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Cointegration and Causality of Stock Markets in Two Small Open Economies and Their Major Trading Partner Nations

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Abstract

This paper examines cointegration and Granger causality among the stock markets in the United States, the United Kindom, Germany, Sweden and Finland. The first three nations are the biggest trading partners of the two small open Nordic economies, Finland and Sweden. We apply standard univariate VAR models and a system of VAR models under the assumption of multivariate cointegration, first introduced in Johansen (1988). Our results from causality analysis contradict the prior understanding with respect to the causal relations between the Nordic and other stock markets. Our multivariate cointegration analysis suggests that the stock markets are cointegrated with one cointegrating vector when prices are measured in local currencies or in Finnish markkas and two cointegrating vectors when prices are measured in US dollars. The Finnish stock market is always found to be led by the German market, and also by the UK market when returns are measured in local currencies or in Finnish markkas. We also found that the Swedish stock market is Granger caused by the UK market instead of the US market as previously suggested. The data covers the period 1974–1989.

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Contents

1 Introduction

Several papers have recently considered interdependencies in international stock markets. Interdependencies may be either short-term or long-term relations. The former studies have concentrated on the international transmission of returns and volatility (e.g. Eun and Shim (1989), Hamao, Masulis and Ng (1990), and King and Wadhwani (1990)) and found that stock markets are in many cases less than fully integrated. This implies that shocks are transferred from one market to another as meteor showers instead of heat waves in terms of Engle, Ito and Lin (1990) and Ito, Engle and Lin (1991). Studies of the latter type analyse whether the national stock markets move together in the long-run, i.e. are they cointegrated? If they are, the number of stochastic trends is analysed, as e.g. in Kasa (1992). Kasa argues that there is a single common trend driving the stock markets of the US, Japan, UK, Germany, and Canada. He also raises an interesting question as to what are the sources of this trend. He suggests that a stochastic world economic growth factor could be the underlying force driving national earnings and dividends.

The purpose of this study is to analyze cointegration and order of integration among the stock markets of the United States, the United Kindom, Germany, Sweden and Finland. The former three nations are the biggest trading partners of the two small open Nordic economies, Finland and Sweden. We will consider an unrestricted VAR model for each country in order to carry out traditional Granger causality tests. We will also employ the VAR models under the assuption of multivariate cointegration, first introduced in Johansen (1988a), in order to analyze the hypothetical long-term relations and short-term dynamics simultaneously, thus using all the information contained in the data. The short-term causalities are analysed conditional to the long-term relations when applying the Johansen method. We use end-of-month return data of good quality from 1974–1989. All the tests are computed over the returns denominated in (a) local currencies, (b) U.S. dollars and (c) Finnish markkas and in their nominal and excess forms.

The interdependencies among the Nordic and non-Nordic stock markets have been analyzed recently by Hietala (1989), Mathur and Subrahmanyam, henceforth MS (1990) and (1991), Malkamäki, Martikainen and Perttunen, henceforth MMP (1991) and Malkamäki, Martikainen, Perttunen and Puttonen, henceforth MMPP (1991). All the authors emphazised that the Nordic Stock Markets are less than fully integrated. MS employed the Granger causality procedure to analyse interdependencies among Danish, Finnish, Norwegian and Swedish stock market indices. They used monthly (average, mid-month or end of month) data provided in the IMF satistics from 1974–1985. MS (1990) used the vector autoregressive (VAR) technique and MS (1991) the seemingly unrelated regression (SUR) procedure and found that the Swedish market index led the indices in Denmark, Finland and Norway. The Norwegian market influenced the Danish and Swedish markets, whereas the Danish and Finnish markets did not influence any other markets. However, MS did not test for the cointegration, and the quality of data was mixed.

These two studies were extended by MMPP (1991). They used daily returns measured in US dollars from February 1988 – April 1990 and also included the World stock index in the analysis. MMPP employed the single equation approach and tested for cointegration by applying the Engle-Granger (1987) two-step procedure. They found no cointegration among the indices but again found that the Swedish stock market led the other Scandinavian markets. However, the other Scandinavian markets did not significantly influence any other markets. The world-wide returns were found to have leading causality for Scandinavian stock market returns.

Recalling the paper by Kasa (1992), one would expect that the stock markets of all industrialized western countries move together in the long-run, i.e. that the indices studied here are cointegrated and cannot drift too far from the equilibrium path. If the stock markets studied here are cointegrated and share a common stochastic trend, there are no long-term gains to international diversification among these markets, assuming that transitory deviations from trend do not persist too long and that investors have a finite horizon.

Full stock market integration would imply that risk adjusted stock returns denominated in the numeraire currency are equal in all countries. One would expect that at least the stock markets of the USA and UK are fully integrated since both markets are of reasonable size and there have not been any significant restrictions on capital movements between these markets. The Finnish and Swedish stock markets have been subject to regulation that has prohibited the free entry of foreign investors. Furthermore, the market capitalization of these markets, as well as the German stock market, has been relatively small and illiquid. Such markets are typically subject to nonsynchronous trading. Therefore, one would expect that especially the Finnish and Swedish stock markets are not necessarily fully integrated with the UK and US stock markets.

Finland and Sweden are small open economies, highly dependent on exports. The most important trading partners of Finland (excluding the Soviet Union) are Sweden, Germany and the United Kindom. For Sweden, they are Norway, Germany, the United Kindom and the United States. If the stock markets of Finland and Sweden are not fully integrated, we expect that they are Granger-caused by the stock markets of their prime trading partner nations. Thus, the Finnish market is expected to be led by the German, Swedish and/or UK stock markets and the Swedish market by the German, UK and/or US stock markets.

Our multivariate cointegration analysis suggested that the stock markets examined here are cointegrated having one common vector when prices are measured in local currences or in Finnish markkas and two common vectors when prices are in U.S. dollars. The results from Granger causality analysis of returns in all three currencies contradicts the prior results of MS (1990) and (1991). They emphasized that the stock market index of Sweden leads the Finnish one. We did not find that kind of causality. We, instead, found that the Finnish stock market is in all cases led by the German market as well as the UK market when returns are measured in local currencies or in Finnish markkas. This contradiction may be due to the fact that the construction of the data differs between these two studies. End-of-month returns are used here for all the countries, while MS used somewhat mixed data. The number of relevant lags was also found to be considerably lower in our study.

We also found that the Swedish stock market is Granger caused by the UK market instead of the U.S. market, as suggested in MMPP (1992). However, this contradiction may be due simply to data differences, since MMPP employed daily data from 1988–April 1990. The US stock market was always able to predict the German stock market returns. Somewhat surprisingly, the German stock market was also led by the Swedish stock market in all currencies. On the other hand, we found some evidence that the German index was able to predict the UK stock market.

The remainder of this paper is organised as follows. Section two discusses the methodologies employed and the next section describes the data. Empirical results are presented in section four, and section five concludes with the key findings of the paper.

2 Methodology

Time series used in econometric analysis (Granger causality tests in our case) should be stationary in order to apply standard inference techniques. Stock price series are typically non-stationary. Differencing the logarithmic levels once usually produces stationarity, and hence we conlude that the series have one unit root, i.e. they are first order integrated, I(1).[1] Thus, standard distributional results apply to the model estimates computed on differenced variables. The presence of unit roots gives rise to stochastic trends with innovations to an integrated process being permanent. On the other hand, Granger (1981) showed that a vector of variables that are stationary only after differencing may have linear combinations which are stationary without differencing, i.e. the variables may be cointegrated. Cointegration of a vector of variables implies that the number of unit roots in the system is less than the number of unit roots in the corresponding univariate series. This implies that the variables share at least one common (stochastic) trend.[2]

Engle and Granger (1987) first formalized cointegration theory, providing us with tests for evaluating the existence of equalibrium relationships between the variables. They also showed that a cointegrated system can be represented in an error-correction structure that incorporates both changes and levels of variables such that all the elements are stationary. The levels of variables contain long-term information, which we loose when differencing the data unless short-term effects are identical to long-term effects, which is unusual. Error-correction models (ECM) allow us to test the possibility of different short and long-run dynamics. If a set of variables is cointegrated, the ECM term should be included when estimating a dynamic model. Otherwise the model is not consistent with the data and relevant information is omitted.[3]

2.1 Granger Causality

A number of causality tests have been proposed and applied in the literature. A review of these tests is given in Geweke, Meese and Dent (1983). Our tests for causality essentially employ the regression technique of Granger (1969). A time series {Yt} is said to Granger cause another time series {Xt} if the present X is better predicted by the past values of Y than without them in addition to other relevant information, including the past values of X. The null hypothesis is that there is no causality. The alternative is that {Yt} Granger cause {Xt}. This is tested by means of an F-test of the joint significance of the retained regressors, i.e. the lagged values of {Yt}.

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[1] We should keep in mind the argument of Christiano and Eichenbaum (1990) that it is often extremely difficult to separate trend and difference stationarity from each other. If a variable is trend stationary, innovations to it have no effect on long-run forecasts of it.

[2] Unit roots and Cointegration are described in detail e.g. in Engle and Yoo (1987), Stock and Watson (1988) and Dolado, Jenkinson and Sosvilla-Rivero (1990).

[3] For a review of cointegration, see Engle and Granger (1987), Johansen and Juselius (1990).

2.2 Johansen Cointegration

In case of cointegrated variables, the equilibrium error should be included as an additional regressor to the causality tests of stationary variables. Most of the cointegration tests are carried out using the Engle-Granger (1987) two-step procedure, which may employ either a static linear regression approach or a dynamic linear model procedure. Johansen (1988) presents an autoregressive formulation of the multivariate error-correction model.[4] The multivariate cointegration approach of Johansen allows us to analyze hypothetical long-run relations and short-term dynamics simultaneously using a maximum likelihood estimation procedure. This approach relaxes the assumption that the cointegrating vector is unigue and takes into account the error structure of the underlying process. It also allows for several tests regarding the cointegrating vectors and tests for weak exogeneity among the variables. The multivariate model is developed further in Johansen and Juselius (1990) and Johansen (1991). The basic p-dimensional vector autoregressive model with gaussian errors is

$$X_t = A_1 X_{t-1} + \dots + A_k X_{t-k} + \mu + \psi D_t + \varepsilon_t, \qquad t = 1, \dots, T \tag{1}$$

where X_t is a px1 vector of stochastic variables, $X_{-k+1},\dots,X_0$ are fixed, k is the number of lags, $\varepsilon_1,\dots,\varepsilon_T$ are i.i.d. $N_p(0,\Sigma)$ and D_t are centered seasonal dummies. It is convenient to rewrite equation 1 in error correction form as

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \dots + \Gamma_{k-1} \Delta X_{t-k-1} + \Pi X_{t-k} + \mu + \psi D_t + \varepsilon_t, \qquad t = 1, \dots, T \tag{2}$$

where Δ is the difference operator and

$$\Gamma_i = -(I - A_1 - \dots - A_i), \qquad i = 1, \dots, k-1,$$

$$\Pi = -(I - A_1 - \dots - A_k).$$

Now all the long-run information is contained in the levels component ΠX_{t-k}. The hypothesis of cointegration is based on the determination of the rank of the Π-matrix:[5]

$$H_1(r): \ \Pi = \alpha\beta', \tag{3}$$

where α and β are pxr matrices. The parameters in β are the cointegration vectors and α the adjustment vectors. Under certain conditions (see Johansen, 1989), the relations $\beta' X_t$ can be interpreted as the stationary relations among nonstationary variables, i.e. as cointegration relations. In this case, equation (2) can be interpreted as an error-correction model (see e.g. Engle and Granger, 1987 or

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[4] Juselius (1990) reviews the differences between these methodologies.

[5] Details of the estimation procedure are reviewed in Johansen and Juselius (1990).

Johansen, 1988). If the rank of the matrix Π is zero the model implies that no linear cointegration vectors exist. The model is still consistent, but it is reduced to the standard VAR model in first differences. If the rank r of the matrix Π is greater than zero the model would imply r linear cointegration vectors. The formulation of equations 2 and 3 allows us to test alternative hypotheses, such as weak exogeneity, i.e. causality, on the cointegration space. This is essential if more than one cointegration vector exists.[6]

2.3 Unit Roots

Standard Johansen methodology assumes that the variables analysed are first order integrated. The Granger causality tests assume stationary time-series. Engle and Granger suggested seven alternative tests for determining the order of integration. We employ the augmented Dickey-Fuller (ADF) test to consider the stationarity of stock prices and returns. The ADF test is based on the following regression:

$$\Delta x_t = \alpha_0 + \phi x_{t-1} + \sum_{i=1}^{n} \beta_i \Delta x_{t-i} + \sum_{j=1}^{11} \gamma_j M_{jt} + \lambda t + e_t \qquad (4)$$

where Δ is the difference operator, M_{jt} are seasonal dummies, t is the trend and e_t is a stationary random error term. The null hypothesis is that x_t is non-stationary, i.e. it has a unit root I(1). The H_0 is rejected if ϕ is statistically significant. This would imply that the variable is I(0). Christiano and Eichenbaum (1990) state that in many cases it difficult to provide a compelling case that a variable is either difference or trend stationary. If a variable is trend stationary, innovations to it have no inpact on its own long-run forecasts. The difference stationarity I(1) would imply that stock prices are best characterized as a stochastic process (e.g. a random walk process) that does not revert to a deterministic trend path. This would imply that innovations to stock prices persist and contain relevant information on future stock prices.

[6] These tests are applied e.g. in Johansen and Juselius (1991).

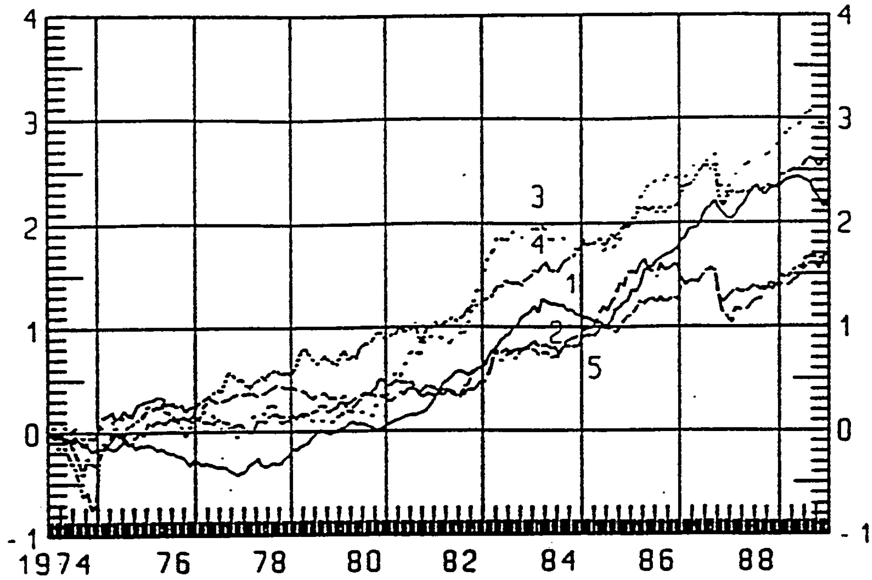
3 Data

This study examines interdependencies among the stock markets in the United States, the United Kindom, Germany, Sweden and Finland. We employ end-of-month stock market logarithmic price indices in local currencies constructed by Morgan Stanley Capital International for all the countries except Finland. MSCI index for Finland doesn't begin until late 1980s. For Finland, we use an index (see Berglund et al. (1983)) similar to the MSCI indices. The log of price series for each country are illustrated in Figure 1. In the indices, prices are corrected for dividends, splits, stock dividends and new issues. The correction is based on the principle that all income from a stock is reinvested in the stock with no transaction cost. Stock market returns are measured as changes in logarithmic prices.

All the analyses are conducted using the indices in US Dollars and Finnish markkas. Figures 2 and 3 present these indices. We take dollar and markka investors' points of view in analyzing these indices. This implies that we leave the foreign exchange risk unhedged. Furthermore, we eliminate the hypothetical impact of inflation in our analysis by re-computing everything on indices that are measured in the excess short term money market rate (see Appendix 1 for these index values. End-of-month foreign exchange rates were collected from the Bank of Finland archives. The corresponding one-month Euromarket deposit rates were taken from the DRI and Nomura databanks. The one-month interest rate was not available for the 1970s on the Finnish markka. Therefore, we collected end-of-month data on three-month currency forward prices, currency spot rates and US dollar interest rates and computed the corresponding one-month return on the three month Eurorate for the markka. This interest rate series is introduced in Malkamäki (1992).

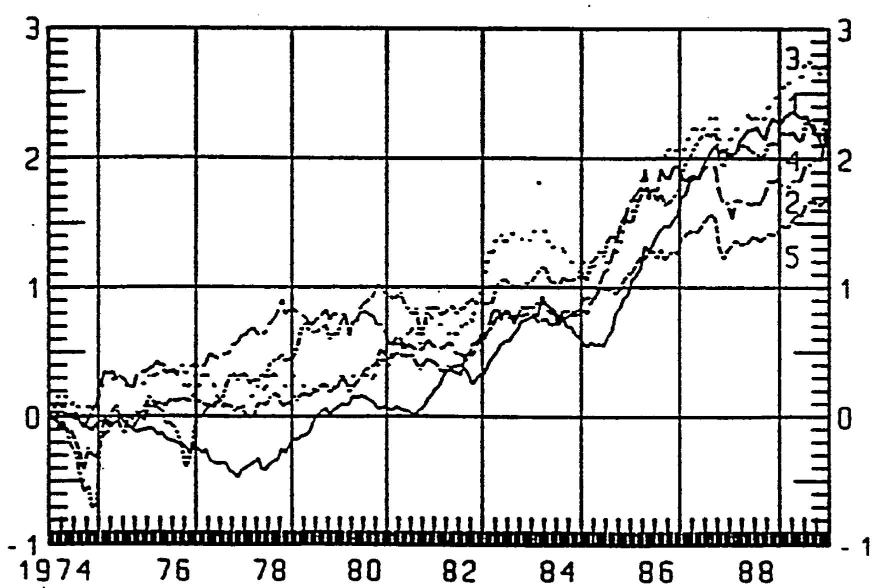
Table 1 presents summary statistics for monthly stock market returns in local currences, U.S. dollars and Finnish markkas. We see from the table that the distributional properties of returns are almost the same regardless of currency denomination. The returns are somewhat skewed to the right in Finland and the U.K. and to the left in the other countries. Excess kurtosis is present especially in the German, U.K. and U.S. returns. The Finnish stock market returns were found to be strongly autocorrelated, although the fourth order autocorrelation coefficient was already close to zero. The lower sequence of the table tabulates cross-correlation matrices. The U.K. and U.S. returns correlate most highly with each other. The Finnish returns correlate least with the returns from the other markets.

Figure 1. **Logarithmic stock market indices, local currencies**



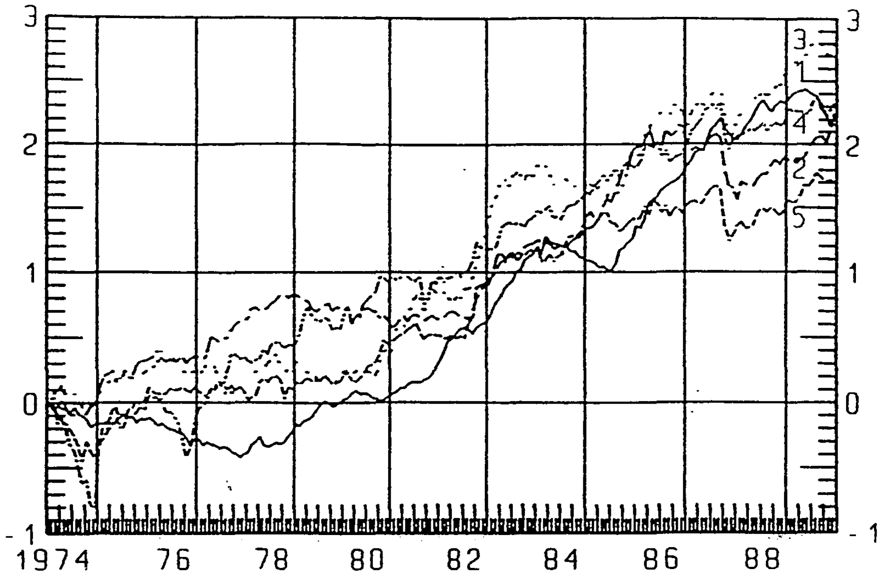
1 Finland
2 Germany
3 Sweden
4 The United Kingdom
5 The United States

Figure 2. **Logarithmic stock market indices, US dollars**



1 Finland
2 Germany
3 Sweden
4 The United Kingdom
5 The United States

Figure 3. **Logarithmic stock market indices, Finnish markkas**



1 Finland
2 Germany
3 Sweden
4 The United Kingdom
5 The United States

Table 1. **Summary statistics for nominal stock market returns (in percentages/100 per month) for 1974:1–1989:12, 192 observations**

Return	Symbol	Mean	Std. dev.	Skew.	Ex. Kurt.	ρ_1	ρ_2	ρ_3
Local Currencies								
Finland	FIN	0.011	0.039	0.160	0.776	0.276	0.282	0.208
Germany	GER	0.009	0.051	−0.694	4.130	0.098	−0.023	0.072
Sweden	SWE	0.016	0.060	−0.164	1.241	0.165	0.024	0.104
The UK	UK	0.014	0.072	0.337	7.632	0.079	−0.096	0.086
The US	US	0.009	0.048	−0.563	3.633	0.034	−0.064	0.005
U.S. Dollars								
FIN	–	0.011	0.046	0.433	0.811	0.186	0.243	0.231
GER	–	0.012	0.061	−0.169	0.984	0.019	0.078	0.081
SWE	–	0.014	0.064	−0.124	0.147	0.059	0.009	0.104
UK	–	0.012	0.080	0.529	4.595	0.070	−0.065	0.061
US	–	0.009	0.048	−0.563	3.633	0.034	−0.064	0.005
Finnish markkas								
FIN	–	0.011	0.039	0.160	0.776	0.276	0.282	0.208
GER	–	0.121	0.055	−0.354	2.174	0.084	−0.006	0.089
SWE	–	0.148	0.063	−0.362	1.215	0.110	0.023	0.072
UK	–	0.012	0.077	0.278	5.434	0.106	−0.104	0.076
US	–	0.009	0.056	−0.453	4.173	0.023	−0.005	−0.005

Cross-moment matrix, returns in local currencies

Variable	FIN	GER	SWE	UK	US
FIN	1.000				
GER	0.139	1.000			
SWE	0.318	0.325	1.000		
UK	0.102	0.384	0.390	1.000	
US	0.135	0.401	0.419	0.584	1.000

Cross-moment matrix, returns in US dollars

Variable	FIN	GER	SWE	UK	US
FIN	1.000				
GER	0.313	1.000			
SWE	0.374	0.385	1.000		
UK	0.223	0.403	0.415	1.000	
US	0.109	0.341	0.402	0.515	1.000

Cross-moment matrix, returns in Finnish markkas

Variable	FIN	GER	SWE	UK	US
FIN	1.000				
GER	0.108	1.000			
SWE	0.296	0.313	1.000		
UK	0.098	0.329	0.377	1.000	
US	0.152	0.342	0.445	0.501	1.000

4 Empirical results

4.1 Unit Root Tests

Both the cointegration and Granger causality tests assume that the order of integration of variables is known. The standard Johansen methodology which we apply assumes that the variables analysed are first order integrated. The Granger causality tests assume stationary time-series. We employ the augmented Dickey-Fuller (ADF) test reviewed in subsection 2.3 to consider the stationarity of stock prices and returns in local currencies. We found that two lags were enough (n=2). The critical values for the t-test are tabulated in Fuller (1976).

The outcome of the analysis is presented in Table 2. The results indicate that the stock price series are always non-stationary. However, the prices are quite clearly trend-stationary in the U.K., which is seen also in Figure 1. Differencing the levels once produces stationarity in all cases. We conclude, simply put, that all the price series have one unit root, i.e. they are first order integrated, I(1). Thus, the standard distributional results apply to our model estimates.

Table 2. **Augmented Dickey-Fuller Unit Root tests for stock market indices in local currencies**

Variable	FIN	GER	SWE	UK	USA
Δx_t = first difference Reg. coefficient					
ϕ (ADF-test)	−2.36	−1.66	−1.88	-4.32^c	−2.94
Order of integration	I(1)	I(1)	I(1)	I(0)	I(1)
γ_j (t-test for seasonals)	$-2.22\ M_9$ $2.56\ M_{12}$	$-2.17\ M_5$	$-2.13\ M_8$ $2.02\ M_{12}$	$2.20\ M_1$ $4.39\ M_{12}$	$2.92\ M_{12}$
λ (t-test for trend)	2.70	1.78	2.25	4.38	3.17
Δx_t = second difference Reg. coefficient					
ϕ (ADF-test)	-5.01^c	-6.72^c	-6.51^c	-7.38^c	-7.89^c
Order of	I(0)	I(0)	I(0)	I(0)	I(0)
γ_j (t-test for seasonals)	$-2.02\ M_8$ $-2.45\ M_9$ $-2.01\ M_{10}$	$-2.15\ M_5$	$-1.92\ M_5$ $-2.15\ M_8$	$2.24\ M_1$	–
λ (t-test for trend)	−1.36	0.58	1.32	0.21	1.22

Augmented Dickey-Fuller model, equation 4.
Reported t-values are heteroscedastic consistent
[a–c] correspond to significance levels of 10 % (−3.15), 5 % (−3.45), and 1 % (−3.73) respectively. The critical values (in parentheses) are tabulated in Fuller (1976).

4.2 A Standard VAR Model

A standard vector autoregression model is fit to the data before testing for cointegration. This is done in order to compare our results with the ones presented in MS (1990) and (1991). According to the Akaike and Schwartz information criteria, we need only 1 or 2 lags respectively in our VAR models on stock market returns.

Table 3. **VAR estimation for stock market returns in local currencies, 1974–1989**

Significance of lags 1 and 2

		Lag 1					Lag 2				
	Constant	FIN	GER	SWE	UK	USA	FIN	GER	SWE	UK	USA
FIN	0.005	0.160	0.083	0.106	0.017	−0.064	0.232	−0.142	0.011	0.064	0.014
(t)	(1.72)	(2.13)	(1.34)	(1.99)	(0.35)	(0.89)	(3.12)	(2.36)	(0.21)	(1.35)	(0.19)
GER	0.009	0.014	0.056	0.166	−0.080	0.161	−0.265	−0.027	0.027	0.121	−0.137
(t)	(2.19)	(0.14)	(0.67)	(2.30)	(1.25)	(1.66)	(2.64)	(0.33)	(0.37)	(1.89)	(1.38)
SWE	0.012	0.026	0.052	0.115	−0.080	0.238	0.054	0.026	−0.009	0.020	−0.128
(t)	(2.53)	(0.21)	(0.51)	(1.30)	(1.02)	(1.98)	(0.43)	(0.26)	(0.10)	(0.26)	(1.05)
UK	0.015	0.140	0.030	−0.038	0.083	0.024	−0.129	0.220	−0.113	−0.141	0.019
(t)	(2.75)	(0.95)	(0.25)	(0.36)	(0.90)	(0.17)	(0.89)	(1.87)	(1.08)	(1.52)	(0.13)
USA	0.010	0.020	−0.054	0.094	0.035	−0.008	−0.094	0.138	−0.095	0.007	−0.086
(t)	(2.48)	(0.19)	(0.65)	(1.31)	(0.56)	(0.08)	(0.94)	(1.71)	(1.32)	(0.12)	(0.88)

Marginal significance of retained regressors by nation

Variable	FIN[a]	GER[a]	SWE[a]	UK[a]	USA[a]
FIN	0.000	0.028	0.135	0.365	0.649
GER	0.030	0.761	0.067	0.096	0.080
SWE	0.868	0.849	0.431	0.587	0.068
UK	0.497	0.171	0.515	0.235	0.978
USA	0.641	0.195	0.189	0.845	0.681

[a] Marginal significance of F-test (P(F-test)) for retained regressors by nation.

Our results shown in Table 3 indicate that the Finnish index is caused in the Granger sense by its own and the German lags. We do not find clear causality from Sweden to Finland. This contradicts the prior results of MS (1990) and (1991). They emphasized that the Swedish stock index leads the Finnish index by one month. Our results may differ due to the fact that the quality of the data employed here is better than in MS and/or we have included three indices that are likely to explain index returns in Sweden as well as in Finland. The Swedish stock market is led by the US stock market if the marginal risk of 6.8 % is accepted. The German stock returns are affected by lags of all the markets included here except its own. The leading ability of Finnish returns is surprising, and it is hard to conceive of an economic explanation for this result. The UK and US stock markets are not Granger caused by any markets.

We did the corresponding analysis for the excess returns in local currencies and got almost identical results (see Appendix 2A). This implies that inflation differentials do not play a significant role in our tests. Appendices 2B and 2C present the outcome from the VAR estimation on nominal returns in US dollars and Finnish markkas. One can see from appendix 1B that the behavior of the US dollar in the period studied has major effects in our tests. The US stock market clearly leads the German and Swedish markets here. The German market has lead capability for the UK market. The Finnish stock market is now affected only by its own lags. It is somewhat puzzling that the Finnish market still has some impact on the German market. However, these results indicate that the strong appreciation and subsequent depreciation of the US dollar had a marked impact on economic expectations in the other markets. This implies that expectations regarding the value of the US dollar contain information that is relevant to investors in the determination of stock prices. The corresponding analysis of the returns in Finnish markkas indicates that markka markets contain less relevant information for stock market investors.

4.3 Cointegration and Causality Tests

4.3.1 Indices in Local Currences

Our empirical analysis begins with model (2) and the reduced rank hypothesis (3). We estimate model (2) assuming that there are linear trends in the data. The motivation for the assumption is straightforward based on Figures 1–3 and Table 2. The presence of linear trends in the model implies that we do not impose any restrictions on the constant term and alters the rank inference as shown in Johansen and Juselius (1990). The common trends will show up in the estimation of the constant term but not in the cointegration relations. However, we found that an explicit linear trend in the cointegration relations alters the results considerably and the trend term produces high t-values. This indicates that there is some linear growth in the data which our model is unable to account for.[7] Therefore, we reformulated the model (2) as:[8]

$$\Delta X_t = \Gamma_1 X_{t-1} + \ldots + \Gamma_{k-1}\Delta X_{t-k-1} + \Pi X_{t-k} + \mu + \lambda t + \varepsilon_t, \qquad t = 1,\ldots,T \tag{5}$$

where t is the trend.

[7] Johansen and Juselius (1991) provide more detailed discussion regarding restrictions on the constant term and linear trends.

[8] We will add the seasonals later on.

The number of cointegration vectors is considered in Table 4. We find that the hypothesis $r \leq 0$ is not rejected according to maximal eigenvalue and trace tests in the 90 percent quantile. This indicates that there is at most one cointegration relation in the data. Our test procedures provide mixed results regarding the hypothesis r=0. The trace test rejects the hypothesis whereas the maximal eigenvalue test does not. Johansen and Juselius (1991) got similar results and state that the ambiguity of the tests is due to their low power in cases where the cointegration relation is close to the nonstationary boundary. In such a case, it is reasonable to accept the existence of the cointegration relation.[9]

Table 4. **Maximal eigenvalue and trace tests for the cointegration rank, k=3[a]**

H(r)	Eigenvalue	ME[b] test	Crit. value[c]	Trace test	Crit. value[c]
	λ_i	$-T\ln(1-\lambda_i)$	$\lambda_{max}(.90)$	$-T\Sigma\ln(1-\lambda_i)$	$\lambda_{trace}(.90)$
$r \leq 4$	.023	4.388	6.691	4.388	6.691
$r \leq 3$	.035	6.800	12.783	11.188	15.583
$r \leq 2$	.043	8.315	18.959	19.502	28.436
$r \leq 1$	.103	20.551	24.917	40.053	45.248
$r = 0$	.137	27.811	30.818	67.864	65.956

[a] Number of lags in the VAR
[b] Maximum eigenvalue
[c] Critical values are tabulated in Johasen and Juselius (1990:208), Table A2.

The coefficient estimates of the cointegration vectors α and β are found in Table 5. The cointegration vector β can be interpreted as an error correction mechanism. The excess price effect is derived through the estimated long term equilibrium relation (standardised for Finland) and given by

$$FIN = 2.51*GER + .558*SWE - 6.024*UK - .724*USA.$$

The correspondin α coefficients indicate the average speed of adjustment towards the estimated long term equilibrium state. The α coefficients indicate that the eigenvector is least important for Finnish stock prices and most important for UK stock prices. The speed of adjustment of Finnish prices may be slow, for example, due to restrictions on capital flows in the period studied, high adjustment costs and other short-run effects which tend to lengthen the deviations from the equilibrium path. Such effects could be present in Finland, for example, because of the strong business cycles due to the forest industry's central role in the economy and the deregulation of financial markets.

[9] See also Johansen and Juselius (1990) 183-192.

Table 5. **The stationary cointegration vector and its weights (eigenvalue .137)**

	Beta	Alfa
FIN	1.000	–.007
GER	–2.510	–.019
SWE	–.558	–.015
UK	6.024	–.040
USA	.724	–.018

The maximum likelihood estimates for model (5) are presented in Table 6. All the coefficients and statistics are now based on the assumption of one cointegration relation. When we compare the short-term dynamics with those expressed in table 3 we notice that all the markets except the Swedish one Granger cause the Finnish market at lag 1, Germany and the United Kindom having the strongest influece. According to table 3, the German market was the only one that led the Finnish market.[10] The German market is influenced at lag one by the US and German markets and at lag two by the Swedish market. The puzzling causality from Finland to Germany is now lacking in the short-term dynamics.[11]

The long-term relations are expressed in the middle of the Table 6. The Π matrix ($\Pi = \alpha\beta'$ for $H_1(1)$) implied by model (5) is provided with its standard deviations. The lower part of the table exhibits estimated coefficients for the constant and trend terms. Both coefficients have significant t-values in all regressions except the one for Finnish returns.

Table 7 gives some misspecification statistics for the estimated model. The results are quite satisfactory. The residuals are not autocorrelated and the ARCH effect is clearly observed only in eq. 4 (UK). There is excess kurtosis and slight skewness to the left, especially in eq. 2, 4 and 5, and the Jarque-Pera test indicates that the residuals for these equations are clearly not normally distributed.[12] This is not surprising recalling that the purpose of the German, UK and US stock returns were to explain the return behavior in Finland and Sweden

[10] We estimated model (6) also by adding monthly centered seasonals. They did not generally produce high t-values. However, the German stock market turned out to be the only one to have a statistically significant t-value (2.9 at lag one) in the VAR model for Finnish returns. The US stock market lost its leading ability for Swedish returns. The univariate residual statistics were somewhat better for Finland but worse for Sweden. The short-term dynamics are presented in Appendix 3. Detailed results are available from the author on request.

[11] The corresponding analysis of the stock indices in the excess short term money market rate gave results very similar to those in table 6.

[12] Box-Pierce Q-statistic is distributed as $\chi^2(47)/44$, ARCH test as $\chi^2(3)$ and Jarque-Bera test statistics for normality $\chi^2(2)$.

Table 6. **Maximum likelihood estimates for the restricted model based on one cointegration vector (r=1), local currencies**

Short-term relations (Γ_1 and Γ_2 matrices and t-values for the estimates)

	Lag 1					Lag 2				
	FIN	GER	SWE	UK	USA	FIN	GER	SWE	UK	USA
FIN	.156	.222	.066	–.163	.105	.012	.034	.086	–.069	.011
(t)	(2.0)	(2.9)	(1.0)	(2.6)	(2.0)	(.2)	(.7)	(1.8)	(.9)	(.1)
GER	.021	–.264	.005	–.085	.164	.030	–.037	.175	.160	–.134
(t)	(.2)	(2.6)	(.1)	(1.0)	(2.3)	(.4)	(.6)	(2.7)	(1.7)	(1.4)
SWE	.022	.040	.016	–.018	.113	–.007	–.045	.065	.230	–.132
(t)	(.2)	(.3)	(.2)	(.2)	(1.3)	(.1)	(.6)	(.8)	(1.9)	(1.1)
UK	.171	–.102	–.081	.094	–.038	–.107	.171	–.032	.033	.037
(t)	(1.2)	(.7)	(.7)	(.8)	(.4)	(1.1)	(1.9)	(.4)	(.2)	(.3)
USA	.021	–.102	–.101	.082	.092	–.093	.078	.061	–.013	–.087
(t)	(.2)	(1.0)	(1.2)	(1.0)	(1.3)	(1.3)	(1.2)	(.9)	(.1)	(.9)

Long-term relations (PI-matrix and its std. dev.)

FIN	–.007	.018	.004	–.044	–.005
(σ)	.004	.010	.002	.025	.003
GER	–.019	.048	.011	–.114	–.014
(σ)	.006	.014	.003	.033	.004
SWE	–.015	.037	.008	–.089	–.011
(σ)	.007	.017	.004	.042	.005
UK	–.040	.100	.022	–.239	–.029
(σ)	.008	.019	.004	.047	.006
USA	–.018	.046	.010	–.111	–.013
(σ)	.005	.014	.003	.033	.004

Coefficients for the constant and trend

Constant	.149	.395	.307	.831	.380
(t)	(1.6)	(3.3)	(2.0)	(5.0)	(3.2)
Trend	.001	.002	.001	.003	.002
(t)	(1.8)	(3.4)	(2.2)	(4.9)	(3.4)

Table 7. **Misspecification tests for the model**

Autocovariance/correlation matrix of the residuals

.001195				
.110115	.002101			
.306551	.270815	.003277		
.121483	.391312	.397623	.004092	
.147598	.375645	.409087	.551412	.002055

Univariate analysis of the residuals (Pox-Pierce Q, ARCH, skewness, excess kurtosis and Jarque-Pera tests)

B–P.Q(47)/44	ARCH(3)	SKEW.	EX.KURT.	J–B.NORM.
.929	8.168	–.072	1.525	18.485
1.067	5.911	–.639	2.400	58.189
.622	9.773	–.094	.620	3.311
1.034	25.649	–.254	3.822	117.075
.731	1.698	–.594	2.747	70.533

Autocorrelation; 2*(1/SQRT(T)) = .14548, lag 1–8

–.017	–.037	.059	–.009	.037	–.071	.116	.030
–.011	.001	.038	–.105	–.075	–.067	–.051	.061
.006	–.023	.095	.081	–.000	–.003	–.021	–.129
.032	–.086	.117	–.011	–.177	–.065	–.029	–.116
–.005	–.026	.006	–.053	.112	–.054	–.079	–.067

and not vice versa.[13] Actually, the statistics indicate that we would need additional lags or variables if we wanted to model non-Nordic stock returns. However, the deviations from normality are mainly due to the excess kurtosis, which is not a serious problem. Excess kurtosis means in practice that we will reject the null hypothesis too often. This implies that we could accept even lower t-values than 1.96 at the 5 per cent level of risk. On the other hand, t-values of size 2.0 can be taken to imply a rejection, which implies lower than 5 per cent probability of false rejection.

[13] The above non-normality of the residuals is not a serious problem. Actually, the excess kurtosis is very small. Negative skewness indicates that we have too few positive error terms, which means that we will reject the null hypothesis too often at a given level of risk. Therefore, the t-value of 2.0 implies that the risk that we falsely reject the null hypothesis is smaller than 5 %, but we do not now how much smaller. However, this is not a serious problem.

Table 8. **Test for some known parameters in the cointegration vector beta**

	Beta
FIN	.0
GER	1.0
SWE	.0
UK	−1.0
USA	−1.0

We carried out some restriction tests for the beta vector, presented in table 5. We restricted the Finnish and Swedish stock markets to have no impact in the cointegration relation and the other stock markets to have a coefficient of 1 or −1 (see Table 8). We were not able to reject the null hypothesis. The probability that it is false to reject the null hypothesis was as high as .58. This implies that the Finnish and Swedish stock markets may deviate from the equilibrium path without having a statistically significant impact on the three other markets. The reverse does not necessarily hold.[14] The short-term dynamics conditional to the restricted beta vector were almost identical to those presented in Table 6.

4.3.2 Indices in U.S. Dollars

We repeated the above analysis on the stock market indices transformed into the US dollars. Table 9 gives the results. The maximal eigenvalue and trace tests for the cointegration rank imply that the indices share two cointegration vectors. One can argue that the second cointegration vector appeared due to the transformation of the indices and thus reflects the impact of fluctuations in the value of the US dollar. The second cointegration vector seems to have the greatest impact on Finnish, Swedish and US stock prices. The speed of adjustment towards the equilibrium is fastest in the US and Finland. The relatively high speed of adjustment in Finnish stock prices is reasonable if the second cointegration vector reflects the common impact of changes in the value of the US dollar, since the US dollar is the dominant currency in Finnish foreign trade. The corresponding currency in Swedish foreign trade is the Swedish krona (SEK). Therefore, it would be reasonable for the Swedish stock market not to have a large alfa coefficient for the cointegration vector 2.

Our results are slightly different from those of Kasa (1992). He did not find a single cointegration vector in monthly real stock market indices. However, he included the stock markets of Japan and Canada, instead of Finland and Sweden,

[14] The German, the UK and/or the US stock markets are likely to be weakly exogenous in the cointegration relation implying the direction of causality from these countries to Finland and Sweden. Examples of these tests are provided in Johansen and Juselius (1991). We do not test for weak exogeneity since we assume that all stock indices are dependent variables and thus included also in the analysis of short-term effects. However, these tests are a topic for further research.

Table 9. **Maximum likelihood estimates for the restricted model based on two cointegration vectors (r=2), indices in USD**

Eigenvalues	.159	.119	.060	.038	.007
Lambdamax	32.688	23.848	11.599	7.234	1.404
Tracetest	76.773	44.086	20.237	8.638	1.404

The two stationary cointegration vectors and their weights[a]

Beta 1	1.000	1.572	−1.576	−3.957	.495
Alfa 1	.008	.041	.017	.066	.021
Beta 2	1.000	−.831	−1.866	−.873	4.025
Alfa 2	−.025	.006	.003	−.010	−.038

Short-term relations (Γ_1 and Γ_2 matrices and t-values for the estimates)[a]

	Lag 1					Lag 2				
	FIN	GER	SWE	UK	USA	FIN	GER	SWE	UK	USA
FINUSD	.044	.194	.053	−.053	.077	.011	−.043	.043	.018	−.001
(t)	(.5)	(2.3)	(.8)	(.8)	(1.2)	(.2)	(.2)	(.8)	(.2)	(.0)
GERUSD	−.141	−.208	−.069	.031	.249	.131	−.081	.152	.147	−.250
(t)	(1.3)	(1.9)	(.8)	(.4)	(2.9)	(1.6)	(1.2)	(2.2)	(1.3)	(2.2)
SWEUSD	−.007	.022	.030	.051	.043	.024	−.093	.018	.283	−.192
(t)	(.1)	(.2)	(.3)	(.5)	(.5)	(.3)	(1.2)	(.2)	(2.3)	(1.6)
UKUSD	.066	.008	−.136	.165	.048	−.020	.152	−.031	.032	−.041
(t)	(.5)	(.1)	(1.2)	(1.5)	(.4)	(.2)	(1.7)	(1.7)	(.2)	(.3)
USAUSD	−.028	−.166	−.081	.097	.096	−.045	.023	.026	.048	−.075
(t)	(.3)	(1.9)	(1.1)	(1.4)	(1.4)	(.7)	(.4)	(.5)	(.5)	(.8)

Univariate analysis of the residuals (Pox-Pierce Q, ARCH, skewness, excess kurtosis and Jarque-Pera tests)

B–P.Q(47)/44	ARCH(3)	SKEW.	EX.KURT.	J–B.NORM.
.838	3.472	.186	.757	5.597
.815	5.032	−.270	1.009	10.310
.901	.777	−.154	−.081	.798
.880	23.717	−.087	2.195	38.168
.704	.873	−.621	2.895	78.152

[a] The restricted matrices based on 2 co-int. vectors

in his study and reported his results for 2 lags in the model specification instead of 3 as employed here. Kasa analysed mainly higher order VAR models including 10–15 lags (10 lags in quarterly models). We found in our misspecification tests of the alternative models on monthly data that lag length 3 already produces some signs of overparameterization in the residual sum of squares.

The short-run dynamics of returns in US dollar forms are slightly different from those found in the previous section. The Finnish stock market is now led only by the German market at lag 1. The German market is caused by the US market at lags 1 and 2 and by the Swedish market at lag 2. The UK stock market has a clear leading ability at lag 2 for the Swedish market. Somewhat surprisingly, the t-value for the German stock market to Granger cause the US market at lag 1 is as high as 1.9. The corresponding t-value is 2.2 when the corresponding analysis is carried out with excess indices, which indicates that the German stock market really is able to lead the US market, at least in this data set.

Univariate misspecification analysis shows that the residuals are more normally distributed in the U.S. dollar data than in local currency data. Defined non-normality is mainly due to excess kurtosis and is therefore not a serious problem.

4.3.3 Indices in Finnish Markkas

We transformed the data into Finnish markkas and did the above analysis once again (see Table 10). We find in the Table 10 that the results are very similar to those for the returns in local currencies. There is again only one cointegration vector among the stock market indices, although the speed of adjustment towards the equilibrium is now somewhat slower. The short-run dynamics are also very similar to those reported in subsection 4.3.1. The leading abilities of the UK stock market for the Finnish market, the US market for the German market and the German market for the UK market are now somewhat stronger. The UK stock market returns are no longer able to predict the Swedish returns. However, analysis with the indices in excess short term Finnish money market rate indicates that the Swedish stock market is led by the UK market. The similarity of the empirical results found in the analysis with indices in local currences and in Finnish markkas indicates that the Finnish currency market cointains almost no relevant information for stock market investors, which is intuitively realistic.

Table 10. **Maximum likelihood estimates for the restricted model based on one cointegration vector (r=1), indices in FIM**

Eigenvalues	.153	.084	.064	.037	.022
Lambdamax	31.393	16.585	12.520	7.134	4.151
Tracetest	71.782	40.389	23.805	11.285	4.151

The stationary cointegration vector and its weight[a]

BETA	1.000	.831	−2.624	−6.200	4.077
ALFA	−.003	.020	.009	.041	.003

Short-term relations (Γ_1 and Γ_2 matrices and t-values for the estimates)[a]

	Lag 1					Lag 2				
	FIN	GER	SWE	UK	USA	FIN	GER	SWE	UK	USA
FINFIM	.142	.206	.091	−.102	.108	.012	.028	.060	−.116	−.030
(t)	(1.8)	(2.7)	(1.6)	(1.8)	(2.0)	(.2)	(.6)	(1.4)	(1.9)	(.5)
GERFIM	.011	−.276	.008	−.045	.239	.097	−.031	.133	.065	−.176
(t)	(.1)	(2.5)	(.1)	(.6)	(3.1)	(1.3)	(.5)	(2.1)	(.8)	(2.0)
SWEFIM	.078	.048	.067	−.018	.053	.025	−.024	.014	.158	−.105
(t)	(.6)	(.4)	(.7)	(.2)	(.6)	(.3)	(.3)	(.2)	(1.5)	(1.0)
UKFIM	.260	.003	−.046	.111	.063	−.054	.236	−.005	−.142	−.086
(t)	(1.7)	(.0)	(.4)	(1.0)	(.6)	(.5)	(2.7)	(.1)	(1.2)	(.7)
USAFIM	.070	−.118	−.035	.042	.118	−.049	.092	.024	−.091	−.015
(t)	(.6)	(1.0)	(.4)	(.5)	(1.4)	(.6)	(1.4)	(.3)	(1.0)	(.2)

Univariate analysis of the residuals (Pox-Pierce Q, ARCH, skewness, excess kurtosis and Jarque-Pera tests)

B–P.Q(47)/44	ARCH(3)	SKEW.	EX.KURT.	J–B.NORM.
.914	6.999	−.123	1.371	15.274
.984	6.378	−.514	1.731	31.924
.786	6.578	−.302	.752	7.334
.997	13.245	−.360	3.512	101.183
.758	1.127	−.588	4.747	188.327

[a]The restricted matrices based on 1 co-int. vectors

5 Conclusions

This paper analyses interdependencies among the stock markets in the United States, the United Kindom, Germany, Sweden and Finland, examining their cointegration and order of integration. The former three nations are the biggest trading partners of the two small open Nordic economies, Finland and Sweden. We started by considering unrestricted VAR models for each country in order to carry out traditional Granger causality tests. We also employed the VAR models under the assuption of multivariate cointegration, first introduced in Johansen (1988), in order to analyze the hypothetical long-run relations and short-term dynamics simultaneously, thus using all the information contained in the data. In this approach, the short-term causalities are analysed conditional to the long-term relations. The data studied include end-of-month observations from 1974–1989. All the tests were computed over the variables denominated in (a) local currencies, (b) US dollars and (c) Finnish markkas, in both nominal and excess forms.

Our multivariate cointegration analysis suggested that the stock markets studied here are cointegrated having one cointegration vector when prices are measured in local currencies or in Finnish markkas and two cointegration vectors when prices are in US dollars. This implies that the stock markets studied have a long-run steady-state relationship and can not drift too far from the equilibrium path. On the other hand, we found that the Finnish and Swedish stock markets may deviate from the equilibrium path without having a significant impact on the three other markets, which indicates that the direction of causality is from other stock markets to Finland and Sweden. The order of cointegration implies that there are several common stochastic trends driving national stock market prices. We suggest that the economic forces behind a trend could be, for instance, expectations regarding the future state of the world economy and the value of the US dollar.

Our results from Granger causality analysis indicate that the US and UK stock markets are fully integrated. This implies that risk adjusted stock returns are equal in these countries in the numeraire currency. However, we were able to predict the Finnish, German and Swedish stock market returns with the US and UK returns. To be more specific, the Finnish stock market was Granger caused by the German and UK stock markets, the Swedish stock market by the UK market and the German stock market by the US market. This implies that Finnish, Swedish and German stock markets are not fully integrated with the bigger stock markets included in the study. The leading ability of the German and UK markets for the Finnish market can be considered reasonable since these nations are among the biggest trading partners of Finland. The United States and United Kindom are also among the biggest trading partners of Sweden and Germany.

It seems that stock returns in smaller markets do not adjust instantaneously to new information. However, this does not necessarily indicate market inefficiency, since abnormally high returns are not necessarily earned. The poor rate of integration of the Finnish and Swedish stock markets may be due to significant restrictions on portfolio investments of foreign investors in the period studied. Furthermore, the market capitalization of these markets, as well as of the German stock market, has been relatively small and trading has been relatively modest most of the time, which typically implies nonsynchronous trading.

Our results from Granger causality analysis contradict the prior understanding that the Swedish stock market index leads the Finnish one. This contradiction may be due to the more efficient estimation technique used here and to the fact that we included stock market indices of Germany, the United Kingdom and the United States, which are likely to explain index returns in Sweden as well as in Finland. Another explanation for the contradiction may be the fact that the construction of the data differs between these studies. The end-of-month returns are used here for all the countries, whereas rather mixed data was used in earlier studies. The number of relevant lags was also found to be considerably smaller in our study. We also found that the Swedish stock market is Granger caused by the UK market instead of the US market, as suggested earlier. This contradiction may be simply due to the data differences, as earlier results were computed in daily data from 1988–April 1990.

This study could be extended in further research, for instance, by analysing whether the low rate of integration found here could be used in trading to earn abnormally high returns on stock market index futures. We would also expect that the causal relations found here could be found in the Asian stock markets as well.

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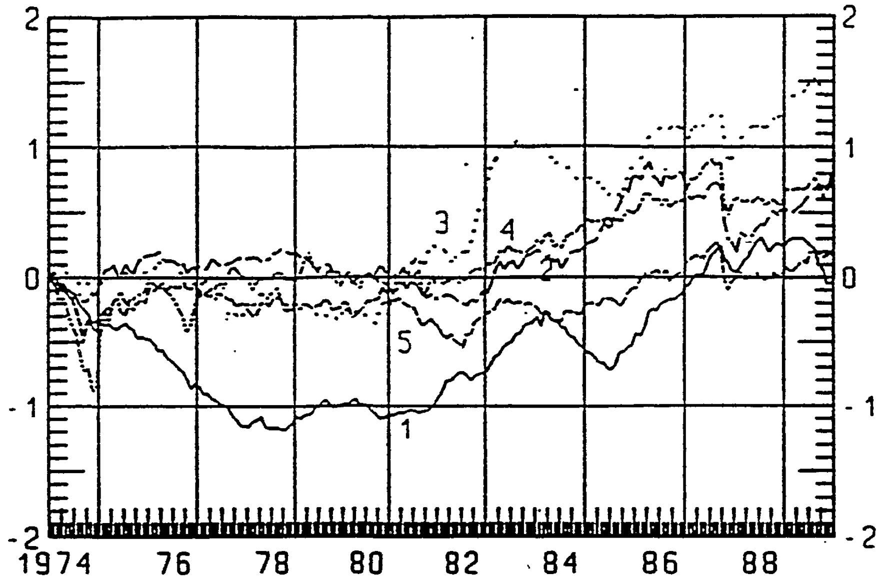
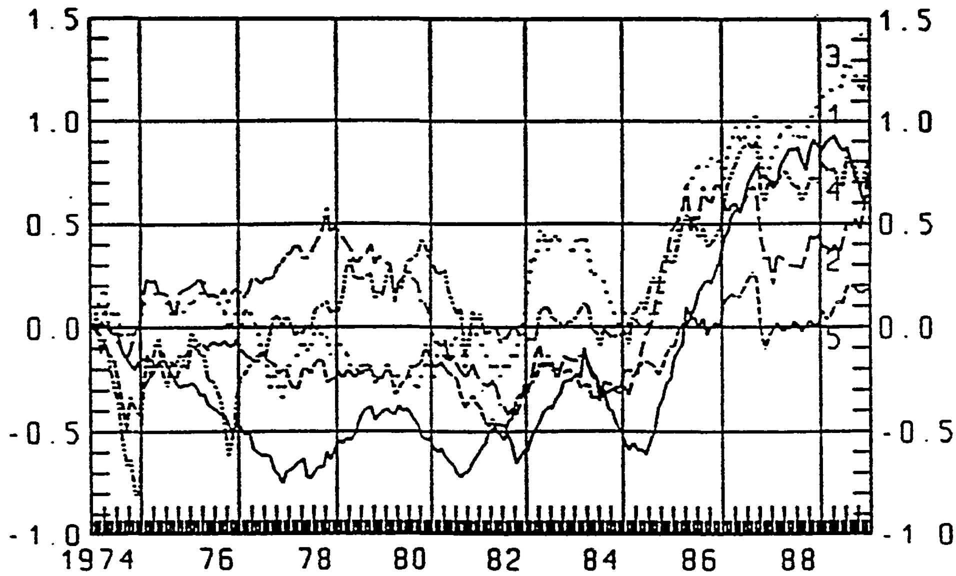
Appendix 1 **Logarithmic stock market indices in excess short-term money market rate, alternative currencies**

Figure 1 **Indices in excess local money market rates, local currencies**



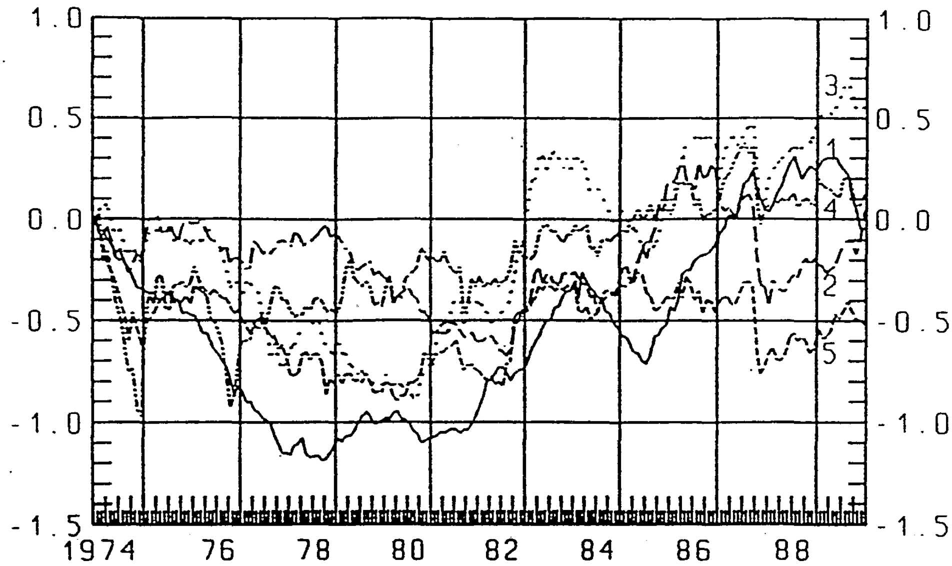
1 Finland
2 Germany
3 Sweden
4 The United Kingdom
5 The United States

Figure 2 **Indices in excess US money market rate, US dollars**



1 Finland
2 Germany
3 Sweden
4 The United Kingdom
5 The United States

Figure 3 **Indices in excess Finnish money market rate, Finnish markkas**



1 Finland
2 Germany
3 Sweden
4 The United Kingdom
5 The United States

Appendix 2A **VAR estimation for the excess stock returns in local currencies, 1974–1989**

Variable	FIN[a]	GER[a]	SWE[a]	UK[a]	USA[a]
FINE	0.000	0.032	0.150	0.359	0.700
GERE	0.045	0.758	0.106	0.091	0.074
SWEE	0.739	0.872	0.487	0.579	0.069
UKE	0.539	0.167	0.443	0.253	0.966
USAE	0.688	0.185	0.184	0.840	0.751

[a] Marginal significance of F-test (P(F-test)) for retained regressors by nation.

Appendix 2B **VAR estimation for the stock market returns in US dollars, 1974–1989**

Variable	FIN[a]	GER[a]	SWE[a]	UK[a]	USA[a]
FIN	0.004	0.461	0.428	0.601	0.970
GER	0.069	0.247	0.171	0.066	0.020
SWE	0.885	0.486	0.990	0.236	0.008
UK	0.798	0.010	0.326	0.350	0.872
USA	0.491	0.113	0.236	0.876	0.518

[a] Marginal significance of F-test (P(F-test)) for retained regressors by nation.

Appendix 2C **VAR estimation for stock market returns in finnish Markkas, 1974–1989**

Variablea	FIN[a]	GER[a]	SWE[a]	UK[a]	USA[a]
FIN	0.000	0.055	0.226	0.473	0.684
GER	0.009	0.883	0.042	0.260	0.173
SWE	0.727	0.779	0.915	0.662	0.035
UK	0.385	0.210	0.251	0.118	0.862
USA	0.591	0.144	0.272	0.905	0.540

[a] Marginal significance of F-test (P(F-test)) for retained regressors by nation.

Appendix 3 **Short-run dynamics when 11 seasonal dummies are added to the model, k=3, local currencies**

	Lag 1					Lag 2				
	FIN	GER	SWE	UK	USA	FIN	GER	SWE	UK	USA
FIN	.142	.230	.077	–.113	.101	.017	.036	.057	–.076	–.009
(t)	(1.8)	(2.9)	(1.2)	(1.8)	(1.8)	(.3)	(.7)	(1.1)	(1.0)	(.1)
GER	–.017	–.273	.012	–.083	.183	.015	–.032	.158	.151	–.115
(t)	(.2)	(2.6)	(.1)	(.9)	(2.4)	(.2)	(.5)	(2.3)	(1.5)	(1.1)
SWE	–.064	.083	.047	.078	.122	–.008	–.084	.024	.209	–.156
(t)	(.5)	(.6)	(.4)	(.7)	(1.3)	(.1)	(1.0)	(.3)	(1.7)	(1.3)
UK	–.014	–.086	–.066	.166	–.086	–.133	.119	–.086	.107	.038
(t)	(.1)	(.6)	(.6)	(1.4)	(.9)	(1.3)	(1.3)	(.9)	(.8)	(.3)
USA	–.035	–.114	–.118	.075	.082	–.079	.095	.038	.016	–.076
(t)	(.3)	(1.1)	(1.4)	(.9)	(1.1)	(1.1)	(1.4)	(.6)	(.2)	(.8)

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