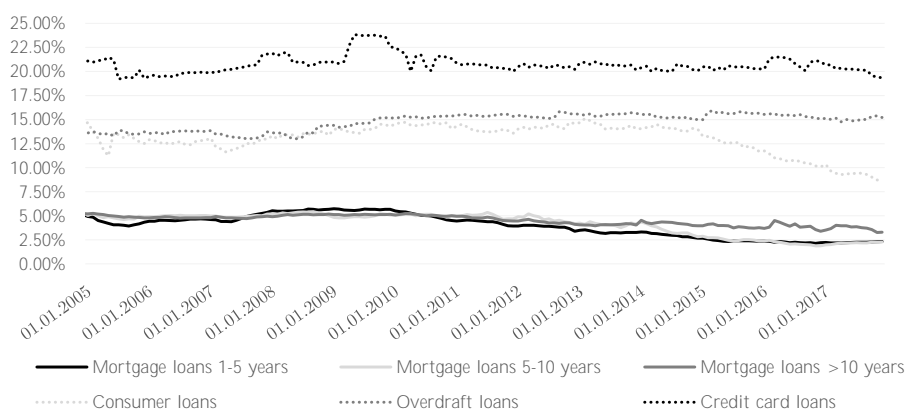
Fig. 3.26: Client loans of banking system 2005-2017



Source: CNB (ARAD), own processing

alluring speculative capital from abroad. Compared to the annual growth of loans from the pre-crisis period the actual year-on-year changes are incomparable and do not pose any immediate threat. This is the same conclusion as the one from Chapter 3.4.1 which stated that the quantity of money in an economy is determined by endogenous economic variables and requirements of the real economy and can be hardly affected by autonomous decisions of the central bank. It is clear that the asset growth was primarily reflected in the increase in receivables from the central bank.

Fig. 3.27: Interest rates on CZK loans - new business 2005-2017



Source: CNB (ARAD), own processing

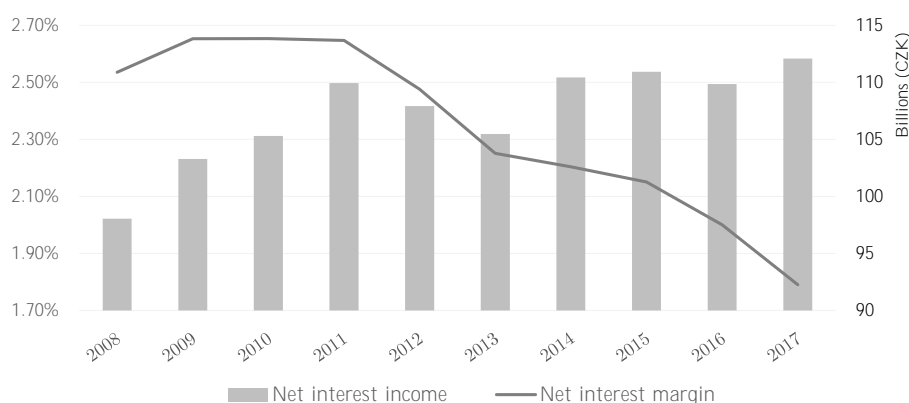
The development of bank lending rates is shown in Fig. 3.27. While

3.5. Balance sheet of Czech banking system

new overdrafts and credit card loans maintained akin rates throughout the monitored period, consumer loans were steadily decreasing from 2015 and mortgage loans were continuously falling to the historical lows already from 2009. For example, a bank client on average would negotiate a mortgage loan with the fixation longer than five years with an annual rate of approximately 5.5%. The same client would subsequently receive a rate of about 1.8% at the end of 2016 when the prices for mortgages were at their lowest.

The overall impact of declining interest rates across markets is summarized in Fig. 3.28. The Czech banking sector managed to retain similar absolute level in net interest income throughout the period of strongly eased monetary conditions. From 2010 the net interest income, which was calculated as interest expenses subtracted from interest incomes, fluctuated in the range of CZK 105 billion to CZK 115 billion and therefore can be considered relatively stable. However, the banks needed much greater balance sheets (Fig. 3.25) and loan portfolios (Fig. 3.26) to achieve such interest gains. The net interest margin presented in the same figure shows a significantly unfavorable trend. The net interest margin was calculated as a ratio of net interest income divided by an annual average of interest yielding assets. Further easing of monetary policy thus demonstrably led to a decline in the interest margin of the Czech banks.

Fig. 3.28: Net interest margin 2008-2017



Source: Own calculation, CNB (ARAD)

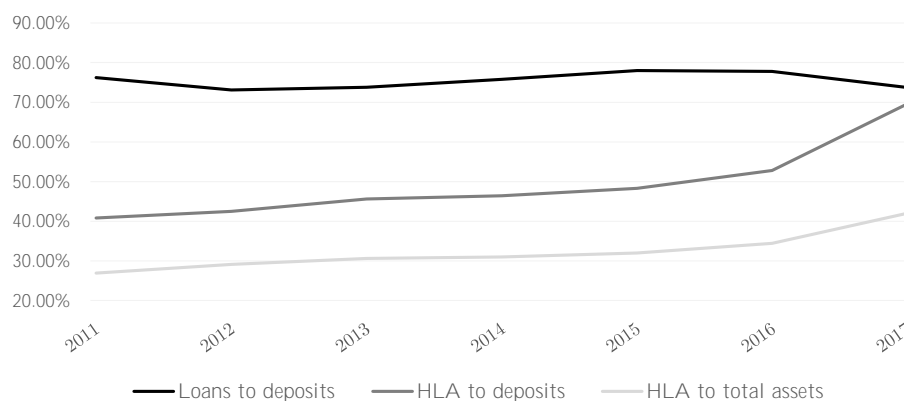
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3.5.1 Assessment of liquidity of banking system

Although the information that would be required for a detailed assessment of the liquidity situation of individual banks is of a non-public character, published data by the central bank and the analysis of the recent development associated with unconventional monetary tools allow, up to some degree, to assess the liquidity of the banking sector as a whole.

Fig. 3.29 shows three liquidity indicators *loans to deposits*, *HLA to deposits* and *HLA to total assets*. All these indicators show a favorable trend with respect to increasing liquidity mainly in the last period of FX interventions. The liquidity position of the banking sector improved further mainly due to the increasing exposures to the CNB which were driven by increased inflows of speculative capital. Fig. 3.29 also confirms the previous statements and indicates no excessive lending activity of the Czech banks.

Fig. 3.29: Liquidity indicators of banking system 2011-2017



Source: CNB (ARAD), own processing

Due to the non-public nature of the data for the analysis of individual institutions, it is not possible to consider every single bank in the Czech Republic over-liquid. Nevertheless, the banking system as a whole exhibits such aspects. The analysis of aggregated data suggests that liquidity of the banking system excessively high already before the initiation of FX interventions and its volume further increased along with the upcoming exit. According to the CNB's public data, the aggregated LCR is currently approximately two times higher¹⁸ than required by the regulator and only confirms more than sufficient liquidity of the entire banking sector.

¹⁸The aggregate value of the LCR for the Czech banking system was 183.9% in the third quarter of 2017.

When focusing on the LCR, there are primarily two factors that cause this indicator to exceed the required value substantially. As the Czech banks focus primarily on lending to retail and corporate clients, their activities on the capital markets are rather peripheral, and because of the low risk appetite, they invest almost exclusively into highly rated securities. Together with a relatively low ratio of loans to deposits, the analysis showed that banks hold considerable part of their balance sheets in the form of reserves with the central bank. The second most sizable item constituting liquid assets are receivables from the Czech government in the form of debt securities. The LCR methodology classifies all these assets as Level 1, and they are fully counted into HQLA with no haircuts. Consequently, the stock of liquidity buffer of the Czech banks is currently more than sufficient.

The favorable development can also be observed on the liability side of the balance sheet. A strong advantage of the Czech banking sector is the structure of its resources, namely a high share of retail deposits on total liabilities. If these, gradually increasing and relatively stable, resources are not instantly distributed by banks in the form of long-term loans, this trend has a strongly positive impact on the aggregate liquidity of the banking sector and namely on the LCR as retail funding gets the lowest run-off weight when calculating the indicator.

It is important to emphasize that if the increase in the reserves placed at the central bank is financed by short-term funding by financial institutions with maturity up to 30 days and consequently this source is assessed with 100% run-off weight, such a situation has an adverse impact on the ratio even though the absolute gap (HQLA - Net outflows) remains the same. The explanation is such that since the LCR of the banking sector is higher than one, an equal increase in the numerator and the denominator will logically reduce the value of the ratio. Despite this potential decline in the LCR, and it is highly probable that such volatility in the situation of speculative capital inflows occurred, it cannot be claimed that the liquidity of the institution decreased. Consequently, it is vital to analyze the potential volatility of the LCR more closely and it is not appropriate to rely solely on the resulting single number.

The LCR is currently being considered to be one of the main indicators assessing the liquidity of financial institutions and is consistent with the conclusion of research that the Czech banking system is substantially over-liquid. Although this indicator provides up to some degree relevant information on very short-term liquidity, it is necessary to stress that neither the banks nor the regulator can assess liquidity risk only on the basis of one indicator. For a high-quality liquidity risk assessment at individual banks it is necessary to use a comprehensive portfolio of risk metrics in-

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cluding static/dynamic liquidity gaps showing the development of liquidity over time, structural indicators like NSFR focusing on longer time horizons or additional monitoring metrics that complement the overall picture of potential threats that have a negative impact on the liquidity of the bank.

Conclusion

Although the unconventional tools in the form of quantitative easing and FX interventions can replace the standard interest rate transmission mechanism in the situation of a liquidity trap, opinions on their implementation are not uniform. One of the essential reasons why the recent monetary policy is experiencing a conflict between two groups of economists is their different views on the acceptability of deflation and its potential unfavorable effects on the economy. While the argument, which is advocated by the majority of the central banks, states that declining prices lead to delaying consumption and other adverse aspects that could escalate into a deflationary trap and severe economic downturn, other economists refuse this reasoning. The disagreement results mainly from the historical experience that frequently connects a decline in prices in the economy with economic growth and the example of the Great Depression, which is often referred to by central banks, is considered as the only historical case of a severe deflation spiral.

Other arguments criticize that unconventional tools focus primarily on reviving aggregate demand and ignore systemic difficulties associated with the over-indebtedness of private and public entities and other macro and microeconomic imbalances that the non-standard policy measures cannot solve. Such policies then reduce pressures on governments to make necessary structural changes and support a further increase in debt burden. Whereas these tools do not help to eliminate the various distortions on the supply side of the economy, they rather create new ones as a consequence of the significant easing of monetary conditions. An example may be the ECB which through its monetary policy allows further financing of already over-indebted countries.

Despite opinion disputes on possible impacts of newly implemented instruments, it was shown that in an open pro-export economy FX interventions may represent an alternative tool for easing of monetary conditions as

depreciation of the domestic currency should through numerous transmission channels result in upward pressures on inflation and lower real interest rates. A strong advantage of exchange rate commitment is its relatively quick transmission into economic variables. A small open economy, which is heavily export-oriented, should experience a relatively fast increase in price levels as a result of inter-temporal and intra-temporal substitutions. The rise in inflation is supported mainly by higher prices of imports and secondary through substitution of foreign goods and services in favor of domestic production. Simultaneously, weakened exchange rate favors exporters as their goods become cheaper for non-residents. These factors have to some degree potential to support aggregate demand and increase inflation.

With respect to the CNB, the research proved that FX interventions force the central bank to operate with negative equity due to the costs of withdrawals of excess liquidity and primarily due to the future exchange rate losses resulting from the long FX position and the appreciation of the domestic currency. These losses are expected to further deepen in the future as the Czech Republic is a type of economy for which the exchange rate channel is essential for convergence towards advanced countries. Although the aspect of the profitability of the central bank is considered by representatives of monetary policy as marginal and irrelevant, opinions that the negative economic result has real macroeconomic effects refute this claim.

As well as there were disputes regarding the actual implementation of FX interventions as a temporary main monetary tool, the exit strategy and its communication also did not avoid criticism. The main objections are aimed at postponing the termination of FX interventions which led to the accelerating growth of the inflows of speculative capital in the last months of the CNB's exchange rate commitment. The main causes of increased speculation were the robust economic growth and the favorable economic outlook combined with expectations of strengthening of the koruna upon termination of the commitment. Consequently, the CNB was forced to intervene heavily to prevent its currency from appreciating in this period.

The non-standard monetary policy influenced the banking sector primarily through a further decrease in interest rates, which was primarily reflected in Czech bonds. The increasing demand for Czech government debt and its limited offer from the MFCR shifted the yields of government bonds and treasury bills to their historical lows with shorter tenors yielding even negative interest rates. Since foreign speculators were willing to accept very low or negative interest rates as a result of the expected appreciation of the Czech koruna, there was a considerable decrease in holdings of Czech government bonds in the portfolios of domestic banks. A decline

in interest rates can also be seen in other assets classes, including rates on new loans to clients which also dropped to their historically lowest numbers. However, the dynamics of credit growth, despite the extremely eased monetary conditions, do not indicate excessive credit activity of the Czech banks. This finding is in line with the previous expectations, as the Czech banks experienced liquidity surplus already before FX interventions were introduced.

The liquidity excess existing since the 1990s was further and substantially enhanced by the unconventional instruments. Due to the high volume of FX interventions, there was a major increase in liquidity supply, while the demand for liquidity grew only moderately, primarily due to higher central government deposits. The banking system in the Czech Republic is currently strongly over-liquid which was confirmed on the basis of analyses of liquidity indicators for the entire banking sector. Namely the aggregated LCR of the Czech banks was almost double as high as required by the regulation in the third quarter of 2017 and confirms more than sufficient liquidity of the entire banking sector. However, high liquidity has also several adverse aspects, including the high exposure to the central bank and the consequent unfavorable impact on the net interest margin.

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