ECONOMIC ANALYSIS AND WORKERS' MANAGEMENT, 1, XXIV (1990), 83—93

A MODEL OF MONEY DEMAND IN YUGOSLAVIA: 1952—1985

*James E. PAYNE**

I. INTRODUCTION

The importance of the money demand relationship to aggregate economic activity as well as the formulation of monetary policy is well documented (Laidler, 1977). This paper examines a model of money demand in Yugoslavia over the time frame 1952—1985. Prior work by Tyson (1979) concentrated upon the demand for money on the part of Yugoslav enterprises during the period 1961—1971 in order to explain "illiquidity crises" often faced by Yugoslav firms. Appealing to Tyson's specification for the money demand function, the focus of this paper is to present a model of money demand in Yugoslavia which is able to predict the behavior of cash balances over the post-war era. Emphasizing the importance of money demand, the acceleration of inflation occurring in Yugoslavia in the 1980's has caused a fall in the holdings of real cash balances as well as pushing velocity upwards (Cagan, 1956; Payne, 1989). Thus, the task is one of examining a model of money demand which has both favorable within and out-of-sample tracking performance. Section II presents the model along with the empirical findings. Section III discusses the within and out-of-sample tracking performance of the money demand model as well as a test for temporal stability. Section IV provides concluding remarks.

II. THE MODEL AND EMPIRICAL FINDINGS

The money demand specification used is that of a traditional transactions model including a scale variable, opportunity cost variable, and an expected inflation variable. The scale variable which measures the volume of transactions is current income. With the lack of well-developed financial markets within Yugoslavia the substitution between money and other assets is greatly inhibited. Tyson (1979) recognizing the ineffectiveness of the unchanging behavior of interest rates as an

* Oakland University, Rochester, Michigan, USA.

** The author would like to thank Mark Klinedinst and Edward Nissan for helpful suggestions. The usual disclaimer applies.

opportunity cost variable utilized a proxy for credit market conditions, namely, the change in consumer credit.[1] The premise is that tightened credit markets mean more credit markets mean more rationing of credit which in turn means a higher opportunity cost for holding cash balances. On the other hand, relaxed credit markets mean the increased availability of credit thus a lower opportunity cost to rebuild cash balances to prior levels (see Tyson, pp. 55—56, 1979). Following Tyson's work the opportunity cost variable utilized is the change in consumer credit which is in turn positively related to the demand for cash balances. Finally, a model of money demand would not be complete without some measure of inflationary expectations. Under the assumption of perfect foresight and the equality between the expected and observed rates of inflation, the actual rate of inflation will be used as a proxy for inflationary expectations (Darrat, 1985; Cardoso, 1983; Crockett and Evans, 1980; Tyson, 1972).[2]

The model of money demand will be cast in real terms which suggests that changes in the price level alone will cause no changes in the demand for real money balances in turn assuring the absence of money illusion (Meltzer, 1963). The following model of money demand in log-linear format appears as follows:

$$ln\left(\frac{M}{P}\right) = \beta_0 + \beta_1 ln\left(\frac{Y}{P}\right) + \beta_2 ln\left(\frac{M_{t-1}}{P_{t-1}}\right) + \beta_3 \Delta ln\left(\frac{CR}{P}\right) + \beta_4 ln\left(\frac{P}{P_{t-1}}\right) + \mu_t. \quad (1)$$

where the coefficients are hypothesized as β_1, β_2, $\beta_3 > 0$ and $\beta_4 < 0$. Moreover, the error term μ_t is considered white noise with zero mean and constant variance. The partial adjustment model exemplified in equation (1) utilizes a Koyck lag structure which is restrictive with regard to the lag process; however, the use of annual data as in this study limits more elaborate lag structures.[3] Tyson (1979) in her work

---

[1] The discount rate set forth by the National Bank of Yugoslavia was utilized in preliminary empirical work yielding statistically insignificant results at the 5 percent level.

[2] The nature of using annual data limits the consctruction of a more elaborate model of inflationary expectations. Crockett and Evans (1980) in their study of money demand in Middle Eastern Countries use the actual rate of inflation as a proxy for the expected rate of inflation. Tyson (1979) also utilized the actual rate of inflation as one proxy for the expected rate of inflation. Moreover, Gapinski, et al. (1989) argues the "nearsightedness" of economic agents when in an inflationary environment.

[3] Griliches (1967) and Goldfeld (1973) address the restrictive nature of a Koyck adjustment mechanism. In particular, use of a Koyck-lag implies an identical lag for all independent variables with geometrically declining weights.

on the demand for money by Yugoslav enterprises and Portes and Winter (1977) in their work on money demand in centrally planned economies use a Koyck adjustment formulation similar to the one specified by equation (1).

Utilizing annual data provided by the Ekonomski Institut Zagreb, over the period 1952—1985, equation (1) was estimated by both ordinary least squares (OLS) as well as instrumental variables (IV).[4] The use of instrumental variables estimation attempts to circumvent the simultaneous equation bias often encountered in money demand studies (Cooley and LeRoy, 1981).[5] Table 1 presents the results of estimating equation (1) by both OLS and IV over the time period 1954—1985. Under the column labelled OLS all the parameter estimates are correctly signed and statistically significant at the 1 percent level. A summary of the respective short and long-run elasticities for both estimation results, OLS and IV, appears in Table 2. With respect to OLS the short-run elasticity of real cash balances with respect to income is .2813, suggesting that a 1 percent increase in real current income necessitates an increase in the demand real cash balances of .2813 percent whereas the long-run income elasticity is 1.59. Prior studies have shown that developing economies tend to exhibit an income elasticity closer to 1.5.[6] The speed of adjustment $\lambda = (1 - .8229)$ where $\beta_2 = .8229$ is .1771, slightly lower than the speed of adjustment found by Tyson, meaning that at the end of each year 17.71 percent of the difference between the actual and desired holdings of real cash balances will be narrowed by the public's actions. As for the opportunity cost variable, a 1 percent increase in the availability of credit corresponds to a .2176 percent hike in the demand for real cash balances with a corresponding long-run response of 1.23. Inflationary expectations captured by the actual rate of inflation suggests that a 1 percent increase in inflation corresponds to a decrease in the demand for real cash balances of .6089 percent with an extremely large long-run inflation elasticity of —3.44. The strong performance of the inflation variable demonstrates the strength of inflation as a determinant in the long-run behavior of cash holdings.[7]

---

[4] Borislav Skegro and Zoran Anusić of the Ekonomski Institut Zagreb compiled the data from the Federal Statistical Office in Beograd, Yugoslavia (see Skegro, 1987).

[5] Method of instrumental variables involves the search for a new variable Z which is both highly correlated with the independent variable X as well as being uncorrelated with the error term (Johnston, 1983).

[6] Aghevli, Khan, Narvekar, and Short (1979) in a study of six Asian economies found income elasticities ranging from 1.33 to 1.85. Crockett and Evans (1980) in a study of nineteen Middle Eastern economies found thirteen of the nineteen economies exhibiting income elasticities in excess of unity.

[7] Empirical work on developing economies have not been successful in finding significant and stable coefficients for inflation elasticities. Galbis (1979) found only some evidence of significant negative inflation elasticities.

Table 1

Ordinary Least Squares and Instrumental Variable Estimation of Money Demand in Yugoslavia 1954—1985

	OLS*	IV**
CONSTANT	—.6403	—.6374
	(—3.408)	(—2.810)
$\ln\left(\frac{Y}{P}\right)$	.2813	.2772
	(3.135)	(2.274)
$\ln\left(\frac{M_{t-1}}{P_{t-1}}\right)$	.8229	.8220
	(9.167)	(6.656)
$\Delta\ln\left(\frac{CR}{P}\right)$	.2176	.2836
	(3.703)	(1.531)
$\ln\left(\frac{P}{P_{t-1}}\right)$	—.6089	—.4925
	(—3.595	(—1.699)
$\overline{R}^2$	.978	.977
F	.343	.325
DW	1.70	1.77
Durbin's h	.985	.907

* OLS = ordinary least squares.
** IV = instrumental variables: additional lag for each of the regressors used in the money demand model.

Table 2

Estimated Elasticities of the Demand for Money in Yugoslavia 1954—1985

OLS	Short-Run	Long-Run
$\ln\left(\frac{Y}{P}\right)$	.2813	1.59
$\Delta\ln\left(\frac{CR}{P}\right)$	.2176	1.23
$\ln\left(\frac{P}{P_{t-1}}\right)$	—.6089	—3.44

IV	Short-Run	Long-Run
$\ln\left(\frac{Y}{P}\right)$	.2772	1.56
$\Delta\ln\left(\frac{CR}{P}\right)$	.2836	1.59
$\ln\left(\frac{P}{P_{t-1}}\right)$	—.4925	—2.77

Equation (1) estimated by OLS performs exceedingly well with regard to predictive power with a high adjusted R^2 and overall F-statistic. Moreover, the model is free of autocorrelation via Durbin's h failing to fall in the critical region.

The column labelled IV differs somewhat fromh te results displayed by the OLS column. In comparison to the OLS column, the income elasticity, the consumer credit elasticity as well as the speed of adjustment do not differ substantially. Though the point estimate on the change in consumer credit variable is quiet similar, the point estimate obtained via IV estimation is significant at only the 10 percent level. Moreover, IV estimation rendered a lower short-run inflation elasticity of —.4925 in comparison to the OLS short-run inflation elasticity of —.6089. However, with these noted exceptions the IV estimation of the money demand model is absent of autocorrelation via Durbin's h, indeed, having high predictive power as evidence by the adjusted R^2 and overall F-statistic.[8]

III. PREDICTIVE PERFORMANCE AND TEMPORAL STABILITY

Given the favourable statistical diagnostics of the model the question then is "how well does the model track history?" Figure 1 displays the behavior of the actual level of real cash balances over the period of 1954—1985 as well as the predicted level of real cash balances via OLS and IV estimation. The money demand model estimated in Table 1 by both OLS and IV performs exceedingly well. In

[8] The data series used in the estimation work did not exhibit significant time trends. The data series were not detrended and the empirical results were not changed with the inclusion of a time trend variable (Nelson and Plosser, 1982). Moreover, Dickey and Fuller (1979) find that the test statistic used in distinguishing between trend and difference stationary processes is biased for a sample under 50 in size where the data set used in this study has 32 observations.

comparison to the actual values, the predicted values of the money demand model obtained by OLS yields a correlation coefficient of .979 and a root-mean-squared error of .104. As for IV estimation, the predicted values in comparison to the actual values provides a correlation coefficient of .981 and a root-mean-squared-error .097.[9]

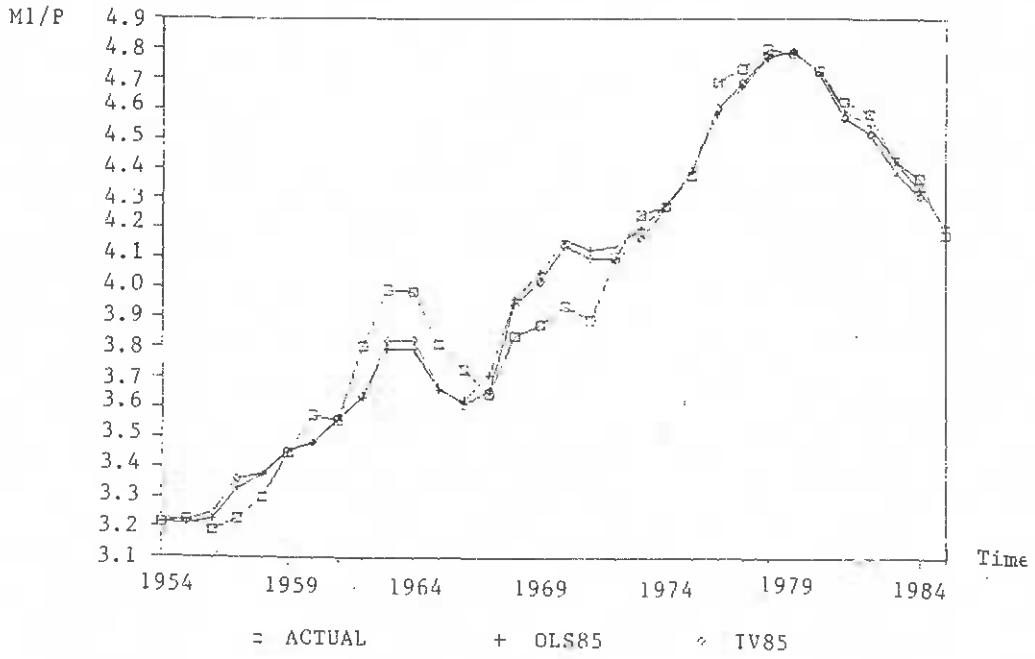

Figure 1.

Actual vs. Predicted Real Money Balances (natural logarithms)

OLS 85 — predicted value from ordinary least squares estimation
IV 85 — predicted value from instrumental variable estimation

Specifically, the money demand model tracks the downturn in real cash balances between 1964 through 1967. This downturn in real cash balances was attributed to the emergence of money substitutes such as savings accounts and foreign exchange accounts as a result of the 1963—1964 credit reforms.[10] The money demand model captures the upward climb of the series prior to the 1980's. The period of 1979 to 1985 witnessed the decline in real cash balances due in large part to the acceleration in the rate of inflation providing for an increase in velocity. This acceleration in inflation can be attributed to the often cited "price markup" explanation of inflation. Simply put, nominal wage growth exceeding the growth in labour productivity (Yagci and

[9] For more of a discussion on evaluating model performance see Pindyck and Rubinfeld (1981) as well as Theil (1971).

[10] Savings accounts increased in real terms by 628% over the period 1966 to 1971 along with foreign exchange accounts increasing in real terms by 47%. The reason for such growth in savings accounts has been attributed to greater dependence on bank financing on the part of Yugoslav firms. Moreover. restrictive monetary actions in terms of rationing lines of credit had made banks require borrowers to hold savings accounts as collateral for the extension of lines of credit (see Tyson, 1979).

Kamin, 1987). Furthermore, the emergence of nongovernmental money has contributed to the economic cliché, "too much money chasing too few goods". Nongovernmental money originates from the issuance of bills of exchange or what Yugoslav specialists have labelled "inter-enterprise" credits. With the presence of negative real interest rates along with credit market controls, an insatiable demand on the part of firms for loanable funds was created. The result has been the tendency of firms to take it upon themselves to finance such investment demands via "inter-enterprise" credits. The circulation of these bills of exchange among firms and banks fulfill the monetary function of medium of exchange. What eventually happens is these bills of exchange are rediscounted by banks creating in turn dinar-based reserves. Thus, the bills of exchange have a twofold purpose both as medium of exchange as well as high-powered money (Bradley and Smith, 1988).[11] With these inflationary dynamics in mind, the model performs most favorably in tracking the downturn in real cash balances in the 1979 to 1985 period.

The next question is "how well does the model forecast ex post?" Namely, "how well does the model forecast the downturn in the behavior of real cash balances as seen in the 1980's?" To answer this question the money demand model was re-estimated over the time period 1954 to 1979 by both OLS and IV estimation techniques. The results of this estimation are presented in Table 3. The column labelled OLS renders favorable results with all coefficients correctly signed and significant at the 5 percent level with the exception of the rate of inflation. The rate of inflation though correctly signed is insignificant. This result suggests that the rate of inflation was not a significant determinant with regard to the holdings of real cash balances prior to the 1980's. In comparison to the results in Table 1, one can readily see how the upsurge in rate of inlation in 1980's yielded its significance in explaining real cash balances. IV estimation yields similar results to those found by OLS estimation; however, in addition to the rate of inflation being insignificant, the change in real consumer credit is insignificant. However, the forecasting capacity from both OLS and IV estimation is strong with high adjusted R^2's and overall F-statistic.

---

[11] Bradley and Smith (1988) as well as Tyson (1978) elaborate upon the complexity of effective implementation of monetary policy in the presence of these "inter-enterprise" credits. Kornai (1979) suggests these "inter-enterprise" credits reflect the operation of the "soft" budget constraint on the behalf of Yugoslav firms.

Table 3

Ordinary Least Squares and Instrumental Variable Estimation of Money Demand in Yugoslavia 1954—1979

	OLS	IV*
CONSTANT	—.6378	—.5454
	(—3.118)	(—1.808)
$\ln\left(\frac{Y}{P}\right)$	.3287	.3930
	(3.038)	(2.321)
$\ln\left(\frac{M_{t-1}}{P_{t-1}}\right)$	.7486	.6041
	(6.206)	(2.503)
$\Delta\ln\left(\frac{CR}{P}\right)$	.2467	.3799
	(3.437)	(1.155)
$\ln\left(\frac{P}{P_{t-1}}\right)$	—.2661	.8009
	(—.7058)	(.4841)
$\bar{R}^2$	.973	.961
F	223	153
DW	1.73	2.00
Durbin's h	.873	.017

* OLS = ordinary least squares
IV = instrumental variables

With the empirical results of Table 3 the task then is to construct ex post (out-of-sample) forecasts of real cash balances over the time period 1980 to 1985. The OLS forecasts perform reasonably well in tracking the behavior of the actual time series with a correlation coefficient of .929 and a root-mean-squared-error of .131. However, the IV forecasts perform less than admirably with a correlation coefficient of —.769 and a root-mean-squared-error of .440. The IV forecasts move in the opposite direction of the behavior of the actual time series.

Though the money demand model performs favorably in tracking the behavior of real cash balances over the period 1954 to 1985 and reasonably so with the ex post forecasts with regard to OLS over the period 1980 to 1985, what is the model's temporal stability? Stability tests were performed at two points over the time horizon of the model's estimation. First, the data was spliced in half resulting in two periods: 1953 to 1969 and 1970 to 1985. A Chow test was then performed on these two sets of regressions to see whether or not the difference

between the residual sum of squares from the two subperiods were statistically significant. In both cases of OLS and IV estimation, the F-statistic rendered was extremely low failing to reflect the null hypothesis of no statistical difference in the residual sum of squares between the two subperiods (Chow, 1960). Second, a priori knowledge of the decline in real cash balances in the period of the 1980's due to the acceleration in inflation suggested to test for possible structural change in the money demand model over this period. With the second subperiod 1980 to 1985 yielding six observations while the number of parameters estimated being five (including the intercept), an F test following Fisher's (1970) derivation was used.[12] Again, the resulting F-statistic from both OLS and IV estimation was rather low failing to the reflected the null hypothesis of no statistical difference in the residual sum of squares between the two subperiods. Thus, with these two stability tests performed there appears to be some evidence that the money demand model is relatively stable over time, in turn, capable of tracking the behavior of real cash balance holdings. Indeed, the stability of a money demand relationship is crucial to the implementation of monetary policy as has been emphasized by Laidler (1977) and Goldfeld (1973).

IV. CONCLUDING REMARKS

The task of this paper has been to re-examine the money demand model of Yugoslavia set forth by Tyson over the period 1952—1985 with an entirely different data set. The empirical findings support Tyson's earlier work, namely, real income, the change in real consumer credit, and the rate of inflation exert significant influences upon real money demand in Yugoslavia. Moreover, the money demand model performs well with regard to forecasting capacity. Furthermore, there is some evidence that the model is temporally stable, particularly, the model's ability to capture the turbulent period of the 1980's. Given that a stable money demand function is vital to monetary policy, the findings of this paper indeed appear relevant to the monetary authorities of Yugoslavia.

Received: 08. 09. 1989
Revised: 23. 12. 1989

DATA APPENDIX

Data (See footnote 4):

M1 Nominal money supply (narrowly defined), billion dinars.
Y Total Nominal Social Product, billion dinars.

[12] Fisher's (1970) test for structural change is equivalent to the use of recursive residuals of Brown, Durbin, and Evans (1975) when the second subperiod contains fewer observations than parameters estimated, see also Harvey (1976) for an alternative proof.

CR Nominal consumer credit, billion dinars.
P Implicit Price Deflator, Social Product, 1972 = 1.00.

REFERENCES

Aghevli, Bijan B., Mohsin, S. Khan, P. R. Narvekar, and Brock K. Short. (1979) "Monetary Policy in Selected Asian Countries", *IMF Staff Papers*, v. 26, December, pp. 775—824.

Bradley, Michael D. and Stephen C. Smith. (1988) "On Illyrian Macroeconomics," forthcoming, *Economica*.

Brown, R. J., J. Durbin, and J. M. Evans. (1975) "Techniques for Testing the Constancy Regression Relationships over Time," *Journal of the Royal Statistical Society*, Ser. B. v. 37, pp. 149—192.

Cagan, Phillip. (1956) "The Monetary Dynamics of Hiperinflation," ed. Milton Friedman *Studies in the Quantity Theory of Money* (Chicago: University of Chicago Press), pp. 25—117.

Cardoso, Eliana A. (1983) "A Money Demand Equation for Brazil," *Journal of Development Economics*, 12, pp. 183—193.

Chow, Gregory C. (1960) "Tests of Equality Between Sets of Coefficients in Two Linear Regressions," *Econometrica*, v. 28, pp. 591—605.

Cooley, Thomas F. and Stephen F. Leroy. (1981) "Identification and Estimation of Money Demand," *American Economic Review*, 71, 5, December, pp. 825—844.

Crockett, Andrew D. and Owen J. Evans. (1980) "Demand for Money in Middle Eastern Countries," *IMF Staff Papers*, v. 27, September, pp. 543—577.

Darrat, Ali F. (1985) "The Demand for Money in Brazil: Some Further Results," *Journal of Development Economics*, 18, pp. 485—491.

Dickey, David A. and Wayne A. Fuller. (1979) "Distribution of the Estimates for Autoregressive Time Series with a Unit Root," *Journal of the American Statistical Association* 74, pp. 427—431.

Fisher, F. M. (1970) "Tests on Equality Between Sets of Coefficients in Two Linear Regressions: An Expository Note," *Econometrica*, 28, pp. 361—366.

Galbis, Vicente. (1979) "Money, Investment, and Growth in Latin America, 1961—1973," *Economic Development and Cultural Change*, v. 27, April, pp. 423—443.

Gapinski, James H., Borislav Skegro, and Thomas W. Zuehlke (1989) "A Model of Yugoslav Economic Performance," *Journal of Comparative Economics*, 13, 15—46.

Goldfeld, Stephen M. (1973) "The Demand for Money Revisited," *Brookings Papers on Economic Activity*, 3.

Griliches, Zvi. (1967) "Distributed Lags: A Survey," *Econometrica* 35, January.

Harvey, A. C. (1976) "An Alternative Proof and Generalization of a Test for Structural Change," *The American Statistician*, v. 30, pp. 122—123.

Johnston, J. (1983) *Econometric Methods*, 3rd edition (New York: McGraw-Hill).

Kornai, Janos'. (1979) "Resource-Constrained versus Demand-Constrained Systems," *Econometrica*, 47, pp. 802—820.

Laidler, David. (1977) *The Demand for Money: Theories and Evidence,* 2nd ed. (New York: Harper and Row).

Meltzer, Allan. (1963) "The Demand for Money: The Evidence from Time Series," *Journal of Political Economy,* 71, June, pp. 405—422.

Nelson, Charles R. and Charles I. Plosser. (1982) "Trends and Random Walks in Macroeconomic Time Series: Some Evidence and Implications," *Journal of Monetary Economics,* v. 10 pp. 139—162.

Payne, James E. (1989) "Yugoslav Price Inflation: An Empirical Investigation," Manuscript, Oakland University.

Pindyck, Robert S. and Daniel L. Rubinfeld. (1981) *Econometric Models and Economic Forecasts,* 2nd ed. (New York: McGraw-Hill).

Portes, Richard and David Winter. (1977) "The Demand for Money and for Consumption Goods in Centrally Planned Economies," *Review of Economics and Statistics,* pp. 8—18.

Skegro, Borislav. (1987), "Data Set Description, Mimeograph," February, Ekonomski Institut, Zagreb.

Theil, Henri. (1971) *Principles of Econometrics* (Wiley: New York).

Tyson, Laura D'. (1979) "Enterprise Demand for Money and Illiquidity Crises in Yugoslavia," *European Economic Review,* 12, pp. 53—71.