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Money Market Liquidity under Currency Board – Empirical Investigations for Bulgaria

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Abstract: Over the last years the efficiency and existence of an automatic adjustment mechanism of currency boards are in the centre of economic discussions. This study is intended to provide an empirical analysis of the volume and interest rate of unsecured overnight deposits at Bulgarian interbank market. Three empirical models are developed in order to explain the behaviour of demand, supply and interest rates. The impact of reserve requirements, operations connected with government budget, transactions in reserve currency (Euro) and some seasonal factors is discussed. The developments of interest rates and volumes are well captured by the employed variables and their statistically significant signs coincide with the theoretical literature.

JEL – Classification: E4, E5
Keywords: money market, currency board, Bulgaria

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1 Introduction

The motives for studying the interbank money market could be sought in several directions.

First, where a Currency board (CB) is involved, usually two of its advantages are cited: (i) its ability to restore and maintain credibility in money and the financial system and (ii), the existence of an automatic adjustment mechanism. Credibility and especially the automatic mechanism (symmetric dynamics of the balance of payments and the money stock) require flexibility in the other parts of the economic system and especially in the interbank money market (for detailed description of Bulgarian currency board see annex 3). Whereas under CB arrangement the central bank does not pursue monetary policy and has severely restricted LLR functions, it is not possible to provide liquidity to banks and manipulate interest rates through changes in reserve money[1]. In this configuration, banks should rely on the interbank money market. The development of this market, its depth and volatility acquire particular importance in the analysis of CB.

Second, analysis and modeling of money market are instrumental to the construction of an overall systemic risk model and simulation of various types of shocks that could provoke it. Under CB, being a static arrangement, the systemic risk has severe consequences.

Third, the study of interbank market interest rates and especially overnight interest rate could be used for analyzing the term structure of interest rates and the dynamics of economic agents' expectations, respectively. More, Bulgarian money market experience shows that there are days when interest rates rise dramatically (see chart 1). This brings to the fore the question of the optimal volatility of interest rates and the factors behind its fluctuations.

Fourth, modeling of this market gives a starting point for studying the relationship between fiscal flows and liquidity and between fiscal policy and the CB in general. This element is related to the ongoing discussion of the role and efficient management of the government's fiscal reserves (included in CB liabilities).

Our ambitions in this paper can be reduced to the following: (i) identification of the institutional characteristics of the Bulgarian interbank market, Part 2 (ii) analysis of the factors impacting interest rates dynamics, liquidity demand and supply, summarized in a theoretical model,

[1] For detailed description on CB operation see Hanke (2002).

Part 3, (iii) an empirical test of the model with daily data for the period 01.12.2001 – 04. 11. 2003, Part 4.

Our ambitions are also motivated by the fact that there are only two empirical studies, more or less related to the problems of the interbank market. Petrov (2000) makes a systemic analysis of the demand and supply of commercial banks' excess reserves, and Nenovsky et al. (2001) establish that fiscal reserves affect the monetary base and as a consequence interbank market interest rates dynamics (liquidity effect).

2 Institutional framework of Bulgarian money market

Generally, CB sets the framework of possible operations on the Bulgarian interbank market and its structure.

Lev operations prevail in the currency structure (the key characteristics of the money market are presented in chart 1 and in the tables and charts in Appendices 1 and 2). The other two major currencies - Euro and US dollar - have smaller volumes and operations in British pounds, Swedish and Norwegian crowns are negligible. The average levels (for the period January 1998 - November 2003) of monthly volumes in the lev money market as % of M1 and M2 aggregates account for 30% and 12% respectively.

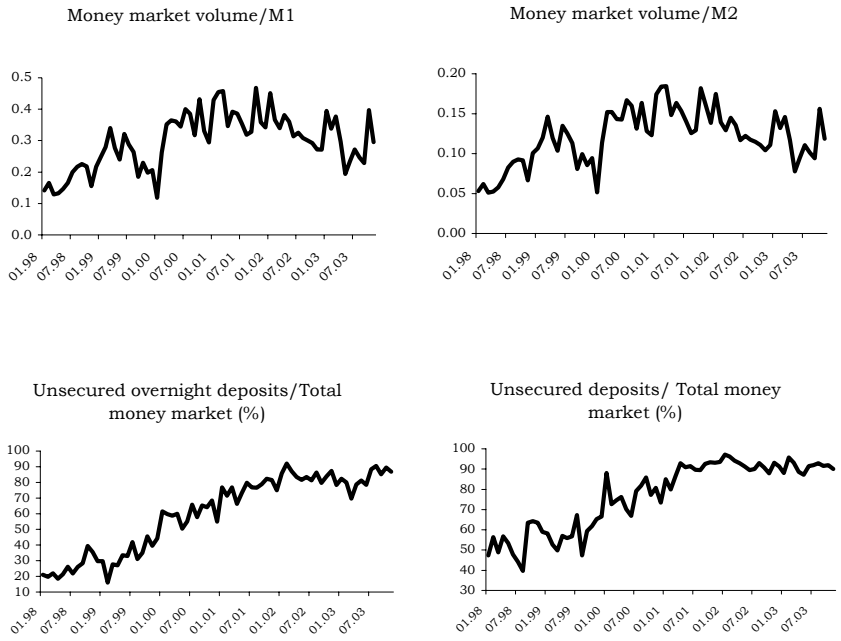
Major market instruments are unsecured deposits, secured deposits and repo agreements. For the period January 1998 - November 2003 unsecured deposits prevail, accounting for 77% of total operations in the lev money market. The dynamics during this period is as follows. Initially, after the adoption of the CB and the legacy from the severe financial crisis of 1996-1997, the share of unsecured deposits was about 40%. In the period 1998-2002 a sustainable upward trend developed. After January 2001 trust among major participants in the banking system increased whereby the share of unsecured deposits reached an average level of 91% (combined with contracted volumes and shares of secured deposits and repo agreements).

The maturity structure of the lev money market is dominated by overnight unsecured deposits which demonstrate an upward trend both in share and volume in the period (since the beginning of 1998 till now). Throughout the review period unsecured overnight deposits account for an average of 60% in the money market and from the beginning of 2001 to November 2003 their

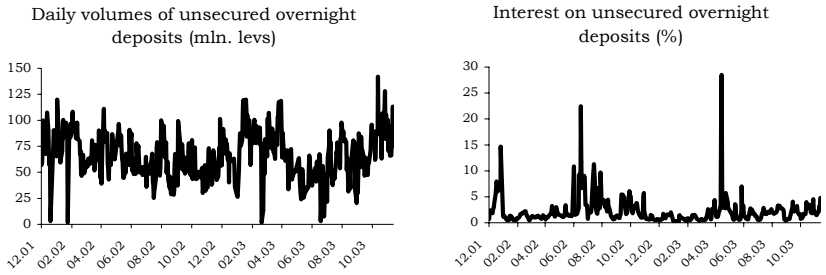
average level rose to 81%. The high share predetermines in part the focus of the present study – unsecured lev overnight deposits.

Daily data about the volume of overnight deposits show that their volume typically varies between BGN 25 and BGN 100 million. The mean for the period since the beginning of 1998 is BGN 65.7 million with standard deviation of BGN 21.9 million. The interest rate usually varies from 0 to 5%, and the mean is 2.22%, the standard deviation is 2.58%, with the maximum of 28.51% (!) hit in April 2003[2]. Dramatic interest rate fluctuations focus our attention as they are a major factor that could trigger a possible liquidity crisis; therefore it is necessary to study the factors behind such dynamics.

Chart 1. Interest rate dynamics and liquidity dynamics on the interbank money market in Bulgaria



[2] The analysis of the fisrst diferences of the overnight interest rate shows that the 94% of the observations are within the interval (-2; 2), 84% within the interval of (-1;1), and 71% within the interval of (-0.5; 0.5).



To understand the above-mentioned structure, however, the key institutional characteristics setting the framework of the money market need to be described.

Under discretionary monetary policy, interest rate on overnight deposits could fluctuate within specific limits. Overnight rate moves within a corridor determined by the possibility for depositing or receiving funds at (or from) the central bank. The minimum limit of the corridor is the interest that banks receive after depositing excess liquidity with the central bank (deposit facility). The upper limit of the corridor is the interest paid by banks on receiving liquid funds from the central bank (marginal lending facility), against an acceptable collateral (for details see Gaspar et al., 2003). Under CB, the central bank does not set a base interest rate and does not enter into such relations with commercial banks. By construction this allows biggest fluctuations of overnight interest rate.

The first important factor establishing the institutional framework of the money market is the regulation of *minimum reserve requirements* (MRR). Meeting the requirements for specific funds availability on accounts with the Bulgarian National Bank (BNB) is a major factor determining the behavior of commercial banks and their liquidity needs. The basis of setting the amount of minimum reserve requirements is the banks' attracted funds in lev and foreign currency (with up to two-year term) without those from local banks, which funds form the so-called deposit base. The banks maintain MRR in lev or foreign currency (US dollar, Euro, Swiss franc). The period of monitoring the deposit base of banks in order to determine the amount of MRR is called a base period and it coincides with calendar months. The period in which the banks must maintain MRR starts from the fourth day of the reporting base period and ends on the third day of the next reporting period and is called maintenance period. The total amount of MRR to be reached by each bank at the end of the maintenance period is determined as a product of the sum total of the deposit bases of the bank through all days of the base period and the percent of MRR (8% since June 2000 and 11% before that). From this product the sum total of the bank's available cash in

lev in vaults and ATM terminals through all the days of the base period is deducted.[3] A bank is considered to have met MRR if the amount of reserve assets maintained with the BNB through all the days of the maintenance period is equal to or higher than the above calculated amount (banks are entitled to use up to 100% of MRR, but they pay penalty rate on the amount above 50%). The BNB does not pay interest on the required MRR amount.

The second major factor impacting money market liquidity is the *behavior of the government*. The item "Deposits of the government and budget organizations" is included in the liabilities of the Issue Department (see Table 1).

Table 1. Bulgarian Currency Board balance sheet

Issue Department balance sheet

ASSETS	LIABILITIES
Cash and accounts in foreign currency	Currency in circulation
Monetary gold	Bank deposits and current accounts
Foreign securities	Government deposits and accounts
	Banking Department deposit

Banking Department balance sheet

ASSETS	LIABILITIES
Non-monetary gold and other precious metals	Borrowings from IMF
Investment in securities	Liabilities to other international financial organizations
Loans and advances to banks	Capital
Claims on government	Reserves
Bulgarian's IMF quota and holdings in other international financial organizations	Retained profit
Deposit within the Issue Department	

The main reason for this is (in addition to the fiscal agent function of central bank) transparency on the funds available to the government to cover its liabilities to local and mostly foreign creditors. The deposit of the government reflects cash inflows and outflows related to the activity of the Ministry of Finance and the other primary budget spenders, including budget payments and foreign debt operations. To optimize the organization and process of payment of the Ministry of Finance with the other economic agents the so-called single account at the BNB was cre-

[3] As of 1 July 2002 100% of the available cash in banks' cash desks are counted toward MRR (until that date only 60% were counted to MRR).

ated aimed to cover and centralize revenues and expenditures of budget spenders. According to the Law on the State Budget for 2003, it includes funds on budgetary, extrabudgetary, suspense and deposit accounts in lev and foreign currency with the Bulgarian National Bank of the central budget, ministries, agencies, the National Audit Office, the Bulgarian National Television, the Bulgarian National Radio, the Bulgarian Academy of Sciences, higher schools, the judiciary authorities, the National Social Security Institute and the National Health Insurance Fund.

Budget-related cash flows have a major impact on the liquidity in the banking system as they decrease or increase available funds of commercial banks depending on the nature of the operations effected by them. The principles and mechanism of payments and the centralization of revenues in the Single Account of the spenders serviced by the BNB and commercial banks are embedded in the specifically established to the purpose System for Electronic Budget transfers (SEBRA) through which the limits and payments of the spenders participating in the system are managed and controlled. Through SEBRA a connection is made with the interbank payments system. Since the beginning of 2001 the Ministry of Finance began progressive integration of budget spenders into SEBRA. Statistical data describing the main flows in the Single Account are available since 1 December 2001 which predetermines the period used in the empirical evaluation of the money market.

In the middle of each moth there is concentration of tax payments, exerting pressure on the money market and dramatic interest rate fluctuations. Slightly reduced volatility is observed after the end of May 2003 when the BNB allowed commercial banks to buy Euro against levs with same day value date through the funds maintained on their MMR accounts with the BNB. This ensured partial liquidity to cover their liabilities. In addition, as of 1 June 2003 the real-time gross settlement system RINGS started operation for big, systemic important payments, which allows better monitoring and management of commercial banks' liquidity. Through the old system BISERA operating before, payments were not effected in real time and this led to sizeable cautionary demand for liquidity by banks as they had no information on their incoming current payments and had to ensure more liquid funds for the normal execution of all ordered payments for the day. BISERA continues operating along with RINGS, for payments of no systemic importance (amounts less than BGN 100,000).

3 Theoretical elements of the study

Although the objectives of the study are mainly empirical, some theoretical aspects should be noted (for theoretical review of different approaches to the money market see Ewerhart et al., 2003).

First, we model the overnight interest rate whose behavior is central not only to any money market and discretionary central bank (as a part of transmission channel), but, as we have seen, it is of key significance for the Bulgarian money market (Part 3).

Second, as we already stated, this study uses high frequency data – daily observations. Use of daily data is most appropriate for the analysis of money market volatility and eliminates the heteroscedasticity of the series (Hamilton, 1996). GARCH models provide good possibility to capture not only the factors that affect liquidity demand and supply and the interest rate, but also to identify the factors determining their volatility.

Third, modeling of the seasonal behavior of liquidity and interest rate is particularly interesting (emphasized in the literature, Hamilton, 1996).

Fourth, we construct three independent equations (for liquidity demand, liquidity supply and the interest rate) specifying in detail the various factors affecting them.

(1) Equation of liquidity demand

$$L^D = \alpha_0 + \alpha_1 i + \alpha_2 RR + \alpha_3 G^D + \alpha_4 Spread + \alpha_5 forex + \alpha_6 L(lags) + \varepsilon$$

i – comprises OVNINT variable (this is the interest rate on overnight unsecured deposits denominated in levs, which is the price of demanded liquidity, and expected relationship with the volume is reverse).

RR – a vector comprising variables related to the minimum reserve requirements, namely:

MRRBGN, which is minimum required reserves (MRR) in levs. Demand for reserves in order to meet the regulation requirements influences interbank liquidity, which is the source of liquidity funds. The expected relationship between the variables is positive because if reserve requirements increase then the demand for liquidity rises.

MRRFX – MRR in foreign currency. The above-mentioned effect still holds – when reserve requirements increase demand for liquidity rises.

G^D - a vector describing the influence of government operations upon the demand for deposits. We put the following variables here:

B_NOBUDBUD – payments through BISERA, without BNB participation, from non-budget persons and organizations to the budget. This variable is very important and when it increases the systemic liquidity decreases and this, in turn, leads to rise in the demand for overnight deposits. This variable is forecasted hardly by the banks and very often the concentration mainly of tax payments in the middle of the month leads to large market fluctuations.

B_BUDBUD – payments between budget organizations without BNB participation. This variable is forecasted easier by banks due to better payment coordination and planning as a part of budget process.

Spread – this variable presents the spread between bid and ask EUR/BGN exchange rate on the interbank market. Widening in this systemic risk estimator is expected to increase the precautionary demand in the banking system.

Forex – here, we examine the FX variable, which presents the exchange of euro against levs between commercial banks and BNB[4,] and its growth should lead to decrease in demand for deposits, as it is an alternative source of liquidity.

Lags – lags of the dependent variable, which capture the inertia in the demand for liquidity.

(2) Equation of liquidity supply

$$L^S = \beta_0 + \beta_1 ER + \beta_2 G^S + \beta_3 Season + \beta_4 L(lags) + \varepsilon$$

ER – represents the influence of excess reserves. It consists of the following variable:

ERBGN – excess reserves denominated in levs. If there are excess reserves, banks act optimally aiming profits and try to allocate these excess reserves on the interbank market and to earn incomes, which increases the supply of overnight deposits.

G^S – shows the impact of government on supply. It consists of the variables:

B_BUDNOBUD – payments through BISERA, without BNB participation, of budget to non-budget organizations. It increases the systemic liquidity, is easily forecasted by banks and influences positively the liquidity supply.

[4] Positive sign of the variable indicates that commercial banks buy levs against euro.

PENSIONS – pension payments through the Single account. It is easily forecasted and leads to increase in banks' available funds due to the transfers from the government's deposits to their reserves at BNB and enables them to supply more deposits.

REV_BANKS – other payments from the budget to the banks through the Single account. Bank reserves, systemic liquidity and the ability to supply deposits rise.

Season – includes dummies to model the seasonality:

D2 – represents the beginning of maintaining period on MRR regulation. The effect of meeting minimum reverse requirements is weaker because of possibility for averaging the funds needed during the whole maintenance period. It enables banks to supply more overnight deposits in order to earn incomes. Conventionally, it leads to a growth in supply and a fall in interest rates (Hamilton, 1996).

D_DEC – represents the influence of the last month in the year – December. On principle, the presence of great number of holidays during the month declines banks' willingness to supply liquidity. Many payments are made from and to the budget and the precautionary motive strengthens due to harder forecasting. We should pay much attention to December 2001, which preceded the introduction of euro notes and, thus, required bigger liquidity from any bank.

Lags – represents lags of the dependent variable and measures liquidity supply inertia.

(3) Equation of interest rate

$$i = \gamma_0 + \gamma_1 ER + \beta_2 G + \beta_3 Season + \beta_4 ovneur\,\text{int} + \beta_5 i(lags) + \varepsilon$$

ER – represents the influence of excess reserves. It consists of:

ERBGN - excess reserves denominated in levs. If there are excess reserves banks need less reserves and are able to supply more free funds and the interest rate is expected to fall.

G – shows the influence of government operations on the interest rate. Consists of the following variables:

B_NOBUDBUD – payments through BISERA, without BNB participation, from non-budget persons to the budget. This variable is very important and when it increases the systemic liquidity decreases and this, in turn, leads to rise in the demand for deposits. As we pointed out above,

it is forecasted hardly by the banks and concentration of tax payments in the middle of the month implies higher interest rates.

B_BUDNOBUD – payments through BISERA, without BNB participation, from budget to non-budget persons. It increases the systemic liquidity and is easily forecasted by banks and influences positively the liquidity supply and leads to a fall in interest rates.

BI_NOBUDBUD – payments through BISERA and executed by BNB. It also includes transfers from non-budget persons to the budget, which are forecasted hardly and should raise interest rates.

EXP_BANK – bank expenditures on transfers to the budget that are forecasted hardly and are made through the Single account. They decrease banks' funds and are expected to raise interest rates.

Season – shows the influence of seasonal factors:

D3 – dummy for days in the middle of the month, when tax payments are concentrated and there are high volatility and increase of interest rates.

D_NOV – dummy for November. In 2002, the lack of budget policy optimization led to concentration of large budget outflows in the end of the year. This process started in November and raised to great extent the systemic liquidity and the expected impact of it is a fall in interest rates.

D_APR – April. The conclusion of the previous accounting year is in March, so in April there are large tax payments. This implies higher demand for liquidity and is forecasted hardly by banks, so, the interest rate rises. The interest rate reached the highest levels in the middle of April 2003.

D_WEEK – dummy that includes Fridays and days preceding holidays. These days are characterized by higher precautionary demand and interest rate.

OVNEURINT – interest rate on overnight deposits denominated in euro. It is examined as an opportunity yield to interest in levs and the expected relation is reverse[5].

In equation of interest variation we use seasonal variables, apart from the conventional ARCH component:

[5] The comparison between interest rate on overnight deposits in levs and eonia is not compelety correct because of the fact that there are lags between maintenance periods in Eurozone and Bulgaria. The effects at the end and in the beginning of the maintenance period take plays at different days of the month. The idea is to adapt our maintenance period to this in the Eurozone during the convergence stage.

D4 – days in the end of the month. Two factors are combined: approaching the end of maintaining period and tax payments. Large interest rate fluctuations are observed.

D_JAN – January. In principle, there is a lot of liquidity in the banking system, excess reserves and, thus, interest rate fluctuations are smoothed.

4 Empirical results and discussion

The results from the econometric estimations of equations (1), (2) and (3) are shown in Table 1[6].

The source of the data is BNB statistics. Use of high frequency data limits to some extent the number of available variables. The daily basis allows for an in-depth analysis of the factors that impact the behavior of dependent variables but it sets requirements to the methods of econometric modeling. The data are unique for Bulgaria, not published officially and available only at the BNB. They are monitored on a decentralized basis and this is the first attempt to incorporate them in an integrated analysis.

Data about dependent variables are based on the money market statistics, orderly series existing and being maintained since the beginning of 1998. Interest on deposits exchanged on the money market is the mean based on the transactions effected throughout the day. Monthly information on interest is the mean based on the volumes in the respective days of the month. Data about the money market are available only on business days, which entailed only their inclusion in the analysis. This required processing of the series used in to obtain coincidence of the periods.

The beginning of the period of analysis is predetermined by the beginning of constructing an orderly and economically grounded system of cash flows under the Single Account, which happened in early December 2001. It was then that the beginning of the series of data on budget inflows and outflows was put, based on primary accounting information.

Another source is BISERA, maintaining series of the various types of transfers within the settlement system at specific time. Accumulation of data on the behavior of the RINGS payment system will allow (in the future) to elaborate the analysis by including additional factors.

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[6] Daily data are used, including only business days. Data about the volumes and the various types of cash flows are in thousand BGN, data about interest rates are in percent and the spread between ask and bid price is in BGN.

We also used daily data about commercial banks' reserves at the BNB, the division being mainly into required and excess reserves and into lev and foreign currency components.

Before running the regressions we checked for unit root, and we found that all the series are stationary[7].

In a whole, the results shown in Table 2 demonstrate expected signs of the impact of different factors on the behaviour of the liquidity at interbank market, as well as of the overnight interest rates, that we have mentioned in Part 3.

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[7] All tests are avaibale from autorhs upon request.

Table 2: Empirical results

	Model 1 (interest rate)	Model 2 (demand for liquidity, L^D)	Model 3 (supply of liquidity, L^S)
Variables*	Dependent variable Interest rate	Dependent variable Liquidity volume	Dependent variable Liquidity volume
Mean equation			
Ovnint(-1)	0.62 (41)	-660.12 (-2.35)	
D(ovnint(-2))	-0.04 (-3.93)		
Ovnvol (-1)		0.68 (15.9)	0.85 (37.8)
D(ovnvol(-1))		-0.16 (-3.36)	-0.25 (-4.78)
ERBGN(-1)	-3.43E-06 (-18.86)		0.02 (2.22)
B_nobudbud	2.70E-05 (23.4)	0.08 (1.95)	
Exp_bank	9.50E-06 (11.58)		
B_budbud	-1.16E-05 (-8.9)		
B_budbud(-1)		-0.19 (-2.58)	
BI_nobudbud	0.0004 (3.41)		
Ovneurint	-0.11 (-6.31)		
MRRBGN		0.03 (4.25)	
MRRFX		0.02 (3.84)	
Spread		14085635 (3.42)	
FX		-0.16 (-2.18)	
B_budnobud(1)			0.16 (3.09)
Pensions(1)+Pensions(2)			0.06 (3.12)
Rev_bank(1)+rev_bank(2)			0.09 (1.84)
D2			9890 (4.42)
D3	0.37 (6.22)		
D_apr	0.64 (9.98)		
D_nov	-0.41 (-6.74)		
D-dec			-7674 (-2.69)
D_week	0.14 (3.16)		
Variance equation			
intercept	0.11 (5.72)	2.09E+08 (19.69)	2.22E+0.8 (17.96)
Arch(1)	2.78 (12.38)	0.12 (2.21)	0.12 (2.06)
D4	1.17 (5.45)		
D_jan	-0.09 (-3.41)		
R2	0.53	0.50	0.46
R2 adjusted	0.52	0.49	0.45
log likelihood	-630	-5305	-5308

* z values in parentheses

5 Conclusions

The models of the Bulgarian money market presented by us have good technical characteristics and can be used in forecasting the dynamics of liquidity and interest rates. The hypothesis that the cash flows of the government need cautious monitoring and forecasting is confirmed, as

well as the importance of the institutional innovations (development of the payment system, etc.) for the dynamics of this market. This gains particular importance in the conditions of CB, when the central bank cannot pursue active monetary policy.

Notwithstanding its development, the Bulgarian money market still has not reached that level of maturity when banks will build longer-term relations (credit lines, etc.[8]). Clearly, the market is still segmented and fragmented and individual banks' behavior does not "accommodate" other banks. A microanalysis of the interbank liquidity at bank level will be particularly interesting, making an attempt at explaining not only the behavior of the two groups of banks (those generally borrowing funds and those generally providing funds), but also making an in-depth analysis of the two groups. Our efforts in the next study of the interbank market will focus on this.

[8] On the importance of the relationships between banks, see the analysis of Cocco et al., (2003).

Bibliography

Berlemann, K., N. Nenovsky (2003). Lending of First Versus Lending of Last Resort: The Bulgarian Financial Crisis of 1996/1997, *Comparative Economic Studies,* forthcoming.

Bernholz, Peter (2003): Monetary Regimes and Inflation. History, Economic and Political Relationships, Cheltenham, Edward Elgar.

Camillieri Gilson, Marie-Therese (2002): Policy pre-commitment and institutional design: a synthetic indicator applied to Currency Boards, *OECD Working paper* N 16.

Caporale, G., J. Miller, K. Hristov, N. Nenovsky, B. Petrov (2001). "The banking system in Bulgaria", in *Banking reforms in South-East Europe*, ed. Z. Sevic, Edward Elgar.

Cocco, J., F. Gomes, N. Martins (2003). Lending Relationship in the Interbank Market, mimeo

Della Paolera, Gerardo and Alan Taylor (2002): Internal versus external convertibility and emerging-marker crises: lesson from Argentine History, *Explorations in Economic History*, vol. 39, pp. 357-389.

Dobrinsky, R. (2000). Transition crisis in Bulgaria, *Cambridge Journal of Economics*, vol. 24, n. 5, pp. 581-602.

Ewerhart, C., N. Cassola, S. Ejerskov, N. Valla (2003) The Euro Money Market: Stylized Facts and Open Questions, mimeo 25+9ch

Gaspar, V., H. Mendizabal,G. Perez-Quiros. (2003) Interest Rate Behaviour in the Interbank Market, mimeo

Hamilton, J. (1996). The Daily Market for Federal Funds *Journal of Political Economy*, 1996 vol. 104 no.1

Hanke, S. (2002). "Currency Boards", *Annals of American Academy of Political and Social Science*, 579, pp. 87-105.

Mouré, Kenneth (1998): La politique du Franc Poncaré (1926-1936), Paris, Albin Michel.

Nenovsky, N., K. Hristov, M. Mihaylov (2001). Comparing Currency Board Automatic Mechanism in Bulgaria, Estonia and Lithuania, *Journal des Economistes et des Etudes Humaines*, 2001, vol. XI, n 4, pp. 575 – 616.

Nenovsky, N., K. Hristov (2002). "New Currency Boards and discretion. The empirical evidence from Bulgaria", *Economic Systems*, March, vol.26. n° 1, pp. 55-72.

Nenovsky, N., Y. Rizopolos (2003): Extreme Monetary Regime Change. Evidence from Currency Board Introduction in Bulgaria, *Journal of Economic Issues*, vol. XXXVII, N4, December, pp. 909 – 941

Nenovsky, N., Y. Rizopoulos (2004): Peut-on mesurer le changement institutionnel du régime monétaire ?, *Revue d'économie financière*, vol. 75, 2004, forthcoming.

Petrov, B., (2000). Bank Reserves Dynamics under Currency Board in Bulgaria, *Bulgarian National Bank Discussion Paper, DP/15/00.*

Schuler, Kurt (1992): Currency Board;, Ph.D. Thesis, Fairfax: George Mason University.

Schuler, Kurt (2003): Argentina's Economic Crisis: Causes and Cures; Joint Economic Committee USA Congress, June 2003, available online: http://www.house.gov/jec.

Annexes

Annex 1

Monthly data (mln.)

	Unsecured deposits	Unsecured overnight deposits	Secured deposits	Repo	Total money market	Euro	USD
Minimum	140	55	4	20	286	128	40
Maximum	2204	2146	115	396	2396	764	522
Mean	978	818	38	155	1173	394	190
Standart deviation	572	558	22	82	543	168	96

Monthly data - shared of total money markets (%)

	Unsecured deposits	Unsecured overnight deposits	Secured deposits	Repo
Minimum	39.7	16.0	0.3	2.1
Maximum	97.2	92.0	17.9	51.8
Mean	76.9	60.2	5.0	18.0
Standart deviation	17.2	24.5	4.8	13.2

Monthly data - shares in monetary aggregates

	Money market/M1	Money market/M2
Minimum	0.12	0.05
Maximum	0.47	0.18
Mean	0.30	0.12
Standart deviation	0.09	0.04

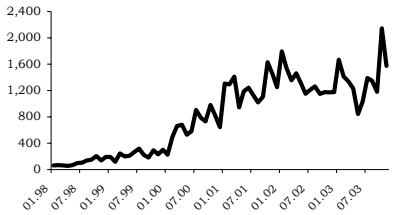
Daily data - overnight unsecured deposits

	Volume (mln. levs)	Interest (%)
Mean	65.74	2.22
Median	63.85	1.56
Maximum	141.84	28.51
Minimum	2.00	0.21
Standart deviation	21.90	2.58

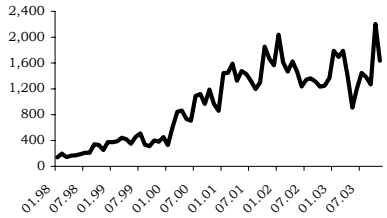
Annex 2

Some trends of Bulgarian money market

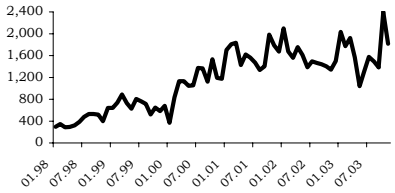
Volumes of unsecured overnight deposits (mln. levs)



Volumes of unsecured deposits (mln. levs)



Volumes total money market (mln. levs)



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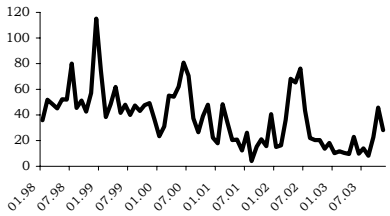
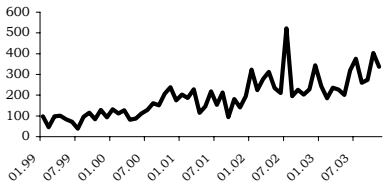
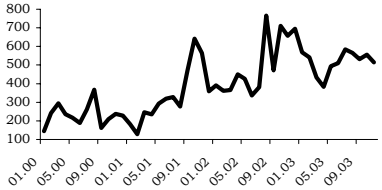


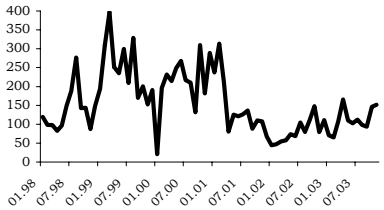
Volumes of deposits in USD (mln.)



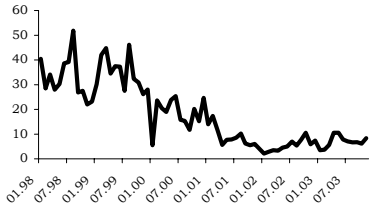
Volumes of deposits in Euro (mln.)



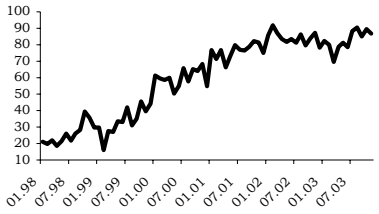
Volumes of Repo (mln. levs)



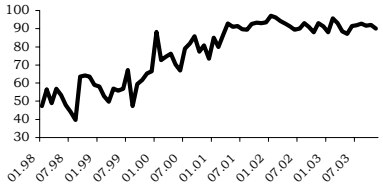
Share of repos of total money market (%)



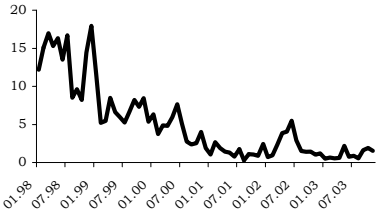
Share of unsecured overnight deposits of total money market (%)



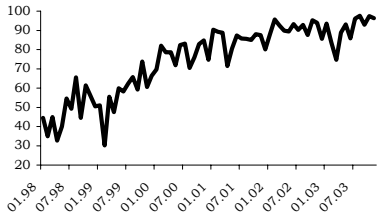
Share of unsecured deposits of total money market (%)



Share of secured deposits of total money market (%)



Share of overnight of unsecured deposits (%)



Annex 3

More on Bulgarian Currency Board

Currency boards (CBs) are typically viewed as some sort of monetary constitution which strengthen the confidence in the monetary system and contribute as a whole to financial stability.[9] In practice, currency boards appear in a great institutional variety (Schuler (1992), Camilleri Gilson (2002)). This diversity can be explained by the specific historical context, namely, the fact that currency boards were established during different historical periods such as for instance in the colonial and post-colonial period, or during the period of post-socialism. When disregarding the details, we can summarize the basic features of modern currency boards as follows:

First, CBs include a legally provided fixed exchange rate pegged to a stable foreign currency, which has strong reputation for preserving purchasing power. It is obligatory for monetary authorities to exchange the national currency upon request against the reserve currency (convertibility principle). In some configurations the reserve currency circulates as a legal tender along with the national currency (as it was f. ex. the case during Argentina's Convertibility period). Second, under a CB the domestic money supply is legally backed (fully or partially) by reserve assets which can easily be converted into the reserve currency. As the currency supply in modern economies exceeds by much the reserve currency (compared to 19th century for instance), this type of regime is more like a fractional form of a gold standard. Third, under CBs there is typically no or only minimal room for monetary policy and lender of last resort functions. Interest rates, typical instruments of discretionary acting central banks, are formed on the interbank money market under CBs. Fourth, CBs include liberalization of capital movement and price flexibility (including interest rates and salaries). This requires an appropriate institutional framework in place for the major economic players. When all these conditions are met there is an "automatic" link between the balance of payments dynamics, the reserve currency

[9] Besides the issues of credibility and confidence there are some additional similarities between CBs and the gold standard: (i) existence of an automatic mechanism, which links both money demand and supply to the balance of payments and leads to a relatively quick adjustment; automaticism means that one way or another there are cause-and-effect chains and two-way interaction whereby without the discretion of a central monetary authority (or with it, while, however, observing the "rules of the game") the balance is adjusted (restored) after a shock, and (ii) both monetary regimes significantly constrain domestic economic policies.

and, finally, domestic money supply. Thus, there is almost no room for discretionary decisions of politicians or central bank officials.[10]

Although it is quite hard to define the pure form of a currency board, Hanke (2003)[11] made an attempt to define such an archetype which will be called "orthodox currency board" in the following. This attempt is quite useful since it allows us to highlight the specific characteristics of the various existing currency boards and helps to explain the success and failures of CBs. Hanke believes that orthodox CBs are those, which in addition to a fixed exchange rate have a few other features, in particular (i) they do not hold domestic assets in their balance sheets, (ii) they have only banknotes and coins as liabilities, (iii) they guarantee full convertibility, (iv) they do not have a lender-of-last-resort function, (v) do not regulate commercial banks, (vi) can not finance government, and (vii) the foreign exchange reserve coverage is 100 - 115%. However, when we in fact use this definition of an orthodox CB, then all contemporary forms of CBs have to be judged as unorthodox (Nenovsky and Hristov (2002)). In the literature we often find the distinction between first- and second generation currency boards. While the term "first generation currency boards" is used for colonial CBs which are quite close to what Hanke calls orthodox CBs, second generation currency boards have a number of discretionary elements. We highlight the nature of these discretionary elements in the next sections at the examples of the Bulgarian and the Argentine CBs. However, a common element of these (and additional) second generation currency boards is that they were introduced to end severe financial crises during which the national currencies lost their basic functions[12]. Second generation CBs are often introduced after a period of fiscal dominance of monetary policy and highly discretionary acting central banks. Again, Argentina and Bulgaria are good examples in this respect. Both countries

[10] When comparing CBs with the gold standard some additional features of CBs stand out. First, when studying examples from history it could be noticed that a CB is a *domestic* monetary arrangement most often employed by individual, usually not advanced, small or medium size economies, while the gold standard was in most of the periods an *international* monetary arrangement. The countries which operate CBs are typically "peripheral" economies. Moreover CBs are typically established in specific periods, such as for instance: (i) during the transition from a colonial system to a national discretionary acting bank (the colonial system) and (ii) after a period of financial crisis, which is itself caused by the monetary discretion of a central bank (Latin America and East Europe). Second, unlike the gold standard a CB is a constructed monetary regime; it does not evolve from the long and spontaneous evolution of money, but rather as a result of the competition (and cooperation) of certain groups of economic actors (Nenovsky and Rizopoulos (2003a,2003b)). Third, contrary to the gold standard the sources of confidence into the national currency are external (imported confidence), and are not based on previous experience, that is, from the evolution of monetary policy itself.

[11] A less detailed definition of an orthodox CB has been given by Schuler (2003), p.19.

also shared another common feature - a so-called "crony economy" and a very poor quality of the political process. The hope to overcome these fundamental (crony) characteristics was one of the reasons for the CB introduction, and ironically, one of the major threats for the stability of the CBs.[13]

In bulgarian case (see table 1) the balance sheet of the Issue Department, which in practice plays the role of the currency board, includes international assets, covering the department's liabilities. The liabilities are comprised of items typical of an orthodox currency board: banknotes and coins, and items typical of second generation currency boards: commercial bank reserves, government fiscal reserves and net worth expressed by the deposit of the Banking Department. The item recording the net worth of the currency board also exists in the orthodox variant but in this case it only plays the role of a buffer which absorbs shocks triggered by asset operations. A positive net worth (expressed by a Banking Department deposit) allows second generation currency boards to perform at least some discretionary monetary policy and provides an opportunity for exercising a strictly limited LOLR-function in the case of systemic banking crisis.

The Banking Department deposit provides the link between the Issue Department and the Banking Department and also reflects the relationship between the government and the central bank. The relationship between the government and the International Monetary Fund passes through the central bank (article 45 of Law on the BNB). This is due to the fact that drawing rights received from the IMF are recorded twice in the balance sheet of the Banking Department. On the one hand the IMF quota is a liability of the Banking department with respect to the IMF, on the other hand it is an asset of the Banking department that is deposited in the Issue Department. Within 90 days of receipt, IMF-tranches are transferred to the government account whereby the Banking Department deposit decreases and the government deposit increases by the same amount. In the balance sheet of the Banking Department this transformation is recorded by crediting the deposit at the Issue Department and debiting the central bank lending to the government item. When the government does not utilize borrowings from the IMF they stay

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[12] In this respect (restoring stability after crisis) some similarity can be down with gold standard restoration in European countries after the First World War (see for more details Bernholz (2003) and Moure, 1998).

[13] The stability of the Argentine CB and the crony economy in Argentina are analysed in della Paolera and Taylor (2002). For a study of the relationship between the corruption-inducive environment and the CB in Bulgaria see Nenovsky et al. (2003).

within the Banking Department deposit, thus providing larger funds for the currency board LOLR function.

Under the Bulgarian CB the main channels of monetary discretion could be divided into two types: traditional and new. The first type is associated with functions inherited from the classical central bank and the second is determined by the specific design of modern, second generation currency boards.

According to classical central bank instruments, in most currency board countries *minimum required reserves* were preserved to different degrees. In Bulgaria minimum required reserves are set in the standard way. This leaves room for central bank manipulation of reserve money and money supply through changes in the level and the reporting methodology for commercial bank minimum required reserves. Usually this tool is used quite sparingly though, despite existing opportunities. In Bulgaria the level of minimum required reserves was set at 11 percent of the commercial bank deposit base upon the introduction of the currency board and has not been modified till June 2000. This is true despite the country's exposure to adverse external shocks related to the Russian Financial Crisis and the Kosovo War. In April 1998 the methodology of reporting minimum required reserves was modified to provide more commercial bank autonomy and flexibility in liquidity management. Since July 2000 BNB has decreased minimum reserves requirements from 11 percent to 8 percent. This decision represents the strategic long run policy of the central bank to gradually reduce the reserve requirements to the 2 percent Euro-area level. After some hesitations in the middle of 2003 the decision to keep government money within the central bank in order to offset shocks generated by the policy of the Ministry of Finance (establishment of a single fiscal account within the central bank) was preserved.

A second function of the central bank under a new generation currency board is to serve as a lender of last resort (for a more detailed description see Berlemann and Nenovsky (2003)). BNB may extend loans in BGN to banks through the Banking Department (up to the level of central bank excess reserves) in the event of a liquidity risk affecting the stability of the banking system only to solvent banks experiencing an acute need of liquidity that cannot be provided from other sources. Such loans could be extended only against collateral of liquid assets and the loan repayment term shall not exceed three months. BNB's Regulation N6 defines liquidity risk as a situation where the amount of the ordered but unpaid payment documents in the RTGS

(previously in the existing net payment system BISERA) exceeds 15 percent of its total amount for each of the last two days.

Another discretionary channel of monetary policy under second generation currency boards is given by the choice of liabilities that have to be backed by reserve currency and the degree of backing. In first generation currency boards liabilities have to be backed at a 100 percent level and the assets to back currency board liabilities have to be issued by nonresidents. Departures from this principle provide possibilities for the pursuit of discretionary monetary policy. Inclusion of *government fiscal reserves* on the liability side of a currency board (i.e. covering them with international reserves) is the major channel of monetary policy transmission in the Bulgarian and Lithuanian versions of currency boards. Therefore, revenue and expenditure policies have a direct impact on reserve money and money supply. In addition privatization revenues, which are a major part of foreign direct investment inflows in the country, go directly to the government deposit with the central bank. This mechanism creates a kind of automatic sterilization of foreign direct investment inflows as far as the central bank is obliged by law to invest its reserves in securities issued by nonresidents (in the case that those privatization revenues are not used to finance government expenditures). In other words, the government may conduct (intentionally or not) some kind of monetary discretion. This mechanism can destroy the automatic link between balance of payments dynamics and reserve money dynamics (Nenovsky and Hristov (2002)). Under these circumstances money market disequilibria do not disappear with interest rate adjustment, as they do under an orthodox currency board, but rather require a management of government reserves in the central bank's balance sheet. Using this opportunity, the government is capable of executing discretion, integrating fiscal and monetary policies into a *syncretic* whole.[14]

[14] Extensive research has been conducted to explore treasury of treasury activity on the liquidity conditions and central banks monetary policies (see for more a survey Petrov, 2000). The main difference under a currency board is that - since central banks do not conduct any kind of monetary policy operations - treasury activities create asymmetric liquidity shocks which could not be offset in practice by the central bank. For instance, Petrov (2000) concludes that treasury operations are the most significant source of shocks on Bulgarian interbank interest rates. Nenovsky et al. (2001) found *liquidity effects* when the fiscal reserve movements impact interbank interest rates. From our point of view major arguments in favor of the inclusion of government reserves on the liability side of the currency board balance are that free movement of capital and high capital mobility cause large capital flow volatility which directly influences reserve money and interest rates since they are automatically linked to the balance of payments. Under these circumstances government fiscal policy approximated with fiscal reserve dynamics in the balance sheet of the currency board may offset shocks and help smooth reserve money and interest rate fluctuations.

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