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The Monthly Transaction Money Demand in Croatia

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Ante Babić*

THE MONTHLY TRANSACTION MONEY DEMAND IN CROATIA

Abstract

In this paper, the monthly transaction money demand function in Croatia is empirically estimated. It is a continuation of previous money demand research by the author based on quarterly data in 1999. The main emphasis here is on a classical OLS analysis of transaction money demand relationships for various transaction money aggregates: currency outside banks – M0, currency outside banks plus demand deposits – M1, and M1 plus budgetary and extra-budgetary transaction balances held with commercial banks – M1a. The results are confirmed by stationarity tests, cointegration, Granger causality and unrestricted VARs.

JEL: E41; E47; E31; P24;

Key words: M0; M1; money demand; transaction money demand

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The views expressed are those of the author and do not necessarily represent those of the Croatian National Bank or the Economics Institute, Zagreb.

Contents

Ante Babić

THE MONTHLY TRANSACTION MONEY DEMAND IN CROATIA

1. Introduction

One of the main functions of any government according to the economic literature is to maximize the social welfare function. Although there are various theories about what should be included in such a function, the majority of economists agree that the stability of price levels and sustainable growth should be the top priorities. To achieve price stability and growth, every government has several economic policies available, of which monetary and fiscal policies are the most prominent.

Many economists agree that the fundamental task of monetary policy is to provide "just the right" quantity of money in order to achieve price stability. Inflation is, as Friedman[1] argued, a monetary phenomenon and price stability must be achieved via monetary policy. In other words, the monetary authorities should supply "just the right" quantity of money, according to the quantity of money demanded by the businesses and individuals in the economy. In order to do so properly, the monetary authorities need to know how the quantity of the balances demanded in an economy is determined. Therefore, various money demand functions are estimated for use in forecasting and economic policymaking.

A desirable feature of the money demand function is stability. According to Judd and Scadding,[2] the money demand function is considered stable if the estimated demand function is predictable (according to the usual goodness-of-fit statistics), its coefficients are accurate, the out-of-sample estimations are fair, the money demand is a function of relatively few variables and the explanatory variables in the estimated function represent theoretically and economically plausible relationships between money and real economic activity.

In this paper, the monthly transaction money demand function (the money demand function for money that is considered to perform the transaction functions of money, a unit of accounting and a medium of exchange) is estimated empirically and various issues are discussed concerning money demand in Croatia. This is a continuation of research on the quarterly transaction demand for money published by the author in 1999.[3] For the sake of further analysis and comparison, the same methodology is employed. Therefore, this paper focuses more upon empirical results than theory or methodology.

1 Friedman (1956).

2 Judd and Scadding (1982), pp. 993–1023.

3 Babić (1999).

In the next section, some theoretical foundations are reviewed and the layout of the research is provided. In the following section, the results of classical regression analysis are presented and analyzed, along with tests of the stationarity of frequently used variables. This is followed by a long-run specification of the money demand in Croatia and an examination of short-run relationships.

2. Theoretical and Empirical Issues

Usually, money demand functions estimate the relationship between the quantity of money in the economy and various macroeconomic variables (assuming that there is a stable equilibrium on the money market). Underlying the estimating equations are various theoretical specifications of the money demand function.

Almost all monetary theorists after Keynes divide money demand into three components: the demand for everyday transactions, precautionary demand and speculative demand. The first two are frequently merged into a single "transaction" demand for money, which depends on a number of transactions in an economy frequently represented by a measure of economic activity. It is assumed that the relationship between the desired transaction amount of money and economic activity is positive, meaning that greater economic activity needs more money for the larger number of transactions. Speculative demand for money highlights the wealth-hoarding function of money and the opportunity cost of holding money against the opportunity of holding interest-bearing assets. It is assumed that the relationship between the desired speculation amount of money and the market interest rate (as a measure of the opportunity cost of holding money) is negative, meaning that higher market interest induces a bigger portion of the wealth into the interest-bearing instruments and away from money.

However, Baumol and Tobin revisited Keynes' transaction demand for money and found that even the transaction demand for money has an inverse relationship to the market rates of relatively safe and liquid bonds.[4]

The most frequent explanatory variables in the money demand function are, therefore, the variable of activity (measuring activity in the economy, assuming a positive relationship between economic activity and the demand for money), the variable of price levels (for deflating nominal variables to obtain the real variables), the variable of opportunity cost (measuring earnings forgone from holding money instead of bonds and securities, assuming a negative relationship between the opportunity cost variable and demanded money holdings) and various other variables.[5]

For the variable of economic activity, the most frequent choices have been the gross domestic product (GDP), gross national income (GNI), gross national disposable income (GNDI), GDP per capita, industrial production, consumption expenditure, wealth and permanent income. The most frequently used proxies of opportunity cost are the money market interest rates, treasury bill interest rates, savings and time de-

4 Baumol (1952), pp. 545–556; Tobin (1956), pp. 241–247.

5 For surveys of theoretical foundations, it is useful to go through Laidler (1993); Goldfeld and Sichel (1990). For a contemporaneous survey of the money demand relations in various European countries, a useful reference is Browne, Fagan and Henry (1997).

posit interest rates and the differences between those interest rates and the interest rate of money, often measured by the demand deposit interest rate. Price levels have been measured in various studies by the consumer price index (CPI), producer price index (PPI), GDP deflator etc. Other variables frequently used are the actual or expected inflation rate, real or nominal wages, the riskiness of alternative financial instruments to money (measured by its standard deviation) etc.

The most frequent functional forms have been levels and logarithm functional forms:

$$(M^d/p)_t = a_0 + a_1 y_t + a_2 r_t + a_3 ost + u_t \quad \text{(i)}$$

and

$$\ln(M^d/p)_t = b_0 + b_1 \ln(y_t) + b_2 \ln(r_t) + b_3 \ln(ost) + u_t \quad \text{(ii)}$$

where y is the real variable of activity, r is the variable of opportunity cost, p is the variable of the price level and *ost* refers to other variable(s).

Many economists have realized that estimating money demand functions in forms of (i) and (ii) introduces the problems of identification and serial correlation, while also imposing instantaneous adjustment on the money market equilibrium. Partial adjustment models (PAM)[6] of money demand were introduced in the late 1980s to emphasize the short-run dynamics on the money market and the fact that clearing on the money market does not occur instantaneously but rather in several subsequent periods.

PAM models begin with the function of the public's desired real holdings of money:

$$\ln(M^{*d}/p)_t = c_0 + c_1 \ln(y_t) + c_2 \ln(r_t) + c_3 \ln\pi + u_t, \quad \text{(iii)}$$

where π is the inflation rate or the rate of the change in the price level p.

A rational money holder minimizes the costs incurred from holding money, consisting of the cost of disequilibrium on the money market and the cost of the adjustment of actual real money balances to the desired money balances. It is assumed that the cost function (C) is quadratic:

$$C = d_1[\ln M_t^* - \ln M_t]^2 + d_2[(\ln M_t - \ln M_{t-1}) + e(\ln p_t - \ln p_{t-1})]^2, \quad \text{(iv)}$$

where M_t represents the actual money stock in period t, whereas M_t^* represents the "desired money stock in period t". The term in the first bracket on the righthandside is the disequilibrium cost and the term in the second bracket is the adjustment cost.

If $e=0$, the term in the second bracket becomes $[\ln M_t - \ln M_{t-1}]^2$, implying that the adjustment process goes only through the adjustment of nominal terms (or that the process is said to be a model of nominal adjustment or nominal PAM). On the con-

6 See: Goldfeld and Sichel (1990); or Laidler (1993).

trary, if e=1, the second bracket term becomes $[(\ln M_t - \ln M_{t-1}) - (\ln p_t - \ln p_{t-1})]^2$ or $[\ln(M/p)_t - \ln(M/p)_{t-1}]^2$, implying an adjustment process in real terms only (or a model of real adjustment or real PAM). A combination between the two extremes is assumed for e ranging from 0 to 1.[7]

If the cost function (Equation iv) is minimized over M_t, we obtain:

$$\ln M_t - \ln M_{t-1} = f(\ln M_t^* - \ln M_{t-1}) + g(\ln p_t - \ln p_{t-1}), \quad \text{(v)}$$

where $f = d_1/(d_1 + d_2)$ and $g = ed_1/(d_1 + d_2) = ef$.

Equation (v) represents the optimal amount of money. If the standard specification of the desired money stock (Equation iii) is plugged into Equation (v), we obtain the standard PAM:

$$\ln(M/p)_t = fc_0 + fc_1\ln(y_t) + fc_2\ln(r_t) + (1-f)\ln(M/p)_{t-1} + h\ln\pi_t + u_t, \quad \text{(vi)}$$

where $h = fc_3 + (1-f)(e-1)$. If we substitute k_i in the new coefficients, we obtain the final version of the standard PAM:

$$\ln(M/p)_t = k_0 + k_1\ln(y_t) + k_2\ln(r_t) + k_3\ln(M/p)_{t-1} + k_4\ln\pi_t + u_t, \quad \text{(vii)}$$

where all the substituted coefficients should be interpreted in terms of Equation (vi), the activity variable coefficient (k_1) should be positive according to the theory (positive constant elasticity) but it now incorporates not only the income elasticity but also the estimated coefficients of adjustment, or $d_1/(d_1 + d_2)$. The opportunity cost variable coefficient (k_2) should be negative according to the theory (negative constant elasticity) but also the interpretation should include the $d_1/(d_1 + d_2)$ factor. The constant (k_0) should tell something about the velocity of circulation but its interpretation is also ambiguous because of $d_1/(d_1 + d_2)$. Coefficients k_3 and k_4 are less ambiguous and represent the nominal and real parts of the adjustment process. If $k_4 = 0$, Equation (vii) represents a pure real PAM with exclusive real adjustment. If $k_4 = -k_3$, Equation (vii) becomes a pure nominal PAM with exclusively nominal adjustment.

3. Classical OLS Estimation

So far, the research of monthly demand for money for Croatia has been conducted very rarely, of which works of Z. Anušić[8] and V. Šonje[9] should be mentioned.

Anušić estimated a partial adjustment model based on the monthly data from January 1991 to November 1993 (which includes the first two months of the Croatian 1993–94 antiinflation program[10]):

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7 Fair (1987) found that nominal adjustment is more frequent and significant than real adjustment in a study of 27 mostly OECD countries.

8 Anušić (1993), pp. 47–89. A revised version of the article can be found in Anušić, Rohatinski and Šonje (eds.) (1995), Chapter 2, pp. 97–108.

9 Šonje (1999), pp. 241–280.

$$lm_t = b_0 + b_1 lm_{t-1} + b_2 ly_t + b_3 LINFLA_t + b_4 LTECAJ_{t-1} + b_5 LTECAJ_{t-2} + b_6 LKAM_{t-2} + b_7 DUM78_t + b_8 DUM10_t + b_4 DUM12_t + u_t, \quad \text{(viii)}$$

where *lm* is the natural logarithm of the real M1 at the end of the month deflated by the arithmetic mean of the monthly consumer price index and the producer price index in December 1989, *ly* is the natural logarithm of the real social product,[11] *LINFLA* is the natural logarithm of the rate of change in the deflator, *LTECAJ* is the natural logarithm of the rate of change in the nominal effective exchange rate index of the Croatian Dinar,[12] *LKAM* is the logarithm of the arithmetic mean of the monthly nominal interest rates on the short-term deposits of the five biggest banks in Croatia, *DUM*78 is a dummy variable for July and August of 1992 and 1993 which takes the tourist season into account,[13] *DUM*10 is a dummy for October and *DUM*12 is a dummy for December.

In the same article, the author estimates the same equation for the period from January 1991 until September 1993, leaving out the first two months of the antiinflation program.

The results presented in Table 1a at the end of this paper are significant but specific to the period of hyperinflation. It turns out that the main determinants of the money demand during this period were inflation, real economic activity and lagged real money. The interest rate did not not have a significant influence on the money demand during this period. These results confirm Cagan's well-known analysis of hyperinflation.[14] Instead of taking out the seasonal effects of the tourist season on the money demand using dummies, this problem should have been addressed by a seasonal adjustment or detrending of the monthly data. Also, the economic activity is proxied by the social product, which omits the so-called "unproductive services" from the total value added, thereby having narrower coverage than the GDP.

After the period for which the money demand was estimated by Anušić, Croatia entered a period of low inflation (after the successful start of the antiinflation program), which effectively means that there was a structural break and Anušić's estimated money demand function no longer worked. Moreover, the Croatian Statistical Office (CSO) stopped compiling macroeconomic aggregates according to the MPS and switched to the SNA 1993 macroeconomic aggregates. Also, from the government side, there has been an increasing need to monitor the monetary developments following the antiinflationary program and to formulate monetary policy according to the new low-inflation environment. The need for a new money demand function for the period since 1994 provided further motivation for the research in this paper.

10 The Croatian antiinflationary program was announced on October 4, 1993. See Anušić, Rohatinski and Šonje (eds.) (1995).

11 A MPS (Material Product System) equivalent of the GDP in the SNA (System of National Accounts).

12 Temporary currency issued in December 1991, which was subsequently replaced by the Croatian kuna, the present Croatian currency, on May 30, 1994, at a rate of 1,000 Croatian dinars: 1 Croatian kuna. See Anušić, Rohatinski and Šonje (eds.) (1995).

13 In 1991, the results from the tourist season were very weak because the atrocities against Croatia started in the late summer of that year.

14 Cagan (1956), pp. 25–117.

In the other work,[15] V. Šonje also estimates a PAM on the monthly data for the period from March 1993 to March 1997:

$$m_t = b_0 + b_1 m_{t-1} + b_2 Y_t + b_3 \pi_t + b_4 i_{1t} + b_5 i_{2t} + b_6 e_t + b_7 D_t + u_t, \qquad \text{(ix)}$$

where m is the real M1a monetary aggregate (M1 plus transaction deposits of budgetary and extra-budgetary funds) measured at the end of the month, Y is the real economic activity measured by the monthly retail trade turnover, π is the monthly CPI inflation, $i1$ is the DMB's weighted nominal interest rate on demand deposits in kuna, $i2$ is the DMB's weighted nominal interest rate on time deposits in kuna, e is the rate of the nominal depreciation of the Croatian kuna compared to the German mark and D is a dummy variable representing the month when the antiinflationary program started ($D = 1$ in October of 1993, otherwise $D = 0$). Šonje estimated two versions of the model, one with interest rates $i1$ and $i2$, and without nominal depreciation e (Equation 1) and the other without the interest rates and with nominal depreciation (Equation 2).

The results are shown in Table 1b at the end of this paper. Šonje's results are also significant but contain a drastic structural break due to the start of the antiinflationary program.[16] The monthly inflation rate is found to have a large impact, confirming the Cagan results but unjustifiably extended to the post-inflationary period. Also, the exchange rate appreciation was found to have had an unusually high impact, probably due to the inclusion of the structural break. Interpretation of the coefficients can also be difficult because they only represent point elasticities, not constant elasticities (the variables were not in the logarithms).

This paper will attempt to estimate the OLS transaction money demand function for the stable period after the launching of the successful antiinflationary program in 1993, from the second half of 1994, after the initial effects of the antiinflationary program wore out and up to the end of 1998. Although there were several events in 1998, such as the introduction of the VAT and the bank crisis that could make the use of 1998 data doubtful, their effects were either smaller than initally predicted, caused in the previous years or (especially the bank crisis) will have their ultimate impact after 1998.

The methodology of this research was laid down by Babić in 1999.[17] This paper follows it very strictly but uses monthly data in order to estimate the monthly transaction demand for money. The monetary aggregates in this analysis will therefore be M1 (currency plus demand deposits), M1a (M1 plus transaction deposits of budgetary and extra-budgetary funds)[18] and M0 (only the currency outside the banks).

The variable of economic activity will be the monthly real GDP, extracted from the quarterly real GDP of the CSO by a statistical procedure that preserves the sea-

15 Šonje (1999), pp. 241–280.

16 This is believed to have lasted from the October 1993 almost until June 1994, when all the effects of the beginning of the antiinflationary program were fully transmitted to the economy.

17 Babić (1999).

18 Total government, budgetary and extra-budgetary funds still comprise a major part of economic activity.

sonal dynamics.[19] Another possible variable of the economic activity was the CSO index of industrial production but it was ruled out as insignificant in a previous research.[20]

The variable of opportunity cost will be DMB_DEPO_KNDD, the weighted average of the commercial banks' interest rates on demand deposits in kuna, DMB_DEPO_FCDD, the weighted average of the commercial banks' interest rates on demand deposits in foreign currency and MMRATE, the money market interest rate on the Zagreb money market.

The price level variable is going to be the CSO consumer price index (1990=100) and inflation (the rate of change in the consumer price index). Other price indices were also tried, such as the producer price index or cost of living index but the results were not different.

For each monetary aggregate, there will be four specifications:

$$\ln(M^d/p)_t = b_0 + b_1\ln(y_t) + b_2\ln(r_t) + u_t, \qquad \text{(x)}$$

the current real monetary aggregate as a function of the real variable of the economic activity (y) and the nominal opportunity cost variable (r);

$$\ln(M^d/p)_t = b_0 + b_1\ln(y_t) + b_2\ln(r_t) + b_3\ln(M^d/p)_{t-1} + u_t, \qquad \text{(xi)}$$

the current real monetary aggregate as a function of the real variable of the economic activity (y), the nominal opportunity cost variable (r) and the lagged real money aggregate;

$$\ln(M^d/p)_t = b_0 + b_1\ln(y_t) + b_2\ln(r_t) + b_3\ln(\pi_t) + u_{t,} \qquad \text{(xii)}$$

the current real monetary aggregate as a function of the real variable of economic activity (y), the nominal opportunity cost variable (r) and inflation (π);

$$\ln(M^d/p)_t = b_0 + b_1\ln(y_t) + b_2\ln(r_t) + b_3\ln(M^d/p)_{t-1} + b_4\ln(\pi_t) + u_t, \qquad \text{(xiii)}$$

the current real monetary aggregate as a function of the real variable of economic activity (y), the nominal opportunity cost variable (r), the lagged real money aggregate and inflation (π). The (xiii) specification is the PAM model. Because of the high autocorrelation, all the specifications will be adjusted by the one-step Cochrane-Orcutt procedure.[21]

19 This is according to Belullo (1998) in "Utjecaj promjene novčane ponude na ekonomsku aktivnost u Republici Hrvatskoj (The Effects of Changes in the Money Supply on Economic Activity in the Republic of Croatia)"; by the courtesy of the author.

20 Babić (1997).

21 Pindyck and Rubinfeld (1991).

3.1. Estimating the Demand for the M0

The money aggregate (M0) used in this paper contains only currency outside the banks (according to Babić, 1999) and is calculated from the data of the Croatian National Bank (CNB).[22] The rationale for modeling the demand for this monetary aggregate comes from the fact that the currency outside the bank and the non-bank public's desire to hold cash are ouside the direct influence of the CNB and thus can explain the behavior of the non-bank public regarding the holding of cash.

The results of the OLS estimation comparable to the methodology laid down by Babić (1999) are given in Table 2 at the end of this paper. The best estimated equation (according to econometric criteria) is, of course, of Type xiii (estimated Equation 4 or Equation 4' as an adjusted version in Table 2) or the estimated PAM for the M0. The best variable of the economic activity is the logarithm of the real monthly GDP (extracted from the real quarterly GDP of the CSO), which is better than the index of industrial production that was also tried. The logarithm of the weighted average of the interest rates of the commercial banks' demand deposits in kuna was the best variable of opportunity cost, among other candidates such as the logarithm of the weighted average of the commercial banks' demand deposit interest rates in foreign currency, the logarithm of the weighted average of the commercial banks' time deposit interest rates in kuna and foreign currency, as well as the Zagreb money market interest rate and the three-period centered moving average of the Zagreb money market interest rate.

According to the estimated PAM in Equations 4 and 4', the monthly demand for the real M0 in Croatia is a function of the real monthly GDP, the weighted average of the interest rates of the commercial banks' demand deposits in kuna, the real M0 from the previous month and the rate of inflation. About 30–35 percent of the change in the demand for the real M0 comes from the change in the current real GDP and 75 percent from the change in the real M0 from the previous month. The interest rate and inflation account for about –0.1 percent and –0.01 percent of the change in the demand for the real M0, respectively. Almost all of the estimated coefficients are significant at the 95 percent confidence level except the coefficient for the real GDP (significant at the 88 percent confidence level) and the coefficient for inflation (significant at the 80 percent level). All the other statistics are high and strong, including R-squared, adjusted R-squared, the Durbin-Watson statistic, and the Schwartz and Akaike information criteria.

Because of the logarithm form, all the coefficients are constant elasticities. The income elasticity of the demand for the real M0 is 0.36, which means that if the real monthly GDP rises 1 percent, individuals will be willing to hold 0.36 percent more of the real M0, which is a theoretically and economically correct result. The interest rate elasticity is –0.10, which means that if the weighted average of the interest rates of the commercial banks on demand deposits in kuna rises by 1 percent, individuals will be willing to hold 0.10 percent less of the real M0, which is also theoretically and economically correct because demand deposits are a very close substitute for cash but they ac-

22 The Croatian National Bank (CNB) is the Croatian central bank.

crue at interest rate. The constant elasticity of the real M0 from the previous period is 0.75, which captures the dynamics of the adjustment in the money market. If the real M0 increased in the previous period by 1 percent, individuals would be willing to hold 0.75 percent more of the real M0 in this period as well and the adjustment would die out in the following periods. The inflation has the smallest constant elasticity (–0.01) which shows that inflation does not have a big influence on the demand for the real M0 since the antiinflationary program took place. The constant, the inverse of the velocity of money, is equal to –0.71, or approximately 0.20 when we take the antilogarithm, which means that the constant velocity of money in this period is the inverse, or 5.13.

According to the theory behind the PAM model, laid down in Equations (iii) to (vii) in the previous section of this paper, the inflation coefficient and lagged real M0 coefficient determine the nature of the adjustment process. An inflation coefficient close to zero and insignificant means that the process of the adjustment between the actual real amount of money and the desired real amount of money is performed by adjusting the real variables.

Compared to the quarterly results in Babić (1999), income elasticity is lower (monthly 0.36 compared to quarterly 0.7), interest elasticity is lower in absolute terms (–0.10 compared to –0.15), lagged money elasticity is higher (0.75 compared to 0.55), inflation elasticity is lower (–0.01 compared to 0.06) and the constant is lower in absolute terms (–0.71 compared to –2.00). Although the quarterly equations suffer from the low number of observations, these results are consistent with economic logic because long-term demand curves are more elastic than short-term ones.

Many researchers (e.g. Fair, 1987) suggest that interest rates should enter the money demand function without being logarithmically transformed because they are small compared to the other variables and by logarithmic transformation the interest rate fluctuations become less important. The interest rate was used without logarithmic transformation but there was no dramatic change in the results, both in the estimated coefficients and the choice of the interest rate representing the opportunity cost.

Following the logic behind the use of non-logarithmed interest rates, the PAM model was estimated with a non-logarithmed inflation rate. The results presented as Equation 5 in Table 3 show a dramatic change compared to Equations 4 and 4'. The most probable reason is the gain of observations because the logarithm of the negative numbers is not defined and Croatia had a period of deflation and low monthly inflation following the introduction of the antiiflationary program. Because the observations for the logarithm of the inflation rate were not defined in certain months, those observations were not used in the OLS regression, which can be seen by comparing the N (number of observations) in Equations 1, 1', 2 and 2' with the *N* in Equations 3, 3', 4 and 4', which have the logarithm of inflation as an explanatory variable. Because of the introduction of inflation instead of the logarithm of inflation, the coefficients changed slightly but the significance of the coefficients improved dramatically, as did that of the other statistics. The income elasticity of the demand for the real M0 is 0.35, close to that in Table 2; the interest rate elasticity is –0.07, slightly less in absolute terms than in Equations 4 and 4'; the constant elasticity of the real M0 from the previous period is 0.79, higher than before; the inflation elasticity is the same (–0.01) and the constant equals –0.65, less than before (the constant velocity is lower, about 4.47).

Another interesting point shown in Table 3 is the estimated PAM of the detrended variables. As suggested by Babić (1998b), the Croatian monetary aggregates exhibit a trend and therefore detrended variables should reveal the true relationship (interest rates and inflation were not detrended because they did not exhibit a strong trend). This version (Equation 7) shows the strongest link between the detrended current real M0 and the detrended lagged real M0, as well as the inflation rate. The other coefficients are highly insignificant and the estimated statistics are low. If the monetary aggregates and explanatory variables are trend stationary, however, Equation 7 will be the econometrically correct equation.

Also according to Babić (1998b), there is evident seasonality in the movements of monetary aggregates. In Table 3, there is a PAM estimated upon seasonally adjusted variables (interest rates and inflation were not seasonally adjusted because they did not exhibit a strong trend nor a strong seasonal movements), according to Babić (1998b). As can be seen from Equation 6, the estimated coefficients for the seasonally adjusted PAM are very similar to those in Equation 5 but are more significant and the equation statistics are better. Even the inflation coefficient is significant, which means that if the seasonal effects are thrown out of the demand equation, the adjustment process that takes place on the money market goes through an adjustment of the real and nominal values. The coefficients are similar to those in Equations 5 and 4(4'), so the constant elasticites and their implications are also similar. About 35 percent of the change in the demand for the seasonally adjusted real M0 comes from the change in the seasonally adjusted current real GDP and about 80 percent from the seasonally adjusted real M0 from the previous month. The interest rate and inflation account for approximately –0.04 percent and 0.01 percent of the change in the demand for the seasonally adjusted real M0. Almost all of the estimated coefficients are significant at the 95 percent confidence level except the coefficient for the seasonally adjusted real GDP (significant at the 93 percent confidence level) and the interest rate coefficient (significant at the 90 percent confidence level).

To conclude, the estimated PAM of the demand for the real M0 (Equations 4 and 4' in Table 2) yields the best OLS estimation of the transaction demand for the real M0. Seasonal effects are also important and they should be incorporated (Equation 6 in Table 3). For the purposes of forecasting and monetary policymaking, Equations 4, 4', 5 and 6 are recommendable, since they have high estimated overall statistics and similar coefficients. However, seasonal adjustment is needed for Equation 6, which is more cumbersome than Equations 4 or 5 and the interpretation of the results is more difficult. All the above estimated Equations (4, 4', 5 and 6) have the desired properties of the stable money demand of Judd and Scadding (1982).

3.2. Estimating the Demand for the M1

The money aggregate M1 contains currency outside the banks and demand deposits and represents the most widely known "narrow" money aggregate. By modeling the demand for the M1, the whole transaction demand for money is covered (in contrast to modeling the demand for the M0) and it also provides an internationally comparable money demand equation.[23]

The results of the OLS estimation comparable to the Babić (1999) methodology are given in Table 4 at the end of this paper. The best estimated equation is of Type xiii, or PAM for M1 (Equation 11 and Equation 11' adjusted for autocorrelation with the one-step Cochrane-Orcutt procedure, in Table 4). The best variable of economic activity is the logarithm of the monthly real GDP (extracted from the quarterly real GDP of the CSO). The best variable of opportunity cost is the logarithm of the weighted average of interest rates on the commercial banks' demand deposit in kuna. It is interesting that neither the logarithm of the weighted average of the interest rates on the commercial banks' time and savings deposits in kuna or foreign currency nor the Zagreb money market interest rate was found to be a better opportunity cost variable than the logarithm of the weighted average of the interest rates on the commercial banks' demand deposits in kuna, which is the own rate of interest of the part of the M1.

Equations 11 and 11' show that the monthly demand for the real M1 in Croatia is a function of the real monthly GDP, the weighted average of the interest rates on the commercial banks' demand deposits in kuna, the real M1 from the previous month and the monthly rate of inflation. About 40–50 percent of the change in the demand for the real M1 comes from the change in the current real monthly GDP and 75–85 percent from the change in the real M1 from the previous month. The interest rate and inflation account for about a –0.02 percent and –0.01 percent change in the demand for the real M1, respectively. Almost all of the estimated coefficients are significant at the 95 percent confidence level except the coefficient for the interest rate (significant at the 30 percent confidence level) and the coefficient for inflation (significant at the 90 percent confidence level). All the other statistics are high and strong, including R-squared, adjusted R-squared, the Durbin-Watson statistic, and the Schwartz and Akaike information criteria.

All the estimated coefficients represent constant elasticities. The income elasticity of the demand for the real M1 is 0.38. In other words, a 1 percent increase in the real GDP causes individuals to become willing to hold the real M1 for 0.38 percent, which has the theoretically correct sign and makes sense economically. The interest elasticity is –0.02, or if the weighted average of the commercial banks' interest rates on demand deposits in kuna rises, individuals will be willing to hold 0.02 percent less of the real M1, which is also theoretically and economically correct if the interest rate is believed to represent the price of the real M1, which is partly the case (the interest rate is the weighted average of the interest rates on the commercial banks' demand deposits in kuna, which are one component of the M1). Again, no other interest rate was proven better. The constant elasticity of the lagged M1 is 0.85, or if the M1 increased in previous period by 1 percent, individuals would then be willing to hold 0.85 percent more of the M1 in the current period, as the dynamics of the adjustment on the money market dies out slowly. The inflation elasticity is –0.01 and since the

23 This is because most of the countries use the same definition for the M1, whereas broader monetary aggregates differ from country to country because of the coverage.

antiinflationary program started in October of 1993, a 1 percent increase in inflation causes people to hold 0.01 percent less of the real M1. The constant is equal to –0.39, or when we take the antilogarithm, equal to 0.41, which means that the constant velocity of money in this period was the inverse, or 2.46.

According to the theory behind the PAM model, an inflation coefficient close to zero and insignificant means that the process of the adjustment on the money market goes exclusively through the adjustment of the real values. The inflation coefficient is insignificant at the 95 percent confidence level and very close to zero but is significant at the 90 percent confidence level. That would mean that most of the adjustment goes through the adjustment of the real values but there are also traces of the adjustment of nominal values.

Compared to the quarterly results in Babić (1999), income elasticity is lower (monthly 0.38 compared to quarterly 1.23), lagged money elasticity is higher (0.85 compared to 0.50), inflation elasticity is lower (–0.01 compared to 0.08) and the constant is lower in absolute terms (-0.47 compared to –3.46). Interest elasticity is lower in absolute terms (–0.02 compared to –0.05), but in the quarterly equation, the best interest rate was the centered three-period moving average of the Zagreb money market rate. Although the quarterly equations suffer from the low number of observations, these results are also consistent with economic logic because long-term demand curves are more elastic than short-term ones.

As in the case of the M0, interest was used without logarithmic transformation as suggested by several studies, although the results did not change much.

On the contrary, including the inflation rate without logarithmic transformation (in estimated Equations 12 and 12' in Table 5) produced a remarkable change in the significance of the estimated coefficients, as well as the significance of the regression. The improvement is due to the addition of the observations that were rejected from the regression because the logarithm of the negative inflation was not defined. The income elasticity of the demand for the real M1 is 0.31, close to that in Table 4; the interest rate elasticity is –0.03, slightly higher in absolute terms than in Equations 11(11'); the constant elasticity of the real M0 from the previous period is 0.85, the same; the inflation elasticity is (–0.02), slightly higher in absolute terms than in the estimated Equations 11 and 11' and the constant is –0.37, less in absolute terms than before (the constant velocity is lower, about 2.34).

The estimated PAM of the detrended variables in Table 5 (estimated Equation 14) shows the strong link between the detrended current real M1, as a dependent variable and the detrended real monthly GDP, the lagged real M1 and inflation, explanatory variables, with significant coefficients close to those in the non-detrended PAMs (estimated Equations 11, 11' and 12). The interest rate and inflation were not detrended because they did not exhibit a strong trend. The statistics of the estimated equation are lower than those for Equations 11, 11' and 12. However, if the monetary aggregates and explanatory variables are trend stationary, Equation 14 will be econometrically correct.

The estimated PAM of the seasonally adjusted variables in Table 5 (estimated Equation 13) shows a very strong relationship between the seasonally adjusted real M1, as a dependent variable, and the seasonally adjusted real monthly GDP, interest rate, the seasonally adjusted lagged real M1 and inflation as explanatory variables. The interest rate and inflation were not seasonally adjusted because they did not exhibit strong seasonal effects. The estimated coefficients in the PAM of the seasonally adjusted variables are very close to the ones estimated in the PAM of non-seasonally adjusted variables in estimated Equations 11 and 11' but are more significant, as are the equation statistics. The interest rate and inflation coefficient are insignificant at the 95 percent confidence level but the interest rate coefficient is significant at the 90 percent confidence level. About 30 percent of the change in the demand for the seasonally adjusted real M1 comes from the change in the seasonally adjusted current real GDP and about 85 percent from the seasonally adjusted real M1 from the previous month. The interest rate and inflation account for very small changes in the demand for the seasonally adjusted real M1, approximately –0.03 and –0.02, respectively.

The estimated PAM of the demand for the real M1 (estimated Equations 11 and 11' in Table 4) gives the best OLS estimation of the transaction demand for the real M1. Seasonal effects are also important and should be incorporated (Equation 13 in Table 5), as suggested by Babić (1998b). Also the PAM between the detrended variables has important implications, especially if the monetary aggregates and other explanatory variables exhibit a strong trend as suggested by Babić (1998b). For the purposes of forecasting and monetary policymaking, estimated Equations 11', 12' and 13 are recommended, since they have high overall equation statistics and similar coefficients. Seasonal adjustment and interpretation of the results from the PAM on the seasonally adjusted variables is more cumbersome. All of the best-performing estimated equations have the desired properties of the stable money demand of Judd and Scadding (1982).

3.3. Estimating the Demand for the M1a

The money aggregate M1a also contains, apart from M1 components, the money balances of various budgetary and extra-budgetary funds. Analysis of this monetary aggregate concludes the analysis of the transaction demand for money because it is the last "narrow" monetary aggregate in Croatia. Its coverage is wider than the usual M1 and that makes this monetary aggregate special, but it also captures the reality on the Croatian money market better because it includes various budgetary and extra-budgetary transactions which still make a large part of the total value-added in Croatia.[24]

In Table 6 at the end of this paper, the results of the OLS estimation comparable to the Babić (1999) methodology are given. The best estimated equation is of Type xiii, or the PAM for the M1a (Equation 18 and adjusted Equation 18'). The best variable of economic activity is, as in the case of the M0 and M1, the logarithm of the monthly real GDP. The best variable of opportunity cost is the logarithm of the weighted average of interest rates on the commercial banks' demand deposits in kuna. Surprisingly, as in the case of the M1, interest rates on time and savings deposits, interest rates on foreign currency deposits, as well as the Zagreb money market rate, were found to be

24 Although Croatia has engaged in privatization and transition to a market economy since its independence in 1991/92, the second wave of privatization (voucher privatization) only came in 1998.

worse opportunity cost variables than the interest rate on kuna deposits, the interest rate of part of the M1a.

According to Equations 18 and 18', the monthly demand for the real M1a is a function of the real monthly GDP, the weighted average of the commercial banks' interest rate on kuna demand deposits, the real M1a from the previous month and the monthly rate of inflation. The main contributors to the change in the real M1a are in roughly the same proportion, 65-67 percent, the change in the current real monthly GDP and the lagged real M1a. The interest rate and inflation account for –0.07 percent and –0.01 percent of the change in the demand for the M1a, respectively. All the estimated coefficients except the interest rate and the inflation coefficients are significant at the 95 percent confidence level. The interest rate coefficient is significant at the 80 percent confidence level and the inflation coefficient only at the 29 percent confidence level. The R-squared, adjusted R-squared and F statistic of estimated Equations 18 and 18' are very high; the Durbin-Watson statistic and the Akaike and Schwartz information criteria are very good.

The income elasticity of the demand for M1a is 0.65, meaning that a 1 percent increase in the real monthly GDP encourages individuals to hold 0.65 percent more of the real M1a, which is theoretically and economically correct. The interest elasticity is –0.07, which means that an increase in the weighted average commercial banks' interest rate on kuna demand deposits of 1 percent discourages the public from holding the real M1a and they will reduce their holdings of the real M1a by 0.07 percent. That also makes sense, both theoretically and economically, if the interest rate is considered to be a price of the real M1a, which it partly is (for the demand deposit part of the M1a). The constant elasticity of the lagged real M1a is 0.67, or a 1 percent increase in the real M1a in the previous month will yield a 0.67 percent rise in the real M1a in the current month. The inflation elasticity is –0.01 and a 1 percent rise in inflation (10 percent) will induce the public to hold 0.01 percent (0.1 percent) less of the real M1a. The constant is equal to –0.80, which means that the constant velocity (antilogarithmed and inversed constant) is 6.30.

Since the inflation coefficient is very close to zero and insignificant, this means (according to the theory behind the PAM model) that the process of the adjustment on the Croatian money market for the M1a occurs exclusively through an adjustment of the real values.

Compared to the quarterly results in Babić (1999), the income elasticity is lower (monthly 0.65 compared to quarterly 1.31), the lagged money elasticity is higher (0.67 compared to 0.38), the inflation elasticity is lower (–0.01 compared to 0.00) and the constant is lower in absolute terms (–0.80 compared to –2.56). The interest elasticity is the same (–0.07), although in the quarterly equation the opportunity variable used was the centered three-period moving average of the Zagreb money market rate.

As in the case of the M0 and M1, the interest rate was used without logarithmic transformation but the results did not change much.

The inflation rate without logarithmic transformation was tried in estimated Equations 19 and 19' in Table 7 and it changed the significance of the estimated coefficients, their value slightly and the significance of the regression, due to the addition of rejected observations (lost because the logarithm of the negative inflation is not defined). The income elasticity of the demand for the real M1a is 0.49, lower than one in Table 6; the interest elasticity is slightly lower in absolute terms (–0.06 compared to –0.07); the constant elasticity of the real M1a from the previous period is 0.74, slightly higher than in Equations 18 and 18'; inflation is the same –0.01; and the constant is –0.59, less in absolute terms than before (the constant velocity is lower, about 3.89).

The estimated PAM of the detrended variables in Table 7 (estimated Equation 21) shows a strong link between the detrended current real M1a, as a dependent variable and the detrended real GDP, the lagged real M1a and inflation, as explanatory variables. The interest rate and inflation were not detrended because they did not exhibit a strong trend. The statistics of estimated Equation 21 are lower than those for Equations 18, 18', 19 and 19'. However, if the real M1a and explanatory variables are trend stationary, Equation 21 is to be used.

The estimated PAM of the seasonally adjusted variables in Table 7 (estimated Equation 20) shows a very strong relationship between the seasonally adjusted current real M1a, as the dependent variable, and the seasonally adjusted real GDP, interest rate, the seasonally adjusted lagged real M1a and inflation as the explanatory variables. The interest rate and inflation were not seasonally adjusted because they did not exhibit strong seasonal effects. Removing the seasonal effects improved the significance of the coefficients, which are close to those in estimated Equations 18, 18', 19 and 19', and the overall regression fit. All the coefficients but one, the inflation coefficient, are significant at the 95 percent confidence level. About 41 percent of the change in the demand for the seasonally adjusted real M1a comes from the change in the seasonally adjusted real GDP. About 75 percent of the change in the demand for the seasonally adjusted real M1a comes from the change in the seasonally adjusted lagged real M1a. The interest rate accounts for very small changes in the demand for the seasonally adjusted real M1, about –0.06. Inflation does not have any influence on the changes of the seasonally adjusted real M1a.

The estimated PAM of the demand for the real M1a (estimated Equations 18 and 18' in Table 6) are the best OLS estimates of the transaction demand for the real M1a. The seasonal effects are also important (excluded in Equation 20 in Table 7), as suggested by Babić (1998b). For the purposes of forecasting and monetary policymaking, estimated Equations 18, 18', 19, 19' and 20 are recommended. Seasonal adjustment is sometimes cumbersome and hard to interpret; 18' and 19' seem to be the best and most convenient for forecasting and monetary policy. These equations also have the desired properties of the stable money demand recommended by Judd and Scadding (1982).

3.4. Stationarity

The classical OLS results derived in the previous sections can lead to wrong inferences if the independent and dependent variables are non-stationary. In such a case of "spurious" regression, the Gauss-Markov theorem does not hold and the OLS estimators are no longer the best (Best Linear Unbiased Estimators – BLUE).

Therefore, it is desirable to test the independent and dependent variables for stationarity. In the present work, the Augmented Dickey Fuller test will be employed for this purpose as well as the Phillips-Perron test in three different modifications: a) including no other explanatory variable except the lagged independent variable (marked as "none" in Table 8), b) including an intercept as an explanatory variable along the lagged independent variable (marked as "intercept" in Table 8) and c) including the intercept and a time trend as the explanatory variables along the lagged independent variable (marked as "trend & intercept" in Table 8) as described in Hamilton (1994). Augmented Dickey Fuller tests will use two lagged expressions. The Phillips-Perron test is performed in the same manner as the Augmented Dickey Fuller test, except that the standard errors of the coefficients are Newey-West HAC (Heteroscedasticity-Autocorrelation) robust standard errors which make the Phillips-Perron test results robust to heteroscedasticity and/or autocorrelation. The results are shown in Table 8, at the end of this paper.

As can be seen, all the tested variables are non-stationary in the levels. The three different modifications of the tests should make a distinction concerning which modification or model best fits the data, or whether the variables in question are trend stationary or difference stationary (unit roots or I(1) processes). Since the tests on the first differences make no distinction among the various modifications of the tests, the conclusion should be that the time trend is present but not dominant, so it is better if the variables in question are transformed to stationarity by first differences. In other words, the conclusion from Table 8 is that tested variables are unit root or I(1) processes, or that they are difference stationary.

Therefore, OLS analysis of the first differences should result in statistically correct coefficients.

In Table 9, the regressions of the first differences in the variables involved in the OLS regressions in Tables 2, 3, 4, 5, 6 and 7 are presented in the following form:

$$\Delta \ln RM = b_0 + b_1 \Delta \ln y + b_2 \Delta \ln r, \qquad \text{(xiv)}$$

where RM is the real monetary aggregate, y the real economic activity variable and r the opportunity cost variable. The explanatory variables were chosen according to the results in previous sections.

The coefficents in Table 9 are not very far from those in the corresponding regressions from previous sections, which could mean that the errors in coefficients from the non-stationarity are not that great and could form a long-term relationship, as suggested by Engle and Granger (1987). The significance of the change in the interest rate coefficient is low in all three estimated equations (estimated Equations 22, 23 and 24). The overall equation significance is very low, so these equations do not add much information.

4. Cointegration and Error Correction

Many economic time series can move together following the path of their equilibrium. That is why some of the "spurious" regressions can even reveal long-term equilibrium behavior. In order to distinguish "spurious" regressions from "long-term-equilibrium" ones, Engle and Granger (1987) developed a series of tests.

In this paper, two of them will be used: the Durbin-Watson test and the Augmented Dickey Fuller test of the residuals from the cointegrating (or "long-term-equilibrium") regression. If the residuals are found stationary by either one of the tests,[25] the regression equation whose residuals were examined is truly a cointegrating one, describing the long-term relationship.

Since the cointegrating regression is a regression that supposedly captures the long-run equilibrium, it should look as follows:

$$\ln RM = b_0 + b_1 \ln y + b_2 \ln r, \qquad \text{(xv)}$$

where RM is the real monetary aggregate, y the real economic activity variable and r the opportunity cost variable. There should neither be lagged RM nor inflation in the cointegrating regression because the long-run equilibrium implies that the money market is moving along its equilibrium path and there is no need for adjustment, whether nominal or real.

The equation of Type (xv) is the same to the equation of Type (x) in the third part of this paper, which is estimated for the M0 in Table 2 (estimated Equations 1 and 1'), for M1 in Table 4 (estimated Equations 8 and 8') and for M1a in Table 6 (estimated Equations 15 and 15'). In order to test these equations for cointegration, their residuals will be tested and the results presented in Table 10 at the end of this paper.

It can be seen that an equation of Type (xv) for the M0 fails the DW test for cointegration, although it passes the ADF test of the stationarity of the residuals. The equation of Type (xv) for the M1 fails both tests. The equation of Type (xv) for the M1a passes the DW test but fails the ADF test.

From the results in Table 10, it can be concluded that neither of the estimated equations of Type (xv) represents a long-term equilibrium equation and that the estimated equations in Tables 2, 3, 4, 5, 6 and 7 represent short-run money demand equations for M0, M1 and M1a. The quarterly money demand equations for the M0, M1 and M1a estimated in Babić (1999) perform better on these tests and quarterly equations should be considered for the long-run or long-run equilibrium equations. This conclusion is not all that surprising because quarterly data in general are longer term in periodicity and exhibit smaller seasonal effects than monthly series.

Because cointegration or a long-run money demand equation for M0, M1 and M1a was not found in the monthly data, there is no error-correction mechanism that can be estimated for these money aggregates. The error-correction mechanism can be derived from the quarterly equations, as in Babić (1999).

5. Granger Causality and VARs

The monthly data analyzed in this paper are very frequent and can provide a good basis for the investigation of the short-run relationships among the money aggregates M0, M1 and M1a and the other explanatory variables in a classical money demand

25 This is done by comparing the calculated DW statistic and the ADF t statistic with the critical DW values for this type of test and the critical Dickey-Fuller t values. The critical values can be found in Hamilton (1994).

function. Short-run relationships are best investigated by Granger causality tests and Vector Auto-Regressive (VAR) models.

5.1. Granger Causality

Granger causality is tested by pairwise Granger causality tests of the money aggregate, the variable of activity and the opportunity cost variable. Since the Granger causality test depends heavily on the number of lags used, all the tests are performed with lags from 2 to 10, of which 2, 4, 6 and 8 lag versions are reported in Tables 11 to 13. The test results that withstand the variation of the lags should be the right ones. The Granger causality tests for the real M0 are reported in Table 11, for the real M1 in Table 12 and for the real M1a in Table 13.

As it can be seen from the Granger causality tests for the real M0 demand variables in Table 11, LOGDMBKNDD (the logarithm of the weighted DMB' interest rates on demand deposits in kuna) always Granger causes LOGRM0 (the logarithm of the real M0), whereas LOGRM0 does not always cause LOGDMBKNDD. The results for the causality between the real M0 and the variable of activity are mixed because in many cases they both Granger cause each other. As for the opportunity cost variable and the variable of activity, the variable of activity never causes interest rates but the interest rates in most of the cases does Granger cause the variable of economic activity.

From the Granger causality tests for the real M1 demand variables in Table 12, it can be concluded that LOGDMBKNDD always Granger causes LOGRM1 (the logarithm of the real M1), whereas LOGRM1 causes LOGDMBKNDD only one time, so the causality goes from LOGDMBKNDD to LOGRM1. The results for the causality between the real M1 and the variable of activity are mixed because in many cases they both Granger cause each other. The variable of activity never causes interest rates but the interest rates in most of the cases Granger cause the variable of economic activity.

From the Granger causality tests for the real M1a demand variables in Table 13, it can be seen that LOGDMBKNDD always Granger causes LOGRM1a, whereas LOGRM1 caused LOGDMBKNDD only once, so the causality goes from LOGDMBKNDD to LOGRM1. The variable of economic activity always Granger causes the real M1a, and the real M1a sometimes causes LOGBDPR (the logarithm of the real monthly GDP). The variable of activity never causes interest rates but the interest rates in most of the cases do Granger cause the variable of economic activity.

The interpretation of these Granger causality results is that they confirm that LOGDMBKNDD should be in the short-term and long-term demand equations for the real money aggregates since it causes each one of them and neither of the real monetary aggregates seems to cause LOGDMBKNDD. LOGBDPR as a variable of economic activity should theoretically be in the money demand functions for the real monetary aggregates but there are major causal relationships that are not modelled with this single-equation approach, exerting influences on both the real money aggregates and the economic activity variable, making them cause each other. This causal relationship should be resolved in both ways by modeling a system of equations.

5.2. The Vector-Autoregressive (VAR) Model

In this paper, only unrestricted VARs[26] will be used because they employ the most information from the data. This will be the major setback; it means that the inferences will not follow any particular theory. Since the aim is to establish short-run relationships, it can be left to further studies.

For each monetary aggregate, a VAR will be estimated on the logarithm (base =1 0) of the nominal monetary aggregate, the logarithm (base = 10) of the variable of economic activity, the logarithm (base = 10) of the nominal interest rate and the logarithm (base = 10) of the consumer price index, showing the influence of the price level, alongside the influences of the economic activity variable and the opportunity cost variable. The VAR for the M0 is presented in Table 14, the VAR for M1 in Table 15, and the VAR for M1a in Table 16. Alongside the estimated VARs, the impulse responses are presented in the graphs accompanying the tables. In Graph 1, after Table 14, the impulse responses for the M0 demand variables are presented. In Graph 2, after Table 15, the impulse responses for the M1 demand variables are presented. The impulse responses for the M1a demand variables are presented in Graph 3, after Table 16.

As can be seen from Tables 14, 15 and 16, all the estimated VARs have high fit and high estimation statistics, which means that these unrestricted VARs capture the short-run relationships among the variables in classical money demand relationships very well.

More information about particular short-term relationships gathered directly from data can be found in impulse responses, or presentations of the time distribution of the reaction of one variable in the VAR to an impulse or a 1 standard deviation random increase in another variable. The impulse responses will be graphed over the subsequent 10 periods (10 months following the impulse).

The impulse of 1 standard deviation in the LOGM0 (the logarithm of M0) increases the LOGM0 by about 0.02 standard deviation in the first period and continues to increase it but with lower increases (about 0.005 after the 10 months), which confirms the high autocorrelation of the LOGM0. The impulse response of the LOGM0 on the LOGBDPR (the logarithm of the real GDP) is ambiguous, showing a very mild rise in the LOGM0 after an impulse in the LOGBDPR lasting for 5 periods and then a mild fall in the next five months. The impulse in the LOGDMBKNDD (the logarithm of the nominal weighted DMB's interest rate on demand deposits in kuna) reduces the LOGM0 by about 0.01 standard deviation in the second month after the impulse occurs and then continues to lower the LOGM0 but at a slower pace, showing that the LOGDMBKNDD is a good opportunity cost vatriable for the M0 (the cash outside the banks). The impulse in the LOGCPI90 (the logarithm of base CPI, 1990=100) does not have an immediate effect on the LOGM0 but starts to increase the LOGM0 three months after the occurrence of the impulse, showing that there is a 3-month transmission of inflation or that it takes 3 months for the public to realize that inflation has

26 This refers to VARs that do not make structural or restrictive assumptions on the structure of the economy and relationships among economic variables, according to economic theory.

occurred and adjust their demanded quantity of the nominal M0. These short-run relationships confirm the results in the classical OLS estimation given in Part 3 of this paper. Graph 1 also shows various other interesting short-term relationships (e.g. between the LOGDMBKNDD and the LOGBDPR) but they are not the main point of interest in this paper.

As shown in Graph 2, an impulse in the LOGM1 increases the LOGM1 by about 0.015 standard deviation in the first period and continues to increase it but at a slower pace (about 0.002 after the 10 months), which confirms the high autocorrelation of the LOGM1. The impulse response of the LOGM1 on the LOGBDPR is ambiguous, showing a very mild rise in the LOGM1 after an impulse in the LOGBDPR lasting for 6 periods and then a mild drop in the next four months, but the response of the M1 to the LOGBDPR is higher than the M0. The impulse in the LOGDMBKNDD reduces the LOGM1 by about 0.005 standard deviation in the second month after the impulse occurs and then continues to lower the LOGM1 but at a slower pace, showing that the LOGDMBKNDD is a good opportunity cost variable even for the M1 (the cash outside the banks plus demand deposits). The impulse in the LOGCPI90 does not have an immediate effect on the LOGM1 but starts to increase the LOGM1 three months after the occurrence of the impulse, showing that it takes 3 months for the public to realize that inflation occurred and to adjust their demanded quantity of nominal M1. These short-run relationships confirm the results in the classical OLS estimation given in Part 3 of this paper. Graph 2 also shows various other interesting short-term relationships.

As shown in Graph 3, the impulse in the LOGM1a increases the LOGM1a by about 0.015 (about the same as in the case of the M1) standard deviation in the first period and continues to increase it but at a slower pace (about 0.002 after the 10 months), which confirms the high autocorrelation of the LOGM1a. The impulse response of the LOGM1a on the LOGBDPR is also ambiguous, showing a very mild rise in the LOGM1a after an impulse in the LOGBDPR lasting for 6 periods and then a mild drop in the next four months, the response of the LOGM1a to the LOGBDPR being similar to that of the LOGM1. The impulse in the LOGDMBKNDD reduces the LOGM1a by about 0.005 standard deviation in the second and third month after the impulse occurs and then continues to lower the LOGM1a, but at a slower pace, showing that the LOGDMBKNDD is a good opportunity cost variable even for the M1a (the cash outside the banks plus the demand deposits plus the transaction balances of budgetary and extra-budgetary funds). The impulse in the LOGCPI90 does not have an immediate effect on the LOGM1a but starts to increase the LOGM0 three months after the occurrence of the impulse, showing that it takes 3 months for the public to realize that inflation has occurred and to adjust their demanded quantity of the nominal M1a. These short-run relationships confirm the results in the classical OLS estimation given in Part 3 of this paper. Graph 3 also shows other various interesting short-term relationships.

These results are a bit different than results for VARs on quarterly data in Babić (1999) but this is due to the small number of observations and different explanatory variables (e.g. the Zagreb money market rate as an opportunity cost variable for the M1 and M1a).

Granger causality and VARs capture short-run relationships that strongly resemble those found in the classical OLS estimation in Part 3 of this paper. Because of the periodicity of the data, it is logical to consider those results (both Granger causality, VARs and classical OLS) to describe the short-run transaction money demand for the three monetary aggregates (M0, M1 and M1a).

Long-term transaction money demand relationships can be derived from the results in Babić (1999), estimated on quarterly data, when the observation number increases.

6. Conclusion

In this paper, the monthly transaction money demand function is estimated empirically and various issues are discussed concerning the money demand in Croatia. This research is a continuation of the research of the demand for money previously performed on quarterly data.

The main emphasis in this paper was on the classical OLS analysis of transaction money demand relationships. The demand equations for various transaction money aggregates, M0 (currency outside banks), M1 (currency outside banks plus demand deposits), and M1a (M1 plus budgetary and extra-budgetary transaction balances), are estimated and then corrected by the Cochrane-Orcutt procedure.

The best estimating model for all of the money aggregates was the Partial Adjustment Model (PAM). Results show that the demand for the real monetary aggregates (deflated with the consumer price index) are a stable function of a few explanatory variables: the variable of economic activity, the opportunity cost variable and the variables of partial adjustment. The best variable of economic activity for the M0, M1 and M1a turned out to be the real monthly GDP, extracted from the quarterly real GDP published by the CSO using statistical procedures. The best opportunity cost variable for the M0, M1 and M1a turned out to be the weighted average interest rate on the commercial banks' demand deposits in kuna. That is very logical for the M0, since cash and demand deposits are substitutes. Nonetheless, it is strange that no other interest rate (not even the weighted average interest rate on the commercial banks' time and savings deposits in kuna or foreign currency) was found to be better for the M1 and M1a. The variables of partial adjustment were, according to the theory of the PAM, the lagged real money aggregate and the rate of inflation, calculated from the consumer price index.

The PAM model also determined that most of the adjustment on the money market in Croatia goes through an adjustment of the real variables, which reflects the still fresh memory of high inflation.

Since the monthly monetary aggregates are highly influenced by seasonal factors, especially during the tourist season in Croatia and the Christmas/New Year shopping period, the transaction demand for the M0, M1 and M1a was estimated on seasonally adjusted data. The results were strong and significant, and those equations are recommended for use in policymaking and forecasting, along with the classical seasonally unadjusted equations.

The stationarity tests of the variables involved in the classical OLS estimation determined that all the variables are I(1), or nonstationary series, but stationary in their first differences. A deterministic trend is not dominant, so the detrending of the variables in the levels would not solve the problem of stationarity. The estimation of the demand equation for the first differences of the real money aggregates using the first differences of the explanatory variables yielded results not very far from those in classical OLS regressions, so the errors in the coefficients and the bias in R-squared due to non-stationarity is not very great. Nevertheless, caution is needed in long-term forecasting and policymaking based upon the estimated OLS regressions.

Furthermore, the demand equations for the real M0, M1 and M1a were tested for cointegration with the Durbin-Watson and Augmented Dickey-Fuller tests of the residuals of the classical OLS regressions. There is no classical OLS regression that qualified as a cointegration regression according to both tests. Since no cointegration regression was found, it was not possible to estimate an error-correction model from the monthly data.

Granger causality and unrestricted VARs were used to determine the short-run relationships between the variables used in the transaction money demand equations for the M0, M1 and M1a. The results of Granger causality and unrestricted VARs confirm that relationships among those variables exist, strongly confirming the results of the classical OLS estimation. Unrestricted VARs also reveal the dynamics of the interrelationships among the transaction money aggregates and the explanatory variables.

This paper concludes with research on the transaction demand for money in Croatia. The results in this paper and Babić (1999) can be updated or expanded to include details in various parts of the research (e.g. expanding unrestricted structural VAR analysis of the transaction demand for money in Croatia based upon both monthly and quarterly data). Also, the demand for broader money aggregates should be included in further research.

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Appendix

Table 1a. Estimated money demand equation from Anušić (1993)

Period	Jan. 1991 – Nov. 1993	Jan. 1991 – Sep. 1993
Dependent variable	lm(t)	lm(t)
Constant	**0.3353**	**0.2992**
t – stat.	3.63	1.87
lm(t – 1)	**0.7663**	**0.773**
t – stat.	18.01	14.58
ly(t)	**0.1833**	**0.1894**
t – stat.	3.75	3.59
LINFLA(t)	**–0.8852**	**–0.8528**
t – stat.	–4.56	–3.18
LTECAJ(t-1)	**–0.0205**	**–0.0206**
t – stat.	–0.49	–0.43
LTECAJ(t – 2)	**–0.1917**	**–0.1877**
t – stat.	–3.85	–3.63
LKAM(t – 1)	**–0.4984**	**–0.4496**
t – stat.	–1.61	–1.31
DUM78(t)	**0.0735**	**0.0723**
t – stat.	3.22	3.05
DUM10(t)	**0.0858**	**0.0951**
t – stat.	3.15	2.65
DUM12(t)	**0.1903**	**0.1871**
t – stat.	4.76	4.5
N =	**35**	**33**
R – sq =	**0.996**	**0.996**
DW =	**1.72**	**1.71**
F =	**988**	**841**

where lm is the natural logarithm of the real M1 at the end of the month deflated by the arithmetic mean of the monthly consumer price index and the producer price index based on December of 1989, *ly* is the natural logarithm of the real social product, LINFLA is the natural logarithm of the rate of change in the deflator, LTECAJ is the natural logarithm of the rate of change in the nominal effective exchange rate index of the Croatian dinar, LKAM is the logarithm of the arithmetic mean of the monthly nominal interest rates on the short-term deposits of the five biggest banks in Croatia, DUM78 is a dummy variable for July and August of 1992 and 1993 which takes into account the tourist season, DUM10 is a dummy for October and DUM12 is a dummy for December.

Table 1b. Estimated money demand equation from Šonje (1999)

Period	Equation 1	Equation 2
Dependent variable	m(t)	m(t)
Constant	**0.1176**	**0.0569**
t – stat.	1.257	0.609
m(t – 1)	**0.6883**	**0.6997**
t – stat.	20.237	23.467
Y(t)	**0.4079**	**0.4112**
t – stat.	7.009	7.231
B(t)	**–0.8245**	**–0.7543**
t – stat.	–8.642	–7.761
i_1(t)	**–0.0011**	
t – stat.	–1.497	
i_2(t)	**0.0001**	
t – stat.	1.409	
e(t)		**–0.2036**
t – stat.		–1.844
D(t)	**–0.1600**	**–0.1646**
t – stat.	–3.848	–4.029
N =	**49**	**49**
R – sq, adj. =	**0.991**	**0.991**
Se of reg.=	**0.041**	**0.040**
DW =	**1.987**	**1.968**
Durbin h =	**0.163**	**–0.355**

where *m* is the real M1a at the end of the month, Y is the retail trade turnover, *B* is the monthly CPI inflation, i_1 is the nominal weighted DMB's interest rate on demand deposits in kuna, i_2 is the nominal weighted DMB's interest rate on time deposits in kuna, *e* is the rate of the nominal depreciation of the Croatian kuna in comparison to the German mark and D is a dummy variable for October of 1993 (the start of the antiinflationary program).

Table 2. Estimated money demand for the M0 (July 1994 – December 1998)

Equation	1	1′	2	2′	3	3′	4	4′
Dependent var. Independ. var.	LOGRM0	LOGRM0	LOGRM0	LOGRM0	LOGRM0	LOGRM0	LOGRM0	LOGRM0
Constant	**–3.95**	**–0.71**	**–0.75**	**–0.56**	**–3.88**	**–1.86**	**–0.71**	**–0.39**
t – stat.=	–9.86	–9.62	–2.62	–1.90	–8.09	–7.79	–2.03	–1.09
$p(t>t_u)=$	0.00	0.00	0.01	0.06	0.00	0.00	0.05	0.28
LOGBDPR(t)	**2.30**	**2.10**	**0.41**	**0.32**	**2.26**	**1.93**	**0.36**	**0.20**
t – stat.=	7.80	7.47	2.21	1.67	6.40	5.96	1.59	0.87
$p(t>t_u)=$	0.00	0.00	0.03	0.10	0.00	0.00	0.12	0.39
LOGDMBKNDD(t)	**–0.28**	**–0.32**	**–0.07**	**–0.04**	**–0.31**	**–0.37**	**–0.10**	**–0.04**
t – stat.=	–3.21	–3.95	–1.77	–0.89	–3.06	–4.12	–2.02	–0.76
$p(t>t_u)=$	0.00	0.00	0.08	0.38	0.00	0.00	0.05	0.45
LOGRM(t – 1)			**0.77**	**0.84**			**0.75**	**0.87**
t – stat.=			14.24	13.27			11.84	10.46
$p(t>t_u)=$			0.00	0.00			0.00	0.00
LOGINFL(t)					**0.00**	**0.01**	**–0.01**	**–0.01**
t – stat.=					0.06	0.67	–0.71	–1.31
$p(t>t_u)=$					0.95	0.51	0.48	0.20
N =	**54**	**53**	**54**	**53**	**41**	**40**	**41**	**40**
F =	**113.30**	**124.52**	**442.14**	**432.67**	**59.28**	**70.86**	**246.88**	**240.66**
$p(F>F_u)$ =	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
R – sq =	**0.82**	**0.83**	**0.96**	**0.96**	**0.83**	**0.86**	**0.97**	**0.96**
Adj.R – sq =	**0.81**	**0.83**	**0.96**	**0.96**	**0.81**	**0.84**	**0.96**	**0.96**
DW =	**0.27**	**0.30**	**1.87**	**1.91**	**0.28**	**0.36**	**1.74**	**2.12**
Schwartz inf. crit.	**–5.85**	**–9.28**	**–7.39**	**–7.44**	**–5.77**	**–7.25**	**–7.26**	**–7.35**
Akaike inform. crit.	**–5.96**	**–9.39**	**–7.54**	**–7.59**	**–5.93**	**–7.42**	**–7.47**	**–7.57**

The equations are adjusted for autocorrelation with the one-step Cochrane-Orcutt procedure.

where LOGRM0 is the logarithm (base=10) of the real M0 deflated by the base consumer price index CPI (1990=100), LOGBDPR is the logarithm (base=10) of the monthly real GDP extracted from the quarterly real GDP from the CSO, LOGDMBKNDD is the logarithm (base=10) of the nominal weighted commercial banks' demand deposit interest rate and LOGINFL is the logarithm (base=10) of the rate of change in the base consumer price index CPI (1990=100).

Table 3. Estimated money demand for M0 (July 1994 – December 1998) (alternative specifications)

Equation	5	6	7
Dependent var. Independ. var.	LOGRM0	LOGRM0DSZ	LOGRM0DTR
Constant	**–0.65**	**–0.64**	**0.00**
t – stat.=	–2.25	–2.19	0.25
$p(t>t_u)=$	–0.03	0.03	0.80
LOGBDPR(t)	**0.35**		
t – stat.=	1.89		
$p(t>t_u)=$	0.06		
LOGBDPRDTR(t)			**0.17**
t – stat.=			0.91
$p(t>t_u)=$			0.37
LOGBDPRDSZ(t)		**0.35**	
t – stat.=		1.85	
$p(t>t_u)=$		0.07	
LOGDMBKNDD(t)	**–0.08**	**–0.04**	**0.01**
t – stat.=	–1.86	–1.66	0.20
$p(t>t_u)=$	0.07	0.10	0.85
LOGRM0(t – 1)	**0.79**		
t – stat.=	14.53		
$p(t>t_u)=$	0.00		
LOGRM0DTR(t – 1)			**0.82**
t – stat.=			9.17
$p(t>t_u)=$			0.00
LOGRM0DSZ(t – 1)		**0.82**	
t – stat.=		17.94	
$p(t>t_u)=$		0.00	
INFL(t)	**–0.01**	**0.01**	**–0.02**
t – stat.=	–1.68	2.26	–2.50
$p(t>t_u)=$	–0.10	0.03	0.02
N =	**54**	**54**	**54**
F =	**344.32**	**880.42**	**28.90**
$p(F>F_u)$ =	**0.00**	**0.00**	**0.00**
R – sq =	**0.97**	**0.99**	**0.71**
Adj.R – sq =	**0.96**	**0.99**	**0.68**
DW =	**1.93**	**2.30**	**1.96**
Schwartz inf. crit.	**–7.37**	**–8.29**	**–7.51**
Akaike inform. crit.	**–7.56**	**–8.47**	**–7.70**

where LOGRM0 is the logarithm (base=10) of the real M0 deflated by the base consumer price index CPI (1990=100), LOGRM0DTR is the detrended logarithm (base=10) of the real M0 deflated by the base consumer price index CPI (1990=100), LOGRM0DSZ is the seasonally adjusted logarithm (base=10) of the real M0 deflated by base consumer price index CPI (1990=100), LOGBDPR is the logarithm (base=10) of the monthly real GDP extracted from the quarterly real GDP from the CSO, LOGBDPRDTR is the detrended logarithm (base=10) of the monthly real GDP extracted from the quarterly real GDP from the CSO, LOGBDPRDZS is the seasonally adjusted logarithm (base=10) of the monthly real GDP extracted from the quarterly real GDP from the CSO, LOGDMBKNDD is the logarithm (base=10) of the nominal weighted commercial banks' demand deposit interest rate and INFL is the rate of change in the base consumer price index CPI (1990=100).

Table 4. Estimated money demand for M1 (July 1994 – December 1998)

Equation	8	8′	9	9′	10	10′	11	11′
Dependent var. Independ. var.	LOGRM1	LOGRM1	LOGRM1	LOGRM1	LOGRM1	LOGRM1	LOGRM1	LOGRM1
Constant	**–3.17**	**–0.65**	**–0.84**	**–0.67**	**–3.22**	**–1.50**	**–0.79**	**–0.47**
t – stat.=	–10.46	–10.45	–3.90	–3.58	–8.81	–8.81	–3.09	–2.12
$p(t>t_u)=$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
LOGBDPR(t)	**1.99**	**1.82**	**0.53**	**0.51**	**2.05**	**1.77**	**0.50**	**0.38**
t – stat.=	8.95	8.83	3.62	3.37	7.61	7.46	2.84	2.04
$p(t>t_u)=$	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.05
LOGDMBKNDD(t)	**–0.25**	**–0.28**	**–0.06**	**–0.05**	**–0.26**	**–0.32**	**–0.06**	**–0.02**
t – stat.=	–3.74	–4.72	–1.76	–1.41	–3.40	–4.76	–1.54	–0.38
$p(t>t_u)=$	0.00	0.00	0.09	0.16	0.00	0.00	0.13	0.70
LOGRM1(t – 1)			**0.73**	**0.74**			**0.75**	**0.85**
t – stat.=			14.08	12.01			12.28	10.00
$p(t>t_u)=$			0.00	0.00			0.00	0.00
LOGINFL(t)					**0.01**	**0.02**	**–0.01**	**–0.01**
t – stat.=					0.59	1.39	–1.26	–1.82
$p(t>t_u)=$					0.56	0.17	0.22	0.08
N =	**54**	**53**	**54**	**53**	**41**	**40**	**41**	**40**
F =	**150.16**	**175.22**	**553.05**	**499.67**	**81.12**	**105.68**	**344.88**	**322.16**
$p(F>F_u)$ =	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
R – sq =	**0.86**	**0.88**	**0.97**	**0.97**	**0.87**	**0.90**	**0.98**	**0.97**
Adj.R – sq =	**0.85**	**0.87**	**0.97**	**0.97**	**0.86**	**0.89**	**0.97**	**0.97**
DW =	**0.27**	**0.29**	**1.62**	**1.65**	**0.30**	**0.46**	**1.38**	**1.55**
Schwartz inf. crit.	**–6.40**	**–9.63**	**–7.93**	**–8.29**	**–6.31**	**–7.92**	**–7.86**	**–8.38**
Akaike inform. crit.	**–6.51**	**–9.74**	**–8.08**	**–8.44**	**–6.47**	**–8.09**	**–8.07**	**–8.60**

The equations are adjusted for autocorrelation with the one-step Cochrane-Orcutt procedure.

where LOGRM1 is the logarithm (base=10) of the real M1 deflated by the base consumer price index CPI (1990=100), LOGBDPR is the logarithm (base=10) of the monthly real GDP extracted from the quarterly real GDP from the CSO, LOGDMBKNDD is the logarithm (base=10) of the nominal weighted commercial banks' demand deposit interest rate and LOGINFL is the logarithm (base=10) of the rate of change in the base consumer price index CPI (1990=100).

Table 5. Estimated money demand for M1 (July1994 – December 1998) (alternative specifications)

Equation	12	12′	13	14
Dependent var. Independ. var.	LOGRM1	LOGRM1	LOGRM1DSZ	LOGRM1DTR
Constant	**–0.64**	**–0.37**	**–0.52**	**0.01**
t – stat.=	–3.10	–2.22	–2.27	0.52
$p(t>t_u)=$	0.00	0.03	0.03	0.61
LOGBDPR(t)	**0.40**	**0.31**		
t – stat.=	2.91	2.17		
$p(t>t_u)=$	0.01	0.04		
LOGBDPRDTR(t)				**0.30**
t – stat.=				2.06
$p(t>t_u)=$				0.05
LOGBDPRDSZ(t)			**0.32**	
t – stat.=			2.06	
$p(t>t_u)=$			0.05	
LOGDMBKNDD(t)	**–0.05**	**–0.03**	**–0.04**	**0.00**
t – stat.=	–1.82	–0.87	–1.70	0.20
$p(t>t_u)=$	0.08	0.39	–0.10	0.85
LOGRM1(t – 1)	**0.78**	**0.85**		
t – stat.=	15.71	13.86		
$p(t>t_u)=$	0.00	0.00		
LOGRM1DTR(t – 1)				**0.86**
t – stat.=				10.12
$p(t>t_u)=$				0.00
LOGRM1DSZ(t – 1)			**0.82**	
t – stat.=			17.54	
$p(t>t_u)=$			0.00	
INFL(t)	**–0.02**	**–0.02**	**0.00**	**–0.02**
t – stat.=	–3.35	–3.84	–0.70	–3.97
$p(t>t_u)=$	0.00	0.00	0.49	0.00
N =	**54**	**54**	**54**	**54**
F =	**502.23**	**483.4**	**861.75**	**44.39**
$p(F>F_u)$ =	**0.00**	**0.00**	**0.00**	**0.00**
R – sq =	**0.98**	**0.98**	**0.99**	**0.79**
Adj.R – sq =	**0.97**	**0.97**	**0.99**	**0.77**
DW =	**1.48**	**1.64**	**2.17**	**1.60**
Schwartz inf. crit.	**–8.06**	**–8.62**	**–8.61**	**–8.08**
Akaike inform. crit.	**–8.25**	**–8.81**	**–8.79**	**–8.26**

The equations are adjusted for autocorrelation with the one-step Cochrane-Orcutt procedure.

where LOGRM1 is the logarithm (base=10) of the real M1 deflated by the base consumer price index CPI (1990=100), LOGRM1DTR is the detrended logarithm (base=10) of the real M1 deflated by the base consumer price index CPI (1990=100), LOGRM1DSZ is the seasonally adjusted logarithm (base=10) of the real M1 deflated by the base consumer price index CPI (1990=100), LOGBDPR is the logarithm (base=10) of the monthly real GDP extracted from the quarterly real GDP from the CSO, LOGBDPRDTR is the detrended logarithm (base=10) of the monthly real GDP extracted from the quarterly real GDP from the CSO, LOGBDPRDZS is the seasonally adjusted logarithm (base=10) of the monthly real GDP extracted from the quarterly real GDP from the CSO, LOGDMBKNDD is the logarithm (base=10) of the nominal weighted commercial banks' demand deposit interest rate and INFL is the rate of change in the base consumer price index CPI (1990=100).

Table 6. Estimated money demand for M1a (July 1994 – December 1998)

Equation	15	15′	16	16′	17	17′	18	18′
Dependent var. Independ. var.	LOGRM1a	LOGRM1a	LOGRM1a	LOGRM1a	LOGRM1a	LOGRM1a	LOGRM1a	LOGRM1a
Constant	**–2.84**	**–0.7**	**–1.12**	**–0.81**	**–2.89**	**–1.26**	**–1.18**	**–0.8**
t – stat.=	–12.22	–12.03	–4.66	–4.17	–10.39	–10.19	–3.98	–3.08
$p(t>t_u)=$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LOGBDPR(t)	**1.75**	**1.63**	**0.69**	**0.66**	**1.79**	**1.61**	**0.73**	**0.65**
t – stat.=	10.21	9.95	4.34	3.97	8.77	8.47	3.70	2.98
$p(t>t_u)=$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
LOGDMBKNDD(t)	**–0.26**	**–0.29**	**–0.10**	**–0.08**	**–0.27**	**–0.31**	**–0.11**	**–0.07**
t – stat.=	–5.17	–5.95	–2.59	–2.01	–4.65	–5.77	–2.37	–1.31
$p(t>t_u)=$	0.00	0.00	0.01	0.05	0.00	0.00	0.02	0.20
LOGRM1a(t – 1)			**0.61**	**0.64**			**0.59**	**0.67**
t – stat.=			8.99	7.85			7.26	5.77
$p(t>t_u)=$			0.00	0.00			0.00	0.00
LOGINFL(t)					**0.01**	**0.02**	**0.00**	**–0.01**
t – stat.=					1.15	1.84	–0.02	–0.38
$p(t>t_u)=$					0.26	0.07	–0.99	0.71
N =	**54**	**53**	**54**	**53**	**41**	**40**	**41**	**40**
F =	**218.69**	**240.25**	**401.08**	**374.93**	**120.34**	**143.75**	**229.6**	**212.64**
$p(F>F_u)$ =	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
R – sq =	**0.90**	**0.91**	**0.96**	**0.96**	**0.91**	**0.92**	**0.96**	**0.96**
Adj.R – sq =	**0.89**	**0.90**	**0.96**	**0.96**	**0.90**	**0.92**	**0.96**	**0.96**
DW =	**0.40**	**0.42**	**1.49**	**1.56**	**0.45**	**0.61**	**1.34**	**1.43**
Schwartz inf. crit.	**–6.93**	**–9.76**	**–7.82**	**–8.35**	**–6.86**	**–8.56**	**–7.67**	**–8.17**
Akaike inform. crit.	**–7.04**	**–9.87**	**–7.97**	**–8.5**	**–7.02**	**–8.73**	**–7.88**	**–8.38**

The equations are adjusted for autocorrelation with the one-step Cochrane-Orcutt procedure.

where LOGRM1a is the logarithm (base=10) of the real M1a deflated by the base consumer price index CPI (1990=100), LOGBDPR is the logarithm (base=10) of the monthly real GDP extracted from the quarterly real GDP from the CSO, LOGDMBKNDD is the logarithm (base=10) of the nominal weighted commercial banks' demand deposit interest rate and LOGINFL is the logarithm (base=10) of the rate of change in the base consumer price index CPI (1990=100).

Table 7. Estimated money demand for M1a (July 1994 – December 1998) (alternative specifications)

Equation	19	19′	20	21
Dependent var. Independ. var.	LOGRM1a	LOGRM1a	LOGRM1aDSZ	LOGRM1aDTR
Constant	**–0.97**	**–0.59**	**–0.67**	**0.01**
t – stat.=	–3.88	–2.87	–2.82	0.94
$p(t>t_u)=$	0.00	0.01	0.01	0.35
LOGBDPR(t)	**0.60**	**0.49**		
t – stat.=	3.66	2.82		
$p(t>t_u)=$	0.00	0.01		
LOGBDPRDTR(t)				**0.44**
t – stat.=				2.54
$p(t>t_u)=$				0.01
LOGBDPRDSZ(t)			**0.41**	
t – stat.=			2.56	
$p(t>t_u)=$			0.01	
LOGDMBKNDD(t)	**–0.09**	**–0.06**	**–0.06**	**–0.01**
t – stat.=	–2.47	–1.40	–2.47	–0.56
$p(t>t_u)=$	0.02	0.17	0.02	0.58
LOGRM1a(t-1)	**0.66**	**0.74**		
t – stat.=	9.24	8.23		
$p(t>t_u)=$	0.00	0.00		
LOGRM1aDTR(t-1)				**0.73**
t – stat.=				6.94
$p(t>t_u)=$				0.00
LOGRM1aDSZ(t-1)			**0.75**	
t – stat.=			13.01	
$p(t>t_u)=$			0.00	
INFL(t)	**–0.01**	**–0.01**	**0.00**	**–0.02**
t – stat.=	–1.82	–2.29	0.58	–2.53
$p(t>t_u)=$	0.07	0.03	0.57	0.02
N =	**54**	**54**	**54**	**54**
F =	**315.65**	**306.75**	**611.87**	**31.04**
$p(F>F_u)$ =	**0.00**	**0.00**	**0.00**	**0.00**
R – sq =	**0.96**	**0.96**	**0.98**	**0.72**
Adj.R – sq =	**0.96**	**0.96**	**0.98**	**0.70**
DW =	**1.44**	**1.62**	**2.05**	**1.58**
Schwartz inf. crit.	**–7.81**	**–8.42**	**–8.49**	**–7.82**
Akaike inform. crit.	**–8.00**	**–8.61**	**–8.67**	**–8.01**

The equations are adjusted for autocorrelation with the one-step Cochrane-Orcutt procedure.

where LOGRM1a is the logarithm (base=10) of the real M1a deflated by the base consumer price index CPI (1990=100), LOGRM1aDTR is the detrended logarithm (base=10) of the real M1a deflated by the base consumer price index CPI (1990=100), LOGRM1aDSZ is the seasonally adjusted logarithm (base=10) of the real M1 deflated by the base consumer price index CPI (1990=100), LOGBDPR is the logarithm (base=10) of the monthly real GDP extracted from the quarterly real GDP from the CSO, LOGBDPRDTR is the detrended logarithm (base=10) of the monthly real GDP extracted from the quarterly real GDP from the CSO, LOGBDPRDZS is the seasonally adjusted logarithm (base=10) of the monthly real GDP extracted from the quarterly real GDP from CSO, LOGDMBKNDD is the logarithm (base=10) of the nominal weighted commercial banks' demand deposit interest rate and INFL is the rate of change in the base consumer price index CPI (1990=100).

Table 8. Stationarity tests for the regression variables

Test	ADF levels			ADF first differences			PP test, levels			PP test, first dif.		
Variable	None	Intercept	Trend & intercept	None	Intercept	Trend & intercept	None	Intercept	Trend & intercept	None	Intercept	Trend & intercept
LOGRM0	–1.06	–0.3	–2.45	–4.71[a]	–4.81[a]	–4.87[a]	–0.91	–0.32	–2.67	–9.98[a]	–10.04[a]	–10.10[a]
LOGRM1	–0.85	–0.5	–2.48	–4.22[a]	–4.25[a]	–4.30[a]	–0.53	–0.61	–3.09	–7.44[a]	–7.42[a]	–7.49[a]
LOGRM1a	–0.82	–0.62	–2.55	–4.08[a]	–4.11[a]	–4.14[a]	–0.73	–0.59	–2.55	–7.08[a]	–7.09[a]	–7.11[a]
LOGBDPR	0.95	–0.85	–2.92	–6.69[a]	–6.85[a]	–6.87[a]	0.52	–1.49	–2.89	–3.83[a]	–3.83[a]	–3.81[a]
LOGDMBKNDD	–1.52	–1.14	–1.39	–3.36[a]	–3.43[a]	–3.44[a]	–1.47	–1.1	–1.49	–9.02[a]	–9.09[a]	–9.05[a]
LOGINFL	–0.89	–0.87	–1.96	–3.99[a]	–3.92[b]	–3.82[b]	–1.9	–1.81	–2.73	–9.14[b]	–8.99[b]	–8.86[b]
INFL	–1.53	–1.53	–2.12	–6.15[a]	–6.13[a]	–6.09[a]	–1.75	–1.83	–2.65	–12.16[a]	–12.11[a]	–12.04[a]

[a] Rejection of the Null hypothesis of the unit root at the 95% level of significance (n=80–85) according to McKinnon critical values calculated upon "Dickey-Fuller t-distribution" derived from Monte-Carlo simulations: for the none test equal to –1.94, for the intercept test equal to –2.89 and for the trend and intercept test equal to –3.46.

[b] Rejection of the Null hypothesis of the unit root at the 95% level of significance (n=40–85) according to McKinnon critical values calculated upon "Dickey-Fuller t-distribution" derived from Monte-Carlo simulations: for the none test equal to –1.95, for the intercept test equal to –2.96 and for the trend and intercept test equal to –3.55.

where LOGRM0 is the logarithm (base=10) of the real M0 (currency outside banks) deflated by the consumer price index, LOGRM1 is the logarithm (base=10) of the real M1 (currency plus demand deposits) deflated by the consumer price index, LOGRM1a is the logarithm (base=10) of the real M1a (M1 plus budgetary and extra-budgetary funds' balances) deflated by the consumer price index, LOGBDPR is the logarithm (base=10) of the monthly real GDP, LOGDMBKNDD is the logarithm (base=10) of the weighted average commercial banks' kuna demand deposit interest rate, LOGINFL is the logarithm (base=10) of inflation (rates of change in the CPI index) and INFL is the inflation (rate of change in the consumer price index).

Table 9. Estimated demand equation for ΔLOGRM0, ΔLOGRM1 and ΔLOGRM1a (July 1994–December 1998)

Equation	22	23	24
Dependent var. Independent var.	ΔLOGRM0	ΔLOGRM1	ΔLOGRM1a
LOGBDPR(t)	**1.27**	**1.25**	**1.37**
t – stat.=	3.78	5.01	5.24
$p(t>t_u)=$	0.00	0.00	0.00
LOGDMBKNDD(t)	**0.02**	**–0.09**	**0.17**
t – stat.=	0.12	–0.74	–1.40
$p(t>t_u)=$	0.91	0.47	0.17
N =	**54**	**54**	**54**
F =	**7.54**	**18.91**	**25.38**
$p(F>F_u)$ =	**0.01**	**0.00**	**0.00**
R – sq =	**0.13**	**0.27**	**0.33**
Adj.R – sq =	**0.11**	**0.25**	**0.32**
DW =	**1.73**	**1.65**	**1.76**
Schwartz inf. crit.	**–7.34**	**–7.94**	**–7.85**
Akaike inform. crit.	**–7.41**	**–8.02**	**–7.93**

where LOGRM0 is the logarithm (base=10) of the real M0 (currency outside banks) deflated by the consumer price index, LOGRM1 is the logarithm (base=10) of the real M1 (currency plus demand deposits) deflated by the consumer price index, LOGRM1a is the logarithm (base=10) of the real M1a (M1 plus budgetary and extra-budgetary funds' balances) deflated by the consumer price index, LOGBDPR is the logarithm (base=10) of the monthly real GDP and LOGDMBKNDD is the logarithm (base=10) of the weighted average commercial banks' kuna demand deposit interest rate.

Table 10. Cointegration tests for M0, M1 and M1a (July 1994–December 1998)

	DW test	ADF test		
		None	Intercept	Trend & iter.
logRM0=f(logBDPr, logDMBKNDD)	DW(54)=0.27	–354	–357	–352
	0.367[a]	–1.95[b]	–2.92[b]	–3.50[b]
logRM1=f(logBDPr, logDMBKNDD)	DW(54)=0.27	–280	–283	–281
	0.367[a]	–1.95[b]	–2.92[b]	–3.50[b]
logRM1a=f(logBDPr, logDMBKNDD)	DW(54)=0.40	–2.58	–2.57	–2.59
	0.367[a]	–1.95[b]	–2.92[b]	–3.50[b]

[a] Critical values of DW test.
[b] McKinnon critical values for the ADF test at 95 percent significance.
Source: Tables 2, 4 and 6

where LOGRM0 is the logarithm (base=10) of the real M0 (currency outside banks) deflated by the consumer price index, LOGRM1 is the logarithm (base=10) of the real M1 (currency plus demand deposits) deflated by the consumer price index, LOGRM1a is the logarithm (base=10) of the real M1a (M1 plus budgetary and extra-budgetary funds' balances) deflated by the consumer price index, LOGBDPR is the logarithm (base=10) of the monthly real GDP and LOGDMBKNDD is the logarithm (base=10) of the weighted average commercial banks' kuna demand deposit interest rate.

Table 11. Granger causality for logRM0 (July 1994–December 1998)

Lags = 2			
Null Hypothesis:	**Obs.**	**F-statistic**	**Probability**
LOGBDPR does not Granger Cause LOGRM0	83	2.6	0.08
LOGRM0 does not Granger Cause LOGBDPR	83	20.32	0
LOGDMBKNDD does not Granger Cause LOGRM0	82	13.09	0
LOGRM0 does not Granger Cause LOGDMBKNDD	82	2.06	0.13
LOGDMBKNDD does not Granger Cause LOGBDPR	82	6.76	0
LOGBDPR does not Granger Cause LOGDMBKNDD	82	0.7	0.5

Lags = 4			
Null Hypothesis:	**Obs.**	**F-statistic**	**Probability**
LOGBDPR does not Granger Cause LOGRM0	81	2.68	0.04
LOGRM0 does not Granger Cause LOGBDPR	81	4.78	0
LOGDMBKNDD does not Granger Cause LOGRM0	80	7.9	0
LOGRM0 does not Granger Cause LOGDMBKNDD	80	0.57	0.69
LOGDMBKNDD does not Granger Cause LOGBDPR	80	2.03	0.1
LOGBDPR does not Granger Cause LOGDMBKNDD	80	0.35	0.84

Lags = 6			
Null Hypothesis:	**Obs.**	**F-statistic**	**Probability**
LOGBDPR does not Granger Cause LOGRM0	79	1.89	0.09
LOGRM0 does not Granger Cause LOGBDPR	79	4.44	0
LOGDMBKNDD does not Granger Cause LOGRM0	78	3.48	0.01
LOGRM0 does not Granger Cause LOGDMBKNDD	78	0.64	0.7
LOGDMBKNDD does not Granger Cause LOGBDPR	78	2.73	0.02
LOGBDPR does not Granger Cause LOGDMBKNDD	78	0.25	0.96

Lags = 8			
Null Hypothesis:	**Obs.**	**F-statistic**	**Probability**
LOGBDPR does not Granger Cause LOGRM0	77	1.93	0.07
LOGRM0 does not Granger Cause LOGBDPR	77	4.34	0
LOGDMBKNDD does not Granger Cause LOGRM0	76	4.22	0
LOGRM0 does not Granger Cause LOGDMBKNDD	76	1.12	0.36
LOGDMBKNDD does not Granger Cause LOGBDPR	76	2.4	0.03
LOGBDPR does not Granger Cause LOGDMBKNDD	76	1.72	0.11

where LOGRM0 is the logarithm (base=10) of the real M0 (currency outside banks) deflated by the consumer price index, LOGBDPR is the logarithm (base=10) of the monthly real GDP and LOGDMBKNDD is the logarithm (base=10) of the weighted average commercial banks' kuna demand deposit interest rate.

Table 12. Granger causality for LOGRM1 (July 1994–December 1998)

Lags = 2

Null Hypothesis:	Obs.	F-statistic	Probability
LOGBDPR does not Granger Cause LOGRM1	83	1.9	0.16
LOGRM1 does not Granger Cause LOGBDPR	83	15.18	0
LOGDMBKNDD does not Granger Cause LOGRM1	82	15.44	0
LOGRM1 does not Granger Cause LOGDMBKNDD	82	3.58	0.03
LOGDMBKNDD does not Granger Cause LOGBDPR	82	6.76	0
LOGBDPR does not Granger Cause LOGDMBKNDD	82	0.71	0.5

Lags = 4

Null Hypothesis:	Obs.	F-statistic	Probability
LOGBDPR does not Granger Cause LOGRM1	81	3.44	0.01
LOGRM1 does not Granger Cause LOGBDPR	81	3.98	0.01
LOGDMBKNDD does not Granger Cause LOGRM1	80	9.97	0
LOGRM1 does not Granger Cause LOGDMBKNDD	80	0.92	0.46
LOGDMBKNDD does not Granger Cause LOGBDPR	80	2.03	0.1
LOGBDPR does not Granger Cause LOGDMBKNDD	80	0.35	0.84

Lags = 6

Null Hypothesis:	Obs.	F-statistic	Probability
LOGBDPR does not Granger Cause LOGRM1	79	3.22	0.01
LOGRM1 does not Granger Cause LOGBDPR	79	5.59	0
LOGDMBKNDD does not Granger Cause LOGRM1	78	4.82	0
LOGRM1 does not Granger Cause LOGDMBKNDD	78	0.9	0.5
LOGDMBKNDD does not Granger Cause LOGBDPR	78	2.73	0.02
LOGBDPR does not Granger Cause LOGDMBKNDD	78	0.25	0.96

Lags = 8

Null Hypothesis:	Obs.	F-statistic	Probability
LOGBDPR does not Granger Cause LOGRM1	77	3.1	0.01
LOGRM1 does not Granger Cause LOGBDPR	77	4.9	0
LOGDMBKNDD does not Granger Cause LOGRM1	76	7.76	0
LOGRM1 does not Granger Cause LOGDMBKNDD	76	0.82	0.59
LOGDMBKNDD does not Granger Cause LOGBDPR	76	2.4	0.03
LOGBDPR does not Granger Cause LOGDMBKNDD	76	1.72	0.11

where LOGRM1 is the logarithm (base=10) of the real M1 (currency plus demand deposits) deflated by the consumer price index, LOGBDPR is the logarithm (base=10) of the monthly real GDP and LOGDMBKNDD is the logarithm (base=10) of the weighted average commercial banks' kuna demand deposit interest rate.

Table 13. Granger causality for LOGRM1a (July 1994–December 1998)

Lags = 2

Null Hypothesis:	Obs.	F-statistic	Probability
LOGBDPR does not Granger Cause LOGRM1a	82	2.52	0.09
LOGRM1a does not Granger Cause LOGBDPR	82	14.16	0
LOGDMBKNDD does not Granger Cause LOGRM1a	82	16.52	0
LOGRM1a does not Granger Cause LOGDMBKNDD	82	3.94	0.02
LOGDMBKNDD does not Granger Cause LOGBDPR	82	6.76	0
LOGBDPR does not Granger Cause LOGDMBKNDD	82	0.71	0.5

Lags = 4

Null Hypothesis:	Obs.	F-statistic	Probability
LOGBDPR does not Granger Cause LOGRM1a	80	3.81	0.01
LOGRM1a does not Granger Cause LOGBDPR	80	3.63	0.01
LOGDMBKNDD does not Granger Cause LOGRM1a	80	10.32	0
LOGRM1a does not Granger Cause LOGDMBKNDD	80	0.89	0.47
LOGDMBKNDD does not Granger Cause LOGBDPR	80	2.03	0.1
LOGBDPR does not Granger Cause LOGDMBKNDD	80	0.35	0.84

Lags = 6

Null Hypothesis:	Obs.	F-statistic	Probability
LOGBDPR does not Granger Cause LOGRM1a	78	3.63	0
LOGRM1a does not Granger Cause LOGBDPR	78	4.69	0
LOGDMBKNDD does not Granger Cause LOGRM1a	78	5.05	0
LOGRM1a does not Granger Cause LOGDMBKNDD	78	0.76	0.61
LOGDMBKNDD does not Granger Cause LOGBDPR	78	2.73	0.02
LOGBDPR does not Granger Cause LOGDMBKNDD	78	0.25	0.96

Lags = 8

Null Hypothesis:	Obs.	F-statistic	Probability
LOGBDPR does not Granger Cause LOGRM1a	76	3.27	0
LOGRM1a does not Granger Cause LOGBDPR	76	5.02	0
LOGDMBKNDD does not Granger Cause LOGRM1a	76	6.21	0
LOGRM1a does not Granger Cause LOGDMBKNDD	76	0.63	0.75
LOGDMBKNDD does not Granger Cause LOGBDPR	76	2.4	0.03
LOGBDPR does not Granger Cause LOGDMBKNDD	76	1.72	0.11

where LOGRM1a is the logarithm (base=10) of the real M1a (M1 plus budgetary and extra-budgetary fund balances) deflated by the consumer price index, LOGBDPR is the logarithm (base=10) of the monthly real GDP and LOGDMBKNDD is the logarithm (base=10) of the weighted average commercial banks' kuna demand deposit interest rate.

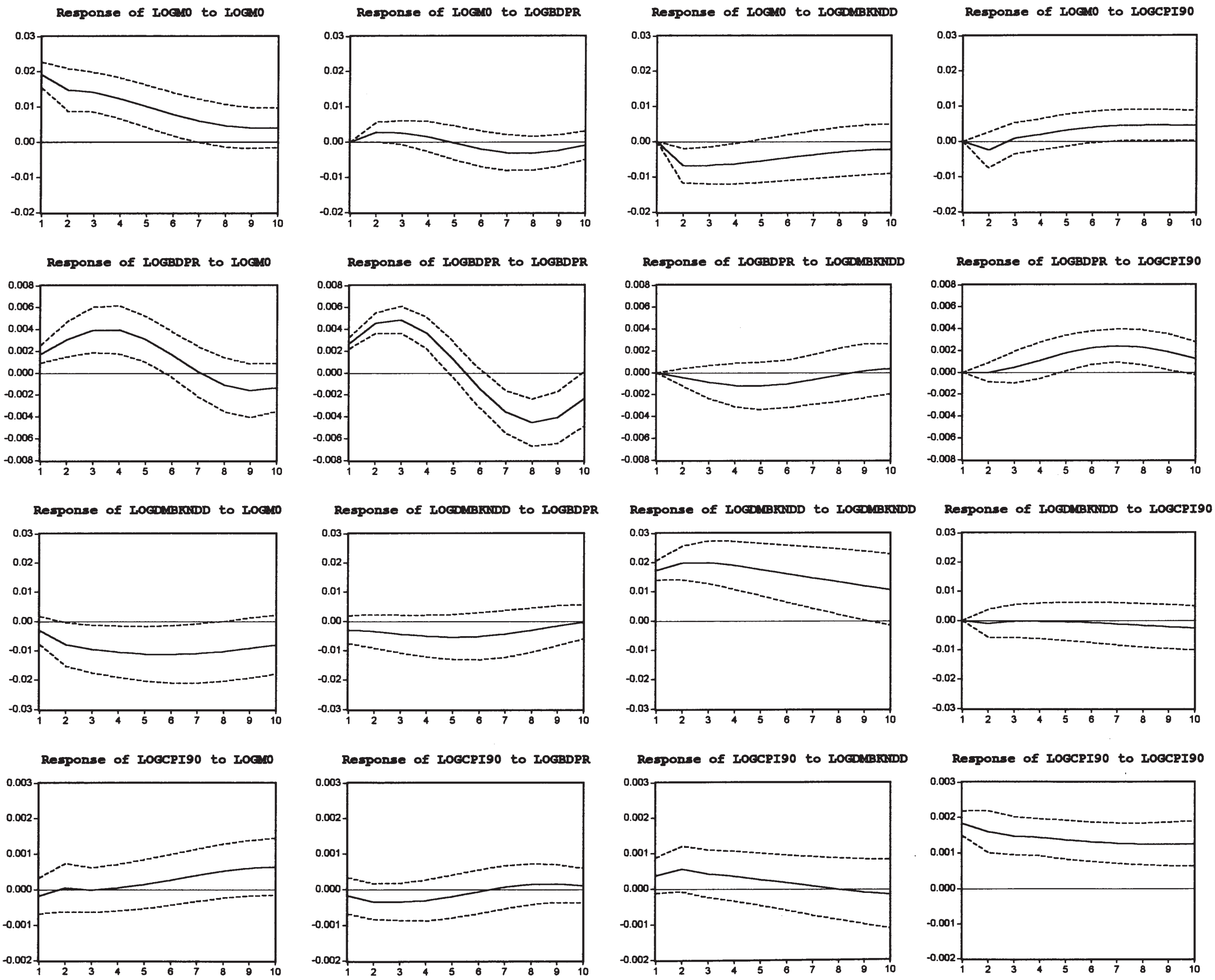
Table 14. VAR estimate for M0 (July 1994–December 1998)

Date: 09/16/99 Time: 17:22
Sample: 1994:07 1998:12
Included observations: 54
Standard errors & t-statistics in parentheses

	LOGM0	LOGBDPR	LOGDMBKNDD	LOGCPI90
LOGM0(–1)	0.651935 (0.15844) (4.11461)	0.008451 (0.02686) (0.31461)	–0.220595 (0.14776) (–1.49290)	0.018285 (0.01564) (1.16925)
LOGM0(–2)	0.141903 (0.14174) (1.00114)	0.016626 (0.02403) (0.69189)	0.138605 (0.13219) (1.04857)	–0.010369 (0.01399) (–0.74119)
LOGBDPR(–1)	0.524915 (0.36806) (1.42616)	1.638349 (0.06240) (26.2557)	–0.064233 (0.34325) (–0.18713)	–0.055633 (0.03633) (–1.53143)
LOGBDPR(–2)	–0.753984 (0.36473) (–2.06724)	–0.960944 (0.06183) (–15.5405)	–0.082616 (0.34014) (–0.24289)	0.061727 (0.03600) (1.71469)
LOGDMBKNDD(–1)	–0.367733 (0.15112) (–2.43343)	–0.025870 (0.02562) (–1.00978)	1.158607 (0.14093) (8.22117)	0.013182 (0.01492) (0.88378)
LOGDMBKNDD(–2)	0.296379 (0.14605) (2.02931)	0.019395 (0.02476) (0.78331)	–0.255030 (0.13620) (–1.87243)	–0.014615 (0.01441) (–1.01390)
LOGCPI90(–1)	–1.319269 (1.53275) (–0.86072)	–0.003440 (0.25986) (–0.01324)	–0.587597 (1.42942) (–0.41107)	0.874691 (0.15128) (5.78189)
LOGCPI90(–2)	2.305653 (1.51646) (1.52041)	0.250108 (0.25709) (0.97282)	0.759575 (1.41423) (0.53709)	0.076298 (0.14967) (0.50976)
C	–3.628944 (1.54202) (–2.35337)	–0.855922 (0.26143) (–3.27404)	–0.296369 (1.43806) (–0.20609)	0.199733 (0.15220) (1.31234)
R-squared	0.979468	0.990513	0.974886	0.993203
Adj. R-squared	0.975818	0.988826	0.970422	0.991995
Sum sq. resids.	0.019682	0.000566	0.017118	0.000192
S.E. equation	0.020914	0.003546	0.019504	0.002064
Log likelihood	137.1368	232.9702	140.9058	262.1834
Akaike AIC	–7.583678	–11.13306	–7.723270	–12.21503
Schwarz SC	–7.252181	–10.80157	–7.391773	–11.88354
Mean dependent	3.583715	1.258988	0.452374	4.765348
S.D. dependent	0.134490	0.033543	0.113406	0.023071

Determinant Residual Covaria	2.72E-18
Log Likelihood	893.5428
Akaike Information Criteria	–39.11235
Schwarz Criteria	–37.78636

Graph 1. Response to one S. D. innovations ±2 S. E.



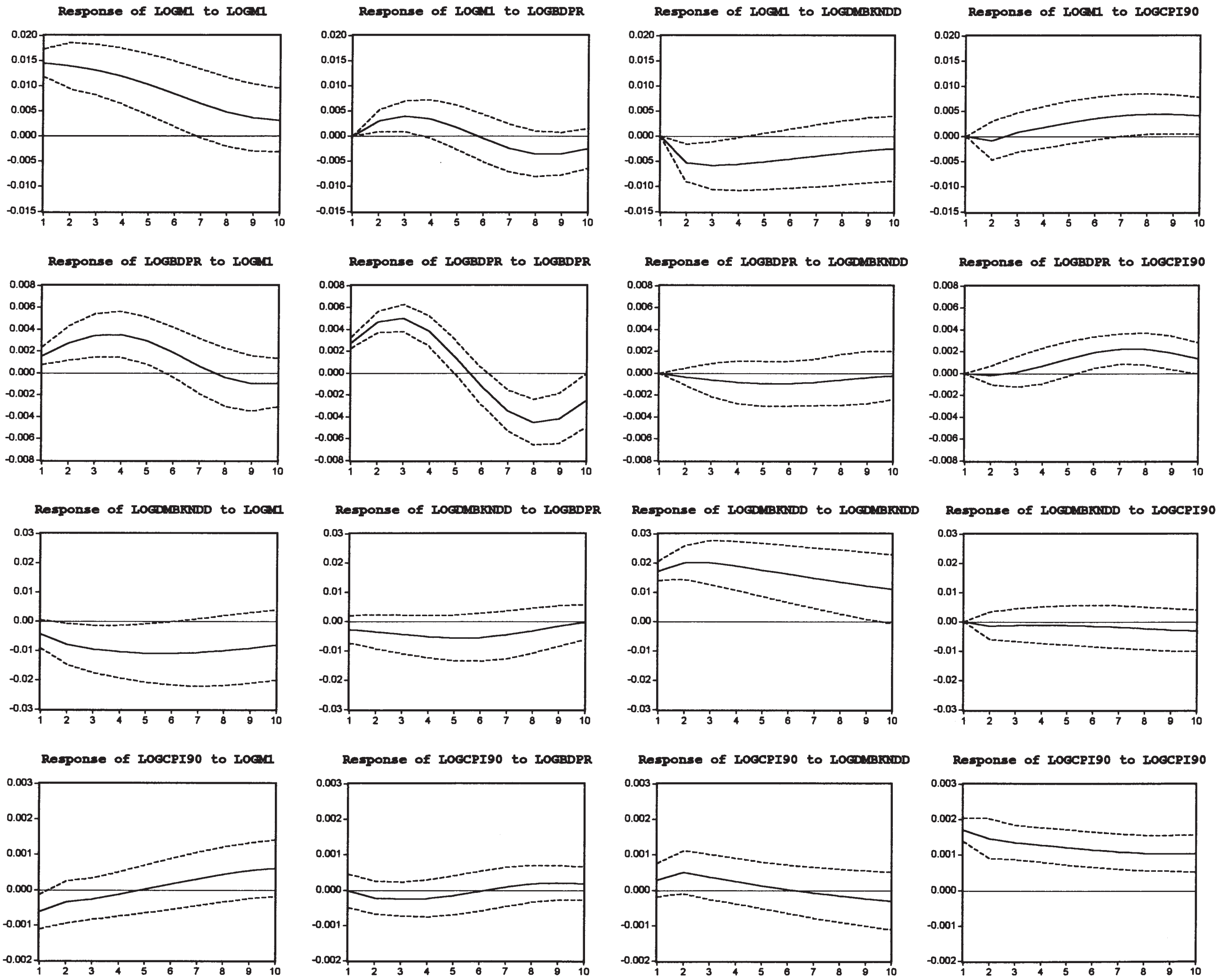
where LOGRM0 is the logarithm (base=10) of the M0 (currency outside banks), LOGBDPR is the logarithm (base=10) of the monthly real GDP, LOGDMBKNDD is the logarithm (base=10) of the weighted average commercial banks' kuna demand deposit interest rate and LOGCPI90 is the logarithm (base=10) of the consumer price index (1990=100).

Table 15. VAR estimate for M1 (July 1994–December 1998)

Date: 09/16/99 Time: 17:26
Sample: 1994:07 1998:12
Included observations: 54
Standard errors & t-statistics in parentheses

	LOGM1	LOGBDPR	LOGDMBKNDD	LOGCPI90
LOGM1(–1)	0.762392 (0.13925) (5.47505)	–0.004888 (0.03065) (–0.15949)	–0.211212 (0.17249) (–1.22448)	0.023176 (0.01762) (1.31565)
LOGM1(–2)	0.071976 (0.14592) (0.49325)	0.044181 (0.03212) (1.37559)	0.144358 (0.18076) (0.79862)	–0.007505 (0.01846) (–0.40653)
LOGBDPR(–1)	0.774440 (0.28243) (2.74203)	1.660082 (0.06216) (26.7047)	–0.110256 (0.34986) (–0.31514)	–0.056388 (0.03573) (–1.57816)
LOGBDPR(–2)	–0.869496 (0.27919) (–3.11430)	–0.992426 (0.06145) (–16.1497)	–0.013150 (0.34585) (–0.03802)	0.048085 (0.03532) (1.36140)
LOGDMBKNDD(–1)	–0.299234 (0.11619) (–2.57547)	–0.018560 (0.02557) (–0.72577)	1.181213 (0.14392) (8.20724)	0.014919 (0.01470) (1.01498)
LOGDMBKNDD(–2)	0.254251 (0.11210) (2.26810)	0.014867 (0.02467) (0.60255)	–0.269582 (0.13886) (–1.94139)	–0.016300 (0.01418) (–1.14938)
LOGCPI90(–1)	–0.516644 (1.23594) (–0.41802)	–0.111044 (0.27203) (–0.40820)	–0.879853 (1.53100) (–0.57469)	0.856108 (0.15636) (5.47537)
LOGCPI90(–2)	1.140961 (1.19027) (0.95858)	0.328346 (0.26198) (1.25332)	0.940568 (1.47442) (0.63793)	0.079036 (0.15058) (0.52489)
C	–2.165533 (1.22588) (–1.76651)	–0.771927 (0.26982) (–2.86089)	0.174088 (1.51854) (0.11464)	0.259121 (0.15508) (1.67084)
R-squared	0.984476	0.990755	0.974384	0.993544
Adj. R-squared	0.981717	0.989112	0.969830	0.992397
Sum sq. resids.	0.011379	0.000551	0.017461	0.000182
S.E. equation	0.015902	0.003500	0.019698	0.002012
Log likelihood	151.9312	233.6688	140.3705	263.5736
Akaike AIC	–8.131618	–11.15894	–7.703446	–12.26652
Schwarz SC	–7.800120	–10.82744	–7.371948	–11.93502
Mean dependent	3.996188	1.258988	0.452374	4.765348
S.D. dependent	0.117604	0.033543	0.113406	0.023071
Determinant Residual Covaria		1.40E-18		
Log Likelihood		911.5722		
Akaike Information Criteria		–39.78011		
Schwarz Criteria		–38.45412		

Graph 2. Response to one S. D. innovations ±2 S. E.



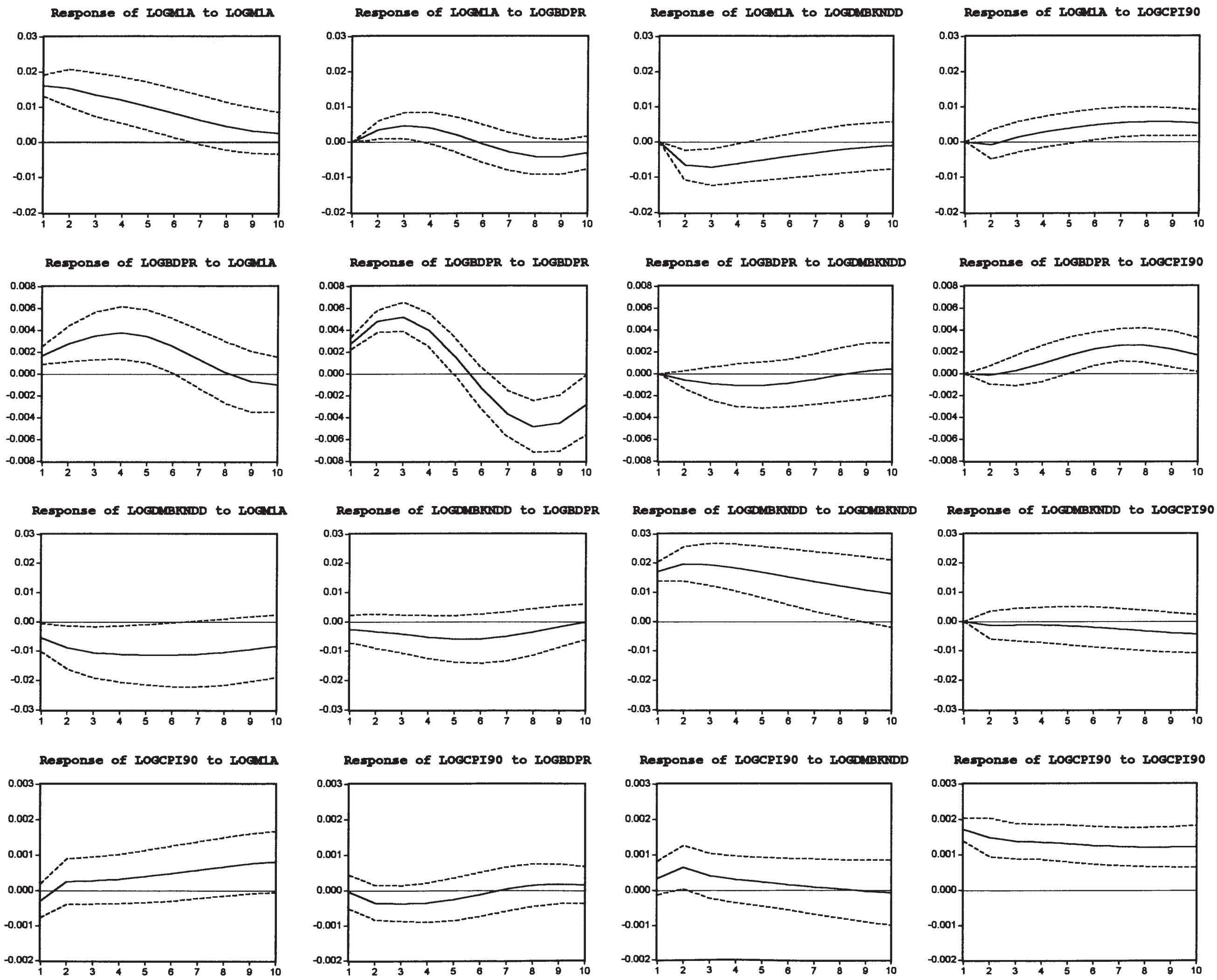
where LOGRM1 is the logarithm (base=10) of the M1 (currency outside banks plus demand deposits), LOGBDPR is the logarithm (base=10) of the monthly real GDP, LOGDMBKNDD is the logarithm (base=10) of the weighted average commercial banks' kuna demand deposit interest rate and LOGCPI90 is the logarithm (base=10) of the consumer price index (1990=100).

Table 16. VAR estimate for M1a (July 1994–December 1998)

Date: 09/16/99 Time: 17:26
Sample: 1994:07 1998:12
Included observations: 54
Standard errors & t-statistics in parentheses

	LOGM1A	LOGBDPR	LOGDMBKNDD	LOGCPI90
LOGM1A(–1)	0.727695 (0.16236) (4.48205)	–0.019178 (0.03291) (–0.58269)	–0.153073 (0.18361) (–0.83366)	0.047145 (0.01786) (2.63941)
LOGM1A(–2)	0.016696 (0.15711) (0.10627)	0.053198 (0.03185) (1.67038)	0.099130 (0.17768) (0.55793)	–0.027911 (0.01728) (–1.61480)
LOGBDPR(–1)	0.871583 (0.33536) (2.59895)	1.679466 (0.06798) (24.7044)	–0.137135 (0.37927) (–0.36158)	–0.090237 (0.03690) (–2.44579)
LOGBDPR(–2)	–0.902719 (0.33359) (–2.70610)	–1.008917 (0.06762) (–14.9197)	–0.031429 (0.37726) (–0.08331)	0.077398 (0.03670) (2.10895)
LOGDMBKNDD(–1)	–0.370738 (0.12969) (–2.85870)	–0.032244 (0.02629) (–1.22648)	1.168095 (0.14667) (7.96425)	0.019997 (0.01427) (1.40156)
LOGDMBKNDD(–2)	0.307964 (0.12346) (2.49451)	0.028384 (0.02503) (1.13415)	–0.261875 (0.13962) (–1.87563)	–0.018748 (0.01358) (–1.38033)
LOGCPI90(–1)	–0.432133 (1.34314) (–0.32173)	–0.075160 (0.27227) (–0.27605)	–0.754537 (1.51899) (–0.49674)	0.872518 (0.14777) (5.90470)
LOGCPI90(–2)	1.299647 (1.30202) (0.99817)	0.324889 (0.26394) (1.23092)	0.769431 (1.47249) (0.52254)	0.071977 (0.14324) (0.50248)
C	–3.036178 (1.28016) (–2.37172)	–0.909273 (0.25951) (–3.50385)	0.400127 (1.44776) (0.27638)	0.204580 (0.14084) (1.45259)
R-squared	0.977494	0.990359	0.973749	0.993998
Adj. R-squared	0.973493	0.988645	0.969083	0.992930
Sum sq. resids	0.013990	0.000575	0.017893	0.000169
S.E. equation	0.017632	0.003574	0.019941	0.001940
Log likelihood	146.3543	232.5358	139.7102	265.5392
Akaike AIC	–7.925065	–11.11698	–7.678990	–12.33932
Schwarz SC	–7.593568	–10.78548	–7.347492	–12.00782
Mean dependent	4.005557	1.258988	0.452374	4.765348
S.D. dependent	0.108299	0.033543	0.113406	0.023071
Determinant Residual Covaria		1.74E-18		
Log Likelihood		905.5413		
Akaike Information Criteria		–39.55674		
Schwarz Criteria		–38.23075		

Graph 3. Response to one S. D. innovations ±2 S. E.



where LOGRM1a is the logarithm (base=10) of the M1a (currency outside banks plus demand deposits plus balances of budgetary and extra-budgetary funds), LOGBDPR is the logarithm (base=10) of the monthly real GDP, LOGDMBKNDD is the logarithm (base=10) of the weighted average commercial banks' kuna demand deposit interest rate and LOGCPI90 is the logarithm (base=10) of the consumer price index (1990=100).

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