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HOW ARE THE KEY FINNISH MARKET INTEREST RATES DETERMINED?

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ABSTRACT

Finnish money markets have undergone profound changes in recent years. In particular, the transition to a more market oriented system has changed the way domestic interest rates are formed. This paper presents and quantifies one way of describing the structure and main linkages of the current setting. Key elements of the model are the dependence of the domestic market interest rates on the foreign interest rate, an explicit formulation of the dependence of the domestic short-term market interest rate on purely domestic factors, and explicit considerations of various institutional features of the domestic money market. Empirical evidence on the formation of the domestic shor-term and long-term market interest rates as well as short-term and long-term lending rates is presented, and the results are well in accordance with the theoretical structure of the model.

TIIVISTELMÄ

Rahamarkkinat ovat Suomessa viime vuosina muuttuneet käänteentekevästi. Erityisesti kotimaisten markkinakorkojen määräytyminen on muuttunut kun on siirrytty markkinaehtoisempaan järjestelmään. Tässä selvityksessä esitetään ja kvantifioidaan yksi tapa kuvata nykyisen järjestelmän rakennetta ja tärkeimpiä kytkentöjä. Mallin keskeisiin piirteisiin kuuluvat kotimaisen markkinakoron riippuvuus ulkomaisesta korosta, eksplisiittinen kuvaus kotimaisen markkinakoron riippuvuudesta kotimaisista tekijöistä sekä kotimaisten rahamarkkinoiden erityispiirteiden eksplisiittinen sisällyttäminen analyysiin. Selvityksessä esitetään empiiristä todistusaineistoa kotimaisten lyhyiden ja pitkien markkinakorkojen sekä lyhyiden ja pitkien antolainauskorkojen muodostumisesta, ja tulokset ovat hyvin sopusoinnussa mallin teoreettisen pohjan kanssa.

CONTENTS

1 INTRODUCTION

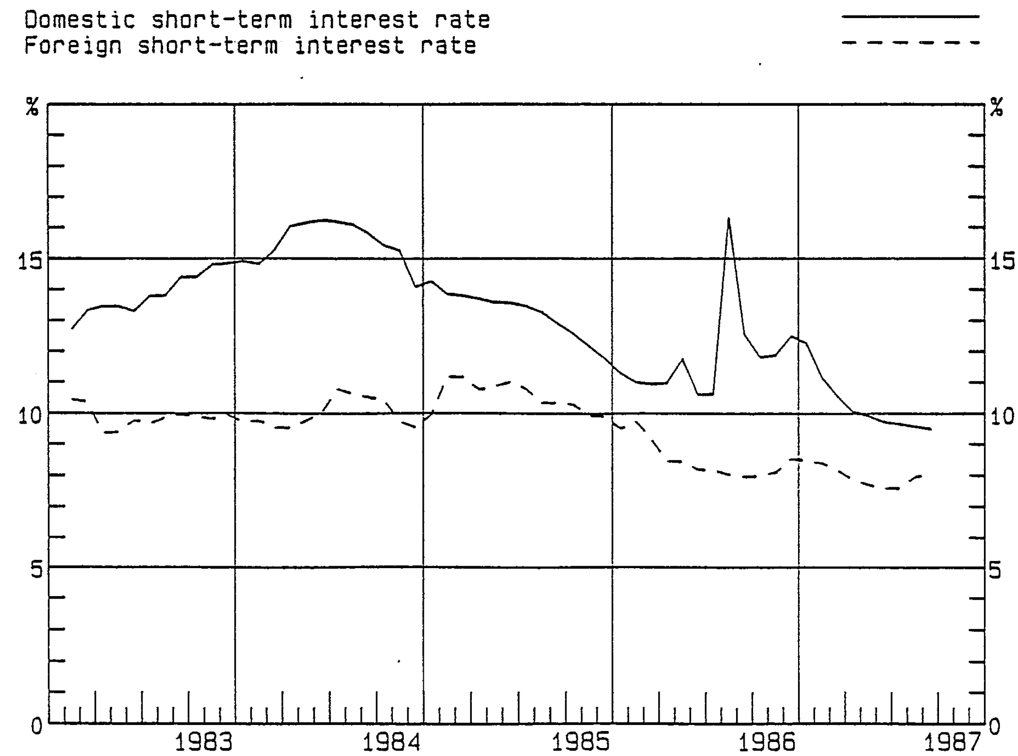
Along with international money markets Finnish money markets have undergone profound changes in recent years. The markets have grown with regard to both depth and width, and wholly new markets have been initiated. Above all, the international linkages among markets have increased beyond anything seen before. Also, the behavior of economic agents is becoming increasingly forward-looking, and awareness of the effective costs of different sources of funding is increasing. In Finland the central bank has actively taken part in this development by gradually liberalizing the financial system and allowing increasing room for market forces. Accordingly, monetary policy is now being conducted utilizing the laws of demand and supply through open market interventions.

The transition to a more market oriented financial system in Finland has altered the role of interest rates and the way domestic interest rates are formed in a profound way. Whereas the main focus was on quantities during the period of credit rationing, emphasis has changed to prices in the unrestricted setting. Interest rates are no longer set by the authorities through administrative measures, but by market forces in fairly well-functioning markets. The aim of this paper is to present and quantify one way of describing the structure and main linkages of the new setting.In section 2 the structure of the framework is presented, and the key behavioral equations are derived in section 3. In section 4 the framework is put to test by contrasting it with Finnish monthly data. Section 5 contains some concluding comments.

2 OVERVIEW OF THE MODEL

During the past few years regulations on capital flows to and from Finland have gradually been eased to the point where the bulk of capital moves next to freely over the borders (see Starck (1988) for a survey of the empirical evidence). As the Finnish markka is credibly pegged to a currency basket this implies that the domestic interest rate cannot diverge from the foreign interest rate more than by a relatively small premium in the long run. Nevertheless, in the short run the domestic interest rate can reflect purely domestic factors (e.g. monetary policy) as well. This theoretical argument is supported by casual inspection of the foreign and domestic interest rate over the period 1983M3 - 1987M9 (see Figure 1), as well as by formal analysis of the data./1/,/2/ A 1 percentage point rise in the foreign interest rate is estimated to lead to a 0.21 percentage point rise in the domestic interest rate in the short run and a 1.01 percentage point rise in the long run. The premium is estimated to be 2.94 percentage points.

Figure 1



Given an equation describing the domestic short-term interest rate as a function of the foreign short term interest rate, factors affecting the domestic short-term interest rate and a premium, one can proceed to the determination of domestic lending rates. The markets for domestic credit in Finland are not yet perfectly competitive, essentially because of the tax-exemption of the publics' deposits with banks. Thus, the lending rate will diverge from the market rate, and in general the lending rate will be affected by the interest rate on deposits and by other factors influencing the demand for credit. With an equation describing the determination of lending rates the link to short-term credits is complete, and the link to long-term lending rates is completed when the formation of long market interest rates is described.

According to the expectations hypothesis of interest rates long interest rates are weighted averages of future short interest rates. However, the theory has not met with convincing empirical success lately. One remedy, which seems particulary relevant to Finnish conditions, is to allow for less than instantaneous adjustment of the long interest rate to movements in the short interest rate. Armed with an equation describing the long market rate the long lending rates can be determined, and the model is complet. The basic structure and linkages of the model is summarized in Chart 1.

Chart 1 Basic structure and linkages of the model

Foreign short-term interest rate ——> Domestic short-term interest rate ——> Short-term lending rates

Domestic short-term interest rate ↓

Domestic long-term interest rate ——> Long-term lending rates

3 BASIC EQUATIONS

Typically, the Fisher parity would be the main theoretical construct to start from when analyzing the determination of the nominal short-term market interest rate (see e.g. Virén (1988) who also presents some empirical evidence for Finland). However, the Fisherian relationship has not met with convincing empirical success, its explanatory power is typically rather limited, and it does not explicitly address issues like international interest rate linkages and monetary policy. One alternative way of describing the determination of the domestic short-term market interest rate r is to decompose it according to

(1) $$r_t = a + r^*_t + bx_t + v_t$$

where a is the premium, r* is the foreign short-term interest rate, x is the part of the domestic short-term interest rate that can be attributed solely to domestic factors (including monetary, and to some extent also fiscal, policy) and v is white noise./3/ The coefficient b of the purely "domestic" part x of the domestic short-term interest rate is one in the short run and zero in the long run.

In general, many factors will influence the purely "domestic" part x of the domestic short-term interest rate. Both the market itself and the monetary authority will presumably react to expectations about the exchange rate e (which is free to move within a fluctuation range of 4.5 percentage points), gross domestic product y, inflation $\dot{p}$, foreign exchange reserves FER and the current account CUA. In addition, x will also be influenced by unexpected events u (including in particular unexpected monetary policy).These factors can be summarized in

(2) $$x_t = c_1e_t + c_2y_t + c_3\dot{p}_t + c_4FER_t + c_5CUA_t + u_t$$

where $x_t = r_t - r^*_t - a$, $c_1,c_2,c_3 > 0$, $c_4,c_5 < 0$ and $u_t = w_t - v_t$ where w is white noise.

Equation (2) can be interpreted as a pooled reaction function for the market and the central bank. When the central bank conducts monetary policy strictly according to a widely known and fully understood, credible policy rule the equation describes the market's expected interest rate setting behavior. This behavior reflects expectations about the economic development as well as expectations about the reactions of the central bank to this economic development. When the central bank conducts discretionary policy, and when new information about the domestic economy arrives, the interest rate setting behavior will be influenced, in addition, by the error term u. If the central bank alters its policy rule the coefficients $c_1 - c_5$ will change. The role of fiscal policy is analogous to the role of monetary policy, although the effects of fiscal policy on the money market presumably are less pronounced than the effects of monetary policy.

The determination of domestic lending rates in Finland has previously been studied i.a. by Lehto (1987) in a theoretical model of dynamic banking duopoly, by Mustonen (1987) using oligopolistic competition under uncertainty as the basic framework and by Vihriälä (1987) who compares the empirical validity of different lending rate equations resulting from different objective functions of the banks. However, for our purposes the approach of Rantala (1987) looks most promising. Rantala explicitly recognizes the market imperfections of the Finnish banking industry, and uses the concept of conjectural variations by Dixit (1986) to derive an estimating equation for the lending rate.

Consider a static, deterministic model of the banking sector with homogenous bank credits and fixed equity, uncovered foreign net position, cash reserves and market shares for deposits. Let the lending rate r^l of the representative bank i be determined by

$$(3) \qquad r^{l,i} = - d_1L + d_2r^d + d_3r + d_4z$$

where L are bank credits, r^d is the rate of interest on bank deposits, z is a vector of factors affecting the demand for bank credits (e.g. the overall economic outlook y^e, the Bank of Finland base rate r^{BF} and the interest rate on foreign long-term government bonds R^*) and $d_1,d_2,d_3,d_4 > 0$. Bank deposits D are given by

$$(4) \qquad D = d_5L + D_0$$

where $d_5 > 0$ and D_0 is a constant. The first term on the rhs of equation (4) describes the effect of bank lending on bank deposits. The profit function P^i of the representative bank is

$$(5) \qquad P^i = (r^{l,i}-r)L^i + (r-r^d)D^i.$$

Let $L^{0,i} = L - L^i$ denote the i:th bank's expectations of the lending behavior of other banks, and $v^i(L^i,L^{0,i})$ the expected effect of the i:th bank's lending on other bank lendings. Then

$$(6) \qquad dL^{0,i}/dL^i = v^i(L^i,L^{0,i})$$

which allows one to rewrite the profit function (5) as

$$(7) \qquad P^i = (-d_1(L^i+L^{0,i})+d_2r^d+(d_3-1)r+d_4z)L^i + m^i(r-r^d)(d_3(L^i+L^{0,i})+D_0)$$

where $m > 0$ is the market share in bank deposits. The banks are assumed to maximize profits given the reactions (3) and (4) of the public and the reactions of other banks (6). Using the profit function (7) the necessary first-order condition for profit maximization is

$$(8) \qquad dP^i/dL^i = -d_1L+d_2r^d+(d_3-1)r+d_4z-d_1(1+v^i)L^i + d_5m^i(1+v^i)(r-r^d) = 0.$$

Solving for L^i, aggregating over all banks and substituting into (3) yields the estimating equation for the lending rate

$$(9) \qquad r^l = f_1r + f_2r^d + f_{3j}z_j + \nu$$

where ν is white noise. The coefficients f_1,f_2 and f_3 will differ from zero if the market forms a Cournot oligopoly, a market share preserving oligopoly or a cartell (see Dixit (1986) and Rantala (1987) for details).

As a point of departure for the determination of long market interest rates in Finland we will take the expectations hypothesis. According to this hypothesis the long market interest rate R is linked to the rationally expected short market rate r by

$$(10) \qquad R_t = (1 - g) \sum_{k=0}^{\infty} g^k r_{t,t+k} + h$$

where $0 < g < 1$ and h is the risk premium. Let the the deviations of the short-term market interest rate r_t from its long run average $\bar{r}$ follow a first-order Markov process, in which case the rational expectation of the short interest rate k steps ahead according to the Wiener-Kolmogorov formula is

$$(11) \qquad r_{t,t+k} = \rho^k (r_t - \bar{r}) + \bar{r}$$

where ρ is the autoregressive parameter satisfying $0 < \rho < 1$. Following Rantala & Pylkkönen (1986) we assume that the markets adjust the long-term interest rate gradually towards the equilibrium R^* according to

$$(12) \qquad R_t = R_{t-1} + q(R_t^* - R_{t-1})$$

where the speed of adjustment q satisfies $0 < q \leq 1$. Substituting (11) and (12) into (10) gives the following estimating equation for the long-term market interest rate

$$(13) \qquad R_t = a_1 r_t + a_2 \bar{r} + a_3 R_{t-1} + e_t$$

where e is white noise and $a_1, a_2, a_3 > 0$. Thus we have completed the model, which consists of equations (1) and (2) linking the foreign short-term market interest rate to the corresponding domestic interest rate, equations of the form (9) which provide the link from the domestic market rates to lending rates, and equation (13) which is the link between the short and the long market interest rate.

4 ESTIMATION RESULTS

The model consisting of equations (1), (2) and (13) and equations of the form (9) was estimated using ordinary least squares from Finnish monthly data covering, at the most, the period 1981M2 - 1987M9. Thus, the maximum number of observations is 80. To capture the extraordinary interest rates observed in connection with the speculative attack on the Finnish markka in 1986M8 - 1986M9 two dummy variables, D^{86M8} and D^{86M9}, were introduced into eqution (2)./4/ The key equations (1) and (2) were estimated in first differences to alleviate the spurious regression problem. Leads and lags on the rhs variables where chosen on the basis of overall goodness of fit of the models. Equation (9) was estimated for the interest rate on deposit banks' FIM-denominated new cheque account overdrafts r^s, new bills of exchange r^{be}, total new credits R^c and new bonds R^b. A dummy variable D^d to capture the deregulation of the lending rate was added to eqution (9). In addition, ad hoc equations denoted (14a) and (14b) were estimated for the interest rate on short-term R^{gs} (4 - 5 years to maturity) and long-term R^{gl} (9 - 10 years to maturity) government tax-exempt, non-indexed bonds./5/ The estimation results are presented in Table 1.

Table 1

Estimation results

Equation	Estimation result	$\bar{R}^2$	SEE	DW	Estimation period
(1)[1,2,3]	$r_t = 2.94 + 0.066r^*_{t+1} + 0.964\,\bar{x}_{t+1}$ (0.41) (17.1)	0.851	0.407	1.67	1983M3 - 1987M9
(2)[1]	$x_t = 25.4e_{t+1} + 12.1y_{t+1} + 1.73p'_t - 0.524FER_{t-1}$ (1.52) (2.86) (2.42) (-1.11)				
	$-0.032CUA_{t+1} + 5.15D_t^{86M8} - 3.67D_t^{86M9}$ (-1.74) (9.63) (-7.13)	0.793	0.492	1.69	1983M2 - 1987M9
(9a)	$r_t^s = 0.427r_t + 1.16r_t^d + 0.930D_t^d$ (5.11) (5.85) (3.24)	0.491	0.757	1.85	1985M3 - 1987M9
(9b)	$r_t^{be} = 0.606r_t + 0.906r_t^d + 1.70D_t^d + 9.55y_t^e$ (8.02) (5.08) (6.31) (2.81)	0.676	0.683	1.23	1985M3 - 1987M9
(13)	$R_t = 0.217r_t + 0.157\bar{r}_t + 0.612R_{t-1}$ (4.69) (3.18) (7.16)	0.901	0.351	1.79	1985M3 - 1987M9
(9c)	$R_t^c = 0.215R_t + 0.523r_t^d + 0.212D_t^d + 0.090\Delta r_t^{BF} + 5.70$ (3.48) (8.37) (2.26) (0.53) (8.31)	0.843	0.185	1.55	1985M3 - 1987M9
(9d)	$R_t^b = 0.067R_t + 0.653r_t^d + 0.440D_t^d + 5.92$ (1.02) (9.58) (4.54) (8.29)	0.808	0.203	1.71	1985M3 - 1987M9
(14a)	$R_t^{gs} = 0.053R_t + 0.050R_t^* + 0.885R_{t-1}^{gs}$ (2.07) (2.04) (18.8)	0.965	0.192	1.43	1981M2 - 1987M9
(14b)	$R_t^{gl} = 0.024R_t + 0.050R_t^* + 0.927R_{t-1}^{gl}$ (1.30) (2.08) (26.6)	0.983	0.173	1.68	1981M2 - 1987M9

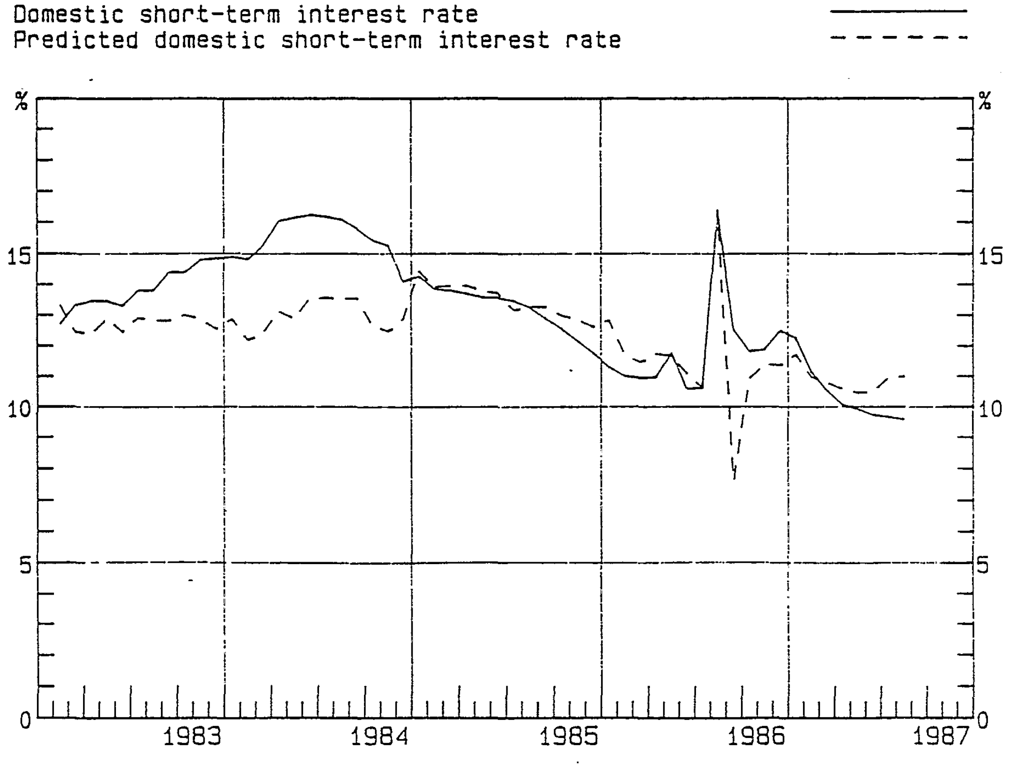
1) Estimated in first differences.
2) The constant is the estimated premium a (see footnote 2).
3) $\bar{x}$ is the fitted value from equation (2)

t-ratios are given in parentheses below parameter estimates.

Turning first to the pooled reaction function (2), one notes the remarkable fit of the model. All estimated coefficients display the expected signs, the coefficients on the expected cyclical situation y and the inflation rate $\dot{p}$ differ significantly from zero, the explanatory power is high (the equation is estimated in first differences) and there are no signs of autocorrelation in the error term./6/ According to the estimation result the domestic short-term market interest rate rises, given the foreign interest rate, most clearly when the Finnish markka is expected to depreciate. A strenghtening of the cyclical outlook and a rise in the inflation rate also affect the domestic interest rate positively. Increases in the foreign exchange reserves and expectations about improvements in the current account deficit tend to lower the domestic interest rate.

Having estimated equation (2) we can use the fitted value $\hat{x}$ as a measure of the part of the domestic short-term market interest rate that can be attributed solely to domestic factors. We also know the foreign short-term interest rate, and we have an estimate of the premium. Thus, we can construct a prediction of the domestic short-term market interest rate according to the decomposition (1). The resulting series is compared to the observed short-term interest rate in Figure 2.

Figure 2



The prediction of the model consisting of equations (1) and (2) tracks the actual outcome fairly well, especially if one focuses on the period from 1985 onwards when capital movements have been largely unregulated. The slight overprediction towards the end of the period considered is mainly due to the ex post strong GDP growth and the widening of the current account deficit. Both factors were more or less unexpected to most observers in Finland at the time. To further illustrate the appropriateness of the model Table 1 contains a direct estimate of equation (1) utilizing the constructed variable $\hat{x}$. As expected, the foreign interest rate plays only a negligeable role whereas the "domestic" part of the domestic interest rate emerges with a weight statistically indistinguishable from unity.

Equations (9a) and (9b) show that the short-term lending rates depend significantly on the short-term market interest rate. In addition, other factors such as the rate of interest on bank deposits influence the lending rates. This points to the existence of oligopolistic competition or a cartell in the Finnish banking industry.

The link between the short-term and the long-term market interest rate as estimated in equation (13) seems to work well. The short-term interest rate affect the long-term interest rate with a weight of 0.217, and some sluggishness in the adjustment of the long-term interst rate seems to exist. The parameters are precisely estimated and the standard error of estimate is small.

Equations (9c) and (9d) give the estimation results for the long-term lending rates. The interest rate on new credits depends significantly on the long-term market interest rate and on the deposit rate. Changes in the Bank of Finland base rate do not seem to affect the interest rate on total new credits to any considerable extent, but this may in part reflect the relatively short time period from which the relationship is estimated. The estimation result for the interest rate on new bonds is similar to the result for new credits, although the role of the long-term market interest rate is smaller. Both equations have high explanatory power, low standard errors of estimate and clean residuals.

Equations for the interest rate on long-term government bonds are given in (14a) and (14b). These interest rates are characterized by a high degree of inertia and a low contemporaneous dependence on the domestic long-term market interest rate. As financing from abroad is an alternative to financing using the domestic market the interest rate on government bonds also depend on the corresponding foreign interest rate.

5 CONCLUDING COMMENTS

The transition to a more market orientated financial system in Finland has altered the way domestic interest rates are formed in a profound way. This paper has presented and quantified one way of describing the structure and main linkages of the current setting. Key elements of the model are the dependence of the domestic market interest rates on the foreign interest rate, an explicit formulation of the dependence of the domestic short-term market interest rate on purely domestic factors, and explicit considerations of various institutional features of the domestic money market. While not lacking rigorous theoretical underpinnings the model should nevertheless be considered mainly as a conceptual framework and a descriptive device. The empirical evidence is well in accordance with the framework.

FOOTNOTES

/1/ All data in this study is taken from the Bank of Finland data base. The domestic short-term interest rate is the HELIBOR 3 months market rate (1987M1 - 1987M9) continued backwards using the average rate of interest on new certificates of deposit (1983M2 - 1986M12). The foreign short-term interest rate is a weighted international 3 months market rate (1986M11 - 1987M9). The international rates are weighted in accordance with the Bank of Finland currency index (twelve currencies). This measure of the international interest rate is continued backwards using a weighted international 3 months market rate based on eight interest rates (1983M2 -1986M10).

/2/ The impact multiplier and the long run response can be estimated from the data using the unrestricted dynamic model

$$\text{(A1)} \qquad A(L)r_t = a + B(L)r_t^* + v_t$$

where A(L) and B(L) are polynomials in the lag operator, a is the premium arising i.a. from imperfect substitutability between domestic and foreign monetary assets and v is white noise. Second order lag polynomials where found to reduce the error term to empirical white noise. The estimation result is

$$\text{(A2)} \qquad r_t = 0.344 + 0.645r_{t-1} + 0.238r_{t-2} + 0.211r_t^* + 0.115r_{t-1}^* - 0.208r_{t-2}^*$$

yielding the results reported in the main text. The estimated premium seems somewhat high, and one cannot altogether rule out the possibility that it still contains a nonzero "devaluation" part.

/3/ The purely "domestic" part x of the domestic short-term interest rate can be positive, zero or negative. Nevertheless, to prevent the domestic nominal short-term interest rate from becoming negative we require that $x_t \geq -(a + r^*_t + v_t)$. The premium a has in Finland typically been positive, and for the period covered in this study it was estimated to be 2.94 per cent (see footnote /2/).

/4/ Potentially, the specification of expectations of the short-term interest rate - and the exchange rate - associated with the speculative attack might be crucial. Formulating and estimating a model of these expectations is, however, well beyond the scope of this paper. For attempts at quantifying expectations of the timing and magnitude of devaluations see Blanco & Garber (1986), for the estimation of devaluation probabilities Cumby & van Wijnbergen (1987), and for expectations of the magnitude of devaluations Himarios (1987). As it happens, the use of dummy variables in the present study did not matter for the overall flavor of the results (see footnote /6/).

/5/ Other variables of the model were constructed in the following manner: e is the growth rate of the Bank of Finland currency index, y is the growth rate of trend deviations of an indicator of gross domestic product (Central Statistical Office of Finland), $\dot{p}$ is the growth rate of consumer prices, FER is the growth rate of foreign exchange reserves relative to average reserves (FIM 12.8 billion), CUR is changes in the current account relative to the average current account deficit (FIM 345 million), y^e is the growth rate of a share price index, $\bar{r}$ = 13.1 percentage points and R* is a weighted international long-term government bond rate with the following weights: Germany 0.67, USA 0.24 and UK 0.09.

/6/ Estimating equation (2) in first differences without dummy variables yields

(A3)
$$x_t = \underset{(2.98)}{90.0}e_{t+1} + \underset{(3.12)}{24.5}y_{t+1} + \underset{(2.70)}{3.59}\dot{p}_t \underset{(-0.53)}{-0.463}FER_{t-1} \underset{(-0.42)}{-0.015}CUA_{t+1}$$

$\bar{R}^2$ = 0.235

SEE = 0.942

DW = 2.45

Period = 1983M2 - 1987M9

Care should be taken when interpreting the magnitude of the estimated coefficients as the endogeneity of the rhs variables has not been taken into account.

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