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The Credibility of Nordic Exchange Rate Bands: 1987-91

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Abstract

The credibility of the exchange rate bands in the Nordic countries during 1987-91 is examined with two tests. The results suggest that the credibility of Finland's exchange rate band within a twelve-month horizon could not be rejected except in the fall of 1991; however, the band lacked credibility within a five-year horizon throughout the period. Denmark's and Norway's bands lacked both short- and long-term credibility at the beginning of the period, but credibility could not be rejected from 1989 for Norway and as of 1990 for Denmark. The credibility of Sweden's band within a one-year horizon could not be rejected up to fall 1989, but thereafter its credibility deteriorated sharply.

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F31; F33

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Summary

This paper examines the credibility of the exchange rate bands in Nordic countries during 1987-91. Its method consists of two separate tests. The first test assumes only that all arbitrage opportunities in the market have been exhausted, the second test uses in addition the assumption of uncovered interest rate parity. The results of these two tests are expressed in the same diagram in terms of forward exchange rates.

The first test defines a rate-of-return band for foreign investment with a given maturity. If the domestic interest rate for a given maturity falls outside the rate-of-return band, the exchange rate band is not considered credible as there would be unexploited profit opportunities should the market believe in the peg. The second test assumes uncovered interest rate parity so that the credibility of the exchange rate band can be quantified. The computed forward exchange rate is equal to the expected future exchange rate, and the further it is from the limits of the official exchange rate band, the less credible is the band.

The results show that Finland's exchange rate was credible during most of the period. Forward exchange rates indicated, however, a sharp deterioration and a lack of credibility in the months preceding the devaluation of the markka in November 1991. Denmark's and Norway's bands lacked credibility at the beginning of the period, but credibility was restored from 1989 for Norway and as of 1990 for Denmark. Credibility of Sweden's band could not be rejected up to fall 1989, but thereafter its credibility deteriorated sharply.

In conclusion, the hypothesis cannot be rejected that participation in the multilateral exchange rate mechanism (ERM) has brought Denmark credibility. However, ERM membership has not brought Denmark immediate credibility. As Norway achieved an even more impressive increase in the credibility of its exchange rate band, the hypothesis that a unilateral exchange rate arrangement can be credible also cannot be rejected. The recent move to European currency unit (ECU) pegs in Norway, Sweden, and Finland were associated with an increase in credibility. But in all cases, the credibility deteriorated again in the period following the change in the peg, and in Finland, the exchange rate was finally devalued. These experiences suggest that at least part of the improvement in credibility was due to a temporary announcement effect. A firmer commitment than a unilateral peg may be necessary for sustained credibility.

I. Introduction

In recent years, the Nordic countries have maintained broadly similar exchange rate arrangements. 1/ During the 1980s, Finland, Norway, and Sweden restricted their exchange rates to a band around a fixed central parity defined in terms of a trade-weighted basket of foreign currencies. Between fall 1990 and summer 1991, the three countries linked their currencies to the ECU, without changing the external value of their currencies or fluctuation limits. Sweden also announced that the change in the peg was an interim step toward participation in the exchange rate mechanism (ERM) of the European Monetary Systems (EMS). Denmark became a member of the ERM in 1979, and accordingly maintained an exchange rate band around bilateral central parities relative to other ERM members (at present Belgium-Luxembourg, France, Germany, Ireland, Italy, the Netherlands, Spain, and the United Kingdom).

The similarity in the countries' exchange rate commitments provides an opportunity to compare the credibility of their exchange rate bands. In particular, it provides an opportunity to examine whether Denmark's membership in the ERM resulted in greater credibility than the other Nordic countries' unilateral exchange rate arrangements. It also makes it possible to examine whether Finland's, Norway's and Sweden's move from a trade-weighted basket peg to an ECU peg was associated with an improvement in credibility.

In this paper we employ a simple but robust test of the credibility of the Nordic exchange rate bands. Section II explains and motivates the method used. Section III presents the data and reports an overview of the results. Section IV discusses some related aspects of economic policy in the Nordic countries. Section V concludes.

II. The Method

The method we use to test exchange rate credibility is described in Svensson (1990b). The method consists of two separate tests; the first one using only the assumption of no arbitrage, the second one in addition using the assumption of uncovered interest parity. 2/ By expressing the first test in terms of forward exchange rates we will be able to conveniently combine the two tests into the same diagram.

1/ The term "Nordic countries" refers only to Denmark, Finland, Norway, and Sweden throughout this paper.

2/ The term "no arbitrage" is used to mean that all arbitrage opportunities have been exhausted.

1. The First Test: No Arbitrage

The first test examines whether the domestic currency interest rate for a given maturity is within the rate-of-return band for that maturity. The rate-of-return band is given by the maximum and minimum domestic rates of return on a foreign investment consistent with the exchange rate staying within the exchange rate band. The limits of the rate-of-return band are given by the foreign interest rate plus the maximum and minimum rates of depreciation of the domestic exchange rate consistent with the exchange rate staying within the band.

If the domestic interest rate for a particular maturity falls outside the rate-of-return band, the first test concludes that the exchange rate band is not credible as there would be unexploited profit opportunities should the market believe in the peg; the hypothesis that there is credibility in the band would be rejected. This test relies only on a no-arbitrage assumption. The role of the no-arbitrage assumption is illustrated by the following. Suppose the exchange rate band is considered completely credible. Then the rate-of-return band shows the maximum and minimum rates of return on an investment in foreign currency. If the domestic interest rate is outside the rate-of-return band there would be an opportunity for profit, either by borrowing abroad and investing at home (when the domestic interest rate is above the rate-of-return band), or by borrowing at home and investing abroad (when the domestic interest rate is below the rate-of-return band). Such sure arbitrage cannot be an equilibrium and would result in huge capital flows. Therefore, if capital flows are normal and the domestic interest rate falls outside the rate-of-return band, the hypothesis that the exchange rate band is credible is rejected.

If domestic interest rates lie within the rate-of-return band, the hypothesis that the band is credible cannot be rejected. However, this does not mean that the band is credible, and the test is inconclusive. The reason the test is inconclusive is that the rate-of-return band shows the maximum and minimum possible rates of return on a foreign investment (conditional upon a maintained exchange rate band). Since we are not assuming uncovered interest rate parity the "true" expected spot rate may not be the same as the forward exchange rate. As a realistic rate-of-return band (which would reflect "true" exchange rate expectations) we may for instance take an econometrically estimated 95 percent confidence interval for the rate of return on a foreign investment. For short maturities, the rate-of-return band is much wider than a "realistic" rate-of-return band for a foreign investment (conditional upon a maintained exchange rate band). Lindberg, Svensson and Söderlind [1991] show that for three months maturity, the width of an econometrically estimated 95 percent confidence interval for the Swedish case is only about one-sixth of the width of the maximal rate-of-return band. Therefore, the domestic interest rate can fall within the maximal rate-of-return band without falling within the realistic rate-of-

return band corresponding to a 95 percent confidence interval. Only if the domestic interest rate falls within the latter band can we be sure that the exchange rate band is credible.

Of course, the no-arbitrage assumption makes sense only if domestic and foreign bonds or deposits are freely traded in an international market. That is clearly the case for currencies and maturities for which a Euro-deposit market exists. Bonds with longer maturities are also internationally traded for some countries.

It is important to realize that the first test is based on the no-arbitrage assumption only. It does <u>not</u> require any assumptions that there is perfect foresight or the lack of uncertainty, that markets are perfect, that the expectations hypothesis for the yield curve holds, that there is uncovered interest parity, that the foreign exchange risk premium is zero, or that different currencies are perfect substitutes.

Formally, the first test is done by defining the lower and upper limit of the rate-of-return band at time t for maturity τ months, $\underline{R}_t^\tau$ and $\bar{R}_t^\tau$ according to

$$\underline{R}_t^\tau=(1+i_t^{*\tau})(\underline{S}/S_t)^{12/\tau}-1 \qquad (1a)$$

and

$$\bar{R}_t^\tau=(1+i_t^{*\tau})(\bar{S}/S_t)^{12/\tau}-1. \qquad (1b)$$

Here $i_t^{*\tau}$ denotes the foreign interest rate at time t for a bond or deposit of maturity τ (expressed as an annualized compounded rate of return), S_t denotes the spot exchange rate at time t (in units of domestic currency per unit of foreign currency), and $\underline{S}$ and $\bar{S}$ denote the lower and upper bound of the exchange rate band. If the domestic interest rate at time t for maturity τ months, i_t^τ, falls <u>outside</u> the rate-of-return band ($i_t^\tau > \bar{R}_t^\tau$ or $i_t^\tau < \underline{R}_t^\tau$), the exchange rate band is not credible. If the domestic interest rate is <u>above</u> the rate-of-return band, a devaluation is expected. If the domestic interest rate is <u>below</u> the rate-of-return band, a revaluation is expected. If the domestic interest rate i_t^τ falls <u>inside</u> the rate-of-return band $\underline{R}_t^\tau \le i_t^\tau \le \bar{R}_t^\tau$, the test is inconclusive and the exchange rate band may or may not be credible.

The first test can be illustrated in diagrams showing domestic interest rates and the rate-of-return bands for different maturities. It can equivalently be expressed in terms of forward exchange rates and the exchange rate

band as the assumption of no arbitrage implies covered interest parity. The assumption of covered interest parity states that the forward premium equals the interest rate differential between domestic and foreign interest rates. Let the forward exchange rate be denoted by F_t^τ, the price contracted at time t to be paid in domestic currency at time $t+\tau$ for one unit of foreign currency at time $t+\tau$. Under the assumption of covered interest parity the forward exchange rate fulfills

$$F_t^\tau = S_t[(1+i_t^\tau)/(1+i_t^{*\tau})]^{\tau/12} \qquad (2)$$

where the maturity τ is measured in months. It is easy to see from (1) and (2) that whether the domestic interest rate falls inside or outside the rate-of-return band is equivalent to whether the forward exchange rate falls inside or outside the exchange rate band. 1/ 2/ Consequently, if the forward exchange rate falls outside the exchange rate band ($F_t^\tau > S$ or $F_t^\tau < \underline{S}$), the exchange rate band is not credible. If the forward exchange rate is above the exchange rate band, a devaluation is expected. If the forward exchange rate is below the exchange rate band, a revaluation is expected. If the forward exchange rate falls inside the exchange rate band ($\underline{S} \leq F_t^\tau \leq S$), the test is inconclusive and the exchange rate band may or may not be credible.

2. The Second Test: Uncovered Interest Parity

The second test makes one additional assumption, namely that the foreign exchange risk premium is small so that uncovered interest parity is a reasonable approximation. The benefit from making this assumption is that the credibility of the exchange rate band can be quantified.

Under uncovered interest parity, the forward exchange rate is equal to the expected future exchange rate. The second test is then to interpret the forward exchange rate calculated in (2) as the expected future exchange rate, and to compare it with the exchange rate band. For a given maturity, the distance the expected future exchange rate is outside the band can be used as a measure of the lack of credibility: the further an expected

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1/ Note that if the interest rates are expressed not as annualized compounded rates of return but as simple annualized rates (which is the case of the Euro-market for maturities of less than one year), equation (2) can be written

$$F_t^\tau = S_t(1+i_t^\tau\tau/12)/(1+i_t^{*\tau}\tau/12)$$

2/ The forward exchange rates computed according to (2) are implicit forward exchange rates, derived from the interest rates. Under covered interest parity they are equal to market forward exchange rates, except for (small) transactions costs reflected in bid-offer spreads.

future exchange rate is from the band, the less credible is the band. If the expected future exchange rate falls inside the exchange rate band, the second test is not inconclusive in the following sense. It is not the case that the exchange rate band is 100 percent credible once the expected future exchange rate falls within the band. For one thing, if the distribution of the future exchange rate has a non-zero variance, some probability mass may still fall outside the exchange rate band. Nevertheless, we can use the distance to the edges of the exchange rate band as a measure of the degree of credibility: for a given maturity, an expected future exchange rate further in from the edge of the band indicates more credibility of the exchange rate band than one closer to the edge.

The assessment of the degree of credibility is made possible by the assumption of uncovered interest rate parity. Without it, one can only say that the exchange rate is not credible when the forward exchange rate falls outside the band, not whether the band is more or less credible.

It is clear from the above that the two tests are closely related, but separate. The assumption underlying the first test, no arbitrage is extremely weak. The additional assumption underlying the second test, uncovered interest parity, is more controversial. If this assumption is not accepted, one should only use the first test to check credibility, but not attempt to quantify the lack of credibility of the exchange rate band.

There are reasons, however, to believe that the foreign exchange risk premium is small in narrow exchange rate bands, even in the presence of realignment risks. These reasons are detailed in Svensson (1990a): In an exchange rate band the foreign exchange risk premium is the sum of two components. The first component is due to exchange rate variability within the band. Previous empirical research has shown that the foreign exchange risk premium associated with floating exchange rates is rather small, around 1-2 percent per year or less. 1/ As exchange rate variability within the band is considerably lower than under a free float, it makes sense that this component of the risk premium is insignificant. The other component of the foreign exchange risk premium arises from uncertainty associated with exchange rate realignments. While this component is larger than the first component, it would still be fairly small. Svensson (1990a) shows that even for a fairly high degree of risk aversion (a coefficient of relative risk aversion equal to 8) and for an expected realignment size of around 10 percent, this component is no larger than a fifth of the interest rate differential. 2/

1/ See Hodrick (1987) for a survey.

2/ The coefficient of relative risk aversion is measured as the negative of the elasticity of marginal utility of consumption with respect to consumption.

For these reasons, the assumption of uncovered interest rate parity should be an acceptable approximation in a narrow exchange rate band, even when there is realignment risk. Accordingly, the second test should be acceptable as well. 1/ 2/

III. The Data and Results

1. Data

The data consists of end-of-month observations of spot exchange rates and short-term interest rates for the January 1987-October 1991 period. Forward exchange rates were calculated according to (2) for three-, six-, twelve-, and sixty-month maturities. For Finland, Norway, and Sweden, exchange rates were measured in terms of each country's currency index during the peg to a trade-weighted basket. For the period following the move to the ECU peg exchange rates were defined in terms of the ECU. For Denmark, the exchange rate was expressed in relation to the deutsche mark, the (implicit) anchor currency of the ERM. Euromarket interest rates were used to calculate forward exchange rates for twelve-month maturities and shorter, in order to minimize the effect of the largely ineffective capital controls that remained during the early part of the period. Domestic government bond rates were used for calculating the five-year forward exchange rates; these may thus be somewhat unreliable since capital controls may have affected domestic bond rates. Bond interest rates in some countries may have also included a liquidity premium due to the thinness of the long-term bond market. 3/ For five-year maturities, the data extends to June 1991.

1/ Traditional tests of uncovered interest rate parity (or whether *forward exchange rates are unbiased predictors of future exchange rates*) which do not explicitly incorporate realignment or regime shift risk (what in the literature has sometimes been called "the Peso problem") are not relevant to the issue of whether uncovered interest rate parity is a good approximation in exchange rate bands (see Froot and Thaler (1990)).

2/ The second test's sensitivity to the size of the foreign exchange risk premium is easy to examine, however, for instance by adjusting the domestic interest rate i_t^7 in (2) for the risk premium.

3/ For example, in Finland, "guesstimates" about the size of the liquidity premium in long-term bond rates are at around 0.7-0.8 percentage points.

2. Exchange rate credibility: An overview

The calculated forward exchange rates and the corresponding spot currency bands are presented in Charts 1 and 2. 1/ Chart 1 shows for each country the exchange rate band, the spot exchange rate and the three-, six- and twelve-month forward exchange rates over the period January 1987 to October 1991.

The first test, using only the assumption of no arbitrage, suggests a lack of credibility in the exchange rate band of Denmark over a one-year horizon during 1987-89. The forward exchange rate for twelve-month maturity was above the ±2.25 percent exchange rate band during the whole period. Three- to six-month forward rates suggest lack of credibility during most of the period. Since the first test is inconclusive when the forward exchange rate is inside the exchange rate band, the exchange rate band may or may not have been credible during 1990 and in the first half of 1991. With the assumption of uncovered interest parity, however, forward exchange rates can be interpreted as expected future exchange rates, and the degree of credibility can be quantified. On this basis, as Chart 1 indicates, it can be concluded that the lack of credibility of the Danish exchange rate band was the highest during the second half of 1987. Credibility improved in early 1988 but only in spring 1990 the short-term forward rates moved to inside the currency band. Since then, except for a brief period of uncertainty in the market in August/September, 1990, and again in December, the credibility of the band over twelve months horizon has remained good.

Norway also has an exchange rate band of ± 2.25 percent. Its twelve-month forward exchange rate was outside the band during 1987-88. Occasionally the three- and six-month forward exchange rates also exceeded the upper limit of the fluctuation band. Thus, during this period the Norwegian krone band lacked credibility within a twelve-month horizon, and occasionally also within a three-month horizon. Since 1989, the short-term forward exchange rates remained inside the exchange rate band, and the first test is inconclusive. However, with the assumption of uncovered interest parity, the second test suggests that the currency band was credible over 1989-91. On October 22, 1990, Norway linked the krone to the ECU. Interest differentials against foreign rates narrowed immediately but a subsequent widening of differentials led to an increase between the spot and forward exchange rates suggesting that at least part of the improvement in credibility associated with the change in the peg was temporary.

Sweden has the narrowest exchange rate band among the Nordic countries (±1.5 percent). From 1987 to late 1989 all short-term forward exchange rates were inside the band, except for the twelve-month rate during a brief period in the winter of 1987-88. Between late 1989 and end-1990 forward exchange rates moved outside the band, indicating lack of credibility,

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1/ For all Nordic countries, the move of the exchange rate toward the upper limit of the band implies a depreciation.

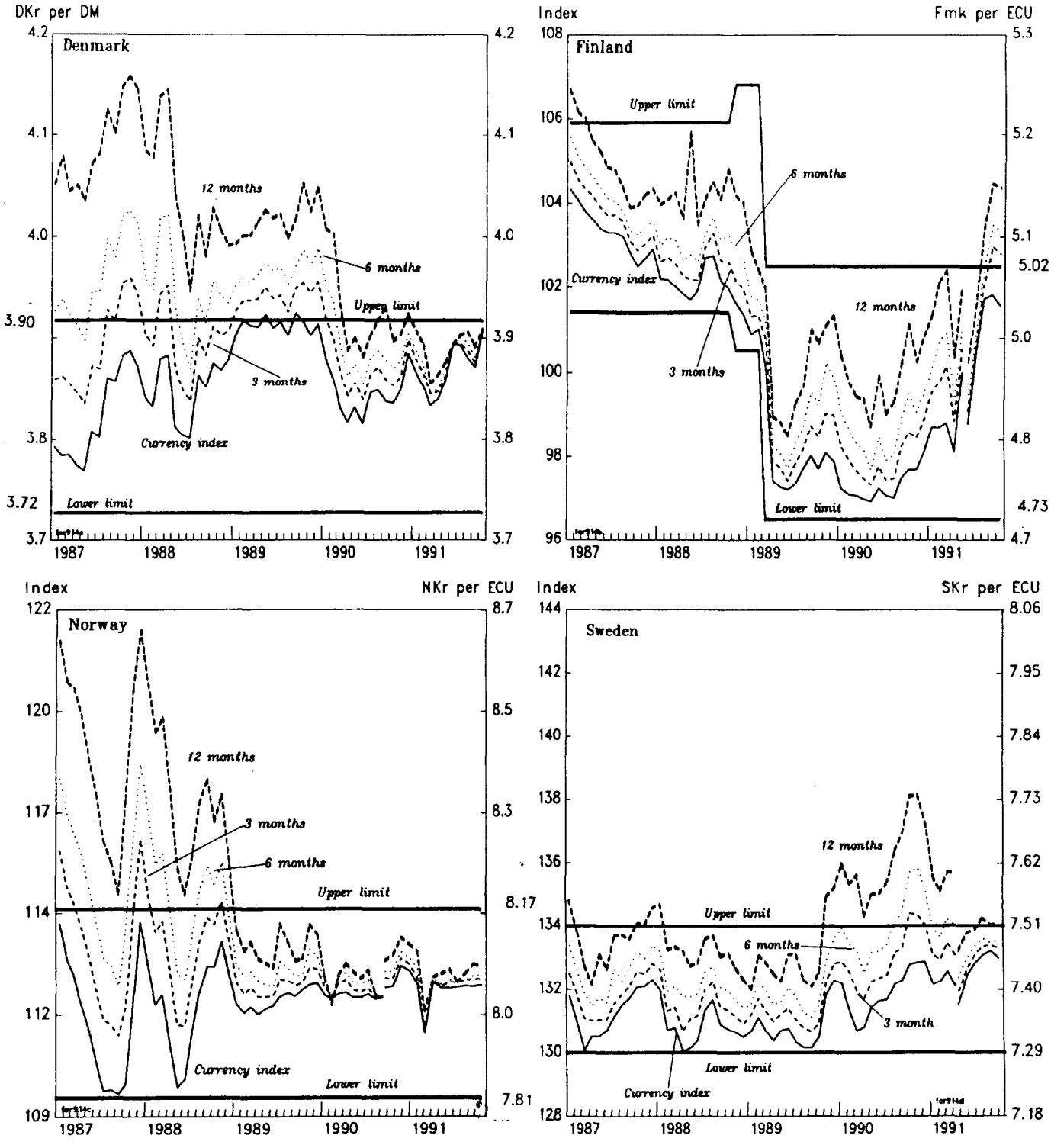
during devaluation rumors in the fall of 1990, even within a three-month horizon. In early 1991, forward rates started to move to inside the band, and following the peg of the krona to the ECU in May 1991, all short-term forward rates were inside the fluctuation limits, except for the twelve-month rate during August-October.

With the assumption of uncovered interest rate parity, exchange rate credibility can be said to have been at its lowest point in October 1990, but improved thereafter, perhaps as a result of the measures taken in response to the crisis. Credibility further improved immediately following the ECU peg in May. However, as in Norway, shortly after the new peg was adopted forward rates moved back toward the upper limit of the band and in August 1991, a month before general elections, the Swedish band was again not fully credible within a 12-month horizon.

In contrast to other Nordic countries, the exchange rate for the Finnish markka remained within its exchange rate band during almost the whole period, except for the very latest part of it. The Finnish experience seems unique among the Nordic countries. Finland's exchange rate band was widened from ±2.25 percent to ±3 percent in November 1988, and the markka was revalued by 4 percent in March 1989. However, devaluation speculations arose in early 1991, but all the short-term forward exchange rates remained within the exchange rate band. The devaluation expectations which arose in the fall of 1991 drove all the short-term forward rates beyond the upper limit of the exchange rate band. The first test is inconclusive since the forward exchange rates were inside the exchange rate band, except for the period starting in September 1991 where there is clearly a lack of credibility. It is worth noting, that the first test is a priori more likely to be inconclusive for Finland than for the other Nordic countries given the size of its exchange rate band. It was double the size of the Swedish band and one third wider than the Danish and Norwegian bands. With the assumption of uncovered interest parity, however, one can conclude that the credibility of the Finnish band deteriorated strongly before the ECU peg in June 1991 and later towards the fall. The new peg improved credibility, but only temporarily as concerns about a record-deep recession intensified. Indeed, the spot rate depreciated sharply within the band in August 1991, and by September, all the forward rates were outside the exchange rate band. Finally, in November, the Bank of Finland devalued the markka. The exchange rate band was moved downward by 15 percent and the markka depreciated by 12 percent.

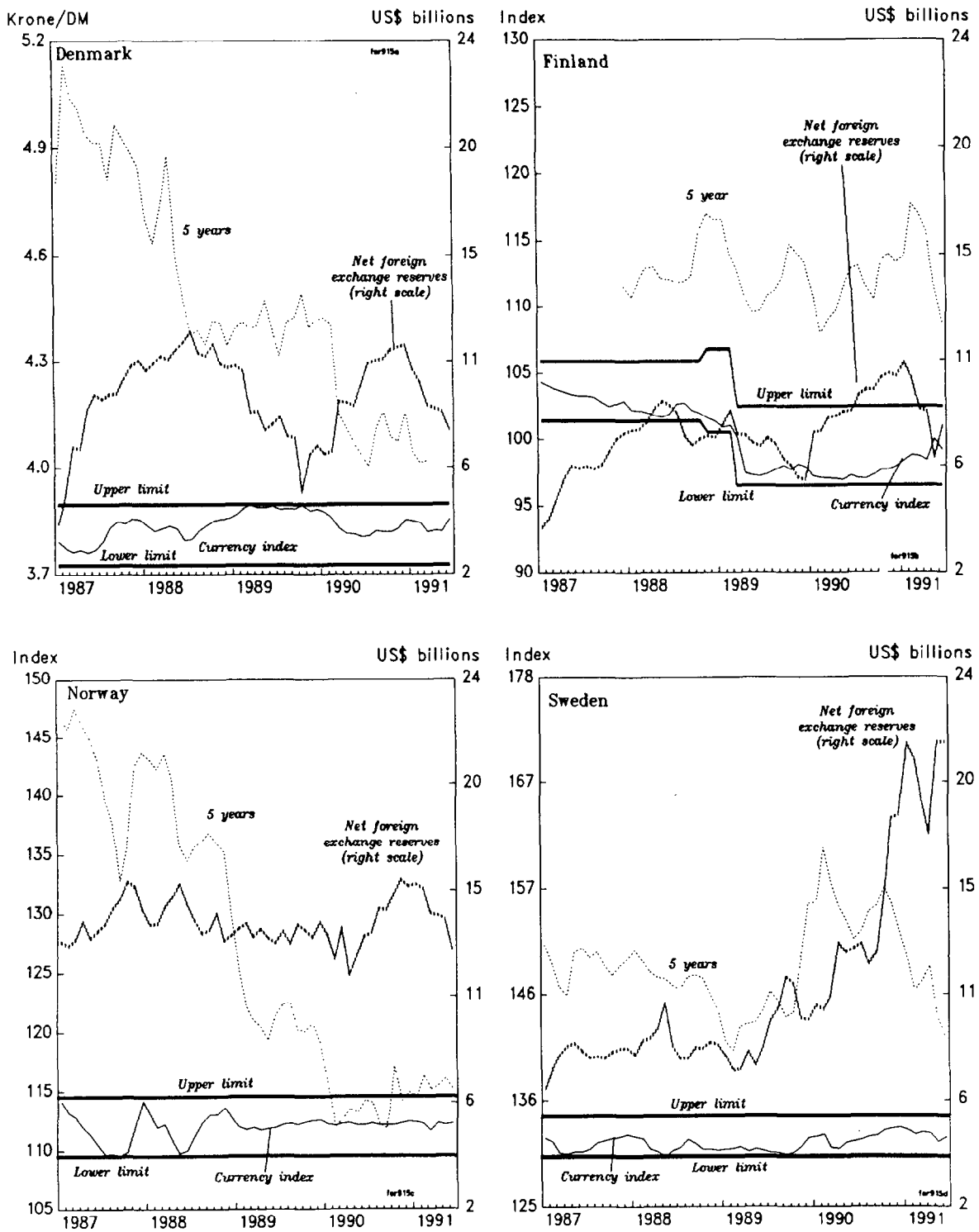
Chart 2, assesses credibility for a five-year horizon. If only no arbitrage is assumed, and hence the first test is applied, the exchange rate band for all four countries lacked credibility within a five-year horizon for 1987-91, except for Norway in most of 1990 when the test is inconclusive. If uncovered interest rate parity is assumed in addition, the second test suggests that credibility within a five-year horizon improved considerably for Denmark and Norway almost throughout the sample period, and for Sweden since late 1990. However, the long-term credibility deteriorated somewhat in Norway at the end of 1990 and during 1991 the

CHART 1
NORDIC COUNTRIES
FORWARD EXCHANGE RATES:
3, 6 AND 12 MONTHS 1/



Sources: National central banks, and staff calculations.
1/ End-of-month data for the period January 1987 to October 1991. The discontinuities in the data for Finland, Norway and Sweden reflect the change in peg to the ECU.

CHART 2
NORDIC COUNTRIES
60-MONTH FORWARD EXCHANGE RATE
AND FOREIGN EXCHANGE RESERVES 1/



Sources: National central banks, and IMF, International Financial Statistics.
1/ Average monthly data for 60-month maturities from January 1987 to June 1991, foreign reserves at the end of month level.

five-year forward rate has remained slightly outside the band. For Finland the long-term credibility deteriorated continuously after early 1990 but an improvement took place in connection with the ECU peg. From winter to summer in 1991, five-year devaluation expectations declined from 14-15 percent to 6-7 percent. Also for Sweden, devaluation expectations over a five-year period, at around 10-11 percent in spring 1991, declined with the ECU peg. In June 1991, the forward rate implied only about 6 percent devaluation over a five-year horizon. For Denmark, in the first half of 1991 the five-year rate still remained slightly above the upper limit of the exchange rate band. It should be remembered, though, that the five-year forward exchange rate, for reasons stated above, may be a less reliable indicator of credibility than the twelve-month and shorter rates. Therefore, these results should be interpreted with great care.

3. Capital movements

Uncovered interest rate parity implies that the expected rate of return on domestic currency deposits is equal to the expected rate of return on foreign currency deposits taking into account the devaluation risk. Investors should accordingly be indifferent between deposits in domestic and foreign currency, and the amount of foreign exchange intervention needed to maintain the exchange rate within the band should be limited. Changes in net foreign exchange reserves may therefore be relevant to an assessment of credibility. If, for example, a central bank is reluctant to raise domestic interest rates to a level that fully compensates for the devaluation risk, the expected rate of return on the domestic currency deposits would be lower than on a foreign currency deposits, leading to large capital outflows and a reduction in foreign exchange reserves. A reduction in net foreign exchange reserves can therefore be indicative of an interest rate differential lower than what corresponds to uncovered interest parity. Consequently, credibility of the exchange rate band would be lower than suggested by forward exchange rates. Conversely, the central bank could push domestic interest rate above the levels corresponding to uncovered interest rate parity. In such situations, the expected rate of return on domestic currency deposits is higher than on foreign currency deposits, and an increase in net foreign exchange reserves occurs. Credibility would accordingly be higher than indicated by forward exchange rates.

Against this background, Chart 2 shows that for Denmark, net foreign exchange reserves increased considerably from early 1987 to mid-1988. Hence, during this period credibility may have been higher than indicated in Chart 1. Subsequently, reserves fell rapidly, up to late 1989, indicating that credibility may have been lower than concluded above. From early 1990, net foreign exchange reserves rose again, indicating that credibility may have been higher than concluded from Chart 1. A reversal of movements in foreign exchange reserves in the first half of 1991 indicates the opposite. For Finland, an increase in net foreign exchange reserves is observed in 1987 and again in 1990, adding to the high credibility until early 1991. However, the rapid fall in reserves in early 1991 suggests that credibility in the markka band was weaker than suggested by Chart 1. For Norway, net

foreign exchange reserves were high through most of the period. The rapid increase in reserves during 1990 adds to the high credibility noted above but the fall in reserves in early 1991 suggests weaker credibility than implied by forward exchange rates. Sweden's net foreign exchange reserves increased sharply after October 1990 indicating that Sveriges Riksbank allowed domestic interest rates to exceed uncovered interest parity somewhat. The loss of credibility toward the end of 1990 may therefore have been a bit less than concluded above.

After this somewhat quick look at the charts, we shall look at developments in the Nordic countries in greater detail. We assume uncovered interest parity so that the degree of exchange rate credibility can be quantified.

IV. Country Developments

1. Denmark

Charts 1 and 2 indicate that the Danish exchange rate band lacked credibility for twelve- and sixty-month horizons throughout 1987-89. Within that period, however, the credibility of the band increased considerably in the Spring 1988. For three- and six-month securities, the forward exchange rates declined to within the exchange rate band in mid-1988. Credibility also improved for five-year horizons. But between mid-1988 and late 1989, credibility deteriorated again. Only in Spring 1990 did forward exchange rates move inside the band for short-term maturities, at the same time as inflation slowed to below 4 percent and the external current account moved into surplus. Although the sixty-month forward exchange rate fell towards the exchange rate band it remained above the upper intervention limit. During the increased uncertainty with the events in the Middle East in August 1990, the twelve months forward exchange rate exceeded slightly the upper limit of the band. This deterioration in credibility was only temporary but some uncertainty arose again in December. In the first half of 1991, with a further decline in inflation and continued current account surplus, the short-term forward rates have remained well within the exchange rate band. Apart from good inflation and current account performance, it is possible that the credibility of the krone has also gained from the strengthening of EMS cooperation indicated by unchanged parities since 1987.

The capital inflows up to mid-1988 indicate that domestic interest rates may have exceeded the level corresponding to uncovered interest parity, and that credibility may have been higher than indicated by the forward exchange rates. The decline in reserves between mid-1988 and late 1989 indicate that the deterioration in credibility during that subperiod may have been larger than suggested by the forward rates. Capital outflows were particularly pronounced in late 1989, possibly following speculations about an ERM realignment. In early 1990, the foreign exchange reserve position strengthened again, indicating credibility higher than the forward exchange rates show. During the rest of 1990, foreign reserves remained at a relatively high level implying that credibility was consistent with the

forward exchange rate indicator. The reserves decreased again in early 1991, suggesting less credibility than the forward exchange rates imply. A possible interpretation of the periods with decreasing reserves is that Danish interest rates were kept low for domestic stabilization purposes.

2. Finland

Apart from the early months of 1987, forward exchange rates for short-term maturities in Finland have remained well within the fluctuation band throughout the period 1987-90. On the other hand, credibility within a five-year horizon seems to have been lacking. However, the level of the sixty-month forward exchange rate until the widening of the band in November, 1988 corresponds to only a small expected rate of devaluation. After the revaluation of the markka in March 1989, the sixty-month forward exchange rate implied on average about 10 percent devaluation over a five-year period and by winter 1991 these expectations rose close to 15 percent. However, an accurate evaluation of long-term credibility of the Finnish exchange rate band is difficult. The Finnish bond market is undeveloped and illiquid and the bond rate may include a liquidity premium. Nevertheless, even with some adjustment for a liquidity premium it seems reasonable to conclude that long-term credibility was lacking, in particular after the revaluation of the markka in spring 1989. 1/

In 1988, the Finnish economy became overheated; the current account deficit widened and inflation accelerated. The Bank of Finland tried to keep interest rates as high as possible given the exchange rate target, but this proved insufficient to stem the overheating as fiscal policy was not sufficiently restrictive. In November 1988, the central bank widened the exchange rate band from ±2.25 percent to ±3 percent, which allowed some appreciation of the markka. In March 1989, the exchange rate was revalued by shifting the currency band downwards by 4 percent. The exchange rate appreciated by about the same amount. But this move was considered temporary as the sixty-month forward exchange rate rose, suggesting a reduction in long-term credibility of the markka. According to that indicator, long-term credibility has not been restored thereafter.

The short-term forward exchange rates rose toward the upper edge of the exchange rate band until November 1989 and foreign exchange reserves fell, indicating a reduction in the band's credibility, probably reflecting continued imbalances in the economy and uncertainty about the outcome of the fall wage settlements. Confidence in the markka improved again during early 1990 but toward the end of the year and in early 1991 short-term forward rates climbed again toward the upper limit of the exchange rate band. However, throughout this period forward exchange rates remained inside the band. Foreign exchange reserves also increased. In early 1991, with

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1/ See Kontulainen, Lehmussaari and Suvanto (1990) for a thorough discussion of the Finnish exchange rate band, including its credibility.

increasing signs of economic difficulties, devaluation speculations mounted and the forward exchange rate approached the upper limit of the band. Reserves decreased sharply. The markka was linked to the ECU on June 12, 1991. The immediate market reaction was reflected in declining interest rates across the maturity spectrum. Short-term exchange rate credibility improved temporarily. Also long-term confidence improved. By the end of July 1991, the gain in short-term credibility from the ECU peg had more or less disappeared, perhaps reflecting concerns over the steepness of the recession with recent economic indicators suggesting a 4-5 percent fall in real GDP in 1991. At the end of August, twelve- and six-month forward rates were outside the exchange rate band, and in September and October, the three-month rate also indicated lack of credibility in the exchange rate band. In November, following a speculative period in which the markka was allowed to float temporarily, the band was moved and the markka depreciated by 12 percent.

3. Norway

After the 10.6 percent devaluation of the Norwegian krone in May 1986, the credibility of the exchange rate band fluctuated considerably. The lack of credibility was pronounced in late 1986, early 1987, late 1987 and late 1988. Capital outflows were also observed during those periods, indicating that credibility was less than indicated by the forward exchange rates. In late 1986 and early 1987 this may have reflected a sluggish adjustment of expectations after the devaluation, but the disturbances in the exchange market in late 1987 and 1988 suggest that the credibility remained fragile for a prolonged period of time.

The loss of credibility in late 1987 was perhaps partly due to the unrest in international foreign exchange and stock markets, but maybe also due to market operators' negative expectations about the development of the Norwegian economy, in particular with regard to prices and wages. The loss of credibility in November 1988 may have resulted from the fall in oil prices and the related uncertainties concerning the National Budget for 1989. A simultaneous rise in unemployment and inflation may have added to pressure on the krone.

On both occasions, Norges Bank intervened heavily in the foreign exchange market to support the krone. After an increase in short-term interest rates, capital flows reversed and the krone strengthened.

In early 1989, credibility of the exchange rate band improved considerably and forward exchange rates remained well within the band since then. Long-term credibility improved and the five-year forward exchange rate moved inside the band in early 1990. In 1990, a negative inflation differential vis-à-vis trade partners and surplus in the external current account have probably contributed to the high credibility. The variability of the exchange rate within the band was much reduced by frequent intramarginal interventions by Norges Bank.

Following the change to the ECU peg in October 1990 interest rate differentials narrowed temporarily but after a while the spread increased again, perhaps reflecting an expansionary budget for 1991 and uncertainties about oil price developments and the Middle East crisis. Nevertheless, credibility of the exchange rate band was sustained although some deterioration took place within the band. Also, after the ECU peg Norges Bank intervened heavily on several occasions to support the krone, suggesting less credibility than the forward rates implied. During 1991, the krone has remained stable vis-à-vis the ECU and the short-term interest rate differentials remained small. The forward exchange rates have remained well within the band despite an increasing deficit in the Government's fiscal balance. The deterioration of the public finances may explain, however, the upward drift of long-term forward rates since fall 1990.

4. Sweden

The Swedish economy was overheated during most of the period 1987-90. From the beginning of the period, Sveriges Riksbank tried to maintain domestic interest rates at high levels in order to contain domestic demand. As the likelihood of a devaluation in the short-run should be small in a situation with over-full employment, it is not surprising that short-term forward exchange rates remained within the exchange rate band. Except for the fall and winter 1987, short-term credibility improved until fall 1989. Then, with expectations of a high wage settlement, credibility deteriorated rapidly. A gloomy official current account forecast in January 1990, a labor-conflict in the banking sector, the resignation of the government and the Minister of Finance was accompanied by a continued lack of credibility within a twelve-month horizon. After an improvement in late spring 1990, short-term credibility deteriorated further, following the Middle East crisis and continuous negative information about the state of the current account, inflation and industrial production. The possibility of a devaluation after the election in September 1991 was frequently discussed in the news media. A low point in credibility was reached in fall 1990, when credibility was lacking even within a three-month horizon. Since then, credibility has improved, although in March-April, 1991, the six- and twelve-month forward rates were still above the band.

Foreign exchange reserves were roughly unchanged between 1987 and early 1989. Reserves fell during fall 1989, indicating that credibility may have been less than shown by the forward exchange rates. During 1990, foreign exchange reserves have increased, indicating that Sveriges Riksbank allowed domestic interest rates to exceed the level corresponding to interest parity needed to compensate for the exchange rate risk. Thus credibility may have been better than shown by the forward exchange rates during 1990. Even so, the loss in credibility compared to the period up to mid 1989 is likely to have been large.

The sixty-month forward exchange rate has always exceeded the upper limit of the band. Long-term credibility deteriorated further in fall 1989. In October 1990, the five year forward exchange rate implied an expected devaluation within five years of about 17 percent.

The linking of the krona to the ECU on May 17, 1991, was announced as the first step to closer European monetary cooperation. Interest rates fell rapidly and the short-term forward exchange rates, which had shown some instability during the spring, moved well within the exchange rate band. In June and July the short-term credibility deteriorated from the post-ECU peg levels. Uncertainties about economic and political developments increased before the general elections and by the end of August the twelve-month forward rate had moved outside the fluctuation band. Over the five-year horizon, despite a considerable improvement in credibility with the ECU peg, the five-year forward exchange rate remained outside the band.

V. Conclusion

The paper has assessed the credibility of the Nordic countries' exchange rate bands for the period 1987-91. Aside from briefly mentioning a few economic and economic-political events above, we do not attempt in this paper to analyze the causes behind the Nordic countries differing credibility experiences. This would require a separate and thorough discussion of economic developments and policies in these countries, and should be subject to further research.

Nevertheless, a few conclusions can be reached. Since Denmark has achieved a substantial improvement in the credibility of its exchange rate band, the hypothesis that participation in the multilateral ERM has brought Denmark credibility cannot be rejected. However, given that the improvement in credibility followed membership in the ERM by several years, ERM membership has not brought Denmark immediate credibility. As Norway achieved an even more impressive increase in the credibility of its exchange rate band, the hypothesis that a unilateral exchange rate arrangement can be credible cannot be rejected. Sweden's poor performance with regard to exchange rate credibility during the period stands out among the Nordic countries and stimulated an intense discussion in Sweden of possible ways to improve the situation, including a peg to the ECU, membership in the ERM, and an independent central bank. Sweden linked its currency to the ECU in May 1991. Finland followed suit in June, but devalued the markka in November following a period in which credibility in the band was lacking.

The recent move to ECU pegs in Finland, Norway, and Sweden were associated with an increase in credibility. But in all cases, the credibility seems to have deteriorated again in the period following the change in the peg. This suggests that at least part of the improvement in credibility was due to a temporary announcement effect. A firmer commitment than a unilateral peg may be necessary for sustained credibility.

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