NBER WORKING PAPERS SERIES

# WORLD INTEREST RATES AND INVESTMENT

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Working Paper No. 3849

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
September 1991

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**ABSTRACT**

In a world of integrated capital markets, the price of credit - which I measure by short-term expected real interest rates - is determined to equate the world aggregate of investment demand to the world aggregate of desired national saving. I implement this approach empirically by approximating the world by aggregates for ten major developed countries. For the period since 1959, the common component of expected real interest rates for these countries relates especially to developments on world stock and oil markets and secondarily, to world monetary and fiscal policies.

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In a world of integrated capital markets, the price of credit—which I measure by short–term expected real interest rates—is determined to equate the world aggregate of investment demand to the world aggregate of desired national saving. In this framework, shifts to the perceived profitability of investment, which are reflected as movements in world stock–market prices, change investment and real interest rates in the same direction. Shifts to the willingness to save, which I relate to changes in oil prices and to fiscal and monetary policies, move investment and real interest rates in opposite directions.

I implement this approach empirically by approximating the world by aggregates for ten major developed countries. For the period since 1959, the common component of expected real interest rates for these countries relates especially to developments on world stock and oil markets and secondarily, to world monetary and fiscal policies. Although real interest rates for individual countries differ significantly from world averages, the country–specific components of interest rates do not relate significantly to variables that I have examined. In particular, these components do not depend on country–specific stock–market returns or monetary and fiscal policies.

## Framework of the Analysis

As in Barro and Sala–i–Martin (1990)—henceforth, B/X—the aggregate of ten industrialized economies—Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Sweden, United Kingdom, and United States—is treated as a closed economy with a single capital market. The expected real interest rate is determined to equate total investment demand to total desired saving.

I use a version of investment demand and desired saving that makes small modifications to the framework in B/X. The ratio of real gross domestic investment demand to real GDP for country i at time t depends on a q variable:

$$(1) \qquad (I/Y)_{it} = \alpha_{0i} + \alpha_1 \cdot \log(q_{i,t-1}) + \text{error term}$$

where $I_{it}$ is investment during period t, $q_{i,t-1}$ is market valuation per unit of capital at the start of period t, the constant term $\alpha_{0i}$ can vary by country, and $\alpha_1 > 0$. The first difference of the investment ratio depends on the growth rate of q, which can be measured by the growth rate of real stock prices in country i, denoted STOCK. (Adjustments for retained earnings would have a minor effect here.)

Distinctions between average and marginal q, generated for example by oil shocks, can shift the relation between changes in the investment ratio and stock returns. I therefore include the ratio of expenditures on crude–oil consumption to GDP, denoted OILCY, as an additional proxy for marginal q. This oil variable is driven mainly by changes in the relative price of crude oil. For 1959–89, the correlation of $OILCY_t$ (aggregated over the ten industrialized countries in the sample) with the relative price of crude oil (based on the U.S. PPI) is 0.87 in levels and 0.77 in first differences. The specific functional form used for the investment ratio is

$$(2) \qquad (I/Y)_{it} = a_0 + (I/Y)_{i,t-1} + a_1 \cdot STOCK_{i,t-1} + a_2 \cdot D(OILCY_{i,t-1}) + u_{it}$$

where D is the first–difference operator. I treat the error term, $u_{it}$, as white noise, which means that shocks to the investment–demand ratio are permanent in character.

The desired national saving rate is given, following B/X, as

$$(3) \qquad (S/Y)_{it} = b_{0i} + b_1 r_t^e + b_2(OILCY_{i,t-1}) + b_3 DM_{i,t-1} + b_4 F_{i,t-1} + b_5 (S/Y)_{i,t-1} + \epsilon_{it}$$

where the constant term $b_{0i}$ can vary by country, $r_t^e$ is the world expected real interest rate, DM is monetary growth, F is a fiscal variable, and $\epsilon_{it}$ is treated as a white-noise error. If the variables other than $r_t^e$ hold constant income effects, then $b_1>0$ from the usual substitution effect. If high oil consumption, OILCY, signifies temporarily low income, then $b_2<0$.[1] Monetary growth generates temporarily high income in some models; hence, $b_3>0$ in these models. If F represents a temporarily high ratio of government purchases to GDP, then $b_4<0$. In some models, a high ratio of the public debt to GDP or a high prospective ratio of real government deficits (changes in the real debt) to real GDP motivate low current national saving. Therefore, $b_4<0$ holds for these fiscal variables in these models. The term, $b_5(S/Y)_{i,t-1}$, picks up slow adjustment in the saving rate. Alternatively, this term can proxy for serial correlation in the error term, $\epsilon_{it}$.

Note that the interest rate, $r_t^e$, does not enter directly into equations (1) and (2). Changes in the interest rate affect investment demand indirectly by first influencing the market valuation of capital. I assume also that the stock-return variable, STOCK, does not enter into the saving equation. This assumption allows identification of the coefficient $b_1$, the interest-sensitivity of the saving rate. The important condition is not that stock returns have a zero effect on desired saving, but rather that the effect on investment demand is much greater than that on desired saving.

The "world" expected real interest rate, $r_t^e$, is determined by equating the sum of the $I_{it}$ from equation (2) to the sum of the $S_{it}$ from equation (3). Therefore, $r_t^e$ is determined as

[1]An ARMA(1,1) regression for $OILCY_t$ (the GDP-weighted average of $OILCY_{it}$ for the ten countries in the sample) over the period 1959–89 yields the AR(1) coefficient, 0.86 (s.e. = 0.09), and the MA(1) coefficient, 0.17 (0.20).

$$(4) \qquad r_t^e = (1/b_1)\cdot[a_0 - b_0 + a_1 STOCK_{t-1} + a_2 D(OILCY_{t-1}) - b_2 OILCY_{t-1} - b_3 DM_{t-1} - b_4 F_{t-1} + (1-b_5)(I/Y)_{t-1} + u_t - \epsilon_t]$$

The variables written without i subscripts on the right side of the equation are GDP–weighted averages of the variables that appear in equations (2) and (3). For example, $STOCK_{t-1}$ is a GDP–weighted average over the countries i of $STOCK_{i,t-1}$, and so on. I refer henceforth to these GDP–weighted averages as world variables.

I assume that the observed real interest rate for country i, $r_{it}^e$, differs from $r_t^e$ by a country–specific constant and an error term:

$$(5) \qquad r_{it}^e = r_t^e + constant_i + (error\ term)_{it}$$

where the error term can be serially correlated. Substitution from equation (4) into equation (5) implies

$$(6) \qquad r_{it}^e = \beta_{0i} + (1/b_1)\cdot[a_1 STOCK_{t-1} + a_2 D(OILCY_{t-1}) - b_2 OILCY_{t-1} - b_3 DM_{t-1} - b_4 F_{t-1} + (1-b_5)(I/Y)_{t-1}] + v_{it}$$

Thus, $r_{it}^e$ depends on a set of world variables: $STOCK_{t-1}$, $D(OILCY)_{t-1}$, $OILCY_{t-1}$, $DM_{t-1}$, $F_{t-1}$, and $(I/Y)_{t-1}$. The only own–country variables that appear are the constant, $\beta_{0i}$, and the serially–correlated error term, $v_{it}$, which I model as an AR(1) process. In contrast, equation (2) implies that $(I/Y)_{it}$ depends only on the own–country variables, $(I/Y)_{i,t-1}$, $STOCK_{i,t-1}$, and $D(OILCY)_{i,t-1}$. I check below for effects of own–country variables on $r_{it}^e$ and for effects of world variables on $(I/Y)_{it}$.

Data

I use annual observations of variables for the ten countries, usually from 1957 to 1990. World measures (GDP–weighted averages) of the investment ratio, $(I/Y)_t$, the ratio of expenditures on crude–oil consumption to GDP, $OILCY_t$, the growth rate of real stock prices, $STOCK_t$, and the growth rate of M1, $DM_t$, appear in Figure 1. Figure 2 shows various concepts of world fiscal variables: the ratio of real government consumption to real GDP, $(G/Y)_t$, the ratio of government revenue (for consolidated general government) to GDP, $GREVY_t$, the ratio of real central government debt to real GDP, $RDEBTY_t$, and the cyclically-adjusted ratio of the central government's real deficit to real GDP, $RDEFYA_t$.[2]

Short–term nominal interest rates (3–month Treasury Bill rates or comparable money–market rates), denoted $R_{it}$, are available over the sample period for all of the countries except Italy. I construct expected inflation, $\pi^e_{it}$, using forecasts generated from an ARMA (1,1) specification for CPI inflation on quarterly data with deterministic seasonals (see B/X). The inflation process is estimated from 1950.2 until the quarter preceding the date to which $\pi^e_{it}$ applies. The variable $r^e_{it}$ is then constructed as $R_{it}-\pi^e_{it}$. (The 3–month nominal interest rates for January, April, July, and October match up with inflation anticipated between January and April, and so on.) The annual data, $r^e_{it}$, are averages of the four quarterly values for the year.

Figure 3 shows world values (GDP–weighted averages for nine countries with Italy excluded) for the nominal interest rate, $R_t$, expected inflation, $\pi^e_t$, and the expected real interest rate, $r^e_t$. Note that I use these averages of interest and inflation rates only for illustrative purposes. The estimation uses the expected real interest rate, $r^e_{it}$, observed

[2]The real deficit is the change in the real debt over the year. The ratio of the real deficit to real GDP, $RDEFY_{it}$, for each country was regressed on the current and four annual lags of the growth rate of real GDP. The residual from this regression is the cyclically–adjusted variable, $RDEFYA_{it}$.

separately for each country in the form of equation (6). Figure 4 plots the series for $r^e_{it}$ for the United States along with the GDP–weighted average of the $r^e_{it}$ values for the eight other countries.

Empirical Results

I use the data to estimate a joint system of 19 equations: the investment ratio, $(I/Y)_{it}$, for 10 countries in the form of equation (2) and the expected real interest rate, $r^e_{it}$, for 9 countries in the form of equation (6). This system constrains the coefficients on the own variables in equation (2) to be the same for all ten countries and constrains the coefficients on the world variables in equation (6) to be the same for all nine countries with interest–rate data. The system allows for country-specific constants and AR(1) error coefficients in equation (6).

Table 1 shows the coefficient estimates for the joint system.[3] The second part of the table shows the fit statistics for the individual equations for $(I/Y)_{it}$ and $r^e_{it}$, along with the estimated AR(1) coefficients for the error process for the interest–rate equations.[4]

The estimated coefficients for the investment ratio, $(I/Y)_{it}$, in the first part of Table 1 correspond to the coefficients $a_i$ shown in equation (2). The table shows a significantly positive effect, $\hat{a}_1 = 0.0231$ (s.e. = 0.0028), of the lagged own–country stock return, $STOCK_{i,t-1}$. A stock return that is one standard deviation (0.156) above

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[3]These estimates are from iterative, weighted least–squares. This procedure provides consistent estimates of the coefficients, but not of the standard errors if the error terms are correlated across the equations. GLS estimation is feasible, but introduces a very large number of parameters; the properties of this technique are unclear in small samples.

[4]The investment equations, estimated in first–difference form, do not show significant serial correlation of the error terms, except for Canada, for which the Durbin–Watson statistic is 2.6, and Japan, for which the statistic is 1.1. The other statistics range between 1.7 and 2.2.

normal is estimated to raise the investment ratio by 0.0036 or by 0.40 of a standard deviation for the change in the world investment ratio.[5]

The table shows a significantly negative effect, $\hat{a}_2 = -0.585$ (0.098), of the change in the share of expenditures on crude oil consumption in GDP, $D(OILCY)_{i,t-1}$. A one standard–deviation oil shock—that is, a value for $D(OILCY)_{t-1}$ of 0.0047—is estimated to reduce the investment ratio by 0.0027 or by 0.30 of a standard deviation. The full adverse effect of an oil shock on the investment ratio is greater than the direct effect because stock returns tend to move inversely with increases in the oil–consumption ratio. A regression of $STOCK_t$ on $D(OILCY)_t$ from 1959 to 1989 yields the slope coefficient –19.7 (s.e. = 4.7).[6] This coefficient implies that a value of $D(OILCY)_{t-1}$ equal to 0.0047 induces $STOCK_{t-1}$ to fall 0.093 below normal, a change that leads to a decline in $(I/Y)_t$ by 0.0021. Hence, the full effect of a one-standard-deviation oil shock is a reduction in next year's investment ratio by 0.0048 or by 0.54 of a standard deviation for the change in the world investment ratio.

The estimated coefficients for the aggregate saving rate, $(S/Y)_t$, in Table 1 correspond to the coefficients $b_i$ in equation (3). The estimated effect, $b_1$, of $r_t^e$ on the desired saving rate is 0.56 (0.09). Thus, for given values of the other influences on saving, a higher expected real interest rate induces an increase in the saving rate. Recall that the identification of this coefficient depends on the exclusion of the stock–return variable, $STOCK_t$, from the saving equation.[7]

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[5]The value 0.156 is the standard deviation of the GDP–weighted average stock return, $STOCK_t$, over the period 1958–89. Similarly, 0.0090 is the standard deviation of $(I/Y)_t-(I/Y)_{t-1}$.

[6]The $R^2$ of this regression is 0.38.

[7]The system as written is overidentified because the lagged first difference of the oil variable appears in the investment equation, whereas the lagged level appears in the saving equation. This restriction is tenuous, however, because it depends on the exclusion of the second lag of the oil variable from the saving equation. A test of the

The oil variable, $OILCY_{t-1}$, has an estimated coefficient $\hat{b}_2 = -0.72$ (0.14). I interpret this effect as the negative response of the desired saving rate to a shortfall of current from permanent income. This interpretation follows if people view shifts in the ratio of expenditures on crude–oil consumption to GDP (and the underlying movements in the relative price of crude oil) as partly transitory. Although this perspective is consistent with the time–series behavior of $OILCY_t$ (n. 1), the time–series evidence is, as usual, not definitive.

The growth rate of M1 (presumably representing unanticipated movements in money) has a positive estimated coefficient, $\hat{b}_3 = 0.131$ (0.025), on the desired saving rate. This result corresponds to the negative estimated relation between $r^e_{it}$ and $DM_{t-1}$ in the form of equation (6). Quantitatively, a one–standard–deviation movement (0.0225) in monetary growth shifts the desired saving rate by 0.0029 or by 0.33 of the standard deviation of the first difference of the world investment ratio. The interpretation of this monetary effect is unclear, but it is worth noting that the relation is between world monetary growth and the real interest rate in the typical country, and not between an individual country's monetary growth and its own real interest rate (see below).

The fiscal variable for government purchases, $(G/Y)_{t-1}$, has an insignificant effect on the desired saving rate. Theoretically, a temporary increase in the government–purchases ratio would lower the desired saving rate, whereas a permanent increase would have little or no effect. Therefore, the insignificant coefficient may reflect the permanent nature of much of the movements in government purchases.[8]

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overidentifying restriction leads to the value for $-2\cdot\log(\text{likelihood ratio})$ of 0.9, which corresponds to a p–value of 0.35 (using the $\chi^2$ distribution with one d.f.). Therefore, the restriction accords with the data.

[8]An ARMA (1,1) equation for $(G/Y)_t$ over the period 1959–89 yields the AR(1) coefficient 0.914 (s.e. = 0.042) and the MA(1) coefficient 0.725 (0.118). The MA(1)

Typically, the main temporary action in government purchases reflects changes in military spending due to war and peace, but little of this behavior arises (even for the Vietnam or Persian Gulf Wars) over the sample period for the ten countries under study.

The debt–GDP ratio, $RDEBTY_{t-1}$, has a significantly negative coefficient on the saving rate, –0.067 (0.019). This coefficient implies that a one-standard-deviation movement in the debt ratio (0.019) shifts the desired saving rate by 0.0012 or by 0.14 of the standard deviation of the first difference of the world investment ratio. In contrast, the cyclically–adjusted deficit–GDP ratio, $RDEFYA_{t-1}$, has an insignificant coefficient of the "wrong" sign, 0.120 (0.070). Of course, in respectable models in which the public debt influences desired national saving—such as Blanchard (1985)—the current budget deficit matters only to the extent that it predicts a weighted sum of future deficits. Thus, the deficit variable may be insignificant in the saving–rate equation because the current deficit–GDP ratio (even cyclically adjusted) is a poor predictor of future deficits.[9]

The estimated coefficient on $(I/Y)_{t-1}$—$\hat{b}_5 = 0.59$ (0.09)—suggests that shocks to the desired saving rate are persistent but not permanent. (Note, however, from the second part of the table that the estimated AR(1) error coefficients for the interest–rate equations are all significantly positive.)

The values of $R^2$ and $\hat{\sigma}$, the standard–error–of–estimate, for the individual equations for $(I/Y)_{it}$ and $r^e_{it}$ are in the second part of Table 1. With respect to

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coefficient likely picks up business–cycle effects related to fluctuations in GDP for given levels of government purchases.

[9]Empirically, over the period 1959–89, the variable $RDEFYA_t$ is virtually uncorrelated with $RDEFY_{t+i}$ for $i>1$. The correlation of $RDEFY_t$ with $RDEFY_{t+i}$ is around 0.3 for i between 3 and 5. This correlation reflects mainly the persistence of the business cycle and hence, the real budget deficit.

investment, the low $R^2$ values for Canada and the United States are notable, although the values of $\hat{\sigma}$ for these countries are not especially high. For the interest–rate equations, the low $R^2$ for Japan indicates that virtually none of the movements in Japanese real interest rates are explained by the model. The high $\hat{\sigma}$ value for the United Kingdom reflects some very large negative values in the mid 1970s that the model cannot explain. This result likely indicates overestimation of expected inflation (in the face of high actual inflation) and hence, measurement error in $r^e_{it}$, rather than a problem with the rest of the model.

### Simulated Effects of a Stock–Market Boom and an Oil Shock

I simulate the effects of some disturbances by using the results from Table 1 for investment demand and desired saving, and hence for the expected real interest rate. I assume in these simulations that the fiscal variables do not change. The processes for $OILCY_t$, $STOCK_t$, and $DM_t$ come from estimated relations over the period 1959–89:

$$\begin{aligned} OILCY_t &= 0.0020 + 0.89 \cdot OILCY_{t-1} \\ STOCK_t &= 0.0243 - 19.7 \cdot D(OILCY)_t \\ DM_t &= 0.0513 + 0.37 \cdot DM_{t-1} - 2.30 \cdot D(OILCY)_t - 0.078 \cdot STOCK_{t-1} \end{aligned} \tag{7}$$

Hence, the simulations incorporate a negative contemporaneous response of the stock market to an increase in the oil variable, as well as responses of monetary growth to its own lag (positive), to an increase in the oil variable (negative), and to lagged stock returns (negative). The simulations begin with a history of values for DM, STOCK, and OILCY equal to their respective steady–state values (0.078, 0.024, and 0.019). The variables $r^e_t$ and $(I/Y)_t$ begin with a history of values equal to the respective sample means (0.0215 and 0.234). As the model is written, these variables are not stationary.

The first simulation pertains to a one-standard-deviation (0.156) shock to stock returns. Figure 5 shows the path of $(I/Y)_t$ and Figure 6 shows the path of $r_t^e$. The shock in year 3 leads in year 4 to an increase in $(I/Y)_t$. The effect on the investment ratio is permanent because nothing in the model generates mean reversion in the stock market; that is, no force tends to bring q back to unity. In fact, the increase in $r_t^e$ in year 4 would depress the stock market and lead thereby to a reduction in $(I/Y)_t$ in year 5. The model should be modified to allow for this feedback effect from $r_t^e$ to stock returns. In Figure 6, $r_t^e$ spikes upward in year 4 and then comes down gradually toward a permanently higher plateau, which corresponds to the permanently higher investment ratio. The real interest rate overshoots mostly because the desired saving rate adjusts only gradually to changes in $r_t^e$ and its other determinants. (The temporary reduction in monetary growth in year 4 tends also to keep $r_t^e$ high in year 5.)

The second simulation considers an oil shock in the form of a one-standard-deviation (0.0047) increase in $OILCY_t$. (In the data, the largest changes in $OILCY_t$ are the rises by 0.017 from 1973 to 1974 and by 0.014 from 1979 to 1981, and the fall by 0.013 from 1985 to 1986.) Recall that the simulation assumes that the rise in OILCY causes a low stock return ($STOCK_t = -0.069$ in the year of the oil shock). The shock in year 3 leads in Figure 7 to a decline in $(I/Y)_t$ in year 4. As OILCY returns gradually to its steady-state value, $(I/Y)_t$ returns gradually toward its initial position. Figure 8 shows that $r_t^e$ declines by a small amount in year 4 because the decline in investment demand is initially greater than the fall in desired saving. Subsequently, the fall in the desired saving rate dominates (according to the estimates) and $r_t^e$ rises to a peak in year 6 (3 years after the shock). After year 6, $r_t^e$ declines gradually back to its initial value.

<u>World and Own-Country Variables</u>

Table 2 adds various world and own-country variables to the systems shown in

Table 1. The first case introduces the world stock return, $STOCK_t$, as a determinant of country i's investment ratio, $(I/Y)_{it}$, in the form of equation (2). The coefficient of $STOCK_t$ is constrained to be the same in all ten investment equations. The estimated coefficient of $STOCK_{t-1}$ is positive, 0.0096 (0.0058), but insignificant at the 5% level (t–value = 1.7). In contrast, the estimated coefficient of the own stock return, $STOCK_{i,t-1}$, remains significantly positive, 0.0175 (0.0044).

The next case in the table adds the world measure of the change in the oil consumption ratio, $D(OILCY)_{t-1}$, to the investment equations. The estimated coefficients of this variable and the own–country counterpart are each negative but insignificant. Thus, the analysis cannot distinguish between the world and own–country effects in this case. One consideration is that the paths of the oil–consumption ratios are similar across the countries. Moreover, measurement error in the data for expenditures on crude-oil consumption for individual countries could enhance the explanatory power of the world average variable for an individual country's investment ratio.

For three of the countries in the sample—Canada, United Kingdom, and United States—the presence of crude–oil production creates a distinction between oil imports and expenditure on crude–oil consumption. (Canada and the Netherlands are also large exporters of natural gas, which should be brought into the analysis.) The next case shown in Table 2 adds the lagged change in the ratio of the value of crude–oil production to GDP, $D(OILPY)_{i,t-1}$, to the investment equations for these countries. The coefficient of this variable is restricted to be the same across the countries. The estimated coefficient is positive but insignificant, 0.125 (0.197), and the estimated coefficient of $D(OILCY)_{i,t-1}$ remains significantly negative. Thus, although an increase in expenditures for oil consumption is bad for investment, there is not much evidence here of an offsetting positive effect associated with higher receipts from oil production.[10]

I have also added own–country variables to the equations for $r^e_{it}$ in the form of equation (6). In each case, the coefficient of the new variable is constrained to be the same in all nine interest–rate equations. Table 2 shows that an individual country's monetary growth rate, $DM_{i,t-1}$, has an insignificant effect. The estimated coefficient, –0.005 (0.009), refers to the effect on the saving rate in the form of equation (3). The estimated coefficient of $DM_{t-1}$ remains significantly positive, 0.135 (0.026), corresponding to a significantly negative effect on $r^e_{it}$. Thus, the results suggest a role for world monetary growth in the determination of the world real interest rate, but not for an individual country's monetary growth in the determination of its own real interest rate.

For the government–purchases ratio, the estimated coefficient of $(G/Y)_{t-1}$ remains insignificant, but the estimated coefficient of $(G/Y)_{i,t-1}$ is significantly negative for the saving rate: –0.266 (0.074). (This result corresponds to a significantly positive effect of $(G/Y)_{i,t-1}$ on $r^e_{it}$.) As mentioned before, theoretical reasoning suggests a negative effect of temporary government purchases on desired saving, but a global capital market implies that $r^e_{it}$ would respond to world government purchases rather than own–country purchases. One possibility is that $(G/Y)_{it}$ is a proxy for country i's tax rate on interest income: even with a global capital market, $r^e_{it}$ would react to the local tax rate to the extent that interest earnings are taxable at that rate. It turns out, however, that ratios of real government purchases to real GDP have

[10] The effects should all be interpreted for given stock returns. For the United Kingdom, stock returns, $STOCK_{it}$, are significantly positively related to the contemporaneous change in the oil–production variable, $D(OILPY)_{it}$, and significantly negatively related to $D(OILCY)_{it}$. The variable $D(OILPY)_{it}$ is, however, insignificant for $STOCK_{it}$ for Canada and the United States.

behaved very differently from ratios of government revenues (for consolidated general government) to GDP for the countries and sample period considered. Figure 2 shows, for the world aggregates, that the purchases ratio has trended downward over the sample, whereas the revenue ratio has trended upward. (The correlation between the two variable is –0.91 in levels and –0.05 in first differences.) The divergence between purchases and revenues corresponds to the substantial increases in transfer payments as a ratio to GDP. If I include the government revenue ratios, $GREVY_{i,t-1}$ and $GREVY_{t-1}$, as determinants of $r_{it}^e$, then the estimated coefficients of these variables are insignificant, whereas the estimated coefficient of $(G/Y)_{i,t-1}$ remains significantly negative for the saving rate (hence, significantly positive for $r_{it}^e$). Since $GREVY_{it}$ would seem to be a better proxy than $(G/Y)_{it}$ for country i's tax rate on interest income, the significantly negative effect of $(G/Y)_{i,t-1}$ on the saving rate likely does not involve a tax–rate effect.

Table 2 shows that the public–debt variable, $RDEBTY_{t-1}$, has a significantly negative effect, –0.089 (0.023), on the saving rate, whereas the own–country variable, $RDEBTY_{i,t-1}$, has a significantly positive effect, 0.024 (0.010). These results correspond to effects on $r_{it}^e$ that are significantly positive for $RDEBTY_{t-1}$ and significantly negative for $RDEBTY_{i,t-1}$. Quantitatively, the results indicate that the main link between public debt and expected real interest rates is from world debt to world real interest rates. There is no evidence that an increase in a country's debt–GDP ratio—for a given world debt–GDP ratio—raises the real interest rate in that country.

With respect to the deficit variables, Table 2 shows that $RDEFYA_{t-1}$ and $RDEFYA_{i,t-1}$ are each insignificantly related to the saving rate. That is, neither world nor own–country budget deficits (cyclically adjusted) are significantly related to $r_{it}^e$.

A number of world variables—$DM_{t-1}$, $(G/Y)_{t-1}$, $RDEBTY_{t-1}$, and $RDEFYA_{t-1}$—were included as possible determinants of the saving rate but were excluded from the equations for the investment ratio. In particular, with the change in marginal q held constant (by the stock–return and oil variables), the theory says that variables that influence desired saving would not matter for changes in the investment ratio. Table 2 shows that the four world variables from the saving equation are jointly insignificant if added to the ten equations for the investment ratio. (The coefficient for each variable is constrained to be the same in all ten equations.) The likelihood–ratio statistic that corresponds to the exclusion of the four variables from the investment equations is 3.7 and the p–value (corresponding to a $\chi^2$ distribution with 4 d.f.) is 0.45.

The last finding does not mean that determinants of the saving rate, including the significant effects from $DM_{t-1}$ and $RDEBTY_{t-1}$, have no effect on investment. The effects on investment work through changes in $r_t^e$ that are transmitted to shifts in the market valuation of capital; that is, to movements in the stock–return variables, $STOCK_{i,t-1}$. Unfortunately, the present empirical results provide no direct evidence about the strength of this channel. The effects depend on the responses of $STOCK_{it}$ to $DM_t$ and $RDEBTY_t$ (working through changes in $r_t^e$), but the endogeneity of the monetary and fiscal variables makes it difficult to sort out the contemporaneous interactions among these variables. (The response of $STOCK_{it}$ to $DM_{t-1}$ and $RDEBTY_{t-1}$ is, not surprisingly, essentially zero.)

Behavior in 1990–1991

Table 3 shows actual values of $r_t^e$ and $(I/Y)_t$ for 1989–90 and values of $r_t^e$ for the first parts of 1991. Forecasts of $r_t^e$ and $(I/Y)_t$ for 1990–91 are shown conditioned on first, information through 1989, second, information through 1990, and third data through 1990 plus updated information on stock returns and oil prices for 1991.1.

Using information through 1989, the model (estimated with data through 1990) "predicts" the values $r_t^e = 0.047$ for 1990 and 0.043 for 1991, compared to the value for 1989 of 0.035 and the sample mean of 0.021. (See Figure 3 for the time series of $r_t^e$.) In particular, the forecast for 1990 matches the high point for $r_t^e$ (over the period since 1959) reached in 1981. As a related matter, the model forecasts an expansion of $(I/Y)_t$ from 0.244 in 1989 to 0.247 in 1990 and 0.248 in 1991.

The actual values for 1990 were $r_t^e = 0.037$ and $(I/Y)_t = 0.246$, thus the real interest rate was substantially overpredicted. The stock return for 1990 was −0.23, the third worst of the sample period (after 1973 and 1974). The bulk of the low return reflects the decline in real stock prices by 19% with the start of the Persian Gulf crisis in the third quarter. Taking account of the information on stock returns for 1990 (along with an estimate for $D(OILCY)_t$ of 0.0017 and the value $DM_t = 0.052$) leads to substantially revised forecasts for 1991: $r_t^e = 0.025$ and $(I/Y)_t = 0.240$. If data for the first quarter of 1991 on stock returns and the oil variable are also incorporated (averaged with a one–quarter weight with the annual data for 1990), then the forecast for 1991 becomes $r_t^e = 0.031$ and $(I/Y)_t = 0.243$. The key element here is the increase in real stock prices by about 11% with the resolution of the Gulf War.

The shifts in the forecasts with the changes in the conditioning information involve primarily the volatility of the stock returns, which in this case reflect primarily the developments in the Persian Gulf. For example, the shift of $STOCK_t$ from 0.16 in 1989 to −0.23 in 1990 means, by itself, that the projected value of $r_t^e$ for 1991 (conditioned on 1990 information) is 0.016 less than the projected value for 1990 (conditioned on 1989 information). Similarly, the projected value of $(I/Y)_t$ for 1991 is lower on this count by 0.009 relative to the value for 1990. The inclusion of the favorable stock return for 1991.1 accounts for the upward revision in the 1991 forecast of $r_t^e$ from 0.025 to 0.031 and for $(I/Y)_t$ from 0.240 to 0.243.

Conclusions

The world perspective explains a good deal of the common experience of real interest rates for the developed countries and this common experience comprises a large part of the variations of real interest rates for each country individually over the last three decades. The framework of a single world credit market leaves unexplained the divergence of each country's real interest rate from the average of rates across the countries. Although these individual–country components are substantial and often persistent over time, these components do not relate systematically to observable variables, such as stock returns, investment ratios, or monetary and fiscal policies, for the various countries.

As an example, my estimate from Table 3 of the U.S. expected real interest rate in early 1991 is only 0.2%, whereas that for the six European countries averages 5.9%. It is tempting to explain this unusually large gap between real interest rates in the United States and Europe by appealing to differences in monetary policies and investment opportunities in the two regions. Unfortunately, the historical analysis does not support this kind of interpretation, at least if monetary policies can be measured by M1 growth and if investment opportunities can be gauged by stock returns and investment–GDP ratios. The analysis does predict that the spread in real interest rates between the United States and Europe will vanish over time.

For the common world component of real interest rates, developments in stock and oil markets play a major role and the patterns in world monetary growth and public debt exert a secondary influence. Thus, although traditional governmental macro policies seem to matter somewhat—when expressed as world aggregates—these policy instruments have not been the central driving forces for world real interest rates over the last thirty years. A more appropriate perspective is that governments operate as relatively minor actors in the overall arena of world credit markets. Governments have a substantial impact on real interest rates through political events such as the Persian Gulf war and the oil crises. These exercises in political instability, rather than conventional monetary and fiscal policies, are the major channel by which governments have influenced world financial markets and hence, the behavior of real interest rates and investment in the developed countries.

## References

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Table 1

Regression Estimates for Investment and Saving

| Variable | $(I/Y)_{it}$ | $(S/Y)_t$ |
|---|---|---|
| $(I/Y)_{i,t-1}$ | 1 | -- |
| $STOCK_{i,t-1}$ | 0.0231 (0.0028) | -- |
| $DOILCY_{i,t-1}$ | -0.585 (0.098) | -- |
| $r_t^e$ | -- | 0.557 (0.092) |
| $OILCY_{t-1}$ | -- | -0.715 (0.140) |
| $DM_{t-1}$ | -- | 0.131 (0.025) |
| $(G/Y)_{t-1}$ | -- | 0.038 (0.125) |
| $RDEBTY_{t-1}$ | -- | -0.067 (0.019) |
| $RDEFYA_{t-1}$ | -- | 0.120 (0.070) |
| $(I/Y)_{t-1}$ | -- | 0.592 (0.091) |

Notes: Estimates are from iterative, weighted least-squares on a system of 10 countries for the investment ratio and 9 countries for the expected real interest rate. Sample period is 1959-90, except 1959-89 for investment for Belgium, Italy, and Sweden. I/Y is the ratio of real domestic investment to real GDP, STOCK is the real return on the stock market (exclusive of dividends), OILCY is the ratio of crude oil consumption to GDP, DOILCY is the first difference of OILCY, DM is the growth rate of M1, G/Y is the ratio of real government consumption to real GDP, RDEBTY is the ratio of real central government debt to real GDP, RDEFYA is the cyclically-adjusted ratio of the real government deficit (the change in the central government's real debt) to real GDP. Variables without i subscripts are GDP-weighted averages over the countries. $r^e$ is the expected real interest rate. Constant terms are not shown. Standard errors are in parentheses.

Table 1, continued

Statistics for Individual Countries

| Country | $(I/Y)_{it}$ $R^2$ $(\hat{\sigma})$ | $r^e_{it}$ $R^2$ $(\hat{\sigma})$ | AR(1) |
|---|---|---|---|
| Belgium | 0.81 (0.0130) | 0.73 (0.0090) | 0.80 (0.11) |
| Canada | 0.12 (0.0148) | 0.70 (0.0157) | 0.44 (0.16) |
| France | 0.83 (0.0104) | 0.78 (0.0129) | 0.66 (0.10) |
| Germany | 0.85 (0.0119) | 0.38 (0.0183) | 0.58 (0.14) |
| Italy | 0.84 (0.0152) | -- | -- |
| Japan | 0.86 (0.0153) | 0.07 (0.0219) | 0.64 (0.13) |
| Netherlands | 0.87 (0.0125) | 0.66 (0.0147) | 0.61 (0.14) |
| Sweden | 0.74 (0.0148) | 0.71 (0.0165) | 0.64 (0.13) |
| U.K. | 0.58 (0.0122) | 0.51 (0.0301) | 0.53 (0.15) |
| U.S. | 0.21 (0.0115) | 0.65 (0.0136) | 0.60 (0.14) |

Notes: The column for $(I/Y)_{it}$ indicates the values of $R^2$ and the standard-error-of-estimate $(\hat{\sigma})$ for the regressions reported in the first part of the table. The statistics for the regressions for $r^e_{it}$ appear in the next column. The estimated coefficient and standard error for the AR(1) error process for the $r^e_{it}$ equations are in the final column.

Table 2

World and Own-Country Variables

| Variable | $(I/Y)_{it}$ | $(S/Y)_t$ $(r^e_{it})$ |
|---|---|---|
| $STOCK_{i,t-1}$ | 0.0175 (0.0044) | -- |
| $STOCK_{t-1}$ | 0.0096 (0.0058) | -- |
| $DOILCY_{i,t-1}$ | -0.262 (0.244) | -- |
| $DOILCY_{t-1}$ | -0.402 (0.279) | -- |
| $DOILCY_{i,t-1}$ | -0.639 (0.132) | -- |
| $DOILPY_{i,t-1}$ | 0.125 (0.197) | -- |
| $DM_{t-1}$ | -- | 0.135 (0.026) |
| $DM_{i,t-1}$ | -- | -0.005 (0.009) |
| $(G/Y)_{t-1}$ | -- | 0.034 (0.097) |
| $(G/Y)_{i,t-1}$ | -- | -0.266 (0.074) |
| $RDEBTY_{t-1}$ | -- | -0.089 (0.023) |
| $RDEBTY_{i,t-1}$ | -- | 0.024 (0.010) |
| $RDEFYA_{t-1}$ | -- | 0.127 (0.072) |
| $RDEFYA_{i,t-1}$ | -- | -0.011 (0.026) |
| $DM_{t-1}$ [a] | -0.058 (0.036) | -- |
| $(G/Y)_{t-1}$ | 0.021 (0.030) | -- |
| $RDEBTY_{t-1}$ | 0.003 (0.011) | -- |
| $RDEFYA_{t-1}$ | 0.044 (0.099) | -- |

Notes: The estimated coefficients and standard errors refer to variables added to the regressions for the system shown in Table 1. DOILPY is the first difference of the ratio of oil production to GDP.

[a] The likelihood-ratio statistic for the test that all four of these coefficients are zero is 3.7, p-value = 0.45.

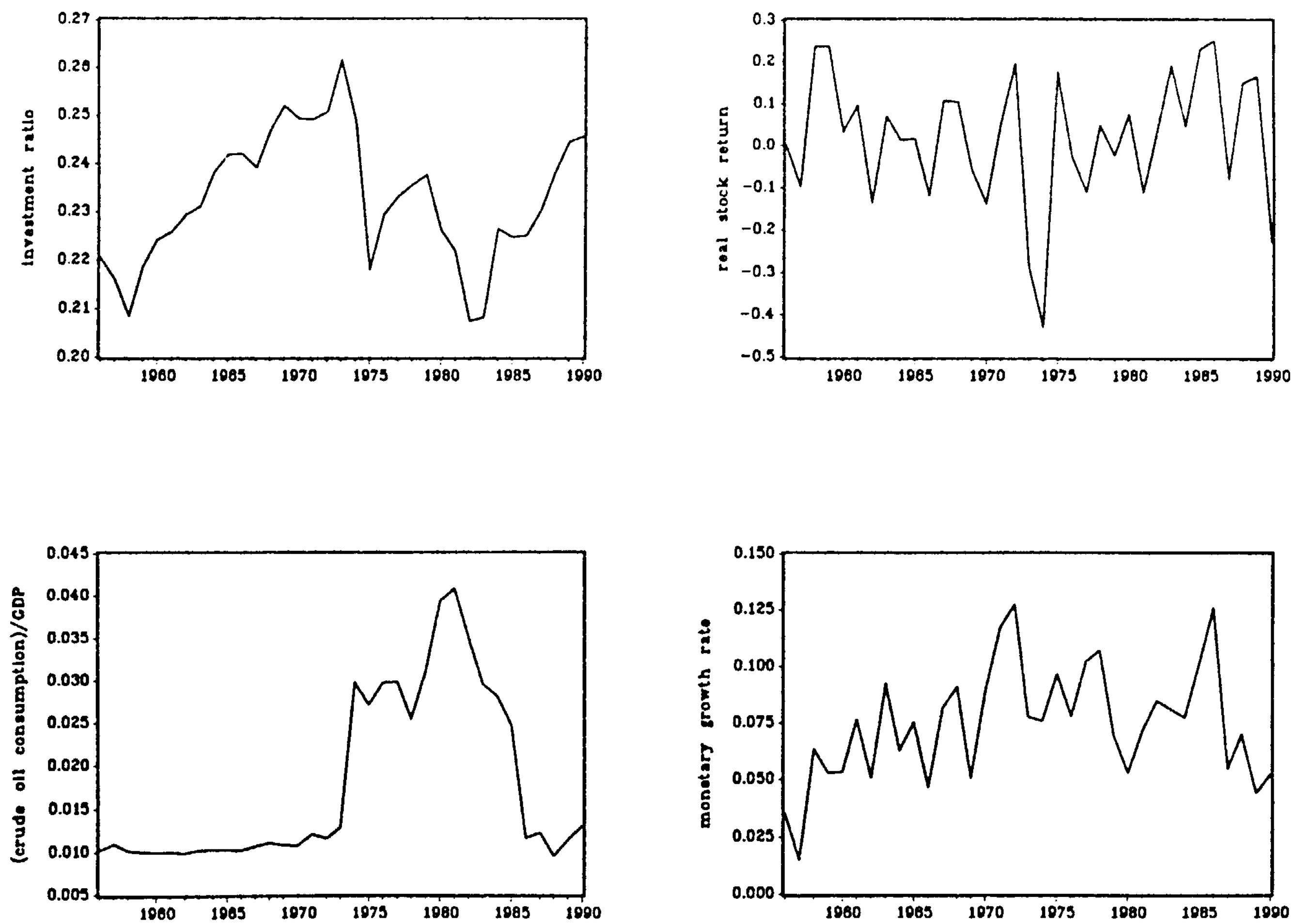
Table 3

Forecasts of Real Interest Rates and Investment Ratios

| Var. | Date | BE | CA | FR | GE | IT | JA | NE | SW | UK | US | WD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Actual Values[a] | | | | | | |
| $r^e$ | 1989 | .043 | .072 | .051 | .037 | .061 | .001 | .042 | .052 | .060 | .036 | .035 |
| | 1990 | .056 | .084 | .061 | .053 | .058 | .024 | .052 | .051 | .052 | .025 | .037 |
| | 1991 | .058 | .035 | .066 | .072 | -- | .033 | .053 | .063 | .043 | .002 | .027 |
| I/Y | 1989 | .216 | .264 | .226 | .230 | .261 | .374 | .222 | .221 | .206 | .206 | .244 |
| | 1990 | -- | .252 | .228 | .245 | -- | .388 | .234 | -- | .192 | .199 | .245 |
| | | | | | | Forecasts from data through 1989, using average values of STOCK and OILCY for 1990 | | | | | | |
| $r^e$ | 1990 | .058 | .070 | .058 | .053 | -- | .024 | .050 | .058 | .058 | .048 | .047 |
| | 1991 | .056 | .059 | .051 | .051 | -- | .026 | .042 | .051 | .047 | .044 | .043 |
| I/Y | 1990 | .216 | .266 | .229 | .235 | .260 | .377 | .225 | .224 | .209 | .209 | .247 |
| | 1991 | .217 | .266 | .230 | .235 | .261 | .378 | .226 | .225 | .210 | .210 | .248 |
| | | | | | | Forecasts from data through 1990 | | | | | | |
| $r^e$ | 1991 | .043 | .054 | .041 | .040 | -- | .015 | .032 | .034 | .032 | .018 | .025 |
| I/Y | 1991 | -- | .245 | .221 | .241 | -- | .375 | .228 | -- | .187 | .195 | .240 |
| | | | | | | Forecasts based on update of STOCK and OILCY to 1991.1 | | | | | | |
| $r^e$ | 1991 | .048 | .059 | .047 | .045 | -- | .020 | .038 | .040 | .037 | .024 | .031 |
| I/Y | 1991 | -- | .248 | .224 | .242 | -- | .378 | .233 | -- | .191 | .199 | .243 |

[a] 1991 data for $r^e$ based on interest rates for January and April 1991 and on inflation through March 1991. 1990 data for I/Y estimated from first three quarters, except for U.S.

Figure 1 World Variables for
Investment Ratio, Stock Returns, Oil Consumption, and Monetary Growth



# Figure 2 World Fiscal Variables

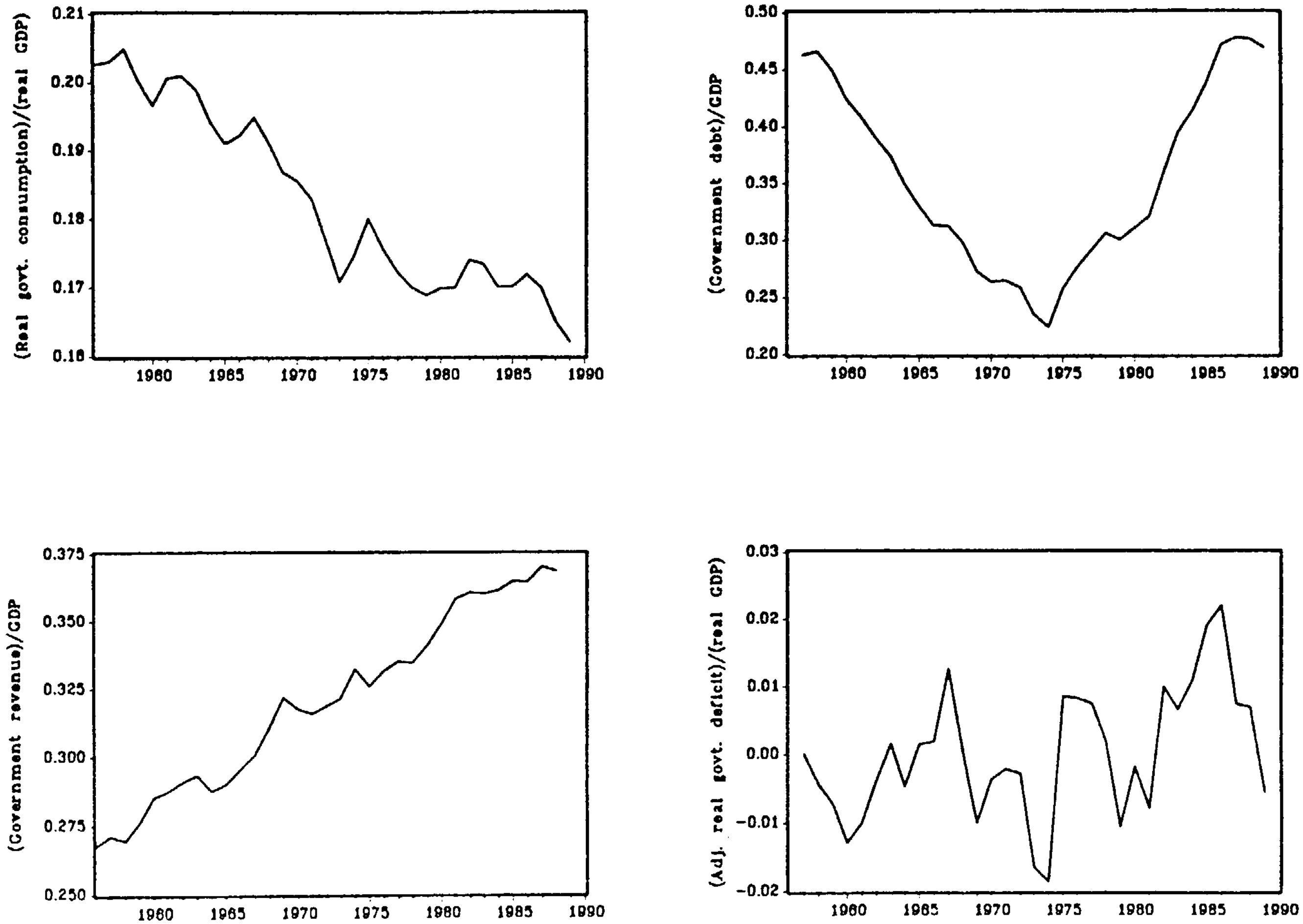


Figure 3 World Nominal and Real Interest Rates and Expected Inflation

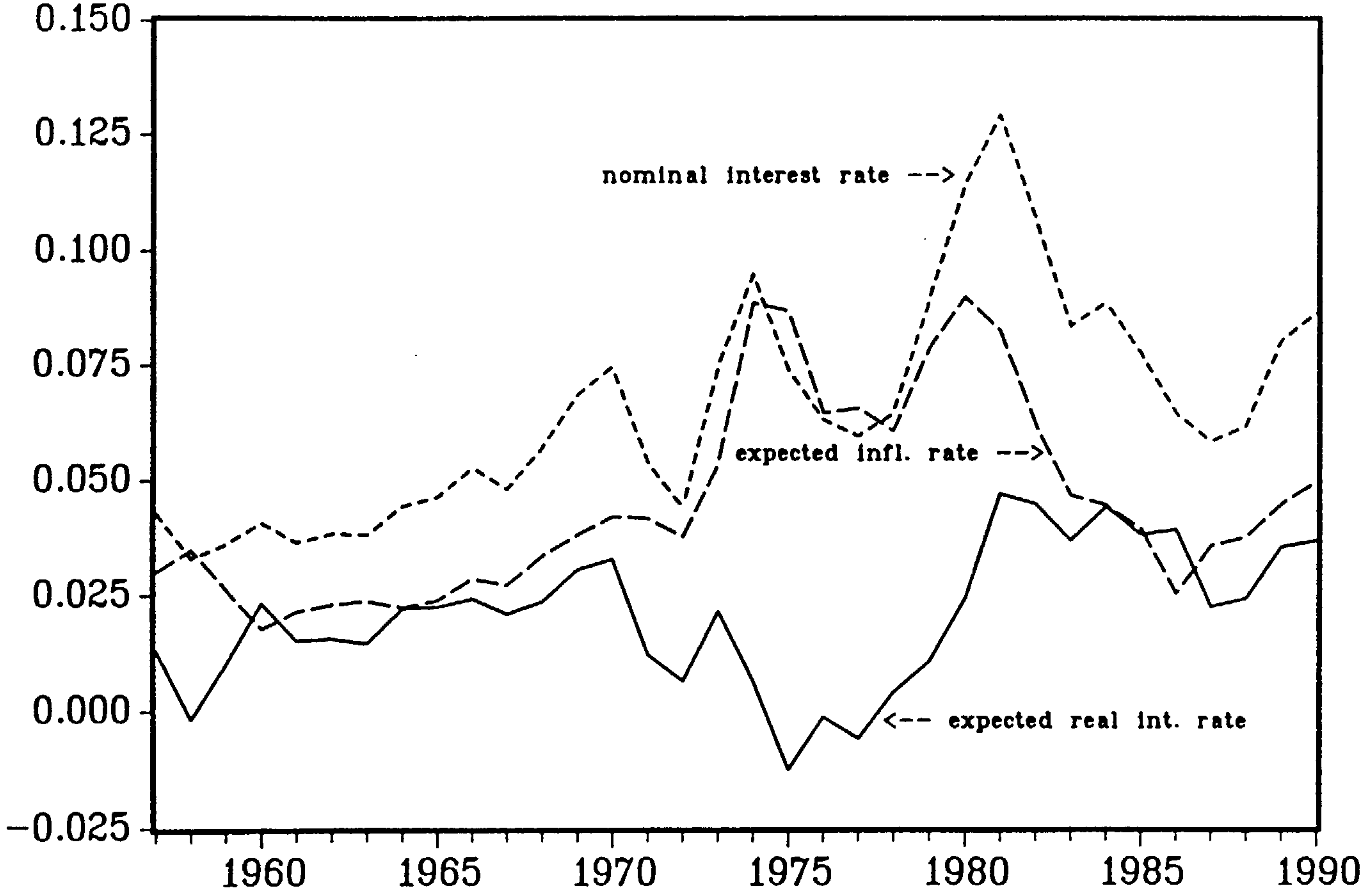


Figure 4 Expected Real Interest Rates in the U.S. and 8 other Countries

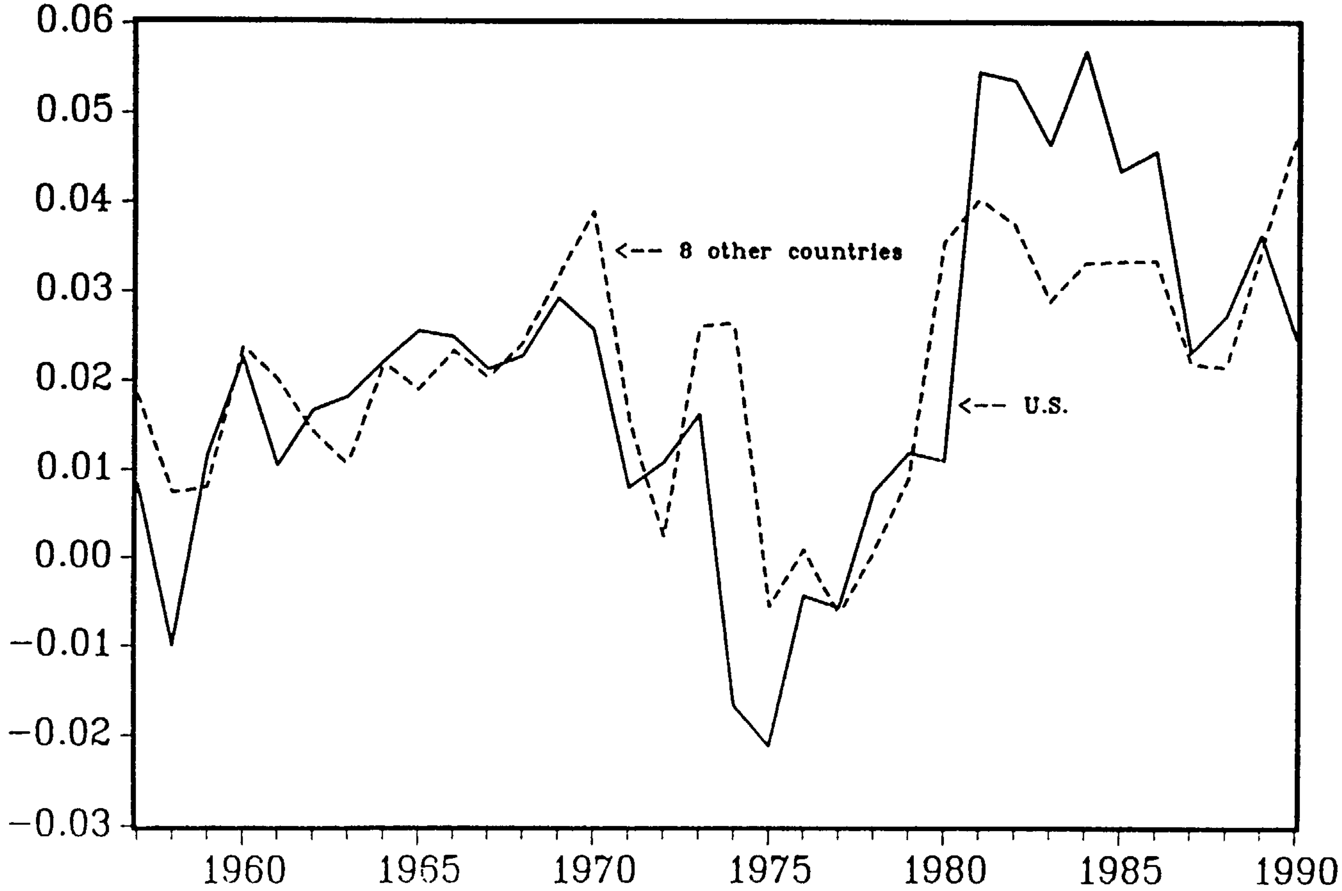


Figure 5 Simulated Effect of Stock-Market Boom on Investment Ratio

Figure 6 Simulated Effect of Stock-Market Boom on Real Interest Rate

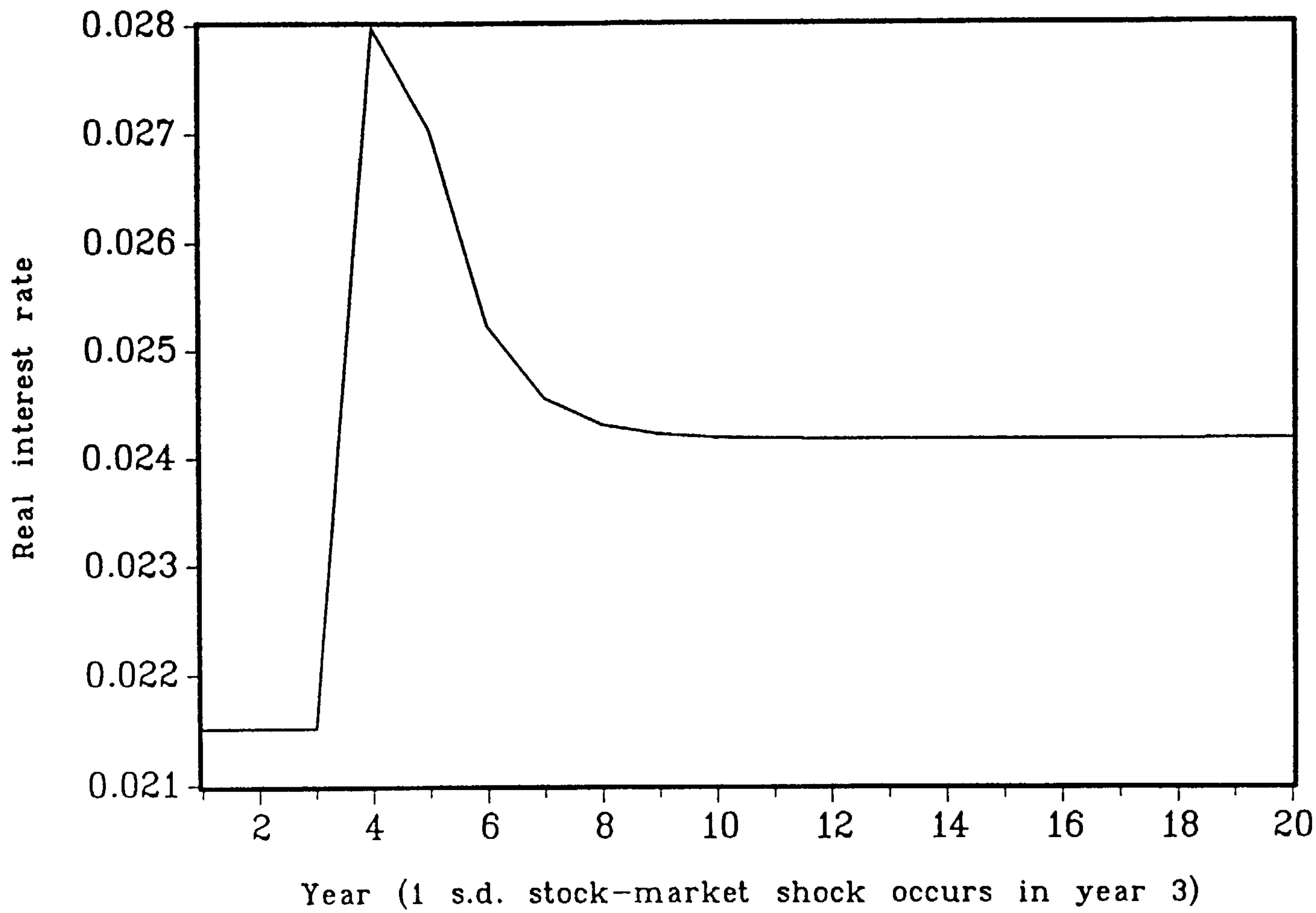


Figure 7 Simulated Effect of Oil Shock on Investment

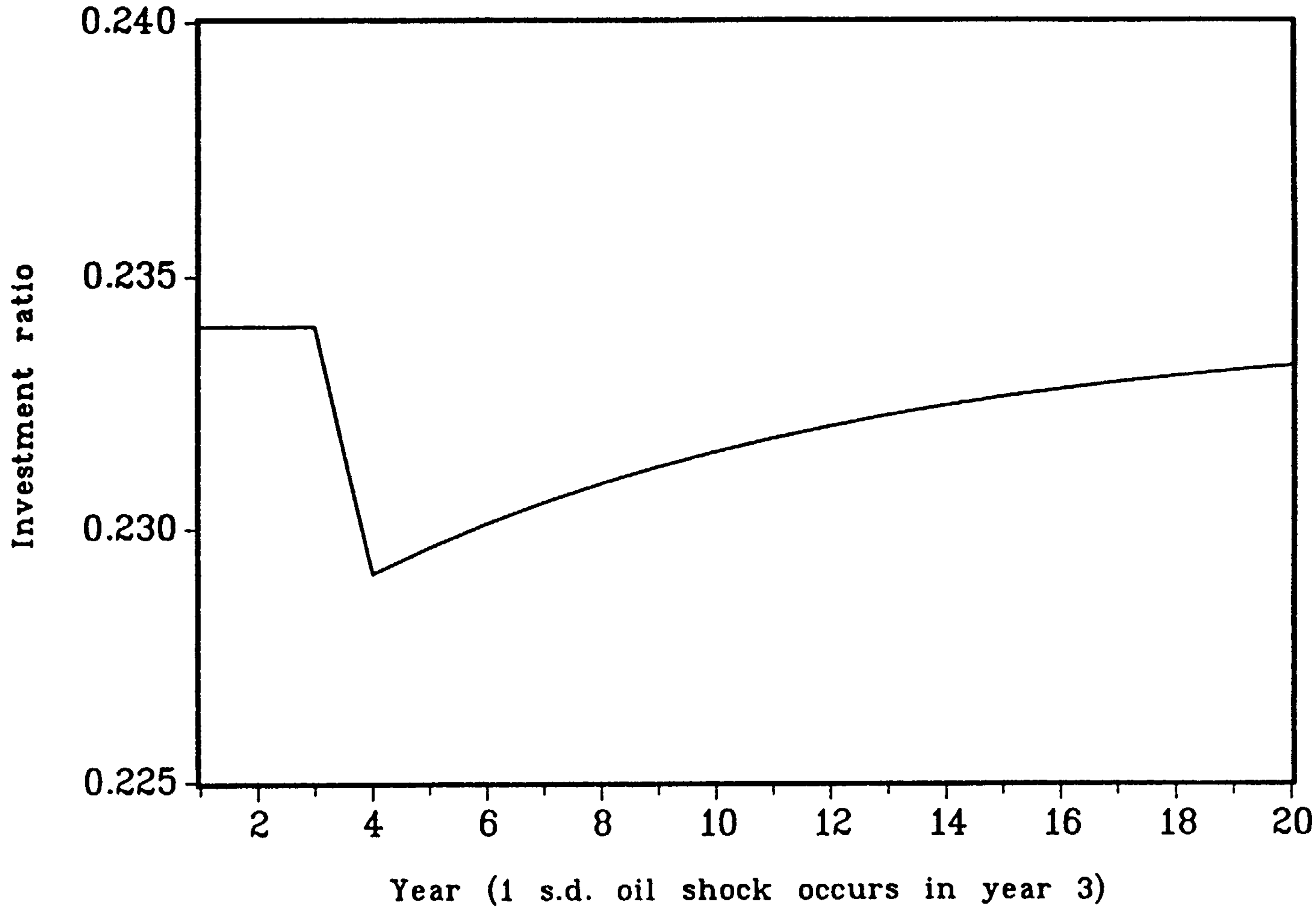


Figure 8 Simulated Effect of Oil Shock on Real Interest Rate