RISK EFFECTS VERSUS MONETARY EFFECTS IN THE DETERMINATION OF SHORT-TERM INTEREST RATES

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ABSTRACT

Economic theory offers two distinct approaches to the modelling of interest rates. At the microeconomic level, interest rates are modelled as an outcome of intertemporal optimisation by investors, so that real interest rates are determined entirely by the real variables that characterise risk. At the macroeconomic level, short term behaviour of interest rates is usually thought of as being governed by the money demand function. This paper tests a model that encompasses both views, using data for four countries. The results suggest that risk factors are empirically insignificant in explaining interest rate behaviour.

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by Malcolm L. Edey

1. Introduction

Economic theory offers two distinct approaches to the explanation of movements in interest rates over time. At the microeconomic level, there is a well developed body of theories of asset pricing based on investor optimisation under conditions of risk; these theories can in principle be applied to the pricing of any asset, and thus can be used to price interest bearing assets in particular. At the macroeconomic level, on the other hand, interest rates have traditionally been viewed as being determined in an economy-wide equilibrium in which the money demand function plays a key part in determining short-run behaviour. The two approaches have some important differences in their empirical implications. Perhaps the most important of these arises when slow adjustment of output prices is assumed, thus introducing short-run non-neutrality of money into the macroeconomic approach. This would imply that money supply movements will have temporary effects on both the level of interest rates and the term structure; depending upon the degree of rigidity assumed in output prices, these effects may be highly persistent. Such effects are not present in asset pricing models based purely upon investor optimisation; in these models, real rates of return are determined entirely by the real variables which characterise the risk-return tradeoff.

Recent empirical work on the behaviour of interest rates has strongly emphasised the approach at the microeconomic level, focussing on efficiency considerations related to the term structure of interest rates (for example, Shiller (1979), Mankiw and Summers (1984), Fama (1984)), and attempting to reconcile returns on interest bearing (and other) assets with intertemporal optimising behaviour on the part of consumers and investors (Hansen and Singleton (1983), Hall (1985), Mankiw et.al (1985)). These studies have been largely unsuccessful in explaining the time series behaviour of interest rates during the 1970s and 1980s. Real interest rates during this period have varied over a much wider range than it seems can be explained by variations in expectations or in systematic risk factors.

One explanation for the lack of success of these models is that they may be insufficiently sophisticated. Hence, it is often suggested that there is a "time-varying risk premium" which explains violations of the simple expectations model of the term structure, and which contributes to the variability of real interest rates over time. However, if this risk premium is to be more than a catch-all residual, it is important that it be empirically modelled, and this has not yet been successfully achieved. A second line of explanation is the one suggested in the introductory remarks to this paper: the presence of short-run nominal rigidities in the system may mean that monetary shocks can have persistent effects on equilibrium real rates of return. As yet, there has been no attempt to test these two theories in an integrated framework or to assess their relative contributions to explaining the time series behaviour of interest rates. It is this task which is attempted in the present paper.

Section 2 of the paper sets out a model of asset pricing based on intertemporal optimisation using the "consumption CAPM" model of Lucas (1978, 1982) and Breeden (1979). An equation for nominal interest rates of various maturities is derived, together with exact expressions for the theoretical risk premiums as functions of a risk aversion coefficient and of the variances of the distributions of future prices and consumption. Section 3 examines the alternative approach, taking a simple macroeconomic equation for the determination of nominal interest rates under price rigidity and rational expectations; this is used to show the effects of unanticipated movements in the money supply and in the steady state inflation rate on nominal interest rates. A general model which encompasses the models from Section 2 and 3 is then proposed. Section 4 tests the general model using data on interest rates for four countries: the United States, United Kingdom, West Germany and Switzerland. Restrictions under which the model reduces to one or other of the two special cases are tested.

The main empirical finding is that a reduction of the general model to a sticky-price monetary model with no risk premium, cannot be rejected; thus the risk premium makes no significant contribution to the explanation of interest rate behaviour over the sample period. Section 5 concludes the paper by discussing implications of this finding for the study of other financial markets.

2. Interest rates in a model of intertemporal optimisation

This section uses the intertemporal asset pricing model of Lucas (1978) to derive empirically testable equations for the determination of nominal interest rates. The Lucas model is the discrete time analogue of Breeden's (1979) model, which is itself a restatement of the intertemporal capital asset pricing model (CAPM) developed by Merton (1973).[1] The model is based on a standard multi-period optimisation problem for a representative consumer. The consumer is assumed to maximise:

$$E_t \sum_{i=0}^{\infty} \beta^i u\,(x_{t+i})$$

subject to the sequence of budget constraints,

$$x_i + q_i' Q_i = q_i' Q_{i-1} + r_i' Q_{i-1}$$

where x_i represents consumption at time i, q_i is the vector of asset prices at time i, Q_i is the vector of asset stocks held, r_i is the vector of asset returns, and y_i is the consumer's non-investment income (assumed to be generated by an exogenous stochastic process).

Lucas showed that a first order condition for an optimium in this problem is:

$$u_{x,t} = \beta^k E_t\,(u_{x,t+k} \cdot R_t^j(k)) \text{ for } k = 1,2, \ldots \tag{1}$$

where $R_t^j(k)$ is the real return yielded by any asset (or portfolio) j held from period t to t+k, and $u_{x,i}$ denotes marginal utility of consumption at time i.

The interpretation of this equation is that the marginal utility of current consumption is equated to the expected marginal utility of consumption yielded at any future period by any investment strategy. A special case of this condition occurs when consumers are risk neutral. In that case, the marginal utility of consumption is constant across time periods, and equation (1) reduces to the condition that the expected real yield on any investment is equal to the inverse of the discount factor.

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1. The Lucas-Breeden model is often referred to as the "consumption CAPM" or "consumption risk" model, because it can be expressed in a form in which all risk is measured by covariance with a consumption index.

Equation (1) can be used to obtain an expression for the equilibrium price of any asset. Consider a k-period pure discount bond which is redeemed for one unit of currency at maturity. The real yield on the bond is given by:

$$R^b_t(k) = \frac{1}{b_t(k)} \cdot \frac{p_t}{p_{t+k}}$$

where $b_t(k)$ is the bond price, and p_t is the price of consumption goods in period t. Using this expression in conjunction with equation (1) gives:

$$b^*_t(k) = \beta^k \, E_t \left\{\frac{u_{x,t+k}}{u_{x,t}} \cdot \frac{p_t}{p_{t+k}}\right\} \qquad (2)$$

which is an expression for the equilibrium bond price as a function of utility parameters and of the conditional distribution of consumption and the price level.[2]

In order to convert this expression to a form that can be easily estimated, two additional assumptions are made (these are identical to the assumptions used by Hansen and Singleton (1983)):

(a) the conditional distributions of x_{t+k} and p_{t+k} are joint lognormal, i.e.

$$\begin{vmatrix} \log x_{t+k} \\ \\ \log p_{t+k} \end{vmatrix} \sim N \begin{vmatrix} E_t(\log x_{t+k}) & \sigma^2(x_{t+k}) & \sigma_t(x_{t+k}, p_{t+k}) \\ & , & \\ E_t(\log p_{t+k}) & \sigma_t(x_{t+k}, p_{t+k}) & \sigma^2(p_{t+k}) \end{vmatrix}$$

(b) the utility function is of the constant relative risk aversion type, i.e. $u_x = x^{-\gamma}$ where γ is the coefficient of risk aversion.

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2. An asterisk is used to distinguish the value of $b_i(k)$ derived in this expression from the one obtained in section 3.

The assumption of constant relative risk aversion is quite standard in empirical work (see for example Hansen and Singleton (1983), Frankel (1982), Grossman and Shiller (1981), Mark (1985)) and has been used in the study of a variety of asset markets. The distributional assumption is more arbitrary, but is almost certainly not important for the empirical results reported in this paper, since for short forecast horizons the conditional variances of x_{t+k} and p_{t+k} turn out to be empirically negligible.

Given assumptions (a) and (b), equation (2) can be written as:

$$b^*_t(k) = \beta^k E_t \left\{ \left(\frac{x_{t+k}}{x_t}\right)^{-\gamma} \cdot \frac{p_t}{p_{t+k}} \right\}.$$

Taking logs of both sides gives[3]

$$\log b^*_t(k) = -\gamma\, E_t(\log x_{t+k} - \log x_t) - BE_t(\log p_{t+k} - \log p_t) + k \log \beta + \theta_t(k) \tag{3}$$

where

$$\theta_t(k) = \frac{\gamma^2}{2}\, \sigma^2_t(x_{t+k}) + \frac{1}{2}\, \sigma^2_t(p_{t+k}) - \gamma\, \sigma_t\, (x_{t+k}, p_{t+k}) \tag{4}$$

$B = 1.$

The term $\theta_t(k)$ represents an exact expression for the theoretical risk premium, in terms of the risk aversion parameter and the underlying variance - covariance structure of the process generating future consumption and price levels. If there is perfect certainty, $\theta_t(k)$ is zero.

This formulation provides a framework in which a number of interesting hypotheses can be tested. The hypothesis that a "time-varying risk premium" makes a significant contribution to variations in interest rates or bond prices can be tested by testing for time variation in the variance - covariance terms given in equation (4). Risk neutrality is tested via the restriction $\gamma = 0$. Absence of money illusion is tested by testing for a unit coefficient (B) on the second term on the right hand side of equation (3).

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3. This result follows straightforwardly from the following property of lognormal distributions. If $\log y \simeq N(\mu, \sigma^2)$ then $\log E(y) = \mu + 1/2\, \sigma^2$. See Mood, Graybill and Boes (1974, p117).

3. Interest rates in a sticky-price monetary model

In the macroeconomic literature, the short-run dynamics of interest rates and other asset prices are typically seen as being influenced by the money demand function. When output prices are not instantaneously market clearing, as for example in the models of Dornbusch (1976), Blanchard (1981) and Buiter and Miller (1982), real returns on assets will be temporarily affected by money and inflation shocks. This section sets out a very simple sticky-price monetary model for the interest rate which can be linearised and combined with the model given in section 2.

Consider the following log-linear demand for money function:

$$\log m_t - \log p_t = -\delta\ (\log\ (1+r_t) - \log\ (1+r_t^*)) - \delta\ E_t(\pi_t)$$

where

r_t is the one period nominal interest rate;

π_t is the inflation rate over the period from t to t+1;

the asterisk denotes an expected steady state equilibrium value.

This function can be thought of as a standard money demand function, except that the real interest rate is expressed as a deviation from a steady state value. The equation can also be written as

$$\log m_t - \log p_t = \delta\ (\log b_t\ (1) - \log b_t^*(1)) - \delta\ E_t\ (\pi_t). \tag{5}$$

When all variables are on their steady state paths, $b_t(1) = b_t^*(1)$, so that (5) can be written as

$$\log p_t^* = \log m_t + \delta\ E_t\pi_t,$$

an expression for the equilibrium price level. The central assumption of this section is the assumption of slow adjustment of the price level. Specifically, it is assumed that:

$$\log p_t - \log p_{t-1} = E_{t-1}(\log p_t^* - \log p_{t-1}^*)$$

$$+ (1-\alpha)(\log p_{t-1}^* - \log p_{t-1}) . \tag{6}$$

In order to simplify this expression, assume that

$$E_{t-1}(\log p_t^*) = \log m_{t-1} + \delta\pi_{t-1}$$

and define

$$\log m_t - E_{t-1}(\log m_t) \equiv \varepsilon_t$$

$$\pi_t - E_{t-1}(\pi_t) \equiv \eta_t .$$

Then equation (6) simplifies to

$$\log p_t - \log p_t^* = \alpha(\log p_{t-1} - \log p_{t-1}^*) - \varepsilon_t - \delta\eta_t . \tag{7}$$

An expression for the deviation of the bond price from steady state equilibrium can now be obtained using (5) and (7). Equation (5) can be rearranged to give:

$$\log b_t(1) - \log b_t^*(1) = -\frac{1}{\delta}\log p_t + \frac{1}{\delta}\log m_t + \pi_t$$

$$= -\frac{1}{\delta}(\log p_t - \log p_t^*)$$

$$= -\frac{\alpha}{\delta}(\log p_{t-1} - \log p_{t-1}^*) + \frac{1}{\delta}\varepsilon_t + \eta_t$$

$$= \alpha(\log b_{t-1}(1) - \log b_{t-1}^*(1)) + \frac{1}{\delta}\varepsilon_t + \eta_t . \tag{8}$$

Equation (8) is the equation for determination of the one-period bond price or nominal interest rate in the sticky price monetary model. Any deviation from the steady state equilibrium will persist because it is associated with a persistent price level disequilibrium which decays at a rate of α per period. Unanticipated increases in the money stock (given by ε_t) and in the inflation rate (η_t) each have a positive influence on the bond price, and hence a negative effect on the interest rate. Anticipated movements in these variables are incorporated directly through their effect on $b_t^*(1)$.

For notational convenience, equation (8) was derived specifically for the case of a one-period bond. It can be easily shown that an analogous expression to (8) can be derived for longer maturities. The equation can be implemented empirically by interpreting $b_t^*(k)$ as the equilibrium bond price determined by equations (3) and (4).

4. Empirical Results

The general model of interest rate determination is given by equations (3), (4) and (8), reproduced below.

$$\log b_t^*(k) = -\gamma\, E_t(\log x_{t+k} - \log x_t) - BE_t(\log p_{t+k} - \log p_t) + k \log \beta + \theta_t(k) \tag{3}$$

where

$$\theta_t(k) = \frac{\gamma^2}{2}\, \sigma_t^2(x_{t+k}) + \frac{1}{2}\, \sigma_t^2(p_{t+k}) - \gamma\, \sigma_t\, (x_{t+k}, p_{t+k}) \tag{4}$$

$B = 1.$

$$\log b_t(1) - \log b_t^*(1) = \alpha\, (\log b_{t-1}(1) - \log b_{t-1}^*(1)) + \frac{1}{\delta}\, \varepsilon_t + \eta_t. \tag{8}$$

Two special cases are of particular interest in this model: when $\gamma = 0$, the model reduces to a sticky-price monetary model of the interest rate, in which risk effects are absent; when $\alpha = 0$, price rigidity is removed and the model become a standard "consumption CAPM" in which the real interest rate is determined entirely by the distributional parameters which characterise risk. The model is estimated using data for four countries: the United States, United Kingdom, West Germany and Switzerland, using a monthly sample over the period 1973:7 to 1984:12. The interest rates used are Eurocurrency deposit rates of one month and three month maturities (i.e. k=1 and k=3). Use of Eurocurrency rates ensures equality of tax treatment and of default risks across currencies, since the relevant deposits are all liabilities of the same banking system. The interest rates are converted to notional bond prices by multiplying by the maturity (in years) and subtracting from one.

Monthly sampling dates are chosen so as to correspond as closely as possible to the exact dates for which official money supply figures are available. This should maximise the power of tests for the significance of unanticipated money supply movements in the interest rate equations. For the U.K., monthly money supply figures are as at a Wednesday close to the middle of each month (the exact dates are included in the Bank of England Quarterly Bulletin), while for the other countries, money supply figures are end-month. The M1 definition of money is used in each case. Daily data on Eurocurrency deposit rates published in the Financial Times were used to obtain interest rate data corresponding to the appropriate money supply dates each month. Data on price levels are retail price indices, seasonally adjusted (source: OECD, Main Economic Indicators). Consumption data are the quarterly national accounts figures for real private final consumption expenditure, interpolated using real monthly retail sales figures (sources: OECD, Quarterly National Accounts, Main Economic Indicators).

Table 1 presents data on the behaviour of real (ex post) interest rates in the four countries during the sample period. The major empirical problem raised by recent empirical work on interest rates and asset prices has been the problem of persistence in deviations of real returns from their average values. This is illustrated most strikingly for the U.S. and the U.K., each of which experienced very low real interest rates during the 1970s, followed by a sustained period of historically high real rates. Whatever explanations may be suggested for this at the macroeconomic level, the observed behaviour of these real interest rates can only be reconciled with the pure consumption CAPM model if they can be correlated positively with movements in the expected rate of growth of consumption. The intuitive reason for this theoretical link is that the real interest rate in an unrationed equilibrium should be equal to the marginal rate of substitution between current and future consumption; this will be positively related to the expected rate of consumption growth under standard assumptions about preferences. The figures in Table 1 show no clear positive correlation between consumption growth and the real interest rate. Real interest rates in fact peaked in 1980 and 1981 when consumption growth was at its lowest. Strictly speaking, of course, these comparisons should be made on an ex ante basis, as is done more rigorously by the empirical estimates of the model.

Table 1: Consumption Growth and Real Interest Rates

Average Annual OECD consumption growth rate calendar year		Mid-year 3-month real interest rate (ex post)			
		U.K.	U.S.	West Germany	Switzerland
1973	3.8	-0.5	1.2	6.8	-7.9
1974	-0.6	-0.2	1.5	8.0	0.7
1975	4.4	-5.0	-0.3	2.3	2.1
1976	4.4	-4.5	0.4	3.5	-0.1
1977	3.3	2.4	0.7	3.0	1.6
1978	4.1	2.3	-0.2	3.0	2.0
1979	2.7	-5.1	-1.2	4.6	-1.2
1980	0.8	5.8	0.3	7.1	1.6
1981	0.5	2.2	10.9	10.2	3.9
1982	2.2	5.8	10.0	6.9	0.0
1983	3.1	3.2	6.5	3.6	3.2
1984	2.5	3.8	7.0	4.7	1.9

Notes:

(a) Consumption growth rates are December quarter on December quarter, OECD average (Source: OECD, Quarterly National Accounts.)

(b) Real interest rates are rate on three month Eurocurrency deposits, maturing July (Source: Financial Times) less three-month inflation rate over the corresponding period (based on RPI, source: OECD, Main Economic Indicators).

The model contains a number of expectations variables that are not observed; these include the expected future price level (p_{t+k}) and consumption index (x_{t+k}), the unanticipated components of the current money supply and inflation rate (ε_t and η_t respectively) and the variance and covariance terms which make up the risk premiums. Instruments for these variables are obtained from a set of auxiliary regressions of the form

$$\begin{aligned} \log p_{t+k} - \log p_t &= Z_t \beta_1 + \eta_{t+k} \\ \log x_{t+k} - \log x_t &= Z_t \beta_2 + u_{t+k} \\ \log m_{t+k} - \log m_t &= Z_t \beta_3 + \varepsilon_{t+k} \end{aligned} \tag{9}$$

where Z_t is a vector of information available at time t, and contains lagged observations on prices, consumption and the money supply. A second set of auxiliary regressions is used to obtain instruments for the variance and covariance terms in equation (4). These take the form:

$$\begin{aligned} (\hat{\eta}_{t+k})^2 &= Z_t \beta_{11} \\ (\hat{\eta}\,\hat{u})_{t+k} &= Z_t \beta_{12} \\ (\hat{u}_{t+k})^2 &= Z_t \beta_{22}. \end{aligned} \tag{10}$$

The fitted values from these regressions can then be used as instruments for $\sigma_t^2(p_{t+k})$, $\sigma_t(p_{t+k}, x_{t+k})$, and $\sigma_t^2(x_{t+k})$ respectively.

Estimates of the average values of these terms can be obtained from the residuals of the auxiliary regressions (9) using

$$\hat{\sigma}_t^2(p_{t+k}) = \frac{1}{T} \Sigma\, \hat{\eta}_{t+k}^2$$

$$\hat{\sigma}_t^2(x_{t+k}) = \frac{1}{T} \Sigma\, \hat{u}_{t+k}^2$$

$$\sigma_t(p_{t+k}, x_{t+k}) = \frac{1}{T} \Sigma\, \hat{\eta}_{t+k}\, \hat{u}_{t+k}.$$

These estimates are reported in Table 2. They represent the variance-covariance structure of the conditional predictors of

Table 2: Estimates of the conditional variance and covariance terms which make up the risk premium

Country and Maturity	Variance of Consumption $(x10^{-4})$	Variance of Price Level $(x10^{-4})$	Covariance of Consumption and Price Level $(x10^{-4})$
U.K., 1 month	2.50	0.02	0.03
3 month	2.56	0.36	0.16
U.S., 1 month	1.25	0.003	0.007
3 month	8.20	0.06	0.06
W. Germany, 1 month	3.67	0.002	0.002
3 month	3.87	0.04	-0.002
Switzerland 1 month	2.89	0.01	-0.01
3 month	3.17	0.14	0.03

(log p_{t+k}, log x_{t+k}), conditioned on information available at t. The important point to emerge from these estimates is that the variance and covariance terms are extremely small: they have orders of magnitude of around 10^{-4}, indicating a contribution of the order of 0.01 per cent to the nominal interest rate when γ, the coefficient of relative risk aversion, is equal to one. It seems unlikely that risk premiums modelled in this way are going to be important in explaining interest rate fluctuations. This is confirmed in estimates to be reported for the model as a whole.

Estimates for the pure comsumption CAPM model defined by equations (3) and (4) are given in Table 3. The results indicate an extremely high degree of serial correlation in the error terms in all equations. The other estimates in the table are therefore of little interest because there is a clear mis-specification, and the reported standard errors will be biased and inconsistent. Evidently, the persistence of nominal interest rate movements is not explained by an equation which relies on consumption and inflation expectations alone, as does the consumption risk model. This problem is not referred to by Hansen and Singleton (1983), who do not report the serial correlation properties of their error terms.

Estimates of the general model given by equation (8) are shown in table 4. The diagnostic statistics in the final three columns show no obvious evidence of mis-specification. The risk aversion coefficient γ is found to be both numerically small, and statistically insignificantly different from zero, in every equation. Although surprising on a priori grounds, this finding is not inconsistent with the findings of earlier studies attempting to estimate the parameter across a wide range of markets; nor is it inconsistent with the stylised facts presented in table 1. On the other hand, the price level inertia parameter (α) is both large and highly significant. It is estimated at around 0.85 in most equations, indicating a mean adjustment lag in the price level of about six months. In each equation, at least one of the money or inflation innovation terms is statistically significant and with the expected sign, apart from the equations for the United States. In the U.S. equations, money shocks are consistently significant but with a negative sign. That is to say, a positive monetary shock tends to increase rather than reduce nominal interest rates. One possible explanation for this may lie in the well recognised phenomenon in U.S. money markets that an unexpectedly high money supply tends to produce expectations of a policy reaction in the opposite direction and a rise in interest rates in anticipation.

Table 3: Estimates of the "Pure" Consumption CAPM Model

Equation (Country and Maturity)	γ	B	log ß	dW	R^2
U.K., 1 month	-0.0207 (0.0152)	0.331 (0.0500)	-0.00783 (0.000431)	0.24	0.39
3 month	-0.764 (0.0518)	0.334 (0.0557)	-0.0237 (0.00146)	0.28	0.38
U.S., 1 month	0.0773 (0.0396)	0.295 (0.083)	-0.00761 (0.00588)	0.26	0.15
3 month	-0.0357 (0.112)	0.269 (0.109)	-0.257 (0.00266)	0.21	0.12
W. Germany, 1 month	-0.0119 (0.0092)	0.996 (0.131)	-0.00264 (0.000475)	0.30	0.42
3 month	-0.0725 (0.0350)	0.971 (0.148)	-0.00852 (0.00162)	0.35	0.43
Switzerland, 1 month	-0.0153 (0.0149)	0.326 (0.124)	-0.00238 (0.000473)	0.19	0.01
3 month	-0.0525 (0.0475)	0.496 (0.170)	-0.00651 (0.00182)	0.20	0.11

Notes: Standard errors in parentheses.

Table 4: Estimates of the General Model

Equation (Country and Maturity	γ	β	$\log \beta$	α	ε_{t+1}	ε_{t+3}	η_{t+1}	η_{t+3}	h	R^2	CHOW
U.K.	0.0364	0.171	-0.0086	0.800	0.015		0.009		-1.57	0.747	1.49
(1 month)	(0.0982)	(0.123)	(0.0014)	(0.051)	(0.007)		(0.127)				
U.K.	-0.126	0.237	-0.0085	0.844		0.029		0.073	-1.35	0.815	1.32
(3 month)	(0.283)	(0.137)	(0.0016)	(0.046)		(0.017)		(0.138)			
U.S.	-0.049	0.755	-0.004	0.945	-0.020		0.378		0.62	0.900	1.31
(1 month)	0.253	(0.605)	(0.004)	(0.030)	(0.006)		(0.597)				
U.S.	-0.602	0.830	-0.005	0.922		-0.037		0.626	1.24	0.893	1.20
(3 month)	(0.550)	(0.497)	(0.004)	(0.032)		(0.020)		(0.485)			
W. Germany	0.025	1.473	-0.0001	0.893	-0.005		1.332		-1.11	0.901	1.60
(1 month)	(0.102)	(0.466)	(0.0002)	(0.035)	(0.003)		(0.459)				
W. Germany	-0.430	1.582	-0.0007	0.903		-0.006		1.621	0.93	0.928	2.24
(3 month)	(0.275)	(0.488)	(0.002)	(0.029)		(0.007)		(0.479)			
Switzerland	-0.029	0.785	-0.001	0.825	0.004		0.789		-1.72	0.845	1.67
(1 month)	(0.80)	(0.199)	(0.001)	(0.041)	(0.004)		(0.196)				
Switzerland	-0.151	0.983	-0.001	0.883		0.012		0.979	-0.87	0.911	1.01
(3 month)	(0.265)	(0.276)	(0.001)	(0.031)		(0.008)		(0.270)			

Notes: Standard errors in parentheses; CHOW is test for significant structural break at 1979:1. Significance points are 2.02 and 2.66 at 5 per cent and 1 per cent levels respectively; h is Durbin's "h-test" for serial correlation of residuals.

5. Conclusions

Most theories of asset pricing can be thought of as determining the rates of return on risky assets relative to the risk free rate (assuming that a risk free asset exists), and so an understanding of what causes the risk free rate to vary must be central to an understanding of the time series behaviour of asset prices in general. For this reason, the study of short-term interest rates seems a good starting point in identifying the most important determining factors for this behaviour. As the estimates in Section 4 indicate, short-term deposits are to a good approximation risk free, since short-term uncertainty about the future price level is empirically negligible.

The paper has argued that there are two major theoretical approaches to the study of short-term interest rates. These were characterised as models based on the microeconomics of risk, and models based at the macroeconomic level on the money demand function. In recent empirical work, explanations based on the consumption risk model can probably be said to have featured the most prominently.

In examining the time series data on short-term interest rates, both nominal and real, one of the features most immediately apparent is the high degree of serial correlation in these series. From a purely econometric point of view this suggests that interest rates are linked to some variable that is slow adjusting; but the consumption growth index, which is the basic determinant of the real interest rate in the consumption risk model, does not have this property. On the other hand, serial correlation of interest rates is exactly what is predicted by the sticky-price monetary model. Consistent with these stylised facts, the empirical results reported in section 4 point strongly towards the rejection of the consumption risk model as an explanation for interest rate behaviour, in favour of the sticky-price monetary model. Of course, the latter model is not without defects: some of the coefficients were not of the expected sign or significance, and the specification used in this paper ignored a number of important macroeconomic variables. Nonetheless, the use of models in which money plays a non-trivial role in short-run behaviour, seems to offer a more fertile ground for improving our understanding of asset price behaviour, than does persistence with refinements of the consumption risk approach.

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