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Currency Circulation after Currency Board Introduction in Bulgaria

(Transactions Demand, Hoarding, Shadow Economy)

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I. The Necessity and Logic of the Study

Currency in circulation (banknotes and coins) is the most liquid monetary aggregate on which economic agents' behavior is focused because currency as a means of exchange approaches most closely the genesis of money.

It is often assumed that currency circulation dynamics is an indicator for monetization or demonetization of the economy. Undoubtedly, this is important but simplifies the importance of its behavior. Under the currency board regime (CB) the behavior of currency in circulation acquires special significance. This is due to the fact that the volume of banknotes and coins is not determined by the central bank and the primary impulse stems from demand for money by the public and companies. Money supply is endogenous which distinguishes it both from exogenous supply models and those with money supply resulting from the function of monetary authorities reaction under preliminary assumed loss function.

Currency in circulation together with commercial bank reserves are the basic components of reserve money dynamics in which disproportions and disequilibria in the economy finally polarize. Fast and automatic balancing of reserve money demand and supply (through interest rate and the volume of reserve money) is the basic mechanism ensuring the stability of the currency board.[1] It is important to study dynamics in the two key components of demand for reserve money for purposes of systemic risk forecast. No matter wherever the initial shock may come from and a possible attack against the fixed exchange rate may start (micro- or macroeconomic, banking or foreign exchange), this attack inevitably will cause a dramatic change in demand for reserve money and will focus on the liabilities of BNB Issue Department.[2]

The main task of the present study is to give a full overview of the reasons determining dynamics and volatility of currency in circulation. Our approach is microeconomic. The goal of the study determines its logic as follows: *first*, we analyze transactions demand for currency which is considered its major component. *Second*, we focus on cur-

[1] See the study on the seasonal character and volatility of monetary aggregates after the introduction of the currency board in Argentina (*Grubisic, E*., 1995 and *Lopetegui, G*., 1996).

[2] For detailed study of speculative attack models see: *Nenovsky, N., K. Hristov* (1997), *Nenovsky, N., K. Hristov, B. Petrov* (1999).

rency circulation dynamics caused by its use as a means of hoarding which is very interesting in the context of a set of studies in the EU. Last but not least we make an attempt to estimate the relationship between banknotes and coins dynamics and those of the shadow economy. The latter accent is also very interesting because, as far as we know, no attempt to estimate the shadow economy in Bulgaria using the currency circulation method has been made. The study of various motives for currency demand has special significance in the context of currency board operation and replacement of the lev by the euro during Bulgaria's future integration into the European Monetary Union. Analysis is reduced to the above three components of currency behavior, while actually these components are strongly interwoven.

The paper includes the following sections: the second section shows the major trends of currency circulation in Bulgaria after the introduction of the currency board. The third section deals with transactions demand for currency. Estimation of the banknotes and coins for hoarding is presented in the fourth section. The fifth section focuses on the relationship between the currency in circulation and the shadow economy. Finally, in the sixth section we draw some theoretical conclusions and policy implications.

II. Currency Circulation Dynamics after Currency Board Introduction in Bulgaria

In the period following the introduction of the currency board a steady upward trend of banknotes and coins per capita is observed. For the two and a half years under the new monetary regime banknotes and coins per capita have increased by 164% in nominal terms. Having in mind low inflation rates after the introduction of the currency board, the real growth is 124%.

Undoubtedly, the fixed exchange rate has a stabilizing effect on the dynamics of banknotes and coins per capita. This effect restored demand for banknotes and coins in national currency by reducing inflation and overcoming inflationary expectations. This effect is consistent with exchange rate based stabilization programs when restoration of real money balances occur after hyperinflation (*Rebelo, S., C. Vegh, 1996*). It finds expression in the fact that economic agents adjust their real money balances to the desired level. Real money balances effect

becomes a basic transmission mechanism and it may be interpreted through money inclusion in the utility function or budget constraints of economic agents.

As is well known, the term of foreign currency substitution and restoration of the national currency as a means of circulation is determined by the credibility of the fixed exchange rate regime. Progressively increasing rates of banknotes and coins after expiry of the initial stabilization effect of the currency board show that other factors affecting its dynamics exist. This is confirmed by the higher rates of banknote and coin increase per capita compared with those of money expenses.

Table 1

CURRENCY CIRCULATION DYNAMICS AFTER CURRENCY BOARD INTRODUCTION IN BULGARIA

	VI'97	IX'97	XII'97	III'98	VI'98	IX'98	XII'98	III'99	VI'99	IX'99	XII'99
C	67	113	150	166	172	172	199	202	180	199	236
ΔC/C	-	68.7	32.7	10.7	3.6	0.0	15.7	1.5	-10.9	10.6	18.6
ΔME/ME	-	48.5	25.1	4.3	4.0	1.8	13.2	-1.0	-4.8	1.6	11.3
AW	157	171	191	190	199	208	213	216	220	238	236
DC	5	6	8	9	10	11	13	16	21	24	32
C/M3	14	18	21	24	23	23	25	27	24	24	27
N50/C	24	47	50	50	52	54	57	59	61	52	50
N20/C										23	23
N10/C	15	9	18	20	21	23	22	22	22	15	14

C – banknotes and coins per capita (in levs);
ΔC/C – percentage growth of banknotes and coins per capita;
ΔME/ME – percentage growth of household money expenses per capita;
AW – average wage in public sector[3];
DC – number of debit cards per 1,000 persons;
N50/C – share of 50-lev banknotes in currency circulation;
N20/C – share of 20-lev banknotes in currency circulation;
N10/C – share of 10-lev banknotes in currency circulation.

[3] The average wage in the private sector is not presented here, since officially reported levels are much lower than those in the public sector which makes the data questionable.

The increased demand for banknotes can be explained by their use for hoarding, in the shadow economy and as a means of circulation and saving by economic agents abroad. The latter is characteristic of countries with stable national currency, as the USA, Germany, Switzerland and Japan.[4] This factor is of no importance for Bulgaria. Currency hoarding and shadow activities service affects most significantly demand for banknotes in Bulgaria. The progressively growing share of currency circulation in M3 is an indicator of increased demand for banknotes. This process is accompanied by a relatively dynamic development of the payment system (retail payments); number of debit cards and volume of payments with them increases steadily in the period after currency board introduction in Bulgaria (see Appendix 1).

The growing share of the two largest denominations in currency circulation proves that they are increasingly used for hoarding and servicing of the shadow economy and not for transactions in the official economy. At the end of 1999 the two largest denominations (BGN 20 and BGN 50) comprised 73% of the currency in circulation (see Appendix 1). Having in mind the structure of household expenses (expenses on food accounting for over 50%), the structure of relative prices and the level of officially registered incomes in the country, we can certainly argue that the two largest denominations are rarely used for transactions service in the official economy.

III. Transactions Demand for Currency

1. The Methodology and the Model

Banknotes and coins are used mainly as a means of exchange which determines the leading role of the transactions motif of demand for currency. The basic impulse for banknotes and coins demand comes from the public, the private business and the public sector. The demand passes through the commercial banks which are the major intermediary between the public, the business and the public sector, on the one hand, and the central bank, on the other. Finally, demand reaches the central

[4] See the studies of *Sprenkle, C.* (1993*), Judson, R., R. Porter* (1996), *Anderson, R. A., R. H. Rasche* (2000) on circulation of the US dollar outside the USA, the study of *Seitz, F.* (1995) on the use of the Deutschemark outside Germany and the study of *Rogoff, K.* (1998) which summarizes circulation of US dollars, Japanese yens and Deutschemarks outside the territory of the countries issuing these currencies.

bank which can supply the needs of currency in circulation against another type of assets. A summarized model of demand for currency (in real terms) may be presented as follows:

$$C^d/P = c\ (Y, \mathbf{R}, n), \quad (4)$$

and

$$\mathbf{R} = [i^{out}, i^{own}, \pi^e, Var\ (\pi)], \quad (5)$$

where

C – currency circulation in nominal terms;
P – general price level;
Y – variable approximating real sector development;
R – vector of assets prices in economic agents' portfolios;
i^{out} – yield of noncash financial assets;
i^{own} – currency yield;
π^e – projected inflation rate;
Var (π) – variance of inflation;
n – proxy of payment system development and financial intermediation.

2. Statistical Data and Results

Following the above theoretical model of demand for banknotes and coins by households and companies, we can build the following operational model.[5]

With the exception of the shadow economy, demand for banknotes and coins is most closely connected with households and companies which produce consumer goods. We follow a widely held approach in modeling transactions demand for banknotes and coins for use of household expenditure as proxy of demand transactions component. It is considered that household money expenses are more closely connected with demand for currency circulation than money income (*Boeschoten, W., 1992, Breedon, F., P. Fisher, 1993, Janssen, N., 1998*). To measure demand for banknotes and coins by companies producing consumer goods, we use receipts from retail sales as an additional transactions variable. We also use household money expenses and receipts from sales estimated on the basis of the National Statistical Institute (NSI) methodology (1998). Approximately 80 – 82% of money expenses are consumer expenses used in the formation of weights for calculation of the consumer price index. This gives us grounds to use the

[5] Recently, sector models have been increasingly used for study of currency circulation (usually households and business) which is a result of asymmetrically located liquidity in the real sector (*Butkiewicz, J., M. McConnel, 1995).*

consumer price index as a variable describing influence of the price level on demand for banknotes and coins.

In contrast to the general models of demand for money where it is estimated in real terms, demand for banknotes and coins is estimated in nominal terms. Under these conditions, in order to estimate the influence of price level on demand for currency, we add inflation rate measured through the consumer price index as an explanatory variable. We define vector **R** based on prices of assets which the economic agents may use in their portfolios, i. e. yield of current accounts in levs, yield of current accounts in US dollars, yield of time deposits in levs, yield of time deposits in US dollars, yield of government securities, and the BGN/USD exchange rate. We include the BGN/USD exchange rate as an opportunity cost of holding banknotes and coins in demand function having in mind the high level of unofficial dollarization in the country and economic agents' preference for saving money in foreign currency. As proxy of financial and payment system development impacting essentially demand for banknotes and coins by households and companies, we use number of ATMs, number of issued credit and debit cards, number of POS terminals and number and volume of transactions conducted via ATMs. Influence of financial innovations and payment and financial system development are estimated using the above variables (not the cumulative interest rate term used in some studies).[6]

We analyze the period after currency board introduction in the country until December 1999 using monthly data from BNB monetary statistics and NSI statistics on household budgets and retail sales. Data on variables used as proxy of the degree of financial and payment system development are based on BORICA (Banking Organization for Payments Initiated by Cards) statistics. All variables are seasonally adjusted using the standard CENSUS X11 procedure. All series with the exception of the interest rate and inflation rate are given in logarithm. The series of ATM number, POS terminals and debit cards are presented per capita. Estimated functions of transactions demand for banknotes and coins are displayed in Table 2 (**t**-statistics are shown in the brackets).

[6] For presenting models of demand for banknotes and coins where the cumulative interest rate is used as proxy of the degree of financial and payment system development, see *Breedon, F., P. Fisher (1993), Astley, M., A. Haldane (1995)* and *Janssen, N. (1998)*.

Table 2

TRANSACTIONS DEMAND FOR CURRENCY MODELS (DEPENDENT VARIABLE C)

Variables	Model 1	Model 2	Model 3	Model 4
Constant	11.95	8.41	6.03	7.64
	(5.00)	(4.54)	(2.49)	(2.75)
C(-1)	0.43	0.41	0.71	0.63
	(5.57)	(4.93)	(20.03)	(10.37)
ME	0.29	0.38	-	-
	(2.18)	(2.90)		
RS	-		0.18	0.11
			(2.12)	(1.21)
I	-	-0.009	-	-0.007
		(-2.96)		(-1.82)
E	-0.32	-	-0.26	-
	(-1.97)		(-1.47)	
π	-0.008	-0.009	-0.0003	-0.007
	(-2.06)	(-2.12)	(-0.081)	(-1.43)
ATM	0.48	0.43	0.26	0.39
	(4.78)	(3.95)	(2.29)	(2.93)
ATMW	-0.22	-0.22	-0.11	-0.19
	(-3.42)	(-3.07)	(-1.41)	(-2.22)
POS	-	-	-	-
CARDS	-	-	-	-
R^2	0.98	0.99	0.98	0.98
Adjusted R^2	0.98	0.98	0.98	0.98
S.E. of regression	0.02	0.03	0.03	0.03
DW Statistics	1.67	1.71	1.82	1.26

where

C – currency circulation;
ME – monetary expenses of households;
RS – retail sales;
I – interest rate on time deposits in levs;
E – monthly average BGN/USD exchange rate;
π – monthly inflation;
ATM – number of ATMs;
ATMW – volume of withdrawals from ATMs;
POS – number of POS terminals;
CARDS – number of debit cards.

Table 2 shows estimated results of major tested models for estimation of transactions demand for banknotes and coins. Household monetary expenses and retail sales have been used as variables approximating demand for banknotes and coins for purely transactions purposes. Models based on household expenses show better results than those based on retail sales. Elasticity of demand for banknotes and coins regarding household monetary expenses is **0.29** and **0.36** respectively dependent on whether the BGN/USD exchange rate or the interest rate on lev time deposits is used as an opportunity cost of holding currency (*Model 1* and *Model 2* respectively). In both models the obtained elasticities are statistically significant and have positive signs which correspond to the elasticities derived in the theory. Elasticity levels of demand for currency in circulation in both models are close to the elasticity level of **0.5** theoretically derived in the *Baumol* model (1952).

The models based on retail sales show relatively worse results. The elasticity of demand for banknotes and coins regarding retail sales is **0.18** and **0.11** respectively dependent on whether the BGN/USD exchange rate or the interest rate on lev time deposits is used as an opportunity cost of holding currency (*Model 3* and *Model 4* respectively). Both coefficients are with the expected positive signs and the elasticity of demand for banknotes to retail sales in Model 4 is statistically insignificant. In the models based on retail sales obtained elasticities of **0.18** and **0.11** respectively deviate significantly from the theoretically expected elasticity of **0.5**.

The results are an additional proof of the adopted view in studying demand for banknotes that household expenses are the best proxy of transactions demand for currency.

Interest rates on time deposits and the BGN/USD exchange rate are considered as an opportunity cost of holding banknotes in the tested models. The use of the BGN/USD exchange rate reflects the fact that the BGN/USD exchange rate is one of the major relative prices in the economy due to sustained significant dollarization despite the fixed exchange rate under the currency board.[7] In the model based on household monetary expenses the BGN/USD exchange rate is statistically significant and the elasticity is **-0.32**. In models based on retail sales the ex-

[7] In this context dollarization means unofficial dollarization in the form of the so-called assets substitution. For more details, see *Calvo, G., C. Vegh* (1992), *Giovanni, A., B. Turtelboom* (1992), *Guidotti, P, C. Rodriguez* (1992).

change rate is insignificant. In both cases the elasticity of demand for banknotes in respect of the exchange rate has the expected negative sign.

Using interest rates on time deposits as an opportunity cost of holding banknotes and coins, the elasticity of demand for banknotes in respect of the interest rate is very low (**-0.02** for both models). This elasticity obtains the theoretically expected sign but deviates significantly from the elasticity of **-0.5** derived in the *Baumol* model. These results – though significantly deviating from theoretically expected elasticities – are not surprising taking into account the low levels of time deposit rates. Given significantly higher interest rates on deposits in US dollars and lower inflation in the USA during the period under review, the BGN/USD exchange rate proves to be a better proxy of the opportunity cost of holding banknotes in levs.

As demand for banknotes is studied in nominal terms, monthly inflation rates have been included as an explanatory variable. In all tested models inflation impacts the demand for banknotes with a negative sign, and elasticities obtained are less than **1%**. These results do not correspond to the expected positive sign of inflation in the demand for money equation. A higher price level should prompt greater demand for banknotes and coins in nominal terms. The negative sign of inflation reflects its volatility after the currency board introduction. In most months of 1998 and several months of 1999, monthly inflation was negative (deflation), which coupled with a progressively increasing currency in circulation resulted in negative elasticity of demand for banknotes and coins in respect of inflation.

In modeling transactions demand for banknotes and coins the following four variables approximating the degree of Bulgaria's financial and payment system development are used: number of ATMs, volume of withdrawals from ATMs, number of issued debit cards and number of POS terminals. Estimates of the models indicate that the number of POS terminals and debit cards is statistically insignificant. Therefore, these variables have not been included in estimating final results of demand for banknotes and coins. The statistical insignificance of this variable is attributable to a certain extent to the small number of POS terminals across the country.

The case with debit cards is quite the opposite: following the introduction of the currency board the number of debit cards dramatically increased (see the right-hand chart in Appendix 2, p. 35). The impact

of a rapidly growing number of debit cards is shown by the volume of withdrawals from ATMs which are statistically significant, and the elasticity ranges between **-0.11** and **-0.22**.

The number of ATMs is also statistically significant in all estimated models in this paper, with the obtained elasticities varying between 0.26 and 0.48. The signs of the variables approximating the development of financial and payment systems should be very carefully interpreted, since the effect of these variables on the demand for currency is divergent. As is well known from theory and empirical research ATMs have an ambiguous effect on demand for banknotes *(Boeschoten, W., 1992; Viren, M., 1989)*. On the one hand, ATMs encourage the use of banknotes facilitating cash acquisition. In addition, the increase in the number of ATMs impacts directly the volume of banknotes in circulation due to a growing need of greater volumes of banknotes to be kept as reserves in ATMs (this effect occurs in denominations of 10 and 20 levs which are used for the ATMs in the Bulgarian banking system). Concurrently, easier provision of banknotes reduces transactions costs resulting in lower monetary reserves held by economic agents. The final result of the interaction between the above effects in the case of Bulgaria indicates that card holders make less transactions while their amount has progressively increased after the introduction of the currency board (see the left-hand chart in Appendix 2, p. 35). Under low inflation rates after 1997 the increased volume of withdrawals is indicative not only of a purely nominal effect but also of card holders preference for holding bigger real money balances.

The effect of ATMs on demand for banknotes influences only the part tied to household demand. Demand for currency in circulation by the real[8] and shadow economies, as well as for hoarding is impacted to a smaller extent by the number of ATMs. Consequently, it is impossible to determine whether the positive or negative effect of ATMs on demand for banknotes is dominating.

To assess the stability of estimated coefficients in the tested models, the standard recursive CUSUM and CUSUMSQ tests[9] are used. Stabil-

[8] Undoubtedly, the number of ATMs influence demand for banknotes by the real economy but the impact is not the same as in household demand. For example, in France law provides for compulsory payment of salaries on account which significantly enhance the impact on demand for banknotes both by the real economy and households.

[9] For description of the characteristics of stability tests of estimated coefficients, see *Johnston, J., J. Di Nardo* (1997).

ity tests of estimated coefficients in the tested models are shown in Appendix 3. The results clearly show that none of the tests is outside the 5% confidence interval which is indicative of the stability of estimated coefficients. In other words, the models indicate stability of transactions demand for currency, a basis for predictability of this variable.

IV. Demand for Currency Intended for Hoarding

1. The Importance

The second major motif of demand for currency in circulation is the economic agents' willingness to save (hoard) in cash. Two forms of hoarding can be distinguished: hoarding associated with the official economy and hoarding associated with the shadow economy. Under the first form economic agents decide on voluntary hoarding of a portion of their savings in banknotes since the income on alternative assets is smaller than transactions costs on portfolio transformation; in general this type of saving can be called '*fair, gratuitous*.' The second form of saving in banknotes relates to servicing the shadow (unofficial) economy. It is used in illegal transactions, tax evasion and various social security contributions and other compulsory payments to the government. The studies of *Boeschoten, W.* (1992), *Van Hove, L., J. Vuchelen* (1996) as well as of *Van Hove, L., J. Vuchelen* (1999) and *Van Hove* (1999) give a relatively clear picture of hoarding in the form of banknotes in developed countries. As far as we know, there is no such study on transition economies.

The analysis of banknote hoarding in Bulgaria would be useful in several aspects. *First*, the share of the two biggest denominations has increased in the total value of currency circulation. There are various reasons behind this growth but it may be assumed that this growth reflects the stabilization effect, a result of currency board introduction and the pegged exchange rate which significantly reduce the exchange rate risk and low income of other assets. In this situation it is much more profitable to hoard Bulgarian banknotes, profiting significantly from tax evasion. This appears to be a paradox: the stabilization boosts profits from tax evasion. *Second*, with the fixed exchange rate, and particularly the currency board under which the amount of currency in circulation is entirely demand driven, an estimation of banknote hoarding would be useful in the exchange of banknotes against reserve currency,

i. e. this will count for the exchange rate stability[10]. *Third*, such estimation (later adjusted with the direct estimation of shadow economy) may give a picture of the size of shadow economy. This appears to be of particular importance in estimating GDP produced in the country (officially registered and illegal) which is significantly undervalued under a sizable share of the shadow economy, hence worsening most macroeconomic indicators. In the context of Bulgaria's pending accession to the European Union this appears to be of essential importance for meeting nominal and real membership criteria as well as Bulgaria's capital quota in the European Central Bank.

2. The Methodology

The methods for estimation of banknote hoarding are well known and initially described by *Anderson, P*. (1977). Later, the estimation methods have been improved and applied many times (*Sumner, S*., 1990; *Boeschoten*, *W*., 1992; *Van Hove*, *L*., *J. Vuchelen*, 1996; *Pedersen, E*., *T. Waganer*, 1996; *Van Hove, L*., *J. Vuchelen*, 1999; *Van Hove, L*., 1999).

The volume of hoarded banknotes can be measured using three different methods: the lifetime method, the frequency-of-return method and the seasonal demand method.[11]

In the present study the lifetime method which is most popular is applied. The choice of this method was predetermined mostly by available data. The method applied follows the logic described below.

The average life of the banknotes of a particular denomination is re-

[10] It may be argued that under a currency board conversion of sizable volumes of national currency into reserve currency should not be treated as a speculative attack against the fixed exchange rate. This argument is based on the explicit central bank's commitment to exchange unconditionally national currency for reserve currency at a fixed exchange rate. Based on theory and empirical tests defining exchange rate crises as a combination of changes in the level of the fixed exchange rate, decreased international reserves and increased interest rates, we assume that the exchange of sizable volumes of national currency into reserve currency should be considered as a speculative attack against the fixed exchange rate (for detailed description of the models of speculative attacks against the fixed exchange rate, see *Krugman, P*., 1979, 1996; *Obstfeld, M*., 1986, 1994; *Kaminsky, G*., *S. Lizondo* and *K. Reinhart*, 1998; *Frankel, Y*. and *A. Rose*, 1996; *Berg, A*. and *C. Pattillo*, 1998). Attacks against the Argentinian peso in 1995 and 1996 and Hong Kong dollar in 1998 are clear examples of attacks against a currency board (for detailed description, see *Caprio, G*., *M. Dooley*, *D. Leipziger* and *C. Walsh*, 1996; *Cavallo*, 1997; *Cheng, L*., *F. Lui*, 1999, 2000). Possibilities for successful attacks against a currency board, depending on the extent to which the government is able to maintain a fixed exchange rate, are beyond the scope of this study.

[11] For detailed review, see *Van Hove, L.* (1999).

garded as proxy of the intensity of use of that denomination. Based on such logic of measurement, the longer life of larger denomination banknotes is assumed as a signal of the existence of hoarding. The percentage of hoarded banknotes of a particular denomination is calculated as the difference between the average life of that banknote denomination and the average life of a smaller banknote denomination. The basic assumption here is that smaller denomination banknotes are used only for transactions purposes.

The average life of denominations is defined as the average period between the banknotes' issue and destruction.

$$AL_{it} = \frac{C_{it} + C_{it-1}}{N_{it} + D_{it}},$$

where,

AL_{it} – average life of the banknote;
C_{it} – number of circulating banknotes of a particular denomination (end of period);
N_{it} – number of newly issued banknotes of a particular denomination;
D_{it} – number of banknotes of a particular denomination withdrawn from circulation.

The above formula shows the actual life of the banknotes in stable macroeconomic environment. If the circulation of banknotes undergoes changes in the analyzed period, or a new banknote or series is introduced, the estimated average life is significantly affected by those short-term fluctuations.

Based on the assumption that smaller denominations are used only for transactions purposes and are not being hoarded, we take their average life as *the normal average life of the banknotes*. It should be taken into account that the average life of smaller denominations is not constant over time and varies for different denominations[12].

[12] *Boeschoten, W.* (1992) adds another consideration. According to him, inflation dynamics considerably impacts the life of banknotes as it causes changes in the average life of smaller denominations by reducing their real value. If this effect is disregarded, the estimate of hoarding will shift toward overvaluation of its level. The author measures this effect through regression, relating the estimated average life of a particular denomination to its real value:

$AL_t = \alpha + \beta \, Ln \, RD_t + \varepsilon_t$,

where Al_t is the estimated average life of the banknotes, and RD_t is the real value of the respective denomination.

The second step involves estimation of the very hoarding by denominations using the formula:

$$HP_{it} = \frac{AL_{it} - NAL_{it}}{AL_{it}},$$

where

HP_{it} – percentage of hoarded banknotes of a particular denomination;
AL_{it} – real average life of the banknotes of a particular denomination;
NAL_{it} – estimated normal average life of the banknotes of a particular denomination.

The second method applied by us for estimating the size of hoarded banknotes is that of the Swiss banker *Jean-Claude Hentsch*. In his survey on the optimum denomination composition carried out in the 1970s and the 1980s (published in the *Journal de la Societe de Statistique de Paris*, 1973, 1973a, 1983, 1985) he made the curious observation that under *échelonnement harmonique* (i.e. the ratio between two consecutive members of the series is a constant) the circulating volume of a particular denomination is proportionate to the square root of that denomination.

The author obtained the adjusted value for each denomination using the formula $\frac{V_i}{\sqrt{v_i}}$, where V_i is the circulating volume of a particular banknote i, and v is the denomination itself, comparing it with the optimal value for each denomination, which is identical for all denominations, and is calculated by the formula:

$$\frac{\sum_{i=1}^{I} V_i}{\sum_{i=1}^{I} \sqrt{v_i}}.$$

Using his own methodology, Hentsch estimated the adjusted (ideal) volume of each banknote and compared it with the actual (real) one, initially for Switzerland and France, and then for other developed countries. Where there is deviation from the optimum series such as the series 1 2 5 10 20 50 (because between 2 and 5 and 20 and 50 the ratio is 2.5, not 2 as with the other denominations) the so-called tooth shapes emerge between the adjusted and the actual volume of a particular de-

nomination[13]. While *Jean-Claude Hentsch* notices the fact that large denominations in France and Switzerland are used for hoarding, which explains the deviation from the square root rule, he does not apply his method for estimation of hoarding. The Belgian authors *Van Hove, L.* and *J. Vuchelen* made an original contribution by demonstrating that one of the major factors for the deviation from the square root principle is due namely to the hoarding of large denomination banknotes (*Van Hove, L. and J. Vuchelen*, 1996).

3. The Estimate for Bulgaria

3.1. Estimation through the Average Life of the Banknotes

To calculate banknote demand for hoarding purposes we use monthly data on the number of banknotes of each denomination in circulation, the number of newly issued banknotes and the number of destroyed banknotes of each denomination (data is provided by the BNB Cash Operations Directorate). This allows us to calculate the average life of each denomination using the above formula. We take the life of the 1-lev banknote (1,000 old levs) as the normal average life of the banknotes and assume that it is used only for transactions purposes, not for hoarding. After obtaining the average life of the banknotes we calculate hoarding for each of the denominations with the exception of the new banknote of 20 levs as it has been in circulation since mid-1999.

The estimates of banknote hoarding correspond to a great extent to those obtained using the *Hentsch* method. The obtained result shows that approximately **30%** of 10-lev circulating banknotes were used for hoarding in 1999. In absolute terms this means that out of the 321 million levs of the 10-lev denomination circulating during the year, **96.5** *million levs were used for hoarding*, not for transactions purposes. For the 50-lev banknote estimates show that **44%** of the circulating banknotes of this denomination were used for hoarding in 1999. In absolute terms this means that out of the 948 million levs of circulating banknotes of this denomination, *417 million levs* were used for hoarding. If our estimate of *513.5 million levs* in banknotes of 10 and 50 levs are used only for hoarding and do not service the shadow economy, these would comprise approximately 12% of savings in the Bulgarian

[13] *Hentsch* himself (1973, 1985) regards the above allocation as more cost-effective than the optimum one in the context of price indices.

banking system in 1999.

Such large volume of liquidity outside the banking system, being almost equal to the average annual amount of commercial banks' reserves (638 million levs), can trigger a strong impulse for speculative attack against the fixed exchange rate if expectations change and currency board credibility erode.[14]

Before we present the results obtained from applying the *Hentsch* method, we should note some of the limitations of the model based on the average life of the banknotes, preset by the dynamics of macroeconomic indicators in the transition period.

High inflation rates between 1991 and mid-1997 did not provide for the pursuit of consistent issuing policy, which entailed the launch of a sequence of new denominations. This policy affected strongly the average life of denominations. Due to this specific development, we focus our study on the period from mid-1997 to end-1999. This predetermined our choice of monthly data. We do not estimate hoarding for 1998 because we regard the increased demand for large denominations as being related to the recovery of real money balances in the wake of financial stabilization. Moreover, the estimate of the average life of the 50-lev banknote in 1998 is strongly biased due to the fact that it was introduced in May 1997.

The redenomination launched in the second half of 1999 affected the estimated volume of hoarded banknotes of 10 and 50 levs (toward undervaluation). The redenomination impacted significantly the process of destroying old banknotes and introducing new denominations, which affected the average life of the banknotes of each denomination (see the formula for estimation of the average life of banknotes). At the same time, the introduction of the new 20-lev banknote shifted hoarding away from the 10-lev banknote to that banknote (this is confirmed in the text below on the application of the *Hentsch* method). Due to the short life of the 20-lev banknote this effect cannot be measured through the method of the average life of banknotes, which leads to undervaluation of hoarding.

[14] The banknotes used for transactions purposes can also be used for a speculative attack , but as is well known from empirical studies flight from the national currency begins initially with the so-called *asset substitution*, i.e. savings are redenominated into foreign currency, to be followed by *currency substitution*, i.e. the use of foreign currency as a means of exchange. For a more detailed presentation, see *Calvo, G., C. Vegh* (1992), *Giovanni, A., B. Turtelboom* (1992), *Guidotti, P., C. Rodriguez* (1992).

3.2. Estimation by the Hentsch Method

The second key element of our analysis of hoarding involves the application of the Hentsch method. This approach is based on deviations from the square root rule, which we interpret, similarly to *Van Hove, L. and J. Vuchelen*, as the use of a particular denomination for transactions purposes (below the zero line) and for hoarding and saving (above the zero line)[15].

Chart 1

USE OF BANKNOTES OF 1, 2 AND 5 LEVS FOR TRANSACTIONS PURPOSES (BELOW THE ZERO LINE) AND FOR HOARDING (ABOVE THE ZERO LINE) – LOGARITHMIC SCALE

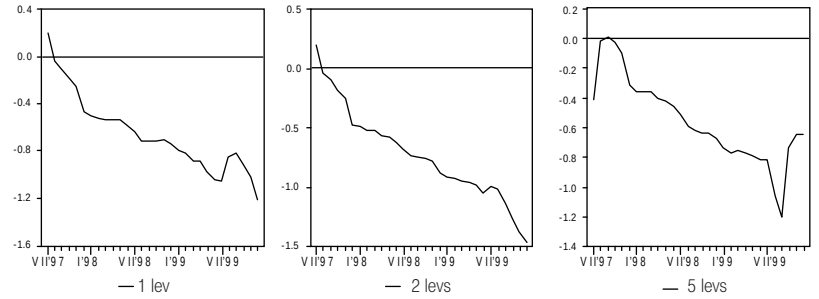
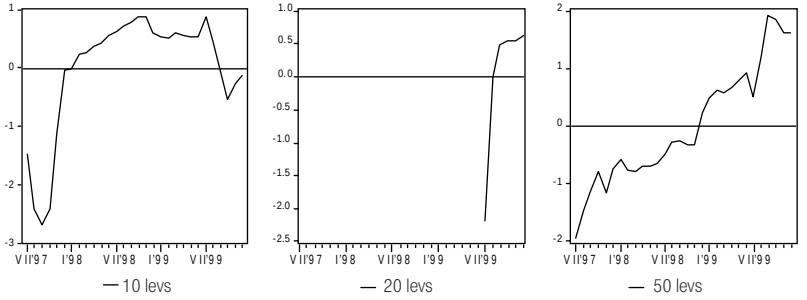


Chart 2

USE OF BANKNOTES OF 10, 20 AND 50 LEVS FOR TRANSACTIONS PURPOSES (BELOW THE ZERO LINE) AND FOR HOARDING (ABOVE THE ZERO LINE) – LOGARITHMIC SCALE



[15] Adjusted optimal values on Charts 1 and 2 are represented by the zero line. A logarithmic scale is used.

The estimates of hoarding using the *Hentsch* method confirm to a great extent the estimates obtained by applying the average life of the banknotes method, supplementing them. Clearly, the three small denominations are used for transactions purposes and their volume is below the optimum, i.e. in practice these service the bulk of transactions in the economy. Since early 1999 the 50-lev banknotes, and since June 1999 the 20-lev banknotes have been used for hoarding. Their volume is above the optimum under the *Hentsch* rule. The dynamics of the 10-lev denomination experienced two breaks: *first,* in early 1998 this banknote was used both to service transactions and for hoarding, and, *second*, after the 20-lev banknote was put into circulation the 10-lev banknote came to be used only for transactions purposes. In general, the assumption that the two large denominations were used mostly for cash saving (or for effecting transactions in the shadow economy) is confirmed. Charts 1 and 2 illustrate the application of the *Hentsch* method. They confirm the existence of hoarding for the 50-lev and 10-lev banknotes (the old 50,000 and 10,000), and for the 20-lev banknote after its circulation. Undoubtedly, deviations from the optimum volume of each banknote are caused by other important factors such as the velocity of circulation of denominations consistent with development of the payment system, as well as the structure of relative prices in the economy. Moreover, the purely psychological factors should also be taken into account since they influence preferences for using different denominations and their velocity of circulation[16].

V. Estimation of the Shadow Economy through Demand for Currency

1. The Importance

The importance of an even relative estimate of the shadow economy is understandable. Such an estimate gives a clearer picture of the economic development of a country, which reflects on all macroeconomic, financial and debt ratios. Such an estimate shows, within a certain frame, what portion of the generated revenue could surface and raise

[16] According to sociological studies the form, size and composition of the amount influence the use of denominations. For example, one and the same amount of 50 levs represented by one denomination is spent more slowly than the same amount represented by 50 pieces of 1-lev denomination (for details, see *Malahov, C.,* 1992).

the officially recorded revenue of the government. Even though the estimate in itself cannot improve the officially calculated GDP, it would be instrumental in making fiscal and monetary decisions. The share of the shadow economy, for example, may serve as useful information in the negotiations for Bulgaria's accession to the European Union and the European Monetary Union. The gross domestic product – through its presence in the multiple criteria for real and nominal convergence – is a key indicator for the integration into the European Union and the European Monetary Union. As is well known, the share of the shadow economy in the transition countries, including Bulgaria, is substantial. Estimates for Bulgaria range from 30 – 40% (*Staikov, I., P. Dimitrova,* 1999), 23% (NSI, 1999) to 35% (*Schmeider, F., D. Enste,* 1999, 2000).

2. *The Methodology*

Quantifying the shadow economy through the number of banknotes and coins is a sub-case of a general model of measuring the shadow economy (*Bhattacharaya, D.,* 1999) which looks like this:

$$X = f(Y_{OF}, Y_{SH}, \mathbf{R}),$$

where

X – a particular type of economic activity (demand for currency circulation, general household spending, electricity consumption, etc.);
Y_{OF} – officially recorded revenue or output;
Y_{SH} – shadow income or output;
R – vector of other variables determining X.

Attempts at estimating the shadow economy through the currency in circulation have a long history (*Cagan, P,* 1958, and *Gutmann, P.,* 1977)[17]. Vito Tanzi argues that while the shadow economy is serviced predominantly through banknotes and coins, its growth will lead to a growth in the currency demand. In the function of the demand for banknotes and coins he includes the average weighted tax rate (direct and indirect taxes) as proxy of the shadow economy (*Tanzi, V.,* 1983). The Tanzi method, widely applied in developed and developing countries, involves the following procedure:

[17] A detailed survey of the reasons, the size and methods for measuring the shadow economy is conducted by *Enste, D., F. Schmeider* (1999, 2000), and by *Thomas, J.* (1999), *Giles, D.* (1999), *Hill, R., M. Kabir* (2000).

First, comparison is made between the econometrically estimated currency dynamics when the tax burden and government regulation are at their lowest and highest levels. The difference between the two estimates of the demand for banknotes and coins is proxy of the shadow economy (determined by the higher tax burden).

The *second* step is based on the assumption of the constant velocity of currency circulation in the shadow economy and in the official economy. Based on the above assumption, the shadow economy is quantified and compared with the official gross domestic product (*Enste, D., F. Schmeider,* 1999, 2000).

3. The Estimate for Bulgaria

In order to accommodate the standard methodology described above to the specificity of Bulgaria and the analyzed period (after the introduction of the currency board), we modify the *Tanzi* procedure and reduce it to the following logical order:

1. A function of *the demand for banknotes and coins* (C^d) with and without tax burden (t) is constructed as proxy of the benefits of hiding income (i.e. the shadow economy). As proxy of the tax burden we take the ratio of *tax revenues to total consumer expenditures*. It is assumed that the demand for banknotes with a shadow economy is greater than that without a shadow economy (i.e. the sign for elasticity in front of t should be positive).

2. The currency volume servicing the shadow economy, C_{SH}, is the difference between the estimated demand for banknotes with and without tax burden respectively.

$$C_{SH} = C[E_{OF}, t, \mathbf{R}] - C[E_{OF}, \mathbf{R}].$$

Officially reported total consumer expenditures, E_{OF}, serve as proxy of the transactions demand for banknotes and coins. **R** is the vector of the other variables explaining the demand for banknotes. In our case the variables in **R** are: interest rates on lev time deposits, monthly inflation based on the consumer price index, number of ATMs and number of withdrawals from ATMs[18].

[18] As emphasized in section three, the number of bank cards and POS terminals is statistically insignificant and therefore we do not include it in the estimation of the demand for banknotes and coins.

3. We assume that the velocity of banknotes and coins in the shadow economy V [C_{SH}], measured through the total consumer expenditures, is equal to that in the official economy V [C_{OF}]:

$V [C_{SH}] = V [C_{OF}] = V.$

The hypothesis of the equal velocity of banknotes and coins in the shadow and in the official economy is the major weakness of the approach to measuring the shadow economy through the currency in circulation, likewise found in the Cagan model and then in the Tanzi model (*Thomas, J.,* 1999).

4. After obtaining the share of the currency servicing the shadow economy [ΔC_{SH}] as a percentage of the monitored (official) volumes of currency in circulation [C_{OF}]

$\Delta C_{SH} = (C_{SH}/C_{OF}) \times 100,$

we generate the hidden share of the economy measured through the general consumer expenditures ΔE_{SH} using the formula

$\Delta E_{SH} = \Delta C_{SH} \times V.$

5. Once we are aware that total household expenditures account for a relatively constant share (80%) of the gross domestic product, we generate its hidden portion ΔY_{SH}:

$\Delta Y_{SH} = \Delta E_{SH} / 0.8.$

The analysis for Bulgaria encompasses the period after the introduction of the currency board from July 1997 to December 1999, a total of 29 observations. All series were seasonally adjusted in advance due to the fact that currency in circulation and total consumer expenditures have a strong seasonal pattern. The seasonal adjustment covers a longer period than the one used in the estimated model (January 1997 – December 1999) because at least three full years are needed for the seasonal adjustment under the standard procedure CENSUS X11. All variables are in logarithm with the exception of the interest rate and inflation. Estimated functions of the currency demand are presented in Table 3 (**t**-statistics are given in brackets).

Chart 3

SHADOW ECONOMY AS A SHARE OF GDP (GENERATED THROUGH TOTAL HOUSEHOLD EXPENDITURES) MEASURED THROUGH CURRENCY CIRCULATION METHOD – CURRENT SHARE AND AVERAGE SHARE FOR THE PERIOD AFTER CURRENCY BOARD INTRODUCTION

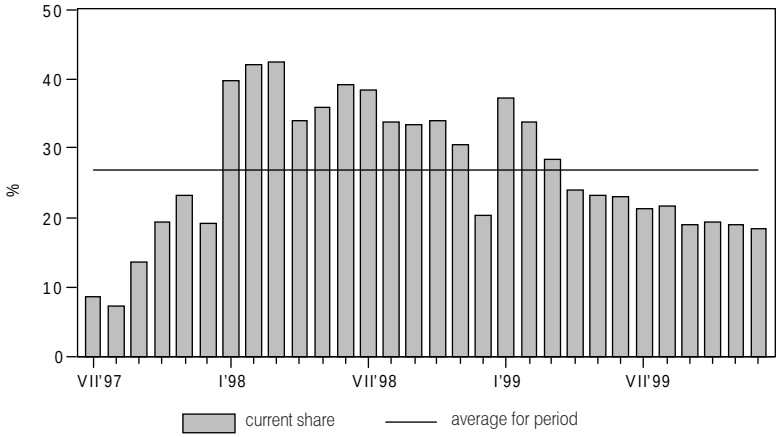


Chart 4

SHADOW ECONOMY AS A SHARE OF GDP (GENERATED THROUGH TOTAL HOUSEHOLD EXPENDITURES) MEASURED THROUGH CURRENCY CIRCULATION METHOD – CURRENT SHARE AND AVERAGE SHARE BY YEAR

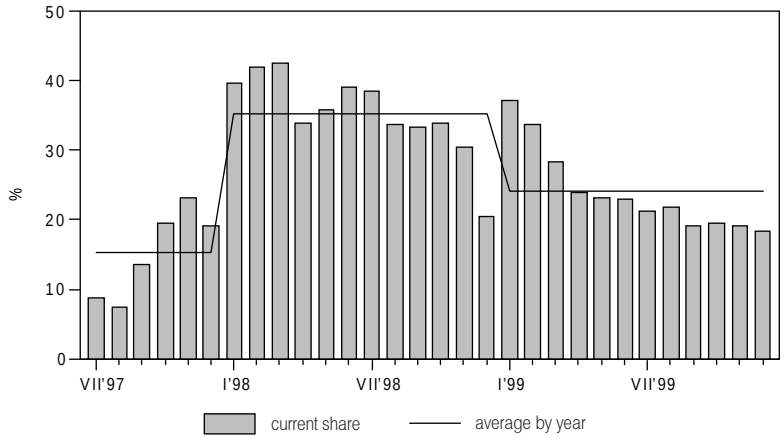


Table 3

DEMAND FOR CURRENCY WITHOUT AND WITH TAXES (DEPENDENT VARIABLE C)

Variables	Model without taxes	Model with taxes
Constant	7.26	6.69
	(4.31)	(4.37)
C(-1)	0.45	0.46
	(6.92)	(8.49)
TE	0.44	
	(4.03)	(5.47)
T/TE	-	0.45
		(2.28)
I	0.05	0.05
	(2.51)	(3.14)
π	-0.01	-0.008
	(-2.54)	(-2.56)
ATM	0.47	0.50
	(4.80)	(5.82)
ATMW	-0.27	-0.32
	(-4.17)	(-5.48)
R^2	0.98	0.99
Adjusted R^2	0.98	0.98
S.E. of regression	0.02	0.02
DW Statistics	2.04	1.92

The abbreviations of the variables have identical meaning with that described in section three. The difference is in the use of total, not monetary expenditures of households (**TE**) and in the introduction of the ratio of *government tax revenues to household general expenditures* (**T/TE**) as proxy of the incentives for tax evasion.

Elasticity and signs obtained in the two models meet expectations with the exception of the sign for inflation, which was analyzed in the section on the estimate of the transaction demand for banknotes and coins. Elasticity, which is of major interest, is that in front of the variable approximating the shadow economy (**T/E**). Its value is comparatively high (**0.45**) and has the expected positive sign.

Following the above procedure, we obtain the values of the shadow economy measured through the currency circulation dynamics.

Table 4

AVERAGE SHARE OF THE SHADOW ECONOMY AS A PERCENT OF GDP BY QUARTER AND ANNUAL AVERAGE AFTER CURRENCY BOARD INTRODUCTION

	I quarter	II quarter	III quarter	IV quarter	Annual average
1997			9.9	20.6	15.2*
1998	41.4	36.3	35.2	28.2	35.3
1999	33.1	23.4	20.7	19.0	24.1

* Only second half of 1997.

Before commenting on the obtained results, it is necessary to make some clarifications.

First, the method applied by us for measuring the shadow economy encompasses only that part which is serviced with levs, i.e. our method does not provide an estimate of the shadow economy that is serviced with foreign currency, mainly US dollars and Deutschemarks. Based on this logic, the obtained estimates are considerably lower than the actual ones. In other words, our estimates can be regarded as a *shadow economy minimum*.

Second, our methodology is based on the hypothesis of the constant velocity of banknotes and coins in the official and in the shadow economy. This assumption may be subject to critique, but in practice it is impossible to measure the velocity of money in the shadow economy. A traditional approach in shadow economy surveys is acceptance of the assumption of equal velocity of banknotes and coins in the official and in the shadow economy. We also follow this logic despite its vulnerability. In actual fact, velocity of money in the shadow economy is greater than that in the official economy (it depends on the type of transactions and the origin of funds, *Malahov*, 1992), which undervalues the size of the shadow economy (*Enste, D., F. Schmeider*, 1999).

For the entire period after the introduction of the currency board in Bulgaria the average value of the shadow economy is 26.78%. Average figures by quarter and year are given in Table 5: low values in 1997, followed by high values in 1998 (especially at the beginning of the year) and a downward trend since early 1999. Such large deviations in the estimates of the shadow economy can be explained by fluctuations in the currency demand and should be regarded as conditional. Low

values for 1997 (after the introduction of the currency board) can be explained by the fact that during the financial crisis and hyperinflation in late 1996 and early 1997 the lev lost completely its functions not only in the official but also in the shadow economy. In practice, the low estimate of the shadow economy for this year reflects a still recovering demand for banknotes and coins in levs.

Restored demand for local currency for transactions purposes contributed to a considerably higher (by 20%) estimate for the shadow economy in 1998, having a two-sided effect. *First*, restoration of the transaction role of the lev made it possible to estimate that part of the shadow economy, which was serviced with foreign currency and could not be measured[19]. *Second*, economic stabilization attained with the introduction of the currency board and restored economic activity in the official economy (for the first six months of 1998 an official GDP growth of 11 percentage points was reported on the same period of the previous year) are related to restoration of economic activity in the shadow economy.

Lower estimates of the shadow economy for 1999 should not be interpreted as a decrease in the share of the shadow economy at the expense of the official economy. This change reflects the behavior of the variables used by us as proxies of the shadow economy. *First*, there was a certain shift away from servicing the shadow economy with levs toward US dollars due to the dollar appreciation against the euro (the lev respectively). In practice, the preference for US dollars in servicing the shadow economy ensures it against currency risk prompted by the movement of the EUR/USD exchange rate (an effect similar to that in early 1997 but of a smaller magnitude). *Second*, employment of the ratio of *tax revenues to household general expenditures* rather than the accumulated amount of direct and indirect taxes as proxy of the incentives for tax evasion influences the estimate for the banknotes servicing the shadow economy. In practice, the lower ratio of *tax revenues to household general expenditures* for 1999 led to a lower estimate for the share of the shadow economy.

[19] The fast emergence of this effect was facilitated by the rapid fall of interest rates on lev deposits and their retention at lower levels than American and German interest rates, which resulted in a cheaper servicing the shadow economy with levs, given the opportunity costs.

VI. Conclusions

High currency circulation growth after the introduction of the currency board in Bulgaria poses the logical question of the factors that determine the process. On the one hand, this is a logical consequence of the financial stabilization and hence restored functions of the national currency as a means of exchange. On the other hand, data shows that there are factors other than the transactions ones, which influence the currency dynamics. Their behavior was reduced to three components: transactions demand, demand for currency as a means of saving and demand for banknotes related to servicing the shadow economy.

Constructed models of transactions currency demand shows that it is most closely related to monetary expenditures of households. Retail sales also have explanative force in the estimate of the transactions demand for banknotes and coins, although the obtained results do not indicate existence of such a strong relation as that with the monetary expenditures of households. The lev/dollar exchange rate remains the main alternative price in the demand for banknotes and coins function. High sensitivity of currency demand to exchange rate movements once again shows that the use of the fixed exchange rate as a nominal anchor has no alternative for a small and open economy as the Bulgarian. Development of the financial and payments system also affects significantly the demand for banknotes. Results show that despite the increased number of ATMs, POS terminals and debit cards, individuals prefer to make less monthly withdrawals while their volume increases. Estimated models of transactions currency demand indicate stable coefficients, which makes them a reliable tool in currency forecasting.

The analysis of banknote hoarding through the lifetime method and through the *Hentsch* method shows hoarding of 10, 20, and mostly 50-lev banknotes. The share of hoarded 50-lev denomination banknotes accounts for 44% of total circulation. This reflects adversely on Bulgaria's development as savings are being accumulated in a highly liquid form and do not generate income, causing liquidity overhang, which may threaten the currency board and the fixed exchange rate under certain circumstances. Small denominations are used mainly for transactions purposes and their circulation is much faster than the optimal. In a sense, their use in the currency turnover is more widespread than should be. It is reasonable to consider the issue of circulating a

banknote of higher denomination (for example 100-lev)[20]. This step would help shift the use of denominations of 10, 20 and 50 levs for hoarding of savings and for servicing larger payments in the shadow economy toward their inclusion in the transactions turnover. This would make it possible for the circulation of smaller denominations of 1, 2, and 5 levs to restore its optimum velocity (by lowering it).

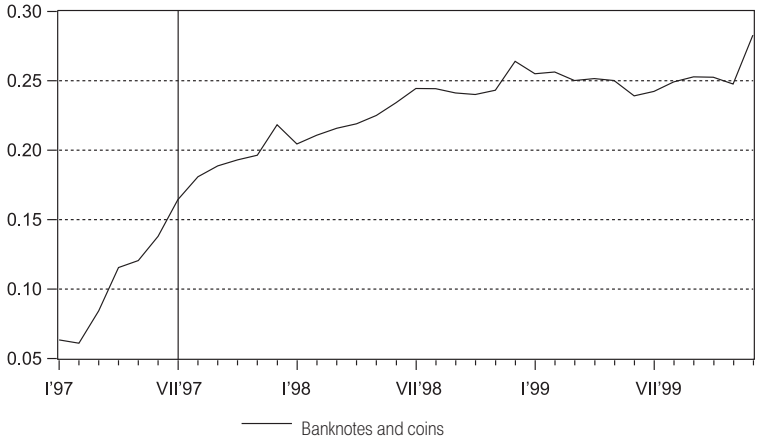
Last but not least, this study is an attempt to assess the share of the shadow economy in the official GDP. According to our estimates, the lowest values or the trough of the lev-serviced 'gray' economy is 27% on average for the period after the introduction of the currency board and by year: 15.2% for 1997 (second half-year), 35.3% for 1998, and 24.1% for 1999. If it is assumed that the national and foreign currencies have equal shares in servicing the shadow economy (like the ratio for the official economy), then its share will account for 50 – 60% of the official GDP.

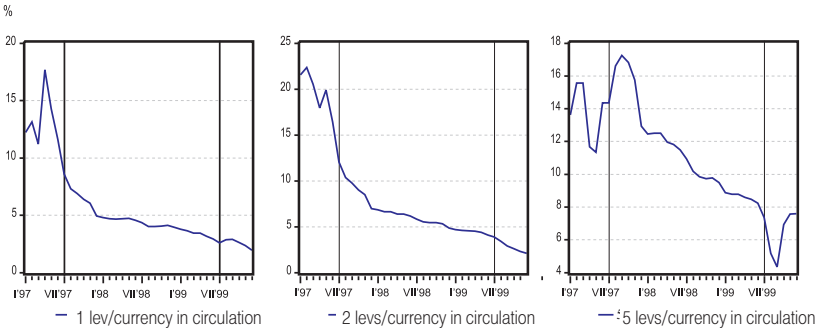
Although the obtained estimates are relative, they may be used as a starting point for future analyses in comparison with other approaches: through electricity consumption or with the mirrorlike statistical method used by the NSI.

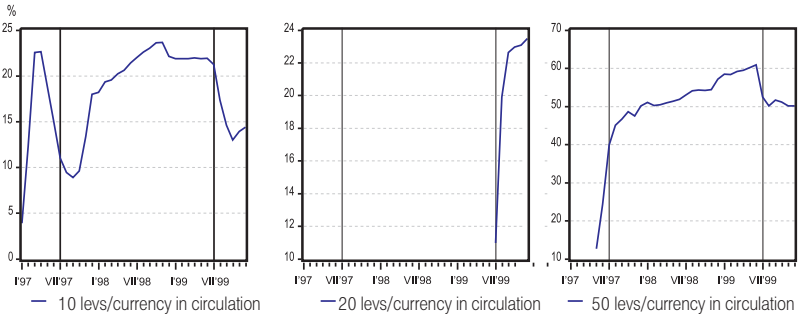
[20] Two arguments against the introduction of a 100-lev denomination banknote emerge here. The *first* is that big denomination banknotes are more attractive for counterfeit because of the higher profits. The *second* is related to the assumption that if higher denominations are used mostly to service transactions in the shadow economy the issue of a 100-lev banknote may facilitate transactions in that part of the economy. While the first argument is acceptable without reserve, the second would be true on the assumption that the only way of making transactions in the shadow economy is through the national currency. Given the presence of denominations of DEM 500 and DEM 1000 and later of EUR 500, the shadow economy in Bulgaria will use these denominations in transactions, whereby seignorage will be transferred to Bundesbank and the ECB (for a detailed answer to the question whether large denominations foster the shadow economy, see *Rogoff, K.* (1998) and his discussion with *Giavazzi* and *Schneider*).

APPENDICES

Appendix 1. Dynamics of Banknotes in Circulation







Appendix 2. Share of the Two Largest Denominations in Circulation

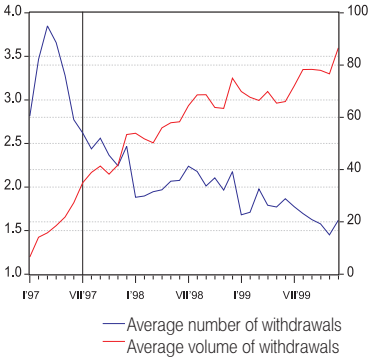
SHARE OF LARGE DENOMINATIONS IN EU MEMBER COUNTRIES

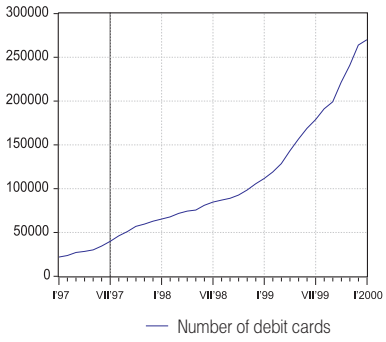
Country	Denomination	Share, % 1997	1998
EU countries			
Austria	ATS 5 000	32	34
	ATS 1 000	31	44
Belgium	BEF 10 000	46	48
	BEF 2 000	33	32
Great Britain	GBP 50	17	17
	GBP 20	50	52
Germany	DEM 1 000	34	34
	DEM 500	11	10
Greece	GRD 10 000	44	56
	GRD 5 000	49	38
Denmark	DKK 1 000	56	53
	DKK 5 00	19	22
Ireland	IEP 100	2	3
	IEP 50	13	16
Spain	ESP 10 000	54	56
	ESP 5 000	38	37
Italy	ITL 500 000	3	8
	ITL 100 000	72	68
Luxembourg	LUF 5 000	70	72
	LUF 1 000	26	24
Portugal	PTE 10 000	26	29
	PTE 5 000	58	56
Finland	FIM 1 000	36	36
	FIM 500	17	16
France	FRF 500	49	52
	FRF 200	31	30
The Netherlands	NLG 1 000	37	36
	NLG 250	13	13
Sweden	SEK 1 000	50	50
	SEK 500	34	35

Country	Denomination	Share, % 1997	1998
Other countries			
Canada	CAD 1 000	10	
	CAD 100	41	
USA	USD 100	67	
	USD 50	11	
Switzerland	CHF 1 000	46	
	CHF 500	5	
Japan	JPY 10 000	83	
	JPY 5 000	4	

SHARE OF LARGE DENOMINATIONS IN TRANSITION ECONOMIES IN THE PROCESS OF ACCESSION TO EU

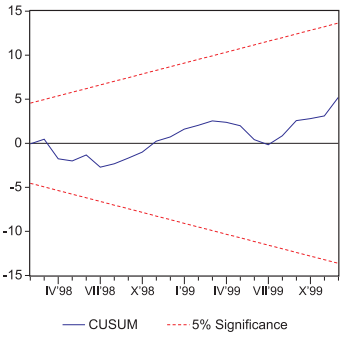
Country	Denomination	Share, % 1997	1998
Bulgaria	BGL 50	50	57
	BGL 10	18	22
Estonia	EKK 500	71	74
	EKK 100	22	20
Cyprus	CYP 20	35	
Latvia	LVL 100	11	
	LVL 50	16	
Lithuania	LTL 200	8	
	LTL 100	66	
Romania	ROL 50 000	55	
	ROL 10 000	33	
Slovakia	SKK 5 000	33	
	SKK 1000	52	
Slovenia	SIT 10 000	42	
	SIT 5 000	38	
Hungary	HUF 10 000	35	
	HUF 5 000	52	
The Czech Republic	CZK 5000	29	

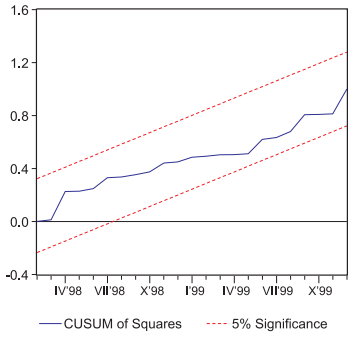




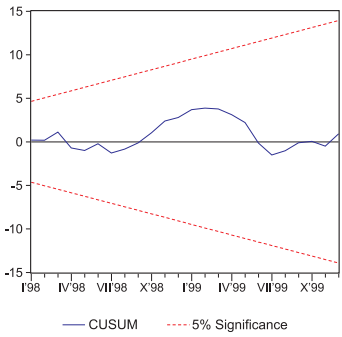
Appendix 3. Estimated Coefficients Stability Tests in the Models of Transactions Demand for Currency

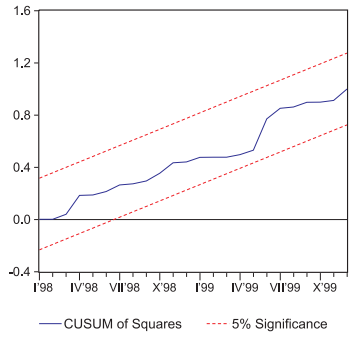
Model 1



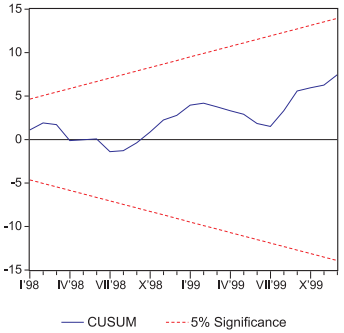


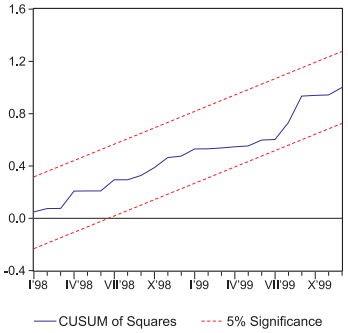
Model 2



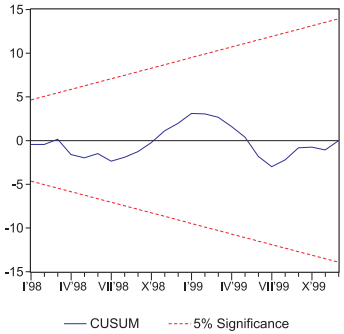


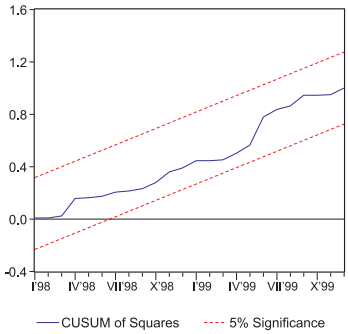
Model 3





Model 4





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