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Wealth and Inflation Effects in the Aggregate Consumption Function

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by

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General Economics Division

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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

This paper examines some alternative specifications of the aggregate consumption function for eight OECD countries. Wealth effects are potentially important as determinants of consumption and as a transmission channel from monetary influences to real variables. However, measurement difficulties prevent direct incorporation of wealth in empirical work on consumption in many countries. Here, wealth effects are incorporated implicitly into estimated functions in a way that differentiates between indexed and non-indexed assets. Results indicate that, while inflation appears to affect measured consumption ratios in all countries examined, an interaction between inflation and interest rates that would be implied by wealth effects is not always present. The implications of different consumption functions are tested within a macroeconomic model, the OECD INTERLINK system. The response of output and consumption to standard fiscal policy shocks generally becomes smaller when inflation effects are included, and crowding-out is strengthened.

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Cette étude examine plusieurs spécifications possibles de la fonction agrégée de consommation pour huit pays membres de l'OCDE. Les effets de richesse sont potentiellement importants en tant que déterminants de la consommation et comme canal de transmission des influences monétaires sur les variables réelles. Cependant dans beaucoup de pays des difficultés de mesure empêchent d'incorporer directement la richesse dans les travaux empiriques sur la consommation. Ici, les effets de richesse sont incorporés implicitement dans les fonctions estimées selon une méthode qui différencie les avoirs indexés des avoirs non-indexés. Des résultats, il ressort qu'alors que dans tous les pays étudiés l'inflation semble affecter les ratios de consommation tels qu'ils ont été mesurés, on ne constate pas toujours l'interaction entre l'inflation et les taux d'intérêt qui devrait découler des effets de richesse. Les implications de différentes fonctions de consommation sont testées à l'intérieur d'un modèle macroéconomique, le système INTERLINK de l'OCDE. La réponse de la production et de la consommation à des chocs classiques de politique fiscale devient généralement plus faible lorsque l'on prend en compte les effets de l'inflation, et l'effet d'éviction est alors renforcé.

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WEALTH AND INFLATION EFFECTS IN THE AGGREGATE CONSUMPTION FUNCTION

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WEALTH AND INFLATION EFFECTS IN THE AGGREGATE CONSUMPTION FUNCTION

INTRODUCTION

1. It was observed in many countries during the 1970s that the ratio of aggregate consumption to household disposable income tended to fall when inflation rose. That was contrary to the predictions of most empirically estimated consumption functions available at that time. A number of reasons were advanced for the phenomenon but the most persuasive by far attributed it to a sort of wealth effect (1).

2. Inflation changes the real value of wealth stocks denominated in money terms, and changes in the rate of inflation generally do so in unanticipated ways. As the nominal interest rate is often slow to adjust when inflation rises, there will be a period in which creditors unexpectedly lose to debtors. A period of higher saving may then ensue as wealth holders restore the real value of their wealth. That effect would be temporary assuming that the real interest rate on outstanding debt was not indefinitely affected by inflation. However, the conventions of national income accounting are such that a permanent effect of inflation on saving would be observed in terms of recorded data. This is because holding gains and losses through the effect of inflation on money-denominated assets are not counted as income in the standard national accounts framework. If inflation rises and the nominal interest rate rises to compensate, preserving the same real interest rate, measured income will increase because the higher money interest payments on outside assets will be counted towards income while the faster erosion of money wealth will not be debited. Clearly in this situation real (price-adjusted) consumption will not change in the absence of money illusion, so that saving will apparently be higher (2).

3. This paper tests some alternative specifications of the aggregate consumption function which take account of these phenomena. A second aim is to obtain better equations for the OECD Secretariat's multi-country economic model, INTERLINK.

4. The objective of specifying the consumption function in a strictly comparable way for a number of countries provided a strong incentive to avoid, if at all possible, the use of explicit data for household wealth. These data are generally impossible to obtain for most countries. Where obtainable they are frequently difficult to "endogenise" satisfactorily in a model. Recorded data do not behave much like the result of perpetual inventory equations on national accounts saving, either because of errors in variables or valuation

effects (3). Sometimes consumption functions to which inflation is added perform better than those to which wealth terms are added (4). This may be because inflation has other effects than those via wealth but is also likely to be due to measurement errors in the wealth series.

5. This exercise also uses published national accounts data for consumption and income and does not adjust these to obtain more refined estimates of household saving such as those set out by Blades (5). Total consumption expenditure is used with no attempt to distinguish durables. Expenditure on durables is not available for some countries, and adjustments for the service stream from durables (to be added in principle to both income and consumption flows) can only be made on the basis of essentially arbitrary assumptions. Other problems to note are the consolidation of households and unincorporated enterprises accounts in most systems of national accounts, the arbitrary treatment of pension and life insurance transactions and the omission of any part of government health and education expenditures from household income (the "social wage"). Life insurance and pension funds are generally missing from available data on stocks of household wealth too.

6. The general strategy, in the absence of relevant data, was to try and reduce the problem by considering functional form rather than by manufacturing proxy data. Part I gives the derivation of the functions estimated; Part II reports the results of preliminary regression analysis and Part III shows the implications of incorporating such functions in the OECD world macro-model INTERLINK.

I. WEALTH AND CONSUMPTION

7. A necessary element in "wealth" explanations of why consumption should respond negatively to inflation is that households wish to maintain the value of wealth stocks -- excluding "human" wealth. One starting point for alternative specifications therefore is that households in the aggregate wish to maintain a stable relation between wealth and income. No explicit justification for this assumption is given on choice-theoretic grounds. It is, of course, preferable if a relation can be derived from an explicit model involving optimisation by economic agents, though the procedure is compromised if it ignores the effect of uncertainty and the problems of aggregation across disparate agents. Problems are compounded if data used do not correspond to theoretical constructs, as is true here. At any rate, a stable wealth/income ratio is a plausible equilibrium outcome of any rational decision-making process by households.

8. A stable relation between wealth and income can take a number of forms. It is also necessary to consider whether some, none or all of household wealth is in "real" assets which have some measure of <u>de facto</u> indexation against inflation. Gains from relative price shifts are ignored but there is assumed to be a class of assets whose price and yield have a high covariance with general inflation. (There is doubt whether such an assumption applies to equities in public companies but it probably applies to equity in houses.) Define A as the desired ratio of wealth (W.p) to income (Y.p) and L as the desired ratio of indexed wealth to the total, subject to $0<L<1$. In initial work, relative price changes are ignored, so that a common price

deflator can be used for both categories of wealth and income, hence W.p/Y.p = W/Y where the latter expression represents the ratio of income to wealth at some base-year prices. A number of alternative hypotheses are considered. The simplest hypothesis is that households want to maintain both a constant income to wealth ratio and a constant proportion of that wealth in real as opposed to money assets. Either A or L could be a function of the real interest rate, R, rather than a "behavioural constant". There are four possibilities:

$$A = \bar{A} \quad ; \quad L = \bar{L} \qquad [i]$$

$$A = a(R) \quad ; \quad L = \bar{L} \qquad [ii]$$

$$A = \bar{A} \quad ; \quad L = l(R) \qquad [iii]$$

$$A = a(R) \quad ; \quad L = l(R) \qquad [iv]$$

9. The ratio of indexed assets to total wealth might be a function of the real interest rate for two reasons. A component of the nominal return on real assets is simply the rate of inflation. The return on non-indexed financial assets (the majority of such assets in most countries) is the nominal interest rate. The more the latter exceeds expected inflation the more attractive relatively are financial assets. Secondly, there are valuation effects. A rise in interest rates reduces the market value of fixed-interest financial securities. While the stream of future payments is unchanged, liquidity is reduced. On the other hand, a rise in the interest rate increases the stream of future interest payments on new or floating-rate debt, raising the valuation of such debt for a given subjective discount rate. If there is an attempt to rebalance the wealth portfolio to correct for these valuation effects, the first would lead to increased acquisition of financial assets, reinforcing the direct interest-rate (substitution) effect; the second would go the other way. While theoretically the effect of the interest rate is therefore indeterminate there is some presumption that if anything it would tend to increase the share of financial assets. Similar arguments could be adduced to support the proposition that desired <u>total</u> wealth should be an increasing function of the real interest rate (so financial assets and consumption including durables are effectively substitutes). On the other hand, of course, higher interest rates raise the income of creditors and consumption may increase more than proportionately. In principle, the after-tax interest rate is relevant but no tax correction is made in view of the difficulty in measuring effective tax rates on interest income. It is assumed that tax rates are stable enough for this not to be a serious source of error.

10. Each of the hypotheses [i] to [iv] entails the assumption that the income elasticity of desired wealth is unity. As there is no particular basis for this assumption it is tested in empirical work against the somewhat weaker constraint that the desired wealth/income ratio tends asymptotically to some limit.

11. Define the operator D( ) as indicating the time derivative of a variable. As there is no change in the price of non-indexed wealth, the proportion of which is (1-L), then by the product rule:

$$D(W.p) = L(D(W)p + D(p).W) + (1-L).(D(W).p)$$

This is equivalent to:

$$D(W.p) = D(W).p + L.D(p).W \qquad [1]$$

i.e. the change in wealth is the change at constant prices plus the change in the valuation of that wealth which is not fixed in money terms.

12. Define s as the ratio of savings to (post-tax) income, both at constant prices, so by identity:

$$D(W).p = s.Y.p \qquad [2]$$

This means "saving" excludes changes in wealth owing to inflation; these also do not occur in the national accounts definition of income. On any of the alternative hypotheses a condition of steady-state equilibrium with a constant real interest rate is taken to be that the growth rates of wealth and income be equal:

$$D(Y.p)/Y.p = D(W.p)/W.p \qquad [3]$$

Given the particular definition of income used, excluding holding gains, this amounts to supposing a constant ratio of wealth to cash-flow or to income on a realisation basis rather than on an accrual basis.

13. Substituting [1] and [2] into [3] gives:

$$D(Y.p)/Y.p = s.Y.p/W.p + L.D(p)W/W.p = s/A + L.D(p)/p \qquad [4]$$

If n is the growth rate of nominal income in the steady state, [4] can be re-written as an expression for the savings ratio:

$$s = n.A - L.A.D(p)/p$$

14. Denoting D(p)/p as $\dot{p}$ and steady state or "permanent" real income growth as g (= n-p), an equation for the steady-state consumption ratio c* may be written:

$$c^* = 1-Ag - (1-L)A\dot{p} \qquad [5]$$

and it is clear that the consumption ratio, as defined, is negatively affected by inflation even in steady state, as long as $L<1$. The propensity to consume is also higher the lower the perceived growth rate and the higher is the proportion of indexed assets in wealth (6).

15. To derive an estimatable equation from [5] it is necessary to posit some dynamic adjustment scheme. If the steady state can be represented as $C^* = c^*Y^*$ where * indicates "permanent" or steady-state value, one possibility is to assume an error correction scheme:

$$\Delta c_t = a.\Delta c_t^* + b(c_{t-1}^* - c_{t-1}) \qquad 0 < a,\ b < 1$$

or, in levels:

$$c_t = (1-b)c_{t-1} + ac_t^* + (b-a)c_{t-1}^*$$

When c^* is represented as in [5] and A and L are expanded according to some combination of hypotheses [i] to [iv] this leads to a rather complicated equation. If, in the interests of simplicity c^*_{t-1} is eliminated, i.e. it is assumed that b=a, this gives:

$$c_t = bc^*_t + (1-b)c_{t-1} \qquad [6]$$

Substituting [5] into [6] and collecting terms yields:

$$c_t = b(1-Ag) - bA(1-L)\dot{p}_t + (1-b)c_{t-1} \qquad [7]$$

16. An alternative is to maintain a similar first-order adjustment for changes in the determinants of c^* but to allow consumption to respond to changes in disposable income *via* an error correction scheme which introduces a lagged term in Y_t. As g and $\dot{p}$ are relatively small numbers and $L < 1$, taking natural logs of [5] gives:

$$\ln C^* \approx -Ag - (1-L)A\dot{p} + \ln Y^*$$

And a particular dynamic adjustment scheme might be:

$$\begin{aligned} \Delta \ln C_t \approx b_0 &+ b_1(-Ag-(1-L)A\dot{p}_t) \\ &+ b_2 \Delta \ln Y_t \\ &+ b_1(\ln Y_{t-1} - \ln C_{t-1}) \end{aligned} \qquad [7']$$

As there is no theoretical presumption in favour of either adjustment model, both [7] and [7'] were estimated. The latter corresponds more nearly to a form that has become popular in the literature (7).

17. In either case, it is necessary to assume something about expectations. Equation [5] contains steady-state values of real income growth and inflation, which raises the question of how these are perceived by agents. Two strong assumptions are made. The elasticity of expectations with respect to inflation is supposed to be unity. This means people expect inflation in the current period to be what it was last period. This is a restrictive assumption but time-series analysis of price deflator series at semi-annual frequency indicates that in many countries, the series is quite close to a random walk in the first difference of the logarithm of the series. If inflation is a random walk, it is best predicted by its own past value. It is also supposed that the elasticity of expectations with respect to the real interest rate (R) is unity. Both these assumptions are made for simplicity; other formulations for expectations are to be considered in further work.

18. The simplest assumption for the elasticity of expectations with respect to real growth is to suppose it to be zero. This entails that people have a view of what is steady-state growth and do not change it in response to current period growth rates. Another possibility is to proxy steady-state growth by some moving average of actual growth rates. This is in the spirit of "permanent income" explanations of consumption which in practice use long moving averages of actual income to proxy permanent income. Both approaches were considered, with the former being preferred unless decisively rejected by the data.

19. The formulation in [7] or [7'] may be combined with any of the hypotheses [i] to [iv]. Here, the exercise is carried out for [7'] but results are parallel for [7]. It remains to specify a functional form for a(R) and l(R). The function a(R) is bounded below at zero but is, in principle, unbounded above; l(R) is bounded below at zero and above at unity. In theory they would both best be represented by non-linear curves with an inflexion point. Again in the interests of simplicity, an initial assumption was that both functions could be approximated over the observed range of R by a linear relation. Hence:

$$A_t = a_0 + a_1 . R_t \quad , \quad a_0 > 0 \quad , \quad a_1 \lesseqgtr 0 \qquad [8a]$$

$$L_t = l_0 + l_1 . R_t \quad , \quad 0 < l_0 < 1 \quad , \quad l_1 < 0 \qquad [8b]$$

Considering the most general case first and substituting [8a] and [8b] into [7'] gives:

$$\Delta \ln C_t = c_0 + c_1 \dot{p}_t + c_2 R_t + c_3 R_t . \dot{p}_t + c_4 R_t^2 . \dot{p}_t + c_5 \Delta \ln Y_t + c_6 \ln(Y_{t-1}/C_{t-1}) \qquad [9]$$

where:

$$c_1 = -b_1 a_0 (1-l_0)$$
$$c_2 = -b_1 a_1 g$$
$$c_3 = -b_1 (a_1 (1-l_0) - a_0 l_1)$$
$$c_4 = b_1 a_1 l_1$$
$$c_5 = b_2$$
$$c_6 = b_1$$

and $c_0 = b_0 - b_1 a_0 g$

where in steady state when C and Y are assumed to be growing at a rate g

$$b_0 = (1-b_2)g - b_1[(-Ag-(1-L)A\dot{p}) + \ln (Y_{t-1}/C_{t-1})]$$

but as $\ln Y_{t-1}/C_{t-1} = - \ln C_{t-1}/Y_{t-1}$, which in steady state $= (-Ag-(1-L)A\dot{p})$, the expression in square brackets vanishes to leave: $(1-b_2)g$. Hence $c_0 = (1-b_2 - b_1 a_0)g$.

20. The consumption ratio is thus a function of the interest rate, the inflation rate, and two interaction terms: the product of the inflation rate and the interest rate, and the product of the inflation rate and the square of the interest rate. If the "permanent" growth rate g is treated as a parameter the parameters of the underlying model are just identified; there are seven such parameters and seven estimable coefficients. Estimates of g can, in principle, be obtained and assessed for plausibility, though they will be non-linear functions of all coefficients and will have unknown but probably very large error variances. Alternatively, g can be treated as a variable if some hypothesis is used to generate data for "permanent" income growth. The system is then overidentified. The overidentifying restrictions can be imposed on the model during estimation and these restrictions tested for

compatibility with the data. That constitutes a joint test of the underlying model together with all the auxiliary hypotheses (including that used to generate g). Note that the relations [8a] and [8b] must be supposed to be non-stochastic or else there will be a serious errors-in-variables problem.

21. If the structural parameter a_1 is positive, the expected signs of coefficients in [9] are: c_5, $c_6 > 0$, c_1, c_2, c_3, $c_4 < 0$, l_1 being assumed always to be negative. In the event that a_1 is negative, c_2 and c_4 become positive and c_3 may be either positive or negative depending on the relative absolute values of $a_1(1-l_0)$ and a_0l_1.

22. If g can be treated as a constant a possible procedure is to estimate [9] and then to test against it the special cases [i] to [iii]. The special cases result in the following alternative equations for estimation.

<u>Case (i)</u>: In this case, both a_1 and l_1 are zero so that all terms in the interest rate are eliminated to give:

$$\ln C_t = c_0 + c_1\dot{p}_t + c_5 \ln Y_t + c_6 \ln(Y_{t-1}/C_{t-1}) \qquad [9i]$$

where, as before
$$\begin{aligned} c_0 &= (1-b_2-b_1 a_0)g \\ c_1 &= -b_1a_0(1-l_0) \\ c_5 &= b_2 \\ c_6 &= b_1. \end{aligned}$$

This system is underidentified with five parameters (including g) and three coefficients; a_0 and l_0 cannot be identified.

<u>Case (ii)</u>: In this case, l_1 is zero and [9] simplifies to:

$$\ln C_t = c_0 + c_1\dot{p}_t + c_2R_t + c_3'R_t\cdot\dot{p}_t + c_5 \ln Y_t + c_6\ln(Y_{t-1}/C_{t-1}) \qquad [9ii]$$

where coefficients are as before except:

$$c_3' = -b_1(a_1(1-l_0))$$

This system is just identified; values of g can be assessed for plausibility.

<u>Case (iii)</u>: In this case, a_1 is zero and [9] simplifies to:

$$\ln C_t = c_0 + c_1\dot{p}_t + c_3''R_t\dot{p}_t + c_5 \ln Y_t + c_6\ln(Y_{t-1}/C_{t-1}) \qquad [9iii]$$

where $c_3'' = b_1a_0l_1$. In this case there is no term in the real interest rate and the system is underidentified.

23. These hypotheses are nested in the order:

$$9 \rightarrow 9ii \rightarrow 9iii \rightarrow 9i$$

In principal a series of standard "F" test or likelihood ratio test can be used to select the hypothesis most consistent with the data. Various auxiliary hypotheses as to the values of g and l_0 may in some circumstances be tested jointly with the model via overidentifying restrictions.

24. In practice matters are not so simple. The assumptions that g, steady-state growth is constant and that A, the desired wealth/income ratio is not a function of income (or of time) should be tested. These hypotheses may, however, interact with the hypotheses [i] to [iv] about the form of A and L and there is no natural order in which to test the combined hypotheses. Other variables have also been found to be correlated with consumption. These include unemployment (affecting precautionary saving), variables proxying demographic or structural factors such as the proportion of the population that is economically active, and variables proxying credit conditions particularly in countries where the interest rate is controlled and poorly reflects the true cost and difficulty of borrowing. The choice between hypotheses [i] to [iv] above was found not always to be insensitive to the inclusion of such variables in equations. The most general specification possible embodying hypothesis [iv] a non-unit elasticity of A with respect to Y, a non-zero elasticity of expectations with respect to g and all possible auxiliary variables results in extreme multi-collinearity and is too complicated to estimate. The appropriate specification therefore has to be selected from among a large number of non-nested possibilities.

25. The rigorous testing of alternatives is not complete and preliminary results are reported below. However, a particular hypothesis to test is that the desired wealth/income ratio is constant for a constant real interest rate. This was tested by introducing the term $1/Y_t$ into equation [9], implying both that the consumption function in level form has a constant and that the desired wealth/income ratio is dependent on the level of Y_t. However, the desired ratio tends asymptotically to A as Y increases -- from above (below) if a_2 is positive (negative). Analogously, $1/Y_{t-1}$ is introduced into the error correction equation [9'] which implies that homogeneity between C and Y holds only asymptotically.

The Interaction of Inflation and Interest Rates: A digression

26. A consequence of hypotheses [iii] or [iv] is that the response of consumption to inflation depends on the level of the real interest rate. This is because the higher is the rate of interest, the greater will be the proportion of non-indexed assets in portfolios. Hence for example comes the term: $b_1 a_0 l_1 . R_t p_t$ in equation [9iii].

27. Differentiating the steady state consumption ratio:

$$c^* = 1 - Ag - (1-L)A\dot{p}$$

with respect to inflation gives:

$$\begin{aligned} dc^*/d\dot{p} &= -A + LA \\ &= A\,(l_0 + l_1 R - 1) \end{aligned}$$

and given hypothesis [iv], $$\begin{aligned} d(dc^*/d\dot{p})/dR &= Al_1 + (l_0+l_1R-1).dA/dR \\ &= Al_1 + (l_0+l_1R-1)a_1 \end{aligned}$$

As l_1 is negative, a_1 is positive and $(l_0+l_1R) < 1$ this confirms that consumption will be reduced more by inflation the higher is the real interest rate, if a_1 is positive. On hypothesis [iii] l_1 being negative is itself sufficient for the inflation effect on consumption to become greater with the real interest rate.

28. However, the above has treated the real interest rate as invariant to inflation. In general, when inflation falls (rises), the real interest rate rises (falls) and the effect is often long-lived. The endogeneity of the "real" rate builds in a feedback, because as inflation falls, depreciation of non-indexed assets falls, encouraging consumption, but the proportion of non-indexed assets rises with the real rate of interest, tending to raise the overall depreciation in portfolios. To explore this further, consider the case where the real rate varied by a proportion of the change in inflation, so:

$$dR/d\dot{p} = u, \quad (o < u < 1)$$

then $dL/d\dot{p} = l_1(u-1)$

and $dc^*/d\dot{p} = A(l_0-1 + l_1I - l_1\dot{p}(2-u))$ where I is nominal interest rates

The condition for a higher interest rate to increase inflation's negative effect now becomes:

$$I > (2-u)\dot{p} \text{ or } R > (1-u)\dot{p}$$

In steady state, u would generally be high ($\rightarrow 1$), so a positive real interest rate would suffice.

30. A consequence of this hypothesis is that if inflation fell at a time of high real interest rates, the rise in the consumption propensity would be particularly steep. This seems to be relevant to the experience of 1982/83 and may explain why this hypothesis seems to do relatively well in dynamic simulation experiments for the recent past (see below).

II. ESTIMATION RESULTS

31. Four equations, those numbered [9] to [9iii], were estimated in both ratio- and log-form specifications for eight OECD economies (the United States, Japan, Germany, France, the United Kingdom, Italy, Canada and Australia). The log form generally dominated the equations in ratio form so only the former are reported. A simple consumption function is also estimated for these countries, with the same independent variables as those of the model set out above but without any interaction terms. In the simple equation, the steady-state average consumption propensity depends on inflation and real long-term interest rates.

32. Estimation is by ordinary least squares. The estimation period is in principle from 1962:I to 1984:II, but varies somewhat across countries because of data availability. Periods are shown with the estimation results. In general it was not possible to reject at a high confidence level the hypothesis that additional variables, such as unemployment, were insignificant

so these variables were omitted to keep equations as uniform as possible across countries. Similarly the hypothesis that g, the expected growth rate, was a variable determined as a moving average of actual growth rates could generally be rejected on the basis of a "t" test and constant g was assumed. The detailed results, which are reported in Tables 1 to 8 which follow, are discussed below on a country by country basis. Data definitions and sources are given in the Annex.

33. <u>The United States</u> is one of three countries (United States, Japan and Germany) for which the hypothesis that the desired wealth to income ratio is not dependent on the level of income is rejected, i.e. a term in the inverse of income is significant. The model does not appear to be consistent with the data for the United States. In equation [9], the coefficients on the interaction terms are insignificant at the 5 per cent level (as is the coefficient on real interest rates (C_2)) and one coefficient (C_3) has an unexpected sign. This cannot be explained as a result of a negative value for the underlying parameter a_1 as then the coefficients C_2 and C_4 should also be positive. In the simple equation (S), inflation terms and real interest rates are well-determined and correctly signed among the regressors. In all equations the difference between income and consumption in the previous period is insignificant at the 5 per cent level. This is a disturbing result suggesting a unit root and mis-specification. Together with signs of residual autocorrelation it suggests the dynamic adjustment schemes posited in [1] and [1'] may be too restrictive (Table 1).

34. For <u>Japan</u> the model is a substantial improvement on the simple specification. Interaction terms have the expected signs and are generally significant. Goodness of fit deteriorates when any of the terms is omitted. As for the United States, the equation is improved by inclusion of the inverse of income variable, although this makes the interest rate term insignificant. Unlike the United States, in most equations the difference between income and consumption both lagged one period is significant at the 5 per cent level when the inverse income term is included (Table 2).

35. For <u>Germany</u>, the theoretical model does not fit the data very well. The inverse income variable is always significant with a positive sign. In equation [9], the interaction terms (C_3 and C_4) are not well-determined and C_4 has an unexpected sign. In equation [9iii], all coefficient estimates are well-determined and correctly signed but in terms of statistical properties the equation [9iii] is dominated by the simple equation without interaction terms (Table 3).

36. For <u>France</u> the inverse of income was never significant. In equation [9], all coefficients are well-determined but the interaction terms (C_3 and C_4) have unexpected signs and are inconsistent with the sign on C_2, according to the hypothesised model. In the simple, unconstrained equation, the inflation term is not well-determined and the coefficient on real interest rates is utterly insignificant (Table 4).

37. For the <u>United Kingdom</u>, coefficients on interaction terms are insignificant at the 5 per cent level or have the wrong sign. The simple equation again dominates the others in terms of goodness of fit. All coefficients in this unconstrained equation are well-determined and correctly signed in the ratio form. The U.K. data does not therefore support the model (Table 5).

38. For Italy, equation [9] has generally poorly-determined coefficients. Equation [9i] has well-determined, correctly-signed coefficients on all independent variables. But equation [9ii] has a number of insignificant coefficients (on real interest rates and interaction term) and one of these has an unexpected sign. In equation [9iii], all coefficients are correctly signed but the interaction term is insignificant. The unconstrained equation, also, has correctly-signed coefficients on all variables but the real interest rate is insignificant. The Italian data are consistent with a variant of the model in which interest rates have no effect on desired wealth holdings (Table 6).

39. For Canada, all coefficients have the expected sign, although some variables are insignificant at the 5 per cent level. For equation [9], the real interest rate and two interaction terms are insignificant as is the interaction term in [9ii]. In equation [9iii] all coefficients are well-determined. The simple equation also generates well-determined and correctly-signed coefficients but in the process of dropping variables some overall explanatory power is lost. The Canadian data seem to be consistent with the model outlined above, though it is not very strongly preferred to the simple equation. Collinearity of independent variables is a clear problem (Table 7).

40. The results for Australia fail to support the model. Equation [9] has an unexpected sign on real interest rates. Equation [9iii] has correctly-signed coefficients on all variables, but the interaction term is insignificant. In the simple equation all coefficients are well-determined and correctly signed and this equation again is slightly better than [9iii] or [9i] (Table 8).

Dynamic simulation properties

41. With the exception of France, each country's results in the log-form specification show at least two equations which satisfy expectations about parameter signs. For Japan and Canada, the specification with interaction terms is better than the simple one on statistical grounds, but in other countries the opposite is the case. The two best equations consistent with the hypothesized model plus the simple equation were simulated dynamically to check tracking performance in the sample period. The tested equations were [9i], [9iii] and [S] with $1/Y_t$ for the United States and Germany, [9], [9i] and [S] with $1/Y_t$ for Japan, [9i], [9iii] and [S] for the United Kingdom, Italy and Australia and [9], [9iii] and [S] for Canada. In France only [9i] and [S] were simulated. Two simulation periods are considered. One is the full estimation sample period and the other is the last five years. The results are presented in the form of root mean square errors (RMSE) in Table 9. The tracking performance of equations for all countries is not bad, and generally differences between equations are not large.

42. For the United States [9i] is slightly better over the full sample but much worse than [S] over the recent short sample. For Japan the full specification [9], dominates the others over the full sample and is similar for the recent past. For Germany [9iii] is slightly worse than [S] over the full sample but much better over the recent past. In the United Kingdom the simple equation is clearly best and the RMSE in recent years is larger than the full sample: the strong fluctuation in the savings rate in 1980 was

responsible because initial large errors were generated and cumulated in the following periods. In Italy [9i] is best. In Canada, as in Japan, [9] is best. In Australia [9i] is best for the recent past but is worst over the full sample where [9iii] is best. Generaly [9iii] dominates [S] reversing the ranking by regression results.

43. Generally, these tests confirmed the ordering by regression results. The hypothesized model, with A and L both being functions of interest rates, fits the data for Japan and Canada and is an improvement on a simple specification. It is an unequivocal failure for the United States and the United Kingdom. Some ambiguity is present in the other results. For Germany and Australia, regression results did not utterly reject a variant of the hypothesized model in which L, though not A, was a function of interest rates, but it was dominated by a simple equation without interaction terms, so that the model was not supported. In dynamic simulation, however, it performed better than the simple equation, on both long and short samples in the case of Australia and on a short recent sample in the case of Germany. For France and Italy, regression results indicte no effect of interest rates on consumption so that the data are not inconsistent with a simple form of the hypothesized model, but in this form it is indistinguishable from any other model in which inflation affects consumption -- for whatever reason.

III. POLICY SIMULATION TESTS

44. The comparison of RMSEs in dynamic simulation in combination with regression results is not always decisive in selecting an equation. Another important criteria is the performance of the equations when subjected to shocks in the context of a full macro-model and for this purpose, the OECD Secretariat model, INTERLINK, was simulated with each of these new consumption functions. The two shocks considered are an increase in government real non-wage consumption expenditure equal to 1 per cent of real baseline GDP with (I) constant money stock (non-accommodating monetary policy) and with (II) constant interest rates (accommodating monetary policy). Simulations were carried out over the period 1981:1 to 1985:2 and are reported in Tables 10 to 17 for both case (I) and (II) showing results for the standard existing model and three alternatives.

45. Generally speaking, the response of consumption to a fiscal shock becomes smaller than it was in the standard version of INTERLINK. Consumption in that version was determined by real disposable income and real interest rates with a common first-order adjustment process. The inclusion of inflation term(s) in the new equations is chiefly responsible for the change in properties. Country-specific observations are the following.

46. For the <u>United States</u>, the initial responses of consumption with non-accommodating monetary policy are quite weak with the new equations because of the inclusion of inflation effects. From the second year there is a negative response for both equation [9iii] and [S]. For [9i], which has no interest rate term, the negative response comes only in the fourth year while in the standard model consumption is positive throughout. The difference in the response of consumption as between alternative monetary policy assumptions is the smallest for equation [9i], and the simple equation shows much larger differences for the alternative monetary policy assumptions (Table 10).

47. The effect of these new equations on Japanese multipliers is marked. For equation [9], fiscal expansion with non-accommodating monetary policy soon has a negative effect on consumption because of real interest-rate and price movements. Indeed for equation [9] fiscal expansion, even with accommodating monetary policy, causes a decline in consumption after two years, due to price effects. With the simple equation price increases do not prevent consumption from increasing, as long as monetary policy is accommodating, and the difference in the response of consumption between alternative monetary policy regimes is therefore large. Both equations [9] and [S] result in inflation being stronger when monetary policy is accommodating in contrast to the perverse results with the standard model (Table 11).

48. With equations [9iii] and [S] the consumption response for Germany, with non-accommodating monetary policy, is negative after the second year. With the other equations the consumption response becomes weaker over time but stays positive throughout the simulation period. On the other hand, consumption responses with accommodating monetary policy become stronger with time with all three new equations and are similar to the standard model in the long run. Generally, for Germany, differences are small between different equations (Table 12).

49. For France, consumption responses to fiscal shocks with non-accommodating monetary policy are little different from standard with either new equation. The difference in response as between monetary policy assumptions becomes smaller than in the standard version because the new equations have either no interest rate term or a smaller coefficient than is imposed in the standard model (Table 13).

50. For the United Kingdom, the three equations generate rather similar responses for consumption to a fiscal shock with non-accommodating monetary policy. Consumption grows steadily over time relative to the baseline in each case. With equation [S] the difference in consumption responses owing to alternative monetary policies becomes wider than in the standard model. On the other hand, with the alternative equations it becomes narrower because of the absence of real interest effects or the small size of estimated interest-rate parameters (Table 14).

51. For Italy, the new consumption responses to a fiscal shock with non-accommodating monetary policy show peak effects in the second year. For equation [9i] the response is strongest because of the lack of the real interest-rate term and the simple equation has the smallest response, reflecting the direct impact of real interest rates. Consumption responses for the three equations with the alternative monetary policy assumptions are generally quite similar, all increasing with time (Table 15).

52. For Canada, the response of consumption with all three new consumption equations, given a fiscal stimulus with non-accommodating monetary policy, decreases with time but remains positive throughout the simulation period. The consumption response given the alternative monetary policy assumption, also increases with time (Table 16).

53. For Australia, the new equations generate rather similar responses to a fiscal increase with both monetary policy assumptions because the interest-rate response to non-accommodating monetary policy is negligible in the model. As compared to standard, the response of consumption is smaller given the inflation effect. The peak effect appears in the third year instead of the second year as in the standard model (Table 17).

IV. CONCLUSIONS

54. A model was hypothesized in which the effect of inflation on nominal wealth accounted for the tendancy of recorded aggregate consumption rates to move inversely with inflation. The model predicted that, if interest rates influence consumption, then interaction terms between inflation and interest rates should be significant regressors in the consumption function. Insignificant interest-rate terms do not imply a rejection of the model but significant interest-rate terms and insignificant interaction terms do imply a rejection. In the cases of France and Italy no convincing interest-rate effect on consumption was found so the model could not be subjected to an adequate test. The data for Japan and Canada appear to support the model, while those for the United States, the United Kingdom, Germany and Australia reject it. For the first two countries the rejection is decisive while for the latter two it is less so. It is tempting to conclude that in those countries where the model is rejected, valuation effects are not the reason for inflation's effect on consumption rates. However, that would be premature. The estimated equation necessarily embodied joint hypotheses. These include some probably counterfactual assumptions such as static expectations in inflation and an ad hoc and abbreviated dynamic specification. Data collinearity is also an intrinsic problem with the specification.

55. Whatever the explanation for inflation effects on consumption, they have strong implications for the properties of conventional macroeconomic models, often tending to reduce the size of multipliers in response to "real" shocks. Where inflation/interest-rate interactions are present these can greatly increase the impact on real demand of monetary variables, including policy instruments. The apparent size of the effects is such as to justify further empirical research into their robustness and reliability.

NOTES AND REFERENCES

1. See P. Sturm, "Determinants of Saving: Theory and Evidence", OECD Economic Studies, No.1 Autumn 1983.

2. P. Hill, "Inflation, Holding Gains and Saving", OECD Economic Studies No.2, Spring 1984.

3. J. Hibbert, "Measuring the Effects of Inflation on Income, Saving and Wealth", a report prepared for OECD and SOEC, 1983, gives such data as are available (annual frequency only) for a number of OECD countries. Pesaran, M.H. and Evans, R.A. "Inflation, Capital Gains and U.K. Personal Savings: 1953-1981", Economic Journal, June 1984, point out that the variance of the error component of wealth series calculated by perpetual inventory will rise over time.

4. See, for example, T. von Ungern-Sternberg, "Inflation and Savings: International Evidence on Inflation-Induced Income Losses", Economic Journal, December 1981, who used money stocks as a proxy for household wealth, arguing that as money is a nominal asset which is less unequally distributed than others, like bonds, it is less likely to yield aggregation biases in estimation of an aggregate equation. In the event, he found a wealth effect for the United Kingdom but not for Germany or the United States. Most studies, however, find significant inflation effects.

5. See D. Blades, "Alternative Measures of Saving", OECD Occasional Studies, June 1983.

6. If wealth is partly held in the form of money-denominated assets and partly as "real" assets whose price, however, can vary compared with the consumer price index, represented by p, this equation becomes:

$$c^* = 1 - qA(p+g-Lq)$$

where q is the relative price of wealth (the real asset in terms of the consumption good) and q is its change. When q = 1 and q = p, this collapses to [5]. This opens up another line of empirical research defining q as some weighting of the indices of house prices and equities.

7. See Davidson, J.E.H., Hendry, D.F., Srba, F. and Yeo, S., "Econometric Modelling of the Aggregate Time-series Relationship Between Consumers' Expenditure and Income in the United Kingdom", Economic Journal, 1978.

Table 1

THE UNITED STATES

$$\Delta \ln C = c_0 + c_1.\dot{P} + c_2.R + c_3.R.\dot{P} + c_4.R^2.\dot{P} + c_5 \Delta \ln Y + c_6(\ln Y_{-1} - \ln C_{-1}) + c_7\ 1/Y$$

Equation	c_0	c_1	c_2	c_3	c_4	c_5	c_6	c_7	$\bar{R}^2$	SEE	DW	LLF
9	0.060 (1.9)	-0.0038 (2.2)	-0.0015 (0.7)	0.00013 (0.8)	-0.000019 (0.7)	0.30 (2.3)	0.050 (0.5)	-21.2 (2.1)	0.613	0.0064	1.7	171.3
9i	0.018 (1.7)	-0.0018 (3.1)				0.46 (4.2)	0.12 (1.4)	-6.47 (1.5)	0.587	0.0066	1.4	168.1
9ii	0.072 (2.8)	-0.0045 (3.5)	-0.0028 (2.1)	0.00016 (1.1)		0.30 (2.4)	0.025 (0.3)	-24.6 (2.7)	0.617	0.0064	1.7	171.0
9iii	0.028 (1.8)	-0.0022 (3.1)		-0.000088 (0.9)		0.44 (3.9)	0.099 (1.1)	-10.3 (1.7)	0.586	0.0066	1.4	168.6
S	0.062 (2.6)	-0.0038 (3.4)	-0.0017 (2.0)			0.34 (2.8)	0.037 (0.4)	-21.5 (2.5)	0.617	0.0064	1.6	170.4

Notes:

1. Estimation period 1962:1 ∼ 1984:2. All equations are estimated by ordinary least squares.

2. $\dot{P} = ((PCP/PCP_{-1})^2 - 1)*100$
   $R = IRL - \dot{P}$
   PCP = deflator for consumption expenditure
   IRL = long-term interest rates
   C = real consumption expenditure
   Y = real disposable income.

3. $\bar{R}^2$ = adjusted R-squared
   SEE = standard error of estimation
   DW = Durbin-Watson statistic
   LLF = log likelihood function

4. Figures in parentheses are t-statistics.

Table 2

JAPAN

$$\Delta \ln C = c_0 + c_1.\dot{P} + c_2.R + c_3.R.\dot{P} + c_4.R^2.\dot{P} + c_5 \Delta \ln Y + c_6(\ln Y_{-1} - \ln C_{-1}) + c_7\ 1/Y$$

Equation	c_0	c_1	c_2	c_3	c_4	c_5	c_6	c_7	$\bar{R}^2$	SEE	DW	LLF
9	-0.00022 (0.0)	-0.0068 (3.3)	-0.0036 (1.3)	-0.00062 (3.1)	-0.000038 (3.4)	0.14 (0.9)	0.12 (1.1)	5.3 (3.1)	0.802	0.0081	1.6	89.8
9i	-0.072 (2.7)	-0.0020 (4.7)				0.51 (5.3)	0.24 (2.4)	5.0 (3.0)	0.714	0.0097	1.7	83.2
9ii	-0.051 (1.0)	-0.0034 (1.5)	-0.0020 (0.6)	0.000014 (0.2)		0.48 (3.6)	0.23 (1.8)	4.4 (2.1)	0.689	0.010	1.7	83.4
9iii	-0.074 (2.5)	-0.0022 (2.0)		-0.000010 (0.2)		0.52 (4.6)	0.25 (2.1)	5.1 (2.9)	0.699	0.010	1.7	83.2
S	-0.057 (1.5)	-0.0033 (1.6)	-0.0016 (0.6)			0.50 (5.1)	0.24 (2.4)	4.6 (2.5)	0.631	0.011	1.7	83.5

Notes: 1. Estimation period 1971:1 ∼ 1983:1.

2. See Table 1.

Table 3

GERMANY

$$\Delta \ln C = c_0 + c_1.\dot{P} + c_2.R + c_3.R.\dot{P} + c_4.R^2.\dot{P} + c_5 \Delta \ln Y + c_6(\ln Y_{-1} - \ln C_{-1}) + c_7\ 1/Y$$

Equation	c_0	c_1	c_2	c_3	c_4	c_5	c_6	c_7	$\bar{R}^2$	SEE	DW	LLF
9	-0.013 (0.9)	-0.0040 (1.8)	-0.0072 (2.9)	-0.0015 (1.2)	0.00032 (1.5)	0.57 (9.9)	0.41 (5.5)	6.2 (2.0)	0.849	0.0054	2.3	175.7
9i	-0.043 (3.1)	-0.0021 (3.1)				0.62 (9.5)	0.34 (4.2)	7.6 (2.3)	0.795	0.0063	1.9	167.1
9ii	-0.019 (1.4)	-0.0056 (2.9)	-0.0050 (2.5)	0.00023 (0.5)		0.57 (9.6)	0.41 (5.4)	6.0 (2.0)	0.844	0.0055	2.2	174.3
9iii	-0.033 (2.5)	-0.0011 (1.5)		-0.00066 (2.7)		0.61 (10.1)	0.33 (4.5)	5.1 (1.6)	0.823	0.0058	2.1	171.0
S	-0.021 (1.6)	-0.0046 (5.2)	-0.0041 (3.8)			0.57 (10.1)	0.39 (5.6)	5.6 (1.9)	0.847	0.0054	2.2	174.2

Notes: 1. Estimation period 1962:1 ~ 1984:1.

2. See Table 1.

Table 4

FRANCE

$$\Delta \ln C = c_0 + c_1.\dot{P} + c_2.R + c_3.R.\dot{P} + c_4.R^2.\dot{P} + c_5 \Delta \ln Y + c_6(\ln Y_{-1} - \ln C_{-1})$$

Equation	c_0	c_1	c_2	c_3	c_4	c_5	c_6	$\bar{R}^2$	SEE	DW	LLF
9	-0.0042 (0.2)	-0.0029 (2.9)	-0.0084 (2.6)	0.00059 (2.5)	0.000047 (2.1)	0.41 (4.5)	0.22 (2.1)	0.624	0.0073	2.3	150.9
9i	-0.037 (2.6)	-0.00046 (1.3)				0.46 (5.3)	0.30 (3.5)	0.585	0.0077	2.0	147.1
9ii	-0.018 (0.8)	-0.00133 (1.9)	-0.0033 (1.5)	0.00029 (1.5)		0.41 (4.3)	0.25 (2.4)	0.588	0.0076	2.3	148.4
9iii	-0.040 (2.3)	-0.00044 (1.2)		0.000020 (0.3)		0.47 (5.2)	0.31 (3.1)	0.574	0.0078	2.0	147.1
S	-0.034 (1.6)	-0.00053 (1.2)	-0.00019 (0.2)			0.46 (4.9)	0.28 (2.7)	0.574	0.0078	2.0	147.1

Notes: 1. Estimation period 1964:1 ∿ 1984:2.

2. See Table 1.

Table 5

THE UNITED KINGDOM

$$\Delta \ln C = c_0 + c_1.\dot{P} + c_2.R + c_3.R.\dot{P} + c_4.R^2.\dot{P} + c_5 \Delta \ln Y + c_6(\ln Y_{-1} - \ln C_{-1})$$

Equation	c_0	c_1	c_2	c_3	c_4	c_5	c_6	$\bar{R}^2$	SEE	DW	LLF
9	-0.0044 (0.5)	-0.0025 (2.5)	-0.0023 (1.2)	0.000045 (0.4)	0.0000016 (0.2)	0.52 (6.0)	0.30 (2.3)	0.560	0.0098	2.3	151.1
9i	-0.0038 (0.4)	-0.0011 (3.4)				0.47 (6.0)	0.16 (2.0)	0.568	0.0097	2.4	149.9
9ii	-0.0053 (0.6)	-0.0024 (2.4)	-0.0020 (1.3)	0.00020 (0.4)		0.52 (6.1)	0.30 (2.4)	0.570	0.0097	2.3	151.1
9iii	-0.0054 (0.6)	-0.0014 (2.3)		-0.000026 (0.6)		0.48 (6.0)	0.20 (2.0)	0.562	0.0098	2.3	150.1
S	-0.0060 (0.7)	-0.0024 (2.5)	-0.0017 (1.5)			0.52 (6.2)	0.30 (2.4)	0.579	0.0096	2.3	151.0

Notes: 1. Estimation period 1962:1 ~ 1984:2.

2. See Table 1.

Table 6

ITALY

$$\Delta \ln C = c_0 + c_1.\dot{P} + c_2.R + c_3.R.\dot{P} + c_4.R^2.\dot{P} + c_5 \Delta \ln Y + c_6(\ln Y_{-1} - \ln C_{-1})$$

Equation	c_0	c_1	c_2	c_3	c_4	c_5	c_6	$\bar{R}^2$	SEE	DW	LLF
9	0.010 (0.3)	-0.0013 (1.7)	-0.0023 (1.0)	0.000089 (0.6)	-0.00000089 (0.1)	0.40 (1.8)	0.084 (0.6)	0.341	0.013	1.5	109.6
9i	-0.020 (1.0)	-0.00099 (2.2)				0.48 (2.8)	0.19 (1.9)	0.372	0.013	1.6	108.7
9ii	0.010 (0.3)	-0.0013 (1.7)	-0.0025 (1.2)	0.00011 (1.1)		0.41 (2.2)	0.083 (0.6)	0.363	0.013	1.5	109.6
9iii	-0.021 (1.0)	-0.0011 (1.4)		-0.0000049 (0.1)		0.47 (2.6)	0.19 (1.6)	0.352	0.013	1.6	108.7
S	-0.018 (0.9)	-0.0014 (1.8)	-0.00052 (0.6)			0.43 (2.3)	0.20 (1.9)	0.360	0.013	1.5	108.9

Notes: 1. Estimation period 1964:1 ~ 1981:2.

2. See Table 1.

Table 7

CANADA

$$\Delta \ln C = c_0 + c_1.\dot{P} + c_2.R + c_3.R.\dot{P} + c_4.R^2.\dot{P} + c_5\Delta \ln Y + c_6(\ln Y_{-1} - \ln C_{-1})$$

Equation	c_0	c_1	c_2	c_3	c_4	c_5	c_6	$\bar{R}^2$	SEE	DW	LLF
9	0.0079 (1.0)	-0.0035 (2.9)	-0.00066 (0.3)	-0.00025 (1.6)	-0.000042 (1.7)	0.60 (6.8)	0.29 (3.8)	0.704	0.0073	1.7	164.9
9i	0.011 (1.9)	-0.0015 (2.9)				0.60 (5.8)	0.053 (1.0)	0.587	0.0086	1.7	155.6
9ii	0.017 (2.8)	-0.0045 (4.3)	-0.0030 (2.1)	-0.000097 (0.7)		0.59 (6.5)	0.28 (3.7)	0.691	0.0075	1.6	163.3
9iii	0.0095 (1.9)	-0.0026 (4.6)		-0.00030 (3.2)		0.57 (6.1)	0.18 (2.8)	0.664	0.0078	1.7	160.8
S	0.019 (3.6)	-0.0048 (5.1)	-0.0038 (4.0)			0.59 (6.7)	0.29 (3.8)	0.694	0.0074	1.6	163.0

Notes: 1. Estimation period 1962:1 ~ 1984:2.

2. See Table 1.

Table 8

AUSTRALIA

$$\Delta \ln C = c_0 + c_1.\dot{P} + c_2.R + c_3.R.\dot{P} + c_4.R^2.\dot{P} + c_5 \Delta \ln Y + c_6(\ln Y_{-1} - \ln C_{-1})$$

Equation	c_0	c_1	c_2	c_3	c_4	c_5	c_6	$\bar{R}^2$	SEE	DW	LLF
9	0.0042 (0.5)	-0.00083 (0.1)	0.0026 (0.9)	-0.00030 (1.1)	-0.000018 (1.3)	0.39 (4.6)	0.10 (1.2)	0.609	0.0062	1.7	117.1
9i	0.00076 (0.0)	-0.0015 (2.9)				0.36 (5.1)	0.16 (2.3)	0.559	0.0066	1.5	113.8
9ii	0.0078 (0.9)	-0.0019 (2.6)	-0.0013 (1.5)	0.00044 (0.7)		0.33 (4.4)	0.15 (2.0)	0.587	0.0064	1.6	116.0
9iii	0.0047 (0.6)	-0.0021 (2.9)		-0.000041 (1.3)		0.33 (4.3)	0.18 (2.4)	0.569	0.0065	1.7	114.7
S	0.0075 (0.9)	-0.0022 (3.4)	-0.00077 (1.9)			0.32 (4.4)	0.17 (2.4)	0.596	0.0063	1.7	115.7

Notes: 1. Estimation period 1969:1 ∼ 1984:1.

2. See Table 1.

Table 9

THE RESULTS OF DYNAMIC SIMULATIONS

Root mean square errors (per cent)

	Equation	Full sample	5 years
United States	9i	1.19	0.75
	9iii	2.22	0.55
	S	1.54	0.36
Japan	9	0.81	0.71
	9i	1.01	1.01
	S	1.01	0.94
Germany	9i	0.80	0.65
	9iii	0.67	0.41
	s	0.59	0.98
France	9i	0.98	0.26
	S	0.91	0.52
United Kingdom	9i	1.35	1.73
	9iii	1.32	1.81
	S	1.23	1.38
Italy	9i	1.87	1.39
	9iii	1.73	1.65
	S	1.82	1.60
Canada	9	1.12	0.41
	9iii	1.30	0.82
	S	1.15	0.64
Australia	9i	1.37	0.85
	9iii	0.91	0.96
	S	0.96	1.19

Table 10

MULTIPLIERS OF THE INTERLINK MODEL:
GOVERNMENT EXPENDITURE SHOCK

THE UNITED STATES

		Standard model		With equation 9i		With equation 9iii		With simple equation	
		I	II	I	II	I	II	I	II
GDPV	1	1.29	1.71	1.19	1.55	1.14	1.53	1.07	1.45
	2	1.04	1.90	0.82	1.43	0.71	1.34	0.59	1.27
	3	0.79	1.88	0.63	1.34	0.50	1.20	0.29	1.13
	4	0.62	1.88	0.47	1.29	0.32	1.10	0.04	1.02
	5	0.36	1.93	0.24	1.26	0.08	1.02	-0.27	0.92
CPV	1	0.41	0.56	0.26	0.36	0.20	0.33	0.08	0.24
	2	0.48	0.88	0.11	0.30	-0.07	0.19	-0.28	0.10
	3	0.37	0.94	0.03	0.27	-0.22	0.09	-0.59	-0.00
	4	0.32	1.07	-0.03	0.30	-0.35	0.05	-0.90	-0.06
	5	0.23	1.22	-0.12	0.34	-0.50	0.03	-1.22	-0.11
PCP	1	0.13	0.14	0.12	0.12	0.11	0.12	0.10	0.11
	2	0.55	0.64	0.49	0.55	0.46	0.54	0.42	0.51
	3	0.97	1.22	0.84	0.99	0.76	0.94	0.66	0.89
	4	1.38	1.81	1.17	1.14	1.04	1.31	0.84	1.24
	5	1.82	2.45	1.53	1.86	1.32	1.70	0.99	1.60
IRL	1	0.43		0.40		0.39		0.37	
	2	0.81		0.70		0.65		0.58	
	3	1.12		0.95		0.85		0.71	
	4	1.45		1.22		1.06		0.81	
	5	1.76		1.47		1.24		0.86	

Notes: 1. GDPV = real GDP
CPV = real consumption expenditure
PCP = consumption deflator
IRL = long-term interest rate

2. The shock was an increase in real government non-wage expenditure equal to 1 per cent of baseline real GDP.

I = non-accommodating monetary policy (unchanged money supply).
II = accommodating monetary policy (unchanged nominal interest rates).

3. Results show the deviation from baseline as a percentage of baseline (except IRL deviation from baseline as percentage point).

Table 11

MULTIPLIERS OF THE INTERLINK MODEL:
GOVERNMENT EXPENDITURE SHOCK

JAPAN

		Standard model		With Equation 9		With Equation 9i		With simple equation	
		I	II	I	II	I	II	I	II
GDPV	1	1.20	1.71	0.82	1.28	1.11	1.53	1.06	1.52
	2	1.25	2.41	0.53	1.47	1.06	1.91	0.95	1.92
	3	1.05	2.75	0.25	1.39	0.90	2.10	0.73	2.12
	4	0.76	2.80	0.04	1.34	0.68	2.12	0.49	2.15
	5	0.47	2.73	-0.09	1.28	0.46	2.08	0.26	2.10
CPV	1	0.52	0.72	-0.30	0.05	0.31	0.43	0.20	0.42
	2	0.77	1.36	-0.77	-0.06	0.35	0.65	0.12	0.65
	3	0.72	1.65	-1.11	-0.16	0.35	0.80	-0.02	0.82
	4	0.66	1.86	-1.33	-0.11	0.37	0.97	-0.13	1.00
	5	0.58	2.01	-1.45	-0.02	0.37	1.11	-0.22	1.15
PCP	1	0.15	0.15	0.08	0.10	0.13	0.13	0.12	0.13
	2	0.50	0.57	0.27	0.37	0.44	0.48	0.40	0.48
	3	0.80	0.99	0.38	0.59	0.70	0.81	0.63	0.81
	4	1.00	1.30	0.42	0.73	0.88	1.04	0.76	1.05
	5	1.15	1.59	0.42	0.86	1.02	1.26	0.86	1.27
IRL	1	0.44		0.29		0.40		0.38	
	2	0.76		0.38		0.65		0.60	
	3	0.97		0.41		0.84		0.73	
	4	1.11		0.39		0.97		0.82	
	5	1.20		0.36		1.06		0.86	

For notes see Table 10.

Table 12

MULTIPLIERS OF THE INTERLINK MODEL:
GOVERNMENT EXPENDITURE SHOCK

GERMANY

		Standard model		With equation 9i		With equation 9iii		With simple equation	
		I	II	I	II	I	II	I	II
GDPV	1	0.94	1.18	0.93	1.17	0.82	1.19	0.82	1.17
	2	0.93	1.51	0.84	1.39	0.65	1.45	0.64	1.46
	3	0.75	1.61	0.68	1.49	0.49	1.53	0.42	1.57
	4	0.50	1.56	0.48	1.49	0.34	1.51	0.22	1.53
	5	0.21	1.45	0.23	1.43	0.16	1.44	0.04	1.45
CPV	1	0.30	0.38	0.28	0.36	0.03	0.40	0.02	0.37
	2	0.42	0.66	0.21	0.42	-0.26	0.52	-0.28	0.56
	3	0.35	0.73	0.18	0.54	-0.35	0.59	-0.52	0.65
	4	0.27	0.76	0.17	0.66	-0.36	0.69	-0.65	0.71
	5	0.14	0.76	0.09	0.72	-0.39	0.74	-0.74	0.75
PCP	1	0.10	0.08	0.10	0.08	0.08	0.09	0.09	0.08
	2	0.48	0.43	0.46	0.41	0.39	0.42	0.39	0.42
	3	0.75	0.58	0.70	0.54	0.55	0.56	0.54	0.56
	4	0.92	0.58	0.85	0.54	0.64	0.55	0.60	0.56
	5	1.04	0.54	0.98	0.51	0.73	0.52	0.64	0.52
IRL	1	0.54		0.54		0.47		0.47	
	2	0.97		0.91		0.74		0.74	
	3	1.19		1.11		0.85		0.81	
	4	1.29		1.21		0.91		0.80	
	5	1.31		1.25		0.94		0.78	

For notes see Table 10.

Table 13

MULTIPLIERS OF THE INTERLINK MODEL:
GOVERNMENT EXPENDITURE SHOCK

FRANCE

		Standard model		With equation 9i		With simple equation	
		I	II	I	II	I	II
GDPV	1	1.20	1.37	1.14	1.31	1.14	1.30
	2	1.32	1.69	1.21	1.53	1.19	1.52
	3	1.17	1.73	1.10	1.58	1.07	1.57
	4	0.93	1.67	0.91	1.55	0.88	1.54
	5	0.66	1.56	0.67	1.46	0.65	1.45
CPV	1	0.37	0.43	0.30	0.34	0.29	0.33
	2	0.67	0.83	0.51	0.61	0.48	0.60
	3	0.69	0.96	0.57	0.75	0.53	0.74
	4	0.69	1.08	0.62	0.89	0.57	0.88
	5	0.66	1.17	0.62	1.00	0.56	0.99
PCP	1	0.02	0.00	0.02	0.00	0.02	0.00
	2	0.23	0.19	0.22	0.18	0.22	0.18
	3	0.46	0.40	0.43	0.37	0.42	0.36
	4	0.66	0.59	0.61	0.53	0.60	0.53
	5	0.84	0.75	0.78	0.68	0.77	0.68
IRL	1	0.28		0.28		0.27	
	2	0.48		0.45		0.45	
	3	0.65		0.61		0.60	
	4	0.79		0.75		0.74	
	5	0.90		0.86		0.84	

For notes see Table 10.

Table 14

MULTIPLIERS OF THE INTERLINK MODEL:
GOVERNMENT EXPENDITURE SHOCK

THE UNITED KINGDOM

		Standard model		With equation 9i		With equation 9iii		With simple equation	
		I	II	I	II	I	II	I	II
GDPV	1	0.87	0.89	0.82	0.83	0.82	0.84	0.83	0.85
	2	1.06	1.12	0.93	0.98	0.93	0.98	0.95	1.03
	3	1.10	1.22	0.93	1.02	0.93	1.02	0.97	1.10
	4	1.04	1.18	0.85	0.96	0.85	0.97	0.88	1.06
	5	0.92	1.08	0.76	0.88	0.76	0.89	0.78	0.98
CPV	1	0.32	0.33	0.20	0.20	0.20	0.21	0.22	0.23
	2	0.54	0.57	0.25	0.27	0.25	0.28	0.31	0.37
	3	0.65	0.73	0.29	0.33	0.28	0.34	0.36	0.49
	4	0.78	0.90	0.36	0.43	0.36	0.44	0.43	0.64
	5	0.84	0.99	0.44	0.53	0.44	0.56	0.48	0.75
PCP	1	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.00
	2	0.21	0.29	0.27	0.26	0.28	0.26	0.28	0.27
	3	0.71	0.68	0.63	0.61	0.63	0.61	0.65	0.63
	4	1.06	1.02	0.92	0.88	0.93	0.89	0.95	0.94
	5	1.25	1.19	1.07	1.01	1.07	1.01	1.10	1.08
IRL	1	0.05		0.04		0.04		0.04	
	2	0.13		0.12		0.12		0.12	
	3	0.22		0.19		0.19		0.20	
	4	0.28		0.24		0.24		0.25	
	5	0.31		0.26		0.26		0.27	

For notes see Table 10.

Table 15

MULTIPLIERS OF THE INTERLINK MODEL:
GOVERNMENT EXPENDITURE SHOCK

ITALY

		Standard model		With equation 9i		With equation 9iii		With simple equation	
		I	II	I	II	I	II	I	II
GDPV	1	0.77	0.81	0.75	0.79	0.75	0.78	0.74	0.78
	2	0.90	1.04	0.81	0.94	0.81	0.94	0.79	0.94
	3	0.79	1.07	0.68	0.93	0.67	0.92	0.66	0.93
	4	0.51	0.94	0.42	0.79	0.41	0.78	0.39	0.80
	5	0.17	0.75	0.13	0.62	0.12	0.61	0.09	0.64
CPV	1	0.23	0.24	0.17	0.17	0.16	0.17	0.14	0.16
	2	0.42	0.47	0.22	0.25	0.20	0.24	0.18	0.25
	3	0.42	0.54	0.16	0.24	0.14	0.23	0.10	0.25
	4	0.32	0.52	0.05	0.19	0.02	0.17	-0.03	0.22
	5	0.13	0.42	-0.08	0.12	-0.11	0.11	-0.18	0.16
PCP	1	0.04	0.03	0.04	0.03	0.04	0.03	0.03	0.03
	2	0.36	0.32	0.33	0.30	0.33	0.30	0.33	0.30
	3	0.86	0.79	0.80	0.73	0.80	0.73	0.78	0.72
	4	1.46	1.35	1.34	1.22	1.33	1.22	1.31	1.22
	5	2.02	1.86	1.83	1.67	1.81	1.66	1.78	1.67
IRL	1	0.16		0.16		0.15		0.15	
	2	0.38		0.35		0.35		0.34	
	3	0.58		0.53		0.53		0.52	
	4	0.76		0.68		0.67		0.66	
	5	0.88		0.79		0.78		0.76	

For notes see Table 10.

Table 16

MULTIPLIERS OF THE INTERLINK MODEL:
GOVERNMENT EXPENDITURE SHOCK

CANADA

		Standard model		With equation 9		With equation 9iii		With simple equation	
		I	II	I	II	I	II	I	II
GDPV	1	1.01	1.11	0.94	1.11	0.93	1.07	0.94	1.08
	2	1.04	1.21	0.83	1.20	0.80	1.06	0.81	1.09
	3	0.97	1.16	0.64	1.09	0.67	0.98	0.68	1.05
	4	0.85	1.07	0.45	0.94	0.54	0.87	0.52	0.97
	5	0.71	1.00	0.30	0.89	0.40	0.82	0.36	0.91
CPV	1	0.44	0.47	0.30	0.47	0.28	0.38	0.30	0.41
	2	0.73	0.78	0.30	0.76	0.24	0.50	0.27	0.54
	3	0.88	0.96	0.20	0.83	0.25	0.59	0.26	0.73
	4	1.04	1.16	0.10	0.90	0.27	0.70	0.25	0.91
	5	1.13	1.31	0.05	1.05	0.27	0.84	0.19	1.06
PCP	1	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
	2	0.34	0.35	0.31	0.35	0.30	0.32	0.31	0.33
	3	0.55	0.56	0.46	0.55	0.46	0.50	0.46	0.51
	4	0.72	0.71	0.56	0.68	0.57	0.61	0.58	0.64
	5	0.86	0.80	0.62	0.74	0.66	0.67	0.65	0.72
IRL	1	0.13		0.12		0.12		0.12	
	2	0.25		0.23		0.23		0.23	
	3	0.37		0.32		0.32		0.32	
	4	0.47		0.38		0.39		0.39	
	5	0.56		0.43		0.45		0.45	

For notes see Table 10.

Table 17

MULTIPLIERS OF THE INTERLINK MODEL:
GOVERNMENT EXPENDITURE SHOCK

AUSTRALIA

		Standard model		With equation 9i		With equation 9iii		With simple equation	
		I	II	I	II	I	II	I	II
GDPV	1	1.27	1.28	1.18	1.18	1.16	1.17	1.16	1.17
	2	1.39	1.42	1.19	1.20	1.18	1.19	1.18	1.20
	3	1.37	1.43	1.17	1.19	1.15	1.17	1.17	1.19
	4	1.24	1.22	1.05	1.06	1.00	1.02	1.05	1.07
	5	0.99	1.10	0.84	0.86	0.79	0.80	0.86	0.88
CPV	1	0.36	0.36	0.21	0.21	0.18	0.19	0.18	0.19
	2	0.64	0.66	0.31	0.32	0.29	0.30	0.29	0.31
	3	0.68	0.71	0.32	0.33	0.29	0.30	0.32	0.33
	4	0.76	0.80	0.34	0.34	0.26	0.27	0.34	0.36
	5	0.68	0.75	0.26	0.26	0.15	0.16	0.27	0.29
PCP	1	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	2	0.15	0.15	0.13	0.13	0.13	0.13	0.13	0.13
	3	0.42	0.43	0.38	0.38	0.38	0.38	0.38	0.38
	4	0.85	0.86	0.75	0.76	0.74	0.75	0.75	0.75
	5	1.38	1.41	1.21	1.22	1.19	1.20	1.20	1.21
IRL	1	0.05		0.04		0.04		0.04	
	2	0.11		0.04		0.04		0.04	
	3	0.16		0.04		0.04		0.04	
	4	0.25		0.04		0.04		0.04	
	5	0.34		0.04		0.04		0.04	

For notes see Table 10.

Annex

DATA SOURCES

CPV Real consumption expenditure
Source: OECD National Accounts

IRL Long-term interest rates, semi-annual average of monthly series
Source: OECD Main Economic Indicators and Financial and Fiscal Affairs Directorate

United States:	Yield on Corporate Bonds (ten years and over)
Japan:	Telephone and Telegraph Bond Yields
Germany:	Public Sector Bond Yield (total)
France:	Yield on Public and Semi-Public Sector Bonds
United Kingdom:	20-year Government Bond Yield
Italy:	Private Sector Bond Yield
Canada:	Long-term Government Bond Yield
Australia:	Long-term Government Bond Yield

PCP Deflator for consumption expenditure
Source: OECD National Accounts

United States:	1970 = 1
Japan:	1975 = 1
Germany:	1980 = 1
France:	1970 = 1
United Kingdom:	1980 = 1
Italy:	1970 = 1
Canada:	1971 = 1
Australia:	1979-80 = 1

YDH Household disposable income
Source: calculated by the following identity:

YDH = WSSS + YOTH + TRRH - INTDBT - TYH - TRPH

INTDBT	Interest on Consumer Debt, OECD National Accounts	
TRPH	Net Transfers paid by Households,	"
TRRH	Net Tranfers received by Households,	"
TYH	Direct Taxes: household	"
YOTH	Entrepreneurial and Property Income,	"
WSSS	Consumption of Employees,	"

YDRH Real Household Disposable Income
Source: YDH/PCP