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STRUCTURAL STABILITY OF THE RATIONAL EXPECTATIONS – PERMANENT INCOME HYPOTHESIS: EVIDENCE FROM YUGOSLAVIA

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ABSTRACT

This paper evaluates the structural stability of alternative specifications of the rational expectations – permanent income hypothesis (REPIH) with regard to Yugoslav consumption in the 1980s. Evidence is presented to suggest that a carefully specified REPIH structural model of consumption is stable throughout the 1980s, whereas single equation reduced form consumption functions are not. This suggests that the recent decline in aggregate consumer expenditures in Yugoslavia is largely explained by declining real per capita income and not by an exogenously determined shift in consumer preferences.

1. INTRODUCTION

A theory which has survived considerable scrutiny virtually intact since the 1950s is the Permanent Income Hypothesis (PIH), set forth by Friedman (1957). Modified in the late 1970s by Hall (1978) in the light of the rational expectations hypothesis (REH) to become the rational expectations – permanent income hypothesis (REPIH), it has recently been the topic of considerable controversy.[3]

One method of testing the REPIH is to evaluate the stability of empirical specifications of the consumption function implied by the theory. A stable

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[3] See Blinder and Deaton (1985) for an extensive survey of the literature and recent empirical results.

consumption function provides evidence to suggest that the relationships implied by the theory are valid empirically. A finding of structural breaks in the empirical consumption function requires either modification of the theory or rejection of the theory in favour of an alternative. This approach to testing is adopted in this paper to examine the validity of the REPIH with regard to the decline in consumption expenditures and real per capita income in Yugoslavia in the 1980s.[4]

The volatility of events in Yugoslavia since the mid-1970s provides an interesting »natural experiment« with which to test the REPIH against conventional specifications of the PIH. Evidence is presented to suggest that a carefully specified REPIH structural model of consumption is stable throughout the 1980s, whereas single equation reduced form consumption functions are not. This suggests that the recent decline in aggregate consumer expenditures in Yugoslavia is largely explained by declining real per capita income and not by an exogenously determined shift in consumer preferences.

The problem with the economic data available from many countries is the lack of variability. This means that the accuracy and usefulness of economic theories can only be tested under a narrow set of conditions. The Yugoslav experience during the 1980s is thus an excellent opportunity to broaden the conditions under which to test the structural stability of the REPIH. The stagflation environment in Yugoslavia during the 1980s due in large part to a deteriorating balance of payments. The appreciation in the real exchange rate caused by accelerating inflation made Yugoslav exports less competitive internationally. As a result Yugoslavia suffered declining output along with rapid inflation.[5]

This period reflects the hyperinflation scenario of Cagan (1956). The decline in real cash holdings during hyperinflations results from variations in the expected rate of inflation. Payne (1991) examines potential sources of the Yugoslav inflationary process and finds both monetary and cost-push considerations are relevant. The monetization of inter-enterprise credits and the increase in money wages in excess of increases in labour productivity translated into higher prices. The resulting decline in real income should, according to the PIH, lead to a decline in real aggregate consumer expenditures.

In the next section alternative specifications of the consumption function popular in the literature are considered. Two tests of structural stability, a Chow test and a predictive test, are outlined in section 3. The structural stability of the alternative specifications is then evaluated in section 4. Section 5 provides concluding remarks.

2. ALTERNATIVE SPECIFICATIONS OF THE CONSUMPTION FUNCTION

According to the PIH, consumer expenditures only change if there is a change in permanent income, where permanent income is the discounted sum

[4] Stiblar (1980) and Payne (1987) provides evidence on the effect of the 1965 Yugoslav reforms on consumption spending, and Zuehlke and Payne (1989) reject the REPIH for several developing economies, including Yugoslavia.

[5] Vacić (1987) surveys the recent Yugoslav economic experience.

of the expected future income stream over the lifetime of the consumer. The problem is to specify an empirically observable proxy for permanent income. The aggregate cosumption function that represents this theory can be characterized by the following equation.

$$c_t = \alpha c_{t-1} + \Delta y_t^P + \phi Z_{t-1} + \varepsilon_t \qquad (1)$$

where c_t = real consumer expenditures in period t, Δy^P_t = the change in permanent income in period t, Z_{t-1} = lagged values of other variables (such as wealth), and ε_t = a random error.

Often, lagged values of income are adopted as proxy variables for permanent income in an instrumental variable estimation procedure. Income is specified as a univariate autoregressive process and this autoregressive equation for income is then substituted directly into the consumption equation to give the following specification (see Blinder, 1981, and Hendry, 1983).

$$c_t = \alpha c_{t-1} + \sum_{i=0}^{n} \beta_i y_{t-i} + \phi Z_{t-1} + \varepsilon_t \qquad (2)$$

where n is the number of lags considered efficient to capture the income generating process. This specification also encompasses other theories of the consumption function, such as the habit theory, the relative income hypothesis and the absolute income hypothesis (see Branson, 1989).

In his seminal paper, Hall (1978) concentrates on the implications of the rational expectations hypothesis for the specification of an aggregate consumption function. The REH implies that Δy_t^P is unobservable and orthogonal to all information available in period t–1 (so it is unpredictable), and the vector $\phi = 0$ because c_{t-1} contains all the information from past observations on other variables relevant for predicting future income. Hall replaces the distributed lag specification with a model based on the REH. From this he obtains the result that the simple relationship

$$c_t = \alpha c_{t-1} + e_t, \quad \alpha > 1 \qquad (3)$$

where e_t is unpredictable at time t–1, is a close approximation to the behavior of consumption under the PIH. In this equation the disturbance term, e_t, »summarizes the impact of all new information that becomes available in period t about the consumer's lifetime well-being« (Hall, 1978, p. 975).

The main controversy surrounding Hall's specification has centred on whether lagged values of other variables, particularly stock prices and income, lead to more accurate unconditional forecasts. It has been argued that if this is true it represents a rejection of the REPIH, i.e. equation (3) should be replaced by

$$c_t = \alpha c_{t-1} + \phi Z_{t-1} + e_t, \qquad (4)$$

where Z_{t-1} is a vector of lagged values of variables other than consumption. If the variables in equation (4) are in first differences form and Z_{t-1} contains the error correction variable this is representative of the error correction mechanism (ECM) specification propounded by Hendry, *inter alia.*[6]

There are a number of reasons, however, why the ECM specification can be considered compatible with the REH. The most widely considered possibility is that some consumers may be liquidity constrained and therefore are

[6] The error correction component is of the form, $z_{t-1} = (c_{t-1} + \delta y_{t-1})$, where δ is the cointegrating parameter. See Davidson et al. (1978), Hendry (1983) and Engle and Granger (1987).

unable to act upon anticipated changes in income immediately. If this is true, and there are a number of studies that suggest it is, variables that help predict future (anticipated) income will help improve forecasts of consumption (see Hayashi, 1985). Income and particularly stock prices thus represent observable proxies for expectations of future income in the consumption function. A second possibility is that the relevance of information on future income that was previously available may not be recognised, i.e. the potential benefits from hindsight are significant. In particular, if agents are uncertain whether a change in income is really permanent or temporary they may delay altering their consumption path until more information is available. Hence it is not clear that the ability to improve unconditional forecasts using specifications like (4) instead of (3) implies that the REPIH must be rejected, particularly if modified to account for liquidity constraints.

A problem with both Hall's model and the lagged income model that is more significant for the present study is that raised by Lucas (1976). Lucas argued cogently that the parameters of reduced form equations are likely to change whenever there is a shift in the underlying structural processes that determine the explanatory variables in a reduced form equation. Lucas (1976) used the consumption function as one of his examples to illustrate the point. If there is a change in the income generating process, due to a change in income tax rates say, then the parameters of the income generating equation will change. Since these parameters are embedded in reduced form equations such as (2) and (3) there will be a structural break in these equations. Therefore a structural model of consumption behavior is needed for the parameters of the consumption function to remain invariant to changes in the data generation process (DGP) for income.

In order to provide a test of the REPIH that addresses the above problem Flavin (1981) attempts to develop an explicit model for permanent income by modeling expectations of future income within an RE framework. In Flavin's model the revision in permanent income in period t, Δy_t^P, is proportional to the innovation in current income, with the factor of proportionality determined by the parameters of the income time-series process. The innovation in current income is the difference between actual income in period t, y_t, and the expectation of y_t formed in t−1, ${}_{t-1}y_t^e$, which under the REH equals the mathematical expectation $E_{t-1}(y_t)$ from the model, i.e.

$$\Delta y_t^P = \beta[y_t - E_{t-1}(y_t)] \tag{5}$$

Thus a simple consumption function that represents the REPIH is

$$c_t = \alpha c_{t-1} + k\beta[y_t - E_{t-1}(y_t)] + \phi Z_{t-1} + u_t \tag{6}$$

where k represents the marginal propensity to consume out of permanent income and u_t represents the transitory component of consumption. In the pure PIH both α and k equal unity. When equation (6) is estimated using aggregate data however, we may expect α to be greater than one because of the upward trend in consumer expenditures. We may also expect $k < 1$ due to uncertainty about future income.

Flavin uses this approach to develop a simple structural econometric model of consumption with which to test the REPIH. In this model when agents observe that the current realization of income is different from that anticipated, i.e. $y_t \neq E_{t-1}(y_t)$, they revise their expectations of future income and, therefore, of permanent income. Flavin models income by

$$y_t = \rho_1 y_{t-1} + \rho_2 y_{t-2} + \ldots + \rho_p y_{t-p} + e_t + \delta_1 e_{t-1} + \ldots + \delta_q e_{t-q} \qquad (7)$$

where e_t is a white noise disturbance. This is equivalent to an infinite order moving-average process;

$$y_t = e_t + q_1 e_{t-1} + q_2 e_{t-2} + \ldots \qquad (8)$$

Since the disturbance terms are white noise by construction, the expectation of all future values of e is zero. When the current forecast error e_t is realized, the predicted value of income at each date in the future is revised proportionally to e_t, i.e.

$$\Delta y_t^P = \sum_{s=0}^{\infty} \left[\frac{1}{1+r}\right]^s (E_t y_{t+s} - E_{t-1} y_{t+s}) =$$

$$= \sum_{s=0}^{\infty} \left[\frac{1}{1+r}\right]^s q_s e_t \qquad (9)$$

where r = the real rate of return, assumed to be constant. Substituting equation (9) into equation (6) gives

$$c_t = \alpha c_{t-1} + k\beta e_t + \phi Z_{t-1} + u_t \qquad (10)$$

where $\phi = \sum_{s=0}^{\infty} \left[\frac{1}{1+r}\right]^s q_s$ and $e_t = (y_t - E_{t-1} y_t)$ so that (10) is equivalent to (6).

The advantage of Flavin's model for the present study is that the DGP for permanent income is modeled as a separate equation from the consumption function. A change in the DGP for income will produce a different series of innovations, e_t, but should not affect the structural parameters of equation (10). The parameters of reduced form equations (2), (3), and (4) are not likely to be invariant to structural breaks in the income DGP. Hence we would expect, *a priori,* to find the structural model of equations (9) and (10) to suffer less from structural breaks than reduced form equations.

3. STRUCTURAL STABILITY TESTS

The conventional means of testing for structural stability is the Chow test, which is an F-test of the following form (Chow, 1960).

$$F_{q,\, n-k} = \frac{(ESS_R - ESS_U)/q}{ESS_U/(n-k)} \qquad (11)$$

where ESS_R = sum of squared residuals from the restricted model, ESS_U = sum of squared residuals from the unrestricted model, and q = the number of parameter restrictions imposed by the null hypothesis of no structural break.

One of the problems with the Chow test is that the fewer observations available after the structural break the weaker the test. In the study herein there are only six observations after the supposed 1980 structural break. As a result we also perform a predictive test for structural change which has the advantage over the Chow test that it only requires a few observations after the structural break (see Lütkepohl, 1988). The predictive test adopted is one proposed by Barone and Roy (1983), based on the asymptotic distribution of one-step-ahead forecasts derived by Schmidt (1974). Lütkepohl (1988) provides a review of the literature and some Monte Carlo results on the small sample properties of this type of test. The test statistic, λ, is the following

$$\lambda = \hat{e}'Q^{-1}\hat{e} \sim \chi^2_m \tag{12}$$

where m = number of periods forecast, $\hat{e}$ = a vector of m one-step-ahead forecast errors, and $\hat{Q}^{-1}$ = an estimate of the covariance matrix from estimation of the forecasting equation.

This statistic compares the estimated residual with the forecast errors. If there has not been a structural break in the-time series process generating the data, then the forecast errors are drawn from the same distribution as the estimation residuals. The χ^2 statistic, λ, will not be significant in this case. The null hypothesis is therefore: no structural change has occurred in the DGP. The predictive test is performed by first estimating the model up to the period when the structural break is suspected to have occurred to obtain parameter estimates and the estimated covariance matrix, Q^{-1}The vector of forecast errors, $\hat{e}$, is then constructed using the estimated model to generate forecasts beyond the estimation period and subtracting these forecasts from actual values. If the forecast errors are large then the test statistic will be significant indicating a structural break.

4. EMPIRICAL RESULTS

This study uses annual data for 1952–1988 from the Federal Statistical Office of Yugoslavia. The data were compiled and made available by the Economics Institute, Zagreb, Yugoslavia. The variables used are: consumption expenditures, defined as aggregate personal consumption including both durable and nondurable goods, and personal disposable income. All variables are in real per capita terms where the price variable is the implicit price deflator for social product, 1972 = 100.

All equations were estimated in both levels and first differences specifications because the levels form tends to suffer from nonstationarity and spurious correlation due to a common trend. First differencing is one way to mitigate these problems which, although crude, has much to commend it over more sophisticated techniques.[7] Initial estimates indicated serial correlation was a problem in most cases, so all estimates reported are for first-order autoregressive error specifications. The Ljung-Box Q statistic is reported as a test for higher order autocorrelation (Durbin-Watson type tests are not valid when the lagged dependent variable is included). As a further diagnostic check, the Breusch and Pagan LM test for heteroskedasticity was conducted. For all specifications considered the null hypothesis of homoskedasticity could not be rejected at the 10% level, so the results of this test are not reported.

[7] See Granger and Newbold (1986), chapter 6.

The first specification tested resembles the traditional consumption function where permanent income is proxied by lagged income, as specified in equation (2). Estimation of equation (2) with the number of autoregressive lags, n, larger than 2 suffers from multicollinearity and reduces the degrees of freedom greatly. As a result two versions of equation (2) are considered, one with n = 2 and an Almon lag specification with an implied n of 8.[8] Tables 1 and 2 present the empirical findings from equation (2) for both levels and first differences specifications. Each of the models presented in Tables 1 and 2 reflect good overall predictive power with regard to R^2 and the Ljung-Box Q statistic is not significant at the 5% level indicating autocorrelation is not a problem. More importantly, in each case evidence of structural instability abounds. Both the Chow F test and the predictive χ^2 test are significant at the 1% level.

Table 3 presents the results for Hall's consumption model. Estimation results for equation (3) indicated the presence of serial correlation in both levels and differences specifications, suggesting dynamic misspecification so that lagged variables other than consumption could improve predictions of c_t (Spanos, 1988). However, given the limited number of degrees of freedom, instead of engaging in a specification search for suitable Z variables in equation (4), we simply corrected for autocorrelation in equation (3) using maximum likelihood procedures to estimate the following specification (see Hendry and Mizon, 1978).

$$c_t = \alpha c_{t-1} + e_t + \rho e_{t-1} \qquad (13)$$

The estimation results presented in Table 3 are for equation (13). Once again there is strong evidence of a structural break. The predictive test is significant at the 1% level for both specifications, the less stringent Chow test rejects structural stability at the 5% level for the levels specification and at the 1% level for the differenced specification.

Finally, results for the structural REPIH model developed by Flavin (1981) are presented in Table 4. First the forecasting equation for income is presented, followed by the consumption equation in both levels and first differences specifications. The Chow test is insignificant at the 10% level for all three equations. The predictive test is significant at the 1% level for the income equation and the levels version of the consumption function. However, the extremely large value for the predictive test statistic, λ, suggests that the levels specification suffers from nonstationarity, whereas the differenced consumption equation has good explanatory power despite differencing. Notably, the predictive test is insignificant at the 10% level for the differenced specification of the consumption function, suggesting a stable consumption-income relationship throughout 1953–1985.

These results indicate that the consumption function in a carefully specified REPIH structural model of consumption is stable throughout the 1980s, whereas single equation reduced form consumption functions are not. The evidence on the income equation is far from conclusive – there may have been a structural break in the DGP for income but with only reduced form

[8] See Judge et al. (1980), p. 641–653

evidence it is not clear why income levelled off in the 1980s.[9] However, this does suggest that the recent decline in aggregate consumer expenditures in Yugoslavia is largely explained by declining per capita income rather than by an exogenously determined shift in consumer preferences.

5. CONCLUSION

Standard lagged income and consumption specifications for permanent income in the consumption function lead to the conclusion that there has been a structural break in the relationship between permanent income and consumer expenditures in Yugoslavia since 1980. This paper demonstrates that empirical specifications of the consumption function that approximate the REPIH more faithfully do not suffer from structural instability. It is demonstrated that a carefully specified consumption function is stable through the 1980s and the decline in consumer expenditures is largely explained by a concurrent decline in real income. This suggests that findings of a structural break in the consumption function may be the result of estimating reduced form aggregate equations rather than any failing in the theory of consumer behavior.

The results on the structural stability of consumption indicate that income is the driving force for consumer expenditures in Yugoslavia, as predicted by the REPIH. These results support Hall's (1978) conclusion that exogenous shocks and policy changes affect consumption only as much as they affect permanent income.

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Table 1: LAGGED INCOME SPECIFICATION

A. Levels:

$$C_t = \underset{(-1.309)}{-0.237} + \underset{(2.924)}{0.639}C_{t-1} + \underset{(0.686)}{0.143}Y_{t-1} + \underset{(1.391)}{0.211}Y_{t-2} + \varepsilon_t + \underset{(0.012)}{0.003}\varepsilon_{t-1}$$

$R^2 = 0.995$

$Q = 14.25$

Structural Stability Tests:

Chow $F(3,24)$ test = 3.696 (0.026)

Predictive $\chi^2(6)$ test = 1163.3 (0.000)

[9] Vacić (1987) discusses causes of the income decline.

B. *First Differences*:

$$\Delta C_t = 0.084 - 0.738\Delta C_{t-1} + 0.270\Delta Y_{t-1} + 0.006\Delta Y_{t-2} + \varepsilon_t - 0.001\varepsilon_{t-1}$$
$$(7.341)(-4.764) \quad (2.246) \quad (0.056) \quad (-0.005)$$

$R^2 = 0.706$

$Q = 9.044$

Structural Stability Tests:

Chow $F(3,23)$ test = 15.51 (0.000)

Predictive $\chi^2(6)$ test = 327.2 (0.000))

t-values (for parameters) and levels of significance (for tests) in parentheses.

Table 2: ALMON LAG SPECIFICATION

A. *Levels:*

$$C_t = -0.280 + 0.585C_{t-1} + 0.310Y_t + 0.098\sum_{i=1}^{8} Y_{t-i} + \varepsilon_t + 0.004\varepsilon_{t-1}$$
$$(-2.193) \quad (3.417) \quad (3.429) \quad (0.623) \quad (0.001)$$

$R^2 = 0.999$

$Q = 9.588$

Structural Stability Tests:

Chow $F(3,18)$ test = 7.706 (0.002)

Predictive $\varepsilon^2(6)$ test = 1156.1 (0.000)

B. *First Differences*:

$$\Delta C_t = 0.021 - 0.263\Delta C_{t-1} + 2.330\Delta Y_t + 0.608\sum_{i=1}^{8} \Delta Y_{t-i} + \varepsilon_t + 0.0002\varepsilon_{t-1}$$
$$(0.883) \quad (-1.157) \quad (2.216) \quad (1.749) \quad (0.0003)$$

$R^2 = 0.840$

$Q = 11.63$

Structural Stability Tests:

Chow $F(3,17)$ test = 4.338 (0.019)

Predictive $\chi^2(6)$ test = 38.93 (0.000)

t-values (for parameters) and levels of significance (for tests) in parentheses.

Table 3: HALL'S SPECIFICATION

A. *Levels:*

$C_t = 0.043 + 0.984C_{t-1} + \varepsilon_t - 0.001\varepsilon_{t-1}$
(2.960) (65.61) (–0.003)

$R^2 = 0.995$

Q = 30.88

Structural Stability Tests:

Chow F(2,28) test = 3.86 (0.033)

Predictive $\chi^2(6)$ test = 358.3 (0.000)

B. *First Differences:*

$\Delta C_t = 0.091 + 0.642\Delta C_{t-1} + \varepsilon_t - 0.001\varepsilon_{t-1}$
(9.431) (–4.497) (–0.003)

$R^2 = 0.633$

Q = 9.975

Structural Stability Tests:

Chow F(2,27) test = 20.56 (0.000)

Predictive $\chi^2(6)$ test = 33.72 (0.000)

t-values (for parameters) and levels of significance (for tests) in parentheses.

Table 4: FLAVIN'S SPECIFICATION

Income Forecasting Equation: AR(1) model

$Y_t = 0.056 + 0.983Y_{t-1} + \varepsilon_t + 0.007\varepsilon_{t-1}$
(5.827) (43.23) (0.038)

$R^2 = 0.991$

Q = 17.55

Structural Stability Tests:

Chow F(2,28) test = 1.037 (0.368)

Predictive $\chi^2(6)$ test = 51.04 (0.000)

Consumption Function

A. *Levels*:

$$C_t = 0.587 + 0.405C_{t-1} + 0.367C_{t-2} + 0.257[Y_t - E_{t-1}Y_t] - 12.56[E_{t-1}Y_t - Y_{t-1}] + \varepsilon_t + 0.001\varepsilon_{t-1}$$
$$(0.990)\quad (2.119)\quad (1.606)\quad (1.599)\quad (-0.875)\quad (0.003)$$

$R^2 = 0.997$

$Q = 14.68$

Structural Stability Tests:

Chow $F(2,25)$ test = 0.554 (0.582)

Predictive $\chi^2(6)$ test = 7635.8 (0.000)

B. *First Differences*:

$$\Delta C_t = -0.021 - 0.403\Delta C_{t-1} + 0.251[Y_t - E_{t-1}Y_t] + 1.843[E_{t-1}Y_t - Y_{t-1}] + \varepsilon_t + 0.001\varepsilon_{t-1}$$
$$(-0.561)\quad (-2.860)\quad (2.312)\quad (2.766)\quad (0.002)$$

$R^2 = 0.769$

$Q = 13.26$

Structural Stability Tests:

Chow $F(2,24)$ test = 0.280 (0.758)

Predictive $\chi^2(6)$ test = 4.002 (0.676)

t-values (for parameters and levels of significance (for tests) in parentheses.

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