The Impact of Net International Capital Inflows on Nominal Long-Term Interest Rates in France

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Previous research on the impact of net international capital inflows on domestic interest rates has been almost exclusively founded in regression analysis and has yielded mixed results. Some studies find that net capital inflows reduce domestic interest rates, whereas others find no such impact. The present study, which applies cointegration techniques to quarterly data over the 1973-93 period, finds that such capital inflows to a major industrialized nation, France, may not only reduce longer term interest rates in that nation but may also offset a large portion of the longer term interest rate impact of that nation's central government budget deficit. (JEL H62, E44, F21)

Introduction

In recent years, determinants of interest rates have been investigated extensively by a number of macroeconometric studies, in most cases using regression analysis [Alexander, 1989; Al-Saji, 1991, 1992, 1993; Barth et al., 1984, 1985; Belton, 1994; Cebula and Belton, 1993; Cebula, 1988, 1992; Cebula and Hung, 1992; Evans, 1985, 1987; Findlay, 1990; Hoelscher, 1983, 1986; Hutchinson and Pyle, 1984; Makin, 1983; Ostrosky, 1990; Saltz, 1992, 1993; Tanzi, 1985; Tran and Swahney, 1988; Zahid, 1988].[1] Although many of these studies address interest rate determinants for the U.S. or Canada, several address this issue for European Economic Community nations such as France, Italy, and the United Kingdom [Al-Saji, 1991, 1992, 1993; Belton, 1994; Cebula, 1992; Evans, 1987; Saltz, 1992].

Macroeconometric interest rate studies more often than not focus on short-term interest rates so that long-term rates tend to be somewhat neglected. This is unfortunate since long-term interest rates—much more than short-term rates—influence capital formation and, hence, economic growth. Another unfortunate trait of these studies is their use of mere regression analysis—most commonly single-equation estimations—which, although useful, is not the most rigorous tool currently available for such analysis. Finally, only a small percentage of these studies focuses on the interest rate effects of international capital flows, which is also unfortunate since the global economy is becoming increasingly integrated and the growth rate of international capital flows is accelerating.

Accordingly, this study seeks to provide further insight into the domestic interest rate impact of net international capital inflows. The focus is on investigating the effects of

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such capital inflows on the nominal long-term interest rate in a major industrialized nation, France, by using an alternative to regression, cointegration. The choice of cointegration in lieu of regression is based on the finding (discussed below) that the time series under study are all nonstationary in levels. In such circumstances, cointegration may be a more appropriate tool of analysis than regression [Ramanthan, 1992, pp. 501-2]. There are studies that empirically find that net capital inflows reduce domestic interest rates or, equivalently, that net capital outflows raise domestic interest rates [Cebula, 1992 for Italy; Cebula, 1988; Cebula and Belton, 1993; Tran and Sawhney, 1988 for the U.S.] or argue that such is the case [Hoelscher, 1986; Zahid, 1988]. However, there are also a number of empirical studies that find capital inflows to not significantly affect interest rates [Al-Saji, 1993; Saltz, 1992 for the United Kingdom; Belton, 1994 for France; Saltz, 1993; Belton, 1992 for the U.S.; Cebula and Hung, 1992 for Canada]. Thus, based on regression studies, this issue is still unresolved.

It is hoped that cointegration analysis can shed light on the true interest rate impact of net international capital inflows. The various tests involved in cointegration analysis can be used to determine the existence of long-term relationships among the variables in a model. Although there are a number of cointegration tests available, the Johansen and Juselius [1990] test is herein adopted since it appears to provide consistent results across a large number of variables.

The focus on the longer term interest rate reflects the concern in this study with a variable that presumably plays a key role in capital formation and long-run economic growth. To focus on short-term rates would be to focus on rates that presumably do relatively little to directly influence domestic capital formation and the rate of economic growth. Finally, the focus on France reflects the fact that relatively few macroeconometric studies have addressed the capital flow and interest rate issue for France. In addition, it reflects the availability of a dependable and consistent set of time series for France. Finally, it shows that France is a major industrialized (G7) nation that plays a visible role in global economic events.

The basic model is provided in the next section, while the third section provides the empirical framework. The cointegration analysis is presented in the fourth section and conclusions are found in the final section.

The Basic Framework

Following many of the previous macroeconometric studies of determinants of interest rates, an open-economy loanable funds model is adopted as the framework for the analysis. Following in principle Barth et al. [1984, 1985], Cebula [1988, 1992], and Hoelscher [1986], the model here regards the long-term nominal interest rate as being determined by a loanable funds equilibrium of the following form:

$$DD + K = DS + D \ , \tag{1}$$

where: DD = real domestic private sector demand for long-term bonds; K = real net capital inflows; DS = real domestic private sector supply of long-term bonds; and D = real net borrowing by the central government. The following behavioral relationships are hypothesized:

$$DD = DD(R, P^e, RSR); \; DD_R > 0, \; DD_{Pe} < 0, \; DD_{RSR} < 0 \tag{2}$$

$$DS = DS(R, P^e, PCY); \; DS_R < 0, \; DS_{Pe} > 0, \; DS_{PCY} > 0 , \tag{3}$$

where: R = nominal long-term interest rate; P^e = expected future inflation; RSR = *ex ante* real short-term interest rate; and PCY = percentage change in real GDP.

It is hypothesized, in accord with the standard loanable funds model, that the real domestic private sector demand for long-term bonds is an increasing function of the nominal long-term interest rate and a decreasing function of expected inflation. In addition, it is expected that the real demand for long-term bonds is a decreasing function of the *ex ante* real short-term interest rate because the higher the latter rate, the greater the degree to which private sector bond demanders (buyers) substitute short-term bonds for long-term bonds.

It also is hypothesized that, in accord with conventional wisdom, the real domestic private sector supply of long-term bonds is a decreasing function of the nominal long-term interest rate and an increasing function of expected inflation. Finally, the variable PCY is included in the bond supply function to help capture any accelerator effects of real GDP changes on aggregate investment demand. This is in principle similar to the treatments in Cebula [1988] and Hoelscher [1986].

Substituting (2) and (3) into (1) and solving for R yields:

$$R = R(P^e, RSR, PCY, K, D) , \tag{4}$$

where it is expected that:

$$R_{Pe} > 0, \quad R_{RSR} > 0, \quad R_{PCY} > 0 \tag{5}$$

$$R_K < 0, \quad R_D > 0 . \tag{6}$$

The first three signs follow directly from (2) and (3). As for the sign on R_K, it is argued here that the higher the net capital inflow, the greater the degree to which downward pressure on interest rates is expected since these net capital inflows absorb domestic debt issues, including those of the central government [Cebula, 1992; Cebula and Belton, 1993; Hoelscher, 1986; Tran and Sawney, 1988; Zahid, 1988]. Finally, as conventional

macroeconomic theory argues, central government budget deficits tend to create upward interest rate pressure as the government competes in the marketplace for funds.

Empirical Framework

The empirical framework is based on the model expressed in (4). That model is modified somewhat for estimation purposes. For example, net capital inflows and the measure of government borrowing (the central government budget deficit) are both expressed as percentages of GDP. This scaling is done so that the net capital inflows and the budget deficit can each be measured relative to the size of the economy [Cebula, 1988; Cebula and Belton, 1993; Evans, 1985, 1987; Hoelscher, 1986; Ostrosky, 1990]. Measuring a variable such as net capital inflows merely in real terms would not provide a perspective against which to judge or interpret its relative size.

The empirical model to be investigated is given by:

$$LTGB = g(D/GDP,\ K/GDP,\ P^e,\ STGB,\ PCY)\ , \tag{7}$$

where: $LTGB$ = nominal average interest rate yield on five-year government bonds, expressed as a percent per annum; D/GDP = the central government budget deficit as a percentage of GDP; K/GDP = net capital inflow as a percentage of GDP; P^e = proxy for expected inflation, expressed as a percent per annum; $STGB$ = *ex ante* real short-term average interest rate yield, expressed in terms of the call money rate, as a percent per annum; and PCY = percent change in real GDP, expressed as an annual rate. Thus, the variables R, D, K, and RSR in (4) through (6) are represented in (7) by $LTGB$, D/GDP, K/GDP, and $STGB$, respectively. The analysis uses quarterly data for the period 1973.2-1993.3. Since it begins with 1973.2, the study period begins after the collapse of Bretton Woods. Hence, an effectively uniform exchange rate system prevails over the entire study period.

Quarterly data series from the International Financial Statistics (IFS) CD-ROM were obtained for the variables. The net capital inflow variable was calculated from the components of the capital account as given in the balance of payments section of the IFS CD-ROM. The sum of the direct, portfolio, and other investment series was converted to French francs using an average of quarter exchange rates. The expected inflation variable was estimated as follows:

$$P_t^e = (4P_{t-1} + 3P_{t-2} + 2P_{t-2} + P_{t-4})/10\ , \tag{8}$$

where: P_t^e = expected inflation in quarter t, as a percent per annum and P_{t-j} = actual inflation in quarter $t - j$, as a percent per annum, $j = 1, \ldots, 4$.

Here, in principle following Cebula [1992, p. 400], expected inflation in a given quarter is treated as a weighted average of actual inflation rates over the previous four quarters, with the more recent actual inflation experiences having more weight than the

less recent ones. Although this study uses the formulation in (8), it should be noted that using the previous quarter's actual inflation rate as the measure of expected inflation (as apparently done by Al-Saji [1991] for the case of Italy, in Belton [1994] for the case of France, and in Findlay [1990] for the U.S.) does not alter the conclusions in any significant way. The short-term interest rate was converted from nominal to *ex ante* real terms using the formulation for P^e in (8). The original data series and transformations applied thereto are summarized in Table 1.

Cointegration

Prior to the cointegration analysis, the Augmented Dickey-Fuller (ADF) test was performed on each of the data series to test for stationarity of the variables. The lag length (=1) used for each ADF test was set using a Ljung-Box Q test. The lag lengths were identical to those of the Lagrange-Multiplier test. The results of the ADF test are shown in Table 2. In all cases, the variables are found to be stationary in first differences.

To begin the cointegration analysis, the order of the vector autoregression (VAR) system for the model was determined. Beginning with $m = 1$, a series of likelihood ratio tests comparing VAR models with m and $m + 1$ lag lengths was performed. The index m was increased until the test statistic failed to reject at the 5 percent level of significance the hypothesis that the order is m against the alternative that the order is $m + 1$. Cointegration test statistics were generated using the residuals from the following two regression models [Johansen and Juselius, 1990, pp. 171, 175]:

$$\delta Y_t = b_0 + \sum_{i=1}^{m-1} b_i \delta Y_{t-i} + e_t \tag{9}$$

$$Y1_{t-m} = \sum_{i=1}^{m-1} c_i \delta Y_{t-i} + e1_t \,, \tag{10}$$

where: Y_t is a sequence of random vectors with components *LTGB*, *D/GDP*, *K/GDP*, *STGB*, P^e, and *PCY*; e_t and $e1_t$ are vectors of residual series; and $Y1_t$ represents the vector of series Y_t with a constant series (of ones) appended. The possible inclusion of a linear trend in the cointegration model was investigated and ultimately dismissed. This is because a likelihood ratio test comparing a model with a trend versus a model without a trend resulted in negative test statistics, indicating that a trend variable would overspecify the model.

The canonical correlations of the two sets of residuals, e_t and $e1_t$, were calculated. Eigenvalues generated from this process, which are squared canonical correlations, are employed in the maximum eigenvalue and trace tests developed by Johansen [1988] and Johansen and Juselius [1990]. Eigenvalues for France were produced from the squared

TABLE 1
Data Description and Identification from the IFS CD-ROM

Variable	IFS Series Description	IFS Time Series Key	Units
LTGB (Long-term government bond rate)	Government Bond Yield	13261	Percent per annum
K/GDP (Net capital inflow scaled by GDP)	Direct Investment N.I.E.	13277 BADZF	Millions of U.S. dollars (converted to billions in this study)
	Portfolio Investment N.I.E.	13277 BBDZF...	Millions of U.S. dollars (converted to billions in this study)
(Average exchange rate series)	Official Rate	132..RF.ZF...	n.c. unit: U.S. dollar Seasonal adjustment (X-11)
D/GDP (Budget deficit scaled by GDP)	Deficit (-) or Surplus (+)	13280...ZF...	Billions of n.c. units Seasonal adjustment (X-11)
P (Inflation)	Consumer Prices	13264...ZF... 1990=base year	Percent per annum
STGB (Real short-term interest rate)	Call Money Rate-Avg.	13260B..ZF...	Percent per annum
PCY (Real GDP growth rate)	Gross Domestic Product	13299B.CZF...	Billions of n.c. units Seasonal adjustment (X-11)

canonical correlations of e_t and $e1_t$. This procedure produced $v + 1$ eigenvalues, $\tau_1, \ldots, \tau_{v+1}$, where v is the number of variables in the cointegration model. The eigenvalues $\tau_1, \ldots, \tau_{v+1}$ are so ordered that $\tau_1 > \tau_2 > \ldots > \tau_{v+1}$.

TABLE 2
Augmented Dickey-Fuller Test Statistics

Variable First Difference	Lags	π_μ
LTGB	1	-4.30*
D/GDP	1	-10.39*
K/GDP	1	-14.3*
P^e	1	-4.8*
STGB	1	-6.42*
PCY	1	-11.0*

* Indicates rejection of the null hypothesis at the .05 percent level of significance. Critical value: π_μ (n=100) = -2.89.

The trace test has a null hypothesis of r or fewer cointegrating vectors and a general alternative hypothesis. To test H_0: $r \leq R$, the trace test statistic

$$-n \sum_{i=R+1}^{v+1} \ln (1 - \tau_i) \tag{11}$$

was calculated where n is the number of observations. The null hypothesis of the maximum eigenvalue test, that there are exactly r cointegrating vectors, is evaluated against the alternative hypothesis of $r + 1$ cointegrating vectors. In this case, to test H_0: $r = R$, the maximum eigenvalue test statistic was calculated:

$$-n \ln (1 - \tau_{R+1}) \; . \tag{12}$$

Table 3 provides the results of the trace and maximum eigenvalue tests. First consider the trace test results. As shown in Table 3, the nulls $r \leq 0$ and $r \leq 1$ are rejected at the 95 percent confidence level. Next, consider the maximum eigenvalue test results. As shown in Table 3, the nulls $r = 0$ and $r = 1$ are rejected at the 95 percent confidence

level. Thus, according to both the trace and maximum eigenvalue tests, there are two cointegrating vectors.

TABLE 3
Trace Test and Maximum Eigenvalue Test Statistics

Trace Test Statistics		Critical Value (0.5)
$r \leq 0$	143.01*	102.139
$r \leq 1$	87.55*	76.069
$r \leq 2$	47.25	53.116
Maximum Eigenvalue Test Statistics		**Critical Value (0.5)**
$r = 0$	57.19*	40.303
$r = 1$	39.15*	34.400
$r = 2$	25.02	28.138

* Indicates rejection of the null hypothesis at the .05 percent level of significance. Critical values come from Osterwald-Lenum [1992, Table D.3].

The presence of cointegrating vectors implies the existence of long-term relationships among the variables in the model. These relationships can be interpreted economically through normalization of the cointegrating vectors. Each of the two cointegrating vectors was normalized by dividing each vector by its value of the reported *LTGB* coefficient. The results of this normalization process, transformed (by multiplying by -1) for interpretation, are provided in (13) and (14):

$$LTGB = \underset{[0.001]}{9.91} + \underset{[0.041]}{0.41\,D/GDP} - \underset{[0.034]}{0.17\,K/GDP} + \underset{[0.23]}{1.637\,P^e} + \underset{[0.35]}{1.7\,STGB} + 0.86PCY \tag{13}$$

$$LTGB = \underset{[0.0009]}{-270.8} + \underset{[-1.48]}{38.3\,D/GDP} - \underset{[-0.028]}{26.4\,K/GDP} + \underset{[0.059]}{12.9\,P^e} - \underset{[0.32]}{27.2\,STGB} - 32.0PCY. \tag{14}$$

For the convenience of the reader, the alpha coefficient for each variable in each normalized cointegrating vector is provided in (13) and (14) beneath elasticities in brackets. These alpha coefficients can be viewed as the average speed of adjustment toward the equilibrium state. Larger alpha coefficients (expressed in absolute value) indicate a more rapid speed of adjustment, whereas smaller alpha coefficients (expressed in absolute value) indicate a slower speed of adjustment.

In any case, both of the cointegrating vectors have been normalized and can be interpreted. Prior to doing so, however, two observations are in order. First, note that the nonbracketed figures shown in (13) and (14) are actually long-run elasticities. Second, as indicated in Table 1, the original form of the budget deficit data was as follows: a budget surplus was reported as a positive number [surplus (+)] and a budget deficit was reported as a negative number [deficit (-)]. To facilitate the exposition, the budget deficit and surplus data were multiplied by -1.

The results in (13) and (14) are now discussed. As shown, both normalized cointegrating vectors indicate that the nominal long-term interest rate is positively related with expected inflation and the government budget deficit. The latter result is consistent with a number of studies of various nations.[2] The results for the *PCY* variable and the real *ex ante* short-term interest rate (*STGB*) variable are mixed, however, since for both variables the elasticity is negative in one case and positive in the other. However, the results in both vectors do imply that the nominal long-term rate of interest in France is related negatively with net international capital inflows.[3]

A direct comparison of the budget deficit and capital inflow elasticities summarized in (13) and (14) is of interest because a comparison indicates the extent to which net capital flows might offset the interest rate effects of budget deficits. Expressed in terms of absolute values, in (13), the capital flow elasticity is 41 percent of the deficit elasticity, whereas in (14), the capital flow elasticity is 69 percent of the budget deficit elasticity. Thus, it appears that the capital inflow variable may partially offset the long-term interest rate effects of the budget deficit.

To further test the basic model, the likelihood ratio test recommended by Johansen and Juselius [1990] is applied to examine the impact of each individual time series variable in the model. In the likelihood ratio test, the eigenvalues from an unrestricted cointegration model (τ_i) are compared to those from a restricted model (τ_i^*) produced by dropping the variable being examined. The test statistic

$$-n \sum_{i=1}^{r} \ln [(1 - \tau_i^*) / (1 - \tau_i)] \tag{15}$$

is calculated and has a chi-square distribution with $r(v - v^*)$ degrees of freedom, where r is the number of cointegrating vectors, v is the number of variables in the unrestricted cointegration model, and v^* is the number of variables in the restricted model.

The likelihood ratio test statistics are reported in Table 4. All restricted models are rejected in preference for the unrestricted model at the 95 percent confidence level (and even at the 99 percent confidence level). Accordingly, the likelihood ratio test results

strongly imply that all of the variables employed in the model do indeed make a significant contribution during the study period. Thus, to eliminate any of the variables in the system would introduce omitted-variable bias.

TABLE 4
Likelihood Ratio Test Statistics[a]

Variable	Statistic
LTGB	29.7*,**
D/GDP	9.77*,**
K/GDP	17.99*,**
P^e	15.7*,**
STGB	30.8*,**
PCY	41.9*,**

[a] Degrees of freedom = 2. * Indicates rejection of the null hypothesis at the 95 percent confidence level. Critical value = 5.99 [Ramanthan, 1992, Table A.3]. ** Indicates rejection of the null hypothesis at the 99 percent confidence level. Critical value = 9.21 [Ramanthan, 1992, Table A.3].

Conclusion

This study has investigated the impact of net international capital inflows on the nominal longer term interest rate in France during the post-Bretton Woods era. The study is couched in an open-economy loanable funds framework but unlike most earlier related studies, the empirical technique adopted is that of cointegration. The various tests involved in cointegration analysis can be used to determine the existence of long-term relationships among the variables in a model. In the present study, the cointegration results seem to indicate, among other things, that net international capital inflows to France may act to lower the nominal longer term rate of interest in France. Moreover, one very interesting additional finding in this study is that net capital inflows apparently then act to at least partially offset the longer term interest rate effects of central government budget deficits in France. Since the cointegration results would seem to indicate that these budget deficits apparently act to raise longer term interest rates (and thereby presumably to slow both capital formation and the rate of economic growth over time), it appears that net international capital inflows—since they play an offset role to the budget deficit—provide a measurable benefit to the economy of France.

Footnotes

1. Actually, in one case [Alexander, 1989], no formal empirical test is presented.
2. See, for example, the regression analysis in Al-Saji [1991, 1992, 1993], Barth et al. [1984, 1985], Belton [1994], Cebula [1988, 1992], Cebula and Belton [1993], Cebula and Hung [1992], Hoelscher [1986], Hutchinson and Pyle [1984], Saltz [1992, 1993], Tanzi [1985], Tran and Swahney [1988], and Zahid [1988]. The regression studies by Evans [1985, 1987], Findlay [1990], Hoelscher [1983], Makin [1983], and Ostrosky [1990] yield opposing results (although focusing primarily on short-term rather than long-term interest rates).
3. This finding of a negative domestic interest rate impact from net capital inflows (or, equivalently, of a positive domestic interest rate impact from net capital outflows) is consistent with regression findings in Cebula [1988, 1992], Cebula and Belton [1993], and Tran and Swahney [1988] and arguments in Zahid [1988, p. 731]. However, the finding differs from the regression results for capital inflows in the studies by Al-Saji [1993], Belton [1992, 1994], Saltz [1992], and Cebula and Hung [1992].

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