SESO
UNIVERSITAIRE FACULTEITEN ST.-IGNATIUS TE ANTWERPEN

STUDIECENTRUM VOOR ECONOMISCH EN SOCIAAL ONDERZOEK

VAKGROEP MACRO-ECONOMIE

Measuring and Estimating Exchange Market Pressure in the EU

Eric J. PENTECOST* - **Charlotte VAN HOOYDONK****

André VAN POECK***

report 97/349

June 1997

* Loughborough University, Department of Economics, Loughborough LE11 3TU, UK
Email: E.J.PENTECOST@LBORO.AC.UK

** Faculty of Applied Economics, UFSIA (University of Antwerp), Prinsstraat 13, B-2000 Antwerp, Belgium
Email: FTE.VANHOOYDONK.C@ALPHA.UFSIA.AC.BE

*** Faculty of Applied Economics, UFSIA (University of Antwerp), Prinsstraat 13, B-2000 Antwerp, Belgium
Email: FTE.VANPOECK..A@ALPHA.UFSIA.AC.BE

Universitaire Faculteiten St.-Ignatius
Prinsstraat 13 - B 2000 Antwerpen

D/1997/1169/009

Abstract

This paper estimates a model of exchange market pressure for several EU currencies vis-à-vis the German mark over the period 1979-94. It differs from previous work in that we use principal components analysis to derive a composite measure of exchange market pressure, rather than adding exchange rate and reserves changes on ad hoc weighting schemes. Secondly, we also try to explain movements in our measure of exchange market pressure by a the portfolio balance model of the monetary sector. The results suggest that exchange market pressure can be explained by differential money growth, the change in the long-term interest rate differential, real depreciation and the current account.

Keywords: Exchange market pressure, portfolio balance, principal components, EU

JEL Classification No: F31

1. Introduction

The concept of exchange market pressure was introduced into the literature by Girton and Roper (1977) to capture the idea that in practice an excess demand (supply) for foreign currency would result in both a rise (fall) in the price of foreign exchange and a fall (rise) in the foreign exchange reserves of the home country. The importance of the concept is that it is equally relevant to all exchange rate systems and different degrees of exchange rate management. If the regime is primarily a fixed exchange rate system, then the change of exchange market pressure will be dominated by reserve changes. Whereas if the regime is primarily of the floating exchange rate type then it is to be expected that the change in exchange market pressure will be dominated by exchange rate changes. The extent to which exchange rates or reserves change is therefore an empirical question depending on the extent of exchange rate management of the authorities.

The Girton and Roper monetary model of exchange market pressure has been applied to a large number of countries using a variety of estimating techniques, including Canada (Girton and Roper, 1977; Burdekin and Burkett, 1990), Brazil (Connolly and Da Silveira, 1979), Korea (Kim, 1985; Mah, 1991, 1995), Argentina (Modeste, 1981), Costa Rica (Thornton, 1995) and Japan (Lee and Wohar, 1991, 1992). These studies, however, are all subject to Weymark's critique (Weymark, 1995) that the measure of exchange market pressure is model-specific, in that an alternative structural model would yield a different measure of exchange market pressure.

In this paper we develop and estimate an alternative concept of exchange market pressure from a short-run, portfolio balance model of the foreign exchange market, where purchasing power parity is not assumed to hold, such that domestic and foreign assets are imperfect substitutes and the demand for all assets depends directly upon the real stock of non-bank financial wealth. The measure of exchange market pressure includes the change in the short-term interest rate differential, in addition to reserve and nominal exchange rate changes. This is because interest rates are frequently changed to alleviate exchange market pressures, as noted by Eichengreen *et al* (1994, 1995).

A second contribution of this paper, and in contrast to Eichengreen *et al*, is to use principal components analysis to derive the weights and signs to be attached to the three components of the exchange market pressure measure. This has the advantage that we can check the consistency of the signs of each of the components against the theoretical model and the weights are derived from the data set rather than imposed. A third contribution is to apply this general portfolio balance model to the European Union (EU) currencies over the period of the Exchange Rate Mechanism (ERM) from 1979 to 1994.

The rest of the paper is structured as follows. Section 2 sets out the portfolio balance model of exchange market pressure which encompasses our measure of exchange market pressure. Section 3 uses principal components analysis to derive the measures of exchange market pressure used in the subsequent econometric analysis. Section 4 reports the empirical results from testing the portfolio balance model of exchange market pressure for several EMS currencies over the sample period which runs from 1979 to 1994. Section 5 concludes with a discussion of some of the main policy implications and the agenda for future research.

2. A model of exchange market pressure

The model of exchange market pressure developed here is a portfolio balance model, following Branson and Henderson (1985) and Cuddington (1983) in which domestic and foreign bonds are imperfect substitutes and the demands for all assets, including money, depend positively upon the real level of non-bank private sector wealth. Domestic and foreign bond markets, however, are not explicitly modelled since we are primarily interested in the money markets of the two countries and hence exchange rate and reserve changes.

The demand for domestic real money balances is assumed to be directly related to the level of real income, the stock of non-bank private sector wealth and the own return on nominal money balances. This latter effect reflects the fact that most money is held in the form of bank deposits which carry a low, but positive rate of interest [see, for example, Fase and Winder (1993)]. The demand for real money balances also depends inversely upon the yields of the principal competing assets, which are assumed to be domestic and foreign currency bonds, with nominal yields of i and i^* respectively. It is also assumed that there is no significant direct currency substitution so that the domestic money demand function is independent of the own return on foreign money balances[1]. Thus in log-linear form we write:

$$l - p = \alpha y + \vartheta w + \beta i_m - \gamma i - \delta i^* \tag{1}$$

where l is the log of the nominal money demand, p is the log of the price level, y is the log of the level of real GDP, w is the log of non-bank private sector wealth and i_m is the nominal short-term rate of interest on money balances. α is the income elasticity of real money demand, ϑ is the wealth elasticity of money balances and β, γ and δ are the semi-elasticities with respect to money itself, domestic alternative assets and foreign assets, respectively.

The foreign demand for money is assumed to have an identical structure to the domestic demand, so with asterisks denoting foreign variables, we can write:

$$l^* - p^* = \alpha y^* + \vartheta w^* + \beta i_m^* - \delta i - \gamma i^* \tag{2}$$

[1] The lack of direct currency substitution is confirmed by Mizen and Pentecost (1994) for the pound sterling. A review of currency substitution between other EU currencies is given in Mizen and Pentecost (1996).

where, as in equation (1), γ denotes the semi elasticity of the demand for money with respect to the local interest rate, while δ denotes the same elasticity with respect to the foreign rate of interest. If we assume that domestic bonds are closer substitutes for domestic money than foreign bonds then $\gamma > \delta$.

The domestic money supply, M, is made up of domestic credit, D, and foreign reserves R, so, assuming the money multiplier is constant and equal to unity, we have:

$$M = D + R \tag{3}$$

Taking log rates of change of (1) and (3) and assuming continuous domestic money market equilibrium so that $\hat{l} = \hat{m}$, we obtain:

$$\hat{m} = \hat{d} + \hat{r} = \hat{p} + \alpha\hat{y} + \beta\Delta i_m + \vartheta\hat{w} - \gamma\Delta i - \delta\Delta i^* \tag{4}$$

where $\hat{d} = \left(\frac{D}{M}\right)\frac{\partial \ln D}{\partial t}$ and $\hat{r} = \left(\frac{R}{M}\right)\frac{\partial \ln R}{\partial t}$, and where Δ denotes a first difference. The foreign money market is also assumed to be in continuous equilibrium so we have:

$$\hat{m}^* - \hat{p}^* = \alpha\hat{y}^* + \beta\Delta i_m^* + \vartheta\hat{w}^* - \gamma\Delta i^* - \delta\Delta i \tag{5}$$

The domestic and foreign money markets are linked by relative purchasing power parity (PPP) such that:

$$E = Q(P / P^*) \tag{6}$$

which says that the nominal exchange rate, E, depends on the relative price levels, but also upon Q the real exchange rate. The real exchange rate is determined by real-side factors and is assumed to be exogenously given in this model. In terms of proportionate changes equation (6) is re-written as:

$$\hat{e} = \hat{p} - \hat{p}^* + \hat{q} \tag{7}$$

This specification allows for deviations from PPP in the short run, which is consistent with the existing empirical evidence. [See, for example, Froot and Rogoff (1995) and Rogoff (1996)].

In the context of the economies of the European Union during the 1980s the usual assumption that output is at its natural rate seems inappropriate as most of these economies experienced deep recessions in the early 1980s and early 1990s, during which periods output can be regarded as largely demand-determined. To allow for these effects we postulate that the relative growth rates are reflected in the relative growth of demand, which in turn depend upon the proportionate change in the real exchange rate and the change in the interest rate differential. Therefore we have:

$$\hat{y} - \hat{y}^* = \phi\hat{q} - \lambda(\Delta i - \Delta i^*) \tag{8}$$

Thus an improvement in domestic competitiveness or a fall in the rate of interest raises the demand for domestic output.

Substituting (4) and (5) into (7) using (8) gives:

$$\begin{aligned} emp &= \left[\hat{e} + \beta\left(\Delta i_m - \Delta i^*{}_m\right) - \hat{r}\right] \\ &= (\hat{d} - \hat{m}^*) + (1 - \alpha\phi)\hat{q} + (\alpha\lambda + \gamma - \delta)(\Delta i - \Delta i^*) - \vartheta(\hat{w} - \hat{w}^*) \end{aligned} \tag{9}$$

The left-hand side of equation (9) measures (relative domestic) exchange market pressure (***emp***) which, as noted by Weymark (1995), is inevitably a model-specific measure of exchange market pressure. In this portfolio balance model *emp* is made up of both the change in the nominal exchange rate and the growth in foreign exchange reserves, but in contrast to Girton and Roper (1977) and Weymark (1995), also includes the change in the short-term money market interest rate differential. The change in the short-term interest rate differential is also included in the measure of exchange market pressure, since interest rates are often adjusted by the authorities in the defence of a parity (see for example Del Giovane, 1994 for the experience of the ERM countries). In equation (9), the expected sign on the short-term interest rate differential is positive, indicating that pressure can be alleviated by a mixture of depreciation, loss of foreign reserves and an increased (short-term) interest differential with the foreign economy[2].

Furthermore in equation (9) we assume that there is no role for intervention by the foreign authorities, since $\hat{d}* = \hat{m}*$. This follows Girton and Roper (1977) who assumed that the foreign (centre) economy is too large to care about pressure on the domestic currency. Clearly, in an ERM context with compulsory interventions at the margin, this hypothesis is not warranted. The alternative, however, of including the differential proportional change in reserves as in Eichengreen *et al* (1994, 1995) assumes that *all* foreign intervention is undertaken with the purpose of alleviating pressure on the domestic currency. For this reason, and also because our sample includes some non-ERM countries, we keep to a unilateral intervention measure. In our sample of European countries there are, however, additional reasons for not including the change in foreign (German) reserves: first, that interventions by the Bundesbank account for only a small proportion of total ERM interventions and are predominantly in the US dollar market (Gros and Thygesen, 1992); and

[2] A fourth means to ward off speculative attacks is the imposition of capital controls. Within the EU, most controls were removed by July 1st, 1990. Spain and Ireland were exempted until December 31st, 1992 and Portugal and Greece until December 31st, 1995.

second, that Germany would appear to sterilise its interventions within any quarter to a larger extent than other EU members , such as France and Italy (see Mastropasqua et al., 1988)[3].

Equation (9) says that exchange market pressure can be explained by changes in monetary policy, by changes in long-term interest rates, wealth accumulation and changes in the real exchange rate. More rapid domestic monetary expansion than abroad increases pressure. Factors increasing domestic relative to foreign money demand such as a rise in relative non-bank private sector wealth (proxied by the current account and government budget deficit ratios) result in smaller pressure. As noted above, since we expect that $\gamma > \delta$ a rise in the domestic-foreign, long-term interest rate differential increases exchange market pressure. Our model of *emp* thus predicts the same signs on monetary policy, interest rates and the current account, but opposite signs on the budget deficit and real depreciation[4], as the initial theoretical models of speculative attacks. In these models, crises are brought about by the underlying fundamentals, such as expansionary fiscal and monetary policies, real appreciation, increasing trade deficits and domestic interest rates being inconsistent with the time path of the equilibrium exchange rate (see Eichengreen *et al.*, 1994, 1995, and Agenor *et al*, 1992)[5].

3. Measuring exchange market pressure

Prior to estimating equation (9) we need to derive a measure of exchange market pressure. In this measure only the weight on the change in the short-term interest differential is unknown,

---

[3] It should also be noted that neither of these alternatives captures the possibly important third country interventions in support of a weakening currency (in the ERM context e.g. by the Dutch authorities).

[4] In a rational expectations context however, according to the Ricardian equivalence theorem, we would not expect the budget deficit to influence private sector wealth and therefore exchange market pressure.

[5] Subsequent work examines how self-fulfilling expectations trigger currency crises even when macroeconomic policy is in line with exchange rate fundamentals. See for example, Obstfeld (1994) and Funke (1996).

therefore one way to proceed would be to estimate the semi-elasticity of money demand with respect to the short-term interest rate (cf. Weymark, 1995). However, as noted by Eichengreen *et al.* (1994, 1995), the three variables in the index display significantly different variances, calling for another approach to ensure that no single variable dominates the index. While Eichengreen *et al.* deal with this problem by applying volatility-smoothing weights, we use principal components analysis, which standardises all variables prior to the analysis (see, for example, Dunteman (1989) or Jackson (1991))[6].

This principal components technique finds three uncorrelated linear combinations between the three standardised variables. The first linear combination or principal component accounts for the largest proportion of the variance in the set of original variables and can be interpreted as an overall index summarising the information contained in the original variables.

The use of principal components is preferable to Eichengreen *et al.*'s approach for two reasons. First, the weights of the normalised variables are not arbitrarily set to unity and negative unity, as in Eichengreen *et al.* Rather they are data-determined to explain the largest portion of system variance possible. Second, whereas Eichengreen *et al.* fix the sign of these weights in accordance with their a priori beliefs, principal components analysis delivers signed weights. It can also be verified where these do or do not contradict our hypothesised signs as given in equation (9).

The results from the implementation of the principal components analysis are given in Table 1 for thirteen European countries, relative to Germany[7]. The samples cover the ERM-period from 1979:3 up to 1994:4, yielding 62 quarterly observations for most countries. The

---

[6] Thus we derive principal components from the correlation matrix, not from the covariance matrix.

[7] For lack of data, the sample does not include Switzerland, Greece and Ireland (for data sources and definitions, see Data Appendix). The analysis was performed in SPSS. Table A.1 in Appendix gives an idea of the appropriateness of applying a principal components analysis to the data for each country.

variable measuring intervention is constructed as the proportional, transactions-based change in reserves, wherever possible adjusted for government foreign borrowing, because this increases reserves without being the result of a strong currency (cf. Moore and O'Connell, 1992).

The second column of Table 1 shows that the first principal component (PC) explains 41 per cent (Denmark) to 59 percent (Belgium) of total system variance. For eight countries, the three partial measures of exchange market pressure enter this first PC with the expected sign and a fairly high loading. For these eight countries, the first PC can thus be regarded as an overall index of exchange market pressure.

Column three displays information on the second PC for the remaining five countries. It is interesting to note that in three cases the signs on the variables are as expected. However, for Austria and Ireland, the second PC shows a very small coefficient on $\hat{r}$. Moreover, the eigenvalues of these second PC's are below unity, meaning that they hardly explain any system variance. In the subsequent analysis therefore, only the eight first PC's are used as measures of exchange market pressure. The sample of countries for estimation thus consists of four of the original ERM-members (Belgium, France, Italy and Denmark), two countries that joined the ERM later on (Spain in June 1989 and Portugal in April 1992) and two non-members (Norway and Finland). In Figures 1 to 8 the solid lines show the eight measures of exchange market pressure as standardised variables. Values above the zero-line point to higher than average pressure on the currency to weaken.

Table 2 shows the number and proportion of "crisis" quarters for each country where a "crisis" is said to occur when the measure exceeds the zero-mean by plus one, one-and-half or two standard errors. The total number of crises according to the conventional criterion of two standard errors is very small. Interestingly, the proportion of crisis quarters with the expected sign on each of the three partial measures is quite high and increases with the severity of the crisis. That the principal components measure is not dominated by a single partial measure can be inferred from the last row, showing the number and proportion of "crisis" quarters in which only one partial measure is "significant" according to the same criterion (i.e. 1, 1.5 or 2 standard errors around the mean). However, strong depreciation alone accounts for almost 28 percent of the more severe crises.

Table 3 therefore shows the number of crisis quarters together with ERM realignment history. The entire ERM period is divided into four subperiods. The first three are taken from Gros and Thygesen's (1992) description of the ERM; the last subperiod starts with the Danish referendum quarter (1992:2). Of all observations of an ERM-currency in the sample devaluing vis-à-vis the D-mark[8], 41 in total, only 16 result in a crisis quarter according to the one standard error criterion (39 percent); seven of these are two standard error crises (17 percent). The PC-measure does not therefore identify "crises" with realignments. Table 3 also shows that most crises occur in the first subperiod, described by Gros and Thygesen (1992) as the ERM's "turbulent start". In the second period average exchange market pressure falls substantially in all countries (except Norway) and remains low or decreases even further in the relatively uneventful third period. Unsurprisingly, it rises again in the last period which includes the 1992 and 1993 ERM turmoil. The severity of these crises can be inferred from the entries for Italy and Spain for example, with both countries recording a very high average level of pressure[9].

4. Explaining exchange market pressure: Econometric results

[8] Including the widening of the fluctuation band in August 1993.

[9] Pairwise correlations of the exchange market pressure series calculated for the entire sample period as well as for the various subperiods, are given in Table A.2 in Appendix.

For five countries, viz. Belgium, France, Italy, Spain and Finland, a complete data set could be gathered. The sample covers the entire ERM period up until 1994:4, except for Italy (data end in 1991:3). The exchange market pressure series were divided by the weight of nominal exchange rate change in the index. As in the theoretical model, exchange market pressure is now a composite variable with a unity coefficient on nominal depreciation. The change in real non-bank private sector wealth was proxied by the current account surplus (*ca*) and the budget deficit (*def*), both as a fraction of GDP (See Data Appendix for details)[10].

Equation (9) was estimated with all regressors entered in inter-country differential form in order to save degrees of freedom as well as to avoid multicollinearity[11]. We started from a general specification including up to four lagged values of the dependent and independent variables and tested gradually for the exclusion of insignificant variables and for other coefficient restrictions until a parsimonious regression equation was obtained[12].

The ordinary least squares (OLS) results are shown in Table 4. The equations all have good explanatory power[13]. The residuals show no evidence of autocorrelation up to the 4th order (AR1-4), 4th order ARCH-effects (ARCH4), non-normality (NORM) or heteroscedasticity (HET and HET2). There is also no clear sign of functional form misspecification (HET2 and RESET). The regression equations have contemporaneous and therefore possibly endogenous explanatory variables. HAUS is a Hausman test to investigate

[10] Before estimating the model unit root tests of both the Dickey-Fuller and Phillips-Perron type for stationary indicated that none of the regressors or regressands are non-stationary, except perhaps the Blegium current account and the Finnish budget deficit ratios. Given the short time span of the data set (only 15 years) we consider all variables stationary.

[11] The proportional change in domestic credit ($\dot{d}$) and foreign money growth ($\dot{m}^*$) are treated in the same way and combined into a single variable ($\dot{d} - \dot{m}^*$). This variable can be thought of as representing the relative exogenous monetary policy change.

[12] All regressions were run in PCGive 8.0.
For France, a six-lag specification was needed to avoid misspecification.

[13] Because of the absence of a constant term, R^2 cannot be interpreted in the Belgian, Italian, Spanish and Finnish equations. The constant was the ultimate or penultimate regressor dropped. For each country, the (adjusted) R^2 associated with the last regression containing an intercept is very close to the one reported in Table 4.

whether the presence of possibly endogenous right hand side variables yields inconsistent OLS estimates (MacKinnon, 1992)[14]. This test confirms that for each country the consistency of the OLS estimates cannot be rejected.

All the coefficients are significant at the 5 percent level or better (10 per cent for the 4-lagged Belgian real rate of depreciation). Differential money growth ($\hat{d}$ - $\hat{m}^*$), the change in the long-term interest differential (Δi-Δi^*) and real depreciation ($\hat{q}$), both contemporaneous and lagged, appear to be important determinants of exchange market pressure and enter the equations with the expected signs.

The importance and direction of wealth effects (both the budget deficit ratio differential and the current account ratio differential with Germany) are more ambiguous. The current account variable enters all equations but the Italian in some form, and shows the expected inverse relationship with pressure, except for Spain. The budget deficit ratio enters the French and Finnish equations only and has the wrong sign. Wealth effects would appear to operate with a lag. Lagged pressure enters all equations but the Finnish significantly. Interestingly, current and lagged pressure are negatively related in Belgium and France and positively in Italy and Spain.

Figures 1 to 5 show the actual and fitted values of the measures of exchange market pressure resulting from the equations in Table 4, as solid and dotted lines respectively. In the main the equations seem to track exchange market pressure fairly well, including the ERM crises of 1992 and 1993.

---

[14] This involves running separate regressions of the suspected endogenous regressors on a set of instruments and including the fitted values from these auxiliary regressions in the original equation. If the coefficients on the fitted values are jointly insignificantly different from zero, the hypothesis of consistent OLS estimates cannot be rejected. We used up to 4 lagged values of the dependent and independent variables as regressors in the auxiliary regressions.

Finally, n-step ahead Chow tests were calculated to assess in-sample parameter stability[15]. The hypothesis of stability over the 1992-1994 period is rejected for Belgium (at the 1 percent level) and France (10 per cent level), while the Spanish, Finnish and Italian (sample ends in 1991:3) equations do not show any signs of instability at all.

5. Conclusions and final comments

Starting from a portfolio balance model, we have derived a measure of exchange market pressure that is preferable to existing measures. The results from a principal components analysis show that it is a defendable measure of pressure in eight out of the thirteen European countries in our sample. The model relates the level of exchange market pressure to several macroeconomic economic variables frequently cited in theoretical work on the genesis of speculative attacks, albeit with opposite effects on pressure from real depreciation and the budget deficit. The model tracks exchange market pressure well for Belgium, France, Italy, Spain and Finland, with the residuals exhibiting all the desirable properties. However, in-sample parameter constancy must be rejected in a number of cases.

Although these findings represent a substantial improvement on existing models in a number of ways there is scope for further research in the treatment of expectations and contagion effects. Casual observation gives the impression that such effects have been operating from time to time during ERM crises. Indeed, in general, the two-country model developed in Section 2 and applied to the EU countries in Sections 3 and 4, leaves no role for third country effects, such as changes in the DM/$ exchange rate, which are often thought to lead to depreciation pressure on the weaker ERM currencies.

[15] Tests of stability of all coefficients over the entire sample were unable to reject parameter constancy.

References

AGENOR, P-R., BHANDARI, J.S. & FLOOD, R.P., (1992). "Speculative attacks and models of balance of payments crises," *IMF Staff Papers*, vol. 39, pp. 357-394.

BRANSON, William H. & HENDERSON, Dale W., (1985), "The specification and influence of asset markets" in R. W. Jones & P. B. Kenen (eds.), *Handbook of International Economics*, Amsterdam, North Holland, pp. 749-806.

BRUGGEMAN, Annick (1996), *Disaggregating annual GDP data into quarterly figures*, Antwerp, UFSIA, mimeo, September, 26p.

BURDEKIN, Richard C.K. and Paul BURKETT (1990), "A re-examination of the monetary model of exchange market pressure: Canada, 1963-1988", *Review of Economics and Statistics*, vol. 72, no. 4, pp. 677-681.

COMMISSION OF THE EUROPEAN COMMUNITIES (1993), "The ERM in 1992", Study No. 3, *European Economy*, no. 54, pp. 139-157.

CONNOLLY, Michael and José Dantas DA SILVEIRA (1979), "Exchange Market Pressure in Postwar Brazil: An Application of the Girton-Roper Monetary Model", *American Economic Review*, vol. 69, no. 3, pp. 448-454.

CUDDINGTON, John T (1963), "Currency substitution, capital mobility and money demand", *Journal of International Money and Finance,* August 2, pp. 111-133.

DEL GIOVANE, Paolo (1994), "The Defence of Exchange Rates in the EMS: Instruments and Strategies, 1987-1993", Banca d'Italia *Temi di discussione del Servio Studi* No. 228.

DUNTEMAN, George H. (1989), *Principal Components Analysis*, Newbury Park (California), Sage, Quantitative Applications in the Social Sciences no. 69, 96 p.

EICHENGREEN, Barry, Andrew K. ROSE and Charles WYPLOSZ (1994), "Speculative attacks on pegged exchange rates: an empirical exploration with special reference to the European Monetary System", *NBER Working Paper* no. 4898, 49 p.

EICHENGREEN, Barry, Andrew K. ROSE and Charles WYPLOSZ (1995), "Exchange market mayhem: the antecedents and aftermath of speculative attacks", *Economic Policy*, no. 21 (October), pp. 249-312.

FASE, M.M.G. and C.C.A. WINDER (1993) "The Demand for Money in the Netherlands and the other EC countries", *De Economist*, Vol. 141, No.4, pp.471-496.

FROOT, Kenneth A. and Kenneth ROGOFF (1995), "Perspectives on PPP and Long-Run Real Exchange Rates", Ch. in Gene M. Grossman and Kenneth Rogoff (eds.), *Handbook of International Economics Vol. III*, Amsterdam, Elsevier, pp. 1647-1688.

FUNKE, Norbert (1996), 'Vulnerability of fixed exchange rate regimes: the role of economic fundamentals,' *OECD Economic Studies*, No. 26, pp. 151-176.

GIRTON, Lance and Don ROPER (1977), "A Monetary Model of Exchange Market Pressure Applied to the Postwar Canadian Experience", *American Economic Review*, vol. 67, no. 4, pp. 537-548.

GROS, Daniel and Niels THYGESEN (1992), *European Monetary Integration. From the European Monetary System to European Monetary Union*, London, Longman, 494 p.

JACKSON, J. Edward (1991), *A User's Guide To Principal Components*, New York, Wiley, 569 p.

KIM, Inchul (1985), "Exchange Market Pressure in Korea: An Application of the Girton-Roper Monetary Model", *Journal of Money, Credit and Banking*, vol. 17, no. 2, pp. 258-263.

KWIATKOWSKI, Denis, Peter C.B. PHILLIPS, Peter SCHMIDT and Yoncheol SHIN (1992), 'Testing the null hypothesis of stationarity against the alternative unit root. How sure are we that economic time series have a unit root?' *Journal of Econometrics*, Vol. 54, pp. 159-178.

LEE, Bun Song and Mark E. WOHAR (1991), "Testing Alternative Specifications of Reserve Flow Equations: The Japanese Experience, 1959-1986", *International Economic Journal*, vol. 5, no. 1, pp. 35-50.

MACKINNON, James (1992), "Model Specification Tests and Artificial Regressions", *Journal of Economic Literature*, vol. 30, March, pp. 102-146.

MAH, Jai Sheen (1991), "A note on the exchange market pressure: the Korean experience, 1980-1987", *Applied Economics*, vol. 23, no. 4, pp. 587-590.

MAH, Jai Sheen (1995), "An analysis of the structural change in the exchange market pressure: Korea, 1980-89", *Applied Economics Letters*, no. 2, pp. 80-82.

MASTROPAQUA, Christina, Stefano MICOSSI and Roberto RINALDI (1988), "Interventions, sterilisation and monetary policy in European Monetary System countries, 1979-87", in Francesco Giavazzi, Stefano Micossi and Marcus Miller (eds.), *The European Monetary System*, Banca d'Italia Centre for Economic Policy Research, Cambridge University Press, Ch. 10, pp. 252-287.

MIZEN, Paul and Eric J. PENTECOST (1994), 'Evaluating the empirical evidence for currency substitution: a case study of the demand for sterling in Europe,' *The Economic Journal*, Vol. 104, No. 426, pp. 1057-1069.

MIZEN, Paul and Eric J. PENTECOST (1996), 'Currency substitution in theory and practice,' in Paul MIZEN and Eric J. PENTECOST (eds), *The Macroeconomics of International Currencies*. Aldershot: Edward Elgar, pp. 8-43.

MODESTE, Nelson C. (1981), "Exchange Market Pressure During the 1970s in Argentina: An Application of the Girton-Roper Monetary Model", *Journal of Money, Credit and Banking*, vol. 13, no. 2, pp. 234-240.

MOORE, Michael J. and Thomas O'CONNELL (1992), "Monetary Policy in Stage Two of EMU", *Centre for Economic Policy Research Discussion Paper* No. 616, 30 p.

OBSTFELD, Maurice (1994), 'The logic of currency crises,' NBER Working Paper, No. 4640, February.

ROGOFF, Kenneth. (1996), "The purchasing power puzzle," *Journal of Economic Literature*, vol. 34, no. 2, pp. 647-668.

THORNTON, John (1995), "Exchange Market Pressure in Costa Rica, 1986-92: An Application of the Girton-Roper Model", *International Economic Journal*, vol. 9, no. 1, pp. 67-72.

UNGERER, Horst, Jouko J. HAUVONEN, Augusto LOPEZ-CLAROS and Thomas MAYER (1990), "The European Monetary System: Developments and Perspectives", *International Monetary Fund Occasional Paper* No. 73, 99 p.

WEYMARK, Diana N. (1995), "Estimating exchange market pressure and the degree of exchange market intervention for Canada", *Journal of International Economics*, vol. 39, pp. 273-295.

WOHAR, Mark E. and Bun Song LEE (1992), "An application of the Girton-Roper monetary model of exchange market pressure: the Japanese experience, 1959-1991", *Rivista Internazionale di Science Economiche e Commerciali*, vol. 39, no. 12, pp. 993-1013.

Table 1: Principal components output; sample 1979:3 - 1994:4

Country	1st principal component - corr. coefficients - factor scores						2nd principal component - corr. coefficients - factor scores					
	Eigval.	%var.	$\hat{e}$	$\Delta(i_m-i^*_m)$	$\hat{r}$	correct signs	Eigval.	%var.	$\hat{e}$	$\Delta(i_m-i^*_m)$	$\hat{r}$	Correct signs
Belgium	1.77	59.1	.641	.867	-.781							
			.362	.489	-.441	Y						
France	1.57	52.3	.425	.855	-.810							
			.271	.545	-.517	Y						
Netherlands	1.47	48.9	.732	-.815	.515		.93	30.9	-.477	.096	.830	
			.499	-.556	.351	N			-.512	.103	.896	N
U.K.	1.24	41.4	-.753	.456	.683		.96	32.2	.101	.860	-.464	
			-.607	.368	.550	N			.104	.891	-.481	Y
Austria	1.34	44.8	-.636	.607	.756		.91	30.4	.641	.706	-.031	
			-.473	.452	.563	N			.704	.776	-.028	Y
Italy	1.51	50.4	.788	.480	-.812							
			.522	.318	-.537	Y						
Norway	1.45	48.4	.812	.570	-.683							
			.560	.393	-.471	Y						
Sweden	1.40	46.7	.616	-.821	.590		.97	32.3	-.678	.004	.714	
			.440	-.586	.421	N			-.699	.004	.736	N
Finland	1.30	43.2	.798	.572	-.575							
			.616	.442	-.444	Y						
Spain	1.39	46.4	.815	.361	-.773							
			.585	.259	-.556	Y						
Denmark	1.22	40.8	.757	.336	-.733							
			.619	.275	-.599	Y						
Ireland	1.39	46.2	.305	-.781	.826		.99	33.0	.938	.330	-.034	
			.220	-.564	.596	N			.948	.334	-.034	Y
Portugal	1.43	47.6	.690	.587	-.780							
			.483	.411	-.546	Y						

Note: For Denmark and Ireland the sample starts in 1981:1, yielding 56 observations; the Portuguese sample begins in 81:2 (55 obs)

Table 2: Number and proportion of crisis quarters

Country	N.obs	Number of crisis quarters					
		1 standard dev.		1.5 stand. dev.		2 stand. dev.	
		N.obs	prop.	N.obs	prop.	N.obs	prop.
Belgium	62	9	14.5	6	9.7	3	4.8
France	62	10	16.1	5	8.1	2	3.2
Italy	62	7	11.3	2	3.2	1	1.6
Denmark	56	6	10.7	3	5.4	1	1.8
Spain	62	7	11.3	4	6.5	3	4.8
Portugal	55	8	14.5	5	9.1	1	1.8
Norway	62	9	14.5	6	9.7	5	8.1
Finland	62	10	16.1	5	8.1	2	3.2
Total	483	66	13.7	36	7.5	18	3.7
Signs as expected		45	45/66 =68.2	27	27/36 =75.0	15	15/18 =83.3
Only $\hat{e}$ significant		10	15.2	8	22.2	5	27.8
Only $\hat{r}$ sign.		12	18.2	8	22.2	2	11.1
Only $\Delta(i_m - i^*_m)$ sign.		5	7.6	5	13.9	3	16.7

Table 3: Number of crisis quarters and ERM realignment chronology

ERM-period N. obs.	Quarters +realignm. number +depr.vis-à-vis DM	BFR	FF	LIT	DKR	PTA	ESC	NKr	FMk
79:3-83:1	79:3: 1:all		*						
	79:4: 2:DKR,LIT								*
16	81:1: 3:FF,LIT			*	*				
	81:2		***						
	81:3		**						
	81:4: 4:all exc. HFL	**				*			
	82:1: 5:BFR,DKR	***		**	***				
	82:2: 6:all exc. HFL		***			*	**		
	82:3							*	
	82:4	**		*		***	**	**	***
	83:1: 7:all	**	**			*	*		*
N. of crises		**4**	**5**	**3**	**2**	**4**	**3**	**2**	**3**
Avg. press.		**0.55**	**0.46**	**0.37**	**0.78**	**0.47**	**0.74**	**0.03**	**0.20**
83:2-87:1	83:2						***		
	83:4						**		
15	84:1	***							
	84:4						*		
	85:3: 8:LIT	*		*					
	85:4			*					
	86:1	*			**			*	
	86:2: 9:all exc. HFL							***	*
	86:3:10:IRL				*				**
	86:4		*				*	***	
	87:1:11:all exc.HFL		*						
N. of crises		**3**	**2**	**2**	**2**	**0**	**4**	**3**	**2**
Avg. press.		**-0.11**	**-0.26**	**-0.21**	**-0.18**	**-0.19**	**0.38**	**0.09**	**-0.05**
87:2-92:1	87:4	*	**					***	
	89:4							*	**
20	90:1: 12:LIT								
	91:2				*				
	91:4			*					**
N. of crises		**1**	**1**	**1**	**1**	**0**	**0**	**2**	**2**
Avg. press.		**-0.29**	**-0.14**	**-0.41**	**-0.13**	**-0.58**	**-0.68**	**-0.09**	**-0.09**
92:2-94:4	92:2								
	92:3: 13-4:LIT,PTA		*	***		***	**	***	***
11	92:4: 15:PTA,ESC							***	
	93:1: 16:IRL					**			*
	93:2: 17:PTA,ESC					***			
	93:3: 15% margins	***	*		**				*
N. of crises		**1**	**2**	**1**	**1**	**3**	**1**	**2**	**3**
Avg. press.		**-0.06**	**0.04**	**0.55**	**-0.14**	**0.69**	**0.14**	**-0.00**	**-0.03**
N. of crises		9	10	7	6	7	8	9	10

Notes:

*,** and *** denote crisis quarters at 1, 1.5 and 2 standard errors above the mean.

Denmark and Portugal: sample starts in 81:1 and 81:2 resp., yielding 9 resp. 8 obs.

In column 2 "all" means "the currencies of all countries participating in the ERM at that time" (except the D-mark)

Table 4: Regression results

Belgium:

emp =	$0.193\,(\hat{d}-\dot{m}^*)$	$+\,0.042\,(\Delta i-\Delta i^*)$	$+\,1.593\,\dot{q}$	$+\,0.353\,\dot{q}_{-4}$	$-\,0.254\,(ca-ca^*)_{-4}$	$-\,0.156\,emp_{-3}$
	(0.035)	(0.008)	(0.188)	(0.203)	(0.093)	(0.067)
	[5.565]	[5.010]	[8.494]	[1.738]	[-2.723]	[-2.313]

R^2adj. = 0.763 ser = 0.024 N.obs = 58 sample: 1980:3 - 1994:4
AR1-4 = F(4,48) = 0.932 [0.453] HET = F(12,39) = 0.969 [0.493]
ARCH4 = F(4,44) = 1.355 [0.265] HET2 = F(27,24) = 1.333 [0.240]
NORM = $Chi^2(2)$ = 4.379 [0.112] RESET = F(1,51) = 0.254 [0.617] HAUS = F(3,49) = 0.765 [0.519]

France:

emp =	0.014	$+\,0.310\,(\hat{d}-\dot{m}^*)$	$+\,0.072\,(\Delta i-\Delta i^*)$	$+\,2.084\,A\dot{q}$	$+\,0.802\,WA(def-def^*)_{-5}$	$-\,0.481\,\Delta_2(ca-ca^*)_{-2}$	$-0.025\,A emp_{-1}$
	(0.005)	(0.046)	(0.011)	(0.425)	(0.172)	(0.202)	(0.007)
	[2.892]	[6.705]	[6.635]	[4.906]	[4.673]	[-2.380]	[-3.852]

R^2adj. = 0.752 ser = 0.032 N.obs = 56 sample: 1981:1-1994:4
AR1-4 = F(4,45) = 0.504 [0.733] HET = F(12,36) = 0.738 [0.706]
ARCH4 = F(4,41) = 0.527 [0.716] HET2 = F(27,21) = 0.483 [0.962]
NORM = $Chi^2(2)$ = 4.277 [0.118] RESET = F(1,48) = 2.891 [0.096] HAUS = F(3,46) = 0.151 [0.929]

Table 4 Cont'd

Italy:

$emp =$	$0.262\,(\hat{d} - \hat{m}^*)$	$+ 1.503\,\hat{q}$	$+ 0.013\,\Delta_4(\Delta i - \Delta i^*)$	$+ 0.440\, emp_{-4}$
	(0.065)	(0.199)	(0.003)	(0.087)
	[4.030]	[7.561]	[3.949]	[5.035]

R^2adj. = 0.718 ser = 0.026 N.obs = 45 sample: 1980:3 - 1991:3
AR1-4 = F(4,37) = 0.816 [0.523] HET = F(8,32) = 1.707 [0.135]
ARCH4 = F(4,33) = 0.291 [0.882] HET2 = F(14,26) = 1.382 [0.230]
NORM = $Chi^2(2)$ = 1.924 [0.382] RESET = F(1,40) = 1.069 [0.307] HAUS = F(3,38) = 1.475 [0.237]

Spain:

$emp =$	$0.144\,(\hat{d} - \hat{m}^*)$	$+ 1.398\,\hat{q}$	$+ 0.550\,\Delta(ca - ca^*)_{-3}$	$+ 0.125\, emp_{-2}$
	(0.031)	(0.103)	(0.166)	(0.059)
	[4.677]	[13.540]	[3.304]	[2.118]

R^2adj. = 0.809 ser = 0.028 N.obs = 58 sample: 1980:3 - 1994:4
AR1-4 = F(4,50) = 0.894 [0.474] HET = F(8,45) = 0.719 [0.674]
ARCH4 = F(4,46) = 1.318 [0.278] HET2 = F(14,39) = 0.545 [0.890]
NORM = $Chi^2(2)$ = 0.311 [0.856] RESET = F(1,53) = 0.092 [0.763] HAUS = F(2,52) = 1.589 [0.214]

Table 4 Cont'd

Finland:

emp =	0.178 $(\hat{d} - \hat{h}^*)$	+ 1.298 $\hat{q}$	+ 0.172 $(def\text{-}def^*)_{-1}$	- 0.665 $\Delta_2(ca\text{-}ca^*)_{-2}$
	(0.030)	(0.087)	(0.071)	(0.164)
	[6.040]	[14.952]	[2.430	[-4.053]

R^2adj. = 0.830 ser = 0.031 N.obs = 58 sample: 1980:3 - 1994:4
AR1-4 = F(4,50) = 0.590 [0.672] HET = F(8,45) = 1.197 [0.323]
ARCH4 = F(4,46) = 1.177 [0.333] HET2 = F(14,39) = 1.300 [0.251]
NORM = $Chi^2(2)$ = 0.142 [0.932] RESET = F(1,53) = 0.267 [0.607] HAUS = F(2,52) = 0.108 [0.898]

Notes: - Standard errors in parentheses; t-values in brackets
- $D_i(x)$ = difference over i quarters, viz. $x_t - x_{t-i}$
- $WA(x_t)$ = weighted average = $x_t + 0.5x_{t-1}$
- Ax_t = unweighted average = $(x_t + x_{t-1})/2$

Data Appendix

Most series were taken from the IMF's International Financial Statistics (IFS) on CD-Rom. The variables used in the principal components analysis and regressions are constructed as follows:

$\hat{e}$= rate of depreciation of the domestic currency = percentage change of the bilateral exchange rate of the domestic currency vis-à-vis the D-mark, measured as the domestic currency price of one unit of foreign currency (= cross rate implied by bilateral dollar rates in IFS-line ae)

$\hat{r}$ = proportional change in domestic international reserves, wherever possible adjusted for government foreign borrowing; the change in reserves = minus "financing of the balance of payments" (IFS-line 79dad); adjustment was made with IFS-lines 85a (Netherlands, U.K.) or 89a (Belgium, Spain); the whole was deflated by the seasonally-adjusted inherited money base (IFS-line 14) or narrow money (IFS-line 34, for Spain and data provided by the National Bank of Belgium for Belgium)

Δi_m= change in the short-term interest rate (IFS-line 60b and, for Belgium, 60c; for Spain, the call money rate (code 32556304) from OECD's Main Economic Indicators was used)

$\hat{d}$ = proportional change in domestic credit, proxied by the percentage change of the seasonally adjusted money base (IFS-line 14; narrow money from IFS-line 34 for Spain and from National Bank of Belgium for Belgium) minus the proportional change in international reserves ($\hat{r}$)

$\hat{m}^*$= percentage change of the German money base (IFS-line 14)

$\hat{y}$= percentage change of the index of industrial production (IFS-line 66i)

Δi= change in the long-term interest rate (IFS-line 61; for Finland: yield of long-term government bonds from OECD's Main Economic Indicators; the missing value for 90:1 was replaced by the mean rate of the adjacent quarters)

ca= current account (IFS-line 78ald, in U.S. dollar), divided by seasonally adjusted national income (IFS-line 99 for Spain and Finland; data on the other countries were kindly made available by Annick Bruggeman, as part of her output files to Bruggeman (1996)) expressed in U.S. dollars.

def= government deficit (IFS-line 80 and for Belgium, data from the National Bank of Belgium's monthly bulletin), divided by seasonally adjusted national income (see construction of ca)

$\hat{q}$= real rate of depreciation, constructed with $\hat{e}$ (see above) and the percentage change of the seasonally adjusted consumption price index (IFS-line 64)

Table A.1: Appropriateness of principal components analysis

Country	N. of obs.	Bartlett test (sign.level)	KMO measure	prop. of sign. corr. coeff. (at .01 level)	prop. of sign. corr. coeff. (at .05 level)	prop. of sign. corr. coeff. (at .10 level)
Belgium	62	30.16 (.0000)	.57	2/3	2/3	3/3
France	62	19.03 (.0003)	.52	1/3	1/3	2/3
Netherlands	62	11.42 (.0097)	.53	1/3	2/3	2/3
U.K.	62	2.97 (.3962)	.52	0/3	0/3	1/3
Austria	62	5.42 (.1434)	.55	0/3	1/3	2/3
Italy	62	13.50 (.0037)	.54	1/3	1/3	2/3
Norway	62	10.56 (.0144)	.52	1/3	2/3	2/3
Sweden	62	9.33 (.0252)	.49	0/3	2/3	2/3
Finland	62	5.18 (.1592)	.49	0/3	0/3	2/3
Spain	62	8.84 (.0315)	.51	1/3	1/3	1/3
Denmark	56	2.44 (.4856)	.51	0/3	0/3	1/3
Ireland	56	8.24 (.0413)	.50	1/3	1/3	1/3
Portugal	55	7.56 (.0560)	.55	0/3	2/3	2/3

Notes:
Bartlett's test is a test of the null hypothesis that the correlation matrix of the original variables is an identity matrix.
The Kaiser-Meyer-Ohlin (KMO) measure has a value between 0 and 1. It measures whether correlations between pairs of variables can be explained by the other variables. Values below 0.5 are deemed "unacceptable".

Table A.2: Correlation matrices

Period		Belgium	France	Italy	Denmark	Spain	Portugal	Norway	Finland
entire sample	Belgium	1.00							
	France	**.42**	1.00						
	Italy	**.47**	.31	1.00					
	Denm.	**.55**	.31	.32	1.00				
	Spain	**.33**	.19	**.50**	.11	1.00			
	Portugal	.19	*.23*	.29	.13	**.53**	1.00		
	Norway	.25	.29	*.23*	**.34**	.26	*.25*	1.00	
	Finland	**.38**	.25	**.51**	**.41**	**.47**	.33	**.48**	1.00
79:3-83:1	Belgium	1.00							
	France	.09	1.00						
	Italy	.63	-.15	1.00					
	Denm.	.47	-.14	.41	1.00				
	Spain	*.48*	.03	*.48*	-.28	1.00			
	Portugal	.55	-.32	*.62*	.09	.72	1.00		
	Norway	.08	-.04	.02	-.38	*.50*	.57	1.00	
	Finland	.33	-.10	.21	-.19	.62	**.85**	**.83**	1.00
83:2-87:1	Belgium	1.00							
	France	.56	1.00						
	Italy	**.76**	.35	1.00					
	Denm.	.52	.06	.21	1.00				
	Spain	.05	.16	.29	-.07	1.00			
	Portugal	-.29	.03	-.37	-.08	.24	1.00		
	Norway	.31	.28	.12	.42	.23	-.09	1.00	
	Finland	.02	-.09	-.03	*.42*	.25	.05	.51	1.00
87:2-92:1	Belgium	1.00							
	France	**.77**	1.00						
	Italy	.37	.34	1.00					
	Denm.	.37	*.42*	.23	1.00				
	Spain	**.58**	.32	.33	.23	1.00			
	Portugal	.32	.56	.45	.07	.34	1.00		
	Norway	**.84**	**.78**	.19	.44	**.57**	*.43*	1.00	
	Finland	**.75**	.53	**.58**	.50	**.72**	.30	**.58**	1.00
92:2-94:4	Belgium	1.00							
	France	*.58*	1.00						
	Italy	.20	.68	1.00					
	Denm.	*.58*	.62	.38	1.00				
	Spain	.05	.12	.45	.17	1.00			
	Portugal	.02	.29	.45	.23	.65	1.00		
	Norway	.01	.50	.41	.46	.02	.24	1.00	
	Finland	.49	**.78**	**.88**	*.55*	.44	.43	.26	1.00

Notes:
Bold, underline and italics denote significance at the 1, 5 and 10 percent level respectively (two-tailed test).

Figure 1: Exchange market pressure Belgium: actual and fitted values

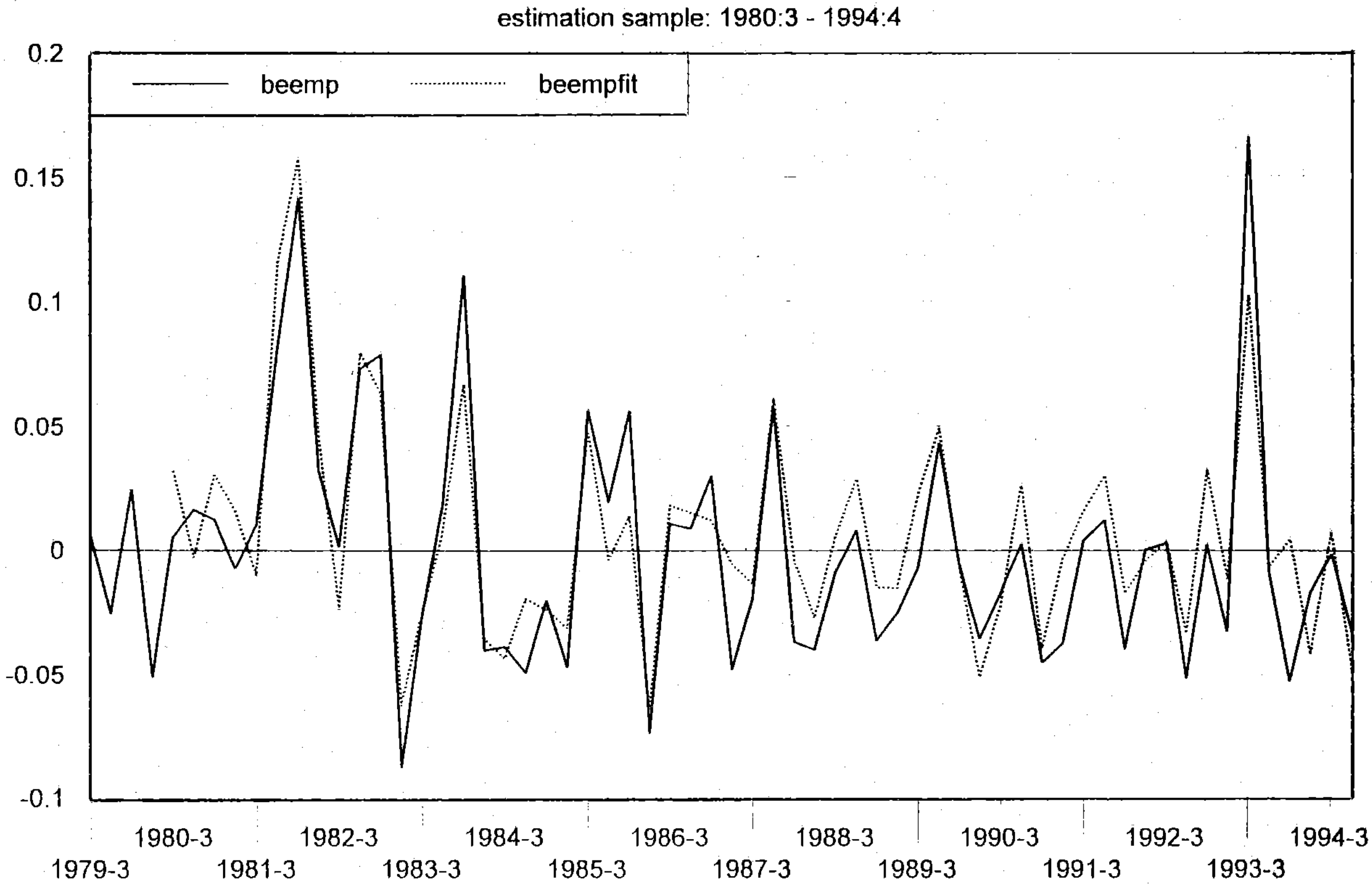


Figure 2: Exchange market pressure France: actual and fitted values

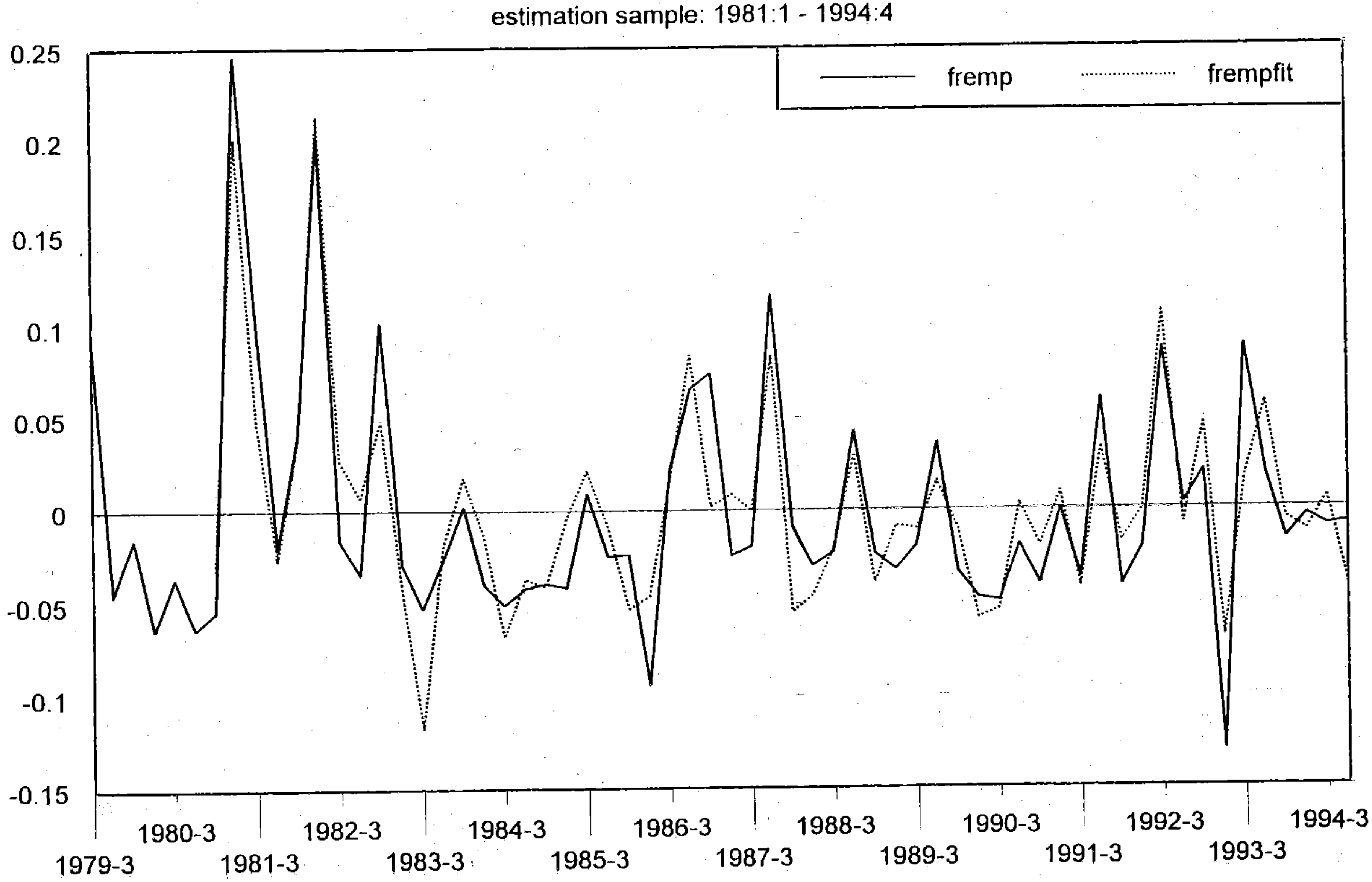


Figure 3: Exchange market pressure Italy: actual and fitted values

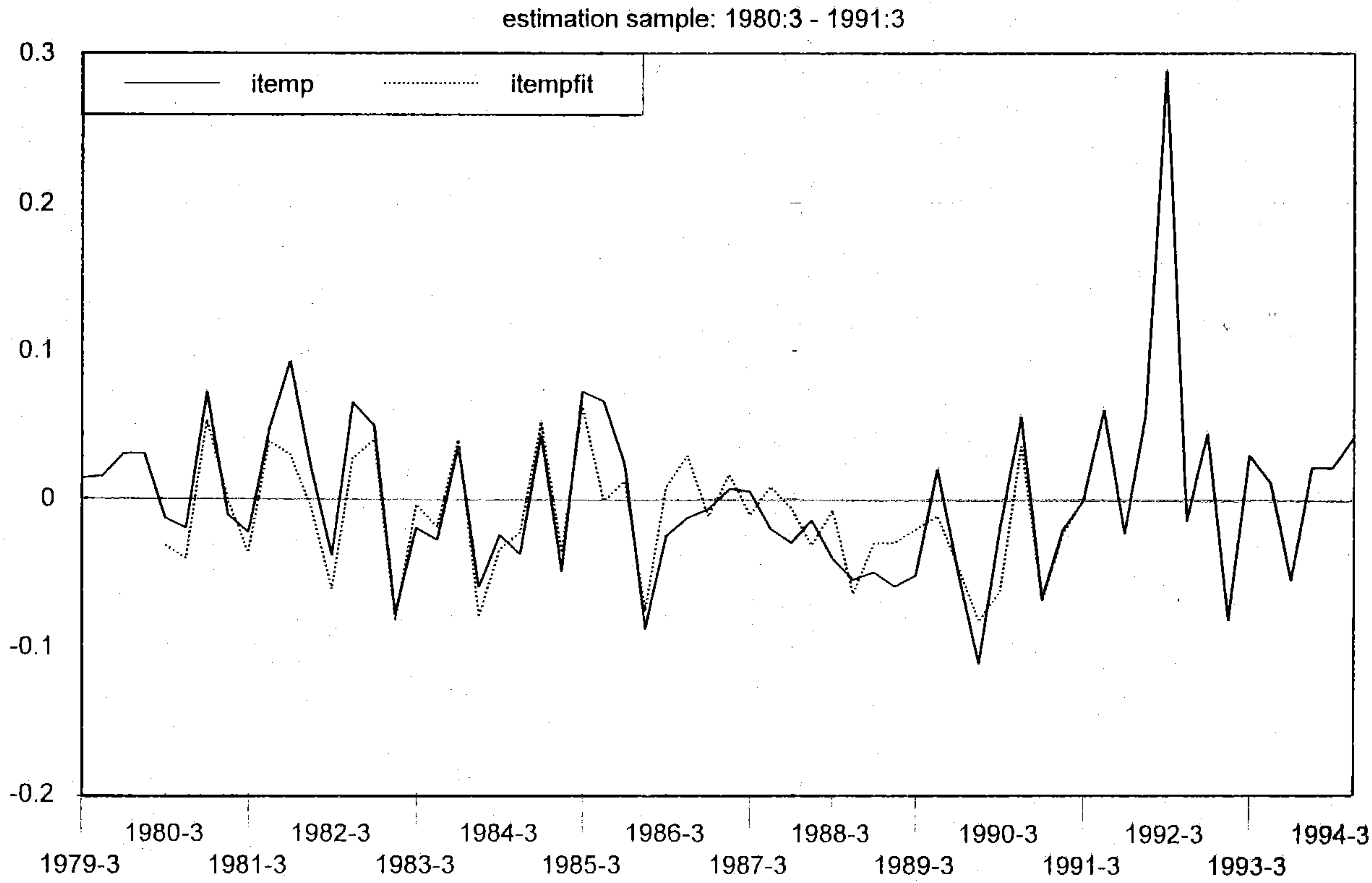


Figure 4: Exchange market pressure Spain: actual and fitted values

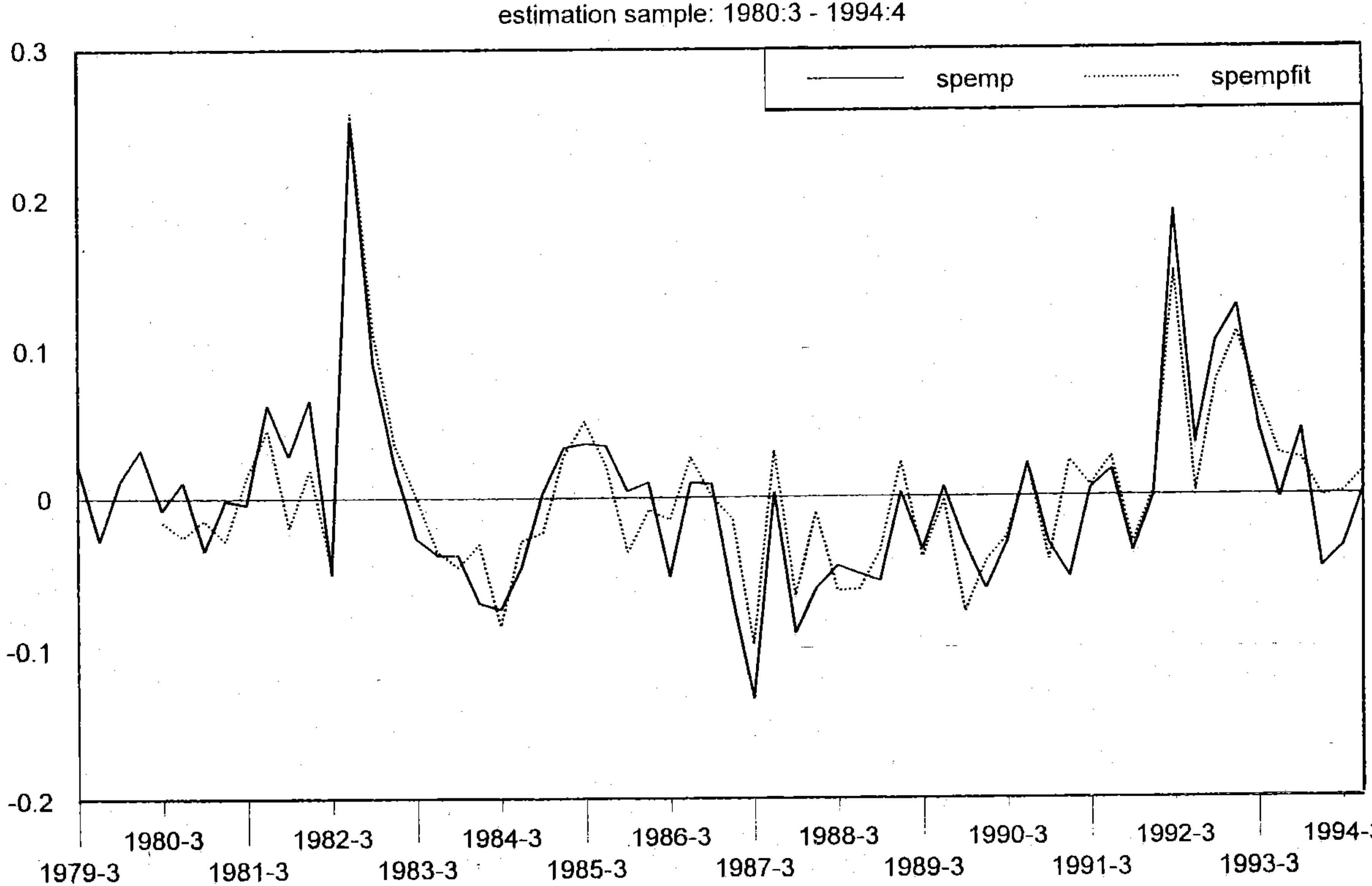
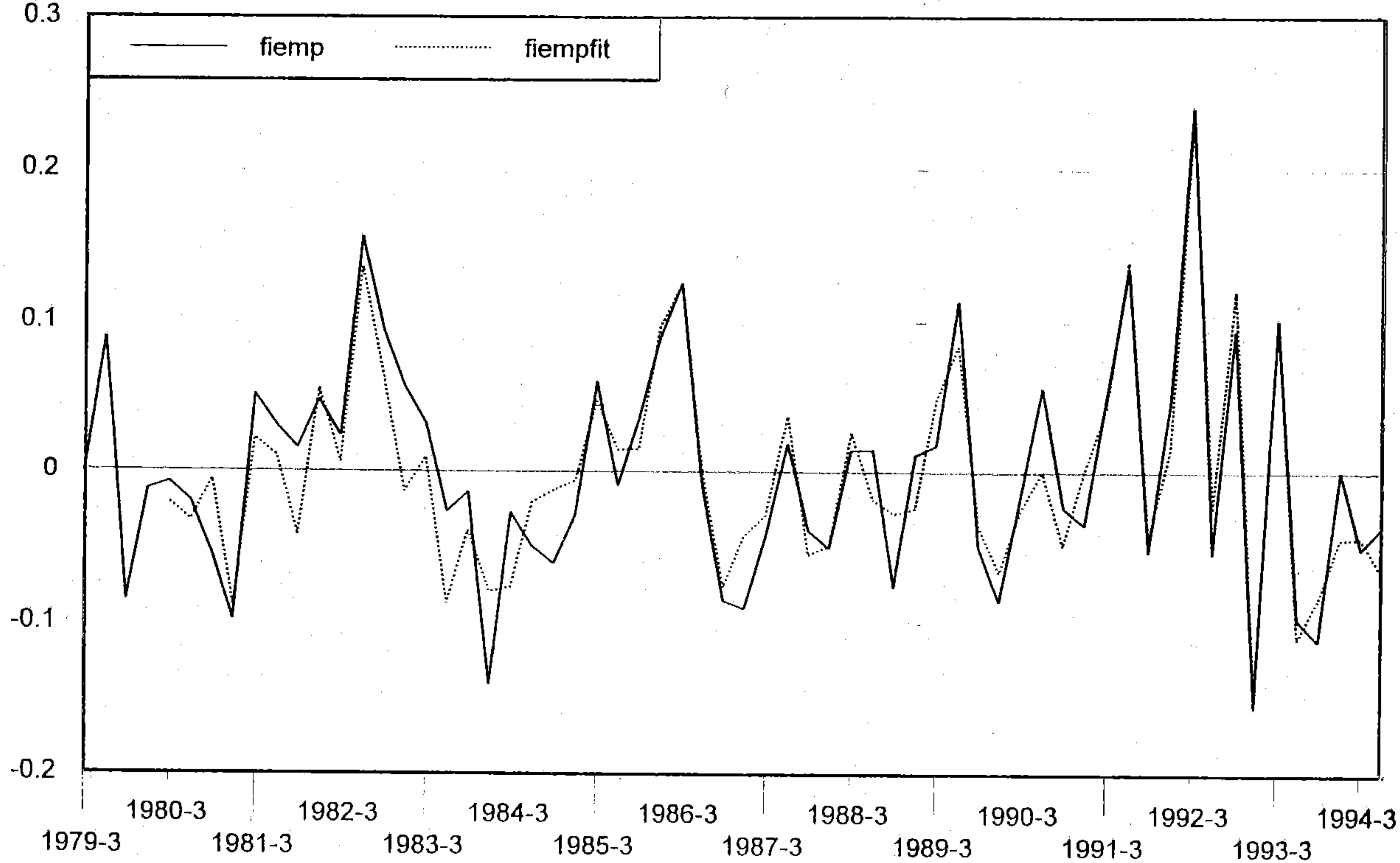


Figure 5: Exchange market pressure Finland: actual and fitted values

estimation sample: 1980:3 - 1994:4



LIJST VAN RECENTE SESO-RAPPORTEN

VERHETSEL A., Ruimtelijke patronen van de socio-economische ontwikkeling 1991-2010, Gewestplanscenario versus structuurplanscenario, december 1995, 69 p. **(95/332)**

KERSTENS K., Technical efficiency measurement and explanation of French Urban Transit Companies, December 1995, 40 p. **(95/333)**

SCHROYEN F., Redistribution and friends : on bilaterally incentive compatible tax schemes, January 1996, 28 p. **(96/334)**

CORTENS I. en W. NONNEMAN, Het redement van onderwijs in België : enkele empirische bevindingen op basis van regionale gegevens, februari 1996, 26 p. **(96/335)**

DE BORGER B., Optimal pricing of public final and intermediate goods in the presence of externalities, February 1996, 27 p. **(96/336)**

SCHELLEKENS P., Does central bank independence reduce inflation at no real cost ? A survey article, March 1996, 25 p. **(96/337)**

GENTIL G. and Tom PAUWELS, EVOTRANS : een simulatieprogramma voor het gedesaggregeerd goederenvervoer, juli 1996, 56 p. **(96/338)**

VAN HOOYDONK C. en A. VAN POECK, Measuring exchange market pressure for the Belgian Franc 1975-1994 : a principal components analysis, July 1996, 22 p. **(96/339)**

BRUGGEMAN A., Computing Quarterly GDP data : a question of economics ?, December 1996, 41 p. **(96/340)**

DE GRAEVE D., DUCHESNE I., Equity in Health and in Medical consumption in Belgium, February 1997, 41 p. **(97/341)**

LOMBAERT, G., DE GRAEVE, D., GOOSSENS, H., Een economische evaluatie van het Pneumokokkenvaccin voor België, februai 1997, 46 p. **(97/342)**

WEEREN A.J.T.M., DUMORTIER F. and J.E.J. PLASMANS, Exchange Rate Modeling by Multivariate Nonlinear Cointegration Analysis using Artificial Neural Networks, March 1997, 20 p. **(97/343)**

BLAUWENS G., Rekeningrijden : De merites van een gedifferentieerde heffing op het autogebruik, Maart 1997, 11 p. **(97/344)**

VEUGELERS R. and Hylke VANDENBUSSCHE, European Anti-Dumping Policy and the Profitability of National and International Collusion, March 1997, 29 p. **(97/345)**

VAN POECK A., EMU and UNEMPLOYMENT, April 1997, 18 p. **(97/346)**

VANHOUDT P., An Assessment of the Macroeconomic Determinants of Inequality, June 1997 **(97/347)**

VANHOUDT P., A Fallacy in Causality Research on Growth and Capital Accumulation, June 1997 **(97/348)**