ECONOMIC ANALYSIS AND WORKERS' MANAGEMENT, 4, XXIII (1989), 335—354

A SMALL-SCALE MACROECONOMETRIC MODEL OF YUGOSLAVIA: 1952—1985

*James E. PAYNE**

I. INTRODUCTION

The objective of this paper is to present an econometric model of the Yugoslav economy over the period 1952—1985. The purpose of which will be policy analysis given the underlying structure of the model. Section II will present the model to be used in policy analysis. Section III will validate the underlying structure of the model via historical simulation along with out-of-sample forecasts. Section IV will entertain the baseline or control solution of the model over the time horizon 1985—1990 along with conducting some policy simulations for improving upon the dismal economic performance of the Yugoslav economy in the 1980's.

II. THE MACRO MODEL

The macro model to follow will be aggregative in nature consisting of 9 behavioral equations and 4 identities using annual data estimated over the time period of 1952—1984.[1] Estimation will proceed via OLS and in some cases by a first-order correction for autocorrelation utilizing the Cochrane-Orcutt iterative procedure. The author realizes that OLS estimates are asymptotically biased in a simultaneous system; however, in small samples as in the case within this endeavor so are all alternative estimators (Johnston, 1983). Full information systems methods (i.e. 3SLS on FIML) may incorporate all available information

* Department of Economics, Oakland University, Rochester, Michigan.
The author would like to thank James H. Gapinski, Thomas Zuehlke, George Macesich, Robert Conn, and Edward Nissan for helpful suggestions on an earlier draft. The author would also like to thank participants of the model's presentation at Texas Christian University and Oakland University. The usual disclaimer applies.

[1] For a more detail macro model of Yugoslavia see Mencinger (1975) and Gapinski et. al. (1989).

into parameter estimates along with having a smaller asymptotic variance-covariance matrix than single equation estimates; however, one runs the risk of specification error. Moreover as Fair (1973) points out from a forecasting perspective OLS with correction for autocorrelation performs as well as other estimators corrected for autocorrelation.

What follows will be a breakdown of the macro model into essentially four sectors: domestic, foreign, wages and prices, and labor. The domestic sector will consist of three behavioral equations — consumption, consumer credit, and gross investment in plant and equipment — along with disposable income and output identities. The foreign sector will consist of two behavioral equations — exports and imports — along with one identity, that being net exports. The sector on money wages and prices consists of two behavioral equations explaining money wages and price inflation, respectively. The labor sector consists of two behavioral equations, employment and labor supply; it also has one identity explaining the unemployment rate.

A. DOMESTIC SECTOR

1. Consumption

The consumption measure utilized is aggregate in nature encompassing both durable and nondurable consumer goods known as total personal consumption expenditures. The consumption function utilized within this study is an augmented version of a habit persistence relationship (Duesenberry, 1948). The specification is augmented in the sense that real consumer credit CR72 is present to capture the durable component of our aggregative consumption measure and in particular the existence of an excess demand for credit given the low rates in the extension of lines of credit. This specification is not unique in that Portes and Winter (1978) in their study of repressed inflation within centrally planned economies found consumption behavior to resemble that of Western economies with the only distinct difference being the presence of quantity constraints on consumption goods. The specification rendered for consumption appears as follows with t-statistics denoted within parentheses.

Equation (1) Consumption: 1954 — 1984 AR(1)

$$C72 = \underset{(1.581)}{2.832} + \underset{(1.639)}{.1010\ YD72} + \underset{(6.800)}{.7804\ C72_{t-1}}$$

$$+ \underset{(2.496)}{.4769\ CR72}$$

$$Adj\ .R^2 = .998 \quad F = 4037 \quad DW = 2.07 \quad DH = -.5656 \quad RHO = ,269$$

As hypothesized in the previous discussion, all variables in the above consumption function are significant. As Porters and Winter (1978) suggest the above specification resembles a consumption function found in most market economies.

Real disposable income is determined via an identity from real social product Y72 less real personal income taxes PITAX72 plus real domestic transfers DOMTRAN72.

Equation (2) Disposable Income Identity:

$$YD72 = Y72 - PITAX72 + DOMTRAN72$$

2. *Consumer Credit*

The inclusion of real consumer credit CR72 in the consumption function calls for an equation for nominal consumer credit CR. The determination of consumer credit stems from both the availability of such credit as well as the cost associated with obtaining such lines of credit. The nominal interest rate DRNBY as provided by the National Bank of Yugoslavia measures the cost of obtaining such lines of credit.[2] The availability of credit is captured by the variable M1, the money supply. Lagged consumer credit CR_{t-1} provides for the inertia present within the credit markets of Yugoslavia (i.e. disequilibrium present within the consumption goods markets; see Portes and Winter, pp. 8, 12—17, 1978).

Equation (3) Consumer Credit: 1954—1984 AR(1)

$$\begin{aligned} CR = {} & 2.420 - .4646\ DRNRY + .6394\ CR_{t-1} \\ & (2.311)\ (-2.54) \qquad\qquad (9.025) \\ & + .0761\ M1 - .0447\ DUM80S * M1 \\ & (7.934) \qquad (-11.448) \end{aligned}$$

$$Adj\ .R^2 = .992 \quad F = 1301 \quad DW = 2.00 \quad DH = -.073 \quad RHO = -.237$$

The above specification performs relatively well. Furthermore, the significance of the structural shift in the availability of credit DUM80S * M1 within the 1980's appears to demonstrate the presence of rationing within the credit markets (Portes, 1978).

3. *Gross Investment in Plant and Equipment*

The aggregate investment function is an augmented version of the flexible accelerator. Investment behavior within Yugoslavia is determined by both capacity variables and financial variables. The capac-

[2] The discount rate within the Yugoslav macro model is taken as exogenous in view of the National Bank's ability to change the rate.

ity variables are denoted by the change in real gross social product $\Delta Y72$ and real investment expenditures the previous period $I72_{t-1}$. The financial variable comes in the form of the real money supply M172.

A unique feature of Yugoslav investment behavior is the presence of the soft budget constraint (Kornai, 1979). Within most market economies a hard budget constraint exists whereby firms base their investment decisions upon earned income (i.e. internally financed sources of income) with external means of finance looked upon as a secondary option. On the other hand, the soft budget constraint is essentially a form of the real bills doctrine in which the demand for credit creates its own supply (Burkett, 1983).[3]

As noted by Tyson (1983) Yugoslav firms have an insatiable demand for investment finance. As a result Yugoslav firms create their own non-bank forms of credit (i.e. circulating bills of exchange, accumulation of accounts payable, decrease in real cash holdings, etc.) in an attempt to maintain their unchanged demand for investment finance (Gedeon, 1986). The end result is illiquidity spread across Yugoslav firms. The increasing presence of inter-enterprise credits, the softening of the firms' budget constraint, arises from essentially two sources: (1) involuntary illiquidity and (2) voluntary illiquidity.

A scenario of involuntary illiquidity stems from an unanticipated decline in aggregate demand resulting in unplanned inventory accumulation. The sources for financing such an inventory accumulation are either lines of credit or payments' defaults (Bukrett, 1983; Tyson, 1979). An example of involuntary illiquidity would be the restrictive monetary policy action in 1965—1966 by the National Bank of Yugoslavia in an attempt to stabilize prices (Dimitrijević and Macesich, 1982). On the other hand, the scenario of voluntary illiquidity is a natural result when faced with an inflationary environment in which aggregate demand is expanding while inventory levels are depleting. Thus, given an inflationary environment with fixed interest rates firms rationally become indebted. Examples of voluntary illiquidity would be the inflationary periods of 1969, 1971, and the 1980's. As Kornai (1986) points out because firms actually control the local and regional banks pressure is placed on the central bank to act as "lender of last resort" in the monetization of enterprise debt once it has been created (Bradley and Smith).[4]

Given the preceding discussion the investment function estimated appears as follows:

Equation (4) Gross Investment in Plant and Equipment: 1953—1984 OLS

$$I72 = \underset{(-.9354)}{-1.386} + \underset{(5.696)}{.5635\ \Delta Y72} + \underset{(10.247)}{.7622\ I72_{t-1}} + \underset{(2.768)}{.2480\ M172}$$

$$Adj.R^2 = .990 \quad F = 1035 \quad DW = 2.02 \quad DH = -.0852$$

[3] See Kornai (1986) for examples of the different ways to "soften" a firms' budget constraint.

[4] The significance of the monetization of enterprise will become more prevalent in the discussion on price inflation in Yugoslavia. Bradley and Smith (1987) conduct Granger-causality tests finding bills of exchange (a form of "inter-enterprise" credits) Granger cause price.

Financial considerations play a more dominant role. Financial considerations are captured by the inclusion of M172 as a proxy, more specifically, to the presence of the soft budget constraint faced by firms and the monetization of enterprise debt.

Output will be determined with a identity. Real output is determined by real personal consumption expenditures C72, real gross investment in plant and equipment I72, real government consumption G72, and the impact of real net exports NX72.

Equation (5) Output Identity:

$$Y72 = C72 + I72 + G72 + NX72$$

B. FOREIGN SECTOR

The foreign sector will be comprised of two behavioral equations real exports EXP72 and real imports IMP72 and one identity for real net exports NX72.

1. *Exports*

Aggregate real exports are explained by three components: an economic activity variable, relative prices, and lagged real exports. Real social product Y72 is used as a proxy for economic activity which is supposed to capture possible repercussionary effects from initial changes in Yugoslav output and imports which in turn lead to changes within Yugoslav exports. The relative price variable is composed of the ratio of domestic prices P to export prices EP adjusted by the real effective exchange rate given by the dinar/dollar average exchange rate DIDOAVG. The lagged value of real exports is inserted as seen in previous export specifications (see Rhomberg and Boissoneault, pp. 381—382, 1965).

Equation (6) Exports: 1954 — 1984 AR(1)

$$EXP72 = \underset{(.7350)}{4.278} + \underset{(3.561)}{.1504\ Y72} - \underset{(-1.282)}{49.456\ P/(DIDOAVG * EP)}$$

$$+ \underset{(1.742)}{.3094\ EXP72_{t-1}}$$

$$Adj.R^2 = .972 \quad F = 353 \quad DW = 1.97 \quad DH = .3909 \quad RHO = .371$$

The above specification performs reasonably well with the exception of the relative price variable. Although correctly signed, it is of little significance perhaps because of the aggregation of exports to Western countries and Eastern-block countries. As Gapinski, et. al. (See pp. 8—9, 1989) point out a relative price variable for exports to socialist countries is not warranted based on the mechanism of bilateral clearing accounts — trade through barter — present among soci-

alist economies. However, the relative price variable will be retained for policy purposes, especially given the prevailing balance of payments crisis of the 1980's.

2. Imports

The aggregate imports specification will depend upon real disposable income YD72 as the economic activity variable displaying the capacity on the part of Yugoslavia to purchase imported goods. In addition to real disposable income, the price variable of import prices IP to domestic prices P adjusted by the real effective exchange rate given by the dinar/dollar average exchange rate DIDOAVG is included as an explanatory variable. Also, lagged real imports is included implying an exponentially decaying lag of the effect of changes in the other variables (Rhomberg and Boissoneault, 1965; Leamer and Stern, 1970).

Equation (7) Imports: 1954 — 1984 AR(1)

$$IMP72 = \underset{(.5513)}{2.378} + \underset{(2.333)}{.1326\ YD72} - \underset{(-1.980)}{.6750\ (DIDOAVG * IP)/P}$$

$$+ \underset{(3.359)}{.5850\ IMP72_{t-1}}$$

$$Adj.R^2 = .965 \quad F = 281 \quad DW = 2.09 \quad DH = -1.194 \quad RHO = .370$$

The above specification performs favorably, especially the relative price construction given Leamer and Stern (see p., 1970) typically find that the relative price variable of imports exhibits little in terms of explanatory power. Net exports NX72 is determined simply through an identity of exports EXP72 minus imports IMP72 as a balancing item in the determination of output.

Equation (8) Net Export Identity:

$$NX72 = EXP72 - IMP72$$

C. WAGES AND PRICES

1. Money Wage Inflation

How are wages determined in Yugoslavia? This question has not completely been resolved. Tyson (p. 117, 1977) surveys two competing hypotheses. First, the labor co-op theory suggests that "firms maximize net income per worker in that payments made to workers are a residual calculated at equilibrium output and employment levels". Alternatively, the limited profit maximization theory somewhat parallels the concept of a wage within the neoclassical model of the capitalist firm. Enterprises maximize profits remaining after paying all non-labor production

costs and a fixed accounting wage to each worker. As Tyson points out between the capitalist and self-managed firms "the only difference lies in the determination of the wage rate. Capitalist firms hire labor at a price determined by conditions of aggregated labor supply and demand while the self-managed enterprise collectively decides on a wage rate according to whatever criteria the workers choose to consider" (p. 118). Thus, the standard wage push model of inflation applies to the limited profit maximization theory mentioned above. However, labor market conditions may be a factor if all Yugoslav enterprises are competing for scarce labor then excess demand for labor will induce an increase in the rate of growth in wages.

Thus, money wage inflation will depend upon labor market conditions and the expected rate of inflation. The unemployment rate lagged one period will be a proxy for labor market conditions (Tyson, 1977; Wyzan and Utter, 1982). The rate of money wage inflation should be negatively related to the unemployment rate, thus a Phillips curve specification. The expected rate of inflation is a variable explaining money wage inflation given the plausible causality stemming from wages to changes in the costs of living (Perry, 1964). Thus, the resulting specification is that of an expectation — augmented Phillips Curve as follows:

Equation (9) Money Wage Inflation: 1953 — 1984 OLS

$$\Delta W/W_{t-1} = \underset{(2.588)}{7.540} - \underset{(-.7743)}{38.926}\, U_{t-1} + \underset{(6.575)}{.8222}\, \Delta P/P_{t-1}$$

$$Adj\ .R^2 = .710 \quad F = 39 \quad DW = 1.64$$

This money wage inflation specification performs rather well. Notice the lagged unemployment rate is correctly signed; however, not statistically significant suggesting that perhaps tenured employment places downward rigidities within the Phillips Curve trade-off between the growth in money wages and unemployment. The current rate of inflation $\Delta P/P_{t-1}$ was utilized as a proxy for the expected rate of inflation (Tyson, 1979; Wyzan and Utter, 1982). This is a particularly viable proxy for the expected rate of inflation given the acceleration in prices within the 1980's where workers become "nearsighted in their formation of inflationary expectations" (see Gapinski, pp. 11—12, 1989).

2. *Price Inflation*

Tyson (1977) entertains several inflation hypotheses prevalent for the Yugoslav economy. There appears to be several dimensions to Yugoslav price inflation: (1) cost push and (2) demand-pull. Although making an empirical distinction between the two hypotheses is almost impossible, structural differences within price inflation did occur in Yugoslavia (Dimitrijević and Macesich, 1982). One aspect of Yugoslav inflation is wage-push inflation due to workers' control over prices and wages, in turn, magnifies inflationary pressures. As pointed out

within money wage inflation, the limited profit maximization theory asserts that workers of self-managed enterprises collectively decide upon a wage rate.

In general, prior to the 1980's Yugoslav inflation could be characterized as a price markup relationship with the growth of wages exceeding the rate of labor productivity growth (Yagci and Kamin, 1987). However, in the 1980's Yugoslav inflation exhibited a structural shift from one of a price-markup relationship to one that could be attributed to excessive monetary expansion. Macesich and Tsai (p 115, 1982) hypothesize that the sharp acceleration in domestic prices stemmed from several sources: devaluation of the dinar in response to the emerging balance of payments deficit, increase in domestic energy prices, prevailing uncertainty associated with the implementation of pricing policy for 1981, and the presence of sectoral imbalances in price controls. Furthermore, the microeconomic phenomena of the "soft" budget constraint demonstrated its macroeconomic ramifications during this period. As mentioned within our discussion on investment, enterprises within Yugoslavia do not entirely base their decisions on a hard budget constraint. Yagci and Kamin (1987) argue that "solidarity among socially-owned firms lead to widespread socialization of financial bases and enable firms to operate under very soft budget constraints" (p. 9). The non-existence of financial discipline upon firms permits otherwise non-operative firms to continue operation. The end result is the eventual monetization of firm debt by the monetary authorities (Bradley and Smith, 1987).

Given this brief discussion on Yugoslav price inflation the following specification was rendered:

Equation (10) Price Inflation: 1954 — 1984 AR(1)

$$\Delta P/P_{t-1} = \underset{(-.2704)}{-.5226} \underset{(-1.438)}{-7.404\ REFORM} + \underset{(1.147)}{8.040\ \Delta M1/M1_{t-1}}$$

$$+ \underset{(3.445)}{40.773\ DUM80S^*\ \Delta M1/M1_{t-1}} + \underset{(5.417)}{.7767\ \Delta W/W_{t-1}}$$

$$Adj.R^2 = .865 \quad F = 49 \quad DW = 1.76 \quad RHO = .187$$

The wage push scenario is captured by money wage inflation $\Delta W/W_{t-1}$. The structural shift in price inflation being one of a wage push prior to the 1980's to one of excessive monetary expansion during the 1980's is captured by DUM80S * $\Delta M1/M1_{t-1}$ exhibiting a positive and significant coefficient whereas the rate of growth in money M1 prior to the 1980's exhibits no significance. The significant negative coefficient on the dummy variable REFORM is an attempt to illustrate the structural change in prices due to the 1965 Economic Reforms. Wyzan and Utter (1982) suggest that a bias toward capital intensive methods of production occurred as a result of the 1965 Economic Reforms due to the fact that labor had been made artificially expensive. Thus, as Ward (1958) demonstrated a change in the price of a product will result in a change

in output and employment in the opposite direction therefore the negative sign on the coefficient on the REFORM variable.[5]

D. LABOR

1. *Employment*

Although many Yugoslav economists argue that no labor market exists within Yugoslavia, the attempt within this section is not to commit economic heresy but perhaps give some functional meaning to Yugoslav economic aggregates. Employment within Yugoslavia is quite unique for several reasons. Wage determination is collectively determined by workers under the auspices of self-managed enterprises. However, labor market conditions are relevant to wage determination in the wake of excess demand for workers. Furthermore, employment within Yugoslavia is characterized by "tenured" employment. Once employed, workers become a part of the firms with regard to employment and wage decisions. In essence, Yugoslav employment is characterized by a "ratchet" effect in that layoffs or fires are not as prevalent as one would see within Western economies (Gapinski, et. al., 1989). For instance, given the presence of the soft budget constraint to ensure finance to the firm, an economic downturn within the Yugoslav economy doest not result in "layoffs" as one would perhaps be seen within Western market economies.

Thus, aggregate employment for Yugoslavia is captured by the following relationship:

Equation (11) Employment: 1954 — 1984 AR(1)

$$E = \underset{(4.406)}{5.452} + \underset{(4.086)}{.0347\ Y72} \underset{(-2.473)}{-.1163\ W72} + \underset{(14.780)}{.7956\ E_{t-t}}$$

$$Adj\ .R^2 = .997 \quad F = 3920 \quad DW = 2.05 \quad DH = -.216 \quad RHO = .222$$

Employment depends in part upon real social output Y72 and lagged employment E_{t-1}. Although correctly signed, real wages are insignificant as would be expected due to wages for the most part not determined via labor market demand and supply considerations but through the collective decision-making of workers.

2. *Labor Supply*

As in the employment specification above the supply condition is essentially the specification entertained by Gapinski, et. al. (1989). Labor supply is similar to that found within Western market economies with the exception of the lagged unemployment rate in West Ger-

[5] For instance, if the prices were to rise an enterprise would attempt to reduce output and employment thus maximize the dividend per worker (see Ward, p. 572, 1958). As well be seen within the labor section, the 1965 Economic Reforms brought forth problems with emigration.

many $UGER_{t-1}$. Sapir (1980) suggests that the decrease of job creation after 1965 was partially compensated by workers migrating to West Germany for employment. Thus, an increase in the West German unemployment rate essentially means fewer workers going abroad therefore increasing the domestic labor supply for Yugoslavia.

The aggregate labor supply function is cast in log-linear fashion as follows:

Equation (12) Labor Supply: 1954 — 1984 AR (1)

$$\ln LS = \underset{(.9644)}{.4562} + \underset{(.6079)}{.0226 \ln W72_{t-1}} + \underset{(35.018)}{.9481 \ln LS_{t-1}} + \underset{(2.190)}{.0128 \ln UGER_{t-1}}$$

$$Adj\ .R^2 = .996 \quad F = 2681 \quad DW = 2.10 \quad DH = -2.97 \quad RHO = .229$$

For similar reasons within our discussion of wages within the employment section, real wages although correctly signed are insignificant. Lagged labor supply exhibits relatively strong inertia given the coefficient being close to one. The unemployment rate in West Germany last period $UGER_{t-1}$ is correctly signed and significant lending support to Sapir's hypothesis. The unemployment rate will be determine via an identity as follows:

Equation (13) Unemployment Rate Identity:

$$U = (LS - E)/LS$$

III. MODEL VALIDATION

Although each equation of the Yugoslav model performs well econometrically, from the standpoint of forecasting and policy prescription the important question is how well do the equations perform together. Does the model track well within sample and does the model forecast well out-of-sample? These issues are considered here.

Though the diagnostics for validating models are numerous (See Hickman, 1972 and Challen and Hagger, 1983), validation in this endeavor will proceed via ex post simulation ("historical simulation") and the comparisons of the solved values of the endogenous variables with their actual counterpart for the period 1985. Ex post simulation essentially asks "how well does the model track actual economic performance over the time bounds used in the model's estimation?" On the other hand, solving for the value of the endogenous variables beyond the time frame of estimation provides one with the model's out-of-sample properties.

IV. YUGOSLAV MODEL PERFORMANCE

A. EX POST SIMULATION

The performance of the Yugoslav macro model historically is captured in the Table 1. Table 1 displays Theil's Inequality Coefficient as well as the correlation coefficients of the respective endogenous variables over the period 1954—1984.[6] Table 1 lends itself to some rather favorable results. The domestic sector of the Yugoslav model does well with real consumption C72, real disposable income YD72, nominal consumer credit CR, real investment in plant and equipment I72, and real output Y72 displaying inequality coefficient less than .11 suggesting that the simulated time series follows the behavior of the actual time series. Evaluation of the respective correlation coefficients substantiates this with correlation coefficients in excess of .94. The nominal credit variable of the Yugoslav model performs surprisingly well with an inequality coefficient of .0319 and a correlation coefficient of .9967.

The foreign sector with the exception of real net exports NX72 displays impressive tracking performance. Real exports EXP72 and real imports IMP72 have respective correlation coefficients of .9238 and .9378. However, the tracking ability of Yugoslav real net exports, NX72, fails miserably, the reason suggested being the interaction of the error terms present from the two behavioral equations for EXP72 and IMP72 (Sapir, 1981).[7]

The labor sector displays essentially the same performance as the foreign sector. Again, total employment E and labor supply LS have inequality coefficients close to zero .0596 and .0166, respectively. Furthermore, the respective correlation coefficients exceed .95 in magnitude. However, as in the above case of real net exports, the trackability of the unemployment rate U plummets with an inequality coefficient .6690 and a relatively low correlation coefficient .1360.

Price inflation $\Delta P/P_{t-1}$ performs more favorably relative to nominal wage inflation $\Delta W/W_{t-1}$ with regard to having a lower inequality coefficient .2538 and a higher correlation coefficient .6580. The simple fact that the wage and price sector is denoted in terms of rates of change rather than levels yields lower correlation coefficient and higher

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[6] Theil's Inequality Coefficient:

$$U = \frac{\sqrt{\frac{1}{T}\sum_{t=1}^{T}(Y_t^S - Y_t^A)^2}}{\sqrt{\frac{1}{T}\sum_{t=1}^{T}(Y_t^S)^2} + \sqrt{\frac{1}{T}\sum_{t=1}^{T}(Y_t^A)^2}}$$

[7] Sapir's (1980) model of Yugoslav migration finds poor performance for those variables determined via an identity relationship as well as those variables denoted in rates of change. Essentially, the problem is that a relatively small error in any two of the estimated variables induces a relatively large error in the variable determined as a residual from the two equations that predict well.

inequality coefficients. Overall, the Yugoslav model performs rather well with 9 of the 13 endogenous variables having a correlation coefficient in excess of .92.

Table 1

Yugoslavia
Theil's Inequality Coefficient and
Correlation Coefficients: 1954—1984

Variable	Theil's Inequality Coefficient	Correlation Coefficient
C72	.0663	.9746
YD72	.0658	.9771
CR	.0319	.9967
I72	.1087	.6447
Y72	.0764	.9698
EXP72	.1273	.9238
IMP72	.0947	.9378
NX72	.4052	.1923
$\Delta W/W_{t-1}$	.2977	.3123
$\Delta P/P_{t-1}$	.2538	.6580
E	.0596	.9649
LS	.0166	.9951
U	.4490	.1360

B. EX POST FORECASTING, 1985

The next task is to evaluate the out-of-sample properties of the Yugoslav model. Table 2 displays the solved values for the endogenous variables compared to the actual values. The difference between the solved and actual values are captured by means of percent error. Of the 13 endogenous variables displayed, 11 are under 15 in absolute percent error whereas the more volatile variables, namely, real net exports NX72 and money wage inflation $\Delta W/W_{t-1}$ exceed 20 in terms of absolute percent error. Notice, as in our discussion of the historical simulated time series, that the overwhelming presence of a negative percent error of the solved values for 1985 suggest a conservative bias in the forecasted values.

V. SOME REMEDIAL POLICY SIMULATIONS

Given the prevailing inflationary environment within Yugoslavia, the policy experiments conducted within this section will attempt to

curtail such an upward climb in the price level.[8] The average rate of inflation from 1952 to 1979 was 11.9 percent whereas the average rate of inflation from 1980 to 1985 was 45.42 percent.[9] Though an infinite horizon of policy experiments can be conducted only two policy experiments will be addressed in this endeavor: (1) restrictive monetary actions with regard to the money supply and (2) devaluation the dinar with an accompanying restrictive monetary policy to offset inflationary tendencies.[10] But before such policy experiments are conducted a few words concerning the simulation process are warranted.

Once the exogenous variables of the macro model have been identified one needs to obtain future values of the exogenous variables over the simulation time horizon in order to conduct a baseline or control solution.[11] The baseline or control solution simply answers the question "what would be the behavior of the economy modelled in the absence of shocks?" There are several ways to obtain future values of the

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[8] As Borislav Skegro at a recent PROJECT LINK meeting in Seoul, Korea states "Yugoslav economy has been weak during the eighties, with real GDP growth of only .08 percent annually, real wage decline of 3 percent annually, and inflation (GDP deflator) soaring from 30 percent in 1980 to 100 percent in 1987 and perhaps 170 percent in 1988."

[9] Yugoslav development has been one with a concentration upon investment in particular an acceleration in capital expenditures. However, this investment drive was not matched by an increase in domestic savings. In turn, the investment drive was financed by foreign savings. Given the availability of credit in international capital markets Yugoslavia simply used borrowing as a substitute for the implementation of domestic policies to improve upon domestic savings behavior. By the end of the 1970's Yugoslavia was experiencing a severe balance of payments situation (see Yagci and Kamin, 1987 for a discussion of this situation along with some counterfactual simulations). This situation however has its roots in the inflationary environment currently prevailing. The appreciation in the real exchange rate due in large part to inflation accelerating made Yugoslav exports less competitive within international markets. Thus, Yugoslav has been stagnating with output declining and prices rising.

[10] Other researchers notably Skegro, et. al. (1989) conduct wage-price controls of alternative strengths finding that with proper implementation wage and price inflation can be augmented with such measures without sacrificing output growth.

[11] Newton's method has appeal because of its rapid convergence of nonlinear simultaneous equation systems. For nonlinear system of equations, the model is linearized around the values of the variables arrived at from the previous iteration. The new linearized model is solved as in the above linear case by matrix inversion as follows:

$$X = A^{-1}b$$

where

A Jacobian with respect to model variables (testing for functional dependence).

b vector of model values computed at the previous iteration.

X direction vector of changes in variables to be computed.

The X direction vector provides for a linear search for better variable values. The criterion function for the search rests upon minimization of sum of squared deviations of the system (see Ortega and Rheinboldt, 1970).

Table 2
Yugoslavia
Ex Post Forecasting, 1985

Variable	For 1985 Solved Value	Actual Value	Percent Error*
C72	196.260	195.209	.5384
YD72	79.8040	89.7004	—11.0327
CR	65.9480	68.8000	—4.1454
I72	384.360	396.543	—3.0723
Y72	313.790	325.989	—3.7422
EXP72	71.9930	74.8224	—3.7815
IMP72	67.1710	66.6338	.8062
NX72	4.8220	8.1886	—41.1133
$\Delta W/W_{t-1}$	.5707	.7262	—21.4237
$\Delta P/P_{t-1}$	.6653	.7727	—13.8993
E	64.1110	65.1600	—1.6099
LS	75.6714	75.5563	.1523
U	.1528	.1376	11.0465

* Percent error is calculated as follows:
100 * [(solved value / actual value) — 1]

exogenous variables: (1) rely on the forecaster's economic intuition of the variables in the future, (2) use actual values of exogenous variables, or (3) construct forecasting equations for the exogenous variables. Due to the lack of actual values of the variables, the future values of the exogenous variables will be obtained by extrapolating the historical mean growth rates of the exogenous variables to cover the simulation time horizon of 1985—1990.[12] The necessary criteria for the forecasting equation is predictive power as captured by high R^2's and overall F-statistic. The time horizon of the forecasts will be the period 1985—1990.

Once the forecasted values of the exogenous variables have been obtained then the model can be solved over the period 1985—1990 to obtain the baseline values of the endogenous variables. Given the baseline for the model then policy experiments can be entertained. The resulting differences between the baseline simulation and the policy simulation can then be attributed to the change in the particular policy variable(s).

The first policy experiment will be a restrictive monetary action, namely a 20 percent decrease from the baseline growth of the money

[12] The extrapolation of the mean growth rates of the exogenous variables are available upon request from the author.

supply as presented in Table 3. As one can see from Table 3 both money wage and price inflation are cut by 6.75 and 8.333 percentage points, respectively. In response, the level of real wages increases from 23.133 to 23.810 billion dinars. The lower growth rate of the money supply responds with lower domestic prices relative to foreign prices. The result is an increase in the growth of real exports by 9.75 billion dinars. Moreover, as Cagan (1956) has hypothesized the real balance effect in turn enhances output. Employment increases by 2.256 percent likewise real output jumps from 377.49 to 429.87 billion dinars. Real consumption and real investment follow with increases of 20.42 and 19.12 billion dinars, respectively.

Table 3

Impact of a 20 Percent
Decrease in Money Supply Growth:
Yugoslavia 1985—1990

	Baseline		With 20% Decrease in Money Supply Growth	
Variable	Mean	Mean Rate of Change	Mean	Mean Rate of Change
Real Consumption	248.49	6.032	268.91	9.610
Real Investment	89.28	—7.720	108.40	2.524
Employment	7,048	2.624	7,367	4.880
Money Wage Inflation	37.533	WH*	30.783	WH
Price Inflation	42.850	WH	34.517	WH
Real Wages	23.133	—4.178	23.810	—3.234
Real Output	377.49	1.510	429.87	7.152
Real Exports	85.192	2.138	94.942	7.124
Real Imports	76.205	0.0404	79.158	2.872

*WH denotes withheld due to the variables are already in mean rates of change.

The second policy experiment is a devaluation of the dinar with an accompanying restrictive monetary policy action. A devaluation is an increase in the domestic currency price of foreign exchange. Devaluation increases the relative price of imported goods in the devaluing country and reduces the relative price of exports from the devaluing country. Thus, devaluation shifts demand from foreign to domestic goods. Devaluation without an associated restrictive policy can lead to excessive demand pressures. In the case at hand, restrictive monetary policy will attempt to circumvent such excessive demand pressures.

Table 4 displays the results of a 10 percent increase in the devaluation of the dinar with an accompanying 10 percent decrease in

nominal money supply growth. As in the first policy experiment,Yugoslav economic performance is improved. The devaluation of the dinar improved real exports from 85.192 to 93.84 billion dinars while real imports declined from 76.205 to 73.13 billion dinars. As net exports expand, output in turn grows as well as employment. Moreover, in responses to the increase in output, real consumption advanced by 14.57 billion dinars whereas real investment increased by 15.65 billion dinars. The accompanying restrictive monetary actions via nominal money supply growth provided a decrease in price inflation of 4.183 percentage points. Given the reduction in price inflation, money wage inflation subsided by 3.416 percentage points.

VI. CONCLUDING REMARKS

The fundamental task of this paper was to present a small-scale macroeconometric model of the Yugoslav economy. The underlying structure of the model was validated via historical simulation and ex post forecasting. Given the stagflation environment of the 1980's, two remedial policy simulations: (1) restrictive monetary policy and (2) devaluation of the dinar with accompanying restrictive monetary actions were undertaken. Both policy experiments improve upon existing Yugoslav performance as exemplified by the baseline. Though the policy experiments conducted are only a small portion of the infinite horizon of policy scenarios the results presented do show the general direction for policymakers to consider.

Table 4
Impact of a 10 Percent Devaluation
of the Dinar with an Accompanying
10 Percent Decrease in Money
Supply Growth:
Yugoslavia 1985—1990

	Baseline		Devaluation/Money Supply	
Variable	Mean	Mean Rate of Change	Mean	Mean Rate of Change
Real Consumption	248.49	6.032	263.06	8.248
Real Investment	89.29	—7.720	104.94	—2.492
Employment	7,048	—2.624	7,366	4.326
Money Wage Inflation	37.533	WH	34.117	WH
Price Inflation	42.850	WH	38.667	WH
Real Wages	23.133	—4.178	23.625	—3.708
Real Output	377.49	1.510	422.20	3.088
Real Exports	85.192	2.138	93.84	5.190
Real Imports	76.205	0.0404	73.13	0.0450

Received: 02. 03. 1989
Revised: 28. 06. 1989

APPENDIX 1
Glossary of Variables

C72	Total Personal Consumption Expenditures, billion dinars 1972 prices
CR	Nominal Consumer Credit, billion dinars CR72*P
CR72	Total Consumer Credit, billion dinars 1972 prices
DIDOAVG*	Average real Effective Exchange Rate dinar/dollar 1972 = 1.00
DOMTRAN72*	Domestic Transfer Payments, billion dinars 1972 prices
DRNBY*	Discount Rate, National Bank of Yugoslavia
DUM80S*	Dummy variable: 1.0 = 1980 — 1985, 0.0 otherwise
E	Total Employment, thousands of persons
EP*	Export Prices, 1972 = 1.00
EXP72	Total Exports, billion dinars 1972 prices
G72*	Government Consumption (excluding wages paid by government and government savings), billion dinars 1972 prices
I72	Total Gross Investment in Plant and Equipment, billion dinars 1972 prices
IMP72	Total Imports, billion dinars 1972 prices
IP*	Import Prices 1972 = 1.00
LS	Civilian Labor Force, thousands of persons
M1	Nominal Money Supply, billion dinars M172*P
M172*	Money Supply, billion dinars 1972 prices
NX72	Net Exports, billion dinars 1972 prices
P	Implicit Price Deflator, Social Product 1972 = 1.00
PITAX72*	Personal Income Taxes, billion dinars 1972 prices
REFORM*	Dummy variable: 1.0 = 1965 — 1966, 0.0 otherwise
U	Unemployment Rate
UGERM*	Civilian Unemployment in West Germany
W	Nominal Wages, billion dinars W72*P
W72	Average Annual Wages, billion dinars 1972 prices
Y72	Total Social Product, billion dinars 1972 prices
YD72	Personal Disposable Income, billion dinars 1972 prices
*	Exogenous variable identifier
Δ	First difference operator
ln	Natural logarithm operator
adj . R^2	Adjusted coefficient of determination
F	F-Statistic
DW	Durbin Watson Statistic
DH	Durbin's h Statistic
OLS	Ordinary Least Squares
AR(1)	Correction for first-order autocorrelation

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