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THE INVESTMENT BEHAVIOUR OF THE LABOUR-MANAGED FIRM: An Econometric Analysis

by

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THE INVESTMENT BEHAVIOUR OF THE LABOUR-MANAGED FIRM: AN ECONOMETRIC ANALYSIS *

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Abstract

The purpose of the paper is to test two alternative investment theories, using regression analysis, on empirical evidence from Yugoslavia in the post-1966 period. The first is Furubotn and Pejovich's theory on the investment behaviour of the labour-managed firm, which assumes Yugoslav firms make investment decisions according to criteria typically used in a market economy. The second is Kornai's theory on the socialist firm, which proposes systemic patterns of firm behaviour for socialist countries, which are determined by specific "socialist" (non-market) criteria.

The results indicate that Kornai's theory is more supported by data from Yugoslavia. The main implication of our results is that the investment behaviour of Yugoslav firms, in spite of decentralisation, self-management and increasing use of the market after 1965, is being determined primarily by the socialist features of the economy, rather than market signals.

Introduction

The purpose of this paper is to confront Furubotn and Pejovich's theory on the investment behaviour of the labour-managed firm (LMF) with Kornai's theory on the socialist firm, in order to evaluate, using econometric methods, which of the two alternative theories is more supported by empirical evidence from Yugoslavia. The two theories are first considered separately, by evaluating the role of the two alternative groups of variables proposed by each of the two theories as being crucial for explaining savings deposits, investment and self-financed investment (Part 1 and 2). Next, the two theories are evaluated jointly, by applying the complete parameter encompassing procedure (unrestricted-restricted model) (Part 3). Finally, some concluding remarks are made.

1. Testing Furubotn and Pejovich's theory

At this stage, it is assumed that Furubotn and Pejovich's theory is correct. According to the theory, "non-owned assets"

(investment in capital stock of the firm) will be less attractive in comparison with "owned assets" (savings deposited in a bank), and the less likely is self-finance activity: 1)the shorter is the collective's planning horizon; 2)the higher is the rate on savings deposits; 3)the lower is the cost of bank credit; and 4)the lower is the marginal productivity of capital in the firm (capital returns) (Furubotn and Pejovich, 1973, p. 281).

The theory therefore proposes that savings deposits, investment, and self-financed investment are determined by the planning horizon, interest rate on savings deposits, cost of bank credit, and capital returns, the first three variables being the dependent, and the last four being the explanatory variables.

In testing the theory on empirical evidence from Yugoslavia, aggregate data has been used for the above seven variables, represented as H (planning horizon), IR (interest rate on savings deposits), LR (interest rate on bank credit), PF (capital returns), SD (savings deposits), INV (investment), and SFI (self-financed investment) (see Appendix). All variables are in real terms. Since it is with the reforms in the mid-60s that self-management was implemented on a wide scale, the period being examined is 1966-84. Investment and self-financed investment data, however, refer to the 1967-84 period, since changes

in the methodology of reporting statistics did not permit the inclusion of 1966.

The following procedure was applied. First, in order to get a first insight into the relationship between these seven variables, correlation coefficients have been calculated, and their significance tested. Second, a series of single regression equations have been estimated. Finally, two simultaneous equation models have been estimated.

1.1. Correlation

The correlation matrix between the seven variables reflecting Furubotn and Pejovich's theory, for the 1967-84 period, is presented in Table 1.

Table 1. CORRELATION MATRIX - FURUBOTN AND PEJOVICH'S THEORY

	SD	INV	SFI	IR	LR	H	PF
SD	**1.000**						
INV	**0.949**	**1.000**					
SFI	**0.929**	**0.951**	**1.000**				
IR	-0.337	-0.452	-0.461	**1.000**			
LR	-0.334	-0.459	-0.403	**0.959**	**1.000**		
H	**0.663**	**0.625**	**0.783**	-0.425	-0.308	**1.000**	
PF	-0.178	-0.306	-0.359	-0.096	-0.147	-0.174	**1.000**

All correlation coefficients higher than 0.5 have been put in bold, in order to render the table more readable. The corresponding t values, which measure the significance of correlation coefficients, reveal that all of the above coeffi-

cients are statistically significant.[1]

Quite surprisingly, there is higher correlation among variables considered dependent by the theory (SD, INV, SFI), than between each of these and the explanatory variables. The only variable that is seems highly correlated with SD, INV, and SFI is the time horizon variable (H).[2] The correlation coefficients between SD, INV, SFI and the other 3 variables, are generally low. As to the relationship among explanatory variables, only two seem highly correlated: the two interest rates.

1.2.The general model

Three single equations have first been estimated using OLS:

(1)Savings deposits equation:

$$SD = b_1 IR + b_2 LR + b_3 H + b_4 PF + b_5 + u \qquad (1.1)$$

$$b_1>0, \quad b_2<0, \quad b_3<0, \quad b_4<0$$ [3]

IR : interest rate on savings deposits
LR : lending rate on credits to firms
H : a proxy for the time horizon

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1. Using the formula $t = \frac{r}{\sqrt{(1-r^2)/df}}$ where r is the correlation coefficient, and df is the degree of freedom, the t test is applied to correlation coefficients (see Mayes and Mayes, 1976, p. 84-86). All reported coefficients proved significant at 5% level, since obtained t-values were higher than the critical t value (for 18 observations, two explanatory variables and hence 16 degrees of freedom, t>2.120).

2. In the case of savings, however, the sign of the coefficient is contrary to what is postulated by the theory.

3. The IR is expected to positively influence SD, whereas the remaining three variables influence savings indirectly, through the investment decision. Thus the lower is the LR, the shorter is H, and the lower are PF, the less likely is SFI, and hence the more likely are SD.

PF : profit rate
u : error term (see Appendix)

(2)The investment equation:

$$INV = b_1 IR + b_2 LR + b_3 H + b_4 PF + b_5 + u \qquad (1.2.)$$

$$b_1<0, \quad b_2>0, \quad b_3>0, \quad b_4>0 \ ^4$$

INV: investment in fixed assets (social sector). All other variables are same as in (1.1).

(3)The self-financed investment equation

$$SFI = b_1 IR + b_2 LR + b_3 H + b_4 PF + b_5 + u \qquad (1.3.)$$

$$b_1<0, \quad b_2>0, \quad b_3>0, \quad b_4>0 \ ^5$$

SFI : self-financed investment in fixed assets (social sector). All other variables are same as in (1.1) and (1.2).

Results:

OLS Period: 1966-84 (1.1.)

Dep. variable: SD R2: 0.620 R2C: 0.511

	Indep. variables	Est. Coeff.	St. dev.	t	BC%
B1	IR	1.644	1.100	1.49	33.0
B2	LR	-1.694	1.034	1.64	35.9
B3	H	23.616	5.136	4.60	27.3
B4	PF	-0.284	0.432	0.66	3.7
B5	Constant	-2288.496	505.614	4.53	0.0

St.error: 7.245 MAPE: 16.90 DW: 0.953 RH0(1): 0.52

OLS Period: 1967-84 (1.2.)

Dep. variable: INV R2: 0.601 R2C: 0.478

	Indep. variables	Est. Coeff.	St. dev.	t	BC%
B1	IR	4.008	2.840	1.41	31.6
B2	LR	-4.824	2.569	1.88	40.2
B3	H	50.015	17.609	2.84	19.1
B4	PF	-1.726	1.080	1.60	9.2
B5	Constant	-4806.978	1737.728	2.77	0.0

St.error: 17.559 MAPE: 15.43 DW: 1.045 RH0(1): 0.46

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4. The lower is the IR on SD, the less likely are SD and the more likely is INV. The higher is the LR, H and PF, the higher is SFI likely to be, and hence also INV.

5. The lower is the IR on SD, the less likely are SD and hence the more likely is SFI. The higher is the LR, H, and PF, the more likely is SFI.

OLS	Period: 1967-84				(1.3.)
Dep. variable: SFI			R2: 0.724	R2C: 0.639	
	Indep. variables	Est. Coeff.	St. dev.	t	BC%
B1	IR	0.826	1.236	0.67	19.8
B2	LR	-1.194	1.118	1.07	30.2
B3	H	30.831	7.661	4.02	35.8
B4	PF	-0.882	0.470	1.88	14.2
B5	Constant	-2978.088	756.053	3.94	0.0
St.error: 7.639		MAPE: 14.63	DW: 0.937	RH0(1): 0.51	

Note: Details on reported statistics are given in the Appendix.

The results are similar for all three equations. The relatively low R2C suggests that the fit is not very good. The Durbin-Watson statistics and the high RH0(1) indicate there may be a problem of serial positive autocorrelation of residuals. Since the DW in all three equations lies in the inconclusive region, the Durbin Watson Exact Test (DWE) was applied, which confirmed positive autocorrelation in all three equations (the H0 on no autocorrelation is rejected, since the probability that it is correct is 0.03%, 0.06% and 0.01% in the three equations respectively, i.e. below 5%).

Autocorrelation of residuals suggests misspecification of the equations, and in its presence inefficient regression estimates and misleading t-statistics are produced. In order to discover which type of specification bias is present,[6] a series of tests have been performed: for normality of residuals,

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6. Misspecification can imply: 1)omission of relevant variables or inclusion of irrelevant ones; 2)incorrect functional form; 3)use of a linear model where a nonlinear model is needed; 4)incorrect specification of the error term, etc.

presence of outliers, heteroscedasticity, linearity of variables, correctness of the functional form and of the model specification (NORMAL, OUTLIE, HETERO, HARVEY, RBOW, DIFF, IMT).[7] The results reveal that the three regressions passed all of the above tests (see Appendix, 2.3.). Therefore, it seems that misspecification derives primarily from the omission of relevant variables and/or inclusion of irrelevant ones.

1.3. Improving the model

In trying to improve the model, three attempts were undertaken. First, in order to correct for autocorrelation, the Cochrane-Orcutt (CO) method has been applied (instead of OLS) in estimating equations 1.1., 1.2., and 1.3., both by including and excluding the first observation. This, however, did not yield satisfactory results, since serial correlation remained a problem (except in one case, where it was at the margin, autocorrelation was confimed by the DWE)[8].

Second, since the two interest rates, IR and LR are highly correlated (correlation coefficient of 0.959), a remedial measure was applied to remove the problem of collinearity, by a

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7. Details on of each of these tests are reported in the Appendix, section 2.2.

8. The DWE on the regressions estimated by CO gave the following probability values: for equation 1.1., 0.15% and 4.25%; for equation 1.2., 0.25% and 0.97%; and for equation 1.3, 0.78% and 5.02% respectively, when including and excluding the first observation.

different parametrisation of the interest rates. IR was retained, while LR has been replaced by a new variable DIR representing the absolute difference between IR and LR, i.e. DIR=IR-LR. However, neither did this procedure provide better results. In all three equations, the results were very similar as before (identical R2, R2C, DW). The t statistics remained unchanged for all variables (DIR had same t statistics as the previous variable LR), except for IR: in the first two equations, it was actually lower than before (quite contrary to expectations), while in the third it was somewhat higher (1.05).

Finally, although Furubotn and Pejovich (1973) very explicitly list IR, LR, H, and PF as the crucial determinants of SD, INV, and SFI, an additional explanatory variable has been added to the original equations. Besides considering the **cost** of credit, captured by the variable LR, it may be equally important to consider the **level** of credit availability. Therefore, bank loans for fixed assets extended to enterprises (BL) has been added to all three equations.

(1)Savings equation: (1.1) + b_5**BL**	$b_5>0$[9]	**(1.4.)**
(2)Investment equation: (1.2.) + b_5**BL**	$b_5<0$	**(1.5.)**
(3)Self-financed investment: (1.3) + b_5**BL**	$b_5<0$	**(1.6.)**

9. The availability of bank loans is expected to decrease SFI, and hence increase SD.

Results:

OLS Period: 1966-84 **(1.4.)**

Dep. variable: SD R2: 0.715 R2C: 0.605

	Indep. variables	Est. Coeff.	St. dev.	t	BC%
B1	IR	2.361	1.048	2.25	36.1
B2	LR	-2.294	0.974	2.36	37.0
B3	H	17.758	5.414	3.28	15.7
B4	PF	-0.026	0.408	0.06	0.3
B5	BL	0.149	0.072	2.08	11.0
B6	Constant	-1735.291	527.089	3.29	0.0

St.error: 6.516 MAPE: 16.25 DW: 0.995 RH0(1): 0.49

DW Exact: Prob. 0.0%

OLS Period: 1967-84 **(1.5.)**

Dep. variable: INV R2: 0.741 R2C: 0.633

	Indep. variables	Est. Coeff.	St. dev.	t	BC%
B1	IR	6.603	2.593	2.55	35.9
B2	LR	-6.855	2.299	2.98	39.4
B3	H	40.151	15.277	2.63	10.6
B4	PF	-0.841	0.971	0.87	3.1
B5	BL	0.426	0.168	2.54	11.0
B6	Constant	-3906.357	1500.518	2.60	0.0

St.error: 14.733 MAPE: 12.41 DW: 1.316 RH0(1): 0.32

DW Exact: Prob. 0.38%

OLS Period: 1967-84 **(1.6.)**

Dep. variable: SFI R2: 0.878 R2C: 0.828

	Indep. variables	Est. Coeff.	St. dev.	t	BC%
B1	IR	2.254	0.929	2.43	30.9
B2	LR	-2.311	0.823	2.81	33.4
B3	H	25.406	5.472	4.64	16.9
B4	PF	-0.396	0.348	1.14	3.7
B5	BL	0.234	0.060	3.90	15.2
B6	Constant	-2482.750	537.503	4.62	0.0

St.error: 5.278 MAPE: 9.09 DW: 1.275 RH0(1): 0.35

DW Exact: Prob. 0.27%

In all three equations, although adding the variable BL improves the fit of the equations, [10] it did not eliminate the problem of autocorrelation, confirmed to be present in all three

10. This was to be expected; adding a variable usually increases R2, never decreases it.

equations by the DWE (Prob. of 0%, 0.38%, and 0.27% in 1.4, 1.5. and 1.6. respectively). Consequently the t statistics, although high for most of the variables, are not precise, and do not permit any definite conclusions.[11]

Therefore, in all of the above single regression equations, the presence of autocorrelation produced misleading t statistics, and inefficient coefficient estimates. Hence little can be concluded about the significance of each of these variables in determining savings deposits, investment and self-financed investment in Yugoslavia.

1.4.A simultaneous equation model

The theory examines the choice of workers whether to distribute retained earnings in the form of personal incomes and put these savings on a bank account, or invest retained earnings in capital stock of the firm. In other words, the theory postulates that savings deposits and self-financed investment are **mutually dependent, moving in the opposite direction.**

Therefore a simultaneous equation model may reflect the theory in a more adequate way. Although the positive sign of the correlation coefficient between SD and SFI suggested just the contrary (a positive linear relationship), a set of simultaneous

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11. This procedure was also applied to an alternative set of equations, where LR is replaced by DIR, which yielded similar results.

equation models have been estimated using TSLS. The first is based on the original three equations (1.1, 1.2, 1.3):

$$SD = a_1 SFI + a_2 IR + a_3 + u_1 \qquad (1.7a.)$$

$$SFI = b_1 SD + b_2 LR + b_3 H + b_4 PF + b_5 + u_2 \qquad (1.7b.)$$

In each of the equations, only those variables which are expected to **directly** influence the dependent variable have been included. Thus in 1.7a, savings deposits are directly influenced by the interest rate and by self-financed investment, whereas all other explanatory variables influence it indirectly, through self-financed investment, and therefore are excluded from 1.7a, but included in 1.7b.

Results:

TSLS Period: 1967-84 (1.7a)

Dep. variable: SD R2: 0.872

	Indep. variables	Est. Coeff.	St. dev.	t	BC%
A1	SFI	0.651	0.102	6.39	93.7
A2	IR	0.092	0.181	0.51	6.3
A3	Constant	5.149	3.584	1.44	0.0

St.error: 3.821 MAPE: 10.47 DW: 0.469 RH0(1): 0.73

ARSIM: value of test-statistics 1.056

TSLS Period: 1967-84 (1.7b)

Dep. variable: SFI R2: 0.913

	Indep. variables	Est. Coeff.	St. dev.	t	BC%
B1	SD	0.486	0.417	1.17	30.0
B2	LR	-0.355	0.206	1.72	14.6
B3	H	18.977	9.003	2.11	35.7
B4	PF	-0.752	0.286	2.63	19.7
B5	Constant	-1828.526	875.430	2.09	0.0

St.error: 4.393 MAPE: 8.56 DW: 1.054 RH0(1): 0.46

ARSIM: value of test-statistics 1.053

Although the model confirms a better fit than the one obtained in single regression (a higher R2), the ARSIM test statistics in both regressions suggest that the H0 on the

presence of autocorrelation cannot be rejected.[12] This model, therefore, did not provide much better results than the single equations.

In the alternative simultaneous equation model, the variable on bank loans for fixed assets (BL) has been added to the second, SFI equation:

$$SD = a_1 SFI + a_2 IR + a_3 + u_1 \qquad (1.8a.)$$

$$SFI = b_1 SD + b_2 LR + b_3 H + b_4 PF + b_5 BL + b_6 + u_2 \qquad (1.8b.)$$

Results:

TSLS Period: 1967-84 (1.8a)

Dep. variable: SD R2: 0.873

	Indep. variables	Est. Coeff.	St. dev.	t	BC%
A1	SFI	0.661	0.089	7.46	93.2
A2	IR	0.101	0.173	0.58	6.8
A3	Constant	4.841	3.180	1.52	0.0

St.error: 3.789 MAPE: 10.45 DW: 0.464 RH0(1): 0.74

ARSIM: value of test-statistics 1.082

TSLS Period: 1967-84 (1.8b)

Dep. variable: SFI R2: 0.991

	Indep. variables	Est. Coeff.	St. dev.	t	BC%
B1	SD	0.842	0.094	8.95	49.0
B2	LR	-0.216	0.062	3.48	8.4
B3	H	8.006	2.036	3.93	14.3
B4	PF	-0.453	0.095	4.78	11.2
B5	BL	0.098	0.017	5.63	17.1
B6	Constant	-777.531	199.059	3.91	0.0

St.error: 1.443 MAPE: 2.87 DW: 2.340 RH0(1):-0.23

ARSIM: value of test-statistics 2.333

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12. The value of the ARSIM test statistics of 1.056 for 1.7a. is at the margin for accepting autocorrelation (the lower bound DW statistics for 18 observations and 2 explanatory variables at 5% level of significance is 1.05), whereas 1.053 for 1.7b. lies in the inconclusive region (for 18 observations and 4 explanatory variables, at 5% level of significance, the lower bound DW is 0.82 and the upper bound 1.87).

The savings equation again suggests there may be autocorrelation,[13] but the self-financed investment equation provides good overall results: a higher R2 than in 1.7b., no autocorrelation of residuals,[14] and high significance of all variables (at 1%).

However, looking at the signs of the estimated coefficients, three out of five are contrary to what is postulated by Furubotn and Pejovich's theory (for variables SD, PF, and BL). Self-financed investment seems highly influenced by savings deposits, but **positively**; the lower are profits, quite contradictorily, the higher will be self-finance; and the availability of bank loans for fixed assets, instead of decreasing self-financing, seems to increase it. These three variables are also the ones which proved most significant (highest t statistics). Therefore, although the equation offers support that LR and H influence self-financed investment, the wrong signs of the coefficients for the remaining three variables obviously indicate that the model does not fulfill one of the

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13. The value of the ARSIM test-statistics of 1.082 lies in the incluclusive region (for 18 observations and 2 explanatory variables at 5% level of significance, the lower and upper bounds of DW statistics are 1.05 and 1.53 respectively).
14. The value of the ARSIM test-statistics of 2.333 is higher than 2.06, the upper bound DW statistics for 18 observations and 5 explanatory variables, at 5% level of significance.

most important conditions for accepting it: congruence with theory.

2.Testing an alternative theory

The alternative hypothesis which will now be tested is that in the field of investment, Yugoslavia is a **socialist** (regulated) and **not** a **market** economy, with similar systemic features present in other socialist countries. For this purpose, Kornai's (1980) theory on the socialist firm (the soft budget constraint) seems appropriate. The following hypotheses seem most relevant for our analysis:

1)Expansion drive. It is expansion drive that explains insatiable investment hunger. Nobody renounces investment voluntarily. Expansion drive is a form of behaviour preconditioned by social relations, which became rooted so deeply in the thinking of leaders that it has become a "natural instinct" (Kornai, 1980, p. 191-194).

Expansion drive can be approximated by the priority of investment growth respect to consumption growth, represented by the variable ED (see Appendix). Expansion drive is present whenever the growth rate of investment in fixed assets is higher than the growth rate of GMP, i.e. at the expense of consumption.

2)Irresistability of growth. One **must** grow. Productive forces of the socialist economy grow incessantly (J. Kornai, 1980, p. 191-194, 202).

The desire to continuously increase productive forces is represented by the variable FXA<1>, fixed assets of the social sector of the economy, lagged by one year (increasing capital stock with respect to previous year).

3)No failure of investment projects. What is important is to get approval for the starting of an investment; once started, it will also end in some way and at some time. A true investment failure (in the financial sense) never occurs (Kornai, 1980, p. 194-198, 523).

This is approximated by a variable on the stock of investment in unfinished projects, WIP (work in progress, see Appendix). The stock of unfinished investment projects, in the absence of failure of unprofitable projects, is expected to put pressure on investment. The higher is the value of unfinished investment projects, the higher is effective investment likely to be.

4)Investment planning. Official expectations regarding investment behaviour is one of the factors which explains investment tension (Kornai, 1980, p. 210).

Planning in the traditional sense has lost much of its meaning in Yugoslavia after 1965, but there are indirect channels of influence. The influence of planned investment growth is represented by the variable PINV (see Appendix).

5)Growth priority. Investment tension is strengthened if central economic policy itself heads expansion efforts, if it forces the

fastest possible rate of economic growth (Kornai, 1980, p. 208-209).

The influence of planned GMP growth is represented by the variable PGMP (see Appendix).

6)Tolerance limit. The upward swing of investment growth will last as long as the process does not hit one of the "tolerance limits". One of these limits is the balance of payments situation. If drastic intervention is necessary, the most obvious field will be investment (Kornai, 1980, p. 211-214).

In Yugoslavia, the tolerance limit (worsening of balance of payments position) was hit at the end of 1979, which brought about a radical change in official policies from 1980 onwards: restrictive policy of all forms of consumption, especially of investment, in order to reduce the balance of payments deficit. Restrictive policies are represented by a dummy variable DA which is 0 until 1979 and 1 thereafter.

7)Reformed socialist economy. After the reforms, the behaviour and motivation of firms has not changed regarding investment (Kornai, 1980, p. 207).

8)Applicability of the theory to Yugoslavia. Although Kornai initially (1980) develops his theory for COMECON countries (primarily for Hungary), he extends the theory to other countries (1986) suggesting that the theory is also applicable to Yugoslavia.

The above hypotheses have been tested using a similar procedure as before. First, correlation coefficients between variables have been calculated, and their significance tested. Second, a series of single regression equations have been estimated. Since SD and SFI are not considered mutually dependent, there was no need to estimate a simultaneous equation model.

2.1.Correlation

The correlation matrix between the variables reflecting Kornai's theory, for the period 1967-84, is presented in Table 2.

Table 2. CORRELATION MATRIX - KORNAI'S THEORY

	INV	SFI	FXA<1>	ED	WIP	PINV	PGMP	DA
INV	**1.000**							
SFI	**0.951**	**1.000**						
FXA<1>	**0.699**	**0.876**	**1.000**					
ED	**0.601**	0.333	-0.145	**1.000**				
WIP	**0.974**	**0.874**	**0.556**	**0.720**	**1.000**			
PINV	**0.968**	**0.924**	**0.694**	**0.554**	**0.951**	**1.000**		
PGMP	**0.800**	**0.936**	**0.981**	0.005	**0.677**	**0.804**	**1.000**	
DA	0.340	**0.537**	**0.878**	-0.431	0.206	0.419	**0.762**	**1.000**

All correlation coefficients higher than 0.5 have been put in bold. The t-test on the significance of the correlation coefficients showed that all are significant at the 5% level, except for one (between ED and PGMP, t=0.16, i.e. lower than 2.12, for 16 df at 5%).

The correlation coefficients between the dependent variables and the explanatory variables are generally high, except between INV and DA, and between SFI and ED and DA. As to the relationship between the explanatory variables, it is clear that

multicollinearity may pose a serious problem, since some of these variables are highly collinear (especially FXA<1> with DA and PGMP; WIP with PINV; PINV with PGMP).

2.2. The general model

Three single equations have first been estimated, using OLS. As before, aggregate data of the Yugoslav economy in the period 1966-84 for the savings equation, and in the period 1967-84 for the investment and self-financed investment equations have been used.

(1) Savings deposits equation. Kornai speaks of **motives** for household savings in a socialist economy (1980, p. 455-459), but doesn't specify which economic aggregates are likely to influence them. He is only explicit in stating that the interest rate is **not** among these. Therefore it was necessary to make our own assumptions. Savings deposits have been considered a function of disposable income, GMP,[15] and government economic policy (limits on personal incomes imposed in the 1980s).

$$\mathbf{SD} = b_1\mathbf{INC} + b_2\mathbf{GMP} + b_3\mathbf{DA} + b_4 + \mathbf{u} \qquad (2.1.)$$

$b_1>0, \quad b_2>0, \quad b_3<0$ [16]

INC: Household disposable income

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15. GMP approximates Kornai's assertion that in a socialist economy, with rising livings standards, the consumption of expensive consumer durables becomes more important, requiring prior savings.

16. SD are expected to increase with the increase of disposable income and the rise in GMP, whereas restrictive policies are likely to have a negative impact.

GMP: Gross material product
DA : Dummy, reflecting restrictive policies of the government from 1980 onwards.

(2)Investment

$$\mathbf{INV}=b_1\mathbf{ED} + b_2\mathbf{FXA<1>} + b_3\mathbf{WIP} + b_4\mathbf{PINV} + b_5\mathbf{PGMP} + b_6\mathbf{DA} + b_7 + \mathbf{u} \quad (2.2.)$$

$b_1>0,\ b_2>0,\ b_3>0,\ b_4>0,\ b_5>0,\ b_6<0$ [17]

All explanatory variables reflect Kornai's hypotheses: ED (hyp. 1 on expansion drive); FXA<1> (hyp. 2 on growth of productive forces); WIP (hyp. 3 on no investment failure); PINV (hyp. 4 on investment planning); PGMP (hyp. 5 on growth priority); and DA (hyp. 6 on tolerance limit).

(3)Self-financed investment

Since Kornai suggests that expansion drive, the principle determinant of investment in a socialist firm, is present at all levels (1980, p. 193), investment financed by firms, representing a part of total investment, should depend on similar factors determining investment. Hence the same variables as in the INV equation have been included.

$$\mathbf{SFI}=b_1\mathbf{ED} + b_2\mathbf{FXA<1>} + b_3\mathbf{WIP} + b_4\mathbf{PINV} + b_5\mathbf{PGMP} + b_6\mathbf{DA} + b_7 + \mathbf{u} \quad (2.3.)$$

$b_1>0,\ b_2>0,\ b_3>0,\ b_4>0,\ b_5>0,\ b_6<0$

All variables are the same as in (2.2).

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17. Expansion drive, increase of fixed assets, stock of unfinished projects, planned investment and GMP growth, are all expected to have a positive influence on INV. The introduction of restrictive policies is expected to negatively influence INV.

Results:

OLS Period: 1966-84					(2.1.)
Dep. variable: SD		R2: 0.957		R2C: 0.949	
	Indep. variables	Est. Coeff.	St. dev.	t	BC%
B1	INC	0.025	0.008	3.01	13.5
B2	GMP	0.142	0.016	8.63	55.9
B3	DA	-13.476	2.192	6.15	30.9
B4	Constant	-15.062	3.132	4.81	0.0
St.error: 2.349	MAPE: 6.90	DW: 1.983	RH0(1): -0.05		

Tests: NORMAL, OUTLIE, HETERO, DIFF, F (see Appendix, 2.3.)

All statistics for this regression are quite satisfactory: the fit is good, DW and RH0 reveal no serial correlation (confirmed by the DW Exact: Prob. of 23.09%). The t-statistics reveals that all three variables are highly significant (at 1%).[18] Hence the regression supports our theoretical postulations: savings deposits are positively influenced by the rise in disposable income and the rise in GMP, whereas restrictive policies have had a strong negative impact on savings. The model passed all of the perfomed tests.

OLS Period: 1967:84					(2.2.)
Dep. variable: INV		R2: 0.999		R2C: 0.999	
	Indep. variables	Est. Coeff.	St. dev.	t	BC%
B1	ED	0.343	0.028	12.37	34.1
B2	FXA<1>	0.028	0.009	3.19	17.9
B3	WIP	0.058	0.019	3.07	11.3
B4	PINV	-0.005	0.049	0.10	0.4
B5	PGMP	0.162	0.034	4.77	32.5
B6	DA	-2.830	1.117	2.53	3.7
B7	Constant	-2.365	2.559	0.92	0.0
St.error: 0.836	MAPE: 0.86	DW: 2.540	RH0(1): -0.34		

Tests: NORMAL, OUTLIE, HETERO, RBOW, DIFF, F (see Appendix, 2.3.)

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18. For 16 degrees of freedom (19 observations and 3 explanatory variables excluding the constant), at 1% level of significance t>2.291.

This regression offers substantial support to Kornai's hypotheses. Not only is the fit very good, but there is no autocorrelation (DW Exact: Prob. of 44.74%). Hence the t-statistics are precise, revealing that five out of six explanatory variables are highly significant (four at 1%, and one at 5% level of significance).[19] However, the PINV variable is not significant. Whether it actually does not affect INV, will be evaluated in section 2.4. The model passed all of the performed tests.

OLS Period: 1967-84 (2.3.)

Dep. variable: SFI R2: 0.996 R2C: 0.994

	Indep. variables	Est. Coeff.	St. dev.	t	BC%
B1	ED	0.063	0.033	1.90	11.3
B2	FXA<1>	0.040	0.011	3.74	45.3
B3	WIP	0.030	0.023	1.32	10.5
B4	PINV	0.054	0.059	0.92	7.1
B5	PGMP	0.036	0.040	0.90	13.2
B6	DA	-5.359	1.325	4.04	12.6
B7	Constant	-5.848	3.037	1.93	0.0

St.error: 0.993 MAPE: 2.01 DW: 2.850 RH0(1): -0.57

Tests: NORMAL, OUTLIE, HETERO, RBWO, DIFF, IMT, F (see Appendix, 2.3.).

This regression again suggests a good fit, and absence of autocorrelation of residuals (DW Exact: Prob. 18.8%). The t statistics reveal that FXA<1> and DA are highly significant at

19. For 13 degrees of freedom (18 observations and 6 variables), at 1% level of significance t>3.055, at 5% t>2.179. Hence ED, FXA<1>, WIP and PGMP are significant at 1%, whereas DA at 5% level of significance.

1%, while ED is significant at 10% level of significance.[20] However, the remaining three variables, WIP, PINV and PGMP have not proved significant. Whether this is due to high multicollinearity will be checked in section 2.4. The model passed all of the tests applied.

2.3. Improving the model

(1) Investment

The investment equation has been reestimated by dropping PINV, the variable which previously was not significant.

Results: **(2.4.)**

OLS Period: 1967-84

Dep. variable: INV R2: 0.999 R2C: 0.999

	Indep. variables	Est. Coeff.	St. dev.	t	BC%
B1	ED	0.342	0.025	13.53	34.3
B2	FXA<1>	0.029	0.007	4.10	18.4
B3	WIP	0.058	0.017	3.43	11.3
B4	PGMP	0.159	0.025	6.46	32.3
B5	DA	-2.894	0.888	3.26	3.8
B6	Constant	-2.247	2.193	1.02	0.0

St.error: 0.801 MAPE: 0.86 DW: 2.531 RH0(1): -0.33

Tests: NORMAL, OUTLIE, HETERO, RBOW, DIFF, F (see Appendix, section 2.3.)

The results reveal that the R2 and R2C remain unchanged, and hence dropping PINV is probably justified. All variables are now highly significant (at 1%, for 13 df, t>3.012). The DW Exact confirms no autocorrelation of residuals (Prob. of 49.29%). The model passed all of the applied tests.

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20. For 18 observations and 6 explanatory variables, and hence 12 degrees of freedom, at 1% level of significance t>3.055, and at 10% t>1.782.

(2)Self-financed investment

In choosing which variables to include in the model, we were guided not only by the t statistics in equation 2.3. but also by the level of correlation between variables. Thus in addition to the highly significant variables in equation 2.3. (FXA<1>, DA), in choosing between two collinear variables, ED and WIP, ED was included because it proved more significant in 2.3. In choosing between the other two highly collinear variables, PINV and PGMP, PINV was included because it proved more significant in 2.3.[21]

Results: (2.5.)

OLS Period: 1967-84

Dep. variable: SFI R2: 0.995 R2C: 0.994

	Indep. variables	Est. Coeff.	St. dev.	t	BC%
B1	ED	0.083	0.022	3.74	14.2
B2	FXA<1>	0.052	0.003	15.66	56.5
B3	PINV	0.124	0.037	3.30	15.5
B4	DA	-6.168	1.250	4.94	13.8
B5	Constant	-1.314	1.319	1.00	0.0

St.error: 1.021 MAPE: 2.11 DW: 2.442 RH0(1): -0.33

Tests: NORMAL, OUTLIE, HETERO, F, DIFF (see Appendix, section 2.3.)

The results reveal that although the R2 is a bit lower than in 2.3. (0.995 respect to 0.996), the R2C remains the same, and hence dropping WIP and PGMP is probably justified. All variables are now highly significant (at 1%, for 14 df, t>2.977). The DW

21. If we had taken into account only t statistics in equation 2.3., this would have led us to include ED and WIP, rather than ED and PINV or PGMP. Precisely because ED and WIP are highly correlated, this in fact, did not give satisfactory results.

Exact confirms no autocorrelation of residuals (Prob. of 50.17%). The model passed all of the tests applied.

2.4.Kornai's theory: a final evaluation

Finally, we wanted to check whether the low t values for single variables which have been dropped in the second stage, really are a sign of no (low) influence of these variables on the dependent variable, or whether this is due to multicollinearity.

In the original INV equation (2.2.), the insignificant variable was PINV. The F test was applied to the estimated coefficient (H0: B4=0), which seemed to indicate that PINV is not significant (Prob. 91.97 that the H0 is correct). However, regressing PINV on INV, a very high R2 is obtained (R2=0.937) which suggests that 94% of variations in INV can actually be explained by this single variable PINV. Therefore, recalling that PINV was highly correlated with WIP and PGMP (correlation coefficients were 0.951 and 0.804 respectively), the low t statistics for PINV in the general model (2.2.) is very likely due to multicollinearity, and not to the small impact of PINV on INV.

In the original SFI equation (2.3.), the insignificant variables were WIP, PINV, and PGMP. The F test was applied to each of the estimated coefficients (H0: B3=0; H0: B4=0; H0: B5=0, for WIP, PINV, and PGMP respectively), which seemed to

confirm that these variables are not significant (the probability that H0 is correct was 21.44%, 37.89% and 38.82% respectively). However, regressing each of these variables separately on SFI, high coefficients of determination are obtained (SFI= b1WIP + b2, R2=0.765; SFI=b1PINV + b2, R2=0.854; SFI=b1PGMP + b2, R2=0.876), which again suggests that each of these variables has substantial influence on SFI.

Recalling that these three variables were highly correlated (correlation coefficient between WIP and PINV was 0.951, and between PGMP and PINV 0.804), it can again be concluded that the low t statistics for these three variables in the original model is again due to multicollinearity, and not to the small influence of WIP, PINV, and PGMP on self-financed investment.

3.Joint testing of the two theories

An alternative way of confronting the two theories is to use the complete parameter encompassing procedure: combine both sets of variables in a single regression equation (the "unrestricted" model), and then apply the F-test to test the significance of each of the two subsets of regression coefficients. If the null hypothesis being tested is accepted, the correct model will be the restricted model (restricted by the zero coefficients). This should reveal which of the two subsets (theories) helps to explain more the variation in the dependent variable.

Two alternative null hypotheses have been tested, in order to see whether the joint effect of the first/second subset of regression coefficients on the dependent variable is equal to zero:[22]

1)First theory: H0(1): B11=B12=...=B1n=0

2)Second theory: H0(2): B21=B22=...=B2n=0

This procedure was applied to three regressions in which the explanatory variables are a combination of the two theories. They have been estimated without the constant in order to test the "net" influence of the first against the second group of variables.

(1)Savings deposits **(3.1.)**

OLS Period: 1966-84

Dep. variable: SD R2: 0.998 R2C: 0.998

	Indep. variables	Est. Coeff.	St. dev.	t	BC%
B11	IR	0.638	0.335	1.90	15.8
B12	LR	-0.314	0.319	0.98	8.2
B13	H	-0.141	0.045	3.16	0.2
B14	PF	0.070	0.122	0.58	1.1
B21	INC	0.036	0.009	4.13	15.8
B22	GMP	0.129	0.015	8.43	41.0
B23	DA	-9.738	2.067	4.71	17.8

St.error: 1.846 MAPE: 4.93 DW: 2.036 RH0(1): -0.03

Results of the F-test:

Probability that H01 (B11=B12=B13=B14=0) is correct: 0.03%

Probability that H02 (B21=B22=B23=0) is correct: 0.00%

22. The F-test gives the probability value that the H01/H02 is correct; whenever this probability is higher than 5%, the H0 is correct and hence can be accepted. In other words, the joint effect of this group of variables has no influence on the dependent variable.

Therefore, we reject both H01 and H02: both groups of variables seem to influence SD. Nevertheless, the lower probability of H02 (rejecting it at 100%) suggests that the second group influences **more** the dependent variable than the first group of variables. Moreover, since there is no autocorrelation[23], additional conclusions can be drawn from t statistics and the Beta Coefficients. The overall significance of the second group of variables is clearly higher than that of the first group, and 74.6% of variation in SD can be explained by changes in the variables proposed by the second theory.

(2)Investment

OLS Period: 1967-84 **(3.2.)**

Dep. variable: INV R2: 1.000 R2C: 1.000

	Indep. variables	Est. Coeff.	St. dev.	t	BC%
B11	IR	0.131	0.249	0.52	2.2
B12	LR	-0.092	0.223	0.41	1.7
B13	H	-0.016	0.058	0.27	0.0
B14	PF	0.099	0.143	0.69	1.1
B21	ED	0.377	0.080	4.73	37.0
B22	FXA<1>	0.029	0.029	1.00	18.2
B23	WIP	0.043	0.042	1.03	8.3
B24	PGMP	0.158	0.075	2.10	31.5

St.error: 1.129 MAPE: 1.06 DW: 2.097 RH0(1): -0.09

Results of the F-test:

Probability that H01 (B11=B12=B13=B14=0) is correct: 83.99%

Probability that H02 (B21=B22=B23=B24=0) is correct: 0.00%

23. DW standard statistics are not directly applicable to regressions without an intercept. Therefore the DWE was applied, which gave a probability of 17.91% that H0 on no autocorrelation is correct.

As a representation of the second theory, the same number of explanatory variables (4) have been included as for the first theory (the ones which proved most significant).

Since the H01 is accepted and the H02 is rejected, the results are rather more straightforward than in the SD equation, offering direct support to the second theory. Since there is no autocorrelation of residuals (DW Exact: Prob. of 20.68%), additional support can be derived from t statistics and the Beta Coefficients. The variables reflecting Kornai's theory are as a group clearly more significant than Furubotn and Pejovich's variables, explaining around 94.0% of variation in INV.

(3)Self-financed investment

Again, as a representation of the second theory, the same number of explanatory (4) variables have been included as for the first theory (the ones which proved most significant).

OLS Period: 1967-84 (3.3.)

Dep. variable: SFI R2: 1.000 R2C: 1.000

	Indep. variables	Est. Coeff.	St. dev.	t	BC%
B11	IR	0.061	0.226	0.27	1.7
B12	LR	-0.094	0.209	0.45	2.7
B13	H	-0.033	0.026	1.24	0.0
B14	PF	0.089	0.085	1.06	1.6
B21	ED	0.104	0.030	3.50	16.5
B22	FXA<1>	0.056	0.005	12.38	56.3
B23	PINV	0.080	0.053	1.52	9.3
B24	DA	-5.683	1.451	3.92	11.8

St.error: 1.065 MAPE: 2.10 DW: 2.786 RH0(1): -0.50

Results of the F-test:

Probability that H01 (B11=B12=B13=B14=0) is correct: 59.86%

Probability that H02 (B21=B22=B23=B24=0) is correct: 0.00%

Since H01 is accepted, and H02 is rejected, the second theory is again directly supported. Since there is no autocorrelation of residuals,[24] additional support can be derived from t statistics and the Beta Coefficients. The variables reflecting Kornai's theory are as a group clearly more significant than Furubotn and Pejovich's variables, explaining around 93.9% of variation in SFI.

4.Concluding remarks

In concluding, all regressions based on Furubotn and Pejovich's theory suggested either misspecification (autocorrelation of residuals) or noncongruence with the theory (wrong signs of the coefficients). The presence of autocorrelation in turn implies imprecise t-statistics on the significance of each of the variables, and inefficient estimates of the Beta coefficients. Therefore, at best, the initial analysis suggested that no definite conclusions could be made about the confirmation of the theory on Yugoslav data.

In testing the alternative theory, on the contrary, quite good overall results were obtained.

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24. The DW Exact gave the probability of 80.16%, rejecting autocorrelation. However, because of the high value of RHO(1), in order to be sure that there is no autocorrelation, an additional test was applied (AR), which confirmed that there is no autocorrelation.

In the joint testing of the two theories, additional evidence is provided which seems to indicate that Kornai's theory is in fact more supported by empirical evidence from Yugoslavia than Furubotn and Pejovich's theory.

The main implication of our results is that the investment behaviour of Yugoslav firms, in spite of decentralisation, self-management and increasing use of the market after 1965, is being determined primarily by the socialist features of the economy, rather than market signals.

Nevertheless, the limitations of the above analysis are at least threefold. The first is the small number of observations. However, quarterly data on some of the variables do not exist, whereas extending the period prior to 1966 would not have been justified. The second limitation is the use of aggregate data to test Furubotn and Pejovich's theory, which however primarily refers to enterprise behaviour. Nevertheless, it should be noted that the theory does propose that underinvestment at the firm level will have similar implications for the economy as a whole. The third limitation is the approximation of several variables, especially of the time horizon (H), profit rate (PF) (ideally, data on the marginal productivity of capital should have been used), and most of Kornai's variables, as they are a simplification of the actual hypotheses (especially expansion drive).

APPENDIX

1.DATA

Deflation: Since the Yugoslav economy has been characterised by high inflation (especially in recent years), all data in current dinars have been deflated and transformed into constant 1972 dinars (current dinar values/cost of living index, base year 1972). 1972 was chosen as the base year because it is the base year usually used by the Federal Statistical Institute in its Statistical Yearbooks of Yugoslavia (SGJ) when reporting statistics in constant prices. All data reported in dinars are billions of constant 1972 dinars.

Variables:

SD: Savings deposits of households (excluding foreign currency), in 1972 dinars, as provided by the SGJ.
(Although households are allowed to have foreign currency accounts, they cannot freely acquire foreign currency, and this justifies the exclusion of foreign currency deposits).

INV: Investment in fixed assets of the social sector, in 1972 dinars.
Calculated from investment in fixed assets of the social sector in current dinars, as provided by SGJ, deflated by the cost of living index (1972=100).

SFI: Investment in fixed assets financed by enterprises of the social sector, in 1972 dinars.
Calculated from SGJ data on investment in fixed assets of the social sector financed by firms in current dinars, deflated by the cost of living index (1972=100).

IR: Real interest rate on savings deposits of households. Calculated from National Bank of Yugoslavia (NBY) data on nominal interest rates on time deposits of households (end-year), and SGJ data on the annual percentage increase of the cost of living index (CLI), according to the formula:

$$IR=\left[\frac{(1+NIR)}{(1+CLI)} - 1\right]*100$$

LR: Real lending rate of bank loans extended to firms. Calculated from NBY data on nominal interest rate on loans to enterprises (end-year maximum), and SGJ data on the annual percentage increase of the cost of living increase (CLI), according to the formula:

$$LR=\left[\frac{(1+NLR)}{(1+CLI)} - 1\right]*100$$

H: A proxy for the time horizon of the average worker, calculated from the indicator on the average monthly fluctuation of workers (labour turnover) (in %):

$$FW = \frac{WL}{WT+WN}$$ where

WL: number of workers left during a month
WL: total number of workers at the begining of month
WN: newly admitted workers during month

The time horizon proxy can be represented as H=1-FW. The lower is the fluctuation of workers, the longer the time horizon of the average worker.
(FW could have been used directly, but since H and FW are inversely related, this provokes confusion in expected signs).

PF: Profit rate (in %), according to balance sheet data of social sector firms distribution of GMP in current dinars (SGJ), using the formula:

$$PF = \frac{GMP - depreciation - personal\ incomes}{Historical\ value\ of\ capital}$$

DIR: Absolute difference between the real interest rate on savings deposits and the real lending rate for enterprises, i.e.

$$DIR = IR - LR$$

BL: Bank loans for fixed assets extended to enterprises (social sector), in 1972 dinars.
Calculated from SGJ data on bank loans for fixed assets given to enterprises in current dinars, deflated by the cost of living index (1972=100).

INC: Total disposable income of households, in 1972 dinars.
Calculated from SGJ values in current dinars, deflated by the cost of living index (1972=100).

GMP: Gross material product, in 1972 dinars, as provided by the SGJ.

DA: Dummy variable, which takes the value of 0 until 1979, and 1 thereafter. It reflects the presence of restrictive measures of the government, after one of the tolerance limits is hit.

FXA<1>: Fixed assets of the social sector of the economy, in 1972 dinars, as provided by the SGJ, lagged for one year.

ED: Kornai's "expansion drive", represented as the difference between the investment index (INV variable, base year 1966=100) and the GMP index (SGMP variable, base year 1966=100):

$$ED = INVi - SGMPi$$

Whenever expansion drive is present (faster growth of investment respect to the growth of GMP, at the expence of consumption), ED is positive.

WIP: Stock of investment in fixed assets in unfinished projects in 1972 dinars.
Calculated from SGJ data on estimated cost of investment in unfinished projects reported in current dinars, deflated by the cost of living index (1972=100).

PINV: Planned growth of investment in fixed assets, in 1972 dinars.
Calculated from the planned annual rate of growth of investment in fixed assets in % (PGRI), as provided by annual resolutions (one-year plans), and the actual level of real investment in fixed assets in previous year:
PINV(t)=INV(t-1) + [(PGRI(t) * INV(t-1)]

PGMP: Planned growth of social sector GMP, in 1972 dinars.
Calculated from the planned annual rate of growth of GMP in % (PGMP), as provided by annual resolutions (one-year plans), and the actual level of real GMP in previous year:
PGMP(t)=GMP(t-1) + [(PGMP(t) * GMP (t-1)]

2.STATISTICS
In all our calculations, the IAS-System has been used, an econometric software package for the analysis of time series data, developed by Sonnberger et al (1986).

2.1.Standard statistics. The standard way of reporting regressions in the IAS-System is the one used in the text, while the meaning of the statistics reported is the following:

R2 is the Coefficient of Determination, and R2C is the Corrected Coefficient of Determination. For regressions without an intercept, R2 and R2C are computed using a special option (R) which takes into account the non-inclusion of the intercept.

BC are the so-called Beta-Coefficients, which measure the percentage of change in the dependent variable explainable by the change in the explanatory variable.

DW is the Durbin-Watson statistic, testing for the presence of serial autocorrelation of the residuals. Whenever DW lies in the inconclusive region, or whenever the standard DW tables are not applicable, as in the case of regressions without an intercept, a user can use the Durbin Exact Test (DWE) to obtain the exact probability that the Durbin-Watson statistics takes a value less than or equal to the sample outcome. The null hypothesis on no autocorrelation is rejected whenever the probability is less

than the assumed %-level of the Durbin-Watson test (usually 5%). Thus at 5% level of significance, if we are testing for positive autocorrelation, its presence will be confirmed if DWE gives a probability lower than 5%; if we are testing for negative autocorrelation, its presence will be confirmed if DWE gives a probability higher than 95%.

RH0(1) is the first order autocorrelation coefficient of the regression residuals.

ST. ERROR: Standard error of the regression.

MAPE is the Mean absolute percentage error of the regression, defined as:

$MAPE = 100\ (1/T \sum_{t=1}^{T} u_t/y_t)$, where u is the estimated residual of the regression, $u = y - xb$.

2.2.Tests:

1)NORMAL: Jarque-Bera test for normality. H0: residuals are normally distributed.

2)HARVEY: Harvey-Collier test for functional misspecification. H0: equation linear in variable X.

3)RBOW: Utts test for correctness of the functional form. H0: Model is correct.

4)DIFF: Plosser-Schwert-White test for correctness of the model specification. H0: Standard assumptions of OLS regression apply.

5)IMT: White and Hall's test for correctness of the model specification. H0: Standard assumptions of OLS regression apply.

6)HETERO: Pagan-Hall-Trivedi test for specific heteroscedasticity. H0: variance of residuals is constant.

7)F test, testing whether single parameters in a regression are equal to certain values.

All of the above tests give the probability value that the null hypothesis is correct. Whenever this probability is higher than 5%, the null hypothesis can be accepted at 5% level of significance.

8)OUTLIE: Cook-Weisberg test for the presence of outliers. The test gives the maximum t-value of the outlier coefficients,

which should be lower than the critical value (reported in tables) in order to conclude that there are no outliers.

9)ARSIM: Harvey-Phillips test for autocorrelation. The test detects first order autoccorelation of the regression disturbances of a single equation in a simultaneous equation system. H0: Residuals of the equation are uncorrelated. The test reports the value of test-statistics, which should then be checked in the DW tables.

10)AR: Breusch-Pagan and Godfrey's test, testing for the presence of higher order autocorrelation of residuals.

2.3.Results of tests performed:

Equation:	1.1.	1.2.	1.3.	2.1.	2.2.	2.3.	2.4.	2.5.
Test								
NORMAL (prob.)	19.84	20.87	26.79	64.09	76.17	45.51	75.68	64.68
OUTLIE (t-value)	2.49	2.28	2.36	2.45	2.16	2.14	2.19	1.92
HETERO (prob.)	26.04	25.22	54.38	23.72	11.70	75.91	11.32	50.63
HARVEY (prob.)								
Variable 1	91.74	74.62	63.24	-	-	-	-	-
Variable 2	81.45	13.14	12.87	-	-	-	-	-
Variable 3	24.97	32.02	35.75	-	-	-	-	-
Variable 4	18.08	38.40	65.10	-	-	-	-	-
RBOW (prob.)	75.79	87.52	91.08	-	95.75	47.06	91.58	-
DIFF (prob.)	17.29	14.60	24.30	33.91	56.81	41.03	42.55	28.41
IMT (prob.)	-	-	99.99	-	-	52.80	-	-

F TEST Equat.2.2. H0: B4=0	Equat.2.3. H0: B3=0	B4=0	B5=0
Prob. H0 correct: 91.97	21.44	37.89	38.82

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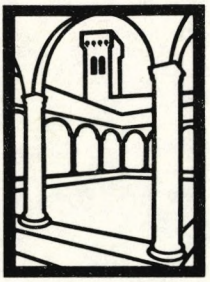

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