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FOREIGN EXCHANGE ISSUES, CAPITAL MARKETS, AND INTERNATIONAL BANKING IN THE 1990s

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Chapter 10

International Co-movements of Capital Markets: Evidence from Two Scandinavian Stock Markets

Teppo Martikainen, Ilkka Virtanen, and Paavo Yli-Olli

International asset pricing and portfolio diversification have reached increasing attention in the empirical research of finance. This is because most of the national capital markets have experienced rapid deregulation and integration in recent years. This development has enhanced the efficiency in the international allocation of capital. Numerous studies have investigated relationships between the average returns of different stock markets. In an early paper, Makridakis and Wheelwright (1974) investigated the short-term stability of the relationships between 14 stock market indices and reported that the co-movements of international stock exchanges seem to be random processes. Similar conclusions have been drawn by Hilliard (1979). However, most studies provide results suggesting a higher level of stability and stronger co-movements of international stock markets (see, for example, Ibbotson et al., 1982; Philippatos et al., 1989; von Furstenberg and Jeon, 1989; Meric and Meric, 1989; Grinold et al., 1989; Jeon and von Furstenberg, 1990; Malkamäki et al., 1991).

In the context of the international CAPM, a typical approach has been to study the sensitivities of individual assets to a worldwide market portfolio (for a test based on the consumption CAPM, see Wheatley, 1988). As suggested by Solnik (1977), an efficient way to test for market segmentation and integration would be to specify the type of imperfection that might create it and to study its specific impact on portfolio optimality and asset pricing. Assuming this specific imperfection to be due to the inability of a group of investors to trade in a subset of securities as a result of portfolio restrictions imposed by some governments, Errunza and Losq (1985) defined the conditional market risk based on return behavior of different stock markets. Some empirical evidence of mild segmentation of the world's capital markets was reported. Their results were further extended by Bradfield (1990) for South African markets. He found that a large proportion of shares in the Johannesburg Stock Exchange appeared to be influenced by the movements in the New York Stock Exchange, but only a small proportion of stocks were influenced by the U.K. and Japanese stock markets. In general, the proposed multimarket model seemed to provide useful information about the risk characteristics of individual South African stocks. Hietala (1988) reported relatively low betas for Finnish securities with respect to a worldwide market portfolio. Recently, Martikainen et al. (1991) found that Finnish securities have significant Swedish risk components, whereas the association between Finnish and U.S. returns was weaker. A significant part of the cross-sectional variation of the international risk components of the investigated Finnish companies could be attributed to industry differences across the investigated firms. An analysis of the underlying restrictive assumptions in this model is offered by Gultekin et al. (1989).

In addition to the international market models, the usefulness of the international Arbitrage Pricing Model (APM) by Solnik (1983) has also been researched intensively. Cho et al. (1986) studied the existence of international common factors in the APM using interbattery factor analysis. Their results indicated that the number of common factors between a pair of countries ranged from one to five, depending on the level of their economic integration. Recently, Yli-Olli et al. (1990) investigated the common factors in the Finnish and Swedish stock markets. They found two or three stable factors generating stock returns in these two neighboring countries. Their results were further extended by Booth et al. (1991), who reported that two of these Scandinavian factors could be regarded as worldwide in nature, being important in the U.S. stock market as well.

THE PURPOSE AND STRUCTURE OF THE STUDY

This study investigates the level of segmentation of the Finnish stock market to the Swedish stock market using the multimarket model suggested by Errunza and Losq (1985). Due to the rapid deregulation of the Finnish stock market, this is an important task to carry out. In Finland the relative importance of other stock markets in generating the risk characteristics of listed firms may be especially high because of thin trading in the Helsinki Stock Exchange, and because of the considerably increased direct investments of Finnish companies abroad. As an open country that carries on foreign trade to a great extent, Finland is highly dependent on the overseas establishment and macroeconomic conditions. On the other hand, the Finnish stock market has generally been regarded as being very different than the major exchanges of the United States, Japan, and Western Europe. It is a very small market composed of generally thinly traded stocks. This thin trading may lead to significantly biased market-based estimates of systematic risk (see, for example, Berglund et al., 1989). In this context, the use of Swedish data, where the trading is clearly more frequent by nature, might be useful when measuring the systematic risk of Finnish securities. In addition, it has been suggested that efficiency of the Finnish stock market is not especially high (see, for example, Virtanen and Yli-Olli, 1987 and Booth et al., 1992). This being the case, the return behavior of the Finnish stock market may be very different from that of the more developed stock markets (compare Mathur and Subrahmanyam, 1991).

In addition, we investigated whether the risk components obtained by the multimarket model contain incremental information with respect to the systematic risk components obtained by the APM. Chen (1983) discovered that the CAPM based on national systematic risk estimates did not produce incremental information with respect to the APM systematic risk components on the U.S. stock market. His results were strongly supported by Östermark (1989), who used a somewhat similar approach on Finnish and Swedish stock markets. This chapter extends these two studies by investigating a two-factor CAPM, where the risk components are produced by market returns of two neighboring capital markets.

METHODOLOGY

The traditional equilibrium model presented in finance literature, the Capital Asset Pricing Model (CAPM), assumes that the expected return of a stock is linearly related to its systematic risk, where the systematic risk of the security is defined to be the covariance of the asset return with the return of the market portfolio divided by the variance of the market portfolio return. Traditionally, betas have been measured using a simple bivariate regression, that is, Sharpe's (1964) market model:

$$\underline{R}_i = \text{Á}_i + \text{Ã}_i\underline{R}_m + \underline{\text{Ÿ}}_i \tag{1}$$

where random variables are denoted by underlining the symbols of the variables. In the above model, $\underline{R}_i$ represents the return of security *i*, Á_i is the intercept term for a security *i*, Ã_i is the measure for systematic risk, beta, of a security *i*, $\underline{R}_m$ is a return of a national stock market index, and $\underline{\text{Ÿ}}_i$ is the idiosyncratic risk of security *i*. Thus, the model assumes that the return of an individual stock is a function of the return of the national stock market.

To investigate the Swedish risk components of Finnish securities, a multimarket model in the spirit of Errunza and Losq (1985) is used in this chapter. To obtain tractable expressions for the risk components of individual assets' Finnish market risk, Swedish market risk, and idiosyncratic risk, the vectors of returns of Finnish and Swedish markets are orthogonalized. Here this means removing the effect of a Swedish index from the index describing the behavior of the Finnish stock market, which can be done by using the following simple bivariate regression:

$$\underline{R}_m(\text{FIN}) = \text{Á} + \text{Ã}\underline{R}_m(\text{SWE}) + \underline{\text{Ÿ}} \tag{2}$$

where $\underline{R}_m$(SWE) represent the returns of the Swedish market, and $\underline{R}_m$(FIN) the return of the Finnish market. The residual term $\underline{\ddot{Y}}$ is the part of the Finnish returns with Swedish returns removed. In the following, let us note the residual term in Eq. (2) with $\underline{R}_m$(FIN − SWE). The multimarket model can now be expressed as

$$\underline{R}_i = \acute{A}_i + \tilde{A}_{1i}\underline{R}_m(\mathrm{SWE}) + \tilde{A}_{2i}\underline{R}_m(\mathrm{FIN} - \mathrm{SWE}) + \underline{\ddot{Y}}_i \tag{3}$$

In the following, the above model is referred to as the Scandinavian market model for Finnish securities. The components of risk for a security i can be obtained considering the expression for the variance of the returns of a security i:

$$\mathrm{Var}(\underline{R}_i) = \tilde{A}_{1i}^2\mathrm{Var}[\underline{R}_m(\mathrm{SWE})] + \tilde{A}_{2i}^2\mathrm{Var}[\underline{R}_m(\mathrm{FIN} - \mathrm{SWE})] + \mathrm{Var}(\underline{\ddot{Y}}_i) \tag{4}$$

The multimarket model makes it possible to investigate the level of segmentation across the two Scandinavian stock markets in terms of individual securities. First, assume the Finnish and Swedish markets to be totally integrated. The second term in Eq. (3), $\tilde{A}_{2i}\underline{R}_m$(FIN − SWE), does not produce significant incremental information with respect to the first term, $\tilde{A}_{1i}\underline{R}_m$(SWE), when the returns of individual assets are investigated. Making an assumption concerning partial segmentation across the two investigated markets, both of the two terms should be significant in the return-generating process of individual assets.

In addition to testing the applicability of the multimarket model, its incremental significance with respect to the asset sensitivities obtained by testing the APM is investigated in this study. The APM, originally formulated by Ross (1976), predicts that on the perfectly competitive and frictionless stock markets the stock return is a linear function of a certain number, say k, economic factors (see Roll and Ross, 1980, pp. 1076–1082). To test the arbitrage pricing theory, two main alternative approaches have been presented. The first is used to estimate the unknown factors and asset sensitivities to these factors simultaneously by factor analysis. Without theory, a decision on how many factors to extract from the data must be made subjectively or by statistical criteria. When the systematic components of the risk are obtained, the risk premia are then estimated using cross-sectional regressions. The second approach tries to specify a priori, on the basis of the theory, the general factors that explain pricing in the stock market (see, for example, Chen et al., 1986 and Martikainen and Yli-Olli, 1990 on Scandinavian data). In this approach, time-series regressions are run for each series of stocks (portfolios) to estimate each stock's (portfolio's) sensitivities to macroeconomic variables. Then the risk premia are estimated by running cross-sectional regressions.

In this study the exploratory factor analysis approach is used to estimate the APM's unknown factors and asset sensitivities to these factors. In the first stage, the following factor analysis model is estimated:

$$\underline{R}_i = E(\underline{R}_i) + b_{i1}\underline{F}_1 + b_{i2}\underline{F}_2 + \cdots + b_{ik}\underline{F}_k + e_i \qquad (5)$$

where $E(\underline{R}_i)$, $i = 1, 2, \ldots, n$, is the expected return of the stock i; $\underline{F}_j$, $j = 1, 2, \ldots, k$, are unobserved economic factors; b_{ij} is the sensitivity of the security i to the economic factor j; and $\underline{e}_i$ are the idiosyncratic risks of the stocks. Ross (1976) has shown that if the number of stocks is sufficiently large, a linear risk-return relationship between expected returns and asset sensitivities can be written. In this study, the risk-return relationship is tested using the following ordinary least squares (OLS) regression:

$$E(\underline{R}) = \lambda_0 + \lambda_1\underline{b}_1 + \lambda_2\underline{b}_2 + \cdots + \lambda_k\underline{b}_k + \underline{\grave{I}} \qquad (6)$$

where λ_0 is a constant riskless rate of return (the common return on all zero-beta stocks) and λ_j, $j = 1, 2, \ldots, k$, represents, in equilibrium, the risk premium for the jth factor.

In the next stage, the part of expected returns unexplained by the APM risk components, that is, $\underline{\grave{I}}$, is explained by the risk components produced by the Scandinavian market model. Thus, the following cross-sectional regression is finally run:

$$\underline{\grave{I}} = \gamma_0 + \gamma_1\underline{\tilde{A}}_1 + \gamma_2\underline{\tilde{A}}_2 + \underline{\grave{I}}' \qquad (7)$$

where $\underline{\grave{I}}$ is the residual term from regression (6), that is, the part of expected returns not explained by the APM systematic risk components; $\underline{\tilde{A}}_1$ represents the Swedish risk component of the Scandinavian market model in (3), and $\underline{\tilde{A}}_2$ is the Finnish risk component of the Scandinavian market model, after first controlling for the average returns of the Swedish stock market. Thus, the main focus in estimating (7) is to discover whether the risk components produced by the Scandinavian market model offer incremental information content with respect to the APM systematic risk components in explaining the cross-sectional variation of expected stock returns.

THE DATA

Monthly stock returns from the Helsinki Stock Exchange for January 1980 to December 1986 are used in this study. These individual asset returns are collected from a data base originally introduced by Berglund, Wahlroos, and Grandell (1983). This study's sample consists of 28 firms that have had their ordinary shares listed for the entire research period. The price indices used in the study are closing values for each month. The prices are corrected for splits, new issues, etc., assuming that dividends are reinvested with zero transaction cost. The returns for each month are determined as first differences of the natural logarithms of these price indices. The market index in use for the Helsinki Stock Exchange is the value-weighted market index collected from the same data base. For Swedish returns, a market index published by a Swedish journal, *Affarsvärlden,* is in use.

A TEST OF THE SCANDINAVIAN MARKET MODEL ON FINNISH SECURITIES

To obtain some preliminary evidence on the relationships of the returns on the investigated stock markets, the following time-series OLS regressions between the market returns are first run:

$$R_{mt}(\text{FIN}) = \text{Á} + \text{Ã}R_{mt}(\text{SWE}) + \text{Ÿ}_t \tag{8}$$

$$R_{mt}(\text{FIN}) = \text{Á} + \text{Ã}R_{mt-1}(\text{SWE}) + \text{Ÿ}_t \tag{9}$$

Table 1 presents the results of these regression analyses. The two markets seem to be positively related to each other. The strongest relationship between the two markets is found in model (8), that is, between the Finnish and Swedish stock markets when the returns are measured from the same month.

To produce evidence on the appropriateness of the so-called multimarket model in Finland, a market model extended to the Swedish stock market is tested next. The nondiversifiable risk components of this model are presented in Table 2. The results of that table are based on the following model:

$$R_{it} = \text{Á}_i + \text{Ã}_{1i}R_{mt}(\text{SWE}) + \text{Ã}_{2i}R_{mt}(\text{FIN} - \text{SWE}) + \text{Ÿ}_{it} \tag{10}$$

where $\underline{R}_m(\text{SWE})$ represents the returns of the Swedish stock market, and $R_{mt}(\text{FIN} - \text{SWE})$ the return of the Finnish market orthogonalized with respect to the returns of the Swedish market, that is, the residual term from the regression $R_{mt}(\text{FIN}) = \text{Á} + \text{Ã}R_{mt}(\text{SWE}) + \text{Ÿ}_t$. Typically, when estimating betas, portfolios have been preferred to single securities. In this study, however, time series of single securities are used, due to the small number of listed securities in the Helsinki Stock Exchange.

Table 1
Regression Analysis Estimates of Market Returns
(*t* values in parentheses)

Model	Constant	Coefficients	R^2	F	
Eq. (8)	0.0156 (3.530)***	0.2250 (2.864)**	0.092	8.200**	$N = 83$
Eq. (9)	0.0167 (3.667)***	0.1852 (2.304)*	0.062	5.307*	$N = 82$

*Significant at .05 level, **significant at .01 level, ***significant at .001 level.

Table 2
Results of the Scandinavian Market Model and Traditional National Market Model (1) for Finnish Stocks

Firm	Sweden	Finland	Total	Traditional market model
Effoa	0.0011	0.0504	0.0515	0.0415**
Kesko	0.0674**	0.2081***	0.2755	0.2636***
Ford	0.0043	0.1137**	0.1180	0.0909***
Stockmann	0.0648*	0.1501***	0.2149	0.1992***
Talouskauppa	0.0036	0.0650*	0.0686	0.0682***
Tamro	0.0614*	0.0206	0.0819	0.0449**
Enso	0.0130	0.0614*	0.0743	0.0732***
Fiskars	0.0020	0.1768***	0.1787	0.1499***
Huhtamäki	0.0625**	0.3697***	0.4322	0.4293***
Instru	0.0352 +	0.2208***	0.2560	0.2547***
Kajaani	0.0790**	0.1992***	0.2783	0.2607***
Kemi	0.0042	0.0625*	0.0667	0.0666***
Kymi	0.0145	0.3031***	0.3176	0.3149***
Lassila	0.0209	0.0689*	0.0898	0.0864***
Lohja	0.0363*	0.4707***	0.5070	0.5063***
Nokia	0.0688**	0.4218***	0.4906	0.4878***
Otava	0.0016	0.0169	0.0184	0.0125
Partek	0.0656**	0.3346***	0.4002	0.3955***
Rauma	0.0203	0.3322***	0.3525	0.3510***
Rosenlew	0.0040	0.0809***	0.0849	0.0843***
Schauman	0.0270(−)	0.0653*	0.0923	0.0375*
Serla	0.0011	0.1791***	0.1802	0.1707***
Sokeri	0.0152 +	0.2277***	0.2549	0.2547***
Trikoo	0.0116	0.0550*	0.0667	0.0657***
Tamfelt	0.0049	0.0965**	0.1014	0.1007***
Tampella	0.0190	0.0487*	0.0677	0.0635***
Wärtsilä	0.1102***	0.3078***	0.4180	0.3961***
Yhtyneet	0.0927***	0.3159***	0.4086	0.3943***

Note. Systematic risk measures obtained by

$$\tilde{A}_{1i}^2 \mathrm{Var}[\underline{R}_m(\mathrm{SWE})]$$

and

$$\tilde{A}_{2i}^2 \mathrm{Var}[\underline{R}_m(\mathrm{FIN} - \mathrm{SWE})]$$

*Significant at .05 level; **significant at .01 level; ***significant at .001 level; +, significant at .10 level; (−), negative.

The first column in Table 2 presents the systematic risk components of securities (in percentage of the total risk associated with the variability of the returns of a security in question) appointed to the Swedish market index. For 12 securities the estimated beta coefficient for Swedish markets has been significantly different from zero. In only one case, Schauman, has beta been negative. Thus, the results clearly support the segmentation hypothesis of Finnish and Swedish security markets. Swedish risk components seem to be important in the return-generating process of Finnish stocks.

The second column in Table 2 contains information about the part of total risk associated with the general return of the Finnish market after first controlling for the behavior of the Swedish stock market. All of the estimated betas have expected positive signs, and almost all are statistically different from zero. These results give support to the so-called mild segmentation hypothesis. There seems to exist significant incremental information in Finnish market returns after removing the part associated with Swedish market returns.

A COMPARISON OF APM AND SCANDINAVIAN MARKET MODEL

In this section the empirical results of the APM and multimarket model are compared. Specifically, the incremental significance of the risk components produced by the multimarket model are compared to those of the APM. The next step in the empirical analysis is to test the APM using the factor analysis procedure to identify the number of factors affecting equilibrium returns. In earlier studies, this procedure has been problematic because the number of factors discovered depends, for example, on the size of the groups of securities one deals with. The estimation of factors can be carried out by different factor analytic methods. In this study, the initial factor extraction is carried out by the principal component method based on the covariance matrices of monthly stock returns; thereafter, a varimax rotation is applied.

In this study, two-, three-, and four-factor solutions were first derived for Finnish returns. The selection of these factor solutions was based on earlier findings by Yli-Olli et al. (1990) and Booth et al. (1991) indicating that no more than four common factors exist in the Finnish stock market. The cumulative proportions of total variance (of the unrotated factor patterns) are presented in Table 3. The figures of cumulative proportions in Table 3 reveal that the first factor accounts for 23.9% of the total variation of Finnish security returns during the research period, while 47% of this variation can be explained by the first four factors appearing in descending order of variance. The results are of about the same order as those reported by Yli-Olli et al. (1990). The slightly

Table 3
Cumulative Proportions of Total Variance Explained

Factor			
1	2	3	4
0.239	0.334	0.404	0.470

Table 4
Regression Analysis Estimates
(*t* values in parentheses)

Number of factors	Constant	Factor 1	2	3	4	R^2	F
2	0.0160	0.0069	0.0153	—	—	0.126	1.808
	(2.878)**	(0.724)	(1.870)+				
3	0.0161	0.0051	0.0173	0.0033	—	0.185	1.816
	(2.933)**	(0.581)	(2.179)*	(0.472)			
4	0.0153	0.0153	0.0062	0.0173	0.0038	0.217	1.590
	(2.119)*	(1.863)+	(0.685)	(2.089)*	(0.530)		

Note. Dependent variable: average monthly return for security; independent variables: factor loadings (k = 2–4).

*Significant at .05 level; **significant at .01 level; ***significant at .001 level; +, significant at .10 level.

higher cumulative proportions of total variance reported by Yli-Olli et al. may be due to the longer estimation period used in this chapter.

The following step involves examining the effect of factor loadings, that is, systematic risk components of the APM, on equilibrium returns. In cross sections the dependent variable is the monthly mean return and the independent variables are factor loadings from factor analysis. The risk-free rate of return is not restricted, but estimated from the stock returns, assuming the intercept term to represent this return. The OLS regression coefficients are the estimated risk premia. In factor analysis there is no absolute meaning to the signs of the parameters or the scaling of the factors; the signs of regression coefficients are also arbitrary. Therefore, only the statistical significance of regression coefficients is relevant, instead of their numerical values. The results of the cross-sectional test of the APM are presented in Table 4. The results in Table 4 support 1–2 priced factors in the APM in the Finnish stock market. However, the R^2 and F values of the regressions are low, indicating that a significant proportion of the cross-sectional variation of expected returns cannot be explained by the risk components of the APM.

Finally, to discover whether the risk components of the Scandinavian multimarket model offer incremental information with respect to the estimated APM risk components, the part of expected returns unexplained by the APM risk components, that is, the residual term of the c cross-sectional regressions shown in Table 4, is explained by the risk components produced by the Scandinavian market model. The results of this incremental information content analysis are reported in Table 5. The results in Table 5 are clear. The international risk components of the Scandinavian market model do not offer incremental information with respect to the APM risk components when explaining the

Table 5
Regressions Analysis Estimates
(t values in parentheses)

Number of factors in the APM	Constant	$\tilde{A}_{1i}\underline{R}_m$(FIN − SWE)	$\tilde{A}_{2i}\underline{R}_m$(SWE)	R^2	F
2	−0.0016	0.0036	−0.0065	0.022	0.275
	(−0.391)	(0.624)	(−0.673)		
3	−0.0007	0.0030	−0.0086	0.033	0.426
	(−0.188)	(0.540)	(−0.921)		
4	−0.0010	0.0025	−0.0051	0.013	0.168
	(−0.263)	(0.457)	(−0.545)		

Note. Dependent variable: residual term of the cross-sectional APM; independent variables: Scandinavian market model risk components.

*Significant at .05 level; **significant at .01 level; ***significant at .001 level; +, significant at .10 level.

cross-sectional variation of expected returns in the Finnish stock market. This can be seen from the statistically insignificant t values of the regression coefficients, and from the low R^2 and F values of the models.

CONCLUSIONS

This study focused on the level of segmentation of the Finnish stock markets to Swedish stock markets and was carried out by exploiting an internationally extended market model for Finnish stocks and the APM originally developed by Ross (1976). The multimarket model of Finnish securities revealed that several Finnish stocks have significant Swedish risk components. The results supported the mild-segmentation hypothesis of the two investigated Scandinavian stock markets.

When analyzing the incremental information of the Scandinavian market model risk components with respect to the APM, in explaining the cross-sectional variation of expected returns, the multimarket model parameters did not produce incremental information content. In this context, this chapter extends the earlier work by Chen (1983) and Östermark (1989), who discovered that traditional market model betas did not offer incremental information with respect to the systematic risk components of the Arbitrage Pricing Model.

Because of the recent deregulation and integration of the world's capital markets, the results obtained here should be applied to other stock markets as well. In addition, the effects of certain macroeconomic changes, such as inflation, demand for money, industrial production, and interest rates, should be considered in terms of the time-series variation of the systematic risk components of the multimarket model. Finally, the level of firm-specific characteristics, such as profitability, financial leverage, operating leverage, and growth, should be investigated with respect to the cross-sectional variation of the systematic risk components of the multimarket model, because these four components can be regarded as theoretical determinants of systematic risk (see, for example, Martikainen, 1992, and the literature cited therein).

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