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ANALYSIS OF THE INTERRELATIONSHIP BETWEEN AGGREGATE NA-
TIONAL DEMAND AND MONEY SUPPLY BY THE TRANSFER FUNCTION
MODEL: THE YUGOSLAV CASE

by

Drago Čepar, Ernest Kocuvan i Marko Voljč

Summary

This paper analyzes the interdependence between aggregate demand
and the quantity of money in Yugoslavia, based on monthly data from
January 1966 to December 1974. The transfer function model has been
used, where one time-series represent the leading indicator for the other.
After giving the general definition of the model, we identified the model
which describes the best relationship between the money supply and aggre-
gate demand in Yugoslavia during the above-specified period. The next step
is the evaluation of the parameters and the testing of the model. A signi-
ficant relationship was found between money supply and aggregate demand
in a model where the money supply time-series is the input to the system
and the aggregate demand its output; but when the input and output time-
-series were reversed, no significant relationship was found. This result seems
to validate the hypothesis that the causal relationship between money and
income is unidirectional. This statement, however, has to be treated cau-
tiously; statistical analysis can prove only statistical dependence or indepen-
dence, and any extension to causal relationships has to be based on addi-
tional facts and evidence. Considering the evidence and a number of dif-
ferent opinions in this field, it is very difficult to arrive at such a conclusion.
It is significant that changes in money supply rapidly influence changes in
aggregate demand. Following the model, we made an aggregate demand
forecast three months in advance for the years 1974 and 1975 and compared
the forecasts with actual values. The forecasts of aggregate demand compu-
ted from the transfer function model are better than the forecasts computed
on the basis of the ARIMA model for aggregate demand; this also proves
that variations in money supply can account for variations in aggregate
demand.

VELOCITY OF MONEY AND ECONOMIC ACTIVITY IN YUGOSLAVIA

Franjo STIBLAR*

I INTRODUCTION

The purpose of this paper is to test the hypothesis of the Quantity
Theory of Money for the Yugoslav Economy. First, it is established by
empirical analysis if the velocity of money is constant and without
cyclical variability. A positive answer would raise the importance of the
monetary policy in the sense of adjustment of the quantity of money
outstanding to a desired level, where the velocity would not play an
autonomous role. Second, after refuting the hypothesis that the velocity
is constant and without cyclical variability, a rudimentary analysis of
the relation between the velocity of money and economic activity is
made. With a correlation analysis used to test the relation between the
two, this part remains merely at the experimental level. Due to the
well-known deficiency of such analyses, interpertation of the results
should be taken with reserve.

The structure of the paper is as follows:

- II. Conception of the velocity of money

III. Representation of different variants of the velocity with
respect to:

— different sectors of the economy
— financial assets of different degrees of liquidity

IV. Analysis of the trend of the velocity of money

V. Analysis of the cyclical variability of the velocity of money

II. CONCEPTION OF THE VELOCITY OF MONEY

The velocity of money (V) is a measure of the frequency with
which money intervenes in transactions in a market economy (transac-

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tion velocity) or is paid as an income (income velocity). Only the holding of money by economic agents, not the jump between them, has a time dimension.

Mathematically, velocity is the ratio between GGNP or GNP and financial assets used in its market transactions. To satisfy the consistency requirement of a close connection between both the components of the velocity, in this study we prefer adjusted financial aggregates over the officially defined one. While from the theoretical point of view such adjusted variants of the velocity are more acceptable, for economic policy use variants with the formal financial assets are better. These are, namely, the only aggregates under the control of the monetary authorities. In this paper we try to take into account both criteria.

There exist different ways of breaking down the velocity of money. Perhaps the most important is the one between transaction and income velocity, where the ratio of the two gives an indication of the vertical structure of the national economy. For planning the necessary quantity of money outstanding, for in appropriate climate in the economy, a sectoral break down of the velocity is decisive. Finally, we can calculate the velocity for different types of financial assets.

The level and variability of velocity (in a time series or cross-section) depend on two types of factors: technical and economic. Technical factors determine an upper limit to the velocity which is then reduced by the economic factors. Identification of the most important factors and their quantitative impact on velocity would enable us to predict velocity on the basis of the known behaviour of its determinants. At this point, it is important to distinguish the determinants of velocity (in a sense of causality) from the variables, which appear with velocity in an exchange equation.

In our empirical research, we chose a monthly time series of the velocity of money. We eliminated the seasonal and stochastic components by the X—11 program. First, we constructed the series of the velocities and then we made seasonal adjustments. This procedure is statistically more correct than if we had constructed the velocities from the seasonally already-adjusted series of real and financial aggregates.

For easier comparison, the monthly series of the velocity of money were converted to annual levels.

III REPRESENTATION OF DIFFERENT VARIANTS OF THE VELOCITY OF MONEY

Sectoral variants of the velocity of money include:

— velocities for the private consumer sector (I/56-XII/73, 216 observations)
— velocities for the socialized business sector   (—,,—   —,,—)
— velocities for the national economy (I/62-XII/73, 144 observations).

Private consumer sector

In the numerator we have either consumer expenditures (I) or consumer personal income (D). In the denominator there are currency (GOT), consumer total financial assets (LSP) or consumer total financial assets plus approved consumer credits (LSPK). Thus, we constructed 5 variants of the velocity:

$$Vp_1 = \frac{I}{GOT}, \quad Vp_2 = \frac{I}{LSP}, \quad Vp_3 = \frac{I}{LSPK}, \quad Vp_4 = \frac{D}{GOT},$$

$$Vp_5 = \frac{D}{LSP}.$$

Consumer expenditure represents a circulation of goods in this sector enabled by the use of money. Some time lag and a difference in the volume between income receipts and their expenditures by consumers exist. Thus, by comparing the income and expenditure variants of the velocity we obtain some additional information about consumption propensity.

Currency is the most liquid element of the financial assets in this sector, the only one which belongs to the official definition of money (M_1) in Yugoslavia (consisting of: currency, demand deposits, unused federal investment funds and float money). Thus, Vp_1 and Vp_4 additionally represent the velocity of currency.

Consumer total financial assets consist of:

— currency, revolving accounts of individuals, their saving deposits and other restricted deposits and the foreign currency accounts of individuals. The liquidity of these elements varies substantially. In the Yugoslav financial institutional system, where there is no possibility of investing in securities, flows between these elements are very important.

Newly-approved consumer credits are added to Vp_3, not their balances, because they perform an exchange function only once, after approval. Due to small magnitude, they do not have a significant effect and therefore the variant with income in the numerator is excluded from the analysis.

Socialized business

This sector includes the productive activities of the Yugoslav economy, while art, health and government are excluded. The numerator of the velocity contains either paid realization — turnover (R) for the transaction variant or the same, reduced by the business costs, representing income for the income variant of the velocity of money in this sector (DG).

The denominator consists of money in the revolving accounts of the enterprises (ZRG), means demand deposits, or the total financial assets of this sector (LSG). The four included variants are:

$$Vg_1 = \frac{R}{ZRG}, \quad Vg_2 = \frac{DG}{ZRG}, \quad Vg_3 = \frac{R}{LSG}, \quad Vg_4 = \frac{DG}{LSG}.$$

These are the best data available as substitutes for GNP and GGNP in this sector. Direct monthly data for them do not exist.

Only the revolving accounts of the enterprises represent the component of the M_1. Their relative magnitude was taken as one of the indicators of liquidity in the business sector (Horvat, B., 1969; Gospodarska gibanja, 1974). Total financial business assets consist of revolving accounts and other demand deposits of the enterprises, their limited and restricted deposits and their foreign money accounts. As in the consumer sector, liquidity of these elements differs significantly.

National economy

This includes all the productive and nonproductive sectors of the country. Indicators of the real flows in the numerator are either gross realization (BR) or final demand (SP), domestic production (PD) or domestic production plus import (PDU). Modified money outstanding (MB) represents the denominator. Thus, we construct four variants:

$$Vs_1 = \frac{BR}{MB}, \quad Vs_2 = \frac{SP}{MB}, \quad Vs_3 = \frac{PD}{MB}, \quad Vs_4 = \frac{PDU}{MB}.$$

In the gross realization or turnover, nonmarket natural production and exchange are excluded. This is theoretically correct because money is also absent there. On the other hand, some market property transactions are also exluded because of the lack of data and not because money would not be used in them.

In the indicators used, GNP is represented from the demand and supply aspects, the former being the sum of the expenditures of all sectors, and the latter being the domestic or available product.

The modified definintion of money, in the limits of 5 per cent, differs from the official one (M_1). The difference consists of small entries to the M_1, which do not perform the function of the medium of exchange (mainly unused investment funds of the government).

At the beginning, 36 variants of the velocity were constructed, but finally only 13 entered the study report. Selection was made primarily on the basis of theoretical accuracy.

In the business and national economy sectors we can make the previously-mentioned distinction between the transaction and income variants of the velocity of money. Vg_1, Vg_2 and Vs_1 represent transaction velocity, while Vg_3, Vg_4, Vs_2, Vs_3 and Vs_4 represent income velocity.
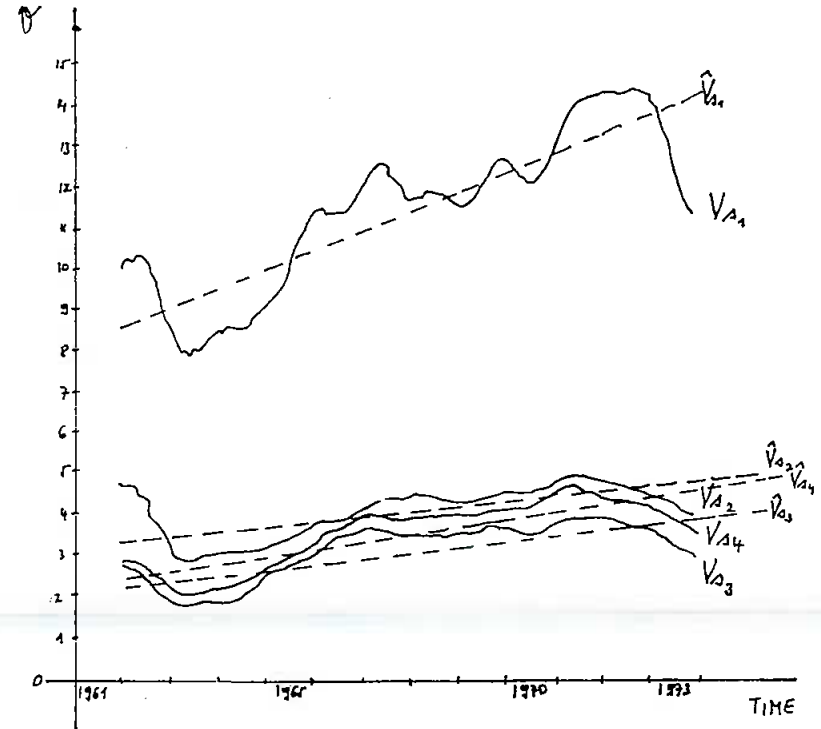
We present all 13 variants of the velocity of money in graphs 1—3.
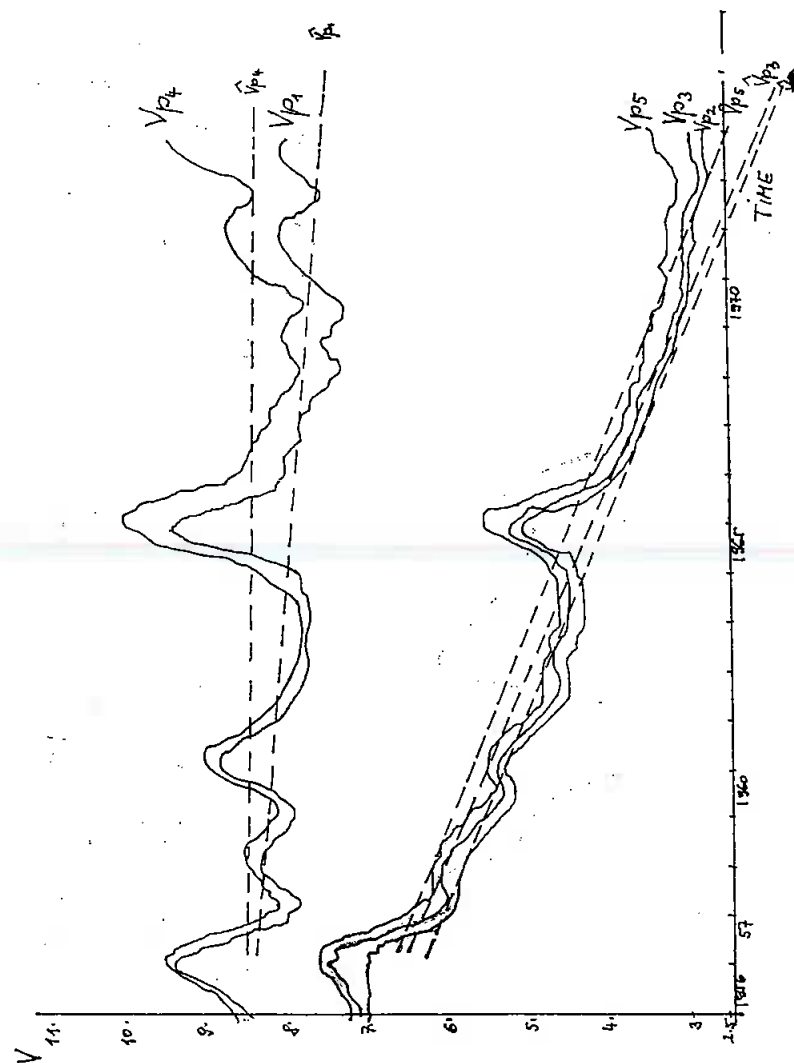
Graph 1. — Velocity of money in the private consumer sector, 1956—1973
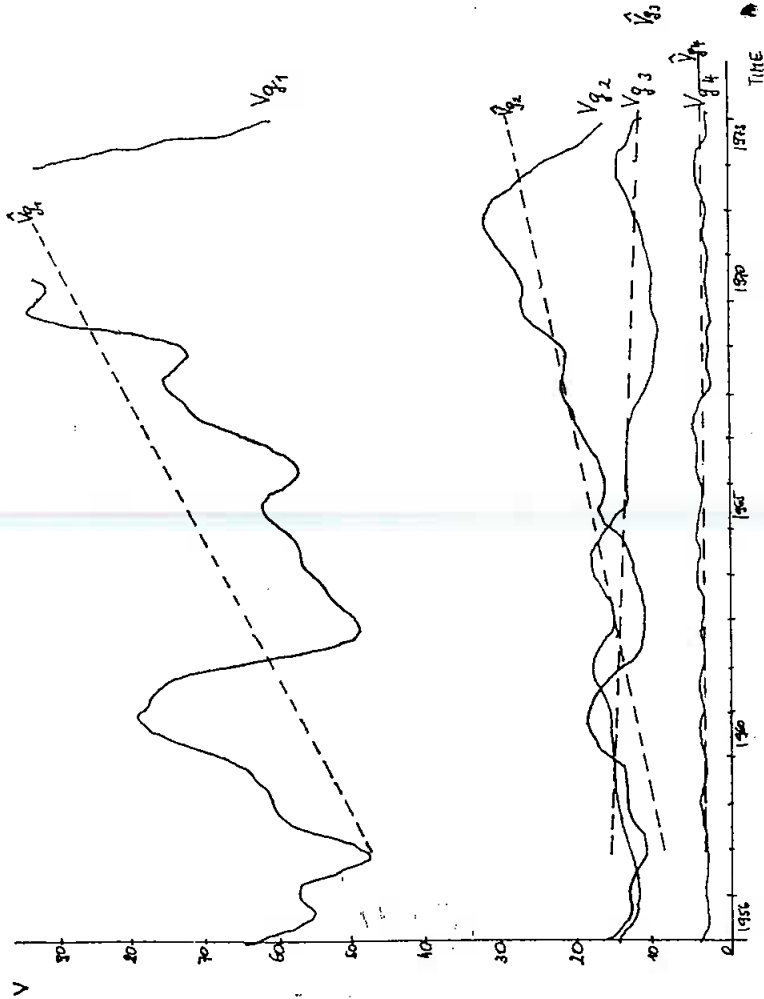
Graph 2. — Velocity of money in the Yugoslav business sector, 1956—1973

Graph 3. — Total velocity of money in the Yugoslav economy, 1962—1973

IV ANALYSIS OF THE TREND OF THE VELOCITY OF MONEY

IV 1. Theoretical Framework

The basic assumption of the Quantity Theory of Money is that the velocity of money is constant over time. Taking the exchange equation as the base, changes in the quantity of money outstanding would then have a direct impact on nominal national income or nominal turnover.

For the New Quantity Theory (M. Friedman, 1956), this basic assumption is somehow relaxed: velocity of money remains a stable function of the number of variables. For a long run trend Friedman asserts that money is a luxury good with elasticity above 1, so that income velocity of money has to decline (M. Friedman, 1963):

$$E_{M.Y} = \frac{dM/M}{dY/Y} > 1 \quad \frac{dV_y}{dt} < 0, \text{ because in } V_y = \frac{Y}{M}, Y \text{ raises}$$

faster than M.

E = elasticity
M = money outstanding
Y = national income
V_y = income velocity of money.

On the contrary, Baumol (1952) and Tobin (1956) developed a theory of the economy of scale in the holdings of money for transaction purposes. According to this theory, money holdings diminish relatively with an increase of the national income. It follows that elasticity $E_{M.Y}$ is less than 1 or that the long run trend is increasing.

Besides the above pure theories of the velocity of money in the sense of permanent upward or downward trends in the velocity, some mixed theories also exist. Gurley and Shaw assert that the velocity of money first decreases and then, at a given level of income per capita in a country, becomes constant. According to Dorrance and Brehmer, after being constant for a while, it begins to rise.

IV 2. Empirical Results in the Literature

Of the few empirical investigations carried out, cross-section analyses prevail (Wallich, 1971; Ezekiel and Adekunle, 1969; Melitz and Correa, 1973). One of the possible reasons for the prevalence of the cross-section analysis is that, in a time series, the demand for money (concept close to the velocity of money, because there is always demand for money at some given level of the national product) is influenced by a raise in money substitutes. Combined with them, money constitutes total financial assets (Johnson, 62)

In the most extensive empirical investigation, Friedman and Meiselman (1963) conclude for the USA that the income velocity for broader-defined money (M_2) in the last 60 years has decreased; but in the period after World War II, it increased. The same conclusion for the post World War II period was reported by Garvy and Blyn (1969) for other countries. Their explanation lies in the relatively more important role of the short-run factors of velocity, which means the greater relative importance of money as a medium of exchange versus money as a liquidity asset. Ezekiel and Adekunle found that, on the average, in countries with a higher per capita income, velocity of money is lower, perhaps due to a more developed financial structure.

IV 3. Hypothesis of the Trend of the Velocity of Money in Yugoslavia

The hypothesis to be tested is that in the post World War II period under investigation, the velocity of money in the Yugoslav economy increased with respect to income as well transaction velo-

cities. Changes in the financial structure, the improvement of the financial mechanism and the relatively greater role of trade credits are some of the factors mentioned in the literature as relevant for the above hypothesis (Golijanin, 1974; Ribnikar, 1972; Stiblar, 1973). The theoretical assumption on the trend of the velocity of money is based on the assumed trend in the two relatively most important sectors of the economy: the socialized business sector and the private consumer sector. While the above-mentioned reasons cause an increase of the velocity in the business sector, due to its larger weight, the velocity can even decrease in the private consumer sector (the reason being the deficiency of the financial mechanism to provide for the flow of money from the private sector back to the business sector) and still total velocity will rise.

IV 4. Empirical Results for Yugoslavia

The decision to use a linear trend has an economical and statistical basis. Statistically, a higher degree of explanation can sometimes be achieved with a more sophisticated trend function, but from the theoretical point of view, only a nonlinear trend of the second degree or an exponential trend can be taken into account. Some of the statistical tests (Quenouill's, Tintner's) showed the insignificancy of these more sophisticated trends.

Economically, first, a planned analysis of velocity requires a per se simple trend assumption because its primary goal is to test long run upward or downward tendencies, for which a linear trend is most appropriate. Second, the cyclical component remains more distinctive as a deviation of the linear trend than of the nonlinear one. And third, in shorter time periods (e. g., our 12—18 years), the linear trend is a satisfactory approximation of the nonlinear trend.

Table 1 represents the results of the trend analysis, and the estimated trend lines are drawn in Graphs 1—3. In the first row of the table we have for a given variant of the velocity regression coefficient (b), coefficient of the determination (r^2) ,and the Durbin-Watson statistic (d). In the second row below a and b are their t-test statistics, r^2 is the standard error of estimation (SE), and d is Snedecor's F-test statistic. The asterisks on the t-tests represent the level of significance of the two-sided t-test: asterisk — level of .05, two asterisks — level of .01, and three asterisks — level of .001.

Conclusions are as follows:

1. Private consumer sector

a) In this sector, the velocity of money in the period under consideration significantly decreased and was, insignificant only in the Vp_4 variant with total financial assets in the denominator. This indicates that the other financial assets of individuals increased faster than currency, but all of them faster than the expenditures or income

Table 1. — Trend of the Velocity of Money in the Yugoslav Economy

Variants	b (t_b)	a (t_a)	$\hat{V} = a + b \cdot t$ r² SE	d F	n
Vp₁	—.0044 —8.3104***	8.4641 138.1218***	.2549 .4317	0367 198.0000	216
Vp₂	—.0192 —50.9530***	6.2522 143.2200***	.9288 .3075	.0316 198.0000	216
Vp₃	—.0264 —49.9118***	6.5010 137.3451***	.9260 .3334	.0322 198.0000	216
Vp₄	—.0069 —1.4448	8.5162 112.7203***	.0054 .5322	.0266 198.0000	216
Vp₅	—.0196 —41.7458***	6.6249 121.4904***	.8975 .3841	.0259 198.0000	216
Vg₁	.2486 15.3545***	47.7020 25.4182***	.5412 13.2204	.0113 198.0000	216
Vg₂	.0946 22.2683***	8.7710 17.8094***	.7132 3.4694	.0109 495.8786	216
Vg₃	—.0187 —7.0719***	15.6792 51.1028***	.1976 2.1614	.0077 50.0120	216
Vg₄	.0011 2.0721*	3.3426 51.5747***	.0163 0.4565	.0176 4.2935	216
Vs₁	.0396 20.5545***	8.6212 53.6065***	.7467 .9599	.0253 142.0000	144
Vs₂	.0102 11.5241***	3.3369 45.2848***	.4796 .4398	.0247 142.0000	144
Vs₃	.0129 15.1303***	2.2126 31.0741***	.6145 .4250	.0207 142.0000	144
Vs₄	.0169 19.3584***	2.3295 31.9251***	.7233 .4355	.0196 142.0000	144

'of the individuals. A high degree of constancy of the Vp₄ can be explained by the fact that currency, for the most part, comes into economy as personal income payments, and in the investigated period the manner in which income was paid did not change. ¨

b) The other variant of the velocity of currency (Vp₁) with consumer expenditures instead of their income in the numerator, shows a more significant negative trend than Vp₄. It shows that a marginal consumption propensity in the private sector is falling. Individuals, with their liquidity preference, have an important impact on the quantity of

currency outsanding. The National Bank, as a creator of money, has the goal of total money outstanding, while in view of the currency share in the total money, the central bank's role is more of an executive than a decisive nature.

c) Graph 1 reveals a different trend of the velocity of currency and the velocity of total financial assets of individuals. While the former was almost constant over the time period under consideration, it later decreased significantly. Major peaks of the velocity occur in the years 1956/57 and 1966/67. These were the periods of economic and particularly financial reforms, when the exogeneous factors of the reforms disturbed the behaviour of the economy. Currency inflow was restricted in both reforms and, in the second one, the inflow of total financial assets in this sector as well.

d) Approximately two-year cycles of the velocity of the consumer sector can be seen in Graph 1.

2. Socialized business sector

a) Except for the transaction velocity of the total financial assets (Vg₃) of enterprises, the trend increased over time. This is more distinctive for the velocities of the revolving accounts and the means demand deposits of enterprises.

b) In this period, the volume of market transactions rose relatively less than the volume of the nominal income of the enterprises, which indicates a vertical integration in the business sector.

c) While total financial assets rose approximately as fast as the size of the flows of commodities, primal liquidity (relative size of the enterprise's demand deposits) fell. The reason for this was the greater binding of the deposits in the business sector, which changed the structure of the total financial assets in a sector by giving a larger share to the less liquid forms of the assets.

d) Graph 2 shows relatively smaller variability of the income variants of the velocity. The cycles in Vg₂ are evidently shorter than in Vg₄. Vg₁ reaches the first peak in 1961/62 and the second in 1971/72, while Vg₃ reaches its peaks in the times of economic reforms. In the income variants of the velocities, cycles are less evident.

3. National economy

a) The trend increased for all variants, though more distinctively for the transaction variant Vs₁, and was still less than for the velocities in the business sector. The most important components of the total velocity of money are its velocities in the private consumer and business sectors. As the former decreased and later even more rapidly increased (also with larger weight), total velocity increased but not as fast as the velocity in the business sector.

b) The lowest point of all the variants of the total velocity of money coincides with the well-known expansive monetary policy in 1963/64. After that, in the economic reform, velocity rose to a higher level. While in the private consumer sector this rise was followed by a fall in velocity to the previous level (which shows the important role of the inherent autonomous factors in this sector), total velocity remained on a higher level.

c) The shorter period under consideration (12 years) enables less definite conclusions about the cyclical movement of the total velocity, although two-year cycles seem to exist.

d) The lowest regression coefficient in the Vs_2 with highest absolute level among all the variants in this sector shows that final demand in those 12 years grew slower than supply, although in the absolute size it was still larger.

For the different velocity variants, trends differ from increasing to decreasing, and some of them were approximately constant. Almost all of them showed cyclical variability. As a quantitative measure for the test of the existence of variability, we used the Durbin-Watson statistic of autocorrelation. Significant autocorrelation means a poor specification of the variables, in this case, of the relation between the velocity of money and time. The theoretical goal of the study (the revealing of cyclical variability) should be a justification of the poor specification.

In the all variants of velocity in the regression on time, we found a positive autocorrelation of the highest level of significance. That is not unusual for monthly data in general. Positive autocorrelation means deviations from the trend in the same direction, for many subsequent months, while negative autocorrelation means changes in the direction of the deviations in the subsequent months. It is clear that the former indicates cyclical variability especially as, according to the graph, deviations from the trend are not of a stochastical nature.

Found with a primary test indicator, cyclical variability is a subject of detailed investigation in the next chapter.

V ANALYSIS OF THE CYCLICAL VARIABILITY OF THE VELOCITY OF MONEY

V 1. Theoretical Framework

Monetary authorities, especially if they share a monetarist's view, would prefer at least a stable velocity of money if it is not constant. Park (1970) shows that a New Quantity Theory of Money is consistent with a variation in the velocity of money, if velocity is a stable function of the permanent income, from which actual income differs.

It was found in comparative international studies that the cyclical variability of the velocity in the less-developed countries exceeds that in the developed countries. As reasons for this, Park mentions greater

economic instability and a larger shifts in the degree of monetization in the economy. The shorter time adjustment of the economy to changes in the money supply, due to poorer financial structure, is enlisted as a factor with an opposite effect. While Friedman considers a basic cause of the cyclical variability of money to be the above-mentioned difference between permanent and actual income, for Latané it is change in the interest rate and the economy of scale in the transaction money balances connected to it. Besides these, changes in the money income adjustment to the changes in the money supply are also mentioned in the literature.

We intend to investigate the cyclical component of the velocity of money. The methodological procedure used is similar to that employed by Bajt in his investigation of business cycles in the socialist economies (Bajt, 1974). We will test the basic hypothesis that the velocity of money in the Yugoslav economy varies cyclically with different patterns for its different variants. Two questions should be answered with the empirical analysis:

1. Existence and the type of cyclical behaviour of the velocity,

2. If the answer to 1. is affirmative, what is the nature of the relation between the cyclical behaviour of the velocity and economic activity.

V 2. Cyclical Variability of the Velocity

Two basic components of the cycle are the period and the amplitude. We will investigate them separately.

V 2.1. Period of the Cycle of the Velocity

Different methods exist for measurement of the cycle period. In this study we used the method of the "upcross cycle". It measures average distance between the points at which velocity crosses its trend line from below. It shows how many time units, on the average, velocity is below and how many time units are above its trend value.

Starting from the linear trend regression: $V_t = a + bT + e_t$ (2), if the velocity varies cyclically, we have a positive serial correlation of the first degree: $e_t = C.e_{t-1} + u_t$ (3) where — C is a coefficient of the autocorrelation of the first degree,

— u_t is a stochastic term without autocorrelation and with constant variability.[*] Length of the cycle (π) is then: $\pi = 360°/\cos^{-1} C$ (Kendall, 1946; Hurwitz, 1968; Klotz, 1973).   (4).

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[*] For large samples and absolute levels, estimation of C is unbiased. For small samples Hurwitz recommended the adjustment factor: $(n-1)$ $(n+1)/(n^2-2n+3)$, where n = number of observations in the sample. For n = 216 (or 144) in the present study, the correction factor is .991 (.986), so that it can be neglected.

Besides the magnitude of the sample, the way trend is eliminated is shown in the literature as one of the possible reasons of the biasness of C. Particularly in the short time series cyclical variations can be eliminated jointly with a trend. This kind of problem occurs, for example, when the rates of change of variables are calculated. This is not the case in our study.

The results of the period calculations are presented in Table 2. For each variant of the velocity we give, first, a coefficient of the autocorrelation C, second, its t-test value (in the all variants it is of the highest level of significance —.001), and third, using formula (4), the average period of the "upcross cycle" is calculated.

Table 2. — *Lengths of the Cycles of the Velocity of Money in Yugoslavia*

$$\pi = 360° / \cos^{-1} C$$

Variant of the Velocity V	Coefficient of Autocorrelation C	t-test t	Lenght of the upcross cycle
Vp_1	.9830	(72.8760)	34.02
Vp_2	.9744	(71.7350)	27.69
Vp_3	.9708	(71.0660)	25.93
Vp_4	.9768	(86.9618)	29.14
Vp_5	.9707	(79.0874)	25.89
Vg_1	.9781	(135.6990)	30.00
Vg_2	.9695	(134.8020)	27.29
Vg_3	—	—	—
Vg_4	.9914	(94.7907)	48.00
Vs_1	.9624	(74.9109)	22.86
Vs_2	—	—	—
Vs_3	.9693	(83.0643)	25.26
Vs_4	.9599	(65.8964)	22.11

Number of observations n = 216 for Vp and Vg and 144 for Vs. All C are significant on the level .001 of the two-sided t-test.

The conclusions of this part of the analysis are as follows:

a) For the velocity of money in the private consumer sector, the average period of the cycle is from 26 to 34 months. Cycles of the velocity of currency are somewhat longer than cycles of the total financial assets of individuals.

b) For Vg_1 and Vg_2 average periods are 30 and 27 months, but for Vg_4 it is 48 months, while cyclical variability is not significant for Vg_3.

c) Cycles of the total financial assets are longer in the business sector than in the private consumer sector.

d) It is interesting to note that the average lenght of Vg_4 is approximately equal to the average lenght of the cycle in Yugoslav industrial production, as calculated by Horvat (1969).

e) Total velocity of money has shortest average periods. Two interpretations for that are at hand. First, total velocities are calculated only for 12 years, while both sectoral variants are calculated

for 18 years. If this is the reason, it indicates that the average length of the cycle becomes shorter. Second, besides the two mentioned sectors, there are other sectors in the national economy also which can affect total velocity by shortening the period of its variability.

f) Cyclical variability for Vs_2 is not significant, while other variants of the total velocity vary with an average period of two years.

V 2.2. Amplitude of the Cycles of the Velocity

For measuring the degree of stability of the velocity of money, the amplitude of the cycle can be even more important than its period. Namely, regardless of the length of the cycle, the variability of the velocity is not significant if the amplitudes are negligibly small.

Amplitude can be measured by the deviation of the actual value of the velocity, either from its average value or from its estimated trend value. In his study, Bajt uses the standard deviation, assuming that the short run trend of economic growth in his study can absorb parts of the long cycle. Also, he uses the absolute measure of the variability on the basic assumption that there is no correlation between variability and absolute level of his indicators. Namely, the data in his study are of the same type with a small difference in the level.

In the present study, the situation is different. First, there is no theoretical base for assuming the existence of long cycles; therefore, we use the standard error of estimation from the linear trend calculation (SE). Park used the same measure and asserts that the use of deviation from the average value of the velocity instead of from its trend value is accurate only if the trend is not significant. This is the case only twice in our study. Second, for purposes of comparison we chose the relative measure of the variability. Namely, we found a strong positive rank correlation between the average level of the velocity $\bar{V}$ and its absolute variability SE (within the groups, the coefficient is +1.0, all together it is +0.67).

We can obtain the relative variation coefficient in two ways, by comparing SE either with a constant (a) in the regression of the velocity on time or with the average value of the velocity ($\bar{V}$). Between these two simple relations exists:

$$\overset{\wedge}{\bar{V}} = a + b \cdot \frac{n + 1}{2} \tag{5}$$

where — n = number of observations,

— $\overset{\wedge}{\bar{V}}$ = the average of the estimated value of the velocity in the time regression.

If the value of the regression coefficient (b) is small, the difference between the two becomes negligible. We calculated rank correlation between both types of relative measures of the variability (amplitudes) of the velocity between the 13 variants and we found that it is really high (+.92).

In Table 3, for every variant of the velocity, first the standard error of estimation in the trend regression (SE) is given, second, the average estimated value of the velocity $\bar{V}$, and third, the adjusted relative coefficient of the variation follows ($\dfrac{SE}{\bar{V}} \cdot 100$). It measures the average relative amplitude of the cycle.

The following may be concluded from the results:

a) The absolute amplitudes (SE) are largest in the business sector and smallest in the private consumer sector.

b) Comparison of the average velocities $(\hat{\bar{V}})$ leads to the conclusion that the average transaction velocity of the demand deposits in the business sector is about 9-times and income velocity 2-times greater than the velocity of the currency. Differences between the average velocities of the total financial assets in both sectors are smaller. While transaction velocity is 3 times larger in the business sector, income velocity is for some variants even smaller. Average total velocity of money is, according to expectations, somewhere between its two components.

c) As a byproduct, the ratios (k) between the average transaction and income velocities are calculated at the beginning and the end of the time series of demand deposits and total financial assets in the business sector and for modified money in the national economy. They are indicators of the vertical dispersity of domestic production.

Table 4 shows lower coefficient in the second period, which indicates that vertical integration takes place in the economy. As one of the coefficients indicates, this integration is probably less intensive from 1962 on. It should be mentioned that, besides vertical integration, the K coefficients also reflect changes in the degree of monetization in the economy and that they depend on when and how average velocity is measured.

d) In the third column of Table 3, we have adjusted the coefficients of the relative amplitude of velocity. According to calculations, relative amplitude in the business sector is greater than in the private consumer sector, while relative amplitude of the total velocity is between them.

In the business sector, the velocity of the demand deposits has larger amplitudes than the velocity of total financial assets, which indicates large shifts in the liquidity of this sector. In general, income variants have greater amplitudes. This means that variation in income exceeds turnover variation. In the private consumer sector, on the contrary, oscillations of turnover and more liquid financial assets are smaller than those of the total financial assets of individuals. Also, the variants with expenditures have smaller amplitudes than those with income in the numerator.

Table 3. — Amplitudes of the Cycles and Average Values of the Velocity of Money in Yugoslavia

Variant of the velocity V	Standard Error of Estimation SE	Average Value $\hat{\bar{V}}$	Relative Amplitude $A = (SE/\hat{\bar{V}}) \cdot 100$
Vp_1	.4317	8.02	5.38
Vp_2	.3334	4.47	7.47
Vp_3	.3075	4.33	6.89
Vp_4	.5322	8.42	6.32
Vp_5	.3841	4.66	8.24
Vg_1	13.2204	72.56	18.21
Vg_2	3.4694	18.23	19.03
Vg_3	2.1614	12.80	15.65
Vg_4	.4565	3.45	13.23
Vs_1	.9590	11.47	10.80
Vs_2	.4398	4.07	8.36
Vs_3	.4250	3.14	13.53
Vs_4	.4355	3.54	12.26

Table 4. — Vertical Diffusion of the Yugoslav Economy in 1956, 1962 and 1973

Type of Financial Asset	K = (transaction velocity / income velocity)			
	1956	1962	1973	K
Revolving Accounts of the Enterprises (Vg_1/Vg_2)	5.44		3.52	3.98
Total Financial Assets in the Business sector (Vg_3/Vg_4)	4.69		3.35	3.99
Modified Money (Vs_1/Vs_3)		3.89	3.52	3.65

In closing, we present a note on the relation between the amplitude and the period of the cycle for different variants of the velocity. From the formula (3) it would be expected that the correlation between them is positive. In a population, the following relation exists between e_t and u_t:

$$6_e = 6_u / 1 - C^2 \qquad\qquad\qquad (6),$$

where 6 is the standard deviation of the population (Johnston, 1972). For a given variability of u_t, the variability of e_t (measured by SE, used as an indicator of the cycle's amplitude in the present study) should be greater if C (which decides the period of the cycle) is greater.

The empirical results in the present study do not confirm the above thesis. The coefficients of the rank correlation between the relative variation coefficient $\dfrac{SE}{V} \cdot 100$ and the autocorrelation coefficient C are, within the groups, significantly negative (in the private consumer sector its value is —.9, in the business sector —.8, for the total economy —.4). The rank coefficient among all 13 variants of the velocity is insignificantly negative (—.18).

VARIABLES AND SYMBOLS

a) Statistical- Mathematical

a	=	constant of the regression
A	=	amplitude
b	=	regression coefficient
C	=	coefficient of the autocorrelation
d	=	Durbin-Watson test statistic
e_t	=	deviation from the trend value in time t
E	=	elasticity
F	=	Snedecor's test statistic
K	=	coefficient of vertical diffusion of the economy
n	=	number of observations
π	=	period of the cycle
r	=	coefficient of correlation
r_R	=	coefficient of the rank correlation
r^2	=	determination coefficient
S	=	standard deviation
SE	=	standard error of the estimation
6	=	standard deviation of the population
t	=	Student t-test statistics
u_t	=	residuum of the autocorrelation of e_t

b) Economic

BR	=	turnover of the whole economy
D	=	personal income
DG	=	income of the business sector (DG = R — business costs)
GOT	=	currency
I	=	expenditures of the private consumer sector
LSG	=	total financial assets of the business sector
LSP	=	total financial assets of the private sector of individuals

LSPK	=	total financial assets + approved consumer credits of individuals
M	=	money outstanding
MB	=	modified money
P	=	level of prices
PD	=	domestic product
PDU	=	domestic product + import
Q	=	industrial production
R	=	realization
SP	=	final demand
V	=	velocity of money (circulation)
$\hat{V}$	=	estimated trend value of V
$\overline{V}$	=	average V
$\overline{\hat{V}}$	=	average trend value of V
Vg	=	velocity of money in the business sector
Vp	=	velocity of money in the private consumer sector
Vs	=	velocity of money for the whole economy
Vg_1	=	R/ZRG
Vg_2	=	DG/ZRG
Vg_3	=	R/LSG
Vg_4	=	DG/LSG
Vp_1	=	I/GOT
Vp_2	=	I/LSP
Vp_3	=	I/LSPK
Vp_4	=	D/GOT
Vp_5	=	D/LSP
Vs_1	=	BR/MB
Vs_2	=	SP/MB
Vs_3	=	PD/MB
Vs_4	=	PDU/MB
Y	=	national income
ZRG	=	revolving accounts of enterprises

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BRZINA OPTICAJA NOVCA I EKONOMSKA AKTIVNOST U JUGOSLAVIJI

Franjo STIBLAR

Rezime

U ovom radu koji predstavlja deo opširnije studije, želi se ustanoviti da li je brzina opticaja novca u Jugoslaviji konstantna i bez cikličke varijabilnosti, pošto bi samo u tom slučaju mogla biti zanemarena kao značajna autonomna komponenta kod kreiranja potrebne količine novca u opticaju. Gledano u širem kontekstu, empirijskom analizom se zapravo testira valjanost za našu zemlju teorije o brzini opticaja novca, kako ju je razvila kvantitativna teorija novca.

Struktura rada je sledeća: najnužnijem teorijskom uvodu o konceptu brzine opticaja novca sledi prikaz izabranih varijanti. Empirijski deo sastavljen je iz analize osnovne linije razvoja i ciklične varijabilnosti (amplituda i perioda ciklusa). Na osnovu empirijske analize dobijeni glavni rezultati dati su u zaključnom delu delomično i kao teze za sledeći stepen analize fenomena brzine opticaja novca.