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DO CHANGES IN CURRENT INCOME HELP TO EXPLAIN CHANGES IN CONSUMPTION IN ISRAEL?

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This paper examines the extent to which the rate of change of private consumption (per capita) can be forecast on the basis of the rates of change of predictable income and the rate of return on assets-share yields and short-term interest. As is well known, a strong link between a change in private consumption and in predictable income contradicts the permanent income hypothesis with rational expectations. The empirical test focuses on the period between 1963 and 2000, by enlarging our previous sample which lasted in 1993. The main empirical result of this study shows the considerable effect of the rate of change of predictable wage income on consumption-around 0.5. In other words, half the population seems to set its consumption on the basis of changes in current income. Another finding is the significant effect of the rate of return on shares on consumption, although its elasticity is relatively small. Including in the sample the large-scale immigration wave from former USSR mildly increased, as expected, the income elasticity, and it slowed the speed of adjustment of consumption to permanent income.

1. INTRODUCTION

This paper examines the extent to which the rate of change of per capita private consumption can be forecast on the basis of the rates of change of predictable income and the return on assets-share yields and the short-term interest rate. The empirical test focuses on the period between 1963 and 2000. As is well known, a strong link between a change in predictable income and one in private consumption contradicts the permanent income hypothesis with rational expectations.

The basis of this study arises from Hall's (1978) seminal study and those which arose from it. Hall claimed that given a constant interest rate, according to the permanent income hypothesis with rational expectations (henceforth PIH-RE), a change in consumption is impossible to forecast. This is because *ceteris paribus*, individuals do not plan changes in consumption, and any change is simply a response to an unexpected change in permanent income, which is by definition unforecastable. Several empirical studies published following Hall's pointed out the strong correlation between changes in expected income and changes in consumption (most

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notable among them being Flavin, 1981; Hall and Mishkin, 1982; Hayashi, 1982; Bernanke, 1985; Campbell and Mankiw, 1989). These results were incompatible with the PIH-RE, however. In principle, excluding the rate of return on assets from the consumption equation could have been the cause of the hyper-sensitivity of consumption with respect to predictable income, but empirical studies have shown that this was not the reason for the sensitivity.

Currently, the most widely-accepted argument is the existence of a liquidity constraint for consumers. Saving for a precautionary motive also enhances the relation between consumption and predictable income. Naturally, the question whether the connection between consumption and current income is stronger than is generally accepted in the framework of the permanent income hypothesis has important implications for economic policy; if such a constraint does exist, temporary changes in taxation can affect consumption. This question brings us back to the old argument between the Keynesian approach and the permanent income hypothesis.

The empirical results of this study show that in Israel, too, the rate of change of predictable wage income has a very large effect on consumption, with a coefficient of about 0.5 (depending on the specification of the equation). This is similar to the results obtained by Campbell and Mankiw. Especially surprising is the result concerning the large contribution of the rate of return on shares and the interest rate to explaining the change in consumption in 1963-2000, despite the low elasticity of consumption to these variables.

The empirical results in Israel, like those in other countries, indicate that consumption and wage income are cointegrative, and that there is an error-correction mechanism (henceforth EC) which guarantees that the short-run dynamic process (between consumption and income) will converge on the long-run trend. However, in the framework of the PIH-RE as formulated by Hall, this mechanism cannot take the form of the lagged adjustment of consumption to income. Instead, the process of adjustment is between disposable income and saving (Deaton, 1992). However, in certain situations (e.g., when there is a liquidity constraint, or in conditions of habit formation) rational behavior may be accompanied by an error-correction process between consumption and income. The empirical results support the existence of such a process, albeit a relatively rapid one.

2. THEORETICAL BACKGROUND: THE PERMANENT INCOME THEORY WITH RATIONAL EXPECTATIONS

Theoretical and empirical studies (mainly in the late 1970s and throughout the 1980s) have raised basic questions about the traditional consumption equations, and developed new empirical theories and approaches. Suffice it to mention the criticism levelled by Lucas (1976) that the traditional version of the consumption equation, which is based on the life cycle-permanent income theory, does not reflect a structural link between consumption and income because the model does not address the way an individual's expectations are created. Hall's (1978) study, which came in the wake of this criticism, incorporated rational expectations in the life-cycle theory. A brief review of this, together with its empirical implications, follows.

Hall's point of departure was the usual assumption implicit in the life cycle-permanent income theory (henceforth PIH-RE) that a representative individual maximizes his expected utility over his lifetime, subject to the intertemporal wealth constraint. He also assumed that in conditions of uncertainty, consumers forecast the future rationally, i.e.:

(1) $$Max E_t \sum_{i=0}^{T-t} (1+\delta)^{-i} U(C_{t+i})$$

$$s.t. \sum_{i=0}^{T-t} (1+r)^{-i} (C_{t+i} - YL_{t+i}) = W_t$$

where

C_t = private consumption at period *t;*
E_t = expectations subject to information at period t;
T = lifetime of individual;
U = utility function of individual;
W_t = wealth excluding human capital at period t;
YL_t = disposable labor income at period t;
δ = rate of subjective time preference;
r = real rate of interest.

Thus, the utility function is separable, and it is also assumed that there is a specific utility function that is well able to represent the entire population. This formulation copes adequately with Lucas' criticism, as it assumes the existence of a representative individual with rational expectations which are incorporated explicitly in the model.

If the representative individual can lend and borrow at a real interest rate, *r* (i.e., the capital market is perfect), then the first-order condition obtained from the above maximization of equation (l) for two consecutive periods (t and t + 1) is

(2) $$E_t U'(C_{t+1}) = \left[\frac{(1+\delta)}{(1+r)} \right] U'(C_t)$$

If we assume that r = δ, and that the marginal utility (U') is a linear or log-linear function of consumption, we find that current consumption is the best predictor of consumption in the next period, i.e.:

(3) $$E_t C_{t+1} = C_t$$

So that the change in consumption is

(4) $$\Delta C_{t+1} = \varepsilon_{t+1}$$

where ε_{t+1} is the rational forecasting error which expresses additional information concerning a change in permanent income that was unknown at period *t*, i.e., $E_t\, \varepsilon_{t+1} = 0$. Hence, ε_{t+1} cannot be correlated with any variable at period *t*. Thus, the implication arising from the permanent income hypothesis with rational expectations is that a change in consumption at period *t*+1 is unforecastable at period *t*, and the change in consumption in accordance with equation (4) should therefore follow a random walk.

The 'random walk' hypothesis of consumption is based on the assumption that the real interest rate is constant. In order to obtain a general formulation of the Euler equation with rational expectations, which allows for changes in the real interest rate, we must assume the existence of an accepted utility function with a constant elasticity of intertemporal substitution, σ.[1] Thus, given the accepted assumptions about the distribution of consumption and the interest rate, it can be shown that the empirical relation between the rate of change of consumption ($\Delta logC_{t+1}$) and the expected interest rate is:

$$\Delta \log C_{t+1} = \alpha + \sigma E_t \log(1 + r_t) + \varepsilon_{t+1} \quad (5)$$

where $E_t r_t = i_t - \pi_t^e$ and: *i* is the nominal interest rate at period *t*; π_t^e is expected inflation rate at period *t*.

A number of studies, including Mankiw (1981) and Hansen and Singleton (1983), have dealt with this subject. Equation (5) above is based on Hall (1988). This expansion is important, because ignoring changes in the interest rate could establish a notional empirical relation between the rate of change of consumption and that of income (Campbell and Mankiw, 1989, p. 196), pointing to an apparent contradiction with the permanent income hypothesis. The expansion also facilitates the estimation of the elasticity of intertemporal substitution.

The positive relation between expected real interest at period t and the expected growth rate of consumption retlects only the substitution effect. The income effect, on the other hand, is expressed in a one-off rise in the level of consumption at period t. If the substitution effect was zero, at period $t + 1$, consumption would remain at the new level determined at period t, i.e., ΔC_{t+1}, would be zero. The substitution effect would work to reduce consumption to some extent at period t (at approximately its new level), and to increase it at period $t + 1$, i.e., ΔC_{t+1} is positively correlated with expected real interest at period t. Thus, at period t the interest rate has two opposing effects - a positive income effect and a negative substitution effect, and their relative intensity is an empirical issue.

The existence of an efficient capital market is important, since it enables the individual to act in accordance with the permanent income hypothesis (given the first-order condition noted above). Restrictions on lending or borrowing will reduce the individual's ability to use liquid assets to bridge consumption and current income paths, creating greater interdependence between the two. Such restrictions might be expressed in the need for special collateral (e.g., holding financial assets) in order to obtain loans. A large interest-rate spread could also reduce resort to the capital market.

Finally, when the behavioral model also incorporates saving for the precautionary motive, the theoretical relation between consumption and current income will be greater than in the classic permanent income model. Thus, when there is uncertainty with regard to income, risk-averse individuals (whose utility function is characterized by relatively constant risk-aversion) will tend to save at an earlier stage in the life-cycle than if there is complete certainty concerning income. This is because individuals need liquid assets in order to hedge against the possibility of a large temporary fall in income or in employment. In principle, were it not for these fears, individuals would prefer not to accrue assets but rather to maintain a higher standard of living. The result is that in a situation of this kind consumption follows income pretty closely, at least

[1] For example, $U(C_t) = C_t^\theta$ when $\theta = 1 - 1/\sigma$. The value $1/\sigma$ is usually regarded as an index or an individual's relative risk-aversion; the greater the risk-aversion, the smaller the elasticity of intertemporal suhstitution (see Hall, 1988. p. 343; Evans, 1983, p. 399).

at the beginning of the life-cycle. According to Modigliani (1996), the demand for saving because of the precautionary motive is increasing because of the substitution of savings in pension and national insurance funds for direct private wealth. This kind of wealth is not liquid, cannot be used as collateral for a loan, and hence cannot serve as a buffer stock.

3. AN EMPIRICAL EXAMINATION OF THE PERMANENT INCOME HYPOTHESIS

In this paper we present two alternative approaches to the empirical testing of the permanent income hypothesis in its new formulation (as suggested by Hall). The first approach is Hall's test and the second approach was suggested by Campbell and Mankiw (1989).

The following general remarks may be made about the estimation of the appropriate equations for each test.[2] The estimation was based on annual data for the period between 1963 and 2000. It was not possible to use quarterly data, mainly because they were not available for the various definitions of disposable income. Time-averaging problems may arise in the first order annual differences if individuals' decisions refer to continuous time, while the measurement averages larger units of time (e.g., a quarter or a year). The variables, which are essentially endogenous (e.g., income and interest), albeit with a one-year lag, may be correlated with the unexplained residual (e_t) in the consumption equation. In other words, there is a serial correlation between the residual (e_t) and the endogenous variables with a one-year lag which should serve as explanatory or instrumental variables. If that is the case, for annual data, legitimate instrumental variables must be lagged at least two years (for a detailed analysis, see Deaton, 1992, p.96; Campbell and Mankiw, 1989, p. 190). The solution proposed-using the instrumental variables with a two-period lag (t - 2)-is difficult to apply in the context of annual data, because this lag is too long for determining expected income (or any other endogenous variable) at period *t*. Nonetheless, since wage agreements in Israel are generally for a year, it is reasonable to assume that most of the decisions individuals make about consumption and saving are also on an annual basis. Hence, the results of the estimation given below are based on instrumental variables lagged both one and two years. The conclusions were generally quite similar, although when the instrumental variables were lagged two years the result was inevitably weaker.

All the equations are in the log-linear form customarily used in empirical research. In this specification it is easier to express the link between the propensity to consume and such variables as the interest rate and population composition. Unexpected changes in permanent income may also be greater at higher income levels, so that the rate of change of consumption is the most appropriate variable for the analysis.

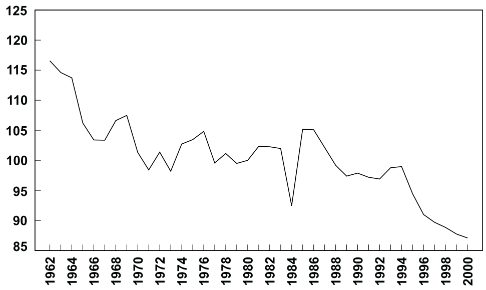
Private consumption, as measured by national accounts data, includes durables purchases, which actually constitute an investment by consumers rather than current consumption. Consequently, empirical studies of consumption generally explain private consumption excluding purchases of durables. Adjusted consumption sometimes also includes services imputed to durables.

[2] More specific comments, referring to each test individually, are included in the description of each one.

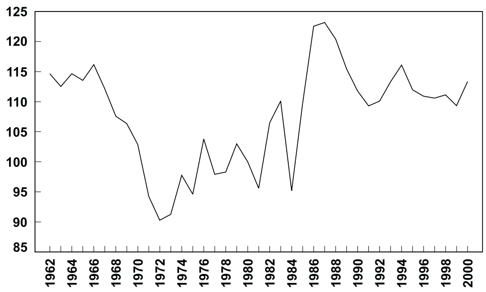
Note that according to the permanent income hypothesis, the ratio of consumption to disposable income should remain constant in the long run. During the 1960s there was a clear trend decline, as Figures 1 shows (which is based on total consumption). From the beginning of the 1970s to the mid-1980s this ratio remained aproximately constant in the long run. In 1984 and 1985, with accelerating inflation, the bank shares crisis, and the eventual implementation of the economic stabilization program (in the middle of 1985), there were extremely wide fluctuations in this ratio which created a break in this serie. Afterwards there was a mild reduction until the beginning of the 90's and then it stabilized in a higher level in the nineties (relatively to the seventies and the first half of the eighties). Relative to disposable wage income, there is also a reduction in the sixties and in the seventies until mid eighties; then it stabilizes, with fluctuations around the stabilization plan of 1985. Since 1984 there was a trend shift, when a decline began. In conclusion, the ratio of total consumption to disposable wage income was stable for a longer period and is a better candidate as an explanator for the consumption equations (see equation in reference 4). A similar picture is obtained when looking at consumption excluding durables relative to income (both total disposable income and wage disposable income).

Figure 1

a. Ratio of Total Consumption to Total Disposable Income , 1962–2000[a]



b. Ratio of Total Private Consumption to Disposable Wage Income , 1962–2000[a]



According to economic theory, the expected rate of return on assets should be included in the Euler equation for consumption. In the present article both the expected rate of return on shares *($\Delta lnPs$)* and the interest rate have been included. It is assumed that the expectations are adaptive, and so the expectations at period t - 1 are equal to the actual rate of return that year, i.e., $E_{t-1}\Delta lnPs_t = (\Delta lnPs_{t-1})$. A test shows that the rate of return on shares could have been reasonably predicted by means of instrumental variables, and this supports the contention that the transitory component is not dominant.

Poterba and Samwick offer another interpretation of the effect of the rate of return on shares (with a one-year lag) on private consumption, namely, the possibility that it serves as a kind of leading indicator for predicting economic developments, i.e., to some extent reflecting unexpected changes in income.

It is generally assumed that the short-term nominal interest rate is largely determined by monetary policy (with certain limitations, because of the size of the economy and its openness to international capital movements). Naturally, the shift from nominal to real interest depends on expectations of inflation, but monetary policy can still direct nominal interest to some extent so that it is more or less in line with the desired real interest. For that reason, real short-term interest (R) is also often treated as an exogenous variable that is determined to a great extent by monetary policy.

a. A broad Hall test

(i) A description of the test

According to the theory of permanent income with rational expectations as formulated by Hall, consumption today is the optimal forecast of consumption tomorrow. This is because all information relevant to the determination of permanent income, known today, is already embodied in the private consumption of today. Because of this, no other variables are able to contribute to the forecast of the next period's consumption. In other words, if we attempt to estimate an equation of the following form

(6) $$C_t = \alpha + \beta C_{t-1} + \gamma X_{t-1} + u_t$$

then according to the theory, $\gamma = 0$ must hold, where X_{t-1} is a vector of variables that express the information available at time *t*, which is relevant to the determination of expected income at the next period.

(ii) The results of the estimation

We start with the equations which closely resemble the original version presented by Hall (presented in Appendix 1). We have used it here mainly so that our results can be compared with Hall's. The main difference between our estimated equations and Hall's is that here empirical expression is also given to the possibility that the interest rate is not fixed. The results are partly inconsistent with the Permanent Income Hypothesis. Note that the wealth effect (at market prices) lagged by one year is found to be significant in every version of the equations. This effect is expressed through the real price of shares (P_{s-1}). Hall obtained similar results (1978), but believed that the wealth effect could be ignored since the quantitative contribution made by this variable to the explanation of the forecast of consumption is extremely small. In Israel, by contrast, it appears that the contribution of this variable to the explanation of consumption in the past was more important. Not too much should be made of the results of the equations in Appendix 1, however, because according to the most recent econometric theory, the t-test for the significance of an estimated parameter is valid only if the variables are stationary, and in the equations of this test (that we have estimated) the variables in general are I(1), so the t-test is invalid.

Flavin (1981), and many other researchers following her, formulated Hall's test slightly differently from the original (as expressed in equation 6 above). They focussed on the question: to what extent can changes in consumption be explained or forecast? In other words, they imposed a coefficient of 1 on lagged consumption. This formulation was not only more correct from a theoretical perspective, but was also superior from an econometric standpoint, since the dependent variable in this case (the change in per capita consumption) is stationary, Table 1 contains the results of estimating our equations using this method, with adaptations to satisfy the requirements of the recent econometric theory. That is to say, all the variables that appear in the estimated equations (that are in general first differences of a level) are stationary according to the Dickey-Fuller Test (hereafter referred to as DF). Therefore, the t-test for the significance of the estimated equations is valid. Thus, the estimated equations are of the following type:

$$(6.1) \qquad \Delta C_{t-1} = \alpha' + \gamma' \Delta X_t + u'_{t+1}$$

We also note that according to economic theory, the Euler equations that are estimated for consumption should contain the level of the return on assets, and not changes in the level. Thus, the rate of return on shares that is defined as the rate of change of the real price of shares *(lnPs)* is stationary, and raises no econometric problems. On the other hand, the real short-term interest rate on credit (R) and the two-year weighted average of it *(RA)* are I(1) in the period surveyed, and only their first differences are stationary; therefore, the first differences of these variables were used in the estimated equations.

The main results based on the estimated equations as presented in Table 1 are:

1. The change of wage income *(lnWD)* (lagged by one and two years) did not have a significant influence on consumption in most of the equations.
2. The elasticity of the return on shares (lagged by one year) was stable and significant, but small, in every version of the estimated equations. Elasticity with respect to the rate of return on shares was higher in general when durables purchases are included in consumption (elasticity increases from 0.04 to 0.06 in the equations based on the whole sample, and to 0.08 in the sample from 1963 to 1993).
3. The interest rate (its change, lagged by one year) was also significant. Significance was obtained in the equations based on the whole sample (mostly), with an elasticity of 0.09 both for consumption including and excluding durables. Note that this elasticity denotes intertemporal substitution, and that the larger this elasticity, the more effective will monetary policy be.

The results concerning the return on shares and the interest rate are similar to those already obtained in other countries. Thus, in his 1988 article (p. 340), Hall concludes that this elasticity is apparently less than 0.1. Campbell and Mankiw came to similar conclusions (1989). In a more recent study, Poterba and Samwick (1995, p. 336) found that the elasticity of the rate of return on shares is around 0.03. But in Israel we found that despite its low elasticity, the contribution of the return on shares to the explanation of the rate of change of consumption during was relatively large (Table 1). The contribution of both return on shares and interest rate together is about 40 percent on total consumption and 37 percent for consumption excluding durables (for the whole sample).[3]

As stated, the rate of return on shares is given with a one-year lag ($lnPs_{-1}$). Consequently, if at the same time (i.e., at period t - l) there were capital gains (a rise in share prices) which may have affected consumption (C_{t-1}), it should act to weaken the positive relation between $lnPs_{-1}$; and lnC_t. Hence, if the positive relation obtained between the rate of change of consumption and the rate of return on shares is biased, this is downwards.

The above results are consistent with the Permanent Income Hypothesis as formulated by Hall. If, however, we accept the possibility that individuals are assisted also by other variables in their estimate of the expected rate of growth of current income, then the results are ambiguous

[3] Based on a non-reported regression where the independent variables are both the rate of return on shares and real interest rate.

Table 1
Regression of Private Consumption (per capita) Rate of Change, Using Lagged Variables (Hall's Test, in its Broadest Interpretation)

Equation	Dependent		Explanatory variables[a]						Statistics		
no.	variable	Period	Const.	$\Delta \ln WD_{-1}$	$\Delta \ln WD_{-2}$	$\Delta\pi_{-1}$	ΔRA_{-1}	$\Delta \ln Ps_{-1}$	$adjR^2$	RMSE	D.W.
1.1	$\Delta \ln C$	1963–93	0.037	–0.038	–0.112		0.089	0.075	0.509	0.032	2.32
			(3.5)	(–0.3)	(–0.9)		(1.8)	(4.2)			
1.2		1963–00	0.036	–0.025	–0.162		0.089	0.060	0.394	0.033	2.13
			(3.74)	(–0.18)	(–1.41)		(1.61)	(3.56)			
2.1		1963–93	0.028	0.032	0.036	–0.000258	0.068	0.079	0.653	0.027	2.44
			(3.0)	(0.3)	(0.3)	(–3.4)	(1.6)	(5.3)			
2.2		1963–00	0.025	0.067	0.01	–0.000269	0.095	0.064	0.541	0.029	2.33
			(2.80)	(0.55)	(0.08)	(–3.40)	(1.96)	(4.32)			
3.1	$\Delta \ln CND$	1963–93	0.027	0.035	–0.029		0.068	0.040	0.328	0.024	2.30
			(3.4)	(0.3)	(–0.3)		(1.8)	(3.0)			
3.2		1963–00	0.031	0.047	–0.083		0.089	0.039	0.363	0.024	1.92
			(4.4)	(0.5)	(–1.0)		(2.2)	(3.2)			
4.1		1963–93	0.020	0.094	0.095	–0.000216	0.051	0.044	0.576	0.019	2.46
			(3.0)	(1.2)	(1.2)	(–4.0)	(1.7)	(4.1)			
4.2		1963–00	0.022	0.118	0.050	–0.000209	0.093	0.042	0.548	0.020	2.15
			(3.5)	(1.4)	(0.6)	(–3.8)	(2.8)	(4.1)			

[a] Figures in parentheses are t-values.

with respect to the Permanent Income Hypothesis. In this paper we used the change in the lagged inflation rate as an additional variable, and it was significant at a 1 percent level. Given that inflation was included in the equation with a one-year lag, this means that the inflation rate was known by the consumers, and consequently it should not affect consumption according to the Hall hypothesis.

Similar, albeit less significant, results were obtained when the instrumental variables were lagged two years.

In conclusion, our findings regarding the PIH-RE do not contradict in general the Hall hypothesis, excluding the result on inflation.

b. The Campbell and Mankiw test

(i) Description of the test

The results of Hall's test should either support or contradict the theory; an intermediate, neutral result is not possible.

Campbell and Mankiw (1989, henceforth C&M) formulated a more general test model that allows for different behavior between parts of the population of consumers. Therefore they assumed that the population of consumers comprised two groups:

Group A behaves in accordance with the Permanent Income Hypothesis and the change in its consumption (ΔC_{At}) is thus determined by unexpected changes in its permanent income (ε_{At}), i.e.

$$(7) \qquad \Delta C_{At} = \varepsilon_{At}$$

Group B sets the changes its consumption (ΔC_{Bt}) in accordance with changes in its current disposable income (ΔY_{Bt}), i.e.,

$$(8) \qquad \Delta C_{Bt} = \Delta Y_{Bt}$$

This behavior (of Group B) does not necessarily imply irrationality. For example, a liquidity constraint could prevent this section of the population from setting its consumption in accordance with its permanent income (see introduction).

What characterizes these groups at the margin is the different way each one sets up consumption. However, it is assumed (for the sake of simplicity) that the rates of change of income of the two groups are almost equal. Therefore, if the share of Group A's income is λ, then the aggregate consumption function of the total population (ΔC_t) will be a weighted average of the change in predictable current income and the unexpected change in permanent income which, by definition, is not forecastable. This is expressed in the next equation:

$$(9) \qquad \Delta C_t = \Delta C_{At} + \Delta C_{Bt}$$

$$= \varepsilon_{At} + \Delta Y_{Bt}$$

$$= \lambda \varepsilon_t + (1 - \lambda) \Delta Y_t$$

As mentioned above, if the interest rate and the rate of return on assets (for the sake of simplicity we include them together in one variable, r) are not fixed, they need to be added to the consumption equation (9) above (see also equation 5 in Section 2 above which describes the conceptual framework). In other words, we derive a general formulation of the Euler Equation for consumption, which is expressed as follows:

$$(10) \qquad \Delta C_t = \lambda \varepsilon_t + \theta r_{t-1} + (1-\lambda)\Delta Y_t$$

where $\theta = \lambda\sigma$ and σ is the intertemporal elasticity of substitution.

The estimation of the parameter (l - λ) in equations (9) and (l0) above gives concrete expression in a quantitative form to the amount of deviation from behavior implied by the Permanent Income Hypothesis, and hence its importance.

(ii) Estimation and results

Note that the equations in this test [(9) and (10)] cannot be estimated using OLS, since by Ordinary Least Squares the error term, ε_t, may be correlated with ΔY_t, or other explanatory variables. The solution is to estimate the equation by means of Instrumental Variables (I.V.). In order to examine whether the variables estimated are not biased, it is necessary to calculate the correlation between the instrumental variables and the unexplained residual obtained in the estimated equation using instrumental variables. If there is no relation, it can be assumed that the coefficients estimated are not biased (Saragan test). The null hypothesis in this test will be that the correlation between the unexplained residual and the instrumental variables is zero. If the critical value, χ^2 with K- I degrees of freedom, is greater than the calculated value of T x R^2, it will not be possible to reject the null hypothesis (T is the number of observations, and R^2 is the correlation coefficient; see C&M, 1989, pp. 189-190).

Table 2 gives the results of the estimation of the equations explaining the rates of change of private consumption per capita *(ΔlnC)*, as suggested by C&M (equations (9) and (10) above). The equations were estimated using TSLS. All the instrumental variables are lagged one or two years, so that individuals can use this information to estimate their expected income in the coming year. Including the variable $(C/WD)_{-1}$, among the instrumental variables is intended to express the process of income error correction (see, e.g., C&M, 1989, p. 193).

The main results are:

1. In accordance with equations (9) and (10), the coefficient of the rate of change of income should reflect the weight (in total income) of the group that determines the rate of change of its consumption according to the rate of change of its expected current income (as stated, this weight is denoted by (1 - λ) in equation 10). In the equations of total consumption, the coefficient estimated ranges from 0.5 to 0.67. In the equations of consumption excluding durables the coefficient ranges from 0.37 to 0.49. The estimates are always very significant, and almost always higher when estimated for the whole sample (until 2000). Similar results were obtained when the instrumental variables in the estimation were lagged two years. However, in one out of three equations for the whole sample, we obtained a coefficient of 0.8, which is much higher than the previously reported coefficients. C&M conclude their study by asserting that about 50 percent of the population in the US determines its consumption on the basis of current consumption (C&M, 1989, p. 195). Deaton, in his book on consumption (1992, p.

Table 2
Regression of Rate of Change of Private Consumption (per capita) on Forecastable Disposable Income and Rate of Return on Assets

Equation no.	Dependent variable	Period	Instrumental variable[a]	First stage regressions[b] ΔInC Eq.	First stage regressions[b] $\Delta InWD$ Eq.	Explanatory variables[c] Const.	Explanatory variables[c] InWD	Explanatory variables[c] $\Delta InPs_{-1}$	Explanatory variables[c] ΔRA_{-1} or ΔR_{-1} (see*)	Statistics adjR^2	Statistics RMSE	Statistics D.W.	Statistics Test of restrictions[d]
1.1	ΔInC	1963–93	$\Delta InWD_{-1}$, ΔInC_{-1}, $\Delta\pi_{-1}$, $\Delta InPs_{-1}$	0.595	0.557	0.112 (1.9)	0.519 (4.6)	0.066 (4.8)		0.667	0.0244	2.22	0.004 (4.2)
1.2		1963–00		0.471	0.506	0.009 (1.61)	0.502 (4.26)	0.054 (4.25)		0.633	0.0253	2.10	0.004
2.1		1963–93	$\Delta InWD_{-1}$, ΔInC_{-1}, $\Delta\pi_{-1}$, $\Delta InPs_{-1}$, ΔRA_{-1}	0.653	0.547	0.014 (2.7)	0.426 (4.2)	0.062 (5.1)	0.084 (3.1)	0.755	0.0212	2.56	–0.078 (3.2)
2.2		1963–00		0.541	0.493	0.010 (1.849)	0.485 (4.617)	0.048 (4.043)	0.099 (3.177)	0.717	0.0225	2.36	–0.098
3.1		1962–93	$\Delta\pi_{-1}$, $\Delta InPs_{-1}$, $In(C/WD)_{-1}$, ΔR_{-1}	0.669	0.656	0.0080 (1.3)	0.620 (5.7)	0.057 (4.2)	0.044* (2.0)	0.707	0.0238	2.48	0.03 (1.01)
3.2		1962–00		0.552	0.535	0.0037 (0.607)	0.665 (5.548)	0.044 (3.378)	0.056* (2.303)	0.651	0.0247	2.32	–0.113
4.1	$\Delta InCND$	1962–93	$\Delta InWD_{-1}$, $\Delta InCND_{-1}$, $\Delta\pi_{-1}$, $\Delta InPs_{-1}$	0.544	0.588	0.013 (3.2)	0.364 (4.7)	0.033 (3.6)		0.607	0.0169	2.37	0.1639 (5.2)
4.2		1962–00		0.439	0.528	0.015 (3.2)	0.375 (4.3)	0.034 (3.5)		0.569	0.0192	1.94	–0.059
5.1		1963–93	$\Delta InWD_{-1}$, $\Delta InCND_{-1}$, $\Delta\pi_{-1}$, $\Delta InPs_{-1}$, ΔRA_{-1}	0.556	0.573	0.015 (3.8)	0.315 (4.2)	0.0297 (3.2)	0.047 (2.3)	0.650	0.0160	2.57	0.1628 (5.0)
5.2		1963–00		0.549	0.513	0.015 (3.7)	0.367 (4.7)	0.0276 (3.1)	0.080 (3.4)	0.675	0.017	2.11	–0.130
6.1		1962–93	$\Delta\pi_{-1}$, $\Delta InPs_{-1}$, $In(CND/WD)_{-1}$, ΔR_{-1}	0.619	0.632	0.010 (2.3)	0.450 (5.6)	0.028 (2.8)	0.021* (1.3)	0.636	0.017	2.65	0.008 (0.3)
6.2		1962–00		0.531	0.523	0.010 (2.2)	0.493 (5.2)	0.026 (2.6)	0.038 (1.9)	0.556	0.019	2.24	–0.117

[a] The equations were estimated using TSLS.

[b] Adjusted R^2 (to degrees of freedom), where the instrumental variables are regressed on income or consumption using a normal OLS regression.

[c] Figures in parentheses are t-values.

[d] Adjusted R^2 (to degrees of freedom), where the instrumental variables are regressed on the unexplained residual: figures in parentheses are calculated values of χ^2 test (see equation in test).

216), maintains that most economists agree that in the equations explaining the rate of change of consumption, the coefficient of the rate of change of predictable income is about 0.4 percent. The results obtained in the present study seem on the whole to be consistent with those of the studies undertaken abroad. This result is surprising, because the financial markets in Israel are less perfect than those in the countries to which those studies relate, so that the effect of the liquidity constraint could have been expected to be greater in Israel. Such a result is in fact obtained when the equations are estimated by the cointegration method (see below).

2. The coefficient of the rate of return on shares (θ) obtained in this estimation is smaller than that in Table 1 (which fits HaII's test). The elasticity obtained in the equations for total consumption is in a range between 0.045-0.06, compared to a range between 0.065–0.075 in Table 1. Similarly, in the equations for consumption excluding durables, the elasticity is 0.03 compared with 0.04 in Table 1. In their article, C&M (1989) note that the elasticity of θ varies around 0.08 (Table 5, p. 202). The elasticity they estimated was in the framework of equations explaining the rate of change of consumption excluding durables. Hence, the elasticity they estimated is twice as large as that given here. This result may reflect the existence of a less-developed capital market in Israel relatively to the U.S. during most of the sample period.

3. The impact of the real interest rate (its change) with a one-year lag, which expresses the predicted interest rate, was found to be positive and significant, in accordance to theory (see equation 10 above). Its level was significantly higher when including durables in the measurement of consumption. This result is similar to the one obtained for the rate of return on shares.

4. Total disposable income (YD) was not found to explain consumption well (even in the equation estimated by the OLS[4] method), in contrast to disposable wage income, whose effect, as stated, was significant with a coefficient of between 0.4 and 0.5. This may reflect the liquidity constraint of wage-earners who, contrary to self-employed persons, do not face a liquidity constraint, and act in accordance with PIH-RE, so that the expected change in their income (which is included in total income) does not contribute to the explanation of the change in consumption (as HaII's test requires).

5. The equations given in Table 2 are based on the assumption that the parameter $1 - \lambda$, which measures the share of the population that determines its expenditure in accordance with its current income, is constant over time. In fact, the weight of this group may not be constant over several years. For example, if the behavior of this group does indeed reflect the liquidity constraints it faces, it is reasonable to assume that new immigrants to Israel will belong to this group, at least in the first few years after immigration, and so will alter the size of this parameter $(1- \lambda)$. In fact, as stated above, in almost all the estimations based on the whole sample until 2000 this parameter mildly increased.

6. We also examined the stability of the coefficients of the equation by means of dummy variables for each year in 1990-2000 (when there was large-scale immigration). From the equation below, for example (based on equation 2.2 in Table 2 with the addition of dummy variables), it can be seen that contrary to expectations, the effect of the dummy variables is

[4] The result obtained from the OLS estimation was

$$\Delta \ln C = \underset{(1.9)}{0.009} + \underset{(4.0)}{0.396}\,\Delta \ln WD + \underset{(1.5)}{0.140}\,\Delta \ln YD + \underset{(4.7)}{0.051}\,\Delta \ln Ps_{-1} + \underset{(3.6)}{0.119}\,\Delta RA_{-1}$$

$adjR^2 = 0.749$; RMSE = 0.0212; D.W. = 2.38

In this equation, even when the variable of disposable income (YD) was replaced by one of nonwage disposable income (YD-WD), its effect was not significant.

not significant for any year (excluding 1993), namely, the coefficients of the equation are stable; i.e., its change is not significant.

$\Delta \ln C$ =	0.008+	$0.602\Delta \ln WD$+	$0.06\ \Delta \ln Ps_{-1}$+	$0.05\Delta R_{-1}$	–0.01DUM90
	(1.1)	(4.7)	(3.5)	(1.9)	(–0.4)
	–0.007DUM91	–0.011DUM92	–0.014DUM93	+0.009DUM94	
	(–0.3)	(–0.4)	(–0.5)	(0.3)	
	+0.0026DUM95	-0.022DUM96	+0.014DUM97	–0.024DUM98	
	(0.8)	(–0.8)	(0.5)	(–0.9)	
	–0.001DUM99	–0.052DUM00			
	(–0.0)	(–1.9)			
$adjR^2$ =	0.608;	RMSE = 0.026;	D.W. = 2.32		

(The key to the symbols used in the equations appears at the end)

7. In all the equations we examined the extent to which the coefficients estimated are biased because a variable is omitted. As stated, the test of this is the existence of a correlation between the unexplained residual of the equation and the instrumental variables. The last column in Table 2 (Test of restrictions) gives the adjusted correlation coefficient for the residual of the equation, with the value calculated by the χ^2 test in parentheses beneath it. The results show that the possibility that the estimated coefficients are biased is rejected at a significant level in every case (the critical value for accepting the null hypothesis that the coefficients are biased is about 11, at the 5 percent level).

4. COINTEGRATION OF CONSUMPTION AND DISPOSABLE INCOME

a. General

The empirical results show that in Israel, as in other countries, consumption and wage income are cointegrative. Consequently, according Engel and Granger (1987), an error-correction mechanism mediates between consumption and disposable income. This means that the lagged deviation of consumption from its long-run relation with income (u_{t-1}) creates a dynamic process that maintains this relation. This can be captured in the following equation:

$$\Delta C_t = \alpha \Delta Y_t - \beta u_{t-1} + \varepsilon_t \tag{11}$$

where $u_{t-1} = C_t - \gamma Y_t$, u_t is stationary, as stated.
Similarly,

ΔC_t, is the change in private consumption at period t;
ΔY_t, is the change in disposable income at period t;
ε_t, is the forecast error at period t, which is white noise.

Campbell (1987) showed that consumption and income are cointegrated when the behavior of individuals fits the permanent income hypothesis.[5] However, Hall's version of the permanent income hypothesis with rational expectations requires a very specific dynamic process that imposes restrictions on the parameters of equation (11), so that $\alpha = \beta = 0$. This, then, is Hall's test, where is the unforecastable error. This means that the error-correction mechanism operates on saving and income, but not on consumption (Engel and Granger, 1987; Deaton, 1992, p. 125): when there are expectations of an increase in permanent income, consumption will rise as soon as the expectations are created, while current saving declines. When the expectations are realized and income rises saving will also increase. The existence of a relation between the change in consumption and that in income, in equation (11), can be consistent with rational behavior by individuals if, for example, it derives from a liquidity constraint that they face (C&M, 1989). If the liquidity constraint is absolute this contention does not explain the existence of the error-correction mechanism, denoted in equation (11) by the expression βu_{t-1}. However, if the liquidity mechanism is not absolute and reflects a process in which illiquid assets are converted into money, an error-correction mechanism may exist. In this case, changes in monetary policy can affect the process by which assets are liquidated (influencing its speed and price), and thus also the error-correction process. Another instance in which the behavior of individuals might be rational yet allow for error correction is the case of habit formation. In this case the individual's utility in the present is also affected by past consumption (for a utility function of this kind, see e.g., Carroll, Overland and Weil, 1994), and hence the utility function is not separable, as Hall assumes. In this case, it can be demonstrated that the change in current consumption is also affected by the lagged change in income and/or consumption, and an error-correction mechanism exists (see Deaton, pp. 99–100). This contention does not contradict rational behavior, but gives the life-cycle-permanent income theory a different interpretation.

b. Estimating dynamic consumption equations with an error-correction mechanism

The results of the tests presented above confirm considerable deviation from the PIH-RE theory in the way consumption is determined in Israel. It seems, therefore, that Campbell's claim (1987, p. 1256) concerning the problematic nature of using the first difference of the

[5] Campbell showed that in the framework of the permanent income hypothesis with rational expectations, and assuming a constant interest rate and infinite lifetime horizon of the individual, the following relation between per capita saving (S) and per capita income (Y)

exists: $S_t = \sum_{k=1}^{\infty} (1+r)^{-k} E_t \Delta Y_{t+k}$.

Assuming that the first difference of income is stationary (the stationarity of the first difference in consumption derives from the theory) and that the interest rate is constant, this equation indicates that the saving level is also stationary. Since saving is the linear combination of consumption and disposable income, there is cointegration between income and consumption. Hence, there is also an error-correction mechanism between consumption and income.

Table 3

Regression of Rate of Change of Private Consumption (per capita) in a Dynamic Equation[a] Based on a Cointegration Equation (see below)[b]

Equation no.	Dependent variable	Period	Instrumental variable[a]	First stage regressions[c]		Explanatory variables[d]					Statistics		
				ΔInC Eq.	ΔInWD Eq.	Const.	InWD	$\Delta InPs_{-1}$	ΔRA_{-1}	RES_{-1}	adjR^2	RMSE	D.W.
1.1	ΔInC	1963–93	O.L.S			0.006 (1.3)	0.633 (7.3)	0.053 (5.0)	0.056 (2.3)	–0.570 (–3.3)	0.841	0.0181	2.23
1.2		1963–00				0.005 (0.9)	0.637 (6.4)	0.042 (3.7)	0.071 (2.2)	–0.405 (–2.2)	0.744	0.0213	2.06
2.1		1963–93	$\Delta InWD_{-1}$, ΔInC_{-1}, $\Delta\pi_{-1}$, $\Delta InPs_{-1}$, ΔRA_{-1}, RES_{-1}	0.653	0.566	0.001 (0.2)	0.768 (4.9)	0.048 (4.0)	0.044 (1.5)	–0.744 (–3.0)	0.800	0.0189	2.09
2.2		1963–00		0.526	0.560	0.000 (0.0)	0.758 (4.0)	0.038 (2.9)	0.060 (1.6)	–0.559 (–2.0)	0.733	0.0218	1.96
3.1		1963–93	$\Delta InWD_{-1}$, $In(C/WD)_{-1}$, $\Delta\pi_{-1}$, $\Delta InPs_{-1}$, ΔRA_{-1}, RES_{-1}	0.692	0.663	0.004 (0.6)	0.705 (5.6)	0.050 (4.5)	0.050 (1.9)	–0.662	0.817	0.0184	2.15
3.2		1963–00		0.526	0.561	0.000 (0.0)	0.759 (4.0)	0.038 (2.9)	0.060 (1.6)	–0.559 (–2.0)	0.733	0.0218	1.96
4.1	ΔInCND	1963–93	O.L.S			0.010 (2.7)	0.445 (6.4)	0.027 (3.2)	0.038 (2.0)	–0.469 (–2.5)	0.752	0.0146	2.21
4.2		1963–00				0.014 (3.6)	0.385 (4.9)	0.028 (3.2)	0.074 (3.1)	–0.143 (–0.9)	0.676	0.0168	2.00
5.1		1963–93	$\Delta InWD_{-1}$, $\Delta InCND_{-1}$, $\Delta\pi_{-1}$ $\Delta InPs_{-1}$, ΔRA_{-1}, RES_{-1}	0.556	0.572	0.007 (1.2)	0.533 (4.5)	0.024 (2.7)	0.032 (1.6)	–0.619 (–2.5)	0.689	0.0151	2.05
5.2		1963–00		0.538	0.581	0.010 (1.6)	0.503 (3.4)	0.026 (2.7)	0.067 (2.5)	–0.302 (–1.3)	0.653	0.0174	1.94
6.1		1963–93	$\Delta InWD_{-1}$, $In(CND/WD)_{-1}$, $\Delta\pi_{-1}$, $\Delta InPs_{-1}$, ΔRA_{-1}, RES_{-1}	0.649	0.639	0.004 (0.9)	0.589 (5.3)	0.022 (2.4)	0.029 (1.4)	–0.714 (–2.9)	0.701	0.0157	1.94
6.2		1963–00		0.538	0.581	0.010 (1.6)	0.503 (3.4)	0.026 (2.7)	0.067 (2.5)	–0.302 (–1.3)	0.654	0.0174	1.94

[a] The equations were estimated using TSLS.

[b] The long-term equation, on which the error-correction equations above were based, is: In C/CND = Const. + In WD + In V_{-1} + $n20_{-1}$ see Table 3.1.

[c] See note b in Table 2.

[d] Figures in parentheses are t-values.

Table 3.1
Long-Term Equation of Private Consumption (per capita)

Period	Dependent variable	Explanatory variables				Statistics			
		Const.	InWD	InV_{-1}	$N20_{-1}$	$adjR^2$	RMSE	D.W.	D.F.
1962–93	InC	1.267	0.811	0.079	-0.009	0.992	0.027	1.76	–5.0
		(8.3)	(19.5)	(1.8)	(–4.1)				
1962–00		1.091	0.809	0.106	-0.009	0.994	0.028	1.44	–4.9
		(6.1)	(32.8)	(3.1)	(–3.4)				
1962–93	InCND	2.212	0.694	0.065	-0.005	0.994	0.020	1.65	–4.59
		(19.4)	(22.4)	(2.0)	(–3.6)				
1962–00		1.147	0.792	0.112	-0.012	0.992	0.027	1.35	–4.29
		(6.5)	(20.8)	(2.7)	(–4.6)				

consumption and income variables for estimating a dynamic equation (when the cointegration arises from the PIH-RE theory) is not relevant.

Theoretically (as explained above), in certain circumstances an error-correction mechanism may be at work for consumption, as well as for saving. Thus, using the cointegration system of estimation gives a fuller description of the way consumption is determined in the long run, as well as of the dynamic process in the short run.

The two-step estimation procedure was used: first the long-run equation was estimated, and the stationarity of the unexplained residual in the equation *(RES)* was examined. After that, the short-run equation was estimated, and the lagged residual (RES_{-1}) was included as an explanatory variable reflecting the error correction process. The dynamic short-run equation was estimated using TSLS. The instrumental variables used in this estimation are those that appear in the equations estimated for the C&M tests (Table 2). The objects of the general estimations discussed in Section 3 above are also relevant here.

The results of the estimation of the consumption equations are given in Tables 3 and 3.1.

The main findings of these estimations are as follows:

1. The coefficient of the rate of change of expected wage income is relatively high, around 0.7 in the equations explaining ΔlnC, and around 0.5 in the equations explaining ΔlnCND. Enlarging the sample until 2000 did not, in general, change the results (in the regression excluding durables the coefficient mildly decreases).
2. The elasticity of the rate of return on shares $(\Delta lnPs_{-1})$ *is* stable and relatively small-around 0.05 in the equations explaining ΔlnC in the 1963-93 sample, and 0.04 in the enlarged sample, In the equations explaining $\Delta lnCND$ the elasticity is even lower, around 0.025 and remained stable when enlarging the sample. The effect of a change in the interest rate (ΔRA_{-1}) was significant in the OLS estimation, while in the TSLS it was not significant. In contrast, in the equations excluding durables, when estimated using the enlarged sample, the coefficient is significant.

3. The process of adjustment (error correction), as expressed in the size of the coefficient of the lagged unexplained residual (RES_{-1}) is relatively quick, especially in the total consumption equations (ΔlnC). In the enlarged sample this coefficient decreased substantially. Since the long-run coeeficient was not affected by enlarging the sample, this result is specific to the process of adjustment. A possible interpretation of these results is that immigrants consumption path converged to the general population in the long-run, but it affected the process of adjustment during the nineties.
4. The effects of wealth (at renewal prices) and the 20-30 age-group (N20) are expressed only in the long run.
5. The long-run income elasticity is estimated between 0.8 (total consumption) and 0.7 (excluding durables) and is stable in the two samples.

5. SUMMARY AND CONCLUSIONS

Some of the empirical findings based on Hall's test seem to be inconsistent with the Permanent Income Hypothesis with rational expectations. The results of Campbell and Mankiw's test are unambiguous: a change in expected wage income has a significant effect on the change in private consumption with a coefficient of 0.5 percent. This means that about half of the population (with disposable income) seems to set its consumption on the basis of the change in its current income. This is a significant departure from the permanent income hypothesis, and may result from liquidity constraints facing this population; alternatively, it may be because the propensity to save is due to the precautionary motive, or because of both of these. The large interest-rate spread in Israel reinforces the assumption of an effective liquidity constraint.

The effect of the rate of return on shares is significant, although its elasticity is relatively small. The effect of the short-term interest rate is not significant in all the specifications of the equations. Nonetheless, these two variables explained 40 percent of the rate of change of total private consumption in 1963-2000, and 37 percent of the rate of change in private consumption excluding durables.

Using the cointegration method of estimation provides a fuller description of the way consumption is determined in the long run, and also describes the dynamic of the short-run process. This obtains assuming there are constraints and rigidities preventing the immediate adjustment of consumption to the desired long-term level, but if the consumption function is not separable (as in the case of habit formation), the gradual process of adjustment derives from the utility function. We found that in such cases the process of error correction is relatively rapid, as expressed in the size of the coefficient *of* RES_{-1} in Table 3. Wealth, at renewal prices, and demographic variables $(N20_{-1})$ do not influence the short-term dynamics, and affect only the determination of consumption in the long run.

Note, finally, the great importance of a change in the lagged inflation rate $(\Delta\pi_{-1})$ and the lagged rate of return on shares $(\Delta lnPs_{-1})$ as instrumental variables in explaining expected income (when the consumption equations were estimated using TSLS).

List of symbols used in tables:

ln	-	natural log of the variable that follows
Δ	-	first difference of the variable that follows
Δ^2	-	second difference of the variable that follows
C	-	private consumption per capita (real)
CND	-	private consumption (per capita, real), excluding durables
D.W.	-	Durbin-Watson statistic
GD	-	public domestic consumption per capita (real)
N20	-	proportion of population aged 20-30 in total population over the age of 20 (percentage)
P_s	-	real price of shares on stock market at end of year (index)
ΔlnP_s	-	real rate of return on shares
R	-	real rate of interest on short-term credit
RA	-	weighted average of R over past two years
$adjR^2$	-	explanatory coefficient adjusted to degrees of freedom
RES	-	unexplained residual from long-run consumption equation
RMSE	-	root mean square error
V	-	the wealth value of the private sector (stock at year-end, real)
WD	-	disposable wage income (per capita, real)
WT	-	world trade (quantitative index)
YD	-	private disposable income (per capita, real)
π	-	rate of inflation (percent)

Appendix Table 1
Regression of Private Consumption, Using Lagged Variables (Hall's Test), 1963–2000

Equation		Explanatory variables[a]								Statistics		
no.	Period	Const.	$InWD_{-1}$	$InWD_{-2}$	RA_{-1}	$InPs_{-1}$	$\Delta\pi_{-1}$	$N20_{-1}$	$InCnd_{-1}$	$adjR^2$	D.W.	RMSE
1.1	1963–93	–0.338	–0.300	0.116				0.00014	1.223	0.9875	1.87	0.029
		(–0.5)	(–1.5)	(1.1)				(0.1)	(4.8)			
1.2	1962–00	–0.274	–0.411	0.139				0.0008	1.298	0.994	1.93	0.028
		(–0.9)	(–2.6)	(1.4)				(0.3)	(7.8)			
2.1	1963–93	0.394	–0.119	0.119	0.091			0.000175	0.951	0.9901	1.783	0.026
		(0.6)	(–0.6)	(1.3)	(2.9)			(0.8)	(3.9)			
2.2	1962–00	–0.083	–0.282	0.112	0.068			0.0015	1.175	0.995	1.780	0.026
		(–0.3)	(–1.8)	(1.2)	(2.3)			(0.6)	(7.0)			
3.1	1963–93	0.300	–0.157	0.145	0.105	0.058		0.0056	0.927	0.9953	2.371	0.018
		(0.7)	(–1.2)	(2.3)	(4.8)	(5.4)		(3.4)	(5.4)			
3.2	1962–00	0.724	–0.165	0.102	0.092	0.055		0.0024	0.948	0.997	1.729	0.019
		(2.7)	(–1.4)	(1.5)	(4.2)	(5.4)		(1.3)	(7.3)			
4.1	1963–93	0.767	0.028	0.199	0.068	0.054	–0.00015	0.0038	0.725	0.9959	2.605	0.017
		(1.7)	(0.2)	(2.0)	(2.6)	(5.3)	(–2.2)	(2.2)	(4.0)			
4.2	1962–00	0.969	–0.017	0.086	0.068	0.055	–0.00014	0.0009	0.797	0.997	2.082	0.018
		(3.6)	(–0.1)	(1.3)	(2.9)	(5.8)	(–2.3)	(0.5)	(5.8)			
5.1	1963–93	0.691		0.123	0.068	0.054	–0.00014	0.0039	0.757	0.996	2.618	0.016
		(3.0)		(2.2)	(2.7)	(5.5)	(–2.6)	(2.6)	(9.6)			
5.2	1962–00	0.994		0.082	0.068	0.055	–0.00014	0.0009	0.782	0.998	2.081	0.018
		(5.4)		(1.5)	(2.9)	(6.0)	(–2.8)	(–2.8)	(11.4)			

[a] Figures in parentheses are t-values.

Appendix Table 2
Regression of Rate of Change of Total Private Consumption (per capita) on Forecastable Disposable Income[a] and Rate of Return on Assets, Using Instrumental Variables with Two Lags

Equation no.	Period	Instrumental variable[a]	First stage regressions[b] $\Delta lnWD$ Eq.	First stage regressions[b] $\Delta lnPs_{-1}$ Eq.	Explanatory variables[c] Const.	Explanatory variables[c] lnWD	Explanatory variables[c] $\Delta lnPs_{-1}$	Explanatory variables[c] ΔRA_{-1} or ΔR_{-1} (see*)	Statistics adjR^2	Statistics RMSE	Statistics D.W.	Statistics Test of restrictions[d]
1.1	1963–93	$\Delta lnWD_{-2}$, ΔlnC_{-2}, $\Delta\pi_{-2}$, $\Delta lnPs_{-2}$	0.245	–0.014	0.009	0.502	0.127		0.261	0.032	2.16	–0.075
					(1.0)	(2.7)	(2.6)					
1.2	1963–00		0.145	0.011	0.005	0.521	0.106		0.475	0.031	2.07	–0.049
					(0.5)	(2.5)	(2.4)					
2.1	1964–93	$\Delta lnWD_{-2}$, ΔlnC_{-2}, $\Delta\pi_{-2}$, $\Delta lnPs_{-2}$, ΔRA_{-2}	0.411	–0.052	0.012	0.460	0.096	0.074	0.526	0.025	2.35	–0.202
					(1.8)	(3.6)	(2.3)	(1.8)				
2.2	1964–00		0.278	–0.017	0.006	0.544	0.076	0.084	0.649	0.025	2.23	–0.158
					(0.8)	(3.9)	(1.9)	(1.9)				
3.1	1963–93	$\Delta\pi_{-2}$, $\Delta lnPs_{-2}$ $ln(C/WD)_{-2}$, ΔR_{-2}	0.302	0.026	0.003	0.652	0.126	0.044	0.251	0.035	2.25	–0.121
					(0.3)	(2.7)	(2.3)	(0.9)				
3.2	1963–00		0.203	–0.012	–0.007	0.802	0.109	0.693	0.255	0.036	2.19	–0.114
					(–0.5)	(2.6)	(1.9)	(1.2)				

[a] The equations were estimated using TSLS.

[b] Adjusted R2 (to degrees of freedom), were the instrumental variables are regressed on income or consumption using a normal OLS regression.

[c] Figures in parentheses are t-values.

[d] Adjusted R2 (to degrees of freedom), were the instrumental variables are regressed on the unexplained residual: figures in parentheses are calculated values of χ^2 test (see equation in text)

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