LTA 4/97 • P. 454–473

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The Stock Market and Macroeconomy in Finland in the APT Framework*

ABSTRACT

In this paper we give an overview of the recent Finnish studies considering the relationships between macroeconomic variables and stock market returns. We are especially concentrating on the studies utilizing the Arbitrage Pricing Theory by Ross (1976) and more specifically, the studies where the role of macroeconomic variables in return generating process has been examined. In addition to giving an overview of the previous Finnish studies we shall propose some routes to follow in order to possibly improve the empirical results in the forthcoming Finnish research on this area.

1 INTRODUCTION

According to modern financial theory, the value of a financial asset is equal to the sum of its discounted expected future cash flows. Thus, any macroeconomic variable that systematically

* We wish to thank Tom Berglund, Kim Nummelin, Mika Vaihekoski and an anonymous referee for very useful comments on earlier drafts of this paper.

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influences either the discount rate or the expected cash flows will have an effect on observed returns. This connection between macrovariables and the stock market has been of great interest in many recent financial studies abroad and also in Finland. The main approaches to investigate the association between stock returns and the macroeconomy in the form of an asset pricing model are offered by the intertemporal version of Sharpe's (1964) *Capital Asset Pricing Model* (ICAPM), (see Merton (1973), and more recently Merton (1994) (or *Arbitrage Pricing Theory* (APT), originally formulated by Ross (1976)[1]. According to the intertemporal version of CAPM, macroeconomic variables may represent state variables that have an effect on the investor's preferences over time and consequently, influence the expected rate of return. The APT model assumes that the factors determining the asset prices might be identified as macroeconomic variables. The latter approach represents the main interest of this study, because some of the recent international studies within this framework, especially when utilising a pre-specified set of macrovariables denoting the APT factors, have been promising.

Most of the empirical studies in the APT framework have utilized U.S. data and a major part of the evidence denotes the importance of macroeconomic variables as determinants of stock returns (see, for example, Chen, Roll and Ross (1986), Kim and Wu (1987), and Chen and Jordan (1993). During the latest two decades the relationship between the macroeconomic variables and stock market has been a subject of vivid research also in Finland. One cannot argue that the empirical results applying the APT framework on the Finnish market would have been encouraging with respect to the explanatory power of macroeconomic variables in the determination of stock return. In general, the obtained results have been quite sensitive to the utilized set of macroeconomic variables and also to the methods in the empirical analysis. However, we see that by modifying the set of pre-specified macrovariables and utilizing some new time series analytical methods there still would be room for the APT to work as the theoretical background in evaluating the connections between the stock market and macroeconomy. The main purpose of this paper is to give an overview of the research where the relationship between macrovariables and the stock market has been analyzed applying Finnish data, in a way that has at least in some way been linked to the APT framework. Our paper first gives a short review of Finnish APT studies in general. The number of studies evaluating the pricing of macroeconomic factors being very limited, the main part of our review will then concentrate on studies evaluating the return generating process of Finnish stocks.

The outline of this paper is as follows. In section 2 we present very briefly the theoretical arguments behind the APT and some general, international results from testing it. Section 3

1 Also the Consumption CAPM by Breeden (1989) and the Global CAPM by Adler and Dumas (1983) provide a theoretical framework to investigate the connection between macroeconomy and stock market.

forms the core of this paper, where we give an overview of the Finnish studies concerning the relationship between the macrovariables and stock returns. In addition to the papers where the APT approach has been used, we also briefly mention some studies utilizing e.g. the CAPM modifications. Finally, in section 4 we propose some possible routes to follow in the forthcoming research, especially with the Finnish data. Section 5 gives conclusive remarks.

2 APT FRAMEWORK AND MACROVARIABLES

The APT model is derived by assuming that capital markets are perfectly competitive, all investors have homogenous expectations, they know the data generating processes of security returns and that they always prefer more to less. The theory suggests the stochastic return generating process to be a k factor model of the form

$$R_{it} = E(R_i) + \beta_{i1}\delta_{1t} + \beta_{i2}\delta_{2t} + \ldots + \beta_{ik}\delta_{kt} + \varepsilon_{it},$$

where R_{it} , $i = 1,\ldots,n$, is the random return of asset i in time t and $E(R_i)$ is the expected return on the asset i. The term δ_{kt} denotes the k^{th} mean zero common factor and b_{ik} is the sensitivity of returns on asset i to movements in common factor δ_{kt}, also denoted as factor beta. This equation states that the return of single asset depends on the expected value of the asset and its sensitiveness to movements in common factors. If the prices and hence, returns of assets conform to the condition of no arbitrage above the expected return vector the expected return on a risky asset i is linear in the factor sensitivities of the asset, i.e.

$$E(R_i) = \lambda_0 + \lambda_1 b_{i1} + \lambda_2 b_{i2} + \ldots + \lambda_k b_{ik},$$

where the λ_0 is the constant riskfree rate of return and λ_j, $(j = 1,\ldots,k)$ represents the risk premium for the j^{th} factor in the market equilibrium. The usual interpretation of the common factors is that these represent unanticipated changes in fundamental economy-wide macroeconomic variables.

The early empirical tests of this pricing model have relied on principal component analysis to estimate the factor betas and the associated risk premiums. Generally, the results from these studies have implied that the APT model performs rather well. There are, however, essential drawbacks associated with interpretation of the results of factor analysis. An often mentioned drawback is that the factor analysis makes it difficult to interpret the statistical results, because there is almost a complete lack of economic meaning attached to the factors. Due to the lack of the usefulness of the APT factors in the real financial predictions, the more recent empirical studies on APT have concentrated in prespecifying macrovariables which would compensate for the factor scores.

In particular, the evidence of the studies where innovations in a group of selected macroeconomic time series have been used to estimate the factor betas and the associated risk premiums are encouraging see for example Chen, Roll and Ross (1986), Chen and Jordan (1993). In their seminal paper Chen, Roll and Ross (CRR) tested a pre-specified set of macrovariables which could be interpreted as representing the risks that are rewarded in the stock market. Their results were further supported by numerous studies. In general, according to at least CRR and Chen and Jordan (CJ) the variables which are systematically affecting stock returns in the U.S. market were the short- and long-term interest rates in the spirit of the term structure of interest rates, inflation expectations, inflation, industrial production and risk premium. Intuitively, they argue that these variables represent the essential factors affecting either the discount rate or future cash flows of the firms.

According to CRR, the theoretical interpretation of the individual macro effects could be the following. The term structure of interest rates is an essential factor affecting the discount rate of the future cash flows. On the other hand, changes in the expected rate of inflation are linked to nominal expected cash flows and nominal rate of interest, whereas unanticipated inflation will have a systematic effect on asset valuation. Changes in the expected level of *real* production would have an influence on the current real value of cash flows. Thus, unanticipated changes in the production level should be rewarded on the stock market. Unanticipated changes in risk premia reflect changes in the indirect marginal utility of real wealth and might also capture the uncertainty in industrial production.

But are the prespecified macrovariables relevant in the U.S studies appropriate when the effects of macroeconomic variables are tested for a stock market of a small open economy, like Finland? Martinez and Rubio (1989) tested the APT model with an identical set of macrovariables to the one in CRR on the Spanish stock market. None of the prespecified variables were reported to have a significant effect on the Spanish market. As another example, Löflund (1992) has discussed the appropriate set of macrovariables affecting stock returns in the Swedish market. By analyzing how the market value of equity of a domestic firm is determined in the market, and both theoretically and intuitively characterizing the importance of foreign influences on goods and capital he came to the conclusion and an a priori hypothesis that both international and domestic factors should affect stock returns in a small open economy. Essential international factors might be the unanticipated changes in (real) exchange rates (i.e. nominal exchange rates and foreign inflation) and unanticipated changes in future foreign economic activity or export demand. In addition, Löflund proposed the essential domestic factors to be unexpected inflation, unanticipated changes in short-term interest rate or the term structure of interest rates and unexpected changes in the domestic real production. Even intuitively, one can well argue that the listed variables should be essential in small open economies

where foreign influences on goods and capital markets are even more important than in larger ones. Hence, the set of pre-specified macrovariables that have been used in U.S. studies might not be the most appropriate one when testing the APT relationships in Finland.

3 OVERVIEW OF FINNISH STUDIES

Most of the studies investigating the stock market in the APT framework in Finland have applied the factor analytic approach where the asset sensitivities and unknown factors are estimated simultaneously from the stock return data by factor (i.e. principal component) analysis. On the other hand, a relatively small amount of attention has been paid to evaluating the APT using prespecified macrovariables. However, the general relation between macroeconomic variables and stock market returns has been a subject of vivid research, and a part of this work can be viewed as an attempt to identify the macroeconomic variables behind the return generating process of the APT[2]. Also, a part of the empirical applications has evaluated the relation between prespecified macrovariables, estimated factors of macrovariables, and the estimated factors resulting from the factor analysis of stock returns.

The studies by Östermark (1987), (1988a), (1988b), (1989), (1990), Vieru (1990), Yli-Olli and Virtanen (1989), Yli-Olli, Virtanen and Martikainen (1990) and, Martikainen, Perttunen, Yli-Olli and Gunasekaran (1994) are all applications of factor analysis to stock return data. Some support for a three-factor model is reported by Östermark (1987) with weekly data from 1970–1983. In later studies Östermark (1988a,1988b) also argued that the APT dominates the CAPM in the Swedish and Finnish stock markets. In addition, APT seemed to 'absorb' the explanatory power of CAPM. Analogous results were further reported by Vieru (1990) and Östermark (1990), who tested the portfolio efficiency of the APT and CAPM. Yli-Olli and Virtanen (1989) reported that three stable factors could be found using monthly time series data of the Finnish firms. Yli-Olli, Virtanen and Martikainen (1990) analyzed the Swedish and Finnish stock markets by testing the stability of the factor structures in both markets. They reported that consistent with Yli-Olli and Virtanen (1989) only three factors seem to be stable in these markets. However, a significant bias due to thin trading was reported in results concerning the APT. Martikainen, Perttunen, Yli-Olli and Gunasekaran (1994) analyzed the effect of the return interval on common factors using daily, weekly and monthly return intervals. The authors reported that the factors produced by alternative return intervals significantly differ from each

2 The connection between macroeconomic variables and the stock market in Finland has also been studied by testing the conditional capital asset pricing models with time-varying parameter specifications [see e.g. Knif (1989), Östermark(1990), Berglung and Knif (1992), Knif and Högholm (1993), Malkamäki (1993), Vaihekoski (1996), Nummelin and Vaihekoski (1996), and Nummelin (1997).

other. All in all, discussion of these studies shows that the interpretation of the results obtained by factor analytical tools is very difficult. Referring to the international results the prespecified macrovariable approach in mimicking the APT factors migth be more fruitful than factor analytical also with respect to the Finnish data.

Östermark (1990), Martikainen and Yli-Olli (1991) and Martikainen, Yli-Olli and Gunasekaran (1991) represent the empirical applications where the connection between the prespecified macrovariables and the factors derived from the stock return data has been attempted to be identified. Östermark (1990) analyzed the effects of money supply, inflation, level of industrial production and the psychological impact of the Stockholm Stock Exchange general index on the stock prices in Finland over the years 1970–1987[3]. The empirical evidence implied that all the four macrovariables were related to the factors resulting from the factor analysis of stock returns and thus could be interpreted as determinants of stock prices. Martikainen and Yli-Olli (1991) used the APT model in order to analyze the effects of 11 macroeconomic factors on Finnish stock returns over the years 1977–1986. They reported that three factors could be found from the set of macroeconomic variables when the dimension of the macrovariable set was reduced by applying factor analysis. In addition, the stability of these factors was tested by using transformation analysis. However, the interpretation of the results from the comparison between the factors derived from the stock returns and the factors derived from the macrovariables proved to be a very difficult task. The results by Martikainen and Yli-Olli have been extented by Martikainen, Yli-Olli and Gunasekaran (1991), who investigated the significance of the factors produced by two different testing methods. According to the results of that study the prespecified factors offered incremental information content with respect to the factors produced by exploratory analysis. However, again this result was interpreted to be the thin trading bias in the systematic risk components produced by factor analysis.

The relation between the stock market and macroeconomy in Finland has been the issue in numerous, but very mixed bag of studies. Generally, these studies represent very different approaches to the analysis of the relationships between the stock market and macroeconomy. Some studies concentrate on specifying the effect of a particular macrovariable, like inflation or the exchange rate, on the stock market (see Kanniainen and Kurikka (1983) on using cross-sectional tests and Wahlroos and Berglund (1986), or Liljeblom (1984) for analyzing the time-series relationships], while others have attempted to identify the causality relation between the macroeconomy and stock market. For example, Liljeblom and Stenius (1993) investigated whether changes in stock market volatility through time can be attributed to time-varying vol-

3 An identical set of macrovariables was tested before Östermark in a study by Virtanen and Yli-Olli (1987). When compared to them, Östermark (1990) checked the effect of these variables , except interest rates, within a more rigorous theoretical, i.e. the APT framework.

atility of a set of macroeconomic variables. Linden and Suonperä (1993) investigated the causality between the returns on financial and macroeconomic variables. Sierimo and Virén (1995) investigated whether there exists some kind of dichotomy between financial and nonfinancial variables in Finland, Norway and Sweden. In addition, in studies by Wahlroos and Berglund (1984) and Wahlroos (1985) the causality from the stock market to macrovariables was the main issue.

A forecasting model with a set of pre-specified macrovariables to predict the future development of stock market prices was used by Virtanen and Yli-Olli (1987). Also Asprem (1989) tested the impact of different kinds of macrovariables on stock returns by testing a particular macrovariable separately and also regressing the changes in the stock prices on the set of selected macrovariables. Some of the previous studies can be characterized as preliminary step for the Fama-MacBeth type of testing procedure[4] of the APT. Basically in these papers see, e.g. Lahti and Pylkkönen (1989) and Viskari (1992) the macroeconomic variables are specified and after deriving their innovations from a Vector Autoregressive (VAR) analysis, the sensitivity coefficients on these innovations are estimated by running the time-series regression of returns on stock portfolios on innovations.

In the next table we present a summary of Finnish studies where the effects of macrovariables on the return generating process in the stock market have been analyzed. By simplifying the table we have attempted to collect the most essential macrovariables, whose explanatory power in explaining the stock returns in Finland has been tested. Inflation, interest rates and real activity represent the corresponding variables. The effect of money supply has also been analyzed in various studies in Finland and can thus be characterized as one of the key variables. The exchange rate seems to also have been an essential factor influencing the stock market of a small open economy. More specifically, in Table 1 we list only the papers and variables where an assumed causality from macroecomy to the stock market has been the main issue.

As we can see from the table above, the most frequently analyzed variables have been inflation and real activity measured by different variations (discussed in more detail in the following subsections). The effects of long-term interest rates and money supply have also been an issue in various studies. On the contrary, the effects of short-term interest rates and exchange rate(s) have been analyzed in fewer studies[5]. Another feature of the listed studies is that they have used varying kinds of measures for stock returns. The effect of macrovariables

4 To put it briefly, in the APT-context the Fama-MacBeth procedure consists of i) estimating the innovations of macroeconomic variables, ii) estimation of sensitivity coefficients for stocks or portfolios of stocks on the macroinnovations obtained from the first step, and iii) the use of estimated sensitivity coefficients (corresponding to so-called factor betas, if factor analysis were used) in explaining the stock or portfolio returns in a cross-sectional regression equation.

TABLE 1. The key macroeconomic variables in the previous Finnish studies.

Author	Liljeblom (1984)	Wahlroos and Berglund (1986)	Virtanen and Yli-Olli (1987)	Asperem (1989)	Lahti and Pylkkönen (1989)*	Viskari (1992)*
Data	Daily and weekly 1977–1982	Monthly 1969–1982	Monthly and quaterly 1975–1986	Quaterly 1968–1984	Monthly 1962–1987	Monthly 1982–1990
Dependent variable	I) Market return based on WI index and II) return of 66 different stocks	I) Market return based on WI index and II) inflation adjusted market return	UNITAS index	Market return based on average buying quotations	Inflation-adjusted market return based on UNITAS index	Inflation-adjusted market return based on UNITAS index
Independent variables/Results						
Inflation						
a) actual			+			
b) expected		– in I) and II)		– [1),2),3)]		
c) unexpected		Unsignif. in I), – in II)		Unsignif.[1)]	–	Unsignif.
(Change in) money supply				+[2),3)]	Unsignif.	+
Interest rates						
a) long-term			–	Unsignif.[1)]	–	
b) short-term				+[2)]		Unsignif.
(Change in) exchange rate(s)	+ in I) when including the de/revaluation days, and unsignif. for foreign oriented stocks in II)			Unsignif.[1)] +[3)]		Unsignif.
Real activity		Unsignif.	–	Unsignif.[1)]	Unsignif.	Unsignif.

+/– denotes the statistically significant positive/negative relationship.
Results from the Asprem (1989) study can be classified as obtained from
[1)] regressions of the market return on individual macrovariables separately,
[2)] regressions of the market return on a set of monetary variables,
[3)] regressions of the market return on the set of macrovariables and returns on different asset portfolios.
* refers to studies where the independent variables have been generated as innovations from a VAR model estimated for the set of macrovariables.

on stock returns via the use of the general index of the HeSe stocks or some sort of compounded value of individual stocks has been examined in studies by Wahlroos and Berglund (1986), Virtanen and Yli-Olli (1987), Lahti and Pylkkönen (1989), Asprem (1989) and Viskari (1992). Liljeblom (1984) used both the market portfolio and individual stock prices in analyzing the effect of exchange rates on the stock market. The notable point is that in the set of studies listed above her paper would seem to be the only Finnish paper analysing the macroeffects on individual company shares.

In addition to the variables listed in Table 1, for example, in the study by Virtanen and Yli-Olli (1987) and Asprem (1989) the effect of foreign stock markets has been analyzed and was found to be positive and significantly different from zero. However, because the main emphasis in our paper is on the analysis of the effects of different kinds of macrovariables on the RGP of Finnish stocks, in the following subsections we outline the general methods and especially the variable definitions in the above listed studies in more detail.

3.1 Inflation

Wahlroos and Berglund (1986) examined the relationship between stock returns and expected as well as unexpected inflation in Finland[6]. They found support for Fama's suggestion that higher inflation may proxy a drop in the money demand induced by a lower growth in real activity, which simultaneously implies a drop in stock prices and hence, returns. That result was in contradiction to the results of Kanniainen and Kurikka (1984), who suggested that inflation would rather be good than bad news for the stock market in Finland (implying a positive relation between stock returns and inflation). In both of these studies statistically significant relationships were reported. However, the results were based on different methodologies and samples of the data. Although analogous results with Kanniainen and Kurikka (1984) were reported by Virtanen and Yli-Olli (1987), some of the Finnish studies seem to support the view that an *unexpected increase* in the inflation rate is bad news for Finnish stock investors see, for example, Lahti and Pylkkönen (1989) . In addition, Asprem (1989) reported that also the *expected* inflation rate affects stock returns negatively. In spite of the rather mutually contradictory results in the above studies, the common feature seems to be that some kind of measure for the inflation rate is a significant determinant of the stock returns in Finland, too. For a notable exception see Viskari (1992). This view was also supported by Öster-

5 Notice that in terms of the CRR paper (and also according to other U.S. results) one of the essential factors affecting the stock prices has been the risk premium. This kind of variable, whose proxy (in the U.S. studies) has been for example the difference between high and low graded bond returns, has not been analyzed in any of the above listed Finnish studies.

6 Nominal stock returns were reported to be strongly negatively related to expected inflation and real stock returns depended negatively on unexpected inflation.

mark (1990) and Martikainen and Yli-Olli (1991), who reported that various inflation measures might be identified as APT factors. In the APT framework the above results should especially be discussed in view of the theoretical argumentation that it is essential to extract the unanticipated part of the macrovariables in order to test whether unanticipated news concerning the macroeconomy represent risks that are rewarded on the stock market. Thus the main interest should be on the results where the effect of the unanticipated part of inflation is tested on the stock market.

Inflation expectations have been measured by various kinds of methods in the above listed studies. Wahlroos and Berglund (1986) obtained the forecast of inflation (used as a proxy for the expected inflation) by employing ARIMA models and estimates from money-supply and real activity-based prediction models. The alternative method of extracting the unanticipated inflation, i.e. the use of VAR model has been employed in studies by Lahti and Pylkkönen (1989) and Viskari (1992). The results of these studies imply a negative relation between unexpected inflation and the stock market in Finland (although not statistically significant in the latter).

3.2 Money supply

Virtanen and Yli-Olli (1987) and also Asprem (1989) found support for Sprinkel's forecasting framework [see Bicksler (1972)] , according to which changes in the money stock could be used to predict changes in the level of the market index. Thus, a rise in money supply would raise the stock market prices. However, according to the empirical results reported in Virtanen and Yli-Olli (1987) the money supply and inflation proved to be alternative explanatory variables in the model so they used actual inflation to mimic the money supply effects. Asprem (1989) used both M1 and M2 measures for money supply and obtained similar conclusions from the analysis. In addition to the studies listed in Table 1, utilizing factor analysis some kind of connection between money supply and the stock market was also found by Östermark (1990), and Martikainen and Yli-Olli (1991). Somewhat in contrast to these results Lahti and Pylkkönen (1989) reported the *unanticipated* part of the *real money supply* to be statistically insignificant in explaining changes in stock prices. Furthermore, the result by Viskari (1992) indicated that the unanticipated nominal money supply deflated by the consumer price index was positively (and statistically significantly) related to stock prices. The unanticipated component of money supply was extracted by the VAR technique in both of the latter mentioned studies.

None of the previous Finnish studies would seem to provide support for another theoretical explanation of the effects of money supply on the stock returns. This approach is based on an equilibrium model in which expected real returns on common stocks are negatively related

to money growth (and expected inflation)[7]. According to the model, the fall in real wealth associated with an increase in expected inflation decreases the real rate of interest and the expected real rate of return on the market portfolio. However, as emphasised by for example Stulz (1986), the origin of the rise of inflation expectations is essential here, because according to his analysis, the effect of a rising money supply in lowering the stock return would be smaller than the corresponding effect from worsening of the investment opportunity set.

3.3 Interest rates

The effect of interest rates on stock returns has been analyzed by using the return of long-term government bonds in most of the Finnish studies listed in this paper. In contrast, the relation between short-term rates and stock returns has not actually been an issue in most of the earlier Finnish studies due to the lack of available data. Thus, a measure corresponding to some sort of term structure variable (like the spread between long- and short-term interest rates) utilized for instance in U.S. studies has not been tested in previous Finnish studies.

In bivariate regressions between the market return and long-term interest rate Asprem (1989) found an insignificant relationship, but when the long-term rate was included in the set of explanatory monetary variables, its effect on market return was found to be positive and significantly different from zero. On the contrary, a negative relationship with respect to the long-term interest rates has been reported by Virtanen and Yli-Olli (1987), and Lahti and Pylkkönen (1989). In the latter study the effect of an unanticipated change in long-term interest rates was tested via extracting the unanticipated component with the VAR technique. More generally, according to the previous Finnish results it would seem that there has been a negative relationship between unanticipated changes in long-term interest rates and stock market returns. However, in modern Finnish markets it might be more interesting to test the relationship between unanticipated changes in the actual term structure of interest rates and stock returns.

3.4 Exchange rate

Foreign trade variables are more important factors affecting a small open economy than in larger economies. We may assume that unanticipated changes in exchange rates have a systematic effect on the value of domestic firms see Löflund (1992) . The depreciation of a currency improves the competitive position of domestic firms and correspondingly, an appreciation of the currency deteriorates it. The underlaying economic factors behind exchanges rate

7 See Stulz (1986) and also Cox, Ingersoll & Ross (1985). Note that the discussion of the money supply effects is very much related to the analysis of inflation effects, but in the latter case the analysis is based on the effects of changes in the money *demand* rather than supply [see also Fama (1981)], which is in connection to the real activity in the overall economy (section 3.1).

changes may also affect the stock prices. Using simple regression analysis Liljeblom (1984) reported that the stock market is sensitive to contemporary changes in the external value of Finnish markka by detecting relationships between the market portfolio and several currencies on daily and weekly data. According to Asprem (1989), if the exchange rate changes are caused by a deteriorating domestic economy, they should have an adverse effect on the local stock market. However, Asprem (1989) did not find a statistically significant relationship when regressing the changes in the stock prices on changes in an effective trade-weighted FIM/USD exchange rate. An insignificant negative coefficient occurred when the lagged values of the exchange rate were used. Nevertheless, the regression coefficient was positive when actual values of exchange rate were used. Viskari (1992) supplemented the previously mentioned Lahti and Pylkkönen's (1989) analysis by including the unanticipated component of the real exhange rate into the set of prespecified macrovariables. The results of that study did not imply a statistically significant relationship between the unanticipated change in the real exhange rate and stock returns.

3.5 Real activity

Asset prices should reflect expectations of future earnings, which are likely to be influenced by the overall real activity in the economy. Measures of real activity such as industrial production, real gross national production, gross capital formation, employment and exports have all been classified as previously used descriptions of real activity for Table 1 above. Wahlroos and Berglund (1986) used the seasonally adjusted industrial production series to denote the real activity of the Finnish economy and documented a strong positive relation between real stock returns and predictions of future activity.

Asprem (1989) found the industrial production to be the most promising of the five above listed real activity measures when stock returns were regressed separately on each of them in 10 European countries, including Finland. However, the coefficients of actual and selected leading values of industrial production were insignificant when explaining stock returns in Finland. Furthermore, a strong negative relationship between the stock returns and lagged values of employment was reported. An explanation was given by intuitively arguing that employment might be expected to increase only in the later stages of a boom period at a point when declining earnings are expected for most firms (see Asprem (1989). The aggregated future cashflow expectations of firms regarding expected change in the order stock for Finnish industry has been used as a measure of real activity by Virtanen and Yli-Olli (1987), where the results implied that this measure is a significant determinant of the development of stock market prices. In addition, innovations of industrial production were reported by Lahti and Pylkkönen (1989) and Viskari (1992) to be insignificant in explaining stock returns.

As emphasised several times already in the two first sections, the main interest in the APT framework is to test whether una*nticipated* movements in macroeconomic variables represent risks that are rewarded on the stock market. It would seem that after all, the explanatory power of individual pre-specified macroeconomic variables in explaining the behaviour of stock returns is somewhat questionable with Finnish data. Clearly the most successful variable would seem to have been the rate of inflation, especially when expectations of it and/or unexpected inflation have been used in the analysis [like in Wahlroos and Berglund (1986)]. However, at least in the APT framework, the earlier results indicate that in general, macroeconomic variables have been poor determinants of stock returns especially for the data prior to the liberalization of the financial markets approximately in the mid 1980's. In the next section, for the forthcoming research utilizing Finnish data we would like to give some suggestions to first of all improve the pre-specified set of macrovariables. Moreover, we also would like to propose some modern empirical methods to be possibly utilized in future studies.

4 SUGGESTIONS FOR FURTHER RESEARCH IN FINLAND

4.1 Additional or new variables

For a small open economy like Finland already the choice of the pre-specified macro variables that *might* be priced in the stock market is a very sensitive step in the analysis. The examination of the role of variables listed in the influential CRR paper has been somewhat limited in the Finnish analysis utilizing the APT framework. For example, none of the previous Finnish studies listed in Table 1 has *parametrically* (e.g. via introducing a proxy for some kind of risk premium) attempted to take any kind of risks[8] connected to the market or economy in general into account. This comes from the fact that in Finland it is difficult to define any risk premium proxies corresponding to, for example, the ones used with the U.S. data, like the difference between the high- and low-rated bond returns due to the lack of such a risk-related bond market. In future empirical studies the effect of risk premium could be mirrorred for example in the instability of the estimated macroeconomic sensitivity coefficients. It is possible to reveal this instability by applying a recursive estimation procedure, enabling also us to specify the possible structural changes in the model and/or variables involved. In addition, prior to the

8 In addition to the use of, for example, beta corrections for the individual asset or portfolio returns also the introduction of separate risk factors, like liquidity constraints, characteristic to the Finnish market, might be worthwhile in the forthcoming studies. The previous Finnish papers also indicate that the empirical results are very much labelled by the choice of the dependent variable when modelling the return generating processes in the market. Naturally, the studies utilizing the market index or alternatively, different sets of portfolios, or even time series of individual company shares, yield strikingly different results. Also the theoretical argumentations are very much dependent on whether we assume the analyzed markets to be fully segmented, fully integrated or something in between. In the Finnish market the degree of integration has risen significantly since the mid 1980's.

liberalisation of financial markets it was difficult to examine the role of the term structure of interest rates in the return generating process, but the quotation of the HELIBOR rates from the beginning of 1987 has made that possible, too.

In addition to the inflation rate and real activity, the most frequently examined macro measures in Finnish studies have been more or less connected to the monetary side of the economy, like the money supply, short- and long-term interest rates and exchange rates (cf. table 1 in section 3). Remembering that the recent change in the focus of monetary policy from the intermediate targets (such as money supply) to more final policy targets (like growth and macroeconomic stability) in many countries has increased the need to quantify the effects of monetary policy instruments on output and inflation we propose the use of one recently introduced new aggregate variable, i.e. the Monetary Conditions Index (MCI)[9] in the future studies. When viewing the MCI in terms of the previous studies listed in this paper, the use of it as a composite univariate measure of the economywide effects of changes in the exchange rates and interest rates might have a role to play also when examining the return generating process of stocks in Finland.

4.2 Structural relations and their stability

In line with the international results, the possible strong multicollinearity between the chosen macrovariables has been recognized as a major problem in most of the Finnish studies, too. From the analytical point of view, for example when including inflation expectations and the yield spread of interest rates to the analysis as separate, independent exogenous variables, the hypothesis that the yield spread between short- and long-term interest yielding assets has predictive power over the changes in future inflation (see Mishkin (1990) and Campbell & Shiller (1991)) is actually implicitly rejected. This question is also related to the famous Fisherian (1930) hypothesis of a one-to-one positive relation between inflation expectations and asset market yields (or interest rates)[10]. Hence, in addition to the possibility of multicollinearity between the variables, even endogeneity of many of the variables in the background macro model(s), should be considered. The richer conditional analysis in the form of testing these structural relationships between the macrovariables before the examination of their role in determining the stock return is one possibly fruitful approach in the future.

9 The MCI has originally been officially introduced by the Bank of Canada [see Freedman (1994)] as a *univariate measure* of the effects of the interest rates and exchange rates on economic activity and inflation. To put it briefly, the index is a weighted sum of changes in a short-term interest rate and exchange rate relative to the values in a baseline year. The weights reflect the variables' estimated relative effects on the long-term target variables, like output or inflation. Even though for both analytical and empirical reasons the use of the MCI in implementing the monetary policy actions might be questionable [see Eica, Ericsson & Nymoen (1996)], it clearly has the nature of an informative variable describing the s*tance of the monetary economy*.

10 Notice that the empirical results have usually been in favour of a negative relation between stock returns and (expected) inflation.

From a purely empirical point of view it might be that it is *simply the different nature of the economic variables involved in the analysis* that has caused the poor performance of the macro variables in affecting the return generating process of common stocks. The stock return is clearly of a short-run nature, because speculation in the stock market during fairly short time intervals (like months, weeks and even days) is very common, whereas for instance macro measures like real economic activity, inflation and the development of the economy in general are more related to the longer (over one year) time horizons. On the other hand, certain macrovariables, like e.g. exchange rates might be a subject for speculative behaviour in a very short run, too. Hence, when analyzing the effects on the stock market, it could be reasonable to take into account both the underlying possible *short- and longer-run relations* between the macroeconomic variables in the modelling and estimation procedure, too.

On a thin market the pricing relations between the macroeconomy and the stock market might be very sensitive to the possible *structural breaks* in the economy[11], and to the *structural instability in the relationships between the macroeconomic variables*. As evident already in table 1, one of the most important and frequently examined macrovariables in previous Finnish (and also foreign) studies has been the rate of inflation. Hence, at least for this variable the obvious structural changes should be explicitly taken into account in the analysis. The forthcoming research involving the data from the latest ten years should at least consider such extreme occasions like both the exceptional boom and recession, changes in the monetary policy and exchange rate regimes and also several changes in the tax regime. All these events might have affected the ex post, and hence, also possibly the ex ante rates of inflation.

4.3 Empirical methods in the time series analysis

In earlier literature at least two alternative methods and their modifications have been used to extract the unanticipated components from the macrovariables for the empirical analysis. First, the differenced values of actual macroeconomic series have been used as innovations as such, in which case the investors have a very restricted information set. Here the possible interpretations of the model are most clearly dependent on the choice of the prespecified macrovariables. Furthermore, one modification of this method is the case where a random walk model has been estimated for the analysed series (which readily induces an assumption that all of the series are *non-stationary*), and the residual series of the RW models for each of the macrovariables constitute the innovation series[12]. In addition to the univariate time series analysis, another method has been to use Vector AutoRegressive (VAR) models introduced by Sims (1980),

11 See, e.g. Löflund (1992) with respect to the Swedish market.
12 In addition to the use of RW models, also the Box-Jenkins, i.e. ARIMA modeling methodology has widely been applied in both the foreign and Finnish studies [see, e.g. Wahlroos & Berglund (1986)].

where the set of macroeconomic variables is treated as forming a dynamic simultaneous equations model, and the innovations, i.e. the residuals from the estimated vectorautoregressive system are considered as unanticipated changes in the macroeconomic variables.

In view of the discussion above, it is fairly obvious that the univariate properties of all the analysed time series should be the starting point of the analysis. Hence, the analysis of *(weak) stationarity*[13] and the use of modern *unit root* techniques might be a possible route to improve the empirical results. One of the most recent applications there is the Johansen procedure[14], which incorporates the VAR modelling methodology to the cointegration framework. Unit roots, cointegration and the data based error-correction models (ECM) have for several years now been of main interest in the empirical analysis of macroeconomic relationships [see Engle & Granger (1987 and 1991)]. The advantage of an ECM is that it enables a flexible presentation of both the short- (differences) and long-run (levels) dynamics of the analysed set of economic variables simultaneously, which is very much related to our discussion on the importance of separating the short- and long- run relations in the empirical analysis of the phenomena considered in this paper. Moreover, the special feature of the Johansen procedure is that it starts by expressing the data generating process of a vector of variables as an unrestricted VAR in the levels of the variables and in addition to testing for the statistical significancy of the cointegrating vectors (long-run relationships) one can also construct likelihood ratio tests for structural linear restrictions (economic hypotheses) on the cointegrating parameters. Thus, already in the beginning all the variables included in the analysis are assumed to be *endogenous* and the (weak) exogeneity of each of the variables at least with respect to the possibly identified structural economic long-run relationships can be tested separately variable by variable. When considering the application of this procedure in the APT framework, also other than the variables in the chosen macro set can be introduced to the ECM as weakly exogenous (conditioning) variables[15] excluded from the cointegration space [see also Johansen (1995)].

All in all, with respect to the time series analytical methods we suggest that the following approaches might we useful in the future research. First, the use of recursive estimation procedures would enable us to reveal the possible structural instabilities in the economic variables and relationships[16]. Moreover, like previously in for example Wahlroos & Berglund (1986),

13 The most frequently cited and utilized test for nonstationarity in the context of stock market data, and in finance literature in general, has been the Cochrane's (1988) variance ratio test.

14 A detailed description of the Johansen procedure can be found in Johansen (1988, 1989, 1991) and Johansen & Juselius (1990) and recent textbook presentations for example in Hamilton (1994) or Banerjee *et al.* (1994).

15 An example of such a variable affecting the possibly identified long-run relationships would be the current stage of the business cycle.

16 It is worth mentioning that the use of recursive and/or rolling regression techniques has been one of the strategies to model the time-variation of macroeconomic risk premia in some of the previous studies (like Ferson and Harvey (1991) for the US data). Here we propose that the recursive analysis should also be considered with respect to the background structural macro relationships possibly identified in the Johansen's procedure. These

one might still apply ARIMA models to construct the unanticipated components of each of the analysed macrovariables separately, but now incorporating the analysis of structural breaks, too[17]. However, due to the above mentioned reasons, the main emphasis in the future research concerning the time series dimension of the Fama-MacBeth type of modelling procedure in the APT framework should according to our view be in the application of the Johansen procedure. The greatest benefit of this would be in separating the short-run macroeconomic relationships from the longer run, perhaps economically more meaningful and structurally identifiable relations, taking into account that both the short- and long-run dynamics might be important in affecting the return generating process of stocks.

5 CONCLUDING REMARKS

In this study we have outlined the previous Finnish studies examining the macro effects on stock market returns. For the main part, the theoretical point of view in this paper was based on the Arbitrage Pricing Theory and more specifically, on the empirical testing of it with prespecified macrovariables. The main result from the previous studies on Finnish data is that in general, the macrovariables might not be very good determinants of the stock returns in the Finnish market. However, some individual economywide variables, like the rate of inflation, have been promising in terms of having explanatory power on stock returns in some of the Finnish studies.

In addition to an overview of Finnish studies, we have also proposed some possible ways to perhaps improve the empirical results in the forthcoming tests of APT with prespecified variables utilizing the Finnish data. We propose that a methodological improvement would be to use unit root econometrics and recursive estimation methods in the empirical analysis. Moreover, we suggest that the use of new, composite macrovariables, like the Monetary Conditions Index (MCI) could be useful in future research. ■

possibly time-varying structural relations (like the Fisher hypthesis or the term structure of interest rates) would then be induced as coefficient restrictions in the underlying macro model, from wich the factor sensitivities of the asset returns would be derived. The rolling or recursive estimation of the ECMs for the macrovariable set would reveal the possible instabilities in both the short- and long-run coefficients (or actually the short-run 'loadings' of the long-run relationships). These might be important in the final stage of APT analysis, i.e. in the examination of the pricing of macroeconomic risks in the stock market.

17 One possibility to take empirically into account structural instabilities in the univariate analysis might be the use of for example Markow switching models (see Hamilton (1989, 1990 and 1994) and for the application for example Evans & Wachtel (1993) and Evans & Lewis (1995)). Another alternative in the ARIMA context would be for instance the so-called Tsay (1988) procedure, the advantage of which is that it would enable one to extract separately and without prior subjective decisions on timing and n*ature* the effect of two different types of outliers (innovational and additive), level shifts and variance changes on the data generating process of inflation [for the applications see for instance Chen & Tiao (1990), Balke & Fomby (1991) and Chen & Liu (1993)].

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