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THE LEAD-LAG EFFECT BETWEEN LARGE AND SMALL FIRMS: EVIDENCE FROM FINLAND

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INTRODUCTION

Recently, Lo and MacKinlay (1990) found a positive correlation between lagged large market value portfolios and this period's small market value portfolio returns. The reverse correlation between this period's large market value portfolio returns and previous period's small market value portfolio returns was not observed. Using cointegration analysis, Connolly and Conrad (1991) investigated the long-term as well as the short-term associations between the stock prices of small and large firms. Their results did not support the hypothesis of cointegration between the stock returns of small and large firms, giving evidence on the weak-form efficiency of the US market.

This paper extends the above US papers by using data from a small security market, i.e., the Helsinki Stock Exchange in Finland. For numerous reasons, the Finnish market offers an interesting arena to investigate the price dynamics between small and large firms. First, there has not existed exact legislation for shareholder information in Finland during our research period. In Finland information offered by large firms has typically been of higher quality and magnitude than information given by small firms. Second, thin trading in the Helsinki Stock Exchange evidently leads to slower price adjustments of infrequently traded stocks, which very often are small market value firms.

Finally, because of the above features, prior studies indicate that the efficiency of the Finnish market has proved to be weak and models predicting future returns based on past return series have appeared successful (e.g., Martikainen et al., 1991, for a review). The results of this paper indicate that the stock prices of large and small Finnish firms are cointegrated. As is asserted by Granger (1986), this kind of cointegrated relationship between prices constitutes evidence of weak-form informational inefficiency. The analysis of this note is performed as follows. The next section describes the data; empirical analysis is carried out in the third section and the final section concludes.

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DATA ENVIRONMENT

Daily stock returns for the period January 1975 to December 1986 are used in this paper. Returns are determined as changes in logarithmic indices including dividends, issues and splits. For a day with no trade, the true price is proxied by the bid quotation. When several trading prices for the same stock on the same day have occurred, arithmetic averages for these prices have been computed. All 28 ordinary shares listed continuously for the whole period are included in the analysis. The stocks are sorted into six portfolios on the basis of the previous year's year-end market value. Portfolio 1 contains the smallest firms while the largest firms belong to the sixth portfolio. Portfolios 3 and 4 consist of four stocks while the other portfolios include five stocks. Because of small sample size, the interpretation of our results must be done with a moderate level of caution.

Table 1 summarises the basic statistical characteristics of the return series used in the paper. The average return of the smallest firms has clearly outperformed the returns of the largest firms. The return of portfolio one has been more than twice as large as the return of portfolio six. This is what can be expected based on the earlier evidence uncovering the small-firm effect almost globally.[1]

The portfolio of the smallest firms indicates the highest time-series variation of stock returns, a phenomenon reported in earlier studies (see e.g., Cohen et al., 1986). Ljung-Box Q-statistics indicate significant autocorrelation in Finnish stock market returns. This is in accordance with previous results on the Finnish market indicating significant autocorrelation. The highest positive autocorrelation is observed for the return series of largest firms, with a first-order autocorrelation of 0.438 indicating that about 19 per cent of the daily

Table 1

Summary Statistics of Portfolio Returns

			Autocorrelation at Lags					
	Mean	*Std. Dev.*	*1*	*2*	*3*	*4*	*5*	*L-B*
R1	0.0013	0.013	−0.208	0.033	0.018	0.016	−0.042	135.13c
R2	0.0009	0.010	−0.148	0.063	0.075	0.060	−0.018	102.39c
R3	0.0009	0.010	−0.001	0.062	0.014	0.041	0.044	22.12c
R4	0.0007	0.008	−0.028	0.083	0.038	0.036	0.002	29.93c
R5	0.0008	0.007	0.301	0.198	0.115	−0.002	−0.013	412.54c
R6	0.0005	0.007	0.438	0.212	0.079	−0.007	−0.005	699.93c

Notes:
R1, R2, R3, R4, R5, R6 = daily returns for six portfolios, respectively.
Portfolio 1 = smallest firms, Portfolio 6 = largest firms.
L-B represents the Ljung-Box test for autocorrelation.
L-B: a, b and c correspond to significance levels of 5%, 1%, and 0.1%, respectively.

return variation is predictable using only the preceding day's returns. Interestingly, autocorrelation tends to be positive for large firms and negative for small ones, a finding consistent with previous studies (see Cohen et al., 1980, for an extensive review). Thus, in general, it appears that the basic statistical properties of our data are similar to those used in earlier analyses.

EMPIRICAL RESULTS

Before examining the potential cointegration and causality between variables, the stationarity of the level series and differenced series was considered. The augmented Dickey-Fuller (ADF) test results indicated that the null hypothesis of non-stationarity was clearly rejected for differenced series. The price levels were found to contain a unit root, i.e., they are non-stationary, which means that the return series is a stationary I(0) variable and the price series is an I(1) variable. As a result, the error correction equations are estimated subsequently with the stationary first differences and level series are used when estimating the cointegration equations.

With cointegration tests, the main interest is to discover whether the residual term in the cointegration regressions is stationary, i.e., I(0) (see e.g., Engle and Granger, 1987). If the residual term is stationary, the price series are called cointegrated which means that they have a common trend. Table 2 reports the ADF *t*-statistics from the cointegration equations based on the level series.

Table 2

Cointegration Regressions. ADF *t*-statistics
H0: Series are Non-cointegrated

Dependent Variable	*Independent Variable*					
	$P1_t$	$P2_t$	$P3_t$	$P4_t$	$P5_t$	$P6_t$
$P1_t$	—	−2.222	−2.984	−3.459	−4.129a	−3.876a
$P2_t$	−2.006	—	−0.683	−0.775	−1.250	−0.664
$P3_t$	−3.443	−1.564	—	−2.581	−2.152	−2.636
$P4_t$	−3.890a	−1.768	−2.700	—	−3.957a	−2.693
$P5_t$	−4.888b	−1.978	−2.516	−3.869a	—	−2.835
$P6_t$	−4.366b	−1.809	−2.849	−2.787	−3.033	—

Notes:
$P1_t$, $P2_t$, $P3_t$, $P4_t$, $P5_t$, and $P6_t$ are level series of stock market prices for the six size-ranked portfolios, respectively.
a, b and c correspond to significance levels of 5%, 1%, and 0.1%, respectively.
The augmented Dickey-Fuller (ADF) test is based on the equation:

$$\Delta\epsilon_t = \theta\epsilon_{t-1} + \sum_{i=1}^{2} \pi_i \Delta\epsilon_{i-i} + v_t$$

where ϵ_t is the error from the cointegration equation; v_t is a stationary random error.

The results indicate that the null hypothesis of non-cointegration is rejected in the context of extreme portfolios. The prices of portfolio 1 representing the smallest firms appear to be cointegrated with the large-firm portfolios 4, 5 and 6. Our results mean that the prices of large and small market value firms are nonstationary and cointegrated, implying that the price response to information shocks is not contemporaneous for all firms. This asymmetry also means deviation from the weak-form informational efficiency. Portfolios 4 and 5 also show some bi-directional cointegration in their price series. Obviously, this cointegration cannot be explained by the firm size-effect. However, it further supports the above finding on the informational inefficiency of the Finnish stock market in the long run. In addition to the firm size effect, some other factors, such as industry differences and ownership structure, might explain the cointegration of stock market prices.

As a result of the above analysis, it becomes necessary to include the error correction term when testing the dynamic linkages of the stock returns of large and small firms. Because of our research setting, the vector error correction (VEC) model including both short- and long-term linkages will be performed with the extreme portfolios, i.e., between portfolios one and six as follows:

$$R6_t = \beta_1\epsilon_{t-1} + \sum_{i=1}^{p} \Omega_i R6_{t-i} + \sum_{j=1}^{q} \pi_j R1_{t-j} + v_{1t} \tag{1}$$

$$R1_t = \beta_2\epsilon_{t-1} + \sum_{i=1}^{p} \mu_i R1_{t-i} + \sum_{j=1}^{q} \theta_j R6_{t-j} + v_{2t} \tag{2}$$

where $R6_t$ and $R1_t$ have been identified as stationary time series; v_{1t} and v_{2t} are zero-mean white noise disturbance terms; ϵ_{t-1} is the lagged error-correction term; and p and q are the lag parameters. In this paper p and q are defined to be two. The longer lags did not lead to any significant improvement in the estimation results. This indicates that the differenced series, i.e., returns, do not contain predictive information for long leads. Table 3 offers the estimation results.

Concerning the short-term adjustments, the results are similar to Lo and MacKinlay (1990). The null hypothesis of no short-term impact of large firms' returns on the returns of small firms is clearly rejected, the F-value being 21.354. However, reverse causality is not observed. The null hypothesis of no impact of small firms' returns on the returns of large firms was not rejected at the 0.05 significance level, the F-value being 2.932. The error correction term becomes significant when predicting the future movements of large firms. This indicates that the co-movements of large and small firms' stock returns may be significantly underestimated if the long-term adjustments between these firms are not given due attention. Our results are in this respect different from the US results reported by Connolly and Conrad (1991).

Table 3

Estimation Results for the Vector Error Correction Model
Small and Large Firms' Returns

Dependent Variable		*Independent Variables*					
	Constant	$Error_{t-1}$	$R1_{t-1}$	$R1_{t-2}$	$R6_{t-1}$	$R6_{t-2}$	R^2
$R1_t$	0.001	0.003	−0.223	−0.027	0.169	0.101	0.059
	(6.040)[b]	(1.727)	(−12.228)[c]	(−1.466)	(4.323)[b]	(2.585)[b]	
$R6_t$	0.000	−0.002	0.019	0.015	0.425	0.020	0.197
	(1.923)	(−2.515)[a]	(2.088)[a]	(1.686)	(22.718)[c]	(1.063)	

Information flow from small firms on large firms:

Hypotheses	*F-statistics*
There is no short term impact	2.932
There is no long term impact	6.352[a]
No short or long term impact	3.159[a]

Information flow from large firms on small firms:

Hypotheses	*F-statistics*
There is no short term impact	21.354[c]
There is no long term impact	2.983
No short or long term impact	22.845[c]

Notes:
R1 and R6 are returns of small firms and large firms, respectively, *t*-values in parentheses.
a, b and c correspond to significance levels of 5%, 1%, and 0.1%, respectively.
Error is the error correction term that represents the residual from the cointegration equation.

DISCUSSION

The results of this paper have several implications for further research. The long-term adjustment between stock market returns should be analysed more carefully when investigating the co-movements of stock returns. It is likely that the co-movements of large and small firms' stock returns may be underestimated especially in small markets if this long-term association is not paid due attention. This finding might be of great importance, for instance, when computing betas for small stocks since these are based on the covariance of small stocks' returns and market portfolio returns. This may also have implications for the observed small firm-effect which has often been explained by the risk underestimation hypothesis. Moreover, our results highlight the dangers generalising the empirical results from larger stock markets to small stock markets.

NOTES

1 These results do not directly support the existence of the small-firm effect since total returns rather than abnormal returns are used here.

REFERENCES

Cohen, K., G. Hawawini, S. Maier, R. Schwartz and D. Whitcomb (1980), 'Implications of Microstructure Theory For Empirical Research on Stock Price Behaviour', *Journal of Finance*, Vol. 35, No. 2 (May), pp. 249–257.

Connolly, R.A. and J. Conrad (1991), 'Cointegration and Lagged Security Price Adjustment', Working Paper (Kenan-Flagler Business School, Chapel Hill, University of North Carolina, October).

Engle, R.F. and C.W.J. Granger (1987), 'Co-integration and an Error Correction: Representation, Estimation and Testing', *Econometrica*, Vol. 55, No. 2 (March), pp. 251–276.

Granger, C.W.J. (1986), 'Developments in the Study of Cointegrated Economic Variables', *Oxford Bulletin of Economics and Statistics*, Vol. 48, No. 2, pp. 213–228.

Lo, A. and A.C. MacKinlay (1990), 'When are Contrarian Profits Due to Stock Market Overreaction'? *Review of Financial Studies*, Vol. 3, No. 2, pp. 175–205.

Martikainen, T., P. Yli-Olli and A. Gunasekaran (1991), 'The Finnish Stock Market: An Investigation for Research and Future Research Directions', *Finnish Journal of Business Economics*, Vol. 40, No. 3 (September), pp. 253–284.