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INTERNATIONAL CAPITAL FLOWS, DEREGULATION AND THE OFFSET COEFFICIENT IN FINLAND 1975–1990

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ABSTRACT

This study examines, using variable-parameter regression, how the offset coefficient in the capital flow equation for Finland has changed over time. We found the constant parameter estimate of the offset coefficient to be stable and quite large. Instead, the interest rate sensitivity has increased due to the liberalization, i.e. international capital flows have become very sensitive to the interest rate differential. We also examined how international capital flows are affected by exchange rate speculations.

TIIVISTELMÄ

Tutkimme muuttuva-parametrisen regressioanalyysin avulla kuinka rahamarkkinoiden liberalisoituminen on vaikuttanut pääomavirtojen vuotokertoimen arvoon Suomessa. Havaitsimme, että estimoitu vuotokerroin on säilynyt vakiona ja on arvoltaan varsin suuri. Sen sijaan korkoherkkyys on kasvanut liberalisoinnin seurauksena, toisin sanoen pääomavirrat ovat tulleet varsin herkiksi kotimaan ja ulkomaiden väliselle korkoerolle. Lopussa analysoimme kuinka valuuttakurssispekulaatiot vaikuttavat pääomavirtoihin.

CONTENTS

1. INTRODUCTION

Historically, financial markets in Finland have been tightly regulated which has given the Bank of Finland a great deal of monetary autonomy. Regulations have included restrictions on international capital flows as well as domestic lending and deposit rates, thus implying credit rationing.

Recently financial markets have experienced deregulation. This has led to a situation where domestic interest rates are determined by the equilibrium in the money market. International capital flows have become more sensitive to the yield differential between domestic and foreign assets. Consequently the monetary autonomy of the central bank has declined because in the present environment offsetting capital flows tend to eliminate, at least partially, the effects of money supply changes on domestic interest rates. Starck (1988) has reviewed some recent evidence concerning the effects of financial liberalization on money markets in Finland.

This study examines empirically, using variable-parameter regression, how the value of the offset coefficient has changed over time due to deregulation. We begin with a theoretical note about the framework and then proceed with the empirical estimation. In the end we discuss shortly how currency speculations have influenced international capital flows.

2. A SUMMARY OF THE MODEL

The economy is described by two market clearing conditions which together determine domestic interest rate and the net flow of capital. The structural model is taken from the Bank of Finland quarterly model (BOF4), hence we will describe it only briefly.

The demand for money is given by eq. (1) and it is a linear function of nominal income and the opportunity cost of holding money. A lagged dependent variable in the money demand equation allows a slow adjustment in money holdings in the short-run.

$$(1)\quad M/Y_{-1} = k + a(DY/Y_{-1}) - c(i-i_d) + e(M/Y)_{-1}$$

where M = money aggregate (will be specified later), Y = nominal GDP, i = short-term market interest rate, i_d = time deposit rate. Hence $i - i_d$ measures the opportunity cost of holding money. A discrete change in variable s is denoted by Ds. In the long-run the income-elasticity of the demand for money is constant. The opportunity cost of holding money is specified as the difference between market and time-deposit rates of interest. For convenience, we rewrite eq. (1) in difference form.

$$(2)\quad DM/Y_{-1} = aD(DY/Y_{-1}) - c(Di-Di_d) + eD(M/Y)_{-1} + (DY_{-1}/Y_{-2})(M/Y)_{-1}$$

The balance of payments equilibrium can be specified as follows:

$$(3)\quad DR = CA + KA$$

where DR = change in official foreign exchange reserves, CA = current account balance and KA = capital account balance which measures the net flow of capital into the country.

We shall assume, as in BOF4, that the net capital flows depend upon the change in the yield differential between domestic and foreign assets. The interest rate effect is normalized by the lagged nominal GDP which serves as a proxy for nominal wealth.

$$(4)\quad KA/Y_{-1} = b(Di-Di_f) + v$$

where i_f = foreign rate of interest and v represents the impact of a change in nominal wealth on capital flows. Before we are ready to write the solution for the net capital flows, we need to specify the supply of money in the domestic economy. In the difference form the supply of money equals

$$(5)\quad DM = DL + DR$$

where DL = change in domestic credit. By using eqs. (2) through (5), we can determine the reduced-form solution for the net capital flows.

$$(6)\quad KA/Y_{-1} = k_1(Di_d-Di_f) + k_2D(M/Y)_{-1} + k_3D(DY/Y_{-1}) - k_4[(CA+DL)/Y_{-1} - (DY_{-1}/Y_{-2})(M/Y)_{-1}] + k_5$$

where $k_1 = bc/(b+c)$, $k_2 = eb/(b+c)$, $k_3 = ab/(b+c)$, $k_4 = b/(b+c)$ and $k_5 = cv/(b+c)$. The above equation is similar to the capital flow equation in Kouri and Porter (1974) where k_4 is interpreted as the offset coefficient. It measures the proportion of a change in the domestic credit which is offset by changes in the capital flows. Ideally, if capital flows are perfectly elastic, the offset coefficient should equal one which implies that domestic monetary authority has no policy autonomy because the policy is unable to influence domestic interest rates. In practice, however, there are several reasons why the offset coefficient may be smaller than one. For instance, capital flows may be restricted because of regulations issued by the policy authority.

Notice that in the present framework exchange rate expectations are assumed to remain constant over time. This is not to argue that exchange rate expectations are unimportant, even though Finland has adopted a fixed exchange rate regime, i.e. under "normal" conditions it is likely that changes in expectations have been relatively small. It mainly reflects the fact that exchange rate expectations are difficult to measure in practice.

In the following section we estimate the reduced-form equation for the net capital flows using quarterly data of the Finnish economy.

3. ESTIMATION USING BROAD MONEY

The estimation is done for a period 1975:1-1990:4 using quarterly data of the Finnish economy. We will use two alternative measures of money supply. We begin by estimating the capital flow equation, eq. (6), using the broad money supply which is also used in the Bank of Finland quarterly model (BOF4). The broad money supply, M3, includes currency and all bank deposits which do not bear market rates of interest. Thus money market liabilities in the form of money market deposits (CD's) are excluded. An alternative measure for the money supply is the narrow money supply, M1, which includes currency, demand deposits and transaction account.

The capital flow equation is estimated using single-equation estimation technique. Table 1 gives the results when the broad monetary aggregate is used.

TABLE 1. Capital Flow Equation Using Broad Money

Coefficient	Estimate	T-statistic
k(1)	0.003	1.006
k(2)	0.849	12.453
k(3)	0.127	1.789
k(4)	0.944	22.275
k(5)	0.001	0.708
Dummy1	-0.130	-7.311
AR(1)	-0.430	-3.204

R^2(adj) = 0.843 RMS error = 0.018 DW = 2.283

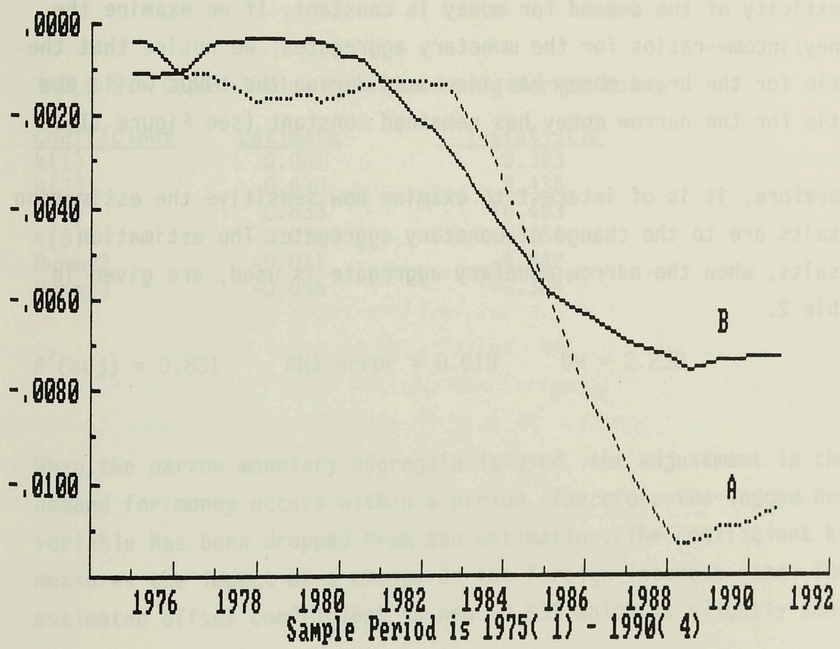
The offset coefficient, k(4), equals -0.944 which indicates that changes in the domestic credit are immediately reflected in the capital account. The test statistic shows that the constant parameter estimate is very stable. Hence the value of the offset coefficient has not responded to the liberalization. The coefficient of interest rate differential, k(1), is not statistically significant. Also the size of the coefficient is small. This may be, at least partly, due to the fact that single-equation estimation technique introduces simultaneous equation bias in the parameter estimates. A more likely reason in the

present situation is that the coefficient is not constant but time-varying. That is, financial liberalization has increased the sensitivity of capital flows to interest rate differential between domestic and foreign assets.

To examine whether or not the offset coefficient, or any other coefficient, has changed over time, we use variable-parameter regression (VPR) which is a generalization of dynamic regression where some coefficients are time-varying, either deterministically or stochastically. In VPR the maximum likelihood parameters are determined by two iterative processes. First a number of iterations are performed by using EM algorithm. Then the remaining iterations are performed using Gauss-Newton method to obtain final convergence. The time-varying coefficients are estimated using a random-walk process, i.e. the coefficient $s(t+1) = s(t) + \epsilon(t+1)$ where $\epsilon(t+1)$ is a white noise process.

In the following we apply the variable-parameter regression, VPR, to the capital flow equation. Curve A in Figure I shows the estimated

FIGURE I



time-varying coefficient of the interest rate differential, k(1), which has increased significantly due to the liberalization. It is also noticable that the interest rate sensitivity of international capital flows started to increase even before the beginning of liberalization in 1984 which indicates that the imposed controls on capital flows were ineffective. By the end of 1980's the interest rate sensitivity of international capital flows has increased by a factor of ten which implies that a one percentage point increase in the interest rate differential, given a constant domestic credit, causes a capital inflow of 2500 million in 1990.

In general, the estimated time-varying coefficients must be viewed as proxies and should be interpreted with caution. This is because the coefficients are sensitive to model specification, hence it is possible that parameter variations are caused by other factors such as omitted variables and incorrect model specification.

4. ESTIMATION USING NARROW MONEY

In the theoretical model it was assumed that the long-run income-elasticity of the demand for money is constant. If we examine the money/income-ratios for the monetary aggregates, we notice that the ratio for the broad money has increased during the 1980s while the ratio for the narrow money has remained constant (see Figure II).

Therefore, it is of interest to examine how sensitive the estimation results are to the change of monetary aggregate. The estimation results, when the narrow monetary aggregate is used, are given in Table 2.

FIGURE II

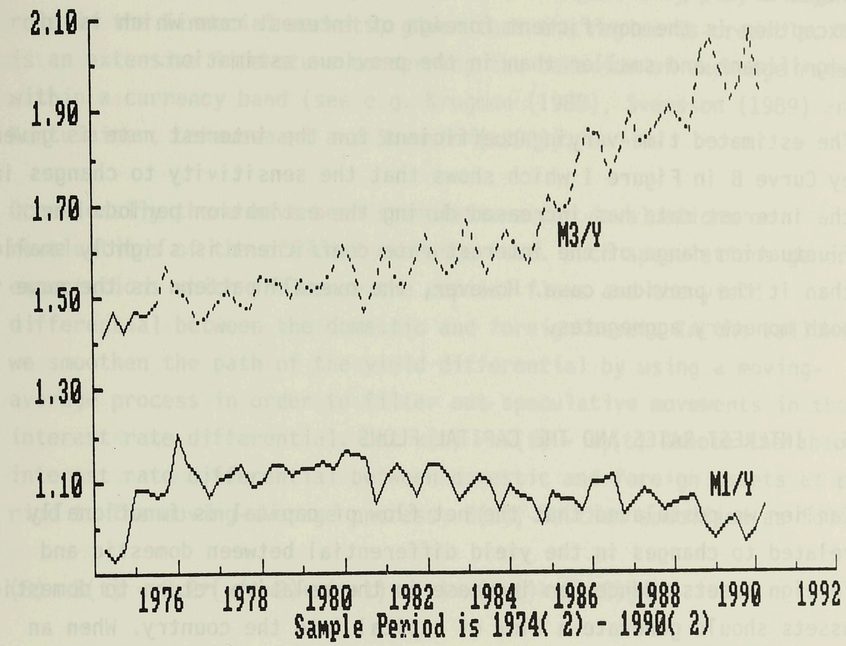


TABLE 2. Capital Flow Equation Using Narrow Money

Coefficient	Estimate	T-statistic
k(1)	0.001	0.323
k(3)	0.630	9.436
k(4)	0.833	16.463
k(5)	0.016	5.354
Dummy2	-0.071	-4.842
Dummy3	-0.056	-9.304

R^2(adj) = 0.831 RMS error = 0.019 DW = 2.230

When the narrow monetary aggregate is used, the adjustment in the demand for money occurs within a period. Therefore the lagged dependent variable has been dropped from the estimation. The coefficient k(1) measures the impact of a change in the foreign interest rate. The estimated offset coefficient is now -0.833 which is slightly smaller

than in the previous estimation. However, it is statistically significant and receives the correct sign. Other coefficients have correct signs as well, and most of them are statistically significant. The only exception is the coefficient foreign of interest rate which is in significant and smaller than in the previous estimation.

The estimated time-varying coefficient for the interest rate is given by Curve B in Figure I which shows that the sensitivity to changes in the interest rate has increased during the estimation period. The fluctuation range of the interest rate coefficient is slightly smaller than it the previous case. However, the overall pattern is the same for both monetary aggregates.

5. INTEREST RATES AND THE CAPITAL FLOWS

Earlier we postulated that the net flow of capital is functionally related to changes in the yield differential between domestic and foreign assets. Hence, an increase in the relative return to domestic assets should generate a flow of capital into the country. When an equation for the net capital flows, see eq. (4), is estimated for the period 1975:1-1990:4, we obtain the following result:

$$(7)\quad KA/Y_{-1} = 0.023 - \underset{(-0.40)}{0.001}[Di-Di_f]$$

$R^2(adj) = 0.00$ RMS error = 0.049 DW = 1.127

The parameter estimate for the return differential is not statistically significant and receives a negative, incorrect, sign. One reason for the poor performance of the capital flow equation may be that at times the interest rate differential and capital flows have moved to opposite directions, for instance, due to currency speculations. When investors expect that the currency is devaluated in the near future, they export capital, even though at the same time the domestic interest rate rises relative to the foreign interest rate.

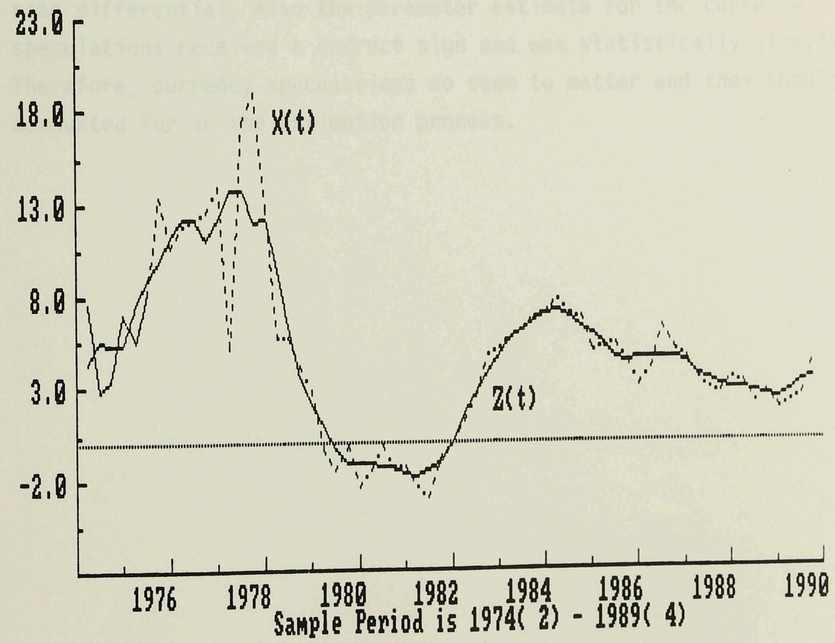
In Finland the monetary authority has adopted a fixed exchange rate regime where the currency index is allowed to move within a currency band. Thus exchange rate expectations do not generally play a major role in the financial markets, given that the regime is credible. There is an extensive literature concerning the behavior of exchange rates within a currency band (see e.g. Krugman (1988), Svensson (1989) and Kontulainen, Lehmussaari and Suvanto (1990)).

Occasionally there have been speculations for devaluations or revaluations of the official exchange rate. Such speculations generate expectations which influence the capital flows and the yield differential between the domestic and foreign asset. In the following we smoothen the path of the yield differential by using a moving-average process in order to filter out speculative movements in the interest rate differential. Let $x(t) = i(t) - i_f(t)$ denote the absolute interest rate differential between domestic and foreign assets at period t. The moving-average process, Z(t), is then specified as follows:

$$(8)\quad Z(t) = 0.2*[x(t+2)+x(t+1)+x(t)+x(t-1)+x(t-2)]$$

where all leads and lags receive identical weights (see Figure III).

FIGURE III.



Suppose that deviation x(t)-Z(t) is due to currency speculations. For instance, if x(t)-Z(t) > 0, then speculations are for devaluation of the exchange rate and should indicate that the flow of capital is out of the country. In the following we estimate the capital flow equation using Z(t) as a proxy for the return differential between domestic and foreign assets while x(t)-Z(t) measures the effect of currency speculations on capital flows.

$$(9)\quad KA/Y_{-1} = 0.023 + \underset{(2.15)}{0.014DZ} - \underset{(-2.451)}{0.015D[x-Z]}$$

R^2(adj) = 0.064 RMS error = 0.046 DW = 1.215

The result shows that the parameter estimate for the return differential is now positive and statistically significant. Additionally, the parameter estimate for currency speculations receives a correct sign, and the coefficient is statistically significant. This indicates that exchange rate expectations are important determinants of international capital flows and hence should be accounted for.

6. CONCLUSIONS

In this study we have examined the effects of financial liberalization in Finland on the offset coefficient and the interest rate sensitivity of international capital flows. We found that in Finland the offset coefficient has remained stable during the estimation period, hence it has not been affected by the financial liberalization. This result is robust for both broad and narrow monetary aggregate. This may be due to the fact that current account imbalances have always been financed through international borrowing. Therefore, capital controls have not imposed a constraint for exports and imports. However, controls on capital movements have mainly limited the demand for foreign capital for speculative purposes. Therefore the elimination of remaining capital controls have increased the interest rate sensitivity of capital flows. From the point of view of monetary policy, the liberalization has reduced the autonomy of domestic monetary authorities, not due to an increase in the offset coefficient, as is commonly thought, but because of an increase in the sensitivity of international capital flows to interest rate differential.

We also estimated the capital flow equation by using a moving-average process for the interest rate differential. The estimation yielded a statistically signicant constant parameter estimate for the interest rate differential. Also the parameter estimate for the currency speculations received a correct sign and was statistically significant. Therefore, currency speculations do seem to matter and they should be accounted for in the estimation process.

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