TESTING AN INTERTEMPORAL APPROACH MODEL OF THE PORTUGUESE CURRENT ACCOUNT*

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1. INTRODUCTION

This paper examines the degree to which a simple intertemporal approach model can explain the behaviour of the Portuguese current account in period 1958-1992. Most studies on the Portuguese economy in this field have favoured the intratemporal trade approach[1]. Here, on the contrary, we focus entirely upon intertemporal trade.

In recent studies on current account determination, this account has increasingly been interpreted as an outcome of forward-looking savings and investment decisions. Sachs (1981, 1982) and Greenwood (1983) first focused on this approach, while Frenkel and Razin (1987), among others, developed extensions to the basic model in several directions. Obstfeld and Rogoff (1995) and Razin (1993) deliver surveys of the theoretical and empirical studies in this area. The model here presented applies the "consumption smoothing" concept of Modigliani, Friedman and Hall to the problem of optimal external indebtedness of an open economy. One of the basic features of this model is that the current account adjusts for shocks of several types; as a result, agents smooth their consumption path intertemporally relative to the path of their income.

The model concludes that the current account balance equals the symmetric of the expected change in future net income (where the net income is defined as gross domestic product net of public expen-

diture and of investment). Hence, a country presents a current account deficit (surplus) whenever agents foresee an increase (decrease) in their net income. Intuitively, if the country expects net income to rise in the future, present savings should be lowered as against the accrued resources raised in the future, which will be reflected in a present current account deficit. If on the contrary agents expect a reduction in net income, the country shall incur in a current account surplus in the present, as to maintain the actual level of consumption in the future at a level which is consistent with the permanent-income hypothesis.

The remainder of this paper is structured as follows: section 2 presents the model on which recent empirical tests of the intertemporal approach applied to other countries are based upon (see Sheffrin and Woo (1990), Otto (1992), Gosh and Ostry (1993), Beyaert *et al.* (1994) and Gosh (1995)). Section 3 describes the econometric method utilised to test the model's implications. Section 4 refers the utilised data and sources. Results are presented in section 5. Section 6 draws the conclusions.

2. AN INTERTEMPORAL MODEL OF THE CURRENT ACCOUNT

Consider a small open economy which produces and consumes a single free-traded good. Free trade includes borrowing and lending in international capital markets. Only one financial asset — a bond — is assumed to be traded at a constant real yield r.

In real *per capita* terms, we have:

$b_t + 1$ — the stock of net external assets of the economy at the end of period t,

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(1) Much of this research has concentrated in estimating relationships between the current account balance and variables such as the exchange rate, gross domestic product, etc., aiming at calculating price and income elasticities.

Y_t — gross domestic product or output in period t,

NT_t — unrequited transfers in period t,

C_t — private consumption in t

G_t — current government expenditure in t, and

I_t — is investment in t.

The accumulation of net external assets of the economy — i.e., its current account CA_t— is given by:

$$CA_t = b_{t+1} - b_t = r.b_t + NT_t + Y_t - G_t - I_t - C_t \qquad (1)$$

The current account balance equals the sum of net external capital income, of net unrequited transfers and of the difference between domestic output and expenditure.

Although this economy can be temporarily indebted vis-à-vis the rest of the world, it cannot be indebted limitless and forever. The rest of the world will refuse to finance a Ponzi scheme. Iterating equation (1) forward, subject to the "no-Ponzi game" constraint, we obtain the intertemporal budget constraint facing the economy:

$$\sum_{i=0}^{\infty}\beta^{i+1}\big[C_{t+i} + G_{t+i} + I_{t+i}\big] = b_t + \sum_{i=0}^{\infty}\beta^{i+1}\big[Y_{t+i} + NT_{t+i}\big] \quad (2)$$

Equation (2) yields that the present-value of future expenditure of the economy must equal the sum of the initial stock of net external assets of the economy with the present-value of future income (of domestic output and unrequited transfers). The intertemporal constraint defines the set of plausible choices of the economy. To describe those situations where current account imbalances occur, firstly one needs to specify how expenditure and output are determined.

Consider that the representative agent living infinitely holds preferences of the following form:

$$U_t = E_t\left[\sum_{i=0}^{\infty}\delta^i u\big(C_{t+i}\big)\right] \qquad (3)$$

with parameter $\delta = 1 / (1 + \theta)$, where $0 < \theta < 1$ stands for the subjective marginal rate of discount. $u(.)$ is the instantaneous utility function. E_t denotes the expectations operator conditional on the agent's information set available at time t. A quadratic specification of instant utility function was chosen so as to obtain a reduced form of consumption.

The central planner maximises (3) subject to the intertemporal budget constraint of the economy (2)[2]. Assuming that the rate of discount (θ) equals the market's real interest rate (r) yields:

$$C_t = r\left[b_t + \beta\sum_{i=0}^{\infty}\beta^i E(NO_{t+i})\right] \qquad (4)$$

where NO_t = net income = $Y_t + NT_t - G_t - I_t$. The term in square brackets stands for the agent's wealth at time t. Permanent income — defined as the highest stream of consumption which is expected to be permanently sustained, given the future net income forecast — is simply r times wealth, since r is assumed to be constant in time. As in Hall (1978), planned consumption is constant at the permanent income level, yet the observed level of consumption will vary according to non-anticipated shocks to net income.

Substituting in (1) the optimal consumption path, given by (4), and rearranging we obtain:

$$CA_t = -\sum_{i=1}^{\infty}\beta^i E_t \Delta NO_{t+i} \qquad (5)$$

where

$$\Delta NO_{t+i} = NO_{t+i} - NO_{t+i-1} \qquad (6)$$

This equation shows that the current account equals the symmetric of the present-value of the expected changes in net income. A current account surplus will arise if agents expect future changes in national cash receipts to be negative. In contrast a current account deficit reflects expected increases in future national net income. Therefore the current account should be as good a predictor of future changes in national net income as any other currently dated variable. This is an easily testable implication of the model. This stands as the major advantage of the presented model which, despite very simple, comprises the main foundations of the intertemporal approach of the current account.

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[2] For simplicity, we present the derivation of the solution of the central planner problem, although competitive equilibrium yields similar results. The small open economy assumption, where the global interest rate is given, allows for output (Y_t) and investment (I_t) to be treated as exogenous to the consumption decision. In addition, also public expenditure (G_t) and unrequited transfers (NT_t) are assumed to be exogenous.

3. A FRAMEWORK FOR TESTING THE MODEL

The methodology here employed to test relationship (5) was developed by Campbell (1987) and Campbell and Schiller (1987). The test's steps can be summarised as follows [3]:

3.1 Stationarity of CA_t, conditional on the stationarity of ΔNO_t

We start from the assumption that net income (NO_t) is an integrated variable of order 1 (I(1)). If NO_t is I(1), then CA_t is stationary (I(0)), as it equals the present value of the expected decreases in No_t.

3.2 Granger-causality

A weak implication of equation (5) is that the current account should in general Granger-cause future changes in cash receipts. The intuitive explanation for this result is that CA_t is an optimal forecast for the weighted sum of future values of ΔNO_t, conditional upon the agent's total information set. If in addition to the past values for that variable, agents hold relevant information to predict ΔNO_t, than that information shall be reflected in CA_t. If agents do not hold that additional information, CA_t will be determined from an exact linear function of actual and past values of ΔNO_t.

It must be noted that Granger-causality does not necessarily mean that a cause-effect relationship is established between CA_t and ΔNO_t — as opposed to the classical concept of causality — solely indicating that changes in CA_t are former to changes in ΔNO_t. Consider for instance that a government change takes place, creating in agents the expectation for a net income reduction, due to a projected growth in public expenditure. A current account surplus will arise from agents' reaction, Granger-causing (i.e., preceding) a negative change in national cash receipts.

3.3 Strong tests

The Granger-causality test is a weak test of the theory. All restrictions of the current account intertemporal model deliver a more demanding test. Campbell (1987) shows that the restriction implicit in the present-value relationship (5) can be tested by regressing $\left[CA_t - \Delta NO_t - (1+r)CA_{t-1} \right]$ over the past values of ΔNO_t and CA_t. All coefficients of these variables must be nil if the strong implications of the model are supported.

This test can be generalised as to relax the assumption of no transitory consumption error in equation (5), should this error be orthogonal to all past information (including its own past values). This being the case, the test is based on the regression of $\left[CA_{t+1} - \Delta NO_{t+1} - (1+r)CA_t \right]$ over the lagged values of CA_t and ΔNO_t.

3.4 Informal test

Finally, $C\hat{A}_t$ can be defined as the prediction delivered by an unrestricted Vector Autoregression (VAR) for the present-value of future reductions in net income, using CA_t and ΔNO_t. A less formal way to evaluate the model consists of comparing the dynamic behaviour of CA_t and $C\hat{A}_t$. If relationship (5) holds, then $C\hat{A}_t$ equals CA_t except for a shock.

4. DATA AND STATISTICAL SOURCES

The empirical analysis uses data covering the period 1958-92. This is the period for which a complete and consistent set of relevant series of Portuguese national accounts can be ensured. Data was drawn from Santos *et al.* (1992) up to 1991. For 1992 we used the estimates released in the 1992 *Relatório Anual* of the Banco de Portugal. All series are valued at 1977 constant prices. To deflate the unrequited transfers and capital income series, we used the deflator of the trade balance, defined as the ratio of the sum of imports and exports of goods and services at current prices to the respective sum at constant prices. All series are presented in *per capita* terms, for which we utilised estimates for the resident population on 31 December every year, disclosed by the Instituto Nacional de Estatística.

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[3] See Manteu (1996) for a more detailed description of the test methodology of the model.

5. EMPIRICAL EVIDENCE

The first step of the test consisted of verifying if variables NO_t and CA_t exhibit the order of integration suggested by theory; for this purposed the ADF test proposed by Dickey and Fuller (1979) was used.

To use the ADF test, a regression was estimated with the following form:

$$\Delta X_t = \mu + \beta.t + \alpha.X_{t-1} + \sum_{i=1}^{p} \theta_i \Delta X_{t-i} + u_t$$

for every variable $X_t = CA_t$, NO_t, ΔNO_t, where t is a time trend and p is chosen so as to ensure that residuals are non-correlated. The ADF consists of testing hypothesis $\alpha = 0$ in this equation. Should this hypothesis be non-rejected, the series is said to contain a unit root — i.e., it is non-stationary. The critical values for the test (which depend on whether the regression includes a trend and/or a drift) can be seen in Fuller (1976). Table 1 presents the results. Charts 1 to 3 exhibit the relevant series. CA_t appears to be stationary at the 2.5 per cent level of significance. In contrast chart 2 clearly suggests that NO_t is non-stationary. In effect, the ADF test delivers a $\hat{\alpha}$ coefficient close to zero, with a t-ratio smaller than the critical value. This indicates that series NO_t is at least I(1) in levels. When ap-

plied to the series in first differences, the t-ratio exceeds the critical value but the estimated α is lower than -1 (when a value between -1 and zero should be expected). The plot of series ΔNO_t (chart 3) suggests that the estimate for the parameter is being affected by outliers, namely that recorded in 1974. To examine the sensitivity of the estimate to this anomalous observation, the ADF test was again carried out, this time including a dummy variable for 1974 in the regression. The result shows that the parameter estimate is now smaller than -1[4]. These results suggest that both the series of the Portuguese current account in levels and of the net income in first differences are stationary.

In the steady state, equation (5) yields $CA = -(1/r)\Delta NO$. Empirically, this implies that the sample mean of CA_t should average – (1/r) times the mean of ΔNO_t. Table 2 exhibits some statistics for variables CA and ΔNO. In the period considered, the average change of net income equals PTE 1.31 thousand, while the current account exhibits an average deficit of PTE 1.89 thousand. The figures clearly indicate that the model's

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(4) Note that, as the ADF critical value table does not include values for regressions encompassing dummy variables, in rigour we cannot evaluate the t-value for $\hat{\alpha}$ (which is not statistically different from that obtained in the regression with no dummies).

Table 1

UNIT ROOT TESTS

Series	p	t_β	t_μ	t_α	$\hat{\alpha}$	$P(4)$	Conclusion
CA_t.	1	-0.26	-1.44	-3.66[5%]	-0.64	0.99	I(0)
	1	-	-2.83	-3.71[2.5%]	-0.64	0.99	
NO_t	0	2.36	2.79	-2.33	-0.31	0.95	
	0	-	1.48	-0.03	-0.00	0.79	
	0	-	-	4.49	0.03	0.90	I(0)
ΔNO_t	1	-0.30	2.75	-4.93[1%]	-1.35	0.99	
	1	-	4.19	-5.02[1%]	-1.35	0.99	
	0	0.14	2.13	-6.15[1%]	-1.13	0.86	
	0	-	4.15	-6.25[1%]	-1.13	0.86	I(0)
	0[a]	-0.05	2.68	-6.11	-0.97	0.63	
	0[a]	-	4.86	-6.23	-0.97	0.63	

Notes:

"t_β," "t_μ" E "t_α" are the t-ratios of the estimated parameters . $\hat{\alpha}$ is the point estimator of the ADF statistic.

"P(4)" is the level of marginal significance of the Ljung-Box statistic for 4 lags. Values indicated with % are statistically significant, i.e., they allow for the rejection of the null hyphotesis at the indicated significance level. No trend and drift t-ratios are presented when these are not included in the regression.

(a) This regression includes a dummy equalling 1 in 1974 (zero otherwise).
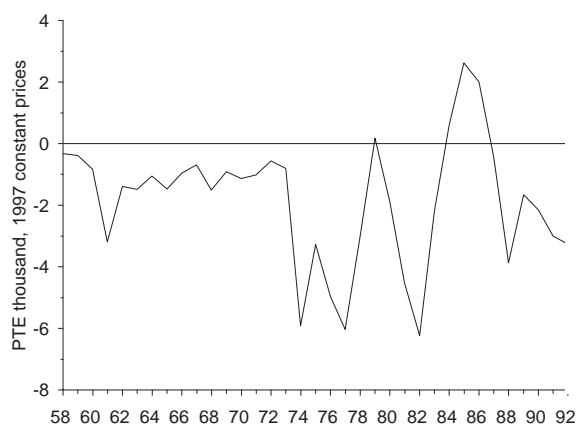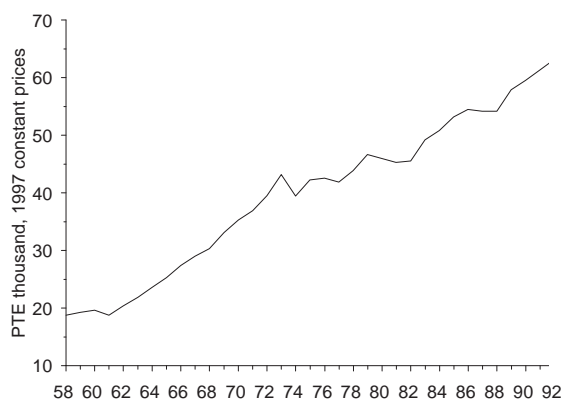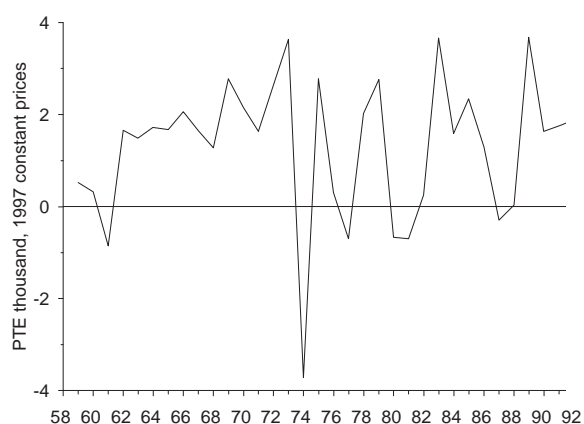
Chart 1
CURRENT ACCOUNT

Chart 2
NET INCOME

Chart 3
NET INCOME WITH A SIMPLE DIFFERENCE

Table 2

SUMMARY STATISTIC OF PORTUGUESE TIMES SERIES

	Mean	Standard deviation	Correlation	
			ΔNO_t	CA_t
ΔNO_t	1.31	1.52	1.00	0.52
CA_t	-1.89	2.04		1.00

est rate, this relationship would yield an average current account deficit clearly above that presented in table 2[5]. To overcome this problem, variables are de-meaned, as in Campbell (1987), Otto (1992), Sheffin and Woo (1990) and Ghosh (1995). Therefore, only the dynamic constraints of the present-value relationship are tested.

The following step consisted of estimating a VAR for ΔNO_t and CA_t, already in de-meaned terms. The results of the estimation and of the statistical tests shown in table 3, are organised as follows. The first column presents the coefficients of the regression for ΔNO_t on the independent variables of the VAR, while the second column includes the coefficients of the regression for CA_t over the same variables. Both regressions utilised the ordinary least squares method. The third column presents the results of the regression where the dependent variable is given by $D_t = \left[CA_t - \Delta NO_t - (1+r)CA_{t-1} \right]$ and the independent variables are the regressors of the VAR. All coefficients presented in this column should equal zero if the hypothesis of unpredictability of revisions to the expected value of future net income (with no transitory consumption) holds. The fourth column shows the results of the regression for $D_{t+1} = [CA_{t+1} - \Delta NO_{t+1} - (1+r)CA_t]$ over the same independent variables; again, all coefficients presented should also be equal to zero, if the hypothesis holds with no transitory consumption. It should be noted that a real interest rate must be

restrictions upon the means of the variables will be strongly rejected. Given the average value of ΔNO and, for any plausible value for the real inter-

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(5) The simplicity of the assumptions explains this unrealistic implication of the model. If, for instance, the infinite-life assumption was dropped, agents would not be able to become indebted offering as collateral the present value of all future net income flows of the economy.

Table 3

ESTIMATION RESULTS AND TESTS OF THE VAR (2)

	(1) ΔNO_t	(2) CA_t	(3) D_t	(4) D_{t+1}
ΔNO_{t-1}	-0.152 [0.508]	-0.617 [0.397]	-0.465 [0.185]	0.104 [0.253]
ΔNO_{t-2}	-0.006 [0.208]	0.169 [0.273]	0.175 [0.118]	-0.114 [0.128]
CA_{t-1}	-0.046 [0.386]	1.11 [0.356]	0.116 [0.135]	-0.353 [0.196]
CA_{t-2}	-0.164 [0.333]	-0.736 [0.314]	-0.572 [0.128]	-0.028 [0.161]
$\chi^2(4)$	3.702 (0.448)	17.329 (0.002)	51.35 (0.000)	34.857 (0.000)
(P)				

CA Granger-causes ΔNO at the 30.94 per cent level in column (1).

Coefficints in (3) are jointly significant at a significance level close to zero.

Coefficients in (4) are jointly significant at a significance level close to zero.

Statistics:

$$\sigma\left(\hat{CA}\right) / \sigma(CA) = 0.304$$
$$corr\left(\hat{CA}, CA\right) = 0.982$$

Note:

Regressions have no constant term. Heteroskedasticity-corrected standard deviations are in square brackets. The data are for the period 1961 to 1992.

specified if D_t and D_{t+1} are to be calculated. For simplicity we assume that r is known and is fixed at $r = 4$ per cent [6]. The table also presents the statistics of the Granger-causality tests between CA_t and ΔNO_t, and for the null hypothesis of coefficients in columns 3 and 4.
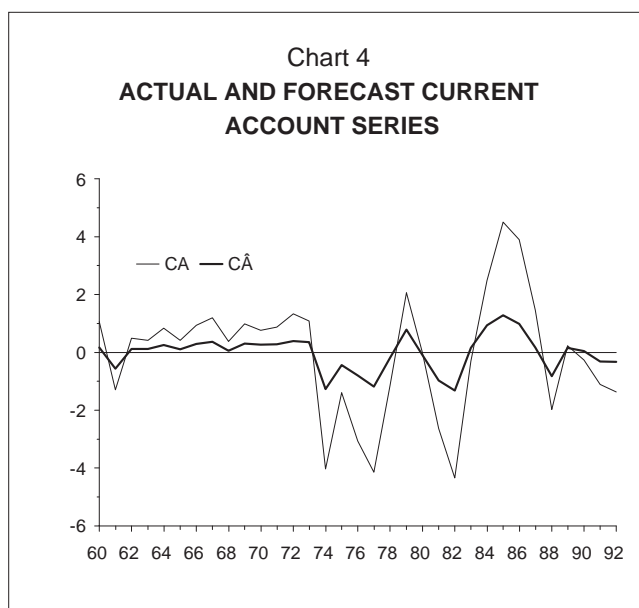
A weak implication of the model is that CA Granger-causes ΔNO. If agents hold additional information on the behaviour of net income (beyond that embodied in the past values of this variable), then the current account Granger-causes ΔNO. However, this implication of the theory is not supported by the data. The sum of the coefficients for CA in the equation of ΔNO is negative (-0.210), as expected. However, a stream of current accounts deficits (surpluses) above the average allow for a prediction of future increases (decreases) above average of net income only at the 31 per cent level of marginal significance. Though improbable, it is theoretically possible that agents do not hold additional information to predict the changes in net income beyond that comprised in the past time-series of net income itself.

The results presented in columns (3) and (4) indicate that the hypothesis of null coefficients for the past values of CA and ΔNO in regressions for D_t and D_{t+1} is rejected. This means that the strong implication of the model — that revisions to the expected value of net income are unpredictable — does not hold, whether or not transitory consumption is taken into account.

One can measure the importance of this rejection, by building a forecast for the present-value of future reductions in net income, $\hat{CA}$ by using the VAR estimates. The model will deliver a good approach to reality if CA (the observed series) and $\hat{CA}$ (the predicted series) behave similarly. Both series are presented in chart 4. The series $\hat{CA}$

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(6) Sheffrin and Woo (1990) and Otto (1992) take into account similar values for the real global interest rate in their research (4 and 4.04 per cent, respectively). Note that results upon real interest rates between 1 and 10 per cent were also obtained, and are much alike those of the $r = 4$ per cent assumption.

Chart 4
ACTUAL AND FORECAST CURRENT ACCOUNT SERIES

excessive capital mobility — in the sense that capital movements are dominated by speculative flows, not by economic fundamentals — hence contradicting the finding of Feldstein and Horioka (1980) according to which the observed movements in the current account are relatively small to be consistent with perfect capital mobility.

If the observed current account is highly volatile, this may suggest that consumption is quite smooth. This fact led Obstfeld and Rogoff (1995) to suggests that these results may be related to the paradox of Deaton (1986); this paradox results from the fact that, if the income series has a unit root, then the closed economy permanent income model stipulates that the changes in aggregate consumption must have a variance higher than that of income innovations, when empirical evidence indicates the opposite. The unit root hypothesis not only leads to a more volatile consumption than that observed — it also yields a less volatile current account series than the observed one.

simulates the dynamic behaviour in the series *CA*. This performance is in fact confirmed by the high correlation between both series (0.98). However, series *CÂ* does not simulate the magnitude of movements of *CA*: the standard deviation of series *CÂ* is quite lower than that of series *CA* (0.62 *versus* 2.05, respectively).

It should be noted that these results are similar to those obtained by other authors in empirical studies regarding other countries, using identical methodologies. For instance, Sheffin and Woo (1990) test the model for Belgium, Canada, Denmark and the United Kingdom, concluding that only for Belgium the formal assumptions of the intertemporal model are not rejected. Informal evidence suggests some adequacy of the model in the Danish case, but fails completely as regards Canada and the United Kingdom. However, for both Belgium and Denmark, the observed current account balance is more volatile than the projected series calculated by using the VAR estimates. Otto (1992) also rejects the formal constraint of the model for both USA and Canada. However, the predicted series is very close to the observed current account series in the USA, while the Canadian current account is much more volatile than the series generated by the model. Finally, Ghosh (1995) compares formally the variances of the projected current accounts in the USA, Japan, Germany, United Kingdom and Canada; except for the USA, the observed series always exhibits a higher variance. Ghosh interprets this finding as a proof of

6. CONCLUSIONS

According to the presented model, the current account equals minus the present-value of future changes in net income: if net income is expected to increase over time on average terms, the present current account will exhibit a deficit, since the representative agent will lower his actual savings vis-à-vis the future income he expects to earn. In contrast if future net income is expected to decrease, then a current account surplus will be recorded. It turns out that the current account is as good a predictor of net income's dynamic behaviour as any other forecast built upon the available information.

This study tests this implication of the model using yearly data for the Portuguese economy for the period 1959-1992. The current account series is compared to the forecast of the present value of future reductions in net income based on a VAR estimate for the current account and changes in net income. The comparison is made formally — calculating statistics for the hypothesis of equality between the actual and forecast series — but also at a less formal level — by comparing graphically

the dynamic behaviour of both series, their correlation and the ratio of the standard deviations.

The implications of the simple intertemporal model on the means of the variables are strongly rejected. For that reason, we only test the dynamic restrictions of the model. The empirical resuts show that the strong restrictions which result from the present value relation are also rejected. However, informal evidence indicates that the present-value model is able to track the direction of movements of the actual current account quite well, although it underestimates the size of those movements.

Extensions to the simple model should yield improved results. A suggestion of further investigation lies upon the consideration of some assumptions advanced by the consumption function literature so that the Deaton paradox is solved — for instance, the existence of habit mechanisms (Deaton (1986)) or of a share of agents facing liquidity constraints (Campbell and Mankiw (1989))[7].

In addition, the model assumes implicitly that all net income shocks are purely idiosyncratic. In reality, the dynamic behaviour of a country's domestic product or investment can be closely correlated to the corresponding behaviour of those aggregates in the rest of the world. Shocks which are perceived in all countries should, however, chiefly affect the global real interest rate, and not the countries' current accounts taken individually[8]. The clear-cut separation of these shocks, together with the abandon of the constant interest rate hypothesis, may become particularly relevant as regards a dependent economy — as is the Portuguese case[9].

Finally, given that we presented a one-good model, foreign trade only takes place as to smooth consumption intertemporally. Another investigation course to be developed may consist of dropping this assumption, and distinguishing between tradable and non-tradable goods (as in the models of Dornbusch (1983) or between exportable and importable goods (as in Frenkel and Razin (1988)). The model would then attribute a role to the real exchange rate and explicitly consider shocks in terms of trade, which certainly were important in determining the recent behaviour of the Portuguese current account.

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(7) Notice that Luz (1992) finds that in the period 1959-86 Portuguese consumers facing liquidity constraints held about 60 per cent of total disposable income.

(8) Note that the intertemporal model seems to fit developing countries better than industrialised countries. This conclusion can be drawn from comparing the evidence presented by Ghosh and Ostry (1993) — who tested the model for a wide sample of developing countries — with that presented by Sheffin and Woo (1990), Otto (1992) and Ghosh (1995) regarding industrialised countries. This is a somewhat unexpected finding, since capital markets in developing countries tend to be less open than in developed countries. A possible explanation to this fact can be related to the distinction between global and country-specific shocks. In fact, developing countries are more likely to be affected by specific shocks than by global shocks (Obstfeld and Rogoff (1995)), hence the presented model — which considers a constant real interest rate — fits those countries better.

(9) Glick and Rogoff (1992) present a model which explicitly distinguishes between shocks, and relates output and investment shocks to productivity shocks. The model is estimated for eight industrialised countries, revealing that in fact country-specific productivity shocks tend to worsen the current account, whereas global shocks have little effect. The application of this model to Portugal would be interesting. However, such is not feasible since we cannot calculate Solow residual productivity measures for the Portuguese economy.

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