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The euro and portfolio choices—a Nordic perspective

Eva Liljeblom and Anders Löflund*

Summary

■ This paper investigates questions concerning benefits from international, equity-market diversification for the Nordic countries:

1. How beneficial is international diversification—now and after the EMU?
2. Are the benefits lower during periods of high market volatility?
3. How important is currency risk for the Nordic countries with their distinctly different currency regimes?
4. Should Nordic investors follow different optimal portfolio strategies because of their home country's special status regarding the EU and EMU?

We investigate time-varying stock-market volatility and co-movement between Nordic markets and European and international benchmarks and find a significantly positive long-run time trend, but no distinct time trend in the 1990s. But we find a significant relationship between volatility and stock return co-movement. Contrary to some researchers, domestic volatility does not seem to determine international co-movement, whereas international volatility is highly significant, indicating lower diversification benefits during high, international volatility periods. The Nordic countries do not seem to differ from each other on the importance of currency risk for international investments. Currency risk starts to play a more important role regarding investments outside Europe. Results for *ex ante* strategies support international diversification by demonstrating the robust superiority of the global minimum variance (MVP) strategy in its unhedged and hedged form for each Nordic country. Relative weights of different investment regions in MVP are similar for all Nordic countries suggesting that EU- and EMU-related currency effects play a secondary role in effective international diversification. ■

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The euro and portfolio choices—a Nordic perspective

Eva Liljeblom and Anders Löflund *

Empirical research of global investments has generally reported significant benefits from international diversification—even for the Nordic countries.[1] Although currency risk may represent a large proportion of the total risk of an unhedged portfolio investment[2], in general, the correlations between international stock markets have been low enough to provide substantial total risk reduction through international diversification, even for unhedged portfolios.

More recent studies have focused on issues concerning the stability of the correlation structure over time. Significant instability was documented in many studies. Some found evidence of an overall increase in long-run correlations as, e.g., in Longin and Solnik (1995) during the 1960-1990 period and in Erb, Harvey, and Viskanta (1994), who concluded that correlations appear to have been gradually increasing during the 1982-1993 period. Moreover, Solnik, Boucrelle, and Le Fur (1996) found that the correlations seem to be higher when market volatility is high, whereas Erb, Harvey, and Viskanta (1994) provided evidence of an asymmetry in terms of a link

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[1] For classical, mainly US-based results, see, e.g., Grubel (1968), Levy and Sarnat (1970), Solnik (1974), Lessard (1973, 1976), Solnik and Noetzlin (1982), Logue (1982), Jorion (1985), and Grauer and Hakansson (1987). Shawky, Kuenzel and Mikhail (1997) provide a recent survey of international evidence. For results on the Nordic countries, see Haavisto and Hansson (1992) and Liljeblom, Löflund and Krokfors (1997).

[2] Eun and Resnick (1988) measured that currency risk directly or indirectly (through the cross-covariances between exchange rates and stock returns), on average, constituted of about 57% of the total risk of a US portfolio investment in a foreign stock market. Liljeblom, Löflund, and Krokfors (1997) obtained only values between 6% and 16% for investors from the Nordic countries during the 1987-1993 period (but a value of 56% for Finnish investors during a short period of the floating FIM regime).

between market correlation and the coherence between the business cycles in the two countries. When comparing phases when the economies of two countries simultaneously either were expanding or in recession, they found that the correlation between their stock markets (which was positive in both cases) was higher during recessions. These latter two results are discouraging for global portfolio managers, because they indicate that the benefits of international diversification seem to be below average when they would have been most needed (during high-volatility and declining-market periods).

For the Nordic stock markets, the 1990s have seen dramatic swings in stock returns, first during the recession in the early 1990s, and lately in the connection with the Asian crisis. A superficial glance on daily stock-price movements would suggest that the Nordic stock markets are currently highly dependent on the world and on the US stocks markets, a dependence that would be expected to have reduced benefits from international diversification, compared to previous studies for these countries.

Increased international dependency may also be expected to be brought about by the coming of the Economic Monetary Union (EMU) at the start of 1999, at least in the form of higher internal dependencies between the stock markets of the countries joining the union. This expected increase in correlations can stem first of all from increased correlations between companies' expected cash flows, e.g., if the EMU stimulates intra-union trade and creates increased monetary stability, leading to greater harmonisation of business cycles[3]. Secondly, increased stock market correlation due to co-moving discount rates is expected. The common risk-free interest rate implies that the stock markets within the EMU will react to the same interest-rate shocks, and higher capital market integration, which leads toward common risk premia, can also be expected. But a common currency will eliminate currency risk within the *euro* area. Because benefits from international diversification depend on the correlation between the different stock markets and on the additional component of currency risk in unhedged international portfolios, the ques-

[3] The issue of whether the elimination of currency risk, e.g., by means of a monetary union is or is not expected to stimulate trade is a debated issue. Many empirical studies point to only weak hampering effects of exchange-rate uncertainty on trade. See, e.g., Edison and Melvin (1990) and Gagnon (1993). But there are also contrary views, such as in De Grauwe and de Bellefroid (1987) and Arize (1995). See also Friberg and Vredin (1997) for a discussion on the effects of the EMU.

tion of whether the EMU provides increased or decreased incentives for portfolio diversification within the union (compared to the time period before the EMU) is ambiguous on a theoretical level.[4]

In an interesting way, the Nordic countries are divided regarding their status concerning the EU and the EMU. Finland is the only Nordic country that belongs to the "ins". That is, Finland joined the EMU at its start on 1 January 1999. Sweden and Denmark are staying outside the EMU in Stage 1, but they are members of the EU and the DKK is within the ERM (±15% band, from September 1998 within a ±2.5% band). Norway is not a member of the EU, and the exchange-rate regimes for the NOK and SEK are floating.[5] So benefits from international portfolio diversification in these four countries might be different right now and affected differently by the coming of the euro.

This paper investigates the current situation and expected effects from the EMU for portfolio investment decisions of investors in Denmark, Finland, Norway, and Sweden (hereafter referred to as the Nordic countries). We seek answers to these questions:

1. In general, is international diversification still beneficial—now and after the EMU?
2. Do benefits diminish or even disappear during periods of high market volatility?
3. How important is currency risk for investments from the Nordic countries—with such distinctly different currency regimes?
4. Should Nordic investors follow different optimal portfolio strategies because of their home country's special status regarding the EU and EMU?

[4] Moreover, Friberg and Vredin (1997) note that although currency risk within the EMU will be eliminated, the currency risk between EMU and non-EMU currencies, and therefore the risk of international investments from the EMU area to markets outside, can be affected in either way.

[5] Formally, NOK belongs to a floating regime in the sense that there is no established bands within which the central bank of Norway is expected to intervene on the markets for foreign exchange. But the Norwegian government has (on May 1994) established "new guidelines for monetary policy under a floating exchange-rate regime" (see, e.g., *Economic Bulletin*, 1994). Due to these, NOK could best be described as following a managed float and has remained quite stable since its float on 10 December 1992. Appendix 3 provides a short description of the exchange-rate regimes of the four currencies.

We start by investigating two components that benefits from international diversification depend on: stock market co-movement and currency risk. Stock market correlation dynamics in the 1990s are investigated for a time trend and in line with Solnik, Boucrelle, and Le Fur (1996), we investigate whether a connection between the time-varying correlation and domestic or foreign volatility shocks can be detected. Because the countries differ in their relations to the EU and the EMU, it is an interesting issue to see whether they also differ from each other in terms of their stock market correlation dynamics. We also look at the current relative importance of currency risk for international investments from the Nordic countries to different foreign markets.

In Liljeblom, Löflund, and Krokfors (1997), several rolling *ex ante* portfolio strategies were conducted for the Nordic countries using data from 1974-1993. The global, minimum-variance portfolio strategy (MVP) had lowest Sharpe ratios for all Nordic countries during the entire period and during the investigated subperiods. Our analysis of the benefits from international diversification starts with a reproduction of these results using later data for the 1990s, i.e., with an analysis of the current situation. We also look at the optimal portfolio weight dynamics as the EMU gets closer. The analysis ends with a simple forecast of the benefits from international portfolio diversification (and optimal portfolio weights) within the EMU.

This paper is organised as follows. Section 1 describes the data that is used. Section 2 reports the results from our analysis of the correlation dynamics and its links to volatility. Section 3 analyses the importance of currency risk. Section 4 investigates current benefits from international diversification by means of *ex ante* strategies for unhedged and hedged portfolios from the viewpoint of investors in each Nordic country. This section also presents a prediction of the situation after the EMU. The prediction was created using:

- The most recent, rolling stock market correlations as predictors of future correlations
- Currency risk assumptions based on recent behaviour of the ECU
- A non-existent currency risk within the EMU

Section 5 presents concluding comments.

1. The data

The analyses are performed on equity returns in 18 national stock markets using monthly data provided by Morgan Stanley Capital International. The countries include 17 OECD countries plus Hong Kong. Table 1 illustrates how the included countries enable an analysis of Nordic co-movement with major non-European and European markets, and of the latter group, both ones that will join or stay outside the EMU in Stage 1.[6]

Table 1. The individual stock market indexes used.

Geographic region	Economic region countries	Country code	Number of countries
Non-European		AUS, CAN, HK, JAP, US	5
European	Joining the EMU	AUT, BEL, FRA, GER, ITA, NET, SPA, FIN	8
	In the EU, not joining the EMU	DEN, SWE, UK	3
	Not in the EU	NOR, SWI	2

Notes: The table lists the 18 individual stock market indexes used in our study with respect to their geographic and economic regions. The stock market indexes are: Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Denmark (DEN), Finland (FIN), France (FRA), Germany (GER), Hong Kong (HK), Italy (ITA), Japan (JP), Netherlands (NET), Norway (NOR), Spain (SPA), Sweden (SWE), Switzerland (SWI), United Kingdom (UK), and United States (US).

The stock market returns include capital gains and dividend payments and are based on value-weighted indexes formed from mainly major companies (based on market capitalisation) on the national stock markets.[7]

[6] Of the actual countries joining the EMU, only stock market indexes for Portugal, Ireland, and Luxembourg are not included in our analysis.

[7] For more data set details, see Liljeblom, Löflund, and Krokfors (1997), where a similar data set was used. The beginning of the index for Finland was constructed at the Swedish School of Economics and Business Administration in Helsinki, Finland. From 1990 onward, we use the official HEX index, constructed by the Helsinki Stock Exchange, in its total return form. Both indexes include all stocks listed on the Helsinki Stock Exchange, with weights corresponding to market capitalisation.

Hedged strategies are constructed with a short-term money market hedge based on one-month interest rates or a close substitute.[8] The overall time period is from September 1974 to May 1998. But many analyses focus on the more recent time period from October 1992 onward.[9]

When total returns from foreign investment are analysed in local Nordic currencies, the translation of the international returns have been performed using month-end exchange rates for the different currencies. Returns are measured as logarithmic differences of indexes that measure the stock market returns or the total foreign portfolio returns. Table A1 in Appendix 2 reports descriptive statistics on domestic currency returns from different stock markets, from the viewpoint of the Nordic currencies.

2. Correlation dynamics for Nordic stock markets

2.1. The evolution of time-varying correlation

To study time-varying co-movement between the Nordic stock markets on one hand, and international markets on the other hand, we use the procedure in, e.g., Kaplanis (1988), Erb et al. (1994), and Solnik et al. (1996). That is, we compute the correlation as the *ex post* correlation during a rolling estimation period. We use a 36-month window of present and past monthly data. The stock returns are measured as total returns in the Nordic home currencies of DKK,

[8] This hedge corresponds to a forward hedge, assuming covered interest parity holding, i.e., assuming forward rates being based on the interest rates used in this study. The interest-rate definitions and data sources are reported in Appendix 1.

[9] The October 1992 is arbitrarily selected, the month being the first full month of the start of the floating exchange-rate regime for FIM. The exchange-rate regimes for SEK and NOK also collapsed soon thereafter, the one for SEK on November 19th, 1992, and the one for NOK on December 10th, 1992. Later, FIM again became pegged by joining the ERM on October 14th, 1996. See Appendix 3 for a short description of the exchange-rate regimes of the Nordic currencies during the 1990s.

FIM, NOK, and SEK. We estimate the correlation with respect to four benchmark indexes:

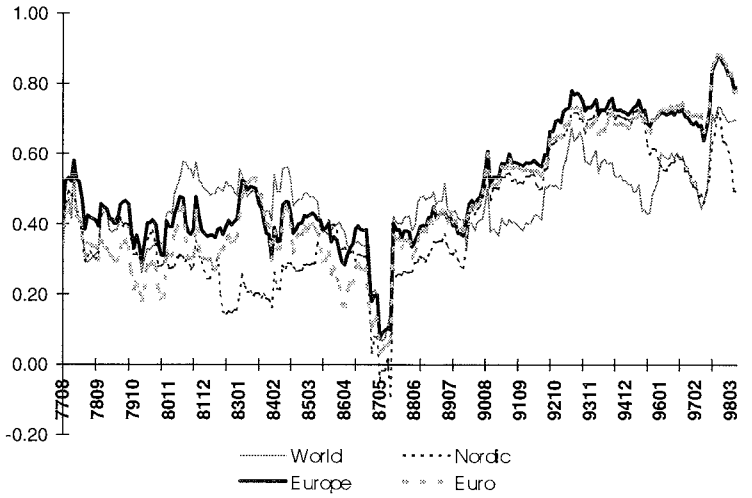
- The Morgan Stanley Capital International (world) market-value, weighted, world index
- Two equally weighted indexes that include either all the other European countries (Europe) or all the (other) countries joining the EMU (euro)
- An equally weighted index of the other Nordic countries (Nordic)

In the last three indexes, the Nordic country, whose co-movement is being analysed, is not in itself included in the benchmark index.[10] Figures 1a to 1d illustrate results for the Nordic countries.

The figures show that during the overall 1977-1998 period, international correlations vary a lot over time and countries. In the 1990s, the co-movement with Europe is in general higher, compared to the co-movement with the world, although the opposite holds in general when older data, from 1977 to 1990, are used. Here, Finland is at odds. On average, Finland is more correlated to Europe than the world—using earlier data—but from October 1992 onward, being somewhat more correlated with the world than with Europe.[11] Much of this might be caused by one company, Nokia, which has a weight above 30% in the Finnish index during a large part of the 1990s and much of its business operations outside Europe. For the other Nordic countries, we cannot find a single period (from October 1992 onward) when the correlation with the world would have been higher than the correlation with Europe.

[10] So the benchmark indexes include 12 countries when co-movement with Europe is analysed, 7 or 8 when co-movement with the EMU area is analysed (depending on whether the analysis is made for Finland or one of the other Nordic countries), and 3 when co-movement with the other Nordic countries is analysed.
[11] The world has during this time period for Finland dominated only with a slight margin, during 52.9% of the rolling individual correlations.

Figure 1a. Time-varying correlation for Denmark.



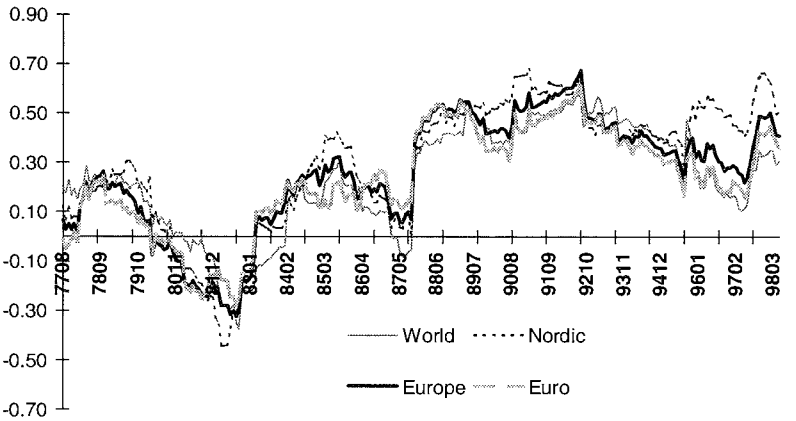
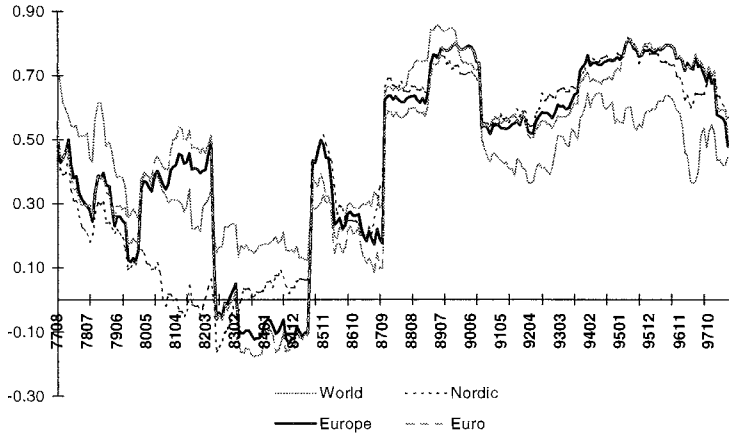
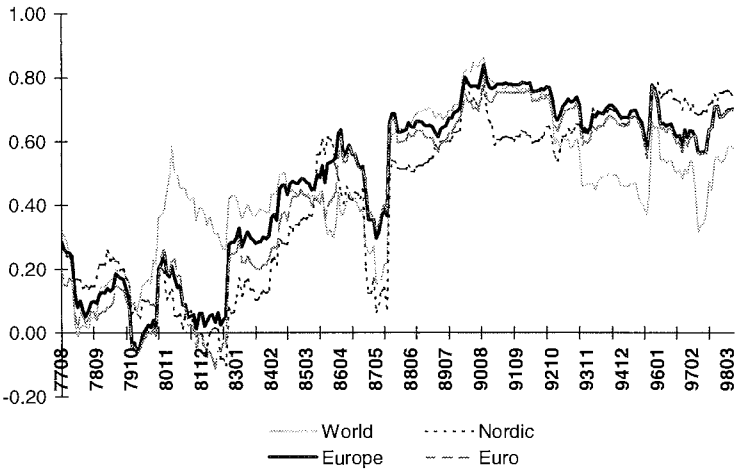


Figure 1c. Time-varying correlation for Norway.





At the end of the period, the level of co-movement is highest for Denmark (at 0.70 and 0.79 against benchmarks of the world and Europe) and thereafter for Sweden (0.58 and 0.70) and Norway (0.42 and 0.48). Paradoxically, Finland, the only country joining the EMU in Stage 1, is again at odds; it shows the lowest level of international co-movement (only 0.31 and 0.41 against the world and Europe).

For the overall period, the figures give the impression of a general increase in international stock market co-movements. To estimate a simple time trend, we fitted a regression line (regressed the correlations against the world and Europe on a time index) using all the data and only data for the last 10 years. Because the serious autocorrelation in our moving average correlation estimates affect the standard errors of such a regression, we only comment to the slope of the line (which should be unbiased) at this stage of our analysis. As expected, a positive and mostly steep time trend could be detected for all four countries against both benchmarks, when data for the overall roughly 25 years is used. But during the last 10 years, the time trend is much flatter and positive only for Denmark and Norway.

2.2. Correlation and volatility shocks

To get a first look at potential links between correlation and volatility, Figure 2a-d illustrates the correlation with the world together with two rolling annualised volatilities, the 36-month rolling standard deviations for the domestic Nordic index and for the world.

At first glance, market volatilities and co-movements do not seem to be especially synchronised, although upward shifts in the world volatility often seem to be associated with similar increases in correlation.

Next, we conducted an econometric investigation of the relationship between correlation and market volatilities. Due to the autocorrelation present by construction in the 36-month moving average correlation and volatility estimates, an autocorrelation so severe that the Newey and West (1987) adjustment is not sufficient as a sole correction[12], we perform our investigation using monthly shocks (innovations) in correlation and volatility.[13] A similar procedure was used,

[12] See Solnik et al. (1996) for a note on this issue.

[13] We first of all prewhiten all the series for an AR(1) process, which mostly produces uncorrelated residuals. In one case, prewhitening is performed with lags 1, 2, and 12. Moreover, we use a Newey and West (1987) adjustment for first order

Figure 2a. Time-varying volatility (left axis) and correlation (right axis) for Denmark.

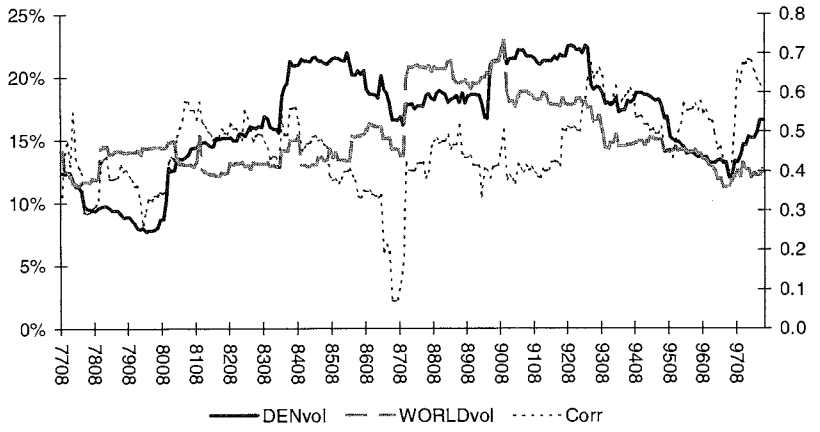
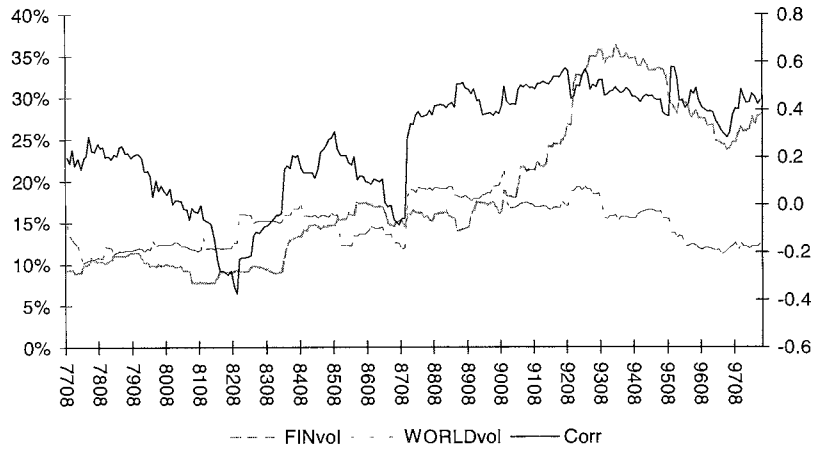
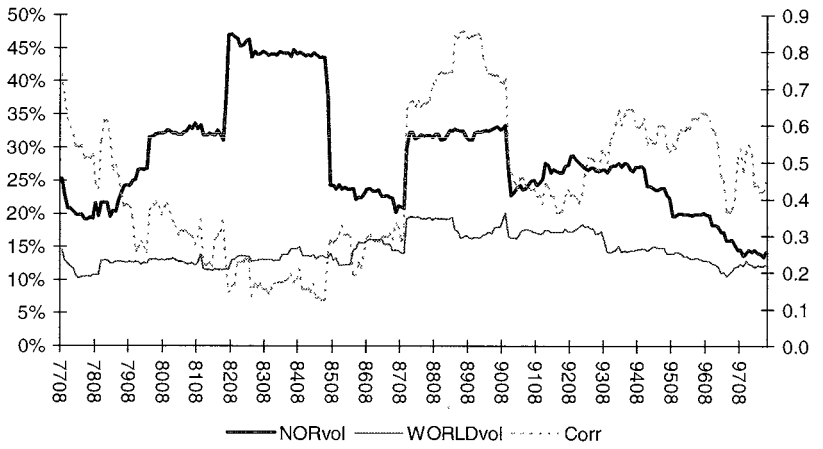


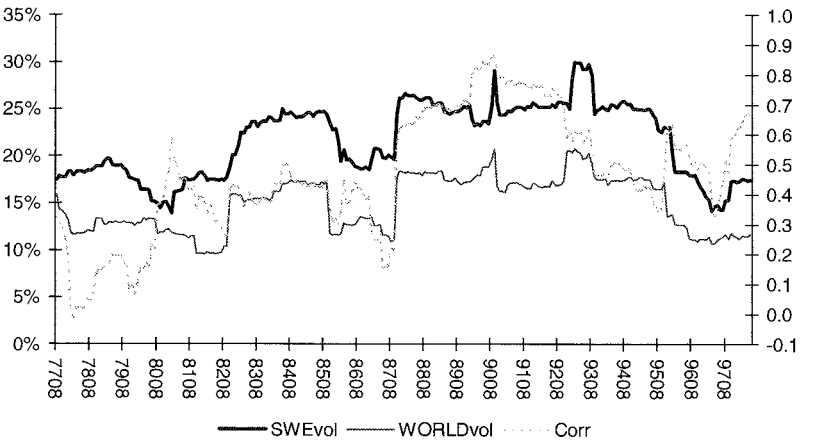
Figure 2b. Time-varying volatility (left axis) and correlation (right axis) for Finland.



autocorrelation (12 order in one case) in the actual regressions. The trend estimate from the prewhitening estimations is added back into the final regression to provide a simultaneous test for a time trend.

Figure 2c. Time-varying volatility (left axis) and correlation (right axis) for Norway.





e.g., in Solnik et al. (1996). We investigate the relationship between correlation (to either the world or Europe) and domestic or international volatility shocks. Table 2 reports the results.[14]

Table 2. Estimation results on the relationship between correlation and volatility: August 1977-May 1998.

Country index analysed	Intercept	Coefficient estimates		Adj.R^2
		Domestic vol. shock	*Foreign vol. shock*	
Panel A. Correlation with the world				
DEN	0.029	0.963	2.697	0.275
	(13.69)	(1.64)	**(5.47)**	
FIN	0.005	0.314	2.416	0.156
	(2.08) *	(0.67)	(2.55) *	
NOR	0.013	0.222	3.515	0.303
	(4.41)	(0.60)	**(3.29)**	
SWE	0.013	0.873	2.095	0.225
	(5.14)	(1.30)	(1.98) *	
Panel B. Correlation with Europe				
DEN	0.012	0.631	2.277	0.327
	(7.31)	(1.19)	**(5.93)**	
FIN	0.006	0.125	1.843	0.101
	(2.36) *	(0.22)	(1.89)	
NOR	0.017	-0.589	3.939	0.296
	(7.77)	(-1.51)	**(3.79)**	
SWE	0.008	0.600	1.894	0.289
	(4.44)	(1.55)	**(2.88)**	

Notes: The table reports the results of a regression of prewhitened correlations on prewhitened domestic and foreign volatilities. Panel A reports results using the world as the foreign market when measuring correlation and foreign volatility, and Panel B from similar analysis using Europe. The domestic country is either Denmark (DEN), Finland (FIN), Norway (NOR), or Sweden (SWE). T-values corrected for first-order autocorrelation (in one case 12) according to Newey and West (1987) are reported in parentheses under the coefficient estimates. Significant coefficients at the 1% level are **bold**, and significance at the 5% level is denoted by an asterisk (*).

[14] The robustness of the results was further checked by means of nonparametric tests. Spearman rank correlation coefficients between correlation and volatility shocks indicate that the results are quite robust. The relationship between foreign volatility and correlation is always significantly positive and stronger than the corresponding one between domestic volatility and correlation.

The results in Table 2 show that when controlling for volatility shocks, a positive and significant time trend during the overall period is present for all countries. Correlation changes seem to be significantly related to foreign (the world or Europe) volatility shocks but not to innovations in domestic volatilities. At the 5% level of significance, the null hypothesis of no relationship between correlation and volatility is rejected—except for Finland, in the case of European volatility.

The results in this section document a significant positive overall time trend in international co-movements but unambiguous trends during the 1990s. The most recent correlations between Nordic stock markets and various international benchmarks show that Finland is the country with the lowest level of international correlations (0.41 or below). The correlation between the Danish stock market and the world and Europe benchmarks is as high as 0.7 or as high as 0.79. These results indicate that the benefits from international portfolio diversification would be expected to vary a lot between the Nordic countries. Tests of the relationships between correlation and volatility shocks indicate that correlations tend to increase with increased international volatility. A practical implication of the time-varying nature of the benefits from international diversification is that dynamic, market volatility-based portfolio strategies, which trigger flight to safer assets, may pay off.[15] Contrary to results for larger stock markets as in Solnik et al. (1996), domestic volatility does not seem to be a significant determinant of international co-movements for the Nordic countries.

3. The relative importance of exchange-rate risk

The benefits from international diversification depend on the degree of stock market co-movement and also on the additional amount of risk brought by exchange rates into unhedged international portfolios. To investigate the relative contribution of stock market and currency risk, a decomposition of the volatility of the total return (measured in the domestic currency) from the investment in one single foreign market was performed in a way similar to that in Eun and Resnick (1988). Assuming a small cross-product between stock return

[15] In the context of pure equity-based investment strategies, an example would be a dynamic minimum variance strategy where low volatility/low correlation assets are systematically emphasised. We consider such strategies in Section 5.1.

and exchange-rate change, the domestic return of a single foreign investment can be approximated by

$$R_{i,\mathrm{dom}} \approx R_i + e_i \tag{1}$$

and the variance of the domestic rate of return as

$$\mathrm{Var}(R_{i,\mathrm{dom}}) \approx \mathrm{Var}(R_i) + \mathrm{Var}(e_i) + 2\,\mathrm{Cov}(R_i, e_i) \tag{2}$$

where $\mathrm{Var}(R_i)$ is the variance of the foreign stock market return (i.e., in local currency) and $\mathrm{Var}(e_i)$ is the variance of the exchange rate for the country of investment. The decomposition was performed from the perspective of all the Nordic countries. Table 3 reports on the relative contribution of the three components to overall variance.

The table shows that during the October 1992 to May 1998 period, a somewhat larger part of the total risk, compared to previous studies on Nordic markets (but a much smaller part compared to studies on the US market), stems from exchange-rate movements.[16] Average local stock market risk stands for between 77%-84% of the total risk, below 80% for all countries except for Norway, whereas the corresponding numbers in the previous study were between 82%-94% during the two previously analysed subperiods. The countries do not seem to differ notably from each other in terms of relative exposures to local stock market risk and exchange-rate risk in general and in different regions. A large difference is perceivable when comparing exposures across regions. For investments outside Europe, exchange-rate risk and cross-correlation risk together stand for 41% to 43% of the overall total risk. But for investments within the coming EMU area, the corresponding numbers only vary between 4% and 15% and are always lower than corresponding numbers for investments in Europe but outside the EMU area. For Finland (EMU member),

[16] For example, in Liljeblom, Löflund, and Krokfors (1997), the amount of risk due to local stock market volatility varies between 82% and 94% during the two subperiods of 1974-1986 and 1987-1993. In Eun and Resnick (1988), on average, only 53% of the return volatility in USD of a foreign investment stems from local stock market volatility.

Table 3. Decomposition of total stock market risk for investors in the Nordic countries: October 1992 to May 1998 (in per cent).

	Investor origin					
Country of investment	**Denmark**			**Finland**		
	Stocks	*Exch. rates*	*Cov.*	*Stocks*	*Exch. rates*	*Cov.*
	(1)	(2)	(3)	(1)	(2)	(3)
Panel A. Investments outside Europe						
AUS	46	37	17	46	44	10
HK	85	7	8	86	11	3
CAN	46	34	20	47	45	7
JAP	68	23	9	68	32	0
US	45	36	19	40	46	14
Average	**58**	**27**	**15**	**58**	**35**	**7**
Panel B. Investments in European countries joining the EMU						
AUT	94	3	4	90	13	-3
BEL	103	3	-7	87	20	-7
FIN	86	4	10	*100*	*0*	*0*
FRA	95	2	3	86	12	2
GER	95	2	2	90	13	-3
ITA	77	9	14	75	10	15
NET	96	3	1	95	18	-13
SPA	77	10	13	74	15	11
Average	**90**	**5**	**5**	**85**	**14**	**0**
Panel C. Investments in Europe, in countries not joining the EMU						
DEN	*100*	*0*	*0*	91	13	-5
NOR	83	6	12	86	13	1
SWE	79	15	6	80	11	9
SWI	96	11	-7	97	21	-19
UK	66	29	5	68	35	-3
Average	**81**	**15**	**4**	**84**	**19**	**-3**
Overall average	***79***	***14***	***8***	***77***	***22***	***1***

Notes: The table reports the results of a decomposition of overall stock market risk (the variance of total returns in domestic currency, i.e., DKK, FIM, NOK, or SEK) into the part caused by the variance of local stock returns in the country of investment (1), the variance of exchange rates (2), and the cross-covariance between stock returns and exchange-rate changes (3). The relative magnitude of each component is reported as a percentage of total variance. In the regional averages reported in the table, the risks of investments in the country itself were not included and are marked in *italic*.

Table 3. continued ...

Country of investment	Investor origin: Norway			Sweden		
	Stocks	*Exch. rates*	*Cov.*	*Stocks*	*Exch. rates*	*Cov.*
	(1)	(2)	(3)	(1)	(2)	(3)
Panel A. Investments outside Europe						
AUS	45	38	17	45	48	7
HK	88	8	4	85	14	0
CAN	49	37	14	47	52	1
JAP	66	27	7	67	44	-11
US	48	40	12	40	60	-1
Average	**59**	**30**	**11**	**57**	**44**	**-1**
Panel B. Investments in European countries joining the EMU						
AUT	98	7	-5	82	26	-8
BEL	101	13	-14	79	43	-22
FIN	90	5	5	88	6	6
FRA	105	6	-12	85	25	-10
GER	105	7	-12	85	27	-13
ITA	85	9	6	85	11	5
NET	104	9	-14	93	38	-31
SPA	84	12	3	83	21	-3
Average	**96**	**9**	**-5**	**85**	**25**	**-9**
Panel C. Investments in Europe, in countries not joining the EMU						
DEN	118	9	-28	96	29	-25
NOR	*100*	*0*	*0*	88	24	-11
SWE	88	17	-5	*100*	*0*	*0*
SWI	91	19	-9	99	44	-43
UK	59	28	13	63	46	-8
Average	**89**	**18**	**-7**	**86**	**36**	**-22**
Overall average	**84**	**17**	**-1**	**77**	**33**	**-10**

there seems to have been some non-negligible amounts of exchange risk present during the 1990s for investments into the countries now forming the EMU, because as much as 14% of the total risk has stemmed from pure exchange-rate changes (compared, e.g., to 5% for Denmark and 9% for Norway).

In this section, a decomposition of total risk was performed for each of the Nordic countries using data from October 1992 onward. The results show that although the importance of exchange-rate changes is somewhat higher than during the 1980s, the difference is not large, and the countries seem to behave in a rather similar fash-

ion. Larger differences are seen across investment regions; the EMU area within Europe is one where the relative importance of currency risk is smallest, whereas areas outside Europe are substantially more exposed. These differences suggest that for international portfolio investments, selective currency hedging may provide more benefits.

4. The performance of *ex ante* investment strategies

4.1. Hedged and unhedged strategies

This section analyses the performance of several *ex ante* investment strategies. These strategies are analysed from the perspective of Danish, Finnish, Norwegian, and Swedish investors. Excess returns are used throughout the analysis.[17]

The pure domestic portfolio is compared to six simple proxies; an:

1. Investment in the domestic stock market (DEN, FIN, NOR, or SWE)
2. Equally weighted Nordic portfolio (Nordic)
3. Equally weighted portfolio of the European country indexes in our sample (Europe)
4. Equally weighted portfolio of all the countries entering the EMU and the common currency (euro)
5. Investment in the value-weighted world market portfolio, i.e., the world index by Morgan Stanley Capital International (MSCI World)

A sixth strategy is to use the *ex ante* (historical) weights of the global minimum variance portfolio (MVP). This strategy assumes that there is no useful asset-specific information in the vector of average returns because only the covariance matrix of returns is used as an input to solve the portfolio problem.[18] This strategy has been one of the dominant ones in many previous studies[19] and given the positive time series relation between volatilities and correlations, it is interesting to see whether a dynamic investment strategy, designed to dy-

[17] For the interest rates used when computing excess returns, see the Appendix.
[18] The instability of sample means, compared to variances and covariances, has been demonstrated in several studies, e.g., by the striking results in Jorion (1985).
[19] See, e.g., Eun and Resnick (1988, 1994), Jorion (1985, 1986), and Liljeblom et al. (1997).

namically minimise risk, actually improves portfolio performance. A short selling restriction is enforced throughout the study.

Results for hedged strategies are also investigated. The actual *ex post* return on a hedged strategy is

$$R_{i,\text{dom}} = \left[1+E(R_i)\right]\left(1+f_i\right)+\left[R_i-E(R_i)\right]\left(1+e_i\right)-1. \tag{3}$$

where R_i and $E(R_i)$ are the actual and expected local currency stock returns, f_i the forward premium or discount (proxied by a money market hedge in our study), and e_i the actual exchange-rate change. But in line with, e.g., Eun and Resnick (1988) and (1994) and Levy and Lim (1994), we assume a complete (100%) hedge, in which case the hedged return can be approximated by

$$R_{i,\text{dom}} \approx R_i + f_i. \tag{4}$$

Because the minimum variance strategy in its hedged (MVPH) and unhedged (MVP) form requires an estimation period, three years are reserved for that.[20] Strategies are then implemented for holding periods of one month. A monthly window is used (next month, new strategies are formed based on an estimation period including the previous 36 months and executed for the that month). We start our estimation period from October 1989, which makes it possible to implement it for the first time for October 1992. This gives us 68 monthly observations of strategy outcomes, from October 1992 to May 1998.

Table 4 summarises the out-of-sample performance of the unhedged strategies for the Nordic countries in Panels A to D. The strategies are evaluated by the use of the Sharpe ratio, which is computed using the average excess return for the monthly strategies, and its time-series standard deviation.

[20] In the previous paper by Liljeblom et al. (1997), an estimation period of five years was used. Because of the evidence on time-varying correlations, and due to the radical changes occurring in the 1990s in the Nordic markets in terms of changing exchange-rate regimes, we choose a shorter estimation period of three years.

Table 4. *Ex ante* investment strategies for the Nordic countries (October 1992-May 1998)

Panel A. Denmark					
	Mean	*Std. dev.*	*Sharpe ratio*	*JK z-stat.*	*(prob.)*
MVP	17.14	12.59	1.361	1.061	(0.144)
Europe	15.70	14.03	1.118	0.603	(0.273)
Euro	14.88	14.92	0.998	0.232	(0.408)
Nordic	16.54	16.75	0.988	0.232	(0.408)
MSCI World	10.75	14.37	0.748	-0.359	(0.640)
DEN	14.73	16.13	0.913		
Panel B. Finland					
	Mean	*Std. dev.*	*Sharpe ratio*	*JK z-stat.*	*(prob.)*
MVP	17.09	13.29	1.286	0.081	(0.468)
Europe	16.89	14.54	1.162	-0.177	(0.547)
Euro	16.08	15.64	1.028	-0.330	(0.629)
Nordic	17.74	16.98	1.045	-0.319	(0.625)
MSCI World	11.95	14.56	0.821	-0.691	(0.755)
FIN	35.51	28.75	1.235		
Panel C. Norway					
	Mean	*Std. dev.*	*Sharpe ratio*	*JK z-stat.*	*(prob.)*
MVP	18.10	12.12	1.493	1.292	(0.098)
Europe	17.69	13.07	1.353	1.150	(0.125)
Euro	16.87	14.06	1.200	0.776	(0.219)
Nordic	18.53	15.27	1.214	1.177	(0.120)
MSCI World	12.74	13.81	0.922	0.225	(0.411)
NOR	14.03	17.33	0.810		
Panel D. Sweden					
	Mean	*Std. dev.*	*Sharpe ratio*	*JK z-stat.*	*(prob.)*
MVP	18.34	13.42	1.367	0.239	(0.406)
Europe	18.35	14.02	1.308	0.149	(0.441)
Euro	17.54	15.36	1.141	-0.203	(0.581)
Nordic	19.20	15.67	1.225	-0.057	(0.523)
MSCI World	13.40	15.06	0.890	-0.632	(0.736)
SWE	25.51	20.55	1.242		

Notes: All returns are in excess of the one-month domestic interest rate (for interest-rate data, see the Appendix). Sample period for strategy outcomes is from October 1992 to May 1998. MVP stands for the *ex ante* unhedged Minimum Variance Portfolio strategy. In the *ex ante* estimation of MVP, a covariance matrix, based on data for the 36 previous months, is used. Europe and the euro are equally weighted portfolios of the 13 and 8 countries in our sample belonging to Europe and joining the EMU, respectively. Nordic stands for an equally weighted portfolio of the Nordic countries. DEN, FIN, NOR, and SWE represent 100% investment in the domestic countries of Denmark, Finland, Norway, and Sweden, respectively. MSCI World is the Morgan Stanley value-weighted world equity index return. Jobson-Korkie z-statistic (p-value in parentheses) tests the difference between Sharpe ratios for each strategy against 100% stock market investment in the domestic Nordic country in question.

Results in Table 4 show that although some of the Nordic stock markets performed very well during our investigation period, the risk-adjusted performance of the global minimum variance portfolio MVP still dominates all other strategies in terms of highest Sharpe ratios. Differences between the Sharpe-ratios were tested using the Jobson-Korkie (1981) z-statistic (strategies are tested against a 100% holding in domestic stocks)[21], but only one significant case of dominance at the 10% level could be detected. For Norway, the MVP is significantly superior at the 10% level against the purely domestic NOR portfolio.

The European integration does not seem to have altogether eliminated international diversification within Europe as a reasonable strategy. The strategy Europe is second best after MVP in three of four cases, and only for Finland dominated by a purely local strategy during the period in question. Contrary, MSCI World suffers from Asian and other crises and performs rather badly overall.

Table 5 reports results for strategies hedged for exchange-rate risk. Because we investigate excess returns in domestic currency for fully hedged strategies, the results correspond to an analysis based on data for local excess returns for the 18 countries.[22] So all hedged strategies yield identical results in terms of means, volatilities, and Sharpe ratios for all four countries. Only Jobson-Korkie and Sharpe-ratio tests differ due to different comparison portfolios (the domestic ones) in each country. Results in Table 5 indicate that hedging for currency risk can still make more improvements. The hedged minimum variance portfolio MVPH dominates its unhedged counterpart for all countries but Norway. But no significant differences between MVPH and purely domestic strategies can be detected.[23]

[21] The Jobson-Korkie test is not affected by the short-selling restriction enforced, because it does not require the computation of a theoretical maximum Sharpe ratio from a sample of assets involving inversion of the covariance matrix, which would allow for negative weights.

[22] The domestic hedged total return was defined as $R_{i,dom} \approx R_i + f_i$. In logarithmic terms, the forward premium is defined as $f_i = \ln (F) - \ln (S)$, which in turn is, due to covered interest parity, equal to the interest-rate differential $r_{dom} - r_{for}$. The hedged total return will then be $R_{i,dom} \approx R_i + r_{dom} - r_{for}$, and the hedged excess return $R_{i,dom} \approx (R_i + r_{dom} - r_{for}) - r_{dom}$, which is identical to the local excess return.

[23] Norway was the only significant case at the 10% level when looking at unhedged strategies. For Norway, the hedged strategy MVPH is worse than the unhedged

Table 5. Results from hedged (H) strategies for Nordic countries.

WorldH	MVPH	EuropeH	EuroH	NordicH	MSCI
Panel A. The hedged strategies					
Mean	14.80	17.38	16.11	18.00	11.85
Std. dev.	10.63	13.51	14.03	15.55	12.04
Sharpe ratio	1.392	1.286	1.148	1.158	0.984
Sharpe ratios, comparison portfolios:			**DEN**	**NOR**	**FIN**	**SWE**
• 100% domestic			0.913	0.810	1.235	1.242
• MVP (unhedged)			1.361	1.493	1.286	1.367
Panel B. Statistical tests of hedged strategies against the domestic one					
DEN					
JK z-stat.	0.916	1.033	0.582	0.715	0.149
(prob.)	(0.180)	(0.151)	(0.280)	(0.237)	(0.441)
FIN					
JK z-stat.	0.268	0.088	-0.15	-0.137	-0.461
(prob.)	(0.394)	(0.465)	(0.560)	(0.554)	(0.678)
NOR					
JK z-stat.	1.191	1.082	0.692	1.016	0.370
(prob.)	(0.117)	(0.140)	(0.244)	(0.155)	(0.356)
SWE					
JK z-stat.	0.288	0.114	-0.206	-0.315	-0.510
(prob.)	(0.387)	(0.454)	(0.582)	(0.623)	(0.695)

Notes: All returns are in excess of the one-month domestic interest rate (for interest-rate data, see the Appendix). Sample period for strategy outcomes is from October 1992 to May 1998. MVPH stands for the *ex ante* hedged Minimum Variance Portfolio strategy. In the *ex ante* estimation of MVPH, a covariance matrix, based on data for the 36 previous months, is used. EuropeH and EuroH are the hedged equally weighted portfolios of the 13 and 8 countries in our sample belonging to Europe and joining the EMU, respectively. NordicH stands for a hedged equally weighted portfolio of the Nordic countries. DEN, FIN, NOR and SWE represent 100% investment in the domestic countries of Denmark, Finland, Norway and Sweden, respectively. Jobson-Korkie z-statistic (p-value in parentheses) tests the difference between Sharpe ratios for each strategy against 100% stock market investment in the domestic Nordic country in question.

Next, we look at optimal strategy weights for the different countries. The previous analysis in Section 2 shows that the Nordic countries differed extensively concerning their correlation levels with respect to international indexes. They also have different exchange-rate systems and different roles with respect to the EU and the EMU. So one might expect some differences in the optimal relative investment

MVP and not sufficiently better than the purely domestic NOR strategy for yielding statistical significance.

allocations to different regions. Figure 3a-d illustrates the time-series development in the weights in the unhedged MVP during October 1992 to May 1998 for the Nordic countries. The weights are grouped according to three different regions: the ins, i.e., countries joining the EMU (euro), the "outs", i.e., the other European countries (other Europe), and countries outside Europe (non-European). These weights sum to 100%, i.e., the weight for the investment in the domestic country is included in the European index into which the analysed country belongs. Besides these three weights, we also include the weight in the MVP strategy for the domestic country in the figure.

Figure 3a-d look fairly similar in terms of the time trends. In general, the minimum variance strategy weights tend to be high for low volatility countries and to lesser extent for countries with average volatility coupled with low average correlation with other countries. Because volatility is time-varying, individual country weights also change notably over time. In all cases, the weight for Europe outside the EMU has been increasing over time in the MVP strategies. This result stems from low volatility especially in the UK and Swiss stock markets in the 1997 to 1998 period. At the end of the time period, the non-EMU Europe weight varies between 74% for Finland and Denmark, to 80% for Norway. The weight for the EMU area in turn varies between 26% for Finland and Denmark to 15% for Sweden in May 1998. The decreasing trend is due to a high but diminishing weight for Netherlands in 1992 and onward, again produced by very low volatility level in the prior 36-month estimation periods. The weight for countries outside Europe is rather low at the end of our time period, but has been close to 40% for Denmark, Finland and Sweden during the middle of the 1990s, and as high as 52% for Norway. The weight for the domestic country is rather low, and the maximum during the time period has varied between 15% (Finland) and 37% (Norway).

Figure 3a. Unhedged minimum variance portfolio (MVP) weights for Denmark.

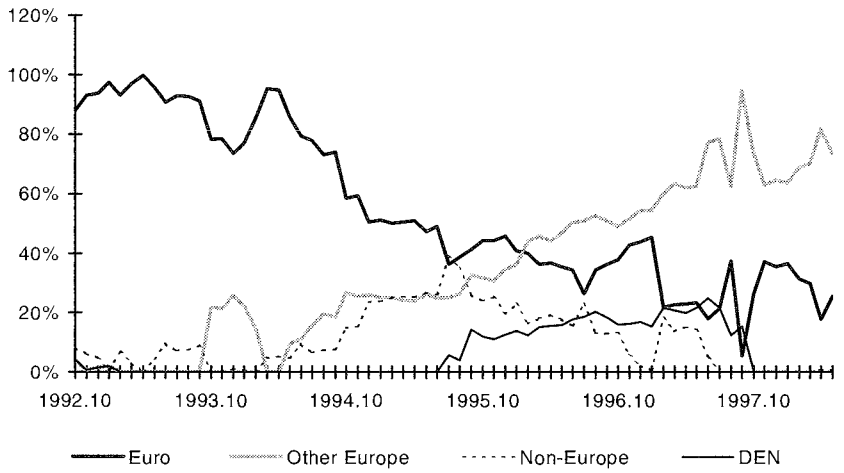


Figure 3b. Unhedged minimum variance portfolio (MVP) weights for Finland.

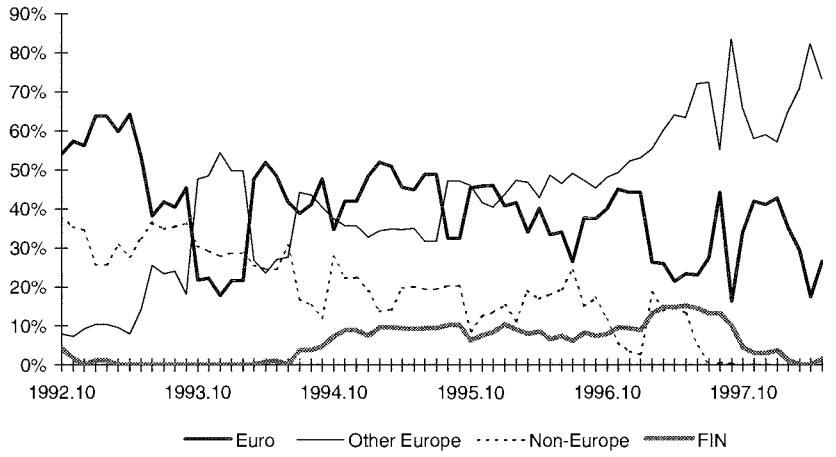


Figure 3c. Unhedged minimum variance portfolio (MVP) weights for Norway.

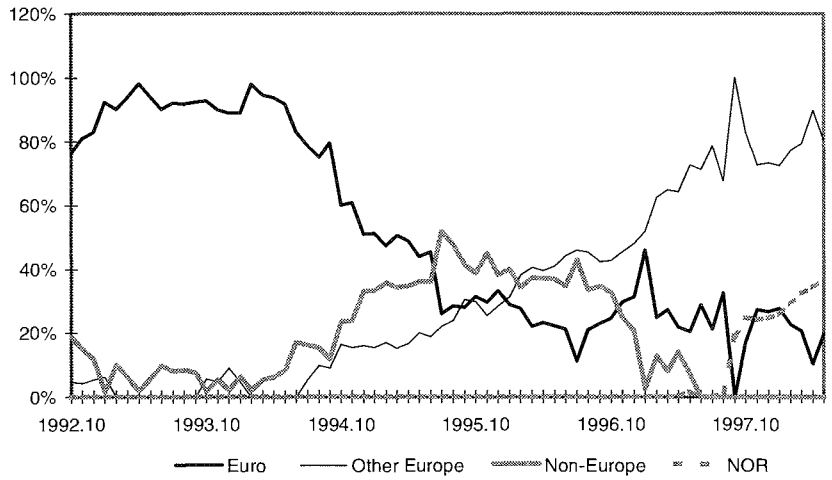


Figure 3d. Unhedged minimum variance portfolio (MVP) weights for Sweden.

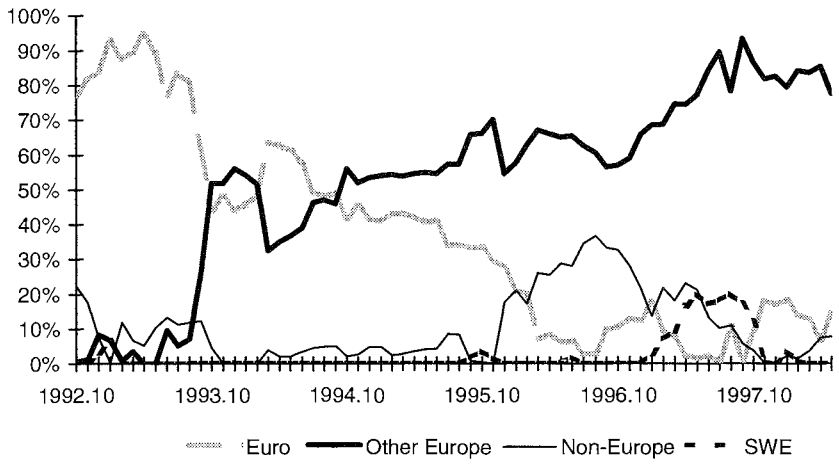
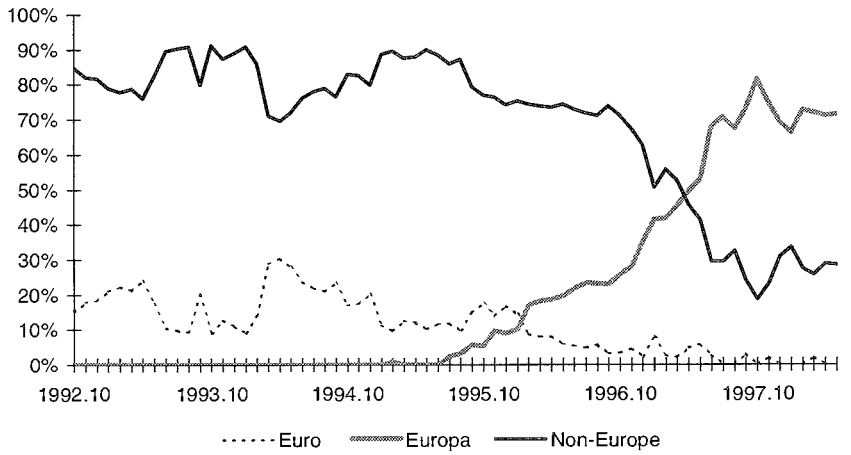


Figure 4 illustrates the weights for the hedged MVPH strategy. The largest difference between the unhedged MVPs and MVPH is that once currency hedging is allowed for, it becomes optimal to invest more in markets outside Europe. This is in line with the results in Table 3, which show that for investments in regions outside Europe, a large part of the total risk comes through currency risk. But even for MVPH, the same recent decline as for the MVPs in the weights for countries outside Europe and the increase in the weight for Europe outside the EMU can be seen. As previously noted, this is due to the dynamic MVP strategy penalising (favouring) high (low) volatility/high (low) correlation countries.

Figure 4. The weights in the hedged minimum variance strategy MVPH.



Results in this section show that despite the rather good performance of the Nordic countries during our investigation period, the international diversification strategy of MVP (the *ex ante* minimum variance portfolio strategy) systematically beats other strategies in all the Nordic countries. But the differences between strategies are not large enough to yield statistical significance using the Jobson-Korkie test (which unfortunately has rather low power). Except for Norway, hedging for exchange risk further improves performance. An inspection of the unhedged MVP weights reveals that the weight of Europe outside the EMU has been increasing in the optimal strategies. Once currency hedging is allowed for, it also becomes relatively more optimal than before to invest in markets outside Europe.

4.2. Anticipating the EMU: A prediction

Finally, we perform a prediction of the situation after the EMU. Investors in the Nordic countries are then either in the EMU (Finland), or outside the EMU (Denmark, Norway, and Sweden). We use data from the last 36 months for the estimation of new stock market volatilities and correlations, modified now by the new exchange-rate assumptions produced by the EMU. We start from the local stock market returns[24] during this period and transform them to domestic returns (in DKK, FIM, NOK, or SEK) using the following exchange-rate assumptions.

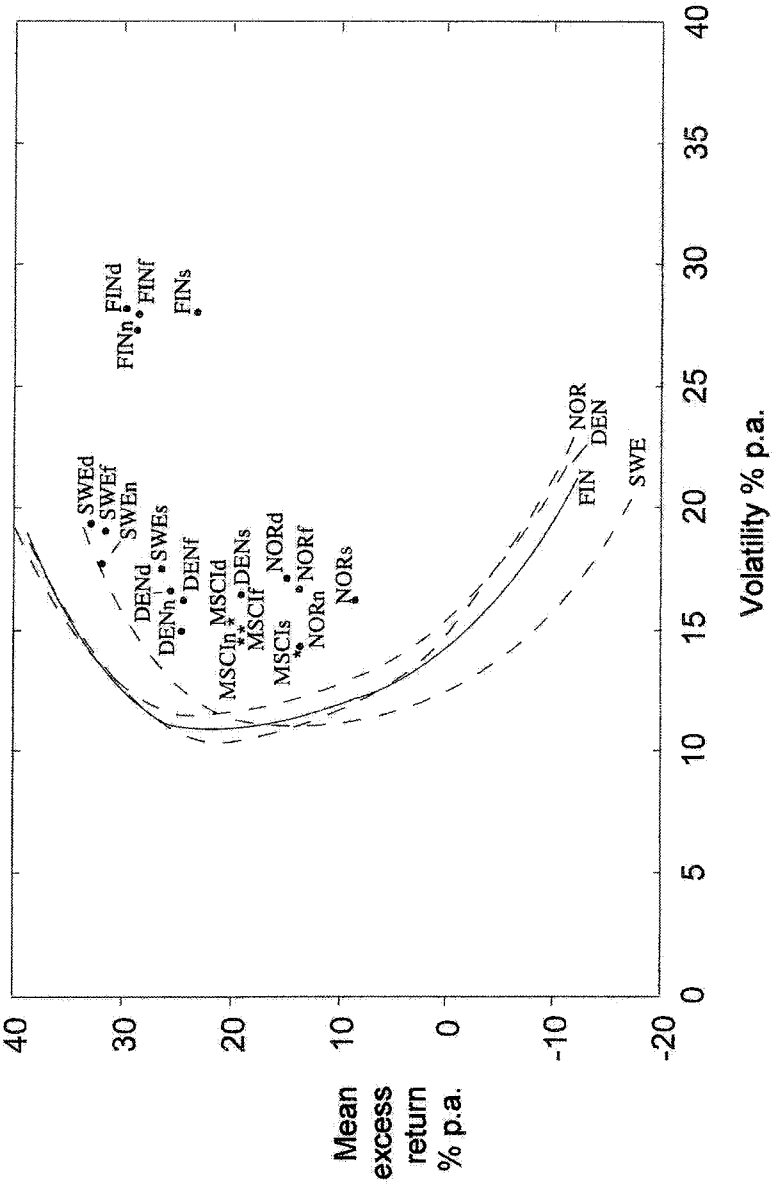
For investors within the EMU (Finnish investors), the total (domestic-currency return) of a foreign stock investment (1) in the EMU region is assumed to be the same as the original local stock market return in that EMU country, and the returns for (2) investments outside the EMU region are approximated by the local return transferred to ECU by the local currency/ECU rate.

For investors outside the EMU (Danish, Norwegian, or Swedish investors), the return from investment (1) within the EMU is approximated by the local EMU country return transferred to domestic (Nordic) currency return by the use of the ECU/domestic currency rate, and (2) the return from investments outside the EMU are estimated as previously, by the local return transferred to the domestic currency by the exchange rate between these two countries' currencies.

Using average returns and a variance-covariance matrix computed on the basis of these modified returns from the estimation period, we then estimate portfolio frontiers and minimum variance (MVP) portfolios for each of the Nordic countries. The Nordic stock markets are then superimposed on the plot separately along with the value-weighted world market index from Morgan Stanley Capital International (MSCI). Figure 5 illustrates these frontiers.

[24] We thus assume unchanged correlations between local stock market returns, i.e., we assume these to be on the same level in the EMU as during the last 3 years. This assumption can be reasonable because we did not detect any clear drift in the degree of international co-movement during the last few years, at least not for the Nordic countries.

Figure 5. Efficient frontiers for four Nordic countries, June 1995 to May 1998.



Notes on Figure 5: Frontiers' computations are based on modified estimation-period returns for the June 1995-May 1998 period. We assumed that investors within the EMU, investing into another EMU country, directly obtain the local stock market return. And when investing into a non-EMU area, they obtain the local return transferred into an ECU return. Investors outside the EMU obtain, when investing into the EMU area, the local stock market return transferred to domestic return by the ECU/domestic currency exchange rate, and when investing outside the EMU, the local return transferred by the local currency/domestic currency exchange rate. Domestic currency returns in FIM, SEK, NOK, and DKK are next transferred into excess returns by the deduction of the domestic risk-free rate. The figure includes four frontiers (computed for each of the Nordic numeraire currencies), and includes five benchmark portfolios: the Nordic (DEN, FIN, NOR, and SWE) and the value-weighted world market index (MSCI). Each portfolio is plotted four times (using each of the Nordic currencies as the numeraire currency). The numeraire currency is indicated like this: d=Danish, f=Finnish, n= Norwegian, and s=Swedish investor, i.e., FINn denotes the stock market index for Finland, as perceived by a Norwegian investor, and MSCIs denotes the value-weighted world index seen from a Swedish viewpoint.

The figure shows that the Nordic country indexes in this prediction are quite close to the frontiers, except for Finland, and the benefits from international diversification do not seem to be as large as in, e.g., Liljeblom, Löflund, and Krokfors (1997). The non-existence of currency risk within the EMU does not seem to affect differently the frontier for Finland, compared to the other three Nordic countries. But the Finnish index, being poorly diversified (with Nokia having a large weight), has a markedly high volatility. So Finnish investors seem to have a change for better risk reduction by means of diversification than the other Nordic investors, not so much due to the non-existence of currency risk within the EMU as due to the poorly diversified domestic index itself.

Finally, we computed the new minimum variance (MVP) portfolio weights during our prediction period for the Nordic countries. Only slight changes from those end-of-period weights in Figure 4 were detected.

5. Conclusions

This paper tries to answer several questions concerning benefits from international diversification—now and after the EMU—for the Nordic countries of Denmark, Finland, Norway, and Sweden. The main questions are:

1. How beneficial is international diversification now and after the EMU?
2. Are the benefits lower during periods of high market volatility?
3. How important is currency risk for investments from the different Nordic countries, with so different currency regimes?
4. How do the optimal portfolio weights differ for investors in different Nordic countries now that these countries differ from each other concerning their status in the EU and the EMU?

We start by an investigation of time-varying stock market volatility and co-movement between the Nordic markets and different European and international benchmarks. We find a significant positive overall time trend in international co-movements but ambiguous trends during the 1990s. Using most recent data, we observe that Finland, the only country joining EMU in Stage 1, has the lowest level of international correlations (0.41 or below), whereas the correlations between the Danish stock market and the world and Europe benchmarks are as high as 0.7 and 0.79. We also find significant relationships between volatility and stock return co-movement, a relationship that reduces the benefits from international diversification. Contrary to Solnik et al. (1996), domestic volatility does not seem to be a determinant of international co-movement, whereas international volatility is highly significant.

A decomposition of total risk for each of the Nordic countries using data from October 1992 onward shows that although the importance of exchange-rate changes is somewhat higher than during the 1980s, the difference is not large, and, when comparing the Nordic countries, no large country-specific differences can be seen. But the risks of investing into different international investment regions vary. The relative importance of currency risk is smallest within the EMU area, whereas areas outside Europe are substantially more exposed. These differences suggest that for international portfolio investments, selective currency hedging may provide more benefits.

The results of the unhedged and hedged *ex ante* investment strategies during a time period just before the EMU demonstrate the robustness of our international diversification strategy, the MVP strategy (the *ex ante* minimum variance portfolio strategy) as the best performing one. But the differences between strategies are not large enough to yield statistical significance. Except for Norway, hedging for exchange risk further improves the performance. A look at the unhedged MVP weights reveals that the patterns of weight developments are rather similar for all Nordic countries, i.e., the weight of Europe outside the EMU has been increasing in all of them. Once currency hedging is allowed for, it also becomes relatively more optimal than before to invest in markets outside Europe.

Finally, a prediction for the portfolio frontiers after the EMU was performed. The non-existence of currency risk within the EMU did not seem to affect differently the frontier for Finland, compared to the other three Nordic countries, nor markedly change the different MVP strategy weights. But except for Finland, the Nordic countries seem to lie quite close to the frontier, indicating only modest benefits from international diversification.

Appendix 1. The interest rates used

Interest rates are use in this study first of all for the computation of excess returns from the perspective of each of the Nordic countries. Secondly, interest rates are needed for the money-market hedge. For both purposes, we use short-term interest rates, preferably one-month interest rates, for the 18 currencies for the October 1989 to May 1998 period. If monthly interest rates have not been obtained, the closest possible maturity has been used, and the interest rates are transferred to the monthly level assuming a flat short-end term structure. The interest rates are month-end interest rates, so the money market hedge for a monthly holding period of $t+1$ is based on the month-end interest rate for the previous period t.

The interest rates are obtained from OECD's Main Economic Indicators (OECD), from the Bank of Finland (BoF), Reuters (Reuters), and the Research Institute of the Finnish Economy (ETLA).

The interest rates are:

		Source:
Austria	1-month Eurorate 1989-1998	BoF
Australia	Short-term money market rate 1989-1998	ETLA
Belgium	1-month Eurorate 1989-1998	BoF
Canada	3-month Treasury bill rate 1989-1990:02	ETLA
	1-month Eurorate 1990:03-1998	BoF
Denmark	1-month Eurorate 1989-1998	BoF
Finland	1-month HELIBOR, i.e., interbank rate 1989-1998	BoF
France	1-month Eurorate 1989-1998	BoF
Germany	1-month Eurorate 1989-1998	BoF
Hong Kong	U.S. 3-month Treasury bill rate 1979-1991:03,	OECD & ETLA
	HKD Eurorate 1991:04-1998	ETLA, Reuters
Italy	1-month Eurorate 1989-1998	BoF
Japan	1-month Eurorate 1989-1998	BoF
Netherlands	1-month Eurorate 1989-1998	BoF
Norway	1-month Eurorate 1989-1998	BoF
Spain	1-month Eurorate 1989-1998	BoF
Sweden	1-month Eurorate 1989-1998	BoF
Switzerland	1-month Eurorate 1989-1998	BoF
UK	1-month Eurorate 1989-1998	BoF
US	1-month Eurorate 1989-1998	BoF

Appendix 2.

Table A1. Descriptive statistics for stock market returns in domestic currency, from September 1974 to May 1998.

Stock market	Average	St.dev.	Skewness	Kurtosis	Min.	Max.
Panel A: Denmark as the domestic country						
AUS	.0100	.0829	-2.12	14.06	-.6438	.2037
AUT	.0091	.0574	.14	4.62	-.2675	.2641
BEL	.0153	.0501	-.01	5.04	-.2613	.2320
CAN	.0098	.0618	-.46	2.10	-.2979	.1884
DEN	.0125	.0498	-.37	1.22	-.1933	.1388
FIN	.0125	.0664	.14	1.84	-.2286	.2633
FRA	.0135	.0633	-.38	1.79	-.2588	.2332
GER	.0132	.0543	-.88	3.36	-.2507	.1551
HK	.0138	.1021	-1.24	6.14	-.6210	.2857
ITA	.0095	.0759	.13	.63	-.2154	.2530
JAP	.0099	.0635	-.19	1.11	-.2197	.2390
NET	.0164	.0485	-.42	4.15	-.2466	.2194
NOR	.0089	.0870	-.78	6.69	-.5096	.4232
SPA	.0083	.0689	-.54	3.02	-.3260	.2421
SWE	.0150	.0673	-.45	1.20	-.2459	.1858
SWI	.0138	.0476	-.49	3.97	-.2535	.2082
UK	.0152	.0685	.25	6.64	-.2987	.4361
US	.0129	.0544	-.90	3.57	-.2882	.1396

Table A1. Continued...

Stock market	Average	St. dev.	Skewness	Kurtosis	Min.	Max.
Panel B: Finland as the domestic country						
AUS	.0109	.0805	-2.16	14.29	-.6258	.2170
AUT	.0100	.0599	.23	3.56	-.2564	.2502
BEL	.0162	.0525	.25	4.65	-.2432	.2693
CAN	.0107	.0604	-.35	2.41	-.2798	.2380
DEN	.0134	.0513	.10	1.09	-.1885	.1662
FIN	.0134	.0599	.32	2.07	-.1800	.2720
FRA	.0144	.0658	-.34	1.58	-.2407	.2341
GER	.0141	.0575	-.56	2.34	-.2326	.1923
HK	.0146	.1004	-1.21	5.77	-.6029	.2819
ITA	.0104	.0756	.11	.17	-.2065	.2227
JAP	.0108	.0625	-.14	.69	-.2068	.2087
NET	.0173	.0501	-.07	3.46	-.2286	.2156
NOR	.0098	.0847	-.93	7.05	-.5113	.3972
SPA	.0091	.0679	-.47	2.86	-.3264	.2118
SWE	.0159	.0651	-.37	1.43	-.2321	.2386
SWI	.0147	.0500	-.14	3.10	-.2355	.2044
UK	.0161	.0662	.39	6.96	-.2806	.4323
US	.0138	.0537	-.39	3.31	-.2701	.2341

Table A1. Continued...

Stock market	Average	St.dev.	Skewness	Kurtosis	Min.	Max.
Panel C: Norway as the domestic country						
AUS	.0108	.0803	-2.09	13.53	-.6128	.2231
AUT	.0098	.0577	.14	4.16	-.2667	.2519
BEL	.0160	.0505	.06	3.61	-.2303	.2237
CAN	.0105	.0598	-.36	1.87	-.2669	.2097
DEN	.0132	.0496	-.27	.86	-.1873	.1490
FIN	.0132	.0639	.24	2.34	-.2076	.2807
FRA	.0142	.0631	-.43	1.69	-.2358	.2344
GER	.0139	.0544	-.68	2.47	-.2197	.1526
HK	.0145	.0996	-1.20	5.59	-.5900	.2683
ITA	.0102	.0741	.12	.42	-.2062	.2578
JAP	.0106	.0635	-.07	.91	-.2078	.2438
NET	.0171	.0478	-.30	2.75	-.2156	.2020
NOR	.0096	.0832	-.84	6.28	-.4806	.3950
SPA	.0090	.0670	-.45	3.07	-.3268	.2470
SWE	.0157	.0643	-.41	1.06	-.2424	.1819
SWI	.0145	.0487	-.28	2.17	-.2225	.1907
UK	.0163	.0690	.32	5.82	-.2775	.4358
US	.0136	.0519	-.54	3.05	-.2572	.1629

Table A1. Continued..

Stock market	Average	St.dev.	Skewness	Kurtosis	Min.	Max.
Panel D: Sweden as the domestic country						
AUS	.0116	.0805	-2.17	14.72	-.6275	.2104
AUT	.0107	.0595	.19	3.57	-.2666	.2555
BEL	.0169	.0517	.02	3.82	-.2449	.2207
CAN	.0114	.0593	-.14	2.97	-.2815	.2765
DEN	.0141	.0514	-.05	1.28	-.1857	.2047
FIN	.0141	.0644	.28	2.68	-.2224	.2818
FRA	.0151	.0656	-.30	1.43	-.2424	.2305
GER	.0148	.0565	-.62	2.32	-.2343	.1555
HK	.0153	.0984	-1.19	6.04	-.6046	.2804
JAP	.0115	.0631	-.02	.89	-.2133	.2056
ITA	.0111	.0746	.23	.60	-.1973	.2779
NET	.0180	.0485	.05	4.47	-.2303	.2413
NOR	.0105	.0848	-.93	7.08	-.5106	.3995
SPA	.0098	.0682	-.49	3.04	-.3304	.2088
SWE	.0166	.0625	-.30	1.59	-.2423	.2138
SWI	.0154	.0495	-.12	3.32	-.2372	.2096
UK	.0168	.0669	.54	6.47	-.2823	.4308
US	.0145	.0528	-.26	4.71	-.2718	.2725

Notes: The table reports descriptive statistics (means, standard deviations, skewness, kurtosis, minimum and maximum values for monthly total returns (including the local stock market return and the exchange-rate change) in the domestic currencies of Denmark, Finland, Norway, and Sweden for the period from September 1974 to May 1998 (285 observations).

Appendix 3

This Appendix gives a short description of the exchange-rate regimes of the Nordic currencies in the 1990s. For a more detailed description of these and of the financial deregulation processes in the Nordic countries, see Oxelheim (1996).

Denmark

The DDK has been a member of the European Monetary System (EMS) since 12 March 1979. In the early 1990s, DKK had, in line with the ERM system, bilateral bands with a margin of ±2.25% (with respect to some currencies, ±6 per cent) to the other ERM currencies. In August 1993, the ERM bands were widened to ±15% for DKK and for other ERM currencies, except for the DEM and NLG pair. In this system, the DKK remained until the end of the old system and the start of the EMU in January 1999. DKK did not join the EMU but joined instead the ERM2 system with a ±2.25% band.

Finland

From 1977 until June 1991, the FIM was fixed to a trade-weighted currency index, including the currencies of Finland's main trading partners, with a band of ±3% in the 1990s (since November 30th, 1988). The external value of the FIM was revised a few times during that period. On 7 June 1991, the FIM became pegged to the ECU instead of the former index, still with a ±3% fluctuation interval. The FIM was devalued on 14 November 1991, leading to a fall of 12.3% in the external (ECU) value of the FIM. On 8 September 1992, the FIM was allowed to temporarily float and fell immediately by about 15% to the ECU on the first day and then stabilised at a level that implied a depreciation of about 10%. On 13 November 1992, the float was made permanent by allowing the Bank of Finland to abandon the fluctuation limits for an indefinite time period. Finally, Finland joined the ERM on 14 October 1996 (with a ±15% band) and the EMU in January 1999.

Norway

From 12 December 1978 onward, the NOK was pegged to a trade-weighted index similar to the Finnish (and Swedish) index. Some reforms of the weights and the index construction (calculation method) were made during the 1980s. On 19 October 1990, the NOK became pegged to the ECU instead of the old index, with a ±2.25% band (same as the former one). The NOK was allowed to float as of 10 December 1992. A first regulation for the new exchange-rate regime was issued on 8 January 1993, and replaced by another on 6 May 1994. Common to both is that no formal fluctuation intervals within which the NOK must be kept by means of interventions from the central bank were specified. On 6 May 1994, the Norwegian government also established (based on recommendations from the central bank) new guidelines for monetary policy under a floating exchange-rate regime. Due to such guidelines, the NOK could probably best be described as following a managed float, and has remained quite stable since its float on 10 December 1992.

Sweden

From August 1977, SEK was pegged to a currency basket with weights based on foreign trade (with some devaluations during the 1980s). On 17 May 1992, the peg was instead set against the ECU with a quite narrow ±1.5% band (same as the old band in the basket system since June 1985). On 19 November 1992, the SEK was allowed to float. Sweden did not join the EMU in January 1999.

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