

This cover page may be removed to conceal the identity of the authors

European Monetary Union and the Impact on non members

A Macroeconomic Experiment

I McAvinchey
W. D. McCausland¹

Department of Economics, University of Aberdeen,
Aberdeen, Scotland, UK AB24 3QY.

12th ICMIF Conference University of Crete 2008

Theme:

Theme: Monetary Union

JEL- Codes: F15, F42, O52

Abstract

This paper looks at the impact on a small outside country if a larger, outsider country were to join a nearby monetary union, exemplified by the likely effects on Norway of the UK deciding to join the Euro. We construct a theoretical model to capture such effects, which focuses on the effect of union on Norway as the *small* outside state. We then estimate the model using data from the period 1980-1999 (the period covering the existence of the ECU and the Euro), and find that there would be substantial implications for the management of the Norwegian economy in response to asymmetric shocks and EU fiscal and monetary policy.

¹ This paper forms part of research on the regional implications of EMU on UK and Norway, organised within Europa-programmet's "Storbritannia-prosjekt" on "Britain, Scandinavia and the EMU".

European Monetary Union and the Outsiders

Theme:

Theme: Monetary Union

JEL- Codes: F15, F42, O52

Abstract

This paper looks at the impact on a small outside country if a larger, outsider country were to join a nearby monetary union, exemplified by the likely effects on Norway of the UK deciding to join the Euro. We construct a theoretical model to capture such effects, which focuses on the effect of union on Norway as the *small* outside state. We then estimate the model using data from the period 1980-1999 (the period covering the existence of the ECU and the Euro), and find that there would be substantial implications for the management of the Norwegian economy in response to asymmetric shocks and EU fiscal and monetary policy.

1. Introduction

In this paper we consider the impact on a small outsider country of the decision taken by a large, outsider country deciding either to remain outside or to join a monetary union. We look at how Norway might be affected by a decision of the UK to join the Euro, using data from the period 1980-1999, during which the ECU and the Euro have been in existence. While this period was not one characterised by a uniform monetary regime, it was dominated by the growing awareness that monetary union was at least an implicit objective for an increasing number of potentially participating countries. This exercised a growing influence on the monetary policies and associated expectations of those countries that were eventually to join the Euro-zone, and it is the macroeconomic behaviour of this group of countries in response to the potential and actual realisation of the Euro that form the central theme of our paper. We explore this theme by counter-factual experimentation. We ask what would have been the impact on Norway had the UK been a member of a monetary union comprising of the current Euro-zone members over this period. We do this by creating a single demand for money function for the member countries and the UK combined while allowing other macroeconomic variables including fiscal policy and income to vary across the member countries. Our results have wider significance than for Norway alone in that there are a number of small countries on the periphery of Europe that may be affected by the actions of their larger neighbours in deciding whether or not to participate in the Euro zone.

One way of addressing this question might have been to estimate three models and attempt a comparison, but an alternative, and the one adopted in this paper, is to construct a model encompassing all three economies (the monetary union, the large outsider and the small outsider) and consider the divergence between them. A suitable theoretical framework to do this is the Levin (1983) model. We have constructed a dynamic extension of this model, and modified it to form two three-country models appropriate to the countries under consideration. The first models the present position from 1980 to the present, where both the UK and Norway have been outside the Euro zone. The second is a hypothetical situation where the UK is taken to have been a member of the Euro zone from its inception, with Norway remaining as an outsider.

This will allow the present two-outsider case to be compared with a constructed version of the one-outsider case.

We find that there would be substantial implications for the Norwegian economy if the UK decided to join the Euro zone.

The paper is set out as follows. In section two we present the theoretical model, followed in section three by the empirical analysis. In section four we present the policy analysis, before concluding in section five.

2. Theoretical Considerations

In this model there are three countries, one is in a monetary union, the second is considering joining the union, and the third is a small country not part of the monetary union, but which trades extensively with it. This differs from Levin's (1983) original paper in which he specified the third country to be "large". This reflects the contemporary interest we have in "small" countries on the periphery of a dominant union in Europe. The model highlights the interdependence of economic policy, both within the currency union and between the union and the non-member country. Capital is taken to be perfectly mobile between all three countries. For each country we have an aggregate expenditure equation, which has a standard form, as detailed below. Correspondingly, each country has a money demand function, which for the two union countries are combined. We use the same notation for variables and coefficients for each country, denoting those for the first country with the superscript EU , those for the second country by the superscript UK , and those for the third country by the superscript N .

There are two key dynamics, those of the exchange rate, and of output. Any divergence between money supply and demand results in instantaneous exchange rate changes. Any divergence between aggregate expenditure and output also results in instantaneous exchange rate changes, followed by gradual output adjustment.

We begin by stating the aggregate expenditure expressions for each country

$$E_t^{EU} = a_1^{EU} Y_t^{EU} - b_1 (R_t^{EU} - \Pi_t^{EU}) + G_t^{EU} + x_1^{EU} Y_t^{UK} + x_2^{EU} S_t - x_3^{EU} Y_t^{EU} + x_4^{EU} Y_t^N + x_5^{EU} T_t \quad (1)$$

$$E_t^{UK} = a_1^{UK} Y_t^{UK} - b_1 (R_t^{UK} - \Pi_t^{UK}) + G_t^{UK} + x_1^{UK} Y_t^{EU} + x_2^{UK} S_t - x_3^{UK} Y_t^{UK} + x_4^{UK} Y_t^N + x_5^{UK} T_t \quad (2)$$

$$E_t^N = a_1^N Y_t^N - b_1 (R_t^N - \Pi_t^N) + G_t^N + x_1^N (Y_t^{EU} + Y_t^{UK}) - x_2^N S_t - x_3^N Y_t^N + x_5^N T_t \quad (3)$$

Taking equation (1) as an example, aggregate expenditure in the first union country, E_t^{EU} , comprises several components. Firstly, domestic consumption, which varies positively with domestic income, represented by the term $a_1^{EU} Y_t^{EU}$, secondly, investment, which varies inversely with the real interest rate (the nominal interest rate, R_t^{EU} , minus the rate of inflation, Π_t^{EU}), according to the term $-b_1(R_t^{EU} - \Pi_t^{EU})$, and thirdly, government borrowing, G_t^{EU} , taken to be exogenous. Finally, net exports are included, which depend positively on foreign income ($x_1^{EU} Y_t^{UK} + x_4^{EU} Y_t^N$), negatively on own income ($-x_3^{EU} Y_t^{EU}$), and positively on the exchange rate $x_2^{EU} S_t$. The exchange rate is defined as the price of the non-union currency (the Krone) in terms of the union currency (the Euro), and a fall in S is therefore an appreciation of the union currency and a depreciation of the non-union currency. A trade shock term, $x_5^{EU} T_t$, is added to capture exogenous external shocks and influences to the trade account. In the two-outsider case this also includes the exchange rate between the large outsider and the union (the Sterling-Euro rate). Equations (2) and (3) follow suit for the second union country and the non-union country respectively, where the superscripts 1 and 3 on the net export terms have been arranged to always correspond to “foreign” and “own” income for each respective country.

We next consider the money demand functions for each country, which are set equal to the real money supply to form a market clearing condition in each case.

$$M_t^{EU} - P_t^{EU} = l_1^{EU} Y_t^{EU} - l_2^{EU} R_t^{EU} \quad (4)$$

$$M_t^{UK} - P_t^{UK} = l_1^{UK} Y_t^{UK} - l_2^{UK} R_t^{UK} \quad (5)$$

$$M_t^N - P_t^N = l_1^N Y_t^N - l_2^N R_t^N \quad (6)$$

Money demand is a positive function of own income and a negative function of the nominal interest rate.

We now proceed to solve the model. We wish to examine the implications for Norway in two situations. The first considers the UK and Norway as joint outsiders to a larger union (the EU11). The second considers a hypothetical situation where the

UK becomes a full member of the Euro zone and Norway remains outside. The first of these situations corresponds to the current state of affairs, while the second represents a possible situation that may have important implications for Norway that would be the sole outsider of the three economies considered. We explicitly solve the model given by equations (1) through to (6) in order to highlight the impact on Norway if the UK joins the Euro zone. Thus, the money demand functions for the two union countries are amalgamated to form equation (7), since in the union there is a common interest rate, R , a common inflation rate, Π , and a combined union real money supply ($M - P$) and income ($Y^{EU} + Y^{UK}$).

$$M_t - P_t = l_1(Y_t^{EU} + Y_t^{UK}) - l_2 R_t \quad (7)$$

The first of the model's two dynamic equations concerns the dynamics of the exchange rate. In accordance with the uncovered parity condition, a positive interest differential ($R_{t-1} - R^N_{t-1}$) > 0 will generate an expected depreciation of the union currency, which is equal to the actual real depreciation, $s_t - s_{t-1}$, as shown in equation (8).

$$s_t - s_{t-1} = R_{t-1} - R^N_{t-1} \quad (8)$$

To solve the model, we rearrange lagged versions of equations (7) and (6) to obtain the equilibrium interest rates for the union and the third country respectively, and substitute these into a equation (8) to yieldⁱ equation (9)

$$s_t - s_{t-1} = \frac{l_1}{l_2}(Y_{t-1}^{EU} + Y_{t-1}^{UK} - Y_{t-1}^N) - \frac{1}{l_2}(M_{t-1} - M_{t-1}^N) + \frac{1}{l_2}(P_{t-1} - P_{t-1}^N) \quad (9)$$

By introducing a definition of the income divergence between the total income of the two union countries ($Y^{EU} + Y^{UK}$) and the income of the non-union country (Y^N), as $y \equiv Y^{EU} + Y^{UK} - Y^N$, the corresponding money supply divergence, as $m \equiv M - M^N$, and the exchange rateⁱⁱ $s \equiv P - P^N$, we can rewrite equation (9) as

$$\Delta s = s_t - s_{t-1} = \frac{l_1}{l_2} y_{t-1} - \frac{1}{l_2} m_{t-1} + \frac{1}{l_2} s_{t-1} \quad (10)$$

The second dynamic equation is formed by substituting equations (1), (2) and (3) into the standard output equals expenditure equation, $y_t = \gamma e_{t-1}$, where γ is the speed of output adjustment, which, using the definition of the output divergence, $y \equiv Y^{EU} + Y^{UK} - Y^N$, and expenditure divergence $e \equiv E^{EU} + E^{UK} - E^N$ yieldsⁱⁱⁱ

$$y_t = \gamma(x_2^{EU} + x_2^{UK} - x_2^N) s_{t-1} + \gamma(a_1^{EU} - x_3^{EU} + x_1^{UK} - x_1^N) y_{t-1} + \gamma g_{t-1} + \gamma(x_5^{EU} + x_5^{UK} - x_5^N) T_{t-1} \quad (11)$$

where the fiscal divergence, g , is defined as $g \equiv G^{EU} + G^{UK} - G^N$. Equation (11) can then be written as

$$\Delta y = y_t - y_{t-1} = \gamma(x_2^{EU} + x_2^{UK} - x_2^N) s_{t-1} + \gamma(a_1^{EU} - x_3^{EU} - 1 + x_1^{UK} - x_1^N) y_{t-1} + \gamma g_{t-1} + \gamma(x_5^{EU} + x_5^{UK} - x_5^N) T_{t-1} \quad (12)$$

By combining equations (10) and (12) we obtain the following representation of the dynamics of the combined economic systems

$$\begin{bmatrix} \Delta s_t \\ \Delta y_t \end{bmatrix} = \begin{bmatrix} 1/l_2 & & & \\ \gamma(x_2^{EU} + x_2^{UK} - x_2^N) & \gamma(a_1^{EU} - x_3^{EU} - 1 + x_1^{UK} - x_1^N) & & \end{bmatrix} \begin{bmatrix} s_{t-1} \\ y_{t-1} \end{bmatrix} + \begin{bmatrix} -1/l_2 & 0 & 0 \\ 0 & \gamma & \gamma(x_5^{EU} + x_5^{UK} - x_5^N) \end{bmatrix} \begin{bmatrix} m_{t-1} \\ g_{t-1} \\ T_{t-1} \end{bmatrix} \quad (13)$$

which is a system of two difference equations for changes in the nominal exchange rate and changes in the nominal GDP divergence (Δs and Δy). It incorporates a number of zero restrictions, known collectively as the classical dichotomy. The explanatory variables in divergence form are GDP, the exchange rate, the monetary aggregate M3, government expenditure, and a trade shock variable, all of which are

nominal, and, (relative to the dependent variables) in levels, each of these levels being absolute divergence of Norway from the EMU-11 aggregate, with the exception of the exchange rate, which is the Euro-Krone spot rate. The implicit solution, if the system is stable, is that both Δs and Δy are zero (that is, the nominal exchange rate and GDP divergence are stationary). For Δs to be zero, a combination of the nominal exchange rate, and the divergence of the GDP and money should relate in such a way to produce a zero effect. Likewise, for Δy to be zero, this implies that nominal exchange rate, and the divergence of the GDP, government expenditure and the trade shock are combined in a way to produce a zero effect. This may imply that these two groups of variables are individually cointegrated - a possibility which is investigated using standard Johansen (1988) techniques. This approach would in turn suggest that the model is of the error correction type, with the two groups of co-integrating variables acting as attractors, which will correct deviations of both Δs and Δy from zero or the equilibrium path. We can then give numerical estimates of how strong the influence of the EMU-11 is on the economy of the outside state, Norway, and test whether EMU membership as at presently constituted strengthens or weakens the effect of the EMU-11 on the outsider.

3. Empirical Analysis

3.1 General Specification

The theoretical model derived above in equation (13) is taken as the basis for an empirical implementation of the processes involved, which takes account of the sequential time ordering of events. First differences are relative to base time values at the end of the previous observation period. A discrete time version of the model will then take the form

$$\begin{bmatrix} \Delta s_t \\ \Delta y_t \end{bmatrix} = \begin{bmatrix} \beta_{11} & \beta_{12} \\ \beta_{21} & \beta_{22} \end{bmatrix} \begin{bmatrix} s_{t-1} \\ y_{t-1} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} \end{bmatrix} \begin{bmatrix} m_{t-1} \\ g_{t-1} \\ T_{t-1} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \end{bmatrix} \quad (14)$$

This implies a model of the error correction (ECM) type for s_t and y_t with exogenous variables m_{t-1} , g_{t-1} and T_{t-1} . The variable T includes other variables, such as the Sterling-Euro exchange rate (ST) and the oil price (OP), which are included in the specification and will be discussed later.

The annual observation interval may hide higher frequency changes in some of the variables specified in the model. In particular, income and the exchange rate are likely to adjust at different speeds, with the income less likely to exhibit overshooting characteristics than the exchange rate. Any monetary policy changes may also impact more immediately on exchange rates than on the income level, while fiscal policy changes may impact more immediately on income. Monetary and fiscal policy stances, as the major instruments of governments in influencing the dynamic behaviour of the economic systems, must be classified more as control variables, and therefore exogenous by implication.

There are three data sets included in the information set to be used for the model estimation. Set A includes data for the eleven countries that belong to the Euro zone at the end of the data period (1999). Set B includes data for the United Kingdom, the largest EU member outside the Euro zone. Set C includes data for Norway, which is not a member of the EU and not a Euro zone country. All three data sets are utilised in constructing the variables from which parameter estimates for equation (14) are obtained.

For the purposes of this paper, the data can be arranged in two ways. One is to treat both Norway and the UK as outsiders as opposed to the eleven insiders. This is the two-outsiders model (EU11, UK+N). A second arrangement is to include the UK with the eleven Euro zone countries as if it is a member of the EU, treating Norway as a single outsider (EU11+UK, N). The two-outsider data (set 2) (EU11, UK+N) and the one-outsider data (set 1) (EU11+UK, N) are used to estimate two separate and corresponding models, which will be compared. The two-outsider case represents the current state of affairs with both the UK and Norway outside the Euro zone, while the one-outsider case is a hypothesized situation where the UK was a member of the Euro zone from 1980 while Norway remained an outsider.

There are a total of nine variables to be specified in the two models, a subset of six of which are specified in each of the two models. For the one-outsider case the variables included are s , y , m , g , OP , ST , while for the two-outsider case the variables in the specification are s , yx , mx , gx , OP , ST . It can be noted that three variables, s , OP and ST , are included in both models, where the ‘ x ’ indicates the two-outsider variables.

Since the data are time series, they should be initially tested for stationarity as this may influence the model specification and suggest a functional form. Stationarity was tested through the Augmented Dickey Fuller (ADF) procedure, with the statistics given in Table 1. It is clear that the hypothesis of a unit root cannot be rejected for any of the nine variables, from critical values based on the response surface results of MacKinnon (1991)

Variable	s	y	m	g	yx	mx	gx	ST	OP
ADF value	-2.652	-2.424	-2.290	-2.102	-0.684	-2.255	-1.415	-2.211	-2.499
Constant and trend	c	c, t		c	c	c, t	c	c	c
Critical value	-3.082	-3.761	-3.735	-3.082	-3.052	-3.761	-3.066	-3.066	-3.066

Table 1: Unit Root ADF Tests on the data series

The theoretical model indicates that the dependent variables, s (the Krone-Euro exchange rate), y and yx (income differential in the one- and two-outsider cases respectively), should be specified as first differences Δs , Δy and Δyx .

3.2 Modelling Strategy

While there are six variables specified in each of the one-outsider and two-outsider models, each of these models has two equations and each of these equations has a different specification. For the two-outsider case the specification is

$$\Delta s = s_2(\mathbf{X}_{21}) \quad (15)$$

$$\Delta yx = y_2(\mathbf{X}_{22})$$

where $\mathbf{X}_{21} = (s \ yx \ mx \ ST \ OP)$ and $\mathbf{X}_{22} = (s \ yx \ gx \ ST \ OP)$. For the one-outsider case the specification of the two equations is

$$\begin{aligned}\Delta s &= s_1(\mathbf{X}_{11}) \\ \Delta y &= y_1(\mathbf{X}_{12})\end{aligned}\tag{16}$$

where $\mathbf{X}_{11} = (s \ y \ m \ ST \ OP)$ and $\mathbf{X}_{12} = (s \ y \ g \ ST \ OP)$.

From the unit root (stationarity) tests, reported in Table 1, all of the variables in the vectors \mathbf{X}_{11} , \mathbf{X}_{12} , \mathbf{X}_{21} and \mathbf{X}_{22} are individually non-stationary with a high probability of a unit root in each. The first differences of s , y and yx are $I(0)$ and stationary. The combination of $I(0)$ and $I(1)$ variables in the specifications (15) and (16) therefore raises considerable statistical problems. Specifications (15) and (16), which follow directly from the theoretical model (13), are acceptable only if the levels variables in each of the vectors \mathbf{X}_{11} , \mathbf{X}_{12} , \mathbf{X}_{21} and \mathbf{X}_{22} are cointegrated. Then, a combination of these variables may be stationary and $I(0)$, making the specifications (15) and (16) acceptable, at least *a priori*. It is then necessary to seek evidence for and against cointegration in these vectors.

The cointegration rank was tested using the Johansen (1988) framework and was based on the maximal eigenvalue and trace statistics. The number of lags which were available was small but the tests on all five variables in each of the vectors \mathbf{X}_{11} , \mathbf{X}_{12} , \mathbf{X}_{21} and \mathbf{X}_{22} are reported in Table 2 through Table 5.

$H_0 : \rho = ()$	$\hat{\lambda}_i$	$-n \ln(1 - \hat{\lambda}_{i-1})$	$\lambda_{\max}(0.95)$	$-n \sum \ln(1 - \hat{\lambda}_i)$	$\lambda_{tr}(0.95)$
$= 0$	0.903	39.96**	33.5	67.15	68.5
≤ 1	0.5369	11.55	27.1	27.19	47.2
≤ 2	0.4758	9.69	21.0	15.64	29.7
≤ 3	0.3162	5.70	14.1	5.95	15.4
≤ 4	0.0167	0.25	3.8	0.25	3.8

Table 2 Tests of the cointegration rank for \mathbf{X}_{21} (1980-1999) (exchange rate equation, two-outsider case)

$H_0 : \rho = ()$	$\hat{\lambda}_i$	$-n \ln(1 - \hat{\lambda}_{i-1})$	$\lambda_{\max}(0.95)$	$-n \sum \ln(1 - \hat{\lambda}_i)$	$\lambda_{tr}(0.95)$
= 0	0.9093	36.00*	33.5	87.34**	68.5
≤ 1	0.7884	23.29	27.1	51.34*	47.2
≤ 2	0.6292	14.88	21.0	28.05	29.7
≤ 3	0.4819	9.86	14.1	13.17	15.4
≤ 4	0.1976	3.30	3.8	3.30	3.8

Table 3 Tests of the cointegration rank for \mathbf{X}_{22} (1980-1999) (income divergence, two-outsider case)

$H_0 : \rho = ()$	$\hat{\lambda}_i$	$-n \ln(1 - \hat{\lambda}_{i-1})$	$\lambda_{\max}(0.95)$	$-n \sum \ln(1 - \hat{\lambda}_i)$	$\lambda_{tr}(0.95)$
= 0	0.7248	24.51	33.5	58.09	68.5
≤ 1	0.5310	14.39	27.1	33.58	47.2
≤ 2	0.4506	11.38	21.0	19.19	29.7
≤ 3	0.2231	4.79	14.1	7.81	15.4
≤ 4	0.1467	3.01	3.8	3.07	3.8

Table 4 Tests of the cointegration rank for \mathbf{X}_{11} (1980-1999) (exchange rate equation, one-outsider case)

$H_0 : \rho = ()$	$\hat{\lambda}_i$	$-n \ln(1 - \hat{\lambda}_{i-1})$	$\lambda_{\max}(0.95)$	$-n \sum \ln(1 - \hat{\lambda}_i)$	$\lambda_{tr}(0.95)$
= 0	0.8485	35.85*	33.5	75.69*	68.5
≤ 1	0.6816	21.74	27.1	39.84	47.2
≤ 2	0.3952	9.55	21.0	18.09	29.7
≤ 3	0.3002	6.78	14.1	8.54	15.4
≤ 4	0.0883	1.76	3.8	1.76	3.8

Table 5 Tests of the cointegration rank for \mathbf{X}_{12} (1980-1999) (income divergence, one-outsider case)

** significant at 1% level

* significant at 5% level

Critical values based on a response surface fitted to the results of Osterwald-Lenum (1992)

The null of zero rank is rejected in three of the vectors, \mathbf{X}_{12} , \mathbf{X}_{21} and \mathbf{X}_{22} , but is not rejected in \mathbf{X}_{11} . In the case of \mathbf{X}_{22} the hypothesis of rank 2 is not rejected, as zero rank and rank 1 are rejected by the $\hat{\lambda}_{\text{trace}}$ statistic, suggesting that there may be up to two cointegrating vectors in \mathbf{X}_{22} .

These results imply that the variables in vectors \mathbf{X}_{12} , \mathbf{X}_{21} and \mathbf{X}_{22} , while individually $I(1)$, are probably combined to result in an $I(0)$ effect, and these combinations of variables may be specified as levels variables in an error correction

type model. The case of \mathbf{X}_{11} , which includes the combination of variables in the exchange rate equation in the one-outsider case, is more problematic. Perhaps since the one-outsider model represents a hypothetical situation this result is not surprising.

To investigate these points further, subsets of the variables included in each model were also examined for evidence of cointegration and therefore a joint $I(0)$ role in the equations. The variables specified fall into three groups

1. Endogenous variables [s , y , yx]. These are the Krone-Euro exchange rate, s , and a measure of income divergence, y or yx , such that [s , y] appears in both equations of the one-outsider model (vectors \mathbf{X}_{11} and \mathbf{X}_{12}), while [s , yx] is specified in both equations of the two-outsider model (vectors \mathbf{X}_{21} and \mathbf{X}_{22}).
2. Exogenous variables [ST , OP]. These are the Sterling-Euro exchange rate, ST , and the oil price, OP .
3. Policy variables [m , g] or [mx , gx]. These are the monetary policy differential (m in the one-outsider model or mx in the two outsider model) and the fiscal policy differential (g in the one-outsider model or gx in the two outsider model). As policy variables, they also may be considered as potentially exogenous variables. It should however be noted that both of these variables do not appear jointly in the same equation.

The cointegration rank of the vectors [s , yx], [s , y] and [ST , OP] was investigated, and in addition the role of [mx , gx] or [m , g] was considered by adding mx or m , and gx or g individually to the three two-variable vectors above. The tests are reported in Table 6 through to Table 12.

$H_0 : \rho = ()$	$\hat{\lambda}_i$	$-n \ln(1 - \hat{\lambda}_{i-1})$	$\lambda_{\max}(0.95)$	$-n \sum \ln(1 - \hat{\lambda}_i)$	$\lambda_{tr}(0.95)$
0	0.5121	11.48	14.1	16.090*	15.4
1	0.2503	4.61*	3.8	4.609*	3.8

Table 6 Test of cointegration rank for [s , yx] (two-outsider case)

$H_0 : \rho = ()$	$\hat{\lambda}_i$	$-n \ln(1 - \hat{\lambda}_{i-1})$	$\lambda_{\max}(0.95)$	$-n \sum \ln(1 - \hat{\lambda}_i)$	$\lambda_{tr}(0.95)$
--------------------	-------------------	-----------------------------------	------------------------	------------------------------------	----------------------

0	0.8921	35.63**	21.0	54.19**	29.7
1	0.6040	14.82*	14.1	18.56*	15.4
2	0.2085	3.74	3.8	3.74	3.8

Table 7 Test of cointegration rank for [s , yx , mx] (two-outsider case)

$H_0 : \rho = ()$	$\hat{\lambda}_i$	$-n \ln(1 - \hat{\lambda}_{i-1})$	$\lambda_{\max}(0.95)$	$-n \sum \ln(1 - \hat{\lambda}_i)$	$\lambda_{tr}(0.95)$
0	0.7298	20.94	21.0	40.67**	29.7
1	0.6403	16.36*	14.1	19.74*	15.4
2	0.1904	3038	3.8	3.38	3.8

Table 8 Test of cointegration rank for [s , yx , gx] (two-outsider case)

$H_0 : \rho = ()$	$\hat{\lambda}_i$	$-n \ln(1 - \hat{\lambda}_{i-1})$	$\lambda_{\max}(0.95)$	$-n \sum \ln(1 - \hat{\lambda}_i)$	$\lambda_{tr}(0.95)$
0	0.7155	18.860**	14.1	19.190*	15.4
1	0.0222	0.336	3.8	0.336	3.8

Table 9 Test of cointegration rank for [s , y] (one-outsider case)

$H_0 : \rho = ()$	$\hat{\lambda}_i$	$-n \ln(1 - \hat{\lambda}_{i-1})$	$\lambda_{\max}(0.95)$	$-n \sum \ln(1 - \hat{\lambda}_i)$	$\lambda_{tr}(0.95)$
0	0.9058	35.44**	21.0	56.23**	29.7
1	0.7216	19.18**	14.1	20.79**	15.4
2	0.1018	1.61	3.8	1.61	3.8

Table 10 Test of cointegration rank for [s , y , m] (one-outsider case)

$H_0 : \rho = ()$	$\hat{\lambda}_i$	$-n \ln(1 - \hat{\lambda}_{i-1})$	$\lambda_{\max}(0.95)$	$-n \sum \ln(1 - \hat{\lambda}_i)$	$\lambda_{tr}(0.95)$
0	0.8060	24.600*	21.00	39.44**	29.7
1	0.4645	9.368	14.10	14.85	15.4
2	0.3059	5.478*	3.80	5.48*	3.8

Table 11 Test of cointegration rank for [s , y , g] (one-outsider case)

$H_0 : \rho = ()$	$\hat{\lambda}_i$	$-n \ln(1 - \hat{\lambda}_{i-1})$	$\lambda_{\max}(0.95)$	$-n \sum \ln(1 - \hat{\lambda}_i)$	$\lambda_{tr}(0.95)$
0	0.7318	19.740**	14.1	22.80**	15.4
1	0.1844	3.057	3.8	3.06	3.8

Table 12 Test of cointegration rank for [ST , OP]

Table 6, Table 7, and Table 8 report the reduced rank tests of the vectors [s , yx], [s , yx , mx] and [s , yx , gx] respectively of the two-outsider model. These vectors are

subsets of the variables in \mathbf{X}_{21} and \mathbf{X}_{22} . In this case the results are not clear-cut. For $[s, yx]$ a contradictory result is reported as both rank zero and rank one are rejected by the trace test while only rank one is rejected by the maximal eigenvalue test. This suggests that the rank is either zero or two. If it is zero, then the levels of s and yx have no role and the model should be in first differences of these variables. If they are of full rank (i.e. two), then the model should be in levels of these variables and not in first differences. This latter suspicion is supported by the role of yx_{t-1} and s_{t-1} in equation (i) of Table 15 where the full model results are reported.

However, this last conclusion on the final model specification may be countered by the tests reported in Table 7 and Table 8 where both the rank tests for the vectors $[s, yx, mx]$ and $[s, yx, gx]$ are considered. In both of these latter tests, the addition of mx or gx to the vector $[s, yx]$ results in the non-rejection of a reduced rank of two for each. This then reinstates s and yx as legitimate variables in the two-outsider model as either mx or gx are catalyst variables and necessary to result in a cointegrating vector for each combination.

Table 9, Table 10, and Table 11 consider the cointegration rank of the vectors $[s, y]$, $[s, y, m]$ and $[s, y, g]$ respectively of the one-outsider model. These are subsets of the variables in \mathbf{X}_{11} and \mathbf{X}_{12} . The hypothesis of reduced rank cannot be rejected for any of these vectors as the tests support the hypotheses that the rank of ρ is $\rho[s, y]=1$, $\rho[s, y, m]=2$ and $\rho[s, y, g]=1$. These results do raise a question over the role of the fiscal divergence variable, g , as from Table 11 the value of the trace statistic is close to the 95% critical value ($14.58 \approx 15.4$) and is therefore close to rejection of rank one. The trace statistic, from the Monte Carlo experiments of Cheung and Lai (1993), is more robust to skewness and kurtosis in the errors than is the maximal eigenvalue test and therefore would have greater reliability in statistical inference.

The cointegration rank tests for $[ST, OP]$ are reported in Table 12 where a reduced rank of one is not rejected by the two tests.

Exogeneity

From equations (11) and (12), s and y are modelled as endogenous variables, while the other included variables are assumed to be exogenous or policy variables. If any of the variables g , gx , m , mx , ST and OP are endogenous then the equation estimates are likely to be inconsistent.

Following Engle *et al* (1983), weak exogeneity is required for valid conditional inference in an econometric model. This allows efficient and consistent estimates of parameters to be obtained and hypotheses to be validly tested.

From Johansen (1992a,b) and Urbain (1992), weak exogeneity may be tested using F-tests on the marginal models. The test results for the null of weak exogeneity are reported in Table 13 for the two-outsider model, and in Table 14 for the one-outsider model. At the 5% level, exogeneity is not rejected for any of the variables in their respective models. However, it is clear from the statistics that g and gx (fiscal divergence) are closest to endogeneity. This is particularly the case with gx (fiscal divergence in the two-outsider model), as exogeneity would be rejected at the 1% level but not at the 5% level. This allows the hypotheses of exogeneity of monetary divergence (m and mx), fiscal divergence (g and gx), the Sterling-Euro exchange rate (ST) and the oil price (OP) to be maintained at the 5% level. The result implies that these variables may be specified in the two equations of each model and the probability of inconsistency will be reduced.

It is interesting that fiscal divergence (g and gx) is closest to endogeneity in both models, unlike monetary divergence (m and mx), which is much more clearly exogenous. This result suggests that fiscal action is more influenced by the long run behaviour of the models than is monetary policy, perhaps because fiscal policy is frequently related to the level and changes in income. Tax revenue in particular is largely determined by income and expenditure and this will directly influence government borrowing. Changes in fiscal policy are generally made at long intervals so government borrowing is likely to be influenced by income and tax revenue, thus giving rise to an endogeneity effect.

Monetary policy, on the other hand, can be changed at short notice, and most likely in response to inflation rates than other indicators. This will show as a strong rejection of endogeneity in the model as specified. With monetary policy largely influenced by inflation rates, and possibly exchange rates, while tax revenues are largely determined by income and expenditures, and hence government borrowing therefore is influenced towards endogeneity, a conclusion supported by the results of Table 13 and Table 14.

Variable	<i>m</i>	<i>g</i>	<i>ST</i>	<i>OP</i>
F(2,12)	0.1913	4.1376	0.0182	0.2834
Probability	[0.8283]	[0.0430]	[0.9820]	[0.7581]

Table 13: Weak exogeneity tests from marginal models for variables in the two-outsider model

Variable	<i>mx</i>	<i>gx</i>	<i>ST</i>	<i>OP</i>
F(2,12)	0.0842	1.8198	0.0534	0.4373
Probability	[0.9198]	[0.2041]	[0.9473]	[0.6556]

Table 14: Weak exogeneity tests from marginal models for variables in the one-outsider model

In summary then, there is evidence to support an error correction type of specification for the one-outsider and two-outsider models. This implies that first differences and levels of the variables may be jointly included in the model specifications, but as can be seen from the discussion of the reduced rank possibilities of the model specification which follows from the theoretical model, the justification may depend on subsets of reduced rank vectors. Cointegration was not imposed in the final model estimates but its probable presence will justify the model specification.

A general to specific methodology was adopted allowing one lag on each variable in the most general model and testing down to the most parsimonious model not rejected by a likelihood ratio test, and not rejected by a set of specification tests (Autocorrelation (AR), ARCH process, Normality, heteroskedasticity, and ADF tests).

Before the model reduction was initiated, the Sterling-Euro exchange rate (*ST*), the spot price of Brent Crude Oil (*OP*), and a structural shift dummy variable (*D2*) were included in the specification. The first differences of the oil price (*DOP*) and of the government borrowing divergence (Δg and Δgx) were also included to explain short

run changes in income and the Krone-Euro exchange rate. Since these first differenced variables are $I(0)$ they may be included in the model and act to explain the short run variation in the dependent variables. The Sterling-Euro exchange rate in particular was included as this implicitly allowed for the Krone-Sterling exchange rate within the model.

3.3 Parameter Estimates

The two-equation model, (14), was then estimated as a system by Full Information Maximum Likelihood (FIML) for each of the data sets. The estimated parameters are given in Table 15 and Table 16. Asymptotic t-values are reported below each parameter estimate, and equation specification diagnostics are reported below each table (* significance at 5% level, ** significance at 10% level).

	Δy_t	Δs_t	Δy_{t-1}	y_{t-1}	s_{t-1}	m_{t-1}	g_{t-1}	ST_{t-1}	OP_{t-1}	ΔOP_t	Δg_t	D2	C
i	-	1	-	0.1919	-0.9158	-0.2794	-	-	-0.3419	-0.1931	0.1856	-	738.9
				4.154*	-2.468*	-3.890*			-1.821**	-3.035*	1.565		3.019*
ii	1	-	0.5388	0.0476	0.2849	-	-1.9709	-2.1816	-0.8491	-	-	75.817	1124.8
			4.608*	0.694	0.2970		-4.156*	-5.817*	-1.810**			3.007*	1.763**

Equation Diagnostics

Equation (i) Δs_t

AR (2) $F(2,14) = 1.7989$ [0.2017]

ARCH (1) $F(1,14) = 0.1121$ [0.7428]

Normality $\chi^2(2) = 0.2911$ [0.8646]

Heteroskedasticity (χ^2) $F(2,13) = 1.8202$ [0.2009]

ADF = -1.327

Equation (ii) Δy_t

AR (2) $F(2,14) = 0.4299$ [0.6589]

ARCH (1) $F(1,14) = 0.3582$ [0.5591]

Normality $\chi^2(2) = 4.6964$ [0.0955]

Heteroskedasticity (χ^2) $F(2,13) = 0.1965$ [0.8240]

ADF = -1.361

Table 15. Two-outsider model

	Δy_t	Δs_t	Δy_{t-1}	y_{t-1}	s_{t-1}	m_{t-1}	g_{t-1}	ST_{t-1}	OP_{t-1}	ΔOP_t	Δg_t	D2	C
iii	-	1	-	-0.0814	-0.8803	0.1582	-	-	-0.4265	-0.3061	-0.4318	-	674.53
				-0.896	-3.971*	1.329			-2.796*	-2.863*	-3.013*		4.395*
iv	1	-	-0.3056	0.0436	-0.1738	-	0.4582	0.2101	0.3252	-	-	164.85	126.57
			-2.093*	2.625*	-0.501		1.851**	0.753	1.744**			6.515*	0.576

Equation Diagnostics

Equation (iii) Δs_t

Equation (iv) Δy_t

AR (2) $F(2,14) = 1.2666$ [0.3122]	AR (2) $F(2,14) = 2.6095$ [0.1088]
ARCH (1) $F(1,14) = 0.4499$ [0.5133]	ARCH (1) $F(1,14) = 0.9401$ [0.3487]
Normality $\chi^2(2) = 1.1223$ [0.5706]	Normality $\chi^2(2) = 4.7924$ [0.0911]
Heteroskedasticity (χ^2) $F(2,13) = 0.6864$ [0.5207]	Heteroskedasticity (χ^2) $F(2,13) = 1.1282$ [0.3533]
ADF = -1.536	ADF = -1.654

Table 16. One-outsider model

From these test statistics it is clear that all four equations (two in Table 15 and two in Table 16) do not fail any of the equation diagnostic tests. These statistics, AR, ARCH, Normality, heteroskedasticity and Augmented Dickey Fuller (ADF) are tests of specification and imply that the specification of both the two-outsider and one-outsider models is not rejected. Attention can then be given to the parameter estimates. In general, the Krone-Euro exchange rate equations Table 15 (i) and Table 16 (iii) are more parsimonious and perform more satisfactorily than the income divergence equations from almost all of the equation diagnostics of Table 15 (ii) and Table 16 (iv).

The explanatory variables in each equation are divided into two groups, ‘core’ variables and ‘non-core’ variables, by the vertical double line. The variables with unity (1) coefficients in the table are the dependent variables in each case (the equations are normalised on these variables), while the remaining variables to the left of the vertical double line are the ‘core’ variables, s and y , from the economic model given in equation (13), with Δy_{t-1} a lagged endogenous variable, and with m , mx , g and gx exogenous. The variables to the right of the vertical double line are ‘non-core’ variables and are exogenous as shown above.

The coefficients on s_{t-1} (the lagged Krone-Euro exchange rate) are negative in the exchange rate equation in both Table 15 and Table 16 providing evidence of an error correcting effect. This implies that the level of the exchange rate acts to correct overshooting on the exchange rate changes, and maintains the exchange rate on a long-term equilibrium path.

All of the core variables are significant in either the exchange rate equations Table 15 (i) and Table 16 (iii) or the income divergence equations Table 15 (ii) and Table 16

(iv). The one exception is the lagged income divergence, which is not significant in equation Table 15 (ii); y_{t-1} does not exercise an error correcting effect on income changes. This is probably explained by the variables y and yx which as divergences of magnitudes are much less volatile than exchange rates, and have a much reduced tendency to overshoot, indeed, income is much more likely to be positively autoregressive. Monetary policy divergences (m and mx) are only significant in the exchange rate equation for the two-outsider case, Table 15 (i), while fiscal policy divergences (g and gx) are significant, but with different signs, in the income divergence equations Table 15 (ii) and Table 16 (iv).

The non-core variables, given in the theoretical model as T , include the lagged Sterling-Euro exchange rate (ST_{t-1}), the lagged oil price (OP_{t-1}), the current period change in the oil price (ΔOP_t), the change in the fiscal stance divergence (Δg_t), and a structural change binary variable ($D2$). $D2$ has a value of zero except for 1989-91 inclusive where $D2 = 1$ and 1993 where $D2 = -1$, introduced following recursive residual analysis of the income divergence variable. These variables represent exogenous long-term influences (ST_{t-1}, OP_{t-1}), short-term adjustment effects ($\Delta OP_t, \Delta g_t, \Delta gx_t$), particularly on exchange rates, and other exogenous shocks ($D2$), particularly on Norwegian income divergence changes. All of these variables are significant in one or both of the equations in each of Table 15 and Table 16.

The Sterling-Euro exchange rate (ST_{t-1}) and oil price (OP_{t-1}) exercise error-correcting effects on both the income differential (Δyx) and Krone-Euro exchange rate (Δs) in Table 15 where both Norway and the UK are joint outsiders. These error-correcting effects are not present in the income divergence equation (iv) in Table 16 where Norway is the sole outsider.

The oil price (OP_{t-1}) has an error correcting effect on the Krone-Euro exchange rate in Table 15 (i) and Table 16 (iii) and on income divergence in Table 15 (ii) and Table 16 (iv), but significance is only at the 10% level in equations (i), (ii) and (iv).

Another noticeable feature of the results is the reversal of the signs on the variables s_{t-1} , g and gx , ST_{t-1} and OP_{t-1} in the income divergence equations for Δy and Δyx .

The classical dichotomy would indicate that the coefficients on s_{t-1} and on the monetary divergence variables (m_{t-1} and mx_{t-1}) should be equal in magnitude but opposite in sign. This hypothesis was tested for both models but was rejected in both cases by a χ^2 test: $\chi^2_{(1)} = 11.824 [0.0006]$ (two-outsider case) and $\chi^2_{(1)} = 9.184 [0.0024]$ (one-outsider case). The classical dichotomy is therefore rejected for both of the models in question.

4 Policy Analysis

The model follows an error correction form with the lagged levels of the variables acting jointly and separately as attractors in each equation. These lagged values have been isolated from Table 15 and Table 16 and placed into Table 17 and Table 18. This enables the long run influences on the exchange rate from each model to be compared in Table 17 and for income divergence changes in Table 18. It must be noted that the oil price, OP_{t-1} , and the Sterling-Euro exchange rate, ST_{t-1} , are exogenous long run variables, placed to the right of the double vertical line in each table.

	yx_{t-1}	s_{t-1}	mx_{t-1}	OP_{t-1}
Two-outsider case	0.1919	-0.9158	-0.2794	-0.3419
	4.154*	-2.468*	-3.890*	-1.821**
One-outsider case	-0.0814	-0.8803	0.1582	-0.4265
	-0.896	-3.971*	1.329	-2.796*

Table 17: Long run influences on exchange rate changes

	y_{t-1}	s_{t-1}	g_{t-1}	ST_{t-1}	OP_{t-1}
Two-outsider case	0.0476	0.2849	-1.9709	-2.1816	-0.8491
	0.694	0.2970	-4.156*	-5.817*	-1.810**
One-outsider case	0.0436	-0.1738	0.4582	0.2101	0.3252
	2.625*	-0.501	1.851**	0.753	1.744**

Table 18: Long run influences on income divergences

A negative sign reflects an error-correcting role for the variable concerned. For the two-outsider model in exchange rate changes, shown in Table 17, three of the four lagged variables are significantly negative (the lagged exchange rate, money divergence and oil price), while for the one-outsider case only two are negative and significant (the lagged exchange rate and oil price). Most noticeable is the change in the sign and significance of the money divergence variable. In the two-outsider case it is negative and significant, while in the one-outsider case it is positive and not significant.

For income divergence, shown in Table 18, in the two outsider case three variables are error correcting and significant (fiscal divergence, the Sterling-Euro exchange rate and the oil price), while lagged income divergence and lagged exchange rate are positive but not significant. In the one-outsider case only the lagged exchange rate has a negative sign, but it is insignificant.

The most important result from Table 17 and Table 18 is the strong and significant error correcting influence of monetary divergence and fiscal divergence in the two-outsider model. This is to be contrasted with the single-outsider case in which neither monetary divergence and fiscal divergence are error correcting, and in fact they are both destabilising, with positive signs which are, however, not quite significant at the 5% level. Monetary and fiscal policies tend to lose their effectiveness as economic stabilisers for Norway when it alone remains outside the Euro zone. Exchange rates and income divergence become much more volatile and much more difficult to control.

For the exogenous variables, the oil price is error correcting for the exchange rate in both models, but is error correcting for income divergence only in the two-outsider case. The Sterling-Euro exchange rate is significant and error correcting in the two-outsider case but destabilising and insignificant in the one-outsider case for income divergence. Thus, for Norway as a single outsider, both exogenous variables represent destabilising influence.

If the UK becomes a full member of the Euro zone and Norway remained outside, the implication of the above analysis may be stated as follows. Firstly, monetary and fiscal policy both lose their effectiveness as stabilising agents, and secondly, the overall stabilising role of the lagged attractor variables effectively disappears for income divergence and is weakened for exchange rate changes. Aspects of the above analysis is now developed in further detail in the following sections.

4.1 Fiscal Policy

Our estimates indicate that a fiscal tightening by the EU-11, measured by a fall in the EU-11 government deficit relative to the two outsiders (UK and Norway) results in an

appreciation of the Krone and a fall in the income divergence between the EU-11 and the outsiders. Aggregate demand is reduced in the Euro zone and their balance of payments deficit is worsened. To restore domestic balance, interest rates and output must fall in the union. External balance requires further depreciation of the Euro (appreciation of the Krone).

First we consider the effect of fiscal divergence, gx , and its impact on the change in the income divergence, Δyx . Noting carefully the definitions of the variables used in both models, for example in the two outsider case

$$gx = G^{EU} - (G^{UK} + G^N) \quad (17)$$

$$yx = Y^{EU} - (Y^{UK} + Y^N) \quad (18)$$

$$\Delta yx_t = Y_t^{EU} - (Y_t^{UK} + Y_t^N) - [Y_{t-1}^{EU} - (Y_{t-1}^{UK} + Y_{t-1}^N)] \quad (19)$$

and remembering the relative size by GDP of the economies of the EU11, UK and Norway (approximately 40:8:1), an increase in gx (with coefficient -1.9709 (-4.156^*)) will lead to a fall in income divergence. To see this, hold G^{UK} and G^N constant and allow g^{EU} alone to increase. This fiscal expansion will raise incomes in the EU11 primarily, but since it is the largest player, the expanding income of the EU11 will spill over to a growth in demand in both the UK and Norway. Income will therefore grow in the EU11, UK and Norway. There will also be a second round increase in Norwegian income due to the growth in UK income. This implies that the income divergence yx will fall. To see this, we can notice that the argument depends on the relative sizes of the three economies, $Y^{EU} > Y^{UK} > Y^N$. Thus, a long-term positive change in EU fiscal policy will provide a very strong external influence on the UK income level, Y^{UK} , and an even larger effect on Norwegian income, Y^N . The net effect is to reduce the income divergence, $yx = Y^{EU} - (Y^{UK} + Y^N)$, at a higher level of income for all participants. This is implied by the coefficient -1.9709 in Table 15. Thus, a net long-term fiscal expansion will raise income levels and reduce income divergence for the three economies in the two-outsider case.

Were the UK to join the existing Euro countries in the hypothetical one-outsider case, our estimates show that, although the effect of fiscal policy in the union on the Krone is reduced, the income divergence between the enlarged Euro zone and Norway would widen in response to fiscal tightening in the union.

In the one-outsider case, there is an increase in G^{EU} and G^{UK} , thus a much larger increase in yx would result since $(Y^{EU} + Y^{UK}) \gg Y^N$ in the one-outsider case (compared to the two-outsider case, $Y^{EU} > (Y^{UK} + Y^N)$) Given our approximate proportions of 40:8:1, it is clear that $48 \gg 1$ in the one-outsider case compared to $40 > 9$ in the two-outsider case. A long-term increase in g (with coefficient 0.4582 (1.851**)) will lead to an increase in income divergence. Therefore income divergence will grow despite all countries having a higher level of income.

In other words, the presence of the UK as a fellow outsider in some way insulates Norway from the effects of divergent union fiscal policy. But the UK as an insider would leave Norway exposed to the full effects of changes in divergent EU fiscal policy, primarily through the effect of trade with the UK. It is of concern that adjustment to this policy stance is through the real side (changes in output and hence employment differentials) rather than changes in nominal variables (prices and exchange rates).

Our results show, therefore, that if the UK does join the Euro, it is highly questionable whether Norway will be able to pursue anything remotely like an independent fiscal policy - UK membership really does tip the balance.

4.2 Monetary Policy

Changes in EU monetary policy divergence appear to affect the whole model but have direct exchange rate effects according to our estimates, offering some support for the Quantity Theory and some justification for the ECB and Bank of England's use of interest rates to control inflation.

A monetary tightening in the EU-11 relative to the two outsiders (the UK and Norway), shown in Table 15, tends to lead to an appreciation of the Krone, because the higher union interest rate increases capital inflow into the union, hence improving the union balance of payments, and requiring an appreciation of the Euro (depreciation of the Krone).

In the single outsider model, shown in Table 16, the effect of monetary tightening in the enlarged Euro zone relative to Norway would have a small positive but insignificant effect. This result suggests that the ability of Norway to pursue an independent monetary policy is also significantly affected by UK membership. Moreover, the switch in sign on the coefficient on the monetary divergence variables from negative to positive indicates that UK membership implies an increase in volatility for the Euro-Krone rate.

Our results also indicate the presence of exchange rate overshooting, where the short run exchange rates adjust more than is required for long run equilibrium, but are pulled back on to the long run path over time. The magnitude of this overshooting remains broadly unchanged by UK entry into the Euro zone. Such exchange rate movements may be explained as follows. A contraction of the EU money supply relative to the Norwegian money stock (or equivalently, a rise in the Euro zone interest rate or fall in the Norwegian interest rate) generates an improvement in the balance of payments in the Euro zone (as capital flows from Norway to the Euro zone on account of the positive interest rate divergence). This requires a compensating depreciation of the Krone vis-à-vis the Euro to attempt to restore balance of payments balance in the long run (that is to make EU goods less competitive compared with Norwegian goods, causing the EU trade balance to deteriorate). However, as we have learnt from recent events, things do not happen like this in the short run. The positive interest differential generates expectations of an appreciation of the Krone in the capital markets. This uncovered interest parity occurs since currency arbitrage requires the expected price of foreign currency to be equal to the spot exchange rate minus the interest foregone in holding that currency. The only way that this short run appreciation can be reconciled with the long run depreciation is for the exchange rate to overshoot its long run level, that is, initially depreciate by more than is necessary

and then appreciate over time to its new long run value (shown by the coefficient of – 0.2794 in Table 17).

4.3 Asymmetric Shocks

The oil price affects the models in two ways, the first is in the level of the oil price (OP_{t-1}) and the second is the impact of a change (ΔOP_t). The results show that a rise in the oil price, ΔOP_t , which can be interpreted as a negative external shock to the non-oil producing Euro-zone countries, leads to an appreciation of the Krone, but a high oil price in the last period, OP_{t-1} , has a more evolutionary effect which depresses aggregate demand in the EU-11 countries and worsens their balance of payments deficit vis-à-vis the outsiders, requiring a relative fall in output and interest rates to restore domestic balance and a depreciation of the Euro (appreciation of the Krone) to restore external balance. The direct shock (ΔOP_t) tends therefore to impact immediately on the exchange rate but a high oil price also tends to affect income with a longer lag. Thus, ΔOP_t and OP_{t-1} represent transitory and longer term effects respectively with the transitory effects more likely in exchange rate changes but OP_{t-1} will have longer term effects on the exchange rate and income divergence.

Had the UK joined the EU-11, leaving Norway as the sole outsider, the magnitude of the Krone appreciation in response to the same high oil price would have increased. A 10% rise in the price of oil causes a 3.42% appreciation of the Krone when the UK is an outsider, but a 4.27% appreciation of the Krone when the UK is an insider and this volatility of the Euro-Krone exchange rate worsens in response to a high oil price when the UK becomes a Euro zone member. Additionally, we find that a high oil price generates a rise in the income divergence between Norway and the enlarged Euro zone (the EU-11 plus the UK). That is, were the UK to become a Euro member, such external shocks can result in an increased income divergence between the Euro area and Norway.

What our results say, therefore, is that the UK is very important for Norway in so far as its membership of the Euro club determines how Norway reacts to external shocks

such as oil price rises. If the UK joins, Norway's exchange rate with the EU will 'take the strain' when asymmetric shocks occur – the exchange rate adjustment will be more pronounced and be more volatile.

5. Concluding Comments

This paper looked at the effects on Norway (a small outside state) of the UK (a large fellow outsider) deciding to join the Euro. We find that the UK's entry into the Euro zone would have substantial implications for the management of the Norwegian economy. The effects of UK entry are predominantly destabilising for the path of Norwegian income and exchange rate. While our results are specific to one country, they may be generalised to illustrate the impact on other small countries peripheral to a large monetary union.

We show that, if the UK were to join the Euro, although the appreciation of the Krone is reduced in response to a fiscal tightening by the EU-11, it would, however, lead to an increase in income divergence (compared with a reduced income divergence if the UK remained outside the union). So, although (nominal) exchange rate effects are reduced, real effects are increased in a negative way. This has serious implications for Norway's ability to conduct an independent fiscal policy.

The effect of monetary policy divergence has direct effects only on exchange rates. In the two-outsider model, a monetary tightening in the EU-11 relative to the UK and Norway leads to an appreciation of the Krone. However, in the single outsider model, the effect of monetary tightening in the enlarged Euro zone relative to Norway would have the opposite effect, suggesting that UK membership implies an increase in volatility for the Euro-Krone rate. However, this effect is small and not statistically significant, suggesting a convergence of monetary policies across the three countries, united by a common anti-inflation objective. We also find evidence of significant exchange rate overshooting of the Krone in response to monetary disturbances. Our results therefore suggest that the ability of Norway to pursue an independent monetary policy is reduced if the UK joins the Euro zone, and that enforced nominal exchange rate stability within a monetary union area (a) transfers exchange rate volatility to outside currencies, and (b) results in increased real divergence.

Our results also indicate the presence of exchange rate overshooting, where the short run exchange rates adjust more than is required for long run equilibrium, but are

pulled back on to the long run path over time. The magnitude of this overshooting is remains broadly unchanged by UK entry into the Euro zone.

Finally, the effect on the Krone of asymmetric shocks, exemplified here by an oil price rise, would be increased were Norway to be left without the UK as a fellow outsider. As with fiscal policy, the effect of the UK joining the monetary union in Europe is that asymmetric shocks lead to increased, rather than reduced, income divergence. In sum, it is likely that Norway would have a very hard time if the UK were to decide to join the Euro.

In conclusion, if the UK becomes a full member of the Euro zone and Norway remained outside, monetary and fiscal policy both lose their effectiveness as stabilising agents, and secondly, the overall stabilising role of the oil price and the Euro-Sterling exchange rate effectively disappears for income divergence and is weakened for exchange rate changes.

Nomenclature

a, x	Marginal propensities to consume (domestic goods, net exports)
b	Interest sensitivity of investment demand
E	Nominal aggregate expenditure
e	Nominal aggregate expenditure differential $e \equiv E^{EU} + E^{UK} - E^N$
G	Nominal government spending
g	Nominal government spending differential $g \equiv G^{EU} + G^{UK} - G^N$
l_1	Income sensitivity of money demand
l_2	Interest sensitivity of money demand
M	Nominal money supply
m	Nominal money supply differential $m \equiv M - M^N = (M^{EU} + M^{UK}) - M^N$
P	Price level
R	Nominal interest rate
S, s	Nominal exchange rate
T	Exogenous trade shock parameter
t	Time subscript
Y	Nominal aggregate income
y	Nominal aggregate income differential $y \equiv Y^{EU} + Y^{UK} - Y^N$
γ	Speed of output adjustment
θ_s, ρ_s	Negative eigen vector and value respectively

References

- Cheung, Y. W. and Lai, K. S. (1993) 'Finite sample sizes of Johansen's likelihood ratio tests for cointegration' *Oxford Bulletin of Economics and Statistics*, vol. 55, pp. 313-28.
- Engle, R. F., Hendry, D. F. and Richard, J. F. (1983) 'Exogeneity' *Econometrica* vol. 51, pp. 251-276.
- Johansen, S. (1988) 'Statistical analysis of cointegrating vectors' *Journal of Economic Dynamics and Control*, vol. 12, pp. 231-54.
- Johansen, S. (1992a) 'Cointegration in partial systems and the efficiency of single-equation analysis' *Journal of Econometrics*, vol. 52, pp. 389-402.
- Johansen, S. (1992b) 'Testing weak exogeneity and the order of Cointegration in UK money demand data' *Journal of Policy Modelling*, vol. 14, pp. 313-34.
- Levin, J. H. (1983) 'A Model of Stabilisation Policy in a Jointly Floating Currency Area' in J.S. Bhandari and B. H. Putnam (eds.) *Economic Interdependence and Flexible Exchange Rates*, MIT Press, Cambridge MA.
- MacKinnon, J. (1991) 'Critical values for cointegration tests' in R. F. Engel and C. W. J. Granger (eds.) *Long Run Economic Relationships*, Oxford University Press, pp. 267-76.
- Osterwald-Lenum, M. (1992) 'A note with quantiles of the asymptotic distribution of the ML cointegration rank test statistics' *Oxford Bulletin of Economics and Statistics*, vol. 54, pp. 461-72.
- Urbain, J. P. (1992) 'On weak exogeneity in error correction models' *Oxford Bulletin of Economics and Statistics*, vol. 54, no. 2, pp. 187-207.

C:\Borgen\l3991.doc was last saved by W David McCausland 01/05/2008 18:18:00

ⁱ We assume that $l_1 = l_1^{EU} = l_1^{UK} = l_1^N$ and $l_2 = l_2^{EU} = l_2^{UK} = l_2^N$ (that is, the income and interest elasticities of money demand are identical). It could be argued that relaxing the first pair of assumptions would improve the generality of the model, whilst retaining the quality of the results, but it would do so at the cost of reducing the elegance by which the model are presented, and needlessly obfuscate the key results.

ⁱⁱ Assuming purchasing power parity, that is, the real exchange rate is equal to unity. The real exchange rate normally would reflect long run productivity differences between the union countries and the non-member country. In practice, they may exist for a whole host of reasons, for example due to imperfect competition in the labour market, barriers to the free movement of goods (including transport costs), and differences in consumer tastes. In this model we assume no such long run differences persist. Such supply side considerations are beyond the scope of analysis of this model.

ⁱⁱⁱ We assume that $a_1^{EU} + x_1^{UK} = a_1^{UK} + x_1^{EU} = a_1^N$, $x_3^{EU} = x_3^{UK} = x_3^N$ and $x_4^{EU} + x_4^{UK} = x_4^N$ (that is, the marginal propensities to consume union goods in union countries are identical and equal to the marginal propensity to consume non-union goods in the non-union country, the marginal propensities to import are

identical in all countries, and the marginal propensities to consume union goods in non-union countries are identical to those for consuming non-union goods in union countries). Once again, an argument could be made that relaxing these assumptions would improve the generality of the model. However, the assumptions are minor in importance and they do considerably enhance the elegance by which the model is presented, without altering the key results. The substitution involves the elimination of the real interest rate from the system, assuming that the real interest rates are constant across the union and non-union countries, that is, $(R^{EU} - \Pi^{EU}) = (R^{UK} - \Pi^{UK}) = (R^N - \Pi^N)$ and the real interest elasticities of investment are equal in the long run.