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Conditional Risk and Predictability of Finnish Stock Returns

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Abstract

This paper studies the driving forces of predictable variation in Finnish stock returns. The dynamics of Ferson and Harvey's (1991) methodology are extended and applied within the Sharpe-Lintner CAPM. We find that market risk is conditionally priced in the thin Finnish stock market. Most of the predictable variation of stock returns is attributed to the time-varying risk premium, which supports the hypothesis of rational behavior by Finnish investors in setting stock prices. However, the conditional residual term accounted for a larger part of the predictable variation of the stock returns than is found in the US market.

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Contents

1 Introduction

The predictability of stock returns has been documented in several recent studies. Keim and Stambaugh (1986) reported this phenomenom first for US returns, and they were followed by Campbell (1987), Fama and French (1988), Poterba and Summers (1988) and others. Virtanen and Yli-Olli (1987) were the first to find return predictability in the Finnish stock market. Similar results were reported later, e.g. in Knif and Högholm (1991) and Malkamäki (1992c). There are two major explanations for this predictability. Either the market is inefficient or the required rate of return is changing over time. Both explanations have been supported by empirical evidence. If the asset pricing models provide a reasonable description of the expected returns of assets, then the predictable variation in the expected returns should be driven by variation in (1) risk exposures, i.e. the betas, (2) the price of beta, i.e. the risk premiums, and/or (3) the riskless rate of return.

Ferson and Harvey (FH) (1991) specify a list of risk factors similar to Chen, Ross and Roll (1986). However, FH focus on predictable variation in expected asset returns in order to analyse the relative importance of the above explanations (1) and (2) for predictability of US monthly portfolio returns. FH suggest that if the rational expectations hypothesis is true, then the expected returns implied by an asset pricing model should mimick the expected returns generated by the type of regression analysis that they employ in the study. If this holds, the predictable variation in the model's returns is driven by predictable variation in the betas, the price of betas or a combination of the two, i.e. if the predictable variation in the model's expected returns closely matches the predictable variation from the regression analysis in forecasting stock returns, then the rational expectations view is supported.

FH (1991) found that most of the predictability (some 81 %) is driven by changes in the expected betas and expected price of betas. They called what is left over "the part due to market inefficiency". This part was generally small (some 10 %). They also found that the primary source of predictability was the time variation in the expected risk premiums – not the betas. Interestingly, the market risk was only weakly priced on average, yet it was extremely important in accounting for variation in the predicted returns in the US stock portfolios.

Recent conditional tests of the Sharpe-Lintner CAPM with Finnish data suggest that market risk is rewarded in the Finnish stock market if the betas are allowed to vary through time according to a mean-reverting AR1 process (see Berglund and Knif (1992) and Malkamäki (1992a) and (1992b)). This provides motivation to replicate the study of FH (1991) to find out to what extent the Kalman filtered, conditional firm-specific betas and conditional market risk premium are able to explain the return predictability in the Finnish stock Market.

This paper aims to extend FH (1991) in four ways. Firstly, we replicate the FH (1991) study with greater dynamics in the parameter estimation for the CAPM, as the betas are allowed to vary through time according to a mean-reverting AR1 process. Secondly, we employ firm-specific betas and thus, in this sense, allow far more idiosyncratic variation in the betas. Thirdly, empirical analysis on the source of the predictable variation in the expected returns is carried out for a thin security market, i.e. the Finnish stock market. Moreover, the data employed here include the highly volatile years around the 1987 stock market crisis. Finally, we use stock returns in excess of the short-term money market rate (used for the first time in Malkamäki (1992c)) in analysing the predictability of Finnish returns.

This paper finds that most of the predictable variation is due to the time-varying risk parameters of the CAPM. Actually, almost none of the predictability was attributed to the betas. However, the conditional residual term mimics fairly well the predictable variation, suggesting that the inefficiency factor in the sense of FH (1991) is considerably larger for the Finnish stock market than for the US market. Our findings concerning the risk premium are very similar to those of FH, i.e. that the risk premium is conditionally time varying and that the conditional risk premium is the primarly source of predictability. Expectation concerning changes in the future order stock for Finnish industry and unexpected changes in inflation are found to capture the variation in the risk premium; and the unexpected changes in inflation, in combination with an instrument for the lagged influence of Finnish, German, Swedish, UK and US stock market returns on the Finnish market, are found to predict firm-specific excess returns fairly well.

The remainder of the paper is organized as follows. Section two discusses the methodologies employed. Section three describes the stock market data and conditioning variables. Empirical results are presented in next section, and section five concludes with the key findings of the paper.

2 Methodologies

2.1 Conditional Market Risk

The CAPM states that expected returns on an asset are linearly related to the systematic risk, which is measured by the asset's beta. The Sharpe-Lintner version of the model in excess-return form is:

$$E(r_i) = \beta_i E(r_m), \quad (1)$$

where $E(r_i)$ = expected excess return for security i

$\beta_i = \dfrac{\mathrm{cov}(r_i, r_m)}{\mathrm{var}(r_m)}$

$E(r_m)$ = expected excess return for the market.

Actually, the CAPM is not testable, as stated in Roll (1977), because the true market portfolio is not observable. Therefore, the CAPM, as applied in empirical work, is just a statement about the mean-variance efficiency of a given market portfolio. Thus, in our empirical analysis, we test whether the observed stock market portfolio is mean-variance efficient. The test is then a joint test of whether the given market portfolio is mean-variance efficient and whether the CAPM is the correct model.

Unfortunately, the true beta coefficient, β_i, implied by the CAPM cannot be observed. It is usually estimated, under the assumption of constant market risk, by computing iteratively an OLS regression over Sharpe's well-known time series (TSR) market model. However, we relax the assumtion of constant market risk and estimate the market model (2) by applying the dynamic Kalman filter estimation procedure, which accounts for time variation in the betas. The market model is now rewritten in state space form as

$$r_{it} = X_t'\theta_t + \varepsilon_t, \tag{2}$$

where $X_t' = [1, r_{mt}]$

$\theta_t' = [\alpha_{it}, \beta_{it}]$

ε_t = a random error with variance v_t.

The parameter vector θ_t is assumed to vary according to the stationary first order autoregressive (AR1) model (see also Knif (1989) and Malkamäki (1992a,b))

$$\theta_t - \bar{\theta} = F(\theta_{t-1} - \bar{\theta}) + u_t, \tag{3}$$

where $\bar{\theta}$ = mean vector of the parameters

F = weights for the AR1 and mean parameters

u_t = random error with covariance matrix M_t.

The state space representation of the market model is now

$$r_{it} = \begin{bmatrix} X_t' & X_t' \end{bmatrix} \begin{bmatrix} \bar{\theta}_t \\ \theta_t - \bar{\theta}_t \end{bmatrix} + \varepsilon_t \tag{4}$$

$$= B_t'\gamma_t + \varepsilon_t$$

and the parameter vector

$$\gamma_t = \begin{bmatrix} \bar{\theta}_t \\ \theta_t - \bar{\theta}_t \end{bmatrix} = \begin{bmatrix} I & 0 \\ 0 & F \end{bmatrix} \begin{bmatrix} \bar{\theta}_{t-1} \\ \theta_{t-1} - \bar{\theta}_{t-1} \end{bmatrix} + \begin{bmatrix} 0 \\ u_t \end{bmatrix} \tag{5}$$

$$= A\gamma_{t-1} + e_t,$$

where F = diag $[\omega_1, \omega_2]$

$\bar{\theta}_1 = \bar{\theta}_{t-1}$ for all t

e_t = random error with covariance matrix N_t

The random errors ε_t and e_t are independent of each other. The corresponding variance v_t and covariance matrix N_t are estimated. The maximum likelyhood (ML) method is employed to estimate minimum mean square values for γ_{t-1} and its covariance matrix Σ_{t-1}. The estimates for the Σ_t and γ_t, given r_{it} and X_t, are updated at each time t by means of the Kalman filter updating equations (see e.g. Harvey (1989) or Malkamäki (1992a)).

The Kalman filter technique used here is actually a three-step procedure.[1] First, a maximum likelihood solution for the parameter vector is found by means of the above forward recursive Kalman equations, which use past and current information. Next, the information from the whole sample period is used to find another set of ML estimators by applying the backward recursions of the Kalman smoother. As a final step, the AR(1) model is employed to estimate the forecasted beta series.

The forecasted betas are used later in Fama and McBeth (1973)-type cross-sectional (CSR) analyses of the price of risk and in conditional tests of predictability. In the first phase, the following second-pass CSR is estimated for each month:

$$r_{it} = \lambda_{0t} + \lambda_{1t}\hat{\beta}_{it-1} + e_{it}, \tag{6}$$

where r_{it} = expected excess return implied by the CAPM on asset i for period (month) t
λ_{0t} = intercept term (= 0 according to the CAPM),
λ_{1t} = risk premium at time t
$\hat{\beta}_{it-1}$ = beta coefficient estimated for the previous period
e_{it} = random error term.

The final Fama-McBeth estimates for the intercept and risk premium are the sample means from the time series of these coefficients. In the univariate test of the CAPM, the estimates for the intercept and average risk premium are the sample means from the time series of these coefficients. The computation of the standard errors is based on the assumption that the time series of cross-sectional estimates are independent and distributed identically with the means of the final estimates. However, we know that the independence assumption is not strictly satisfied due to the use of estimated betas instead of true betas as the explanatory variable. An errors-in-variables (EIV) problem is introduced in the second-pass regression, since the betas are subject to measurement error (for a review of EIV problems, see e.g. Shanken (1991) and for thin markets, Malkamäki (1992a). The EIV problem is reduced at least to some extent in the case of the mean-reverting AR1 model, since forecasted betas are used as the independent variable in the second-pass regressions. This procedure reduces the EIV problem assuming that the changing residual variance of the market model is dependent on the time variation of beta.[2]

[1] For details on the maximization algorithms, see Goodrich (1989).

[2] The critisism regarding the standard deviations of the univariate tests could be avoided at least to some extent by e.g. computing just one regression over pooled return and beta series, as in Malkamäki (1992a) or using a weighted least squares approach, as e.g. in Berglund and Knif (1992). Since our primary interest is in the source of predictability, we proceed to test it.

2.2 Predictable Variation of Stock Returns

Conditional Risk Premium

The monthly risk premiums from the CSR are regressed on the instrumental varibles in order to see whether the variation in premiums can be explained by the instruments. If the risk premiums are constant over time, then the regression of these coefficients on the information variables should not be significant. The model is

$$\lambda_{1t} = \delta_0 + \delta_1 Z_{1,t-1} + \delta_2 Z_{2,t-1} + \delta_3 Z_{3,t-1} + \varepsilon_{jt}, \tag{7}$$

where λ_t represents the estimated risk premium associated with the market risk and Z_{t-1} represents an instrumental variable with a lag structure (not necessarily t–1).

Decomposition of the Predictable Variation

The CSR provides the following decomposition of the driving forces of predictable variation in stock returns:

$$r_{it} = \{\beta_{i,t-1}\lambda_{1t}\} + \{\lambda_{0t} + \varepsilon_{it}\}. \tag{8}$$

The first term is related to the cross-sectional structure and price of the conditional market risk. The second term $(\lambda_{0t} + \varepsilon_{it})$ is not related to systematic risk and should be unpredictable, assuming that the CAPM is the correct model and the pricing of stocks is rational in the sense of Ferson and Harvey (1991).[3]

Two variance ratios can be formed. The first one (VR1) is the ratio of the variance of the model's conditionally predicted returns to the variance of expected returns from a linear regression on the set of instruments (Z). That is

$$VR1 = \frac{Var[E(\beta_{i,t-1}\lambda_{1t}|Z)]}{Var[E(r_{it}|Z)]}, \tag{9}$$

where the expected values are obtained by regressing on the information variables. The second variance ratio (VR2) is the ratio of the variance of the conditional part of a return that is not explained by the model to the variance of the conditionally expected return. Thus

$$VR2 = \frac{Var[E(r_{it} - \beta_{i,t-1}\lambda_{1t}|Z)]}{Var[E(r_{it}|Z)]}. \tag{10}$$

[3] FH provides a discussion of cases where predictability may enter via the λ_{0t} term also.

If most of the predictable variation in returns is due to the changing structure of the risk parameters, then VR1 should be close to one and VR2 close to zero.

Risk Premium vs. Risk Sensitivity

A further decomposition of variance ratios reveals whether time-varying expected risk premium or time-varying risk sensitivities drive the predictable variation in stock returns. The variance is decomposed as:

$$\mathrm{Var}[E(\lambda\beta)\,|\,Z] = [E(\beta)]^2\mathrm{Var}[E(\lambda\,|\,Z)] + [E(\lambda)]^2\mathrm{Var}[E(\beta\,|\,Z)] + \text{interaction terms,} \tag{11}$$

where $E(\lambda)$ and $E(\beta)$ are the unconditional means of estimated parameters and $E[\lambda\,|\,Z)$ and $E(\beta\,|\,Z)$ are linear projections on the λ and β on the instruments. The interaction terms arise because of covariance between the time-varying risk premiums and betas.

3 The Data

This study uses end-of-month stock returns in excess of the short-term interest rate on all 25 restricted[4] ordinary stocks listed on the Helsinki Stock Exchange (HSE) throughout the period 1972–1989 (see Table 1). Returns are measured as logarithmic changes in the indices. The HSE general index, which is used here, is value weighted (see Berglund–Wahlroos–Grandell (1983)). In the index, prices are corrected for cash dividends, splits, stock dividends and new issues. The correction is based on the principle that all income from a stock is reinvested in that stock with no transaction cost. No portfolios are formed for the analysis, as is usually done in US studies. This is because of the extremely limited number of actively traded stocks. The excess returns are computed by using the one-month return entailed in the three-month Eurorate on the Finnish markka. This interest rate series is introduced in Malkamäki (1992a). The whole period is used to estimate the betas. Predictability analyses are carried out on data beginning with 1977, as in Malkamäki (1992a and 1992b).

[4] Only domestic investors are allowed to buy restricted stocks. An observation at an end-of-month day when there was no transaction in a stock is the last bid price for that day.

Table 1 **Stocks included in the analysis: all restricted ordinary shares listed throughout the period 1972:2—1989:12**

Stock	Designation
Bank of Åland Ltd K	AB
Effoa-Finland Steamsip Co Ltd K	EFFO
Enso-Gutzeit Ltd A	ENSOA
Fiskars Corporation	FISKK
Huhtamäki Corporation K	HUHTK
Instrumentarium Corporation	INSTA
Kemi Corporation	KEMI
Kesko Corporation	KESK
KANSALLIS-OSAKE-PANKKI	KOP
Kymmene Corporation	KYMI
Lassila & Tikanoja Ltd	LASS
Lohja Corporation A	LOHJA
Nokia Corporation	NOKIK
Otava Publishing Company Ltd	OTAVK
Partek Corporation	PART
Rauma-Repola Corporation	RAUM
Finnish Sugar Co Ltd I	SOKEI
Stockman A	STOCA
Suomen Trikoo Corp. A	TRIK
Union Bank of Finland Ltd A	SYPA
Tamfelt Group K	TAMF
Tampella Ltd	TAMP
Talous-Osakekauppa Co	TAOK
Wärtsilä Co I	WARTI
United Paper Mills Ltd K	YHTYK

Table 2

Summary statistics for the excess returns (per cent per month) for 1972:2—1989:12 (215 observations)

Asset	Mean	St.dev.	Skewness	Kurtosis
	Excess Returns			
AB	0.746	10.683	1.332	16.702
EFFO	0.423	8.204	0.348	1.448
ENSOA	-0.234	7.922	0.645	3.114
FISKK	1.292	7.252	0.296	1.959
HUHTK	0.782	6.610	1.056	2.655
INSTA	1.156	7.118	0.607	3.206
KEMI	-0.360	10.646	-0.694	4.457
KESK	0.658	5.147	1.060	2.481
KOP	0.104	6.644	0.751	4.821
KYMI	-0.002	6.410	0.597	1.908
LASS	1.298	9.240	1.336	7.143
LOHJA	0.930	7.333	0.141	0.295
NOKIK	-0.009	6.910	0.159	0.684
OTAVK	1.234	9.496	1.773	10.212
PART	0.522	6.594	0.242	0.555
RAUM	0.034	6.741	1.042	2.112
SOKEI	0.694	8.094	0.762	2.001
STOCA	0.895	6.645	0.521	2.684
SYPA	0.433	6.083	1.230	4.425
TAMF	0.717	9.835	-0.486	6.468
TAMP	0.051	7.788	1.276	5.215
TAOK	1.866	9.520	-0.031	1.863
TRIK	0.136	11.697	0.255	6.330
WARTI	0.613	7.480	0.764	1.155
YHTYK	0.707	7.459	0.380	0.934
VWI[a]	0.254	4.230	0.265	0.976

[a] The stock market index return.

Summary statistics for monthly excess returns for 25 firms and for the HSE market index are shown in Table 2. The statistics indicate that the return distributions are somewhat skewed to the right and leptokurtic, as is usual (see e.g. Taylor (1986)).

We use three information variables, which are usually called instruments in the literature. These varibles are assumed to describe the information that investors use to set prices in the stock market (see Table 3). The instruments are FSM, an instrument for the influence of lagged excess returns on the stock markets in Finland, Germany, Sweden, the United Kingdom and the United States, UNEXINF, change in unexpected inflation, and BARIP, expected change in order stock for Finnish industry.[5] FSM is based on Malkamäki (1992c). He applied Johansen's (1988) multidimensional vector autoregressive (VAR) technique, which accounts also for the multivariate cointegration of stock market indices in the above countries and found that the Finnish stock market is clearly Granger caused by these countries' market returns with Germany having the strongest foreign impact. FSM is the fit of the VAR model for the Finnish stock market. The second instrument, UNEXINF, is the difference between actual and forecasted inflation. The forecast is obtained from an ARIMA (1,0,1)(0,0,2) model for percentage changes in the seasonally unadjusted consumer price index.[6] The third instrument, BARIP, is an estimate of the aggregated future cash-flow expectations of firms. BARIP is the percentage change in negative answers regarding expected change in order stock for Finnish industry in the quarterly questionaire of the Confideration of the Finnish Industries. The monthly series is interpolated from the quarterly series.

Table 3 **Instrumental variables**

Instrument	Definition
FSM	An instrument for influence of lagged stock market returns in Finland, Germany, Sweden, UK and US.
UNEXINF	Change in unexpected inflation.
BARIP	Expected change in future order stock for Finnish industry.

Summary satistics for the instruments are given in Table 4. Only FSM is somewhat skewed and leptokurtic. The lower part of the table shows that cross-correlation of the insrumental variables is not a matter of concern. However, one should keep in mind that all the instruments are generated variables. Pagan (1984) discusses econometric issues concerning generated variables and shows that their use may lead to biased estimates in OLS regressions. On the other hand, the market-based instrumental variables most commonly used in US studies were tested here as conditioning instruments before turning to the generated variables, but no significant relations were found. The variables studied include change in the

[5] We also tried most of the instruments that are commonly employed in US studies (see also next paragraph). However, these variables did not show any forecasting power for excess stock returns or risk premium.

[6] The model is stable according to the F-test at the 5 % level of significance.

difference between long- and short-term interest rates, change in the difference between medium and short-term interest rates, nominal and real three month Euromarket returns for the Finnish markka, a bond return index, nominal inflation and real per capita growth of personal consumption (seasonally adjusted). From preliminary analysis of the above instruments, we concluded that the information that is relevant to Finnish investors in setting stock prices differs from that which is relevant in the US market.

Table 4 **Summary statistics for the instrumental variables, 1972:2–1989:12**

Instrument	Mean	Std. dev.	Skew.	Ex. Kurt.
FSM	–.032	.021	–.834	3.396
UNEXINF	.005	.006	.069	–.227
BARIP	–4.300	10.230	–.348	–.043

Correlation matrix

Instrument	FSM	UNEXINF	BARIP
FSM	1.000		
UNEXINF	.176	1.000	
BARIP	–.085	–.044	1.000

4 Empirical Results

4.1 Unconditional vs Conditional Price of Risk

Cross-sectional regressions of the excess returns on the conditional betas are performed for each month. The model estimated is that of equation (6). The slope coefficient for the betas is the monthly risk premium. The results from these regressions are reported in Table 5. The upper part of the table gives the results from the unconditional analysis of the price of beta risk. These results are taken from Malkamäki (1992b). The table shows that the unconditional price of risk is not significant for the period 1977:2–1989:12, and furthermore, the sign of the coefficient is negative. The t-ratios reported in parenthesis are calculated as in Fama-McBeth (1973). The hypothesis tested, as in numerous other studies, is that the mean premium equals zero. However, as stated in FH (1991), a premium may be the most significant premium even if it has zero mean. This is possible if the premium is changing through time or that there is a structural change in the return-generating process for a particular period, as reported in Booth et al. (1991), or that there are several structural changes, as found in Malkamäki (1992a). In such a case, our tests of the significance of average risk premium would be weak.

Table 5 **Unconditional and conditional price of market risk 1977:2–1989:12 (155 observations)**

Unconditional model

λ_0	λ_1	R^2
0.011	−0.003	6.3
(1.85)	(−0.40)	

The model estimated is: $r_{it}=\lambda_{0t}+\lambda_{1t}\beta_{it-1}+e_{it}$, where β_{it-1} is actually a beta forecasted for the period t based on the mean-reverting AR1 model: $\beta_t=\omega\beta_{t-1}+(1-\omega)\beta$.

Conditional model[a]

δ_0	δ_1	δ_2	δ_3	R^2	DW
0.051	0.161	−2.559	0.005	8.7	2.16
(1.28)	(0.78)	(−2.08)	(3.26)		

The model estimated is: $\lambda_{it} = \delta_0 + \delta_1$FSM(t) + δ_2UNEXINF(t−3) + δ_3BARIP(t−4) + u_t. BARIP was second-order differenced in the regression (see text).

[a] Heteroscedasticity-consistent t-values in parenthesis, White (1980).

We test the conditional pricing of market risk by regressing the risk premium of the monthly cross-sectional regressions on the instrumental varibles in order to detect the predictable variation in the premium. If the risk premium is constant, the regression should not detect a significant relation. The outcome of this test is given in the lower part of Table 5. We see that some of the observed variability of the risk premium can be explained by the instruments. The coefficient of determination, 8.7 %, is reasonable in light of the results of FH. Note also that the period studied here includes two extraordinary periods for the Finnish economy, which are found to have a dominating role in unconditional tests of the CAPM. These are the period of three devaluations, 1977:4–1978:2, and the year 1989, when the drastic slowdown of the Finnish economy started. Malkamäki (1992a and 1992b) shows that these periods have a strong impact on the risk-return relationship under the assumption of constant risk premium. The above analysis shows that the conditioning instruments are able to predict the behavior of the risk premium also for these extraordinary periods.

UNEXINF and BARIP turned out to have the greatest effect on the risk premium, BARIP having the strongest influence according to the t-statistics. BARIP had significant t-values and coefficients of same size but opposite sign at lags 4 and 5. It was, therefore, differenced a second time in order to increase the power of the regression analysis. It follows from the second-order differencing that the positive regression coefficient implies a decrease in the expected risk premium as the percentage of negative answers regarding the future order stock for Finnish industry increases, which seems reasonable enough. The negative coefficient of the unexpected inflation at lag 3 implies that an unanticipated increase in inflation reduces the expected risk premium associated with stock investments. This supports the view that unexpected inflation is bad news for Finnish stock investors. A lag structure of this size between economic variables and stock price reactions is also found in Virtanen and Yli-Olli (1987). A possible explanation for this is that macro-information is usually available with a lag of several months.

4.2 Decomposing the Predictable Variation

The cross-sectional regression provides a decomposition of the predictable variation in stock returns. The first term is related to the cross-sectional structure of risk. The second term is a residual that should be unpredictable (see equation (8)). The estimated λ's and β's are assumed to be unbiased estimates of the "true" parameter values. Therefore, we construct artificial data which satisfy the hypothesis that the model captures the predictable variation of the returns when conditioning on the instruments (Z) (see also FH (1991)). We compute mean-centered residuals $u_{it} = r_{it} - \lambda_{1t}\beta_{i,t-1}$ and form the pseudo returns as the sum $u_{it} + \lambda_{1t}\beta_{i,t-1}$. Two variance ratios can be formed based on the above components. The first one, VR1, is the ratio of the variance of the model's predicted returns $E(\lambda\beta|Z)$ to the variance of expected (pseudo) returns (see equation (9)). The expected values are obtained from a linear regression on the instruments. The second variance ratio, VR2, is the ratio of the variance of the expected part of a return that is not explained by the model, i.e. the mean-centered residual, to the variance of the expected return (see equation (10)). This ratio is compared to VR1. If the first variance ratio is close to unity, then most of the predictable variation in returns is due to the changing structure of risk.

Ferson and Harvey (1991) found that some 81 % of the predictability in US returns was driven by changes in the expected betas and expected price of betas. Table 6 gives the corresponding analysis with Finnish stock data. The variance ratio VR1 has, in all cases except three, a bigger value than VR2, which indicates that the predictability of Finnish returns is driven mainly by the component that is related to the cross-sectional structure of risk and the cross-section of expected returns. We characterize this part of predictability as rational. The irrational source of predictability is driven by the variance of expected error term in equation (10). This component, VR2, clearly has a smaller mean than VR1. We do not have a specific test for the significance of the variance ratios. However, the irrational component of the predictability seems to be bigger in Finland than in the US.

The variance ratios are often greater than one, which indicates that the covariance of the numerators in the variance ratios is negative. A closer look at the conditioning regressions reveals that the BARIP is the major source of negative covariation.[7] It should also be noted that the conditioned return in the denominator is the firm-specific return instead of the portfolio return used in Ferson and Harvey. This implies that we also condition an aggregate variable, i.e. the risk premium, in addition to the firm-specific betas in the numerator, whereas only the firm-specific returns are conditioned in the denominator. It is not surprising, given this background, that the variance of the numerator is often smaller than that of the denominator. However, Appendix 1A shows that the coefficients of determination for regressions of the pseudoreturns are reasonable enough. The large VR2s may

[7] See Appendix 1, which gives the results of the conditioning regressions.

actually indicate that the beta risk of these firms is not priced or that the stock returns for these firms are not sensitive to changes in future order-stock expectations, which creates the negative interaction between the conditional risk premium and the mean-centred residuals. the interpretation of FSM is quite straightforward. It is the most significant predictor of firm-specific returns, having a significant t-value (at the 5 % level) in 14 regressions. Unexpected inflation turned up with a significant t-value in 11 regressions out of 25.

Table 6 **Decomposition of predictable variation of stock-specific returns, 1977:6–1989:12 (151 observations)**

Stock	VR1	VR2
AB	1.056	0.768
EFFO	1.342	0.438
ENSOA	1.361	0.475
FISKK	1.752	1.704
HUHTK	0.900	0.776
INSTA	4.434	3.384
KEMI	1.349	0.898
KESK	4.115	2.835
KOP	1.680	1.424
KYMI	1.307	0.553
LASS	1.077	1.392
LOHJA	2.652	0.512
NOKIK	1.301	0.428
OTAVK	0.913	1.270
PART	3.118	2.045
RAUM	6.884	2.960
SOKEI	1.314	0.859
STOCA	1.190	0.440
SYPA	2.399	1.346
TAMF	1.371	0.129
TAMP	1.110	0.908
TAOK	1.438	1.253
TRIK	1.406	1.449
WARTI	2.666	0.608
YHTYK	3.996	1.704
Mean	2.085	1.222

$$VR1 = \frac{Var[E(\lambda\beta|Z)]}{Var[E(r|Z)]} \quad VR2 = \frac{Var[E(r-\lambda\beta|Z)]}{Var[E(r|Z)]}$$

4.3 Risk Premium vs Risk Sensitivity

The numerator of the first variance ratio, VR1, can be decomposed further to determine whether the time-varying expected risk premium or risk sensitivities are driving the predictable variation in the excess stock returns. In the third variance ratio, VR3, the variance of the conditional risk premium is multiplied by the square of the unconditional mean of the betas (see equation (11)). The interaction terms arise because of covariance between the time-varying risk premium and the betas. $E(\lambda)$ and $E(\beta)$ are the unconditional means – which are assumed to be constants. The constancy assumption is accurate at least with respect to the betas, according to Malkamäki (1992a), who found that the betas of the stocks analysed here follow the stationary AR1 process.

Table 7

Decomposition of predictable variation between betas and the price of the betas, 1977:6–1989:12 (151 observations)

Stock	VR3	VR4	Interaction effects
AB	61.092	0.0000	38.908
EFFO	61.104	0.0000	38.896
ENSOA	61.350	0.0000	38.650
FISKK	61.252	0.0000	38.748
HUHTK	60.561	0.0000	39.439
INSTA	61.121	0.0000	38.879
KEMI	59.516	0.0000	40.484
KESK	61.664	0.0000	38.336
KOP	61.103	0.0000	38.897
KYMI	60.598	0.0000	39.402
LASS	59.436	0.0000	40.564
LOHJA	61.056	0.0000	38.944
NOKIK	61.417	0.0000	38.583
OTAVK	59.072	0.0002	40.928
PART	61.084	0.0000	38.916
RAUM	61.312	0.0000	38.688
SOKEI	61.438	0.0000	38.562
STOCA	61.135	0.0000	38.865
SYPA	60.683	0.0000	39.317
TAMF	58.387	0.0000	41.613
TAMP	60.863	0.0000	39.137
TAOK	61.139	0.0000	38.861
TRIK	64.004	0.0004	35.996
WARTI	61.094	0.0000	38.906
YHTYK	61.022	0.0000	38.978
Mean	60.900	0.000	39.100

$$VR3 = \frac{[E(\beta)]^2 Var[E(\lambda|Z)]}{Var[E(\lambda\beta|Z)]} x100 \qquad VR4 = \frac{[E(\lambda)]^2 Var[E(\beta|Z)]}{Var[E(\lambda\beta|Z)]} x100$$

Table 7 shows us that some 61 % of the rational part of predictability is due to the predictable variation of the risk premium. No predictable variation is attributed to the conditional betas, according to VR4 in the table. This supports the findings of FH. They also pointed out that the variance of expected risk premium is on the order of the variance of expected stock returns, and the betas are on the order of 1.0. Furthermore, Malkamäki (1992a) found that the mean-reverting AR1 betas employed here are in most cases constant. Thus, it is not surprising that the predictable variation of Finnish stock returns is attributed to the time-varying risk premium.

5 Conclusions

This paper studies the driving forces of predictable variation in Finnish stock returns. We apply a modified version of the research design of Ferson and Harvey (1991) in order to divide the driving forces of predictabity into rational and irrational parts. However, the analysis is conducted within the Sharpe-Lintner CAPM instead of using the multifactor approach of FH. The rational expectations view is supported in the analysis if the predictable variation of excess stock returns is driven by predictable variation in the betas, the price of the betas or a combination of the two. We allow for greater dynamics in the beta estimation than FH, since the betas are allowed to vary over time according to a mean-reverting AR1 process. We also use firm-specific returns instead of portfolio returns as in FH.

We find that market risk is conditionally priced on the thin Finnish stock market. Finnish investors were found to use change in unexpected inflation, expected change in future order stock for Finnish industry and an instrument for the influence of lagged excess returns on stock markets in Finland, Germany, Sweden, the United Kingdom and the United States, in setting prices in the stock market. The interest-based variables that have been found to be relevant information to US investors did not succeed as conditioning variables in this analysis. Most of the predictable variation in the stock returns is attributed to the time-varying risk premium, which supports the rational behavior of Finnish investors in setting the prices in the market. However, the conditional residual term accounted for a greater part of the predictable variation of the stock returns than that which was found by Ferson and Harvey. The bigger "irrational" part of predictability may be partly due to the data employed, as we used firm-specific returns instead of portfolio returns. Another reason could be that the CAPM is not an adequate model. A conditional multifactor replication of this study could provide further information concerning the pricing of Finnish stocks.

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Appendix 1A **Pseudoreturns on conditioned on the instruments 1977:2–1989:12 (155 observations)**

Stock	Constant	FSM(t)	UNEXINF(t–3)	BARIP(t–4)	R^2	DW
AB	0.030	0.789	–1.328	0.001	3.3	2.47
	(1.79)	(1.96)	(–0.93)	(0.76)		
EFFO	0.028	0.675	–1.631	0.002	5.1	1.71
	(1.97)	(2.00)	(–1.36)	(1.59)		
ENSOA	0.028	0.751	–1.072	0.003	8.0	1.96
	(2.20)	(2.51)	(–1.01)	(2.44)		
FISKK	0.026	0.672	–1.274	0.000	4.1	1.92
	(2.11)	(2.26)	(–1.21)	(0.01)		
HUHTK	0.022	0.581	–0.858	0.001	3.7	1.76
	(1.90)	(2.12)	(–0.88)	(0.78)		
INSTA	0.010	0.399	0.325	0.001	2.4	2.15
	(0.90)	(1.48)	(0.34)	(1.09)		
KEMI	0.010	–0.151	–3.391	0.001	3.3	2.19
	(0.55)	(–0.34)	(–2.16)	(0.34)		
KESK	0.013	0.286	–1.089	0.000	2.8	1.47
	(1.59)	(1.44)	(–1.54)	(0.13)		
KOP	0.032	0.614	–3.014	–0.000	10.8	2.42
	(3.18)	(2.54)	(–3.51)	(–0.26)		
KYMI	0.032	0.652	–2.663	0.002	11.2	1.75
	(3.25)	(2.77)	(–3.18)	(1.47)		
LASS	0.021	0.276	–2.812	–0.001	3.6	1.97
	(1.37)	(0.75)	(–2.16)	(–0.61)		
LOHJA	0.020	0.384	–2.019	0.003	7.2	2.19
	(1.77)	(1.42)	(–2.10)	(2.38)		
NOKIK	0.036	0.773	–2.634	0.002	11.1	1.88
	(3.11)	(2.85)	(–2.73)	(2.02)		
OTAVK	0.022	0.282	–2.958	–0.001	5.0	2.31
	(1.60)	(0.87)	(–2.57)	(–0.71)		
PART	0.026	0.579	–1.864	0.000	6.2	2.05
	(2.51)	(2.36)	(–2.14)	(0.40)		
RAUM	0.004	–0.028	–1.225	0.001	2.3	1.99
	(0.33)	(–0.11)	(–1.37)	(1.27)		
SOKEI	0.034	0.868	–1.531	0.002	6.5	1.86
	(2.55)	(2.77)	(–1.38)	(1.08)		
STOCA	0.029	0.531	–2.828	0.002	9.2	1.89
	(2.70)	(2.08)	(–3.11)	(1.38)		
SYPA	0.027	0.596	–1.990	0.001	8.7	1.90
	(2.97)	(2.76)	(–2.60)	(0.85)		
TAMF	0.022	0.457	–1.523	0.004	6.5	1.81
	(1.69)	(1.49)	(–1.39)	(2.54)		
TAMP	0.039	0.894	–2.395	0.001	8.4	1.85
	(3.07)	(3.00)	(–2.26)	(0.49)		
TAOK	0.017	0.461	–0.533	0.001	1.1	2.20
	(1.03)	(1.21)	(–0.39)	(0.30)		
TRIK	0.036	1.046	–0.868	0.000	2.9	2.38
	(1.69)	(2.05)	(–0.48)	(0.08)		
WARTI	0.016	0.373	–1.072	0.003	4.4	1.99
	(1.27)	(1.28)	(–1.04)	(2.09)		
YHTYK	0.021	0.484	–1.533	0.002	4.1	2.06
	(1.76)	(1.69)	(–1.51)	(1.24)		

Appendix 1B **Fit of the CAPM conditioned on the instruments 1977:6–1989:12 (151 observations)**

Stock	Constant	FSM(t)	UNEXINF(t–3)	BARIP(t–4)	R^2	DW
AB	0.013	0.176	–1.864	0.003	8.7	2.16
	(1.28)	(0.71)	(–2.12)	(3.09)		
EFFO	0.016	0.207	–2.214	0.004	8.7	2.15
	(1.27)	(0.71)	(–2.12)	(3.09)		
ENSOA	0.018	0.236	–2.500	0.005	8.7	2.15
	(1.27)	(0.71)	(–2.11)	(3.09)		
FISKK	0.014	0.186	–1.975	0.004	8.7	2.16
	(1.27)	(0.71)	(–2.12)	(3.09)		
HUHTK	0.009	0.111	–1.275	0.002	8.7	2.17
	(1.29)	(0.67)	(–2.18)	(3.05)		
INSTA	0.015	0.205	–2.164	0.004	8.7	2.15
	(1.28)	(0.71)	(–2.13)	(3.09)		
KEMI	0.017	0.216	–2.337	0.004	8.9	2.17
	(1.32)	(0.72)	(–2.17)	(3.10)		
KESK	0.012	0.147	–1.715	0.003	8.6	2.17
	(1.25)	(0.67)	(–2.18)	(3.04)		
KOP	0.019	0.252	–2.664	0.005	8.7	2.16
	(1.28)	(0.71)	(–2.12)	(3.09)		
KYMI	0.017	0.222	–2.338	0.004	8.8	2.15
	(1.30)	(0.72)	(–2.13)	(3.10)		
LASS	0.013	0.174	–1.797	0.003	8.8	2.15
	(1.30)	(0.74)	(–2.14)	(3.11)		
LOHJA	0.021	0.281	–2.976	0.006	8.7	2.15
	(1.27)	(0.71)	(–2.11)	(3.11)		
NOKIK	0.019	0.252	–2.664	0.005	8.7	2.16
	(1.27)	(0.71)	(–2.11)	(3.09)		
OTAVK	0.013	0.178	–1.724	0.003	8.5	2.10
	(1.29)	(0.76)	(–2.08)	(3.04)		
PART	0.019	0.257	–2.707	0.005	8.7	2.15
	(1.28)	(0.72)	(–2.12)	(3.09)		
RAUM	0.018	0.242	–2.458	0.005	8.7	2.16
	(1.28)	(0.74)	(–2.11)	(3.09)		
SOKEI	0.016	0.219	–2.303	0.004	8.7	2.16
	(1.28)	(0.72)	(–2.12)	(3.10)		
STOCA	0.015	0.204	–2.167	0.004	8.7	2.16
	(1.28)	(0.71)	(–2.12)	(3.09)		
SYPA	0.018	0.240	–2.514	0.005	8.7	2.16
	(1.28)	(0.72)	(–2.12)	(3.10)		
TAMF	0.018	0.239	–2.255	0.004	8.3	2.12
	(1.39)	(0.76)	(–2.02)	(3.04)		
TAMP	0.017	0.252	–2.238	0.004	8.5	2.11
	(1.32)	(0.81)	(–2.03)	(3.09)		
TAOK	0.008	0.110	–1.182	0.002	8.7	2.16
	(1.27)	(0.70)	(–2.13)	(3.09)		
TRIK	0.022	0.376	–2.499	0.005	7.5	2.15
	(1.46)	(1.04)	(–1.94)	(2.78)		
WARTI	0.018	0.236	–2.494	0.005	8.7	2.16
	(1.28)	(0.71)	(–2.12)	(3.09)		
YHTYK	0.020	0.267	–2.871	0.005	8.7	2.16
	(1.26)	(0.70)	(–2.12)	(3.09)		

Appendix 1C **Betas conditioned on the instruments 1977:2–1989:12 (155 observations)**

Stock	Constant	FSM(t)	UNEXINF(t–3)	BARIP(t–4)	R^2	DW
AB	0.748	–0.000	0.001	0.000	0.8	2.47
	(99518.80)	(–0.72)	(0.86)	(0.14)		
EFFO	0.890	0.022	–0.089	0.000	1.8	2.03
	(940.11)	(1.00)	(–1.11)	(0.78)		
ENSOA	1.010	–0.020	–0.149	0.000	2.8	1.90
	(1029.67)	(–0.86)	(–1.80)	(0.30)		
FISKK	0.795	0.004	–0.015	–0.000	0.4	1.62
	(783.77)	(0.16)	(–0.17)	(–0.75)		
HUHTK	0.501	0.145	–0.153	0.000	3.8	0.59
	(168.23)	(2.05)	(–0.61)	(1.21)		
INSTA	0.868	0.006	–0.030	–0.000	1.7	1.95
	(2308.55)	(0.71)	(–0.93)	(–1.06)		
KEMI	0.907	–0.169	0.347	–0.000	1.3	2.39
	(147.68)	(–1.16)	(0.67)	(–0.56)		
KESK	0.670	0.037	0.388	–0.000	1.0	2.77
	(163.73)	(0.38)	(1.12)	(–0.24)		
KOP	1.069	0.002	0.005	0.000	0.9	1.77
	(9129.67)	(0.72)	(0.48)	(0.71)		
KYMI	0.932	–0.035	0.224	0.000	2.9	2.12
	(630.81)	(–0.99)	(1.79)	(0.63)		
LASS	0.711	0.007	0.137	–0.001	1.4	1.10
	(197.70)	(0.08)	(0.45)	(–1.37)		
LOHJA	1.202	0.001	0.002	0.000	0.0	2.37
	(669.97)	(0.03)	(0.01)	(0.26)		
NOKIK	1.075	–0.001	–0.105	–0.000	1.1	2.36
	(1077.99)	(–0.04)	(–1.24)	(–0.12)		
OTAVK	0.681	–0.167	–0.535	–0.004	4.0	1.75
	(39.89)	(–0.41)	(–0.37)	(–2.38)		
PART	1.086	–0.008	0.006	0.000	2.2	1.93
	(3978.36)	(–1.17)	(0.25)	(1.38)		
RAUM	0.993	–0.019	–0.043	–0.000	0.5	2.11
	(544.64)	(–0.45)	(–0.28)	(–0.67)		
SOKEI	0.926	–0.027	0.287	0.000	4.6	1.86
	(533.24)	(–0.66)	(1.96)	(1.67)		
STOCA	0.870	0.003	–0.033	–0.000	0.4	2.59
	(1571.35)	(0.22)	(–0.70)	(–0.14)		
SYPA	1.010	–0.051	–0.407	0.000	2.2	1.80
	(337.98)	(–0.72)	(–1.61)	(0.17)		
TAMF	0.871	–1.029	0.458	0.000	4.4	1.31
	(52.30)	(–2.61)	(0.33)	(0.12)		
TAMP	0.916	–0.332	0.515	–0.001	2.6	0.10
	(102.19)	(–1.56)	(0.68)	(–1.12)		
TAOK	0.473	–0.019	0.002	–0.000	4.5	1.70
	(1529.85)	(–2.59)	(0.07)	(–0.37)		
TRIK	1.065	1.227	3.495	–0.007	1.4	2.77
	(16.34)	(0.79)	(0.64)	(–1.00)		
WARTI	1.001	0.003	0.004	0.000	14.6	1.22
	(35954.78)	(4.05)	(1.89)	(1.97)		
YHTYK	1.153	–0.002	–0.042	–0.000	0.4	1.96
	(591.44)	(–0.03)	(–0.26)	(–0.66)		

Appendix 1D **Mean-centered residuals conditioned on the instruments, 1977:2–1989:12 (155 observations)**

Stock	Constant	FSM(t)	UNEXINF(t–3)	BARIP(t–4)	R^2	DW
AB	0.017	0.612	0.536	–0.002	1.7	2.43
	(0.82)	(1.24)	(0.30)	(–0.93)		
EFFO	0.012	0.468	0.583	–0.002	1.4	2.02
	(0.66)	(1.06)	(0.37)	(–0.84)		
ENSOA	0.010	0.515	1.427	–0.001	2.4	2.28
	(0.60)	(1.33)	(1.04)	(–0.78)		
FISKK	0.012	0.486	0.701	–0.004	4.4	1.94
	(0.78)	(1.30)	(0.53)	(–2.16)		
HUHTK	0.013	0.470	0.417	–0.001	2.2	1.78
	(0.98)	(1.49)	(0.37)	(–0.92)		
INSTA	–0.005	0.195	2.489	–0.003	4.2	2.12
	(–0.34)	(0.53)	(1.89)	(–1.60)		
KEMI	–0.007	–0.368	–1.055	–0.004	2.6	2.08
	(–0.33)	(–0.78)	(–0.63)	(–1.66)		
KESK	0.002	0.139	0.626	–0.003	3.6	1.92
	(0.13)	(0.48)	(0.60)	(–2.22)		
KOP	0.013	0.362	–0.350	–0.005	6.9	2.25
	(0.86)	(0.98)	(–0.27)	(–3.13)		
KYMI	0.015	0.430	–0.325	–0.003	3.1	1.98
	(1.04)	(1.23)	(–0.26)	(–1.76)		
LASS	0.008	0.102	–1.016	–0.004	3.3	2.09
	(0.43)	(0.23)	(–0.63)	(–2.11)		
LOHJA	–0.001	0.103	0.957	–0.003	2.0	2.34
	(–0.07)	(0.27)	(0.71)	(–1.56)		
NOKIK	0.017	0.522	0.030	–0.002	2.8	2.18
	(1.05)	(1.40)	(0.02)	(–1.47)		
OTAVK	0.009	0.104	–1.234	–0.004	4.0	2.21
	(0.54)	(0.25)	(–0.85)	(–2.29)		
PART	0.007	0.322	0.843	–0.005	6.0	2.12
	(0.44)	(0.91)	(0.67)	(–2.85)		
RAUM	–0.014	–0.270	1.233	–0.003	3.7	1.91
	(–0.99)	(–0.79)	(1.02)	(–2.04)		
SOKEI	0.017	0.649	0.772	–0.003	3.3	1.96
	(0.99)	(1.57)	(0.53)	(–1.47)		
STOCA	0.014	0.327	–0.660	–0.002	2.2	1.95
	(0.89)	(0.91)	(–0.52)	(–1.48)		
SYPA	0.009	0.356	0.524	–0.004	4.6	2.05
	(0.61)	(1.02)	(0.42)	(–2.43)		
TAMF	0.004	0.218	0.731	–0.001	0.6	2.31
	(0.23)	(0.60)	(0.57)	(–0.47)		
TAMP	0.021	0.643	–0.157	–0.004	4.9	2.28
	(1.33)	(1.69)	(–0.12)	(–2.14)		
TAOK	0.008	0.351	0.649	–0.002	0.9	2.27
	(0.41)	(0.74)	(0.39)	(–0.78)		
TRIK	0.014	0.670	1.630	–0.004	3.8	2.28
	(0.62)	(1.27)	(0.87)	(–1.84)		
WARTI	–0.002	0.137	1.422	–0.002	1.6	2.08
	(–0.13)	(0.35)	(1.03)	(–1.06)		
YHTYK	0.001	0.217	1.339	–0.004	3.6	2.10
	(0.05)	(0.55)	(0.95)	(–2.07)		

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