

# Exchange rate policy and banking system liquidity absorption: The case of the Czech Republic, Poland and Hungary<sup>1</sup>

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## Abstract:

The paper deals with the choice of exchange rate regimes in transitive economies, accumulation of FX reserves in balance sheets of central banks and its consequences in overall excess of banking system liquidity. The case of banking system liquidity surplus is analyzed focusing on creation of liquidity through FX interventions in the regime of fixed or managed exchange rates. In addition the paper focuses on main sources of liquidity absorption in long run and on stability of currency in circulation and bank reserves backing by net foreign assets of central bank in the context of trend appreciation of domestic currency typical for transitive economies. Last but not least the paper consists of discussions of a speed of FX reserves decumulation in emerging FX markets and implications of exchange rate regime for both exchange rate volatility and foreign exchange market structure. The problems are analyzed and compared using the example of the Czech Republic, Poland and Hungary in 1999-2009. The analysis focuses on main differences in exchange rate policies, the level of liquidity surplus, cost of sterilization, main sources of liquidity absorption and volatility of exchange rates. We found that absorption is influenced by the volume of excess liquidity and costs of sterilization that reflect a level of main policy rate. The trend growth of currency in circulation is a key source of liquidity absorption in all central banks. Decumulation of FX reserves is a limited source of absorption due to lower liquidity of FX markets in CR, Poland and Hungary. It is not possible to confirm a hypothesis about higher exchange rate volatility of floating regimes in CR and Poland as Hungarian forint in fixed rate regime suffers from higher volatility due to macroeconomic instability. As expected, trend appreciation causes a decrease in the backing of currency in circulation and bank reserves by net foreign assets but still these items are fully backed by assets of central banks.

**Keywords:** Exchange rate policy, banking system liquidity, liquidity absorption, exchange rate volatility

**JEL Code:** E42, E44, E58

The continuing process of transformation in the transitive economies has created conditions for starting the convertibility of their national currencies, as well as the development of a national foreign exchange market. One of the important elements of their monetary policy was the selection of a foreign exchange rate regime. For a long time period central banks were following a policy of pegging home currency to stable single foreign currency or basket of foreign currencies. Except initial stabilization effects of this policy in a light of high rate of inflation central banks used home currency anchoring to actively protect the competitiveness of domestic exporters in world markets in connection with natural

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tendency of home currency appreciation. Some banking systems are therefore facing the situation characterized by long-term liquidity surplus resulting from huge outright purchases of foreign currencies by central banks. On the other hand accumulation of foreign exchange reserves is connected with foreign exchange exposure within which the trend appreciation of domestic currency may significantly threaten the backing of currency in circulation and bank reserves by the assets of central banks.

The present paper is aimed at the theoretical definition of the problem of system liquidity surplus of banking systems at macroeconomic equilibrium of an open economy and accumulation of foreign exchange reserves of central banks. The problem of liquidity absorption dynamics and stability of the backing of cash in circulation and bank reserves by net foreign assets of central banks is described in detail. The paper also wants to judge whether there exists a connection between the choice of foreign exchange rate regime in the transitive economies, volatility of the exchange rate of the home currency and the development of the national foreign exchange market. It is followed by empirical analysis and comparison of different approaches to the solution of these problems on an example of banking systems of the Czech Republic (CR), Poland and Hungary.

### **The choice of currency regime in transitive economies – main economic premises and consequences in trend growth of central bank's foreign exchange reserves and volatility of nominal effective exchange rate**

Decision about foreign exchange regime is one of the important elements of monetary policy. Regarding the choice of optimum exchange rate arrangement, there is a lot of literature in economic theory (see e.g. Fischer, 2001; Szapary, 2001; Gosh, Ostry, Gulde and Wolf, 1997; Williamson, 1991; Šaroch and Šindel, 2008) and practical recommendations from the IMF (see e.g. IMF, 1996). Usually, both fundamental macroeconomic factors and institutional, fiscal and monetary policy factors are considered. Fundamental factors of macroeconomic development include first of all structural characteristics of the economy, mainly the extent of price, wage and the production factors flexibility (namely labor mobility) and the degree of internal and external equilibrium. The possibility to use other nominal anchors than the fixed rate (e.g. inflation targets or monetary aggregate targets) for stabilization purposes should also be considered. To follow sustainable foreign exchange rate regime it seems to be important to evaluate the degree of openness of the economy in the area of foreign trade and international movements of capital. All these factors should be thought over the extent and structure of the foreign exchange reserves. Institutional factors also reflect economy's participation in regional groupings binding countries to certain transnational economic policies and certain currency exchange regimes. Last but not least, fiscal and monetary policy factors are considered in a light of fiscal deficit/public indebtedness and degree of independence of monetary policy.

Economists still ask whether the exchange rate regime in use plays any role at all from the viewpoint of macroeconomic environment development. Considerations of the pros and cons of fixed and floating rates have been the subject of a lot of publications (see Friedman (1953); Crockett (1976); Fleming (1975); Caramazza and Aziz (1998)). Attention is also devoted to the influence of the exchange regime on inflation and economic growth (see Duttagupta, Fernandez and Karacadag, 2005; Ghosh and Ostry, 2009). Crucial question is whether the foreign exchange rate regime choice influences the system of a functioning foreign exchange market. It seems to be that fixed rates applied in the transitive economies usually limit the development of the foreign exchange market's activity as fixed rates reduce

the foreign exchange exposure and risk. They are connected with the preference for stability and certainty. On the other hand nominal exchange rates usually do not adjust to the inflationary and productivity changes differential; disequilibrium in the balance of payments is therefore evened out by changes in the foreign exchange reserves, not by changes in the exchange rates.

In case of currency board as a special type of fixed exchange rates the central bank surrenders almost all its instruments of monetary control with the exception of non-sterilized foreign exchange intervention (questions on the practical uses of the currency board regime; see, e.g., Singal and Vijay (1999)). The theoretical basis of the currency board regime comes from the monetarist approach to the balance of payments, which considers disequilibrium in the supply of, and demand for, money to be the cause of disequilibrium in the balance of payments. According to this approach, the dominance of money supply leads to deficit disequilibrium in the balance of payments. Conversely, when the demand for money is greater than the supply, then, there is a surplus disequilibrium in the balance of payments. Non-sterilized foreign exchange intervention represents a self-regulatory mechanism, which constantly brings the supply and demand for money into harmony.

Empirical experience (Durcakova, 2009) however shows that the fixed rate itself does not guarantee exchange rate stability if the fixed rate does not reflect stability in the fundamental factors of the economy. A limited oscillation band, then, is not credible, and therefore resulting economic disequilibrium leads either to the expansion of the oscillation band, or to the devaluation of the currency, even to changes in the currency regime. On the other hand, economies which use floating exchange rate regimes do not necessarily need a growth in inflation, or instability in other macroeconomic elements. They also do not have to create sufficient pre-conditions for the development of the national foreign exchange market, if the floating is only declared; de facto, however, the extent of its flexibility is mostly set by the intervention policy of the central bank. Excluding these marginal cases, the natural hypothesis appears to be that countries with fixed exchange rate should have lower volatility in nominal effective exchange rate comparing with countries that follow the policy of floating exchange rates.

### **External equilibrium, foreign exchange reserves accumulation and system liquidity surplus in banking systems of transitive economies**

In order to understand the consequences of foreign exchange reserve accumulation on banking system liquidity the equation of macroeconomic equilibrium in open economy is applied in which the net export (NX) equals the sum of the difference between private savings (S) and investments (I) and the difference between government revenues (T) and expenditures (G):

$$NX = (S - I) + (T - G) \quad (1)$$

Dynamics of absorption (A) can be described by a difference between the income (Y) and the net export:

$$A = Y - NX \quad (2)$$

The accumulation of foreign exchange reserves is a direct component of the identity of

balance of payments within which the current account balance as the sum of the net export, net yields (NY) and transfers (NT) is financed by the net inflow of capital in the form of the financial account (FA) balance and by a change in foreign exchange reserves of central bank ( $\Delta FR$ ):

$$NX + NY + NT = - FA + \Delta FR \quad (3)$$

By substitution of equation (1) into equation (3) and then of equation (3) into equation (2) it is possible to deduce a close relation of the accumulation of foreign exchange reserves to macroeconomic equilibrium and policy of absorption stabilization:

$$\Delta FR = (S - I) + (T - G) + NY + NT + FA \quad (4)$$

$$A = Y + FA + NY + NT - \Delta FR \quad (5)$$

Following these equations one can solve the problem of foreign exchange reserves optimum size. An approach is to seek both simple indicators of the volume of foreign exchange reserves in relation to the import intensity of economy, short-term foreign indebtedness of economy (Greenspan-Guidotti rule) or wide monetary aggregates and more complicated calculations of an optimum level of foreign exchange reserves. Traditional approaches are based on a linkage between the optimum level of foreign exchange reserves and external equilibrium of economy (Beck and Rahbari, 2008). Many authors, referring to historical cases of financial crises, accentuate the importance of foreign exchange reserves as resources by means of which central banks can decelerate a decrease in the real absorption at a sudden outflow of foreign capital (Jeanne and Ranciere, 2006).

On the contrary, many central banks in transition economies report the accumulation of foreign exchange reserves in the long run markedly above the standard optimum level of foreign exchange reserves (Gros and Schobert, 1999). It happens so even when central banks abandon the fixed exchange rate at a certain phase of transformation and adopt different forms of floating exchange rate systems. These economies do not usually belong to the group of countries exporting key commodities (crude oil, natural gas) where foreign exchange reserves increased in the past years in connection with a steep rise in prices of these commodities (see ECB, 2006). A crucial factor of the accumulation of foreign exchange reserves is mostly a pressure on the trend appreciation of domestic currencies which takes place – in spite of continuing current account deficits – thanks to gradual improvement in the labor productivity and export performance of these economies and mainly due to the massive inflow of foreign capital in the form of direct foreign investments. The accumulation of foreign exchange reserves is a tool how central banks can reduce the negative effects of domestic currency appreciation on the rate of export-pulled economic growth and how to prevent the long-term undershooting of their inflation target at the same time.

In the framework of monetary policy implementation central bank uses monetary-policy instruments for stabilization of interest rates at the short end of the money market yield curve, at a level consistent with the achievement of set monetary targets. Effective stabilization of these interest rates in the close proximity of the announced main policy rate assumes that central bank is able to achieve - on a daily basis - equilibrium between liquidity supply and liquidity demand of the banking system. In this context the banking system liquidity is taken to mean the aggregated balances of all banks within the national banking

system on bank's reserve accounts with central bank. On the one hand, the total volume of banking system liquidity is given by the cumulative volume of monetary operations carried out by central bank; on the other hand, it is influenced exogenously by the dynamics of autonomous factors. Autonomous factors are taken to mean such items on central bank's balance sheet that cause changes in the volume of banking system liquidity which under normal circumstances would lead to a significant deviation of interest rates at the short end of the money market yield curve out of the announced main policy rate of central bank. This deviation forces central banks to accommodate the dynamics of these factors fully or for the most part by supplying/withdrawing liquidity in order to restore the above-mentioned equilibrium.

In the context of banking system liquidity the asset side of the central bank's balance sheet represents sources of liquidity supplied by central bank while the liability side shows the use of this liquidity (except foreign currency operations on the asset and liability side through which no exchange between domestic and foreign currency is effected – e.g. gold transactions or acceptance of credits or deposits in foreign currency, and except changes in instrument values including net yields from foreign currency instruments). From the central bank's aspect, liquidity is provided by purchases of domestic securities through open-market outright operations ( $\Delta SEC_{OUTRIGHT}$ ) or reverse repo operations ( $\Delta SEC_{REVREPO}$ ), by purchases of foreign assets carried out by foreign exchange interventions ( $\Delta FR$ ) or by means of lending facility ( $\Delta SEC_{LF}$ ) (different combinations of these methods are used the most frequently). So it holds good that:

$$\text{liquidity sources} = \Delta FR + \Delta SEC_{OUTRIGHT} + \Delta SEC_{REVREPO} + \Delta SEC_{LF} + \Delta OTHER_{ASSETS} \quad (6)$$

Banks use supplied liquidity to meet the central bank's minimum reserves requirements ( $\Delta MR$ ) or it is held as excess reserves ( $\Delta ER$ ), such liquidity may also be used to satisfy the demand for currency in circulation ( $\Delta CC$ ) or to increase balances of the government's account with central bank ( $\Delta D_{GOV}$ ). In case that the banking system operates under the system surplus of liquidity, supplied liquidity is siphoned off by repo operations ( $\Delta D_{REPO}$ ) or outright issues of central bank's own securities ( $\Delta D_{OUTRIGHT}$ ). At the moment when the banking system works in the regime of the system deficit of liquidity, but the volume of the banking system liquidity momentarily exceeds demand of banks for liquidity, banks can deposit excess liquidity with central bank as deposit facility ( $\Delta D_{DF}$ ). So it holds good that:

$$\text{liquidity use} = \Delta MR + \Delta ER + \Delta CC + \Delta D_{GOV} + \Delta D_{OUTRIGHT} + \Delta D_{REPO} + \Delta D_{DF} + \Delta OTHER_{LIABILITIES} \quad (7)$$

The long-term net liquid position of banking system is characterized by system deficit or surplus of banking system liquidity. For system deficit or surplus of liquidity it holds good that:

$$FR + SEC_{OUTRIGHT} \leq MR + ER + CC + D_{GOV} \quad (8)$$

or

$$FR + SEC_{OUTRIGHT} > MR + ER + CC + D_{GOV} \quad (9)$$

The demand of banks for central bank liquidity is usually met by a combination of outright or repo operations and credit operations or facilities supplied by central bank. In the case of system deficit of liquidity it is applicable that the volume of outright operations does not

exceed in the long run the demand of banks for liquidity complying with the requirement for minimum reserves, volume of excess reserves, volume of currency in circulation and government deposits. System surplus of liquidity is a special situation when (see Ganley, 2004), on the one hand, central bank supplies liquidity like in the case of system deficit, but on the other hand, central bank provides liquidity mainly on the basis of outright operations, the balance of which exceeds in the long run the volume of minimum and excess reserves of banks, currency in circulation and government deposits. Therefore the extensive volume of liquidity supplied by central banks in response to the actual financial crisis through credit facilities cannot be considered as the case of system surplus of liquidity because this liquidity is demanded by banks voluntarily and is held in the form of excess reserves or deposit facility with respect to the advantage of interest rate on these monetary instruments. On the other hand Fed's policy of quantitative easing based on outright purchases of agency and government securities is typical example of how to create system liquidity surplus in banking system.

The creation of the banking system liquidity has to be – by definition - in line with its use, therefore the accumulation of foreign exchange reserves as main source of banking system liquidity surplus is reflected on the central bank's balance sheet as follows:

$$\Delta FR = (\Delta D_{OUTRIGHT} + \Delta D_{REPO} - \Delta SEC_{OUTRIGHT} + \Delta SEC_{REVREPO}) + (\Delta D_{DF} - \Delta SEC_{LF}) + \Delta MR + (\Delta ER + \Delta CC + \Delta D_{GOV}) + (\Delta OTHER_{LIABILITIES} - \Delta OTHER_{ASSETS}) \quad (10)$$

where  $(\Delta D_{OUTRIGHT} + \Delta D_{REPO} - \Delta SEC_{OUTRIGHT} + \Delta SEC_{REVREPO})$  shows a change in the net position of banking system vis-à-vis central bank by virtue of outright or repo open market operations,  $(\Delta D_{DF} - \Delta SEC_{LF})$  expresses a change in the net position of banking system vis-à-vis central bank by virtue of the use of standing facilities,  $(\Delta ER + \Delta CC + \Delta D_{GOV})$  shows the influence of autonomous factors on the volume of banking system liquidity and  $(\Delta OTHER_{LIABILITIES} - \Delta OTHER_{ASSETS})$  illustrates mainly the impacts of value changes in foreign exchange reserves on the central bank's capital incl. realized interest or dividend yields.

### **Limits of banking system long-run liquidity absorption in case of underdeveloped foreign exchange markets and uncovered foreign exchange exposure by central banks**

In the long run the extent of system liquidity surplus is weakened in connection with a trend growth of banking system demand for liquidity (liquidity absorption). The most important factor of liquidity absorption is the issuance of banknotes that usually shows positive growth rate due to high growth in nominal GDP and/or consumption in transitive countries. Trend growth of the requirement for minimum reserves in connection with the volume of primary bank deposits increasing in time also participates in liquidity absorption. On the other hand, taking into account generally low requirements of central banks for the level of minimum reserves the importance of this factor is relatively limited. In transitive countries this trend is also counterbalanced by the process of convergence in monetary policy implementation: the originally high levels of minimum reserves acting as a source of monetary restriction converge to current low values. The potential influence of the state budget on a trend decrease in the banking system liquidity is mostly a purely hypothetical matter because the majority of the governments are not able to generate any surpluses of public budgets in the long run.

It is quite logical to consider decumulation of foreign exchange reserves as a means of important liquidity absorption. However, the concern about domestic currency appreciation was the primary motive of foreign exchange reserve accumulation, therefore the resale of foreign currency puts an additional pressure on domestic currency appreciation that need not be consistent with the inflation target. Central banks have to accommodate the rate of foreign exchange reserve decumulation proportionately to the liquidity of foreign exchange market in domestic currency and to sell foreign exchange reserves gradually at small amounts corresponding to yields of foreign exchange reserves. This method results in a gradual reduction in the volume of excess liquidity, but it does not lead to a trend decrease in foreign exchange reserves, which has negative impacts on central bank's profit at the trend appreciation of domestic currency. The sale of large amounts of foreign exchange reserves may theoretically be realized in the period of higher depreciation of domestic currency; but it means that in spite of the declared policy of floating exchange rate the central bank implicitly behaves as a speculator stabilizing exchange rate fluctuations in the regime of fixed exchange rate with beforehand unknown oscillation ranges.

Reduction in system liquidity surplus through reselling acquired foreign reserves highlights a question whether the exchange rate regime choice influences the system of a functioning foreign exchange market, its liquidity and therefore its ability to absorb central bank's foreign exchange transaction without significant exchange rate reaction. It seems to be that fixed rates applied in the transitive economies usually limit the development of the foreign exchange market's activity. The market appears paralyzed from both the point of view of the application of knowledge, and the development of activity on the foreign exchange market. The fixed rate regime is linked to the prevalent spot transactions. Currency derivatives are added to the foreign exchange market later, as a rule together with the transformation to the exchange rate regime with relatively greater flexibility (fixed rates with wider oscillation bands and floating exchange rates, with either managed or independent floating). The higher volatility of the exchange rate causes the growth of hedging and speculative transactions in foreign exchange markets, and in consequence, this preference for floating rates leads to a growth in forward and swap transactions.

It is so for the following reasons. First of all, at the beginning of transformation period there was, in the business sphere, a lack of knowledge about the foreign exchange market, its functioning and operation (before transformation begun foreign trade transactions were exclusively carried out on the basis of the monopoly of foreign trade enjoyed by the specialized foreign trade firms). Business subjects were just starting to gradually orient themselves in the transactions and instruments which could be useful for hedging. Second, a very narrow margin of fluctuation when using a fixed rate substantially reduces foreign exchange exposure and exchange risk, the need to cover exchange risk does not appear very prominent. Last but not least, the change over to the exchange regime with the greater amount of flexibility increases the foreign exchange risk, and also demands the development of adequate foreign exchange transactions and instruments which serve to cover exchange risk.

Before the process of liquidity absorption is fully finished renewing system liquidity deficit in transitive economies, central banks have to solve the question of stability of monetary policy instruments value with regard to credit and market risk (Broaddus and Goodfriend, 2001). Both alternatives - accumulation of foreign exchange reserves and outright purchases of domestic long-term securities - are comparable from the aspect of credit risk because central banks strictly limit the credit rating of purchased instruments both in foreign

exchange reserves and in domestic bonds. The accumulation of foreign exchange reserves and outright purchases of home securities differ in the final impacts of market risk. In outright purchases of domestic securities interest rate risk connected with fluctuations of long-term interest rates and high duration of the portfolio of these instruments is efficiently limited by the fact that in normal circumstances interest rates are stationary series without trend changes in the long run and that central bank copes with short-term changes in interest rates by the holding of securities until their maturity. Therefore central banks with a high share of outright purchases of domestic securities for the issue of currency in circulation have a good chance to maintain the stability of backing of currency in circulation and bank's reserves and to preserve central bank's capital.

As for foreign exchange reserves, the long-term trend appreciation of domestic currency, particularly typical of transitive economies, brings irreversible losses of the market value of central bank's portfolio of foreign exchange reserves and capital (Ferhani 2007). This problem becomes more serious as the accumulation of foreign exchange reserves at the simultaneous trend appreciation of domestic currency decreases the ratio of central bank's capital to central bank's foreign exchange exposure. A combination of the trend growth of currency in circulation and banks reserves with a decrease in the real value of foreign exchange reserves may definitively cause that in case central banks rely on the issue of currency in circulation and bank's reserves mostly on the basis of foreign exchange reserve accumulation a part of these specific liabilities is not backed by central bank actual assets but by uncertain future net yields of central bank.

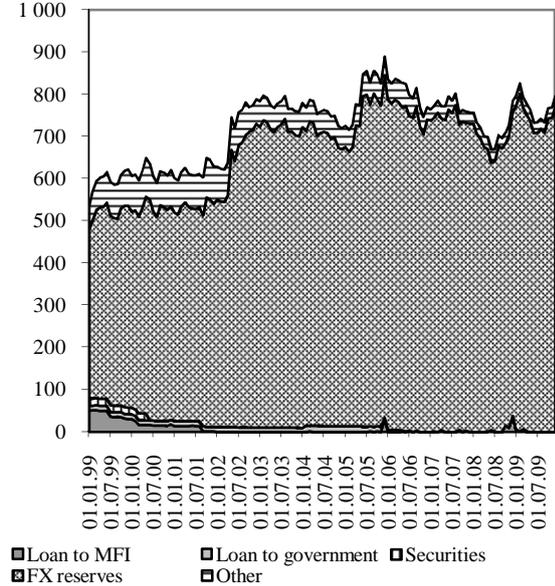
### **Foreign exchange reserves accumulation and monetary policy implementation: The case of the Czech Republic, Poland and Hungary in 1999-2009**

An empirical part contains the analysis of banking system liquidity management in the Czech Republic, Poland and Hungary in the context of foreign exchange reserve accumulation by the Czech National Bank (CNB), National Bank of Poland (NBP) and National Bank of Hungary (NBH) in 1999-2009. These countries fulfilled the criteria set by the European Bank for Reconstruction and Development (EBRD) for measuring development in transition. The EBRD's criteria include a host of integral indicators. They concern, namely, the privatization process, government and business restructuring and price liberalization. In addition, the foreign exchange rate regime, bank reform, securities market and interest liberalization are also considered. The period chosen comprises a time segment when these central banks gradually adopted the monetary strategy of inflation targeting based on monetary tools commonly used in developed countries (in 1998 in case of CNB, 1999 in case of NBP and 2001 in case of NBH).

A common feature of compared countries is the system surplus of banking system liquidity that originated in the first half of the nineties (in 1993 in the Czech Republic, 1994 in Poland and 1995 in Hungary) on the basis of foreign exchange interventions by central banks in the system of fixed exchange rate (Czech Republic) and crawling peg (Poland and Hungary). Fixed exchange rate systems played an important role of the nominal anchor in the stabilization of price development at the beginning of transformation processes. However, over time, with increasing convertibility of domestic currencies and at a significant positive inflation and interest rate differential vis-à-vis developed countries the guaranteed stability of exchange rate created ideal conditions for the inflow of foreign direct and

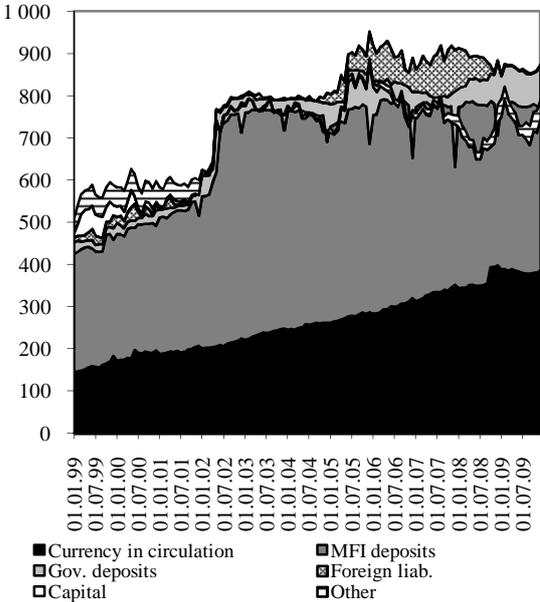
portfolio investments with natural tendency of domestic currency appreciation. Concerns about deterioration of exporter’s competitiveness and deepening of current account deficits forced central banks to carry out foreign exchange interventions to protect domestic currency against appreciation.

**Fig 1: Structure of CNB’s assets (bil. CZK)**



Source: CNB, our own calculations

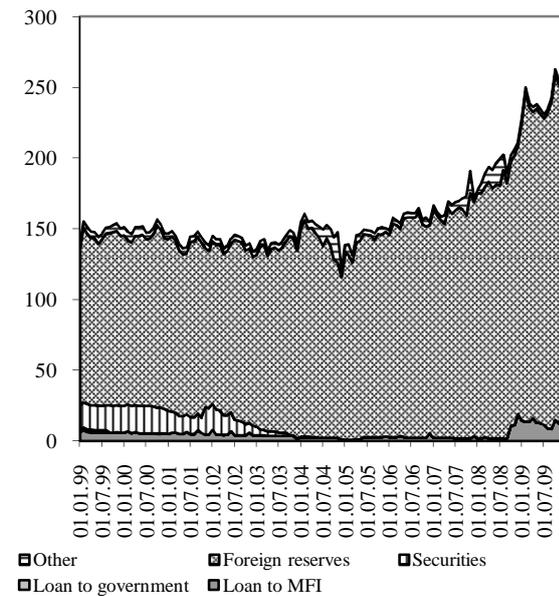
**Fig 2: Structure of CNB’s liabilities (bil. CZK)**



Abandonment of the fixed exchange rate regime and adoption of managed exchange rates in the CR (1997) and in Hungary (2008, with preceding significant widening of oscillation ranges to  $\pm 15\%$  in 2001) and of floating exchange rate in Poland (2000) gradually weakened the intensity of interventions by central banks in the foreign exchange market. However, due to concerns about appreciation tendencies, central banks performed some operations within which they accumulated foreign exchange reserves outside the wholesale foreign exchange market, increasing further the volume of the banking system excess liquidity in this way.

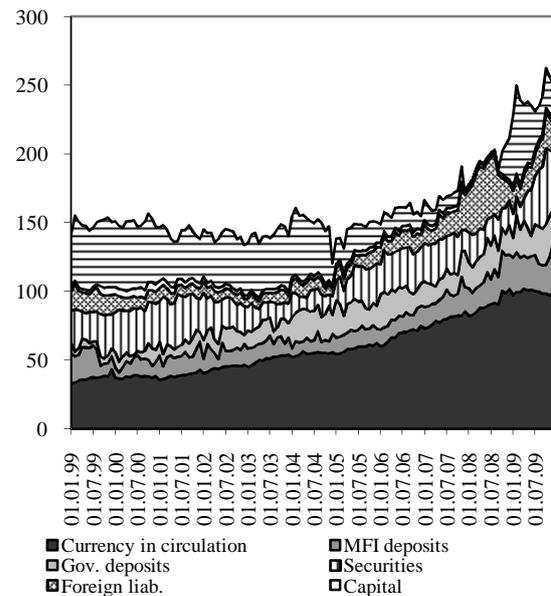
A common practice of all three central banks is the purchase of government privatization incomes realized in foreign currency in exchange for the government deposit with central bank in domestic currency, which subsequently becomes a resource for the settlement of government expenditure/budget deficits. In case of NBP and NBH the increase in liquidity was also connected with the purchase of foreign currency transfers from the EU funds by central banks. In connection with huge indebtedness of the Hungarian government the purchase (by central bank) of resources acquired by the government through the issue of foreign currency bonds in foreign markets became an important source of liquidity increase in the banking system of that country. Consequently, a gradual increase in the absolute and relative volume of foreign exchange reserves on the asset side of their balances was a common feature (see Fig. 1, 3 and 5).

**Fig 3: Structure of NBP's assets (bil. PLN)**

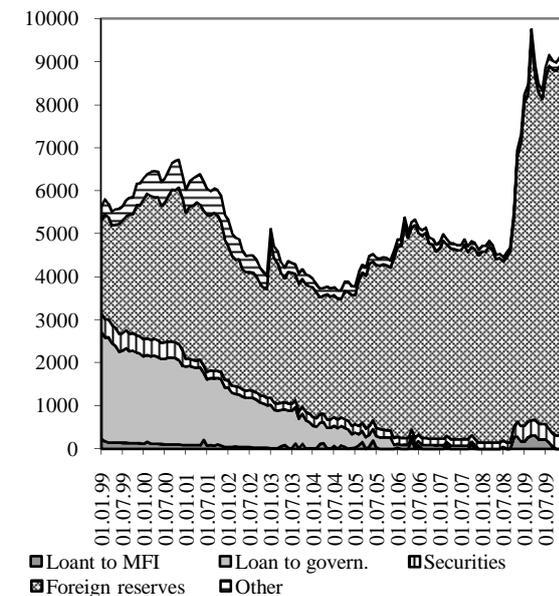


Source: CNB, our own calculations

**Fig 4: Structure of NBP's liabilities (bil. PLN)**

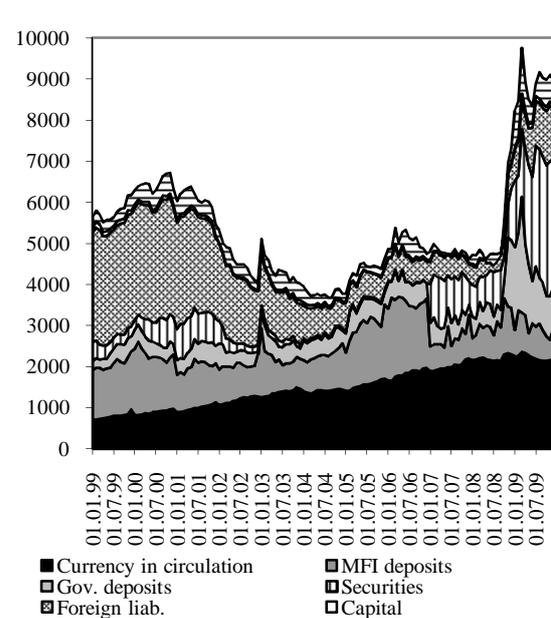


**Fig 5: Structure of HNB's assets (bil. HUF)**



Source: CNB, our own calculations

**Fig 6: Structure of HNB's liabilities (bil. HUF)**



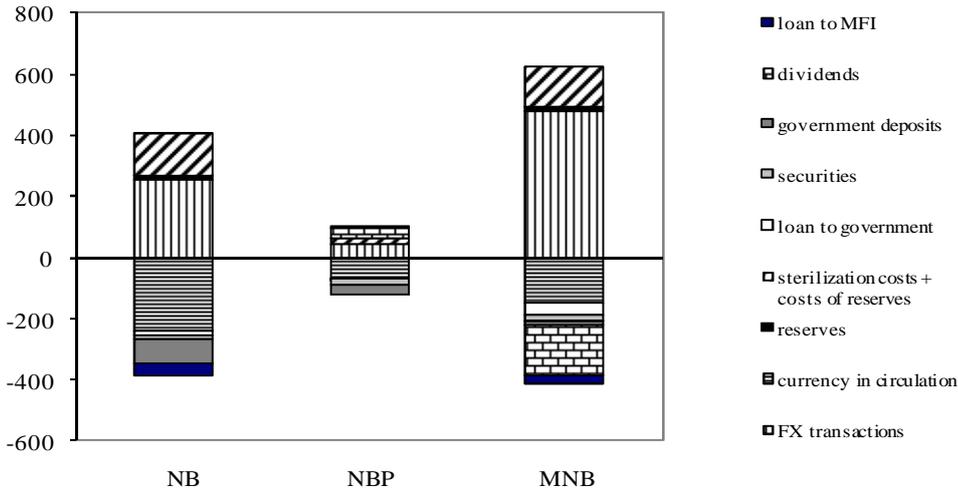
To withdraw excess liquidity CNB carries out open-market operations using a time deposit when banks acquire collateral in the form of CNB treasury bills. Unlike CNB, liquidity sterilization performed by NBP and NBH consists in the outright issue of their own treasury bills (in 1997-2001 NBH also used an unsecured time deposit besides its own treasury bills). CNB manages repo tenders on a daily basis by May 2006 then the frequency of tenders decreased to three times per week, on Monday, Wednesday and Friday. On the contrary, NBP issued treasury bills irregularly by January 2002 in relation to the extent of excess liquidity accumulation causing a significant decrease in O/N interest rates in the money market. Then the regular issue of treasury bills followed, once a week on Friday. NBH

adopted a similar approach: it conducted auctions of its own treasury bills once a week on Tuesday. Through open-market operations CNB maintains a two-week repo rate while NBP uses a seven-day reference rate (its maturity was 28 days by 2002 and two weeks by 2004) and NBH uses a two-week base rate.

**Main liquidity sources and liquidity absorption in emerging FX markets**

The analysis of key resources and liquidity use (see Fig. 7) shows that in the studied period in the case of CNB and NBH newly provided liquidity on the part of central banks exceeds liquidity absorption and so the final volume of excess liquidity is larger than at the beginning. The situation in NBP is almost balanced according to the graph even though the volume of excess liquidity in reality increased in the studied period due to further operations of NBP that are not included in calculations. The main source of liquidity supply is the accumulation of foreign exchange reserves in the form of the positive balance of foreign exchange operations conducted by central bank. It happens so although central banks gradually abandon the regime of fixed exchange rate or crawling peg. System liquidity surplus also causes that the need of liquidity sterilization (incl. the existence of minimum reserves of banks with central banks) subsequently leads to a further increase in liquidity supply through the costs central banks have to spend for liquidity sterilization and minimum reserves of banks. The costs are generally the function of the excess liquidity volume and the level of main policy rate of central bank which usually determines the effective price of withdrawn liquidity and minimum reserves. In this connection CNB benefits from an effective compensation of the high volume of sterilized liquidity and long-time low repo rate resulting from low inflation rate in domestic economy while in spite of the lower volume of excess liquidity NBH pays relatively high costs due to imbalances in Hungarian economy and a high level of the base rate of NBH.

**Fig 7: Sources of liquidity (+) and liquidity absorption (-) (bil. CZK, PLN, tens of bil. HUF)**



Source: CNB, our own calculations

As concerns liquidity absorption, the active approach of central banks consists in an effort to reduce liquidity surplus and make use of natural tendency of banking systems toward the growth of demanded liquidity. Central banks take into consideration that possibilities of

liquidity absorption by restriction of their position vis-à-vis the banking system are minimum because at the beginning of the studied period the banking systems already operated in the regime of system liquidity surplus for several years. The extant position of central banks vis-à-vis the banking system is not characterized by standard operations associated with monetary policy implementation that usually have a short time of payment but by transactions connected with transformations of banking systems or problems of the particular banks. In addition, the capacity of this method of liquidity absorption is restricted by the absence of a liquid secondary market for this type of credits and by the inability of central bank to influence the repayment of credits *ex post facto*. From the aspect of liquidity volume, this way of liquidity absorption is more significant in CNB only while in the case of NBP credits granted to banks are a source of liquidity when the initial decrease in credits is followed due to financial crisis by their increase in connection with NBP programmes to support the Polish banking system liquidity (these activities do not influence the results in CNB and NBH because all credit programmes of CNB and NBH to support liquidity were repaid before the end of 2009).

Central banks particularly aim to eliminate their position vis-à-vis the government, no matter whether it is a position of having granted a direct credit to the government (CNB and NBH) or of the holding of government bonds (CNB and NBP) (see Fig. 1, 3 and 5). The most important position of central bank vis-à-vis the government is that of NBH (in 1999 it accounted for more than 50% of NBH assets while 20% of this position was denominated in domestic currency), which acts as a mediator mainly in the foreign bond market that issues its own registered bonds whereas the acquired resources are used to grant a credit to the government. This source of liquidity absorption is relatively low for CNB and NBP. Liquidity is absorbed by both simple debt redemption and debt rescheduling on the government's part (refinancing of the government in the primary market). However, NBP gradually sells government securities at small tranches, being motivated by minimization of impacts of these operations on the yield curve in the Polish bond market. An increase in the government deposits with central bank that absorbs a part of liquidity issued in the above-mentioned purchases of foreign currency by central bank by virtue of government privatization incomes or transfers from the EU is also a source of liquidity absorption.

As expected, in all cases the growth of currency in circulation is the most important source of liquidity absorption ensuing from the natural tendency of banking systems towards an increase in demand for liquidity (see Fig. 2, 4 and 6). On average, the growth of the volume of currency in circulation is fastest in Poland and Hungary (identically by 11.8% per year) while the growth rate in the CR is moderately lower (10.2%), corresponding to the lowest inflation rate of the compared countries. The growth rate of currency in circulation is higher than the growth rate of nominal GDP in all compared countries (5,5 % in CR, 7,3 % in Poland and 8,4 % in Hungary). On the contrary, the reserves of banks with central bank are a source, not a means, of liquidity absorption for CNB and NBH because the volume of minimum reserves of banks decreased in the studied period in spite of the trend growth of the volume of primary deposits in the banking system. Such a decrease was caused by a significant reduction in the level of minimum reserves and/or by a reduction in the base from which minimum reserves are calculated.

The payout of central bank dividend to the state budget influences the banking system liquidity in a specific way. A standard situation is in NBP, which pays out the dividend regularly and increases the surplus of the banking system liquidity in total to a greater extent than sterilization costs and minimum reserves of banks. NBH paid out dividends by 2002

only, but parallelly the government was obliged to compensate every year to NBH exchange rate losses incurred by the appreciation of HUF. In total, in connection with the distribution of NBH operating result the volume of loss compensations from the state budget significantly exceeds paid out dividends, and so this source becomes the most important way of the banking system liquidity absorption in this country. CNB does not pay out any dividends because of its negative capital while the government compensates *ad hoc* a part of losses incurred by the Czech crown appreciation in connection with the repurchase of government privatization incomes, the level of which is not however publicly known.

**Table 1: Global foreign exchange market turnover by country, currency distribution of global foreign exchange turnover and nominal effective exchange rate volatility** (daily average turnover in April in billions of USD and percentages, relative exchange rate changes volatility)

Country \ Year	1998		2001		2004		2007		2010		Regime
	Amount	% share	Volatility								
Czech Republic	5,1	0,2	2,1	0,1	2,4	0,1	5	0,1	5,1	0,1	floating
CZK	-	0,3	-	0,2	-	0,2	-	0,2	-	0,2	2,38
Poland	2,7	0,1	5,1	0,3	6,5	0,3	9,2	0,2	7,8	0,2	floating
PLN	-	0,1	-	0,5	-	0,4	-	0,8	-	0,8	2,39
Hungary	1,4	0,1	0,6	0	2,8	0,1	6,9	0,2	4,2	0,1	fixed*
HUF	-	0,0	-	0,0	-	0,2	-	0,3	-	0,4	2,79

Data on currency distribution in 1998 based on local market turnover only; \* since 2008 floating

Source: BIS 2010

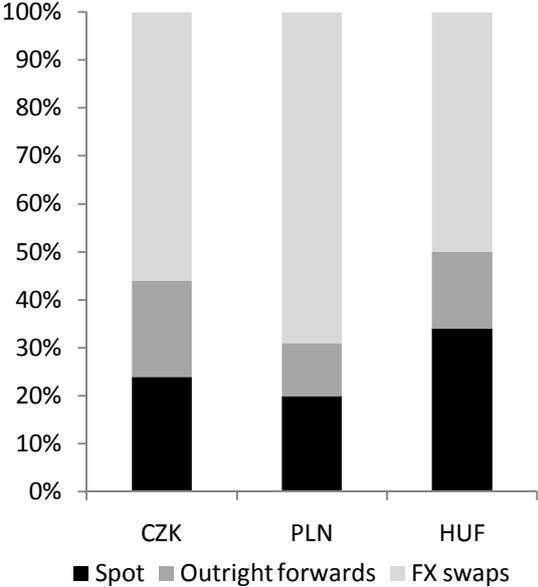
A common feature of CNB, NBP and NBH is the sale of a portion of foreign exchange reserves in order to decrease foreign exchange exposure and to withdraw excess liquidity. The decumulation of foreign exchange reserves is carried out at small portions in the course of the year while central banks clearly declare that they do not intend to influence the exchange rate of domestic currency by these operations. Therefore the annual volume of the resale accounts only for several percents of the foreign assets portfolio, which approximately corresponds to interest yields from foreign exchange reserves. In case of CNB it allows to stabilize the volume of foreign exchange reserves but in the case of NBP and NBH these operations cannot prevent a rapid increase in foreign exchange reserves and issued liquidity in the last years.

The speed of foreign reserves decumulation is mainly limited by relatively low liquidity of the Czech, Polish and Hungarian foreign exchange markets that accounts for about 0,4 % (in total) of a share of the global daily average FX market turnover and by relatively low turnover of their home currencies in global foreign exchange markets that accounts for 0,4 % (in 1998) to max. 1,5 % (in 2010) (see characteristics of individual countries in Table 1). Measured volatility of the currencies under examination does not support an assumption of higher volatility of floating regimes compared to fixed ones as HUF suffered higher volatility due to above mentioned instability of Hungarian economy although it manages a regime of fixed exchange rate.

The question is whether higher volatility or floating exchange rates lead to differing structures of traded instruments in foreign exchange markets (higher share of forward and swap transactions due to higher share of hedging and speculative transactions in foreign

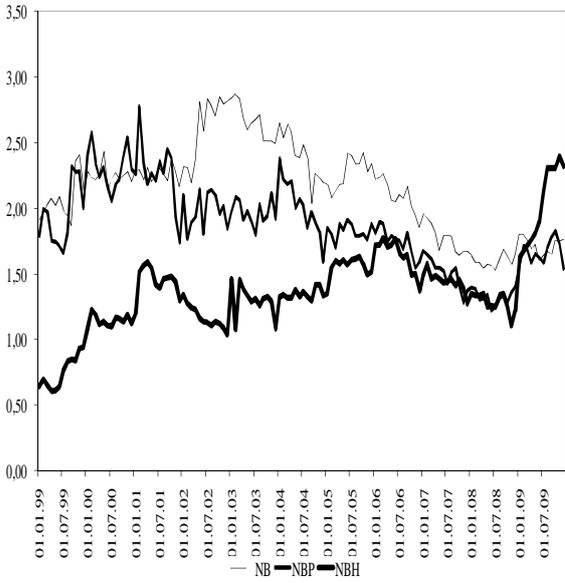
exchange markets). Graph 3 shows the structure of foreign exchange turnover according to the character of the foreign exchange transactions. It is quite surprising that the higher share of spot transactions come from HUF that maintains fixed rate regime and suffered higher volatility (see Fig. 8).

**Fig. 8: FX turnover by currency and instrument in April 2007 (% share)**



Source: CNB, NBP, NBH, our own calculations

**Fig. 9: Net foreign assets against currency in circulation and bank's reserves with central bank**



Source: CNB, NBP, NBH, our own calculations

**Home currency appreciation and monetary base backing in case of liquidity surplus**

The above analysis shows that liquidity supply on the basis of foreign exchange reserve accumulation by CNB, NBP and NBH does not primarily reflect, either in volume or in time, the volatility of demand of domestic banking systems for this liquidity. A volume difference is evident from the existence of liquidity surplus of banking systems, i.e. from the situation when central banks supply liquidity through outright operations carried out as purchases of foreign currency assets beyond the banking system demand. Central bank interventions such as foreign currency purchases and parallel issue of domestic currency due to the real or potential pressure on domestic currency appreciation cannot be identified with an increase in demand for central bank liquidity (i.e. newly issued liquidity) but solely and exclusively with an increase in demand for existing liquidity in domestic currency.

Due to these facts an analysis of the foreign exchange exposure of CNB, NBP and NBH in relation to the volume of currency in circulation and bank reserves (monetary base) (see Fig. 9) confirms the hypothesis about a significant decrease in the backing of monetary base under the accumulation of foreign exchange reserves at simultaneous appreciation of domestic currency and trend growth of currency in circulation (or bank reserves). As there is huge system liquidity surplus more than 100% of monetary base in CNB and NBP was backed by net foreign assets at the beginning of the period concerned. In NBH such backing is at the level of 65% with regard to the significant net credit position of NBH vis-à-vis the

government. In the first phase (by 2001-2002) backing increased in all studied cases as a result of the accumulation of foreign exchange reserves (see Fig. 1, 3 and 5) which was so significant that it overcame the influence of CZK and PLN appreciation against EUR and the increase in currency in circulation. A trend decrease in the monetary base backing by net foreign assets of central bank started in CNB in 2003, in NBP a year later and in NBH in 2006 by significant trend appreciation of domestic currencies (this trend ended in 2008, when, on the contrary, due to financial crisis especially PLN and HUF were hit by strong depreciation against EUR). In this situation the lowest backing in NBP and NBH was about 1.3, which at the simultaneously positive capital of these central banks was the value when the monetary base was sufficiently backed by actual assets of central bank. In comparison with NBP and NBH the highest volume of excess liquidity in CNB caused that in spite of quantitatively extensive appreciation of the Czech crown (by 25% compared to depreciation by 0.3% in PLN and 7.7% in HUF) the lowest ratio of the monetary base backing by net foreign assets was higher than in NBP and NBH (above 1.5). As a result, CNB has been operating with huge negative capital since 2002.

## **Conclusion**

In the present study the problem of the banking system liquidity management is solved in relation to the choice of exchange rate regime and accumulation of foreign exchange reserves of central banks. This problem is examined in the context of external equilibrium of open economy. In the theoretical part the type of system surplus of the banking system liquidity is defined that is caused by the accumulation of foreign exchange reserves. Detailed discussion is focused on problems of liquidity surplus and on factors of liquidity absorption in the long run. Last but not least the structure of monetary tools in the form of outright operations vs. repo operations is analyzed influencing the stability of backing of monetary base by net foreign assets of central bank at the trend appreciation of domestic currency typical of transition economies.

The empirical part contains an analysis of these problems on examples of the CR, Poland and Hungary and a comparison of different approaches of CNB, NBP and NBH to their solution. Although system liquidity surplus caused by foreign exchange reserve accumulation is common to these central banks, there are many differences among them in the practical application of liquidity management. CNB is dominant by the volume of excess liquidity and open foreign exchange position. From the aspect of the costs of excess liquidity sterilization CNB pays a relatively low amount thanks to low inflation rate and main policy rate compared to NBH. The trend growth of currency in circulation is a key source of absorption but NBH can also make use of its decreasing position vis-à-vis the government on a large scale. From the aspect of liquidity absorption dynamics the policy of NBP, which regularly pays out a dividend to the state budget, is significant or it is important that exchange rate losses of NBH are covered by the state budget by virtue of law. Underdeveloped foreign exchange market in countries examined limits a speed of foreign reserves decumulation. In this context fixed regime of HUF does not significantly reduces volatility of its nominal effective exchange rate compared to CZK and PLN. As expected, the appreciation of the currencies of compared countries causes a decrease in the backing of currency in circulation and bank reserves by net foreign assets of central banks but in spite of high exchange rate losses it does not happen that these items would not be backed by actual assets of central banks.

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