Martin-Luther-Universität Halle-Wittenberg

Wirtschaftswissenschaftliche Fakultät

The Effect of Macroeconomic Factors on Asset Returns: A Comparative Analysis of the German and the Turkish Stock Markets in an APT Framework

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Betriebswirtschaftliche Diskussionsbeiträge

Beitrag Nr. 48/2003

Große Steinstraße 73 – D-02108 Halle (Saale)

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May 2003

Abstract

This paper uses factor analytic techniques for deriving factor realizations from a group of main economic indicators of both the German and the Turkish economy in order to test the effect of economic factors on asset returns in an APT framework. The factor structure of the German economy yields 4 factors, whereas the Turkish economy has only 3 factors even though the same economic indicators are employed in the factor analysis procedures. We found some evidence of the unexpected interest rate factor and the unexpected inflation factor beta coefficients having significant effects on asset returns of the German Stock Market. But we were not able to find any unexpected macroeconomic factor beta with a significant influence on asset returns in the Turkish Stock Market.

JEL Classification : C13; G12; G15

Keywords : Asset Pricing; Arbitrage Pricing Theory; Factor Analysis; Expected Returns; Principle Components

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1. Introduction

The Arbitrage Pricing Theory (APT) was introduced by Ross (1976, 1977) as an alternative to the Capital Asset Pricing Model (CAPM) by Sharpe (1964), Lintner (1965) and Mossin (1966), and extended by Huberman (1982), and Chamberlain and Rothschild (1983). Now there is a large theoretical literature about the theory with various empirical studies[1].

APT depends on the law of one price and categorises the risk of an asset into two parts: systematic risk, which is a result of more than one common factor, and unsystematic risk. Thus in the APT framework, a linear relation between the expected return and "*k*" number of common factor betas is proposed under the assumptions of homogeneous investor expectations, risk averse utility maximising investors, a frictionless and perfectly competitive capital market with no asymptotic arbitrage opportunities. This smaller number of assumptions relative to the CAPM, with the unpromising results of various empirical studies on the cross sectional relation between market beta and expected return opposite to CAPM proposals, makes APT more attractive and less restrictive for empirical researchers.

As opposed to *k* factor framework of the APT, CAPM employs only Market Portfolio in the centre of the pricing relation. But among the great number of empirical studies on the CAPM, Gibbons (1982), MacKinlay (1987), Reinganum (1981), Lakonishok and Shapiro (1986) and Coggin and Hunter (1985) could not present strong evidence for the expected return-market beta relation. Nor were Fama and French (1992) able to find statistically significant relation between beta and expected return, yet they found evidence of significant effects on asset returns due to some other factors, such as size and book to market ratio. Hence, these results supported the argument that the Market Portfolio as the only risk source is not capable of explaining returns on average. With its multifactor return generating structure, the APT is thought to fill the gap stated in empirical results found on the

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[1] For example; Reinganum (1981), Jobson (1982), Shanken (1982), Brown and Weinstein (1983), Chamberlain (1983), Chen (1983), Stambaugh (1983), Dhrymes, Friend and Gultekin (1984), Cho, Elton and Gruber (1984), Ingersoll (1984), Chen, Roll, Ross (1986), Connor and Korajczk (1986), Burmeister and McElroy (1988), Tiemann (1988), Lehman and Modest (1988), Ferson and Harvey (1991), Mei (1993), Chen et.al.(1996), Brennan , Chordia and Subrahmanyam (1998).

CAPM. But on the other hand, the APT has a serious disadvantage in defining systematic risk factors. In contrast to the APT, the "Market Portfolio" as the only risk factor in the CAPM is clearly defined, although there is serious criticism of the empirical formulation of this factor, for instance expressed by Roll (1977). But neither the number of factors, nor the type of factors that determine the asset prices are specified in the APT. So these theoretical gaps, combined with further attempts to understand the phenomena in capital markets and the asset pricing problem, provide a motivation for the empirical research in various stock markets in different time periods.

In this paper, various macroeconomic variables representing the basic indicators of an economy are employed in the factor analysis processes and factor realisations of principal economic phenomena are derived. The idea of this kind of analysis is that the macroeconomic variables are considered to be just quantitative indicators of basic economic phenomena. Deriving basic factors from macroeconomic variables and employing these factors in pricing models can provide valuable information about the content of priced factors in different stock markets. Using macroeconomic variables directly in a multivariable regression process can cause estimation problems arising from the multicolinearity problem. On the other hand, generating orthogonal factor realizations eliminates the multicolinearity problem in estimating factor betas and serves to find which economic forces are rewarded by the market .

The organisation of the paper is as follows. In the second section, a brief literature review is presented. The third section describes the methodology of our test. The results of the empirical test can be found in the fourth section. Section five concludes the paper.

2 . A Brief Literature Review

Asset prices are believed to react to economic events. Some macroeconomic changes affect asset prices stronger than others and some do not even affect them at all. Then, the theoretical question of "which economic factors have significant effects on the pricing mechanism" is tried to be resolved by many empirical studies which employ multifactor models[2]. One of the most famous APT tests on this subject was implemented by Chen, Roll and Ross (1986) who considered some significant economic variables to have systematic influence on asset returns. These are: the spread between long and short term interest rates, expected and unexpected inflation, industrial production, and the spread between high- and low-grade bonds. Some other empirical studies of the APT are only focused on determining the number of risk factors that systematically explain the stock market returns by implementing Factor Analysis Methods. There is a great number of papers that employ Factor Analysis methods. For example, Roll and Ross (1980) found that 3 or 4 systematic risk factors are statistically adequate to explain the asset returns in the period of 1962-1972, while on the other hand Chen (1983) found 5 factors in the NYSE and AMEX between 1963-1978. Dhrymes et.al (1985) found a changing number of factors depending on the period length and the size of the stock groups under analysis. Although the number of factors can be estimated in these kinds of analysis, the identification of priced factors is impossible. But in the analysis which employ macroeconomic factors additional information can be obtained by analysing the links between asset returns and macroeconomic events.

Since most APT empirical tests mentioned above deal with the US stock markets, comparative investigations of other markets can give valuable information on the validity of the theory's proposals, for example, the number and the identification of the factors on these markets. In this paper we implement empirical analysis to both German and Turkish stock markets and economic data. Germany and Turkey are both European countries with different levels of economic development. German economy represents an industrialised and developed country with a relatively old stock market, on the other hand, Turkey is a developing country with a young, emerging stock market. Thus estimating the factor structure of both countries and analysing the effects of each country's economic factors on asset returns can

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[2] Some examples of empirical studies that employ macroeconomic variables as explanatory variables in pricing models are: Chan, Chen and Hsieh (1985), Chen, Roll and Ross (1986), Burmeister and Wall (1986), Beenstock and Chan (1988), Burmeister and MacElroy (1988), Chang and Pinegar (1990), Kryzanowski and Zang (1992), Chen and Jordan (1993) and Rahman, Coggin and Lee (1998).

give answers to several questions such as: are factor structures of these countries the same? do the same factors effect asset returns in both markets? are the proposals of APT relevant in both developed and developing markets? which economic risk factors are rewarded in each of these countries?

There are several previous empirical studies of the APT for the German and Turkish Stock Markets. For example, Winkelmann (1984) used monthly returns of 93 assets in the period between 1971-1981 and implemented the principle components analysis method in order to test the APT. Peters (1987) analysed the 1975-1985 period with 21-day stock returns. Frantzman (1989) employed daily returns for 1980-1985 period by using the maximum likelihood factor analysis method. Verlerger (1993) implemented an APT test for weekly stock returns for the period of 1972-1985. Sauer (1994) analysed the 1970-1989 period by implementing the maximum likelihood factor analysis method and also used some macroeconomic variables as potential common risk factors. Adelberger and Lockert (1999) analysed the Frankfurt Stock Exchange in the 1976-1991 period by calculating eigenvalues of weekly and monthly asset returns. All these analyses that have different time periods support the evidence of more than one statistically significant factor explaining the asset returns in the German Stock Market.

A research by Özcam (1997) can be considered an example of APT testing in Istanbul Stock Exchange. In this research, seven macroeconomic variables of Turkish economy are separated into expected and unexpected series by a regression process, then two-step testing methodology is implemented on these series. A sample population of 54 stocks for the period of 01/1989-07/1995 is used. As a result, beta coefficients of expected factors are found significant for asset returns. Altay (2001) is another example of two different APT tests in Istanbul Stock Exchange. In the first test, factor analysis method is employed in daily returns of 121 to 265 stocks in the 1993-2000 period for each year and one dominant significant factor is found among several minor significant factors for each year. The second test employs multivariable regression process in order to examine the significance of macroeconomic variables on asset returns. As a result only expected treasury bill interest rate beta is found significant for explaining asset returns.

All these above stated studies for German and Turkish Stock Markets employ Factor Analysis Methods in order to derive basic common factors from stock returns or utilize regression processes to test the significance of macroeconomic variables and their betas on asset returns. In this paper, a different method is used for testing the effect of macroeconomic factors on asset prices in both markets which has a similar idea with Cheng (1995). Cheng implemented factor analysis on both asset returns and macroeconomic variables in order to derive priced security factors and macroeconomic factors, then compared these two categories of factors with a canonical correlation analysis in order to reach a statistically significant relation. This kind of analysis eliminates the problems of the multicolinearity and the sensitivity of the estimation results to the number of independent variables, in pricing model of classical multivariate regression testing techniques of APT. In our analysis, we use factor analysis techniques on macroeconomic variables in order to extract unexpected factor time series and implement a classical two-stage test methodology. In the first stage, factor beta coefficients of asset returns are estimated by time series regression where portfolio returns are endogenous variables and derived factors are exogenous variables. In the second stage significance of factor betas on average asset returns are tested by a cross sectional regression process. The advantage of such a methodology is the possibility of eliminating multicolinearity problem between macroeconomic variables and testing the relation between asset returns and macroeconomic factors.

3. The Methodology

We use a two-stage testing methodology which is extensively used in both CAPM and APT testing literature, for example by Fama MacBeth (1973), Roll and Ross (1980), Chen (1983), Chen, Roll and Ross (1986), Lehman and Modest (1988). First of all unexpected potential risk factors are derived, then several portfolios are constructed for testing procedure. In the first stage, factor beta coefficients of each portfolio are estimated by time series regression, and in the second stage a cross sectional regression process is run to estimate the relation between factor betas and average asset returns.

3.1. APT Model

The *k* factor linear pricing model of APT can be shown for the system of N assets under no arbitrage condition as follows:

$$R_t = \mu_t + B\delta_t + \varepsilon_t \qquad (1)$$

$$E(\varepsilon_t \backslash \delta_t) = 0 \text{ , } E(\delta_t) = 0 \text{ , } E(\varepsilon_t \varepsilon'_t \backslash \delta_t) = \Sigma$$

where R_t is a $(N\text{x}1)$ vector of asset returns, μ_t is a $(N\text{x}1)$ vector of expected asset returns, B is a $(N\text{x}K)$ matrix of factor beta coefficients (factor loadings), δ_t is a $(K\text{x}1)$ vector of common factor realisations and ε_t is a $(N\text{x}1)$ vector of idiosyncratic return.

In the absence of riskless arbitrage opportunities in large economies, Ross (1976) shows that there is an approximate relation between expected returns and factor betas:

$$\mu_t \approx \iota\,\lambda_0 + B\lambda_K \qquad (2)$$

where ι is a $(N\text{x}1)$ vector of ones, λ_0 is a scalar of zero beta parameter and λ_K is a $(K\text{x}1)$ vector of factor risk premia. The above approximate relation becomes an exact relation with additional assumptions[3]. The exact pricing relation can be shown as follows:

$$\mu_t = \iota\,\lambda_0 + B\lambda_K \qquad (3)$$

3.2. Deriving Potential Macroeconomic Risk Factors

As it has been mentioned before, APT does not specify neither the number nor the contents of the common risk factors. Thus, the first step of an APT analysis should be the determination of potential systematic risk factors. In our analysis, the main question of "which macroeconomic events are rewarded in stock markets" is tried to be answered for German and Turkish stock markets by employing main macroeconomic variables of each economy in the factor analysis process in order to

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[3] Chamberlain (1983) presents the necessity of the risky well diversified portfolio on the efficient frontier for converting approximate relation to exact pricing relation. Connor (1984) presents competitive equilibrium version of APT with the additional assumption of pervasive factors that enable elimination of unsystematic risk without restricting investors' choice of factor risk exposure. This method employs asymptotic principle components technique and several examples of applying this method can be seen: by Chamberlain and Rothschild (1983), Connor and Korajczk (1986), Connor and Korajczk (1988), McCulloch and Rossi (1990), Ferson and Korajczk (1995), Chen et.al.(1998), Brennan, Chordia and Subrahmanyam (1998), Elton (1999), Pastor and Stambaugh (1999) and Jagannathan and Ma (2001).

derive basic economic dimensions that will be the inputs for multifactor pricing model.

Factor analysis produces a smaller number of orthogonal factors which explains the best covariance structure of original high dimensional data. Implementing factor analysis to *M* number of macroeconomic variables results in the following decomposition of covariance structure into the variation from factors and the residual variation:

$$
\begin{aligned}
V &= BF + \xi \\
VV' &= (BF + \xi)(BF + \xi)' \\
&= (BF + \xi)(F'B' + \xi') \\
&= BFF'B' + BF\xi' + \xi F'B' + \xi\xi' \\
E(VV') &= B\,E(FF')B' + BE(F\xi') + E(\xi F')B' + E(\xi\xi') \\
\Omega &= B\,\Omega_K\,B' + D \qquad (4)
\end{aligned}
$$

where V is a (Mx1) vector of macroeconomic variables $[V_1, V_2,..., V_M]'$, B is a (MxK) factor loading matrix, F is a (Kx1) vector of factors and ξ is a (Mx1) vector of measurement errors for V. On the other hand, $E(VV') = \Omega$ is a (MxM) covariance matrix of macroeconomic variables, Ω_K is a (KxK) factor covariance matrix and D is a (MxM) diagonal residual covariance matrix. Equation (4) shows decomposition of the covariance matrix of variables into variation from factors (first term of right-hand side of the equation) and residual variation (second term of right-hand side of the equation).

Using the above decomposition, factor analysis process produces estimators of B and D, enabling to get *k* number of factor time series from macroeconomic time series. Implementing such a factor analysis process to several economic variables enables us to derive common economic factors for each economy within sample periods.

In this research, two different methods: Principle Components Factor Analysis and Maximum Likelihood Factor Analysis are implemented. The Principle Components method is a variance driven method that produce the first principle component as a linear combination of variables with the highest variance; the second principle component as a linear combination of variables with the highest variance and orthogonal to the first principle component and so on. These principle components with eigenvalues higher than one are rotated with varimax rotation with kaiser normalisation method, and serve as factors in the analysis. On the other hand, the maximum likelihood method is covariance driven. In this method, factors that can explain the covariance structure of variables are extracted by maximum likelihood estimators. In our analysis, varimax rotation with kaiser normalisation method is also applied to the maximum likelihood factor extraction.

3.3. Estimation of Factor Beta Coefficients

APT proposes a multivariable pricing model for return generating process of capital markets where all assets are priced according to their relevant risk level, factor betas. In order to estimate factor beta coefficients of assets, the following time series regression model is used:

$$R_{it} = \overline{R}_i + b_1\delta_{1t} + \ldots + b_k\delta_{kt} + \varepsilon_{it}$$

$$R_{it} - \overline{R}_i = b_1\delta_{1t} + \ldots + b_k\delta_{kt} + \varepsilon_{it} \qquad i = 1, \ldots, N \qquad (5)$$

where R_{it} is the time series of i^{th} asset returns, $\overline{R}_i$ is the expected (average) return of asset *i*, δ_{kt} is the *k*'th unexpected common factor realizations, b_k is the sensitivity of asset *i*'s returns to factor *k* (factor beta coefficient) and ε_{it} is the error term.

Each asset's returns in excess of average return are regressed against common factor time series taht are derived from the factor analysis process. Beta coefficients of each asset for each common factor is estimated by Ordinary Least Squares method.

3.4. Estimation of Factor Risk Premia and Hypothesis Testing

After the estimation of factor beta coefficients, a cross sectional regression process is implemented. The following cross sectional regression model is utilized for each time point to get time series of each risk premia and zero beta return:

$$R_i = \lambda_0 + b_{i1}\lambda_1 + \ldots + b_{ik}\lambda_k + e_i \qquad i = 1,\ldots,N$$

$$\textit{for each} \quad t = 1,\ldots,T$$

where R_i is the return of asset i, λ_0 is the zero beta asset return (constant of cross sectional regression model), b_{ik} is the asset i's beta coefficient to factor k, λ_k is the factor risk premium k and e_i is the error term. The above cross sectional regression is estimated for all t's in sample period and time series of expost risk premia for each factor are estimated, then the means and standard deviations of risk premia are calculated for hypothesis testing.

The test hypothesis of this process is; $H_0 = \lambda_0 , \lambda_1 , \ldots , \lambda_k$ are significantly different from zero. To test this hypothesis a two-tail t-test can be implemented to estimated time-series means of expost risk premia. But Shanken (1992) shows that the beta coefficients used in cross sectional regression are only estimated parameters got from the first time series stage. So, in order to correct the test results, an adjustment is needed as presented by Shanken (1992).

4. Data and Empirical Results

4.1. Description of Data Sets and Sample Period

We use two different data sets in the analysis. The first data set consists of various monthly macroeconomic variables of German and Turkish economy and the second data set includes monthly stock returns of the German and Turkish Stock Markets.

The sample period for Germany is January 1988-June 2002 and for Turkey is January 1993-June 2002. The reason of a shorter period for Turkey arises from its relatively young stock market. The Turkish Stock Market, Istanbul Stock Exchange, was founded in 1985 with a relatively small number of listed stocks. For this reason, analysis of the Turkish Stock Market starts in January 1993, when there was a relatively higher number of stocks.

The total sample period of January 1988-June 2002 (174 months) for Germany is divided into two subperiods: January 1988-December 1990 (36 months) and January 1991-June 2002 (138 months). The reason of having two more subperiods within the main period is the requirement of adjusting for the structural change arising from the Unification of West and East Germany.

4.2. Macroeconomic Data

In previous empirical tests of APT, various macroeconomic variables are utilized in order to explain cross sectional asset returns. These variables can be seen in Table 1.

Table 1: Macroeconomic Variables that are Employed in Previous APT Tests

Macroeconomic Variables	Previous Studies which Employ Indicated Variables
Industrial Production	Chan, Chen and Hsieh (1985), Chen, Roll and Ross (1986), Burnmeister and Wall (1986), Beenstock and Chan (1988), Chang and Pinegar (1990), Kryzanowski and Zhang (1992), Chen and Jordan (1993), Sauer (1994), Özcam (1997), Rahman, Coggin and Lee (1998), Altay (2001)
Inflation	Chan, Chen and Hsieh (1985), Chen, Roll and Ross (1986), Burnmeister and Wall (1986), Burmeister and MacElroy (1988), MacElroy and Burmeister (1988), Chang and Pinegar (1990), Kryzanowski and Zhang (1992), Chen and Jordan (1993), Sauer(1994), Rahman, Coggin and Lee (1998), Altay (2001)
Risk Premium	Chan, Chen and Hsieh (1985), Chen, Roll and Ross (1986), Burnmeister and Wall (1986), MacElroy and Burmeister (1988), Chang and Pinegar (1990), Kryzanowski and Zhang (1992), Chen and Jordan (1993), Sauer (1994), Rahman, Coggin and Lee (1998)
Term Structure	Chan, Chen and Hsieh (1985), Chen, Roll and Ross (1986), Burnmeister and Wall (1986), MacElroy and Burmeister (1988), Sauer (1994), Chang and Pinegar (1990), Kryzanowski and Zhang (1992), Chen and Jordan (1993), Rahman, Coggin and Lee (1998)
Real Consumption	Chan, Chen and Hsieh (1985)
Oil Price	Chan, Chen and Hsieh (1985), Chen and Jordan (1993)
Residual Market Factor	Burnmeister and Wall (1986), MacElroy and Burmeister (1988), Kryzanowski and Zhang (1992)
Money Supply	Beenstock and Chan (1988), Sauer (1994), Özcam (1997), Altay (2001)
Retail Prices	Beenstock and Chan (1988)
Capital Flows	Altay (2001)
Retail Sales	Beenstock and Chan (1988), Sauer (1994), Özcam (1997)
Wages	Beenstock and Chan (1988), Sauer (1994)
Export Prices	Beenstock and Chan (1988)
Exports	Beenstock and Chan (1988), Sauer (1994)
Total Revenue	Burmeister and MacElroy (1988), MacElroy and Burmeister (1988)
Short term Interest Rates	Burmeister and MacElroy (1988), Özcam (1997), Altay (2001)
Domestic National Product	Kryzanowski and Zhang (1992)
Foreign Exchange Rate	Kryzanowski and Zhang (1992), Sauer (1994), Özcam (1997), Altay (2001)
Unemployment	Sauer (1994)
Budget Balance	Özcam (1997)
Current Accounts Balance	Özcam (1997), Altay (2001)
Order Level	Sauer (1994)

In this analysis, macroeconomic data for Germany and Turkey are selected according to the following criteria: (1) variables should be the main economic indicators of the countries, (2) variables should be available in both economies, (3) monthly series of variables should be available.

According to the above criteria, the variables presented in Table 2 are used to derive potential risk factors. Consumer Price Index, Whole Sale Price Index, Imports, Exports, Foreign Exchange and Industrial Production variables are converted to a monthly continuous increase rate by taking their first logarithmic differences:

$$R(V_j)_t = \ln P(V_j)_t - \ln P(V_j)_{t-1}$$

where $R(V_j)_t$ is the continuous return of variable j in month t and $P(V_j)_t$ is the level of variable j in month t. Other variables, namely the average yield of public bonds and money market interest rate, are monthly rates of returns.

The data set for Germany contains 8 monthly series over the period of January 1988-June 2002. On the other hand, the data set for Turkey contain the same series for the period January 1993-June 2002.

Table 2 : Macroeconomic Variables Used in the Analysis

Variable	Symbol	Data Source	Explanation
Panel A: Germany			
Consumer Price Index	CPI-G	OECD	12/87-01/91 Period:Western Germany / 1990 base year 01/91-06/02 Period:Germany / 1995 base year
Wholesale Price Index	WPI-G	OECD	12/87-01/91 Period:Western Germany / 1985 base year 01/91-06/02 Period:Germany / 1995 base year
Imports	IMP-G	OECD	Billion USD
Exports	EXP-G	OECD	Billion USD
Foreign Exchange Rate	FEX-G	OECD	Euro / US Dollars
Average Yield of Public Bonds	IntBND-G	Bundesbank	Average yield of public bonds which has the maturiy between 1-2 years. Converted into monthly rate
Industrial Production Index	IPI-G	OECD	Construction Excluded / 1995 base year
Money Market Interest Rate	IntMNY-G	Bundesbank	Frankfurt interbank monthly interest rate
Panel B: Turkey			
Consumer Price Index	CPI-T	OECD	1995 base year
Wholesale Price Index	WPI-T	OECD	1995 base year
Imports	IMP-T	OECD	Billion USD
Exports	EXP-T	OECD	Billion USD
Foreign Exchange Rate	FEX-T	OECD	Turkish Lira / US Dollars
Average Yield of Public Bonds	IntBND-T	DPT*	Average compounded interest rate of domestic debt
Industrial Production Index	IPI-T	OECD	Construction Excluded / 1995 base year
Money Market Interest Rate	IntMNY-T	TCMB**	Weighted interest rate on one month maturity deposits

* DPT = State Planning Organisation of Turkish Republic
** TCMB = Turkish Republic Central Bank

4.3. Derivation of Factors from Macro Economic Data

The macroeconomic series presented in Table 2 are employed in factor analysis processes of both principle components and maximum likelihood estimations for each subperiod. In addition to these variables, a second kind of factor formation is implemented by alo employing DAX-100 index for the German Stock Market and ISE-100 index for Turkish Stock Market in the factor analysis procedures. These market proxy data are got from Datastream[4]. SPSS 11.0 statistical software is used for performing factor analysis. The number of factors derived from each analysis for each subperiod and the composition of the factors can be seen in Table 3 for Germany.

As it can be seen in Table 3, 4 main factors are derived from 8 macroeconomic variables in all subperiods for German economy. Scree test and Kaiser criterion are used to determine the number of factors. All factors derived from these factor analysis procedures have the property of 0 mean and 1 standard deviation. This property makes factor time series equal to unexpected time series of factor values as the differences between factor values and factor mean (expected factor value) are equal to the series itself[5]. These factors can be identified as unexpected interest rate level, unexpected foreign trade, unexpected inflation and unexpected production when only macro economic variables are employed in either Principle Components Factor Analysis or in Maximum Likelihood Factor Analysis in all subperiods. When the return of DAX-100 index is also employed in factor analysis procedure, in period 01/1988-06/2002 and subperiod 01/1991-06/2002 we get a composition of unexpected production factor and market proxy as the fourth factor. On the other hand in the subperiod 01/1988-12/1990, market proxy formed a separate factor with unexpected interest rate level in principle component factor analysis and formed another factor with unexpected foreign exchange level in maximum likelihood factor analysis.

[4] Datastream is provided as a part of the project "Finanzmarktinnovationen und –institutionen als Folge unvollkommener und unvollständiger Märkte"

[5] There are some other methods of deriving unexpected time series apart from assuming average of time series as expected values and extracting unexpected series simply by subtracting the average from the series. For example: Chen, Roll and Ross (1986) and Özcam (1997).

Table 3: Factors Derived from the Macroeconomic Variables and the Market Proxy of Germany

Factor Analysis Type*	Number of Factors	Factors (*δi*)	Composition of Factors	Total Variance Explained: % of Variance	Total Variance Explained: Cumulative %
Panel A: 01/1988 - 06/2002 Period					
PCFA-1	4	*δ 1:* Unexpected Foreign Trade	EXP-G , IMP-G , FEX-G	25.8	25.8
		δ 2: Unexpected Interest Rate Level	IntBND-G , IntMNY-G	25.8	51.7
		δ 3: Unexpected Inflation	WPI-G , CPI-G	18.4	70.0
		δ 4: Unexpected Production	IPI-G	13.5	83.5
PCFA-2	4	*δ 1:* Unexpected Interest Rate Level	IntBND-G , IntMNY-G	23.3	23.3
		δ 2: Unexpected Foreign Trade	EXP-G , IMP-G, FEX-G	23.0	46.3
		δ 3: Unexpected Inflation	WPI-G , CPI-G	16.4	62.7
		δ 4: Unexpected Production + Market Proxy	IPI-G , DAX-100	13.1	75.8
MLFA-1	4	*δ 1:* Unexpected Interest Rate Level	IntMNY-G , IntBND-G	25.0	25.0
		δ 2: Unexpected Foreign Trade	EXP-G , IMP-G , FEX-G	21.5	46.5
		δ 3: Unexpected Inflation	WPI-G , CPI-G	16.4	62.9
		δ 4: Unexpected Production	CPI-G , IPI-G	6.9	69.7
MLFA-2	4	*δ 1:* Unexpected Interest Rate Level	IntMNY-G , IntBND-G	22.6	22.6
		δ 2: Unexpected Foreign Trade	EXP-G , IMP-G , FEX-G	19.2	41.8
		δ 3: Unexpected Inflation	WPI-G , CPI-G	14.3	56.1
		δ 4: Unexpected Production + Market Proxy	CPI-G, IPI-G , DAX-100	15.1	61.2
Panel B : 01/ 1988 – 12/1990 Subperiod					
PCFA-1	4	*δ 1:* Unexpected Interest Rate Level	IntMNY-G , IntBND-G	26.2	26.2
		δ 2: Unexpected Foreign Trade	EXP-G , IMP-G , FEX-G	25.9	52.2
		δ 3: Unexpected Inflation	CPI-G , WPI-G	19.2	71.4
		δ 4: Unexpected Production	IPI-G	13.6	85.0
PCFA-2	4	*δ1:* Unexpected Interest Rate Level+ Market Proxy	IntBND-G , IntMNY-G , DAX-100	23.9	23.9
		δ 2: Unexpected Foreign Trade	EXP-G , IMP-G, FEX-G	23.9	47.9
		δ 3: Unexpected Inflation	CPI-G , WPI-G	17.5	65.3
		δ 4: Unexpected Production	IPI-G	12.1	77.4
MLFA-1	4	*δ 1:* Unexpected Interest Rate Level	IntMNY-G , IntBND-G	25.7	25.7
		δ 2: Unexpected Foreign Trade	EXP-G , IMP-G , FEX-G	22.3	48.0
		δ 3: Unexpected Inflation	WPI-G , CPI-G	14.8	62.8
		δ 4: Unexpected Production	CPI-G , IPI-G	6.7	69.4
MLFA-2	4	*δ 1:* Unexpected Interest Rate Level	IntMNY-G , IntBND-G	22.7	22.7
		δ 2: Unexpected Foreign Trade	EXP-G , IMP-G	18.4	41.1
		δ 3: Unexpected Inflation + Production	WPI-G , CPI-G. IPI-G	15.1	56.2
		δ 4: Unexpected Foreign Exchange Level+ Market Proxy	FEX-G , DAX-100	9.7	65.9
Panel C: 01/ 1991 – 06/2002 Subperiod					
PCFA-1	4	*δ 1:* Unexpected Interest Rate Level	IntMNY-G , IntBND-G	26.3	26.3
		δ 2: Unexpected Foreign Trade	EXP-G , IMP-G , FEX-G	25.6	51.9
		δ 3: Unexpected Inflation	CPI-G , WPI-G	18.3	70.2
		δ 4: Unexpected Production	IPI-G	13.5	83.7
PCFA-2	4	*δ 1:* Unexpected Interest Rate Level	IntMNY-G , IntBND-G	23.7	26.7
		δ 2: Unexpected Foreign Trade	EXP-G , IMP-G, FEX-G	23.3	46.9
		δ 3: Unexpected Inflation	CPI-G , WPI-G	16.3	63.2
		δ 4: Unexpected Production + Market Proxy	IPI-G , DAX-100	13.5	76.7
MLFA-1	4	*δ 1:* Unexpected Interest Rate Level	IntBND-G , IntMNY-G	25.2	25.2
		δ 2: Unexpected Foreign Trade	EXP-G , IMP-G , FEX-G	21.4	46.6
		δ 3: Unexpected Inflation	WPI-G , CPI-G	16.0	62.6
		δ 4: Unexpected Production	CPI-G , IPI-G	7.6	70.3
MLFA-2	4	*δ 1:* Unexpected Interest Rate Level	IntMNY-G , IntBND-G	23.0	23.0
		δ 2: Unexpected Foreign Trade	EXP-G , IMP-G , FEX-G	19.3	42.2
		δ 3: Unexpected Inflation	WPI-G , CPI-G	14.2	56.4
		δ 4: Unexpected Production + Market Proxy	IPI-G , DAX-100	5.9	62.3

* PCFA-1 : Principle Components Factor Analysis - only macro economic variables are employed,
PCFA-2 : Principle Components Factor Analysis - market proxy and macroeconomic variables are employed,
MLFA-1 : Maximum Likelihood Factor Analysis - only macro economic variables are employed,
MLFA-2 : Maximum Likelihood Factor Analysis - market proxy and macroeconomic variables are employed.

The factor analysis results of the Turkish data are presented in Table 4. Although the same variables are employed in the German economy, in principle components and maximum likelihood factor analysis for the Turkish economy, only 3 factors are derived. When the composition of factors is analysed, one can see that the foreign exchange rate variable is grouped in the first factor with wholesale price index and consumer price index. As foreign exchange rates are one of the basic reason of cost inflation in Turkey, this grouping can be considered to be reasonable. Another different grouping occurs in *δ2*, unexpected foreign trade plus production factor. When imports into Turkish economy are analysed, it can be seen that capital and intermediary goods, necessary for production, make up the majority. Hence, grouping of import and production with exports is also reasonable. The third factor, unexpected interest rate level, is a separate factor like in the case of the German economy.

Table 4: Factors Derived from the Macroeconomic Variables and the Market Proxy of Turkey

Factor Analysis Type*	Number of Factors	Factors (*δi*)	Composition of Factors	Total Variance Explained: % of Variance	Total Variance Explained: Cumulative %
		Period: 01/1993 - 06/2002			
PCFA-1	3	*δ 1:* Unexpected Inflation	WPI-T , CPI-T , FEX-T	31.8	31.8
		δ 2: Unexpected Foreign Trade + Production	IMP-T , IPI-T , EXP-T	22.7	54.4
		δ 3: Unexpected Interest Rate Level	IntMNY-T , IntBND-T	19.7	74.1
PCFA-2	3	δ 1: Unexpected Inflation + Market Proxy	WPI-T , CPI-T , FEX-T, ISE-100	27.9	27.9
		δ 2: Unexpected Foreign Trade + Production	IMP-T, IPI-T , EXP-T	20.9	48.9
		δ 3: Unexpected Interest Rate Level	IntMNY-T , IntBND-T	18.1	67.0
MLFA-1	3	*δ 1:* Unexpected Inflation	WPI-T , CPI-T , FEX-T	29.0	29.0
		δ 2: Unexpected Foreign Trade + Production	IMP-T , IPI-T , EXP-T	18.6	47.6
		δ 3: Unexpected Interest Rate Level	IntMNY-T , IntBND-T	17.1	64.8
MLFA-2	3	*δ 1:* Unexpected Inflation + Market Proxy	WPI-T , CPI-T , FEX-T, ISE-100	26.1	26.1
		δ 2: Unexpected Foreign Trade + Production + Market Proxy	IMP-T, IPI-T , EXP-T, ISE-100	17.0	43.1
		δ 3: Unexpected Interest Rate Level	IntMNY-T , IntBND-T	15.5	58.6

* PCFA-1 : Principle Components Factor Analysis - only macro economic variables are employed,
PCFA-2 : Principle Components Factor Analysis - market proxy and macroeconomic variables are employed,
MLFA-1 : Maximum Likelihood Factor Analysis - only macro economic variables are employed,
MLFA-2 : Maximum Likelihood Factor Analysis - market proxy and macroeconomic variables are employed.

The percentage of total variance explained by 4 factors changes between 61.2% - 83.5% in 01/1988-06/2002 period, 69.4% - 85.0% in 01/1988-12/1990 subperiod and 62.3% - 83.7% in 01/1991-06/2002 subperiod for the German economy. On the other hand, 3 variables can explain 58.6% - 74.1% of total variance in variables of the Turkish economy.

In all types of analysis, the Kaiser-Meyer-Olkin test values vary between 50.9 – 56.0 for the German data and 61.0 – 61.1 for the Turkish data. Barlett test of sphericity is also significant at 1% level, indicating that factor analysis is suitable for deriving factors from these macroeconomic data.

4.4. Construction of Portfolios

After deriving potential risk factor series from basic macroeconomic variables, several portfolios are constructed in order to test the effect of these factors on asset returns. We prefer the random portfolio construction method. For this reason, alphabetically ordered stocks are used in portfolio construction process. The sample population of stocks in the German Stock Market require the following criteria: (1) stocks should not be traded only in Freiverkehr[6] Market, (2) thinly traded stocks are excluded, (3) stocks should be traded in the full subperiod. On the other hand, sample population of stocks in the Turkish Stock Market require the following criteria: (1) stocks should be traded in ISE (Istanbul Stock Exchange) National Market, (2) stocks should be traded during the whole subperiod. According to these criteria, the total number of assets included in the analysis can be seen in Table 5.

Table 5: Total Number of Assets Included in the Analysis

Stock Market	**Subperiod**	**Total Number of Stocks included in the Analysis (*N*)**
German Stock Market	01/1988 – 06/2002	101
German Stock Market	01/1988 – 12/1990	101
German Stock Market	01/1991 – 06/2002	177
Turkish Stock Market	01/1993 – 06/2002	101

[6] Freiverkehr Market is a German Stock Market Segment which has very low regulations.

Stock returns are extracted by calculating the first logarithmic difference of "total return index" series of each stock. The total return index data are obtained from the Datastream. The portfolio construction process can be described as follows: first, stocks are listed in their alphabetical order. Then, the total sample population (*N*) is divided by 20 in order to get portfolios with the equal numbers of stocks. The first *N*/20 stocks are included in the first portfolio, the second *N*/20 stocks are included in the second portfolio and so on. The excess number of stocks is included in portfolios one by one starting from the first portfolio. By implementing this method, 20 portfolios are constructed for each stock market and subperiod. The purpose of constructing 20 portfolios is to get a relatively high number of assets that will be used in the cross sectional analysis[7]. Portfolio statistics can be seen in Table 6.

The average portfolio returns of the German Stock market for the 01/1988-12/1990 subperiod are considerably higher than those for the subperiod of 01/1991-06/2002. Total risks, measured as standard deviation, are also higher but not at the same level as asset returns. When we compare portfolios of the Turkish Stock Market with portfolio statistics of the German Stock Market, we can see that Turkish portfolios have relatively high average returns and standard deviations according to all subperiods of the German Stock Market.

[7] The cost of having a relatively high number of portfolios is having less number of stocks included in each portfolio. For this reason, in order to increase the number of stocks in each portfolio, the second portfolio construction method is also implemented by using the same procedure to get only 10 portfolios with a higher number of stocks in each portfolio. The same analysis is done for both the 20-portfolio case and the 10-portfolio case for each stock market and subperiod. The results of the 10-portfolio case can be seen in the appendix.

Table 6: Portfolio Statistics

Portfolios	German Stock Market						Turkish Stock Market	
	Period 01/1988 – 06/2002		Subperiod 01/1988 – 12/1990		Subperiod 01/1991 – 06/2002		Period 01/1993 – 06/2002	
	Average Return $\overline{R}_i$	Standard Deviation $s(R_i)$	Average Return $\overline{R}_i$	Standard Deviation $s(R_i)$	Average Return $\overline{R}_i$	Standard Deviation $s(R_i)$	Average Return $\overline{R}_i$	Standard Deviation $s(R_i)$
P1	0.005	0.062	0.024	0.075	0.002	0.048	0.044	0.159
P2	0.010	0.053	0.018	0.073	-0.002	0.054	0.050	0.192
P3	0.004	0.062	0.010	0.069	0.005	0.048	0.054	0.171
P4	0.006	0.049	0.016	0.060	-0.002	0.061	0.054	0.174
P5	-0.001	0.064	0.011	0.068	0.000	0.058	0.051	0.144
P6	0.002	0.064	0.008	0.064	0.004	0.043	0.041	0.189
P7	0.002	0.053	0.017	0.066	0.007	0.040	0.054	0.173
P8	0.007	0.048	0.018	0.068	0.002	0.039	0.055	0.194
P9	0.008	0.051	0.019	0.067	-0.008	0.059	0.055	0.211
P10	0.003	0.050	0.020	0.060	-0.003	0.042	0.045	0.183
P11	-0.005	0.066	0.029	0.072	0.003	0.053	0.051	0.168
P12	0.002	0.056	0.019	0.069	0.004	0.050	0.046	0.185
P13	0.005	0.056	0.015	0.070	-0.003	0.064	0.046	0.192
P14	0.005	0.060	0.018	0.061	-0.001	0.054	0.052	0.204
P15	0.005	0.058	0.025	0.065	0.007	0.056	0.056	0.191
P16	0.008	0.058	0.014	0.067	-0.002	0.051	0.040	0.197
P17	0.004	0.059	0.015	0.062	0.000	0.041	0.046	0.176
P18	0.005	0.048	0.024	0.065	-0.002	0.049	0.055	0.182
P19	0.008	0.059	0.020	0.068	0.004	0.055	0.046	0.174
P20	0.004	0.053	0.020	0.063	-0.007	0.047	0.048	0.194

4.5. Estimation of Factor Beta Coefficients

Using the following multivariable regression model, time series of asset returns are regressed against macroeconomic factors for each subperiod and stock market to estimate factor beta coefficients.

$$R_{it} - \overline{R}_i = b_1\delta_{1t} + ... + b_{kt}\delta_{kt} + \varepsilon_{it} \qquad i = 1, ..., 20$$

$k = 4$ for German Stock Market

$k = 3$ for Turkish Stock Market

where R_{it} is the time series of portfolio *i*'s return, $\overline{R}_i$ is the mean return of portfolio *i*, δ_{kt} is the time series of unexpected macroeconomic factor *k*, b_k is the factor beta coefficient and ε_{it} is the error term.

Table 7 summarises the time series regression estimates for portfolios of the German stock market. In the table, the percentage of portfolios with significant beta coefficients in the total number of portfolios are stated. The percentage of portfolios which have significant F-statistics with the average level of coefficient of determination are also presented.

When the summarised results of the first stage time series regression (Table 7) are analysed, one can see that the addition of the Market Proxy to the factor derivation process increases the average coefficient of determination and F-statistic levels in all analyses for the German Stock Market. The results from the subperiod of 01/1988-06/2002 shows that the significant unexpected interest rate level factor on asset returns does not have a high percentage in the total number of portfolios. While for a relatively bigger number of assets, unexpected foreign trade and unexpected inflation factors are found significant on asset returns. On the other hand, percentage of portfolios which have significant asset return-unexpected foreign trade factor and unexpected inflation factor relations decrease sharply in 01/1988-12/1990 subperiod. This percentage also decreases for the unexpected production factor which has a high significance percentage in 01/1988-06/2002 period. In the subperiod of 01/1991-06/2002, unexpected foreign trade and unexpected production (with market proxy) factors are significant on most asset returns.

The F-test results of 01/1988-06/2002 period presented in Panel A of Table 7 shows that from 70% to 100% of portfolios have a significant four-factor structure at 10% level depending on the factor analysis method. The addition of the Market Proxy into the factor derivation process causes the production of more significant factors on asset returns and higher coefficient of determinations. In this period, the F-statistics of PCFA-2 and MLFA-2 analysis are found significant for all portfolio returns at 1% level. The individual significance of the factors also increase with the addition of the Market Proxy into the analysis, except the unexpected foreign trade and unexpected interest rate level factors in MLFA-2 analysis. When only macroeconomic variables are used in the factor derivation (PCFA-1 and MLFA-1), the factors of unexpected interest rate are found significant in only 10% of all portfolios. On the other hand, the factors of the unexpected foreign trade are found significant on a larger number of portfolios than the factors of the unexpected interest rate and unexpected production.

Table 7 : Time Series Regression Estimations of the Factor Beta Coefficients in the German Stock Market

$$R_{it} - \overline{R}_i = b_1\delta_{1t} + b_2\delta_{2t} + b_3\delta_{3t} + b_4\delta_{4t} + \varepsilon_{it} \qquad i = 1, \ldots, 20$$

Factor Analysis Type*			Factor Beta Coefficients				Ratio of significant F-test values	Average R^2
			b_1	b_2	b_3	b_4		
Panel A: 01/1988 – 06/2002 Period								
PCFA-1	• Explanation of Factors		UE[a] Foreign Trade	UE Interest Rate Level	UE Inflation	UE Production		
	• Ratio of significant factor beta coefficients	1 % level	10 %	0 %	15 %	0 %	30 %	0.065
		5 % level	50 %	5 %	55 %	15 %	65 %	
		10 % level	75 %	10 %	70 %	25 %	85 %	
PCFA-2	• Explanation of Factors		UE Interest Rate Level	UE Foreign Trade	UE Inflation	UE Production + Market Proxy		
	• Ratio of significant factor beta coefficients	1 % level	10 %	35 %	75 %	100 %	100 %	0.269
		5 % level	30 %	35 %	95 %	100 %	100 %	
		10 % level	35 %	85 %	100 %	100 %	100 %	
MLFA-1	• Explanation of Factors		UE Interest Rate Level	UE Foreign Trade	UE Inflation	UE Production		
	• Ratio of significant factor beta coefficients	1 % level	0 %	5 %	0 %	0 %	5 %	0.050
		5 % level	5 %	35 %	20 %	35 %	40 %	
		10 % level	10 %	55 %	25 %	50 %	70 %	
MLFA-2	• Explanation of Factors		UE Interest Rate Level	UE Foreign Trade	UE Inflation	UE Production + Market Proxy		
	• Ratio of significant factor beta coefficients	1 % level	0 %	5 %	20 %	100 %	100 %	0.145
		5 % level	0 %	25 %	50 %	100 %	100 %	
		10 % level	10 %	45 %	85 %	100 %	100 %	
Panel B: 01/1988 – 12/1990 Subperiod								
PCFA-1	• Explanation of Factors		UE Interest Rate Level	UE Foreign Trade	UE Inflation	UE Production		
	• Ratio of significant factor beta coefficients	1 % level	0 %	0 %	0 %	0 %	0 %	0.106
		5 % level	15 %	0 %	0 %	0 %	0 %	
		10 % level	30 %	0 %	0 %	5 %	0 %	
PCFA-2	• Explanation of Factors		UE Interest RateLevel + Market Proxy	UE Foreign Trade	UE Inflation	UE Production		0.297
	• Ratio of significant factor beta coefficients	1 % level	80 %	0 %	0 %	0 %	25 %	
		5 % level	100 %	0 %	0 %	5 %	85 %	
		10 % level	100 %	0 %	0 %	15 %	90 %	
MLFA-1	• Explanation of Factors		UE Interest Rate Level	UE Foreign Trade	UE Inflation	UE Production		
	• Ratio of significant factor beta coefficients	1 % level	0 %	0 %	0 %	0 %	0 %	0.139
		5 % level	20 %	0 %	0 %	15 %	5 %	
		10 % level	30 %	0 %	0 %	30 %	5 %	
MLFA-2	• Explanation of Factors		UE Interest Rate Level	UE Foreign Trade	UE Inflation + Production	UE Foreign Exchange Level + Market Proxy		0.228
	• Ratio of significant factor beta coefficients	1 % level	0 %	0 %	0 %	5 %	5 %	
		5 % level	5 %	0 %	0 %	55 %	25 %	
		10 % level	20 %	10 %	0 %	95 %	60 %	
Panel C: 01/1991 – 06/2002 Subperiod								
PCFA-1	• Explanation of Factors		UE Interest Rate Level	UE Foreign Trade	UE Inflation	UE Production		
	• Ratio of significant factor beta coefficients	1 % level	0 %	45 %	5 %	10 %	50 %	0.103
		5 % level	10 %	75 %	25 %	30 %	80 %	
		10 % level	15 %	85 %	60 %	55 %	85 %	
PCFA-2	• Explanation of Factors		UE Interest Rate Level	UE Foreign Trade	UE Inflation	UE Production + Market Proxy		
	• Ratio of significant factor beta coefficients	1 % level	0 %	70 %	20 %	100 %	100 %	0.254
		5 % level	15 %	85 %	50 %	100 %	100 %	
		10 % level	30 %	95 %	80 %	100 %	100 %	
MLFA-1	• Explanation of Factors		UE Interest Rate Level	UE Foreign Trade	UE Inflation	UE Production		
	• Ratio of significant factor beta coefficients	1 % level	0 %	35 %	5 %	25 %	55 %	0.088
		5 % level	5 %	65 %	10 %	65 %	85 %	
		10 % level	25 %	85 %	10 %	80 %	90 %	
MLFA-2	• Explanation of Factors		UE Interest Rate Level	UE Foreign Trade	UE Inflation	UE Production + Market Proxy		
	• Ratio of significant factor beta coefficients	1 % level	0 %	35 %	10 %	100 %	100 %	0.198
		5 % level	0 %	70 %	20 %	100 %	100 %	
		10 % level	10 %	85 %	40 %	100 %	100 %	

* PCFA-1 : Principle Components Factor Analysis - only macro economic variables are employed,
PCFA-2 : Principle Components Factor Analysis - market proxy and macroeconomic variables are employed,
MLFA-1 : Maximum Likelihood Factor Analysis - only macro economic variables are employed,
MLFA-2 : Maximum Likelihood Factor Analysis - market proxy and macroeconomic variables are employed.
[a] UE = Unexpected

The time series regression results of 01/1988-12/1990 are presented in Panel B of Table 7. The estimation results of this subperiod do not present strong evidence of a significant relation between asset returns and macroeconomic factors. Both the overall significance level of models and individual significance levels of factors are considerably low in all analyses. In this subperiod, we can get statistically significant beta estimations only when the market proxy enters into the factor formation process. The results of 01/1991-06/2002 subperiod presented in Panel C, are found similar to the results of Panel A.

Table 8 : Time Series Regression Estimations of the Factor Beta Coefficients in the Turkish Stock Market

$$R_{it} - \overline{R}_i = b_1\delta_{1t} + b_2\delta_{2t} + b_3\delta_{3t} + \varepsilon_{it} \qquad i = 1, ...,20$$

Factor Analysis Type*			Factor Beta Coefficients			Ratio of significant F-test values	Average R^2
			b_1	b_2	b_3		
PCFA-1	• Explanation of Factors		UE[a] Inflation	UE Foreign Trade + Production	UE Interest Rate Level		
	• Ratio of significant factor beta coefficients	1 % level	0 %	0 %	0 %	0 %	0.032
		5 % level	15 %	10 %	0 %	0 %	
		10 % level	25 %	30 %	0 %	5 %	
PCFA-2	• Explanation of Factors		UE Inflation + Market Proxy	UE Foreign Trade + Production	UE Interest Rate Level		
	• Ratio of significant factor beta coefficients	1 % level	90 %	90 %	80 %	100 %	0.256
		5 % level	95 %	95 %	100 %	100 %	
		10 % level	100 %	100 %	100 %	100 %	
MLFA-1	• Explanation of Factors		UE Inflation	UE Foreign Trade + Production	UE Interest Rate Level		
	• Ratio of significant factor beta coefficients	1 % level	15 %	15 %	0 %	10 %	0.073
		5 % level	45 %	60 %	0 %	55 %	
		10 % level	50 %	75 %	0 %	85 %	
MLFA-2	• Explanation of Factors		UE Inflation + Market Proxy	UE Foreign Trade + Production + Market Proxy	UE Interest Rate Level		
	• Explanation of Factors	1 % level	15 %	15 %	0 %	10 %	0.073
	• Ratio of significant factor beta coefficients	5 % level	45 %	60 %	0 %	55 %	
		10 % level	50 %	75 %	0 %	85 %	

* PCFA-1 : Principle Components Factor Analysis - only macro economic variables are employed,
PCFA-2 : Principle Components Factor Analysis - market proxy and macroeconomic variables are employed,
MLFA-1 : Maximum Likelihood Factor Analysis - only macro economic variables are employed,
MLFA-2 : Maximum Likelihood Factor Analysis - market proxy and macroeconomic variables are employed.
[a] UE = Unexpeceted

The time series regression analysis results of factor beta estimation for the Turkish Stock Market are summarised in Table 8. The results show that the unexpected interest rate factors, except the one which is derived by PCFA-2 method, have statistically insignificant effect on all portfolios. On the other hand, unexpected foreign trade plus production factors significantly effect more portfolio returns than unexpected inflation factor, in all types of factor derivation methods.

4.6. Estimation of Factor Risk Premia and Significance Tests of Factor Betas on Asset Returns

According to the APT, asset prices are determined by their relevant risk level, indicating a significant linear relation between asset returns and factor beta coefficients. In order to test the significance of factor betas on asset returns, the following cross sectional regression model is estimated for all months in all subperiods. Expost factor risk premia series are estimated and t-test is implemented on the means of these series for both stock markets. The following model is utilized for this process:

$$R_{it} = \lambda_{0t} + b_{i1}\lambda_{1t} + \ldots + b_{ik}\lambda_{kt} + e_{it} \qquad i = 1,\ldots,20$$

$$\text{for each} \quad t = 1,\ldots,T$$

where R_{it} is the return of asset i in month t, λ_{0t} is the zero beta asset return in month t, b_{ik} is the asset i's beta coefficient to factor k, λ_{kt} is the factor risk premium k in month t and e_i is the error term. T=174 for the German Stock Market in the period 01/1988-06/2002, T=36 for the German Stock Market in the subperiod 01/1988-12/1990, T=138 for the German Stock Market in the subperiod 01/1991-06/2002 and T=114 for the Turkish Stock Market in 01/1993-06/2002 period.

Calculating the means of the above estimated series, we get the following exact pricing model:

$$\overline{R}_i = \overline{\lambda}_0 + b_{i1}\overline{\lambda}_1 + \ldots + b_{ik}\overline{\lambda}_k + \varepsilon_i \qquad i = 1,\ldots,n$$

$$\overline{\lambda}_j = \frac{1}{T}\sum_{t=1}^{T}\lambda_t \qquad j = 0,1,\ldots,k$$

where $\overline{R}_i$ is the average return of asset i, $\overline{\lambda}_0$ is the average zero beta asset return, b_{ik} is the asset i's beta coefficient to factor k, $\overline{\lambda}_k$ is the average factor risk premium k and ε_i is the average error term.

The beta coefficients estimated from time series regression analysis of different portfolio construction and factor formation methods are used as exogenous variables in this cross sectional regression model. Summary of the estimation results can be seen in Table 9.

Table 9: Cross Sectional Regression Results of the German Stock Market

$$\overline{R}_i = \overline{\lambda}_0 + b_{i1}\overline{\lambda}_1 + b_{i2}\overline{\lambda}_2 + b_{i3}\overline{\lambda}_3 + b_{i4}\overline{\lambda}_4 + \varepsilon_i \qquad i = 1, .., 20$$

		Factor Risk Premia					Average R^2
		$\overline{\lambda}_0$	$\overline{\lambda}_1$	$\overline{\lambda}_2$	$\overline{\lambda}_3$	$\overline{\lambda}_4$	
Panel A: 01/1988 – 06/2002 Subperiod							
PCFA-1	Average	0.006	-0.006	-0.660	-0.198	0.410	0.306
	Std.dev.	0.052	3.874	3.151	3.782	3.574	
	t-stat	1.588	-0.020	-2.761***	-0.691	1.513	
	Adj.t-stat[a]	1.239	-0.016	-2.155**	-0.539	1.180	
PCFA-2	Average	0.004	-0.810	0.158	0.055	0.125	0.294
	Std.dev.	0.068	3.211	4.546	3.818	2.431	
	t-stat	0.816	-3.326***	0.458	0.189	0.677	
	Adj.t-stat[b]	0.626	-2.552**	0.351	0.145	0.519	
MLFA-1	Average	0.005	-0.792	0.289	0.095	-0.120	0.304
	Std.dev.	0.055	3.900	4.188	3.743	4.818	
	t-stat	1.160	-2.678***	0.911	0.336	-0.328	
	Adj.t-stat[c]	0.875	-2.020**	0.687	0.254	-0.248	
MLFA-2	Average	0.003	-0.899	0.382	0.191	0.027	0.296
	Std.dev.	0.069	3.551	4.700	3.601	2.769	
	t-stat	0.581	-3.341***	1.071	0.700	0.131	
	Adj.t-stat[d]	0.407	-2.344**	0.751	0.491	0.092	
Panel B: 01/1988 – 12/1990 Subperiod							
PCFA-1	Average	0.026	0.364	-0.489	0.134	-0.127	0.355
	Std.dev.	0.070	2.147	1.957	1.929	1.509	
	t-stat	2.254**	1.016	-1.488	0.418	-0.506	
	Adj.t-stat[e]	1.901*	0.857	-1.264	0.352	-0.427	
PCFA-2	Average	0.004	0.415	-0.458	0.120	-0.113	0.347
	Std.dev.	0.083	2.163	1.964	1.944	1.518	
	t-stat	2.672**	1.151	-1.400	0.369	-0.447	
	Adj.t-stat[f]	2.251**	0.970	-1.180	0.311	-0.377	
MLFA-1	Average	0.028	0.459	-0.429	0.045	-0.053	0.220
	Std.dev.	0.073	2.190	1.766	1.522	1.489	
	t-stat	2.327**	1.257	-1.456	0.178	-0.215	
	Adj.t-stat[g]	1.938*	1.047	-1.213	0.148	-0.179	
MLFA-2	Average	0.026	0.545	-0.327	-0.013	0.202	0.346
	Std.dev.	0.079	2.230	1.746	1.529	2.195	
	t-stat	1.980*	1.466	-1.123	-0.050	0.552	
	Adj.t-stat[h]	1.643	1.217	-0.932	-0.041	0.458	
Panel C: 01/1991 – 06/2002 Subperiod							
PCFA-1	Average	-0.004	-0.609	0.274	0.566	-0.119	0.272
	Std.dev.	0.041	2.886	2.940	3.549	4.094	
	t-stat	-1.063	-2.478**	1.094	1.874*	-0.342	
	Adj.t-stat[i]	-0.797	-1.857*	0.820	1.405	-0.256	
PCFA-2	Average	-0.006	-0.620	0.350	0.514	-0.181	0.268
	Std.dev.	0.047	2.933	3.264	3.442	3.038	
	t-stat	-1.528	-2.482**	1.261	1.755*	-0.700	
	Adj.t-stat[j]	-1.138	-1.848*	0.939	1.306	-0.521	
MLFA-1	Average	-0.002	-0.443	0.106	0.617	-0.117	0.256
	Std.dev.	0.049	3.713	2.365	3.423	3.715	
	t-stat	-0.405	-1.400	0.525	2.119**	-0.371	
	Adj.t-stat[k]	-0.319	-1.104	0.414	1.671*	-0.293	
MLFA-2	Average	-0.004	-0.580	0.200	0.581	0.033	0.266
	Std.dev.	0.053	3.362	2.757	3.193	2.450	
	t-stat	-0.791	-2.027**	0.853	2.138**	0.157	
	Adj.t-stat[l]	-0.600	-1.536	0.647	1.620	0.119	

* Significant at 10% level , ** Significant at 5% level , *** Significant at 1% level

[a] EIV adjustment term (c) = 0.642
[b] EIV adjustment term (c) = 0.699
[c] EIV adjustment term (c) = 0.758
[d] EIV adjustment term (c) = 1.032
[e] EIV adjustment term (c) = 0.405
[f] EIV adjustment term (c) = 0.409
[g] EIV adjustment term (c) = 0.441
[h] EIV adjustment term (c) = 0.452
[i] EIV adjustment term (c) = 0.780
[j] EIV adjustment term (c) = 0.804
[k] EIV adjustment term (c) = 0.609
[l] EIV adjustment term (c) = 0.741

In Panel A of Table 9, cross sectional regression results of 01/1988-06/2002 period are presented. According to risk premia estimations, $\overline{\lambda}_2$ in the PCFA-1 analysis and $\overline{\lambda}_1$ in the other analysis are found statistically significantly different from zero even with adjusted values of t-statistic. These parameters are factor risk premia of unexpected interest rate level factors, extracted by different factor analysis techniques. This result indicates evidence of a significant relation between the unexpected interest rate factor beta and the average asset returns. But we can not find evidence of another factor beta for this period.

The regression results reported for 01/1988-12/1990 period in Panel B present no significant effect of any unexpected factors on asset returns for all factor analysis techniques. The results of 01/1991-06/2002 subperiod (Panel C) also support evidence of significant effect of the unexpected interest rate factor beta on asset returns when factors are derived by principle components factor analysis technique. The unexpected inflation factor is also found statistically significant for all factor analysis methods. But when t-values are adjusted, this beta coefficient is found significant only in MLFA-1 factor analysis. Thus, we find evidence of significant effects of unexpected interest rate factor beta and weak evidence of significant unexpected inflation rate factor beta on average asset returns for the German Stock market.

The average coefficient of determinations (R^2), in all analyses is changing between 22.0% and 35.5%. This indicates that beta coefficients belong to macroeconomic factors can not explain a high percentage of average asset prices. One of the possible reasons of such a result may arise from the limited number of macroeconomic variables, employed in factor analysis methods. Some previous researches on the factor structure of different economies utilize wider set of macroeconomic data. For example, Cheng (1995) utilized 19 economic and financial variables in maximum likelihood factor analysis, Artis, Banerjee and Marcellino (2001) employed 80 different economic variables in order to derive factor structure of the UK economy. On the other hand, Cagnetti (2002) employed 25 macroeconomic variables of Italy for testing APT in the Italian Stock Market. Our restriction in the macroeconomic variable selection is based on the availability of monthly series in both German and Turkish statistics. Using a wider data set can result in higher significance of present macroeconomic factor betas or finding new significant macroeconomic factor betas on asset returns by adding more information into the process.

Table 10: Cross Sectional Regression Results of the Turkish Stock Market

$$\overline{R}_i = \overline{\lambda}_0 + b_{i1}\overline{\lambda}_1 + b_{i2}\overline{\lambda}_2 + b_{i3}\overline{\lambda}_3 + \varepsilon_i \qquad i = 1, \ldots, 20$$

		Factor Risk Premia				Average R^2
		$\overline{\lambda}_0$	$\overline{\lambda}_1$	$\overline{\lambda}_2$	$\overline{\lambda}_3$	
01/1993 – 06/2002 Period						
PCFA-1	Average	0.046	0.088	0.121	0.083	0.215
	Std.dev.	0.175	2.029	2.419	3.477	
	t-stat	2.793***	0.463	0.535	0.254	
	Adj.t-stat[a]	2.753***	0.456	0.527	0.250	
PCFA-2	Average	0.035	0.171	0.174	0.089	0.223
	Std.dev.	0.195	2.183	2.266	2.668	
	t-stat	1.894*	0.834	0.819	0.358	
	Adj.t-stat[b]	1.833*	0.807	0.793	0.347	
MLFA-1	Average	0.043	0.103	0.100	0.021	0.201
	Std.dev.	0.172	2.222	2.400	2.905	
	t-stat	2.676***	0.497	0.446	0.076	
	Adj.t-stat[c]	2.648***	0.492	0.441	0.075	
MLFA-2	Average	0.043	0.103	0.100	0.022	0.201
	Std.dev.	0.172	2.231	2.993	2.896	
	t-stat	2.675***	0.493	0.447	0.082	
	Adj.t-stat[d]	2.647***	0.488	0.442	0.081	

* Significant at 10% level , ** Significant at 5% level , *** Significant at 1% level
[a] EIV adjustment term (c) = 0.029
[b] EIV adjustment term (c) = 0.067
[c] EIV adjustment term (c) = 0.021
[d] EIV adjustment term (c) = 0.021

The cross sectional regression results are summarised in Table 10 for the Turkish Stock Market. Although we could find some evidence about a significant effect of unexpected interest rate and unexpected inflation betas on stock returns for the German Stock Market, we could not find any significant factor beta on asset returns in the Turkish Stock Market. Istanbul Stock Exchange is a relatively young stock exchange with a smaller number of stocks listed. The trading volume and free float are also relatively low and efficiency of the market is not high. These structural conditions of the Turkish Stock Market can be the reason of such a result in our analysis.

5. Conclusions

The asset prices are believed to react to macroeconomic factors and unexpected variations in macroeconomic factors are expected to be rewarded in stock markets. In order to understand which factors are rewarded in two different countries with different development levels, we implement a two step APT test procedure of Fama and MacBeth (1973) in the German and Turkish Stock Markets. In the process of analysis, we use macroeconomic factors which are derived by employing main financial sector and real sector variables of these economies in different factor analysis procedures.

The factor structures of the German and Turkish economy are presented by employing the same 8 macroeconomic variables and Stock Market Proxies in the Principle Components and Maximum likelihood Factor Analysis. In each type of analysis of German variables, 4 factors are extracted while only 3 variables are derived from Turkish variables, showing different factor structures of these two economies.

The inclusion of the Market proxies into the factor analysis processes resulted in different factor formations for each country. In the case of Germany, the market proxy formed a factor with industrial production variable within 01/1988-06/2002 period and 01/1991-02/2002 subperiod and formed other factors with interest variables and foreign exchange during 01/1988-12/1990 subperiod. In the case of Turkey, the market proxy formed a factor with wholesale price index, consumer price index and foreign exchange variables. In each case, factors derived with the inclusion of market proxy resulted in a higher coefficient of determination, higher t-significance and F-significance level for the first stage regression. These results can be considered as evidence for the information included in market proxies.

Beta coefficients of derived factors are estimated for different subperiods and their significance for asset returns are tested against “there is more than one statistically significant factor beta coefficient on average asset returns” hypothesis. As a result, for the whole period of the German Stock Market, we find the evidence of only one-factor beta, unexpected interest rate level factor beta, rewarded in the market. On the other hand, unexpected interest rate level factor and unexpected inflation factor betas for 01/1991-06/2002 subperiod are found statistically significant for the German Stock Market even with adjusted t-test values in different kinds of factor analysis procedures. But this result does not support a simultaneous significance of both factor beta coefficients on asset returns, so we can not interpret this result as strong evidence.

The results of 01/1988-12/1990 subperiod for the German Stock Market do not present evidence of a significant factor beta-expected asset return relation for none of factor betas. This result may be due to the shortness of the estimation period (36 months). Another possible reason may be the extraordinary structure of this period. The portfolio statistics of the 01/1988-12/1990 subperiod (Table 6) report that risk-return characteristics of this period are different from those of the full period and the second subperiod with its very high portfolio returns relative to the other periods and their risk levels.

The analysis of the Turkish stock market can not present evidence for statistically significant unexpected macroeconomic factor beta-expected asset return relation for the Turkish stock exchange in the period of 01/1993-06/2002. The factor beta-expected return relation in APT requires an efficient market, thus this result may be due to its relatively low efficiency, low trading volume and low free float.

The empirical results we got in the process of this analysis can be altered by employing a larger number of macroeconomic variables in the factor analysis methods to derive a broader factor structure of each economy. A wider set of variables may bring much information to the testing process, increase the number of factors derived for each economy and present higher support for a multifactor pricing structure. In this paper, our aim was to carry out comparative analysis in two different stock markets with different development levels. Thus, this structure of research restricts the number of the macroeconomic variables that can be used in the analysis, because the number of economic indicators available for both countries is restricted.

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Appendix:
Test Results of the 10-Portfolio Case

Table A1: Portfolio Statistics of the 10-Portfolio case

Portfolios	German Stock Market						Turkish Stock Market	
	Period 01/1988 – 06/2002		Subperiod 01/1988 – 12/1990		Subperiod 01/1991 – 06/2002		Period 01/1993 – 06/2002	
	Average Return $\overline{R}_i$	Standard Deviation $s(R_i)$	Average Return $\overline{R}_i$	Standard Deviation $s(R_i)$	Average Return $\overline{R}_i$	Standard Deviation $s(R_i)$	Average Return $\overline{R}_i$	Standard Deviation $s(R_i)$
P1	0.008	0.051	0.021	0.071	0.000	0.045	0.047	0.165
P2	0.004	0.053	0.011	0.061	0.001	0.047	0.054	0.166
P3	0.001	0.065	0.008	0.069	0.002	0.046	0.046	0.156
P4	0.006	0.044	0.017	0.061	0.004	0.034	0.054	0.177
P5	0.004	0.046	0.019	0.056	-0.006	0.045	0.050	0.190
P6	0.001	0.058	0.022	0.070	0.003	0.049	0.048	0.164
P7	0.006	0.057	0.017	0.062	-0.002	0.050	0.049	0.190
P8	0.006	0.054	0.017	0.064	0.002	0.047	0.048	0.188
P9	0.004	0.050	0.023	0.062	0.000	0.040	0.050	0.171
P10	0.005	0.054	0.018	0.062	-0.002	0.043	0.047	0.172

Table A2 : Time Series Regression Estimations for the Factor Beta Coefficients of the German Stock Market

$$R_{it} - \overline{R}_i = b_1\delta_{1t} + b_2\delta_{2t} + b_3\delta_{3t} + b_4\delta_{4t} + \varepsilon_{it} \qquad i = 1, ...,10$$

Factor Analysis Type*			Factor Beta Coefficients b_1	b_2	b_3	b_4	% of significant F-test values	Average R^2
Panel A: 01/1988 – 06/2002 Subperiod								
	• **Explanation of Factors**		UE[a] Foreign Trade	UE Interest Rate Level	UE Inflation	UE Production		
PCFA-1	• **% of significant**	1 % level	20 %	0 %	10 %	0 %	60 %	0..071
	factor beta	5 % level	80 %	0 %	70 %	30 %	80 %	
	coefficients	10 % level	80 %	10 %	80 %	50 %	80 %	
	• **Explanation of Factors**		UE Interest Rate Level	UE Foreign Trade	UE Inflation	UE Prodc.+ M.Proxy		
PCFA-2	• **% of significant**	1 % level	10 %	50 %	80 %	100 %	100 %	0.288
	factor beta	5 % level	30 %	80 %	100 %	100 %	100 %	
	coefficients	10 % level	50 %	80 %	100 %	100 %	100 %	
	• **Explanation of Factors**		UE Interest Rate Level	UE Foreign Trade	UE Inflation	UE Production		
MLFA-1	• **% of significant**	1 % level	0 %	10 %	0 %	10 %	20 %	0.054
	factor beta	5 % level	0 %	30 %	10 %	50 %	60 %	
	coefficients	10 % level	10 %	70 %	30 %	60 %	80 %	
	• **Explanation of Factors**		UE Interest Rate Level	UE Foreign Trade	UE Inflation	UE Prodc.+ M.Proxy		
MLFA-2	• **% of significant**	1 % level	0 %	10 %	20 %	100 %	100 %	0.157
	factor beta	5 % level	0 %	20 %	80 %	100 %	100 %	
	coefficients	10 % level	0 %	60 %	80 %	100 %	100 %	
Panel B: 01/1988 – 12/1990 Subperiod								
	• **Explanation of Factors**		UE Interest Rate Level	UE Foreign Trade	UE Inflation	UE Production		
PCFA-1	• **% of significant**	1 % level	0 %	0 %	0 %	0 %	0 %	0.110
	factor beta	5 % level	30 %	0 %	0 %	0 %	0 %	
	coefficients	10 % level	50 %	0 %	0 %	0 %	0 %	
	• **Explanation of Factors**		UE Int.RateLevel+ M.Proxy	UE Foreign Trade	UE Inflation	UE Production		
PCFA-2	• **% of significant**	1 % level	80 %	0 %	0 %	0 %	30 %	0.309
	factor beta	5 % level	100 %	0 %	0 %	10 %	80 %	
	coefficients	10 % level	100 %	0 %	0 %	10 %	100 %	
	• **Explanation of Factors**		UE Interest Rate Level	UE Foreign Trade	UE Inflation	UE Production		
MLFA-1	• **% of significant**	1 % level	0 %	0 %	0 %	0 %	0 %	0.146
	factor beta	5 % level	20 %	0 %	0 %	10 %	0 %	
	coefficients	10 % level	40 %	0 %	0 %	20 %	10 %	
	• **Explanation of Factors**		UE Interest Rate Level	UE Foreign Trade	UE Inflation + Production	UE Frg.Ex.Level + M.Proxy		
MLFA-2	• **% of significant**	1 % level	0 %	0 %	0 %	20 %	0 %	0.240
	factor beta	5 % level	0 %	10 %	0 %	100 %	30 %	
	coefficients	10 % level	30 %	20 %	0 %	100 %	90 %	
Panel C: 01/1991 – 06/2002 Subperiod								
	• **Explanation of Factors**		UE Interest Rate Level	UE Foreign Trade	UE Inflation	UE Production		
PCFA-1	• **% of significant**	1 % level	0 %	60 %	10 %	10 %	90 %	0.122
	factor beta	5 % level	10 %	100 %	40 %	50 %	100 %	
	coefficients	10 % level	30 %	100 %	80 %	70 %	100 %	
	• **Explanation of Factors**		UE Interest Rate Level	UE Foreign Trade	UE Inflation	UE Prodc.+ M.Proxy		
PCFA-2	• **% of significant**	1 % level	0 %	100 %	10 %	100 %	100 %	0.311
	factor beta	5 % level	40 %	100 %	70 %	100 %	100 %	
	coefficients	10 % level	50 %	100 %	100 %	100 %	100 %	
	• **Explanation of Factors**		UE Interest Rate Level	UE Foreign Trade	UE Inflation	UE Production		
MLFA-1	• **% of significant**	1 % level	0 %	60 %	0 %	50 %	70 %	0.113
	factor beta	5 % level	10 %	90 %	0 %	80 %	100 %	
	coefficients	10 % level	30 %	100 %	20 %	90 %	100 %	
	• **Explanation of Factors**		UE Interest Rate Level	UE Foreign Trade	UE Inflation	UE Prodc.+ M.Proxy		
MLFA-2	• **% of significant**	1 % level	0 %	60 %	10 %	100 %	100 %	0.250
	factor beta	5 % level	0 %	100 %	40 %	100 %	100 %	
	coefficients	10 % level	10 %	100 %	40 %	100 %	100 %	

* PCFA-1 : Principle Components Factor Analysis - only macro economic variables are employed,
PCFA-2 : Principle Components Factor Analysis - market proxy and macroeconomic variables are employed,
MLFA-1 : Maximum Likelihood Factor Analysis - only macro economic variables are employed,
MLFA-2 : Maximum Likelihood Factor Analysis - market proxy and macroeconomic variables are employed.

[a] UE = Unexpected

Table A3 : Time Series Regression Estimations for the Factor Beta Coefficients of the Turkish Stock Market

$$R_{it} - \overline{R}_i = b_1\delta_{1t} + b_2\delta_{2t} + b_3\delta_{3t} + \varepsilon_{it} \qquad i = 1, \ldots, 10$$

Factor Analysis Type*			Factor Beta Coefficients			% of significant F-test values	Average R^2
			b_1	b_2	b_3		
PCFA-1	• Explanation of Factors		UE[a] Inflation	UE Forg.Trade + Production	UE Interest Rate Level		
	• % of significant factor beta coefficients	1 % level	0 %	0 %	0 %	0 %	0.029
		5 % level	0 %	10 %	0 %	0 %	
		10 % level	20 %	40 %	0 %	0 %	
PCFA-2	• Explanation of Factors		UE Inflation + Market Proxy	UE Forg.Trade + Production	UE Interest Rate Level		
	• % of significant factor beta coefficients	1 % level	100 %	100 %	100 %	100 %	0.276
		5 % level	100 %	100 %	100 %	100 %	
		10 % level	100 %	100 %	100 %	100 %	
MLFA-1	• Explanation of Factors		UE Inflation	UE Forg Trade + Production	UE Interest Rate Level		
	• % of significant factor beta coefficients	1 % level	20 %	10 %	0 %	10 %	0.074
		5 % level	40 %	50 %	0 %	60 %	
		10 % level	50 %	90 %	0 %	80 %	
MLFA-2	• Explanation of Factors		UE Inflation + Market Proxy	UE Forg.Trade + Production + Market Proxy	UE Interest Rate Level		0.069
	• % of significant factor beta coefficients	1 % level	10 %	10 %	0 %	10 %	
		5 % level	30 %	50 %	0 %	60 %	
		10 % level	50 %	90 %	0 %	80 %	

* PCFA-1 : Principle Components Factor Analysis - only macro economic variables are employed,
PCFA-2 : Principle Components Factor Analysis - market proxy and macroeconomic variables are employed,
MLFA-1 : Maximum Likelihood Factor Analysis - only macro economic variables are employed,
MLFA-2 : Maximum Likelihood Factor Analysis - market proxy and macroeconomic variables are employed.
[a] UE = Unexpeceted

Table A4: Cross Sectional Regression Results of the German Stock Market

$$\overline{R_i} = \overline{\lambda}_0 + b_{i1}\overline{\lambda}_1 + b_{i2}\overline{\lambda}_2 + b_{i3}\overline{\lambda}_3 + b_{i4}\overline{\lambda}_4 + \varepsilon_i \qquad i = 1, \ldots, 10$$

		Factor Risk Premia					Average R^2
		$\overline{\lambda}_0$	$\overline{\lambda}_1$	$\overline{\lambda}_2$	$\overline{\lambda}_3$	$\overline{\lambda}_4$	
Panel A: 01/1988 – 06/2002 Subperiod							
PCFA-1	Average	0.002	0.195	-0.606	0.526	0.248	0.505
	Std.dev.	0.068	6.772	4.018	9.195	4.627	
	t-stat	0.290	0.380	-1.989**	0.758	0.708	
	Adj.t-stat[a]	0.220	0.288	-1.506	0.572	0.536	
PCFA-2	Average	-0.007	-0.805	0.757	1.177	-0.082	0.482
	Std.dev.	0.164	4.386	11.958	13.166	4.880	
	t-stat	-0.571	-2.422**	0.835	1.179	-0.221	
	Adj.t-stat[b]	-0.300	-1.274	0.439	0.620	-0.116	
MLFA-1	Average	0.002	-0.550	0.275	0.721	-0.136	0.484
	Std.dev.	-0.064	6.375	7.811	6.459	7.688	
	t-stat	0.422	-1.137	0.465	1.472	-0.233	
	Adj.t-stat[c]	0.303	-0.816	0.334	1.057	-0.167	
MLFA-2	Average	-0.004	-0.764	0.733	1.044	0.114	0.471
	Std.dev.	0.120	4.446	10.091	8.395	4.706	
	t-stat	-0.404	-2.268**	0.959	1.641	0.319	
	Adj.t-stat[d]	-0.218	-1.224	0.517	0.885	0.172	
Panel B: 01/1988 – 12/1990 Subperiod							
PCFA-1	Average	0.018	0.066	-0.790	-0.254	0.230	0.536
	Std.dev.	0.071	2.497	3.258	2.775	1.619	
	t-stat	1.535	0.157	-1.455	-0.548	0.855	
	Adj.t-stat[e]	1.162	0.119	-1.101	-0.415	0.647	
PCFA-2	Average	0.027	0.178	-0.897	-0.288	0.228	0.538
	Std.dev.	0.092	2.444	3.221	2.759	1.620	
	t-stat	1.726*	0.437	-1.671	-0.627	0.845	
	Adj.t-stat[f]	1.230	0.311	-1.190	-0.447	0.602	
MLFA-1	Average	0.019	0.029	-0.459	0.080	0.016	0.560
	Std.dev.	0.072	2.480	2.154	1.785	1.696	
	t-stat	1.592	0.071	-1.280	0.269	0.055	
	Adj.t-stat[g]	1.421	0.063	-1.143	0.241	0.049	
MLFA-2	Average	0.023	0.092	-0.437	0.091	0.092	0.553
	Std.dev.	0.098	2.623	2.439	1.782	2.307	
	t-stat	1.383	0.211	-1.075	0.308	0.240	
	Adj.t-stat[h]	1.244	0.189	-0.967	0.277	0.216	
Panel C: 01/1991 – 06/2002 Subperiod							
PCFA-1	Average	-0.005	-0.682	0.568	0.819	-0.492	0.501
	Std.dev.	0.053	3.891	4.246	6.748	6.048	
	t-stat	-1.118	-2.058**	1.571	1.426	-0.955	
	Adj.t-stat[i]	-0.680	-1.253	0.956	0.868	-0.581	
PCFA-2	Average	-0.006	-0.670	0.491	0.579	-0.246	0.494
	Std.dev.	0.057	3.958	3.956	6.647	3.806	
	t-stat	-1.319	-1.989**	1.459	1.023	-0.760	
	Adj.t-stat[j]	-0.913	-1.377	1.010	0.709	-0.526	
MLFA-1	Average	-0.010	-1.089	0.586	1.098	0.707	0.505
	Std.dev.	0.067	5.191	4.786	6.752	7.353	
	t-stat	-1.655	-2.466**	1.438	1.910*	1.130	
	Adj.t-stat[k]	-0.772	-1.149	0.670	0.891	0.523	
MLFA-2	Average	-0.006	-0.745	0.326	0.687	0.120	0.492
	Std.dev.	0.056	3.886	3.531	5.551	2.731	
	t-stat	-1.193	-2.252**	1.083	1.453	0.517	
	Adj.t-stat[l]	-0.799	-1.509	0.726	0.974	0.346	

* Significant at 10% level , ** Significant at 5% level , *** Significant at 1% level

[a] EIV adjustment term (c) = 0.743
[b] EIV adjustment term (c) = 2.613
[c] EIV adjustment term (c) = 0.758
[d] EIV adjustment term (c) = 1.032
[e] EIV adjustment term (c) = 0.746
[f] EIV adjustment term (c) = 0.972
[g] EIV adjustment term (c) = 0.254
[h] EIV adjustment term (c) = 0.237
[i] EIV adjustment term (c) = 1.086
[j] EIV adjustment term (c) = 1.700
[k] EIV adjustment term (c) = 3.601
[l] EIV adjustment term (c) = 1.226

Table A5: Cross Sectional Regression Results of the Turkish Stock Market

$$\overline{R}_i = \overline{\lambda}_0 + b_{i1}\overline{\lambda}_1 + b_{i2}\overline{\lambda}_2 + b_{i3}\overline{\lambda}_3 + \varepsilon_i \qquad i = 1, .., 10$$

		Factor Risk Premia				Average R^2
		$\overline{\lambda}_0$	$\overline{\lambda}_1$	$\overline{\lambda}_2$	$\overline{\lambda}_3$	
01/1993 – 06/2002 Period						
PCFA-1	Average	0.047	0.061	0.016	-0.189	0.365
	Std.dev.	0.181	2.184	3.018	4.667	
	t-stat	2.786***	0.298	0.057	-0.432	
	Adj.t-stat[a]	2.732***	0.292	0.056	-0.424	
PCFA-2	Average	0.036	0.098	0.048	-0.104	0.347
	Std.dev.	0.229	2.252	2.869	3.042	
	t-stat	1.701*	0.464	0.178	-0.363	
	Adj.t-stat[b]	0.036	0.097	0.047	-0.103	
MLFA-1	Average	0.047	0.060	0.032	0.008	0.341
	Std.dev.	0.195	2.448	3.004	4.306	
	t-stat	2.549**	0.262	0.115	0.020	
	Adj.t-stat[c]	2.543**	0.261	0.115	0.020	
MLFA-2	Average	0.047	0.060	0.033	0.009	0.341
	Std.dev.	0.195	2.473	3.001	4.291	
	t-stat	2.547**	0.260	0.116	0.021	
	Adj.t-stat[d]	2.449**	0.250	0.112	0.202	

* Significant at 10% level, ** Significant at 5% level , *** Significant at 1% level
[a] EIV adjustment term (c) = 0.040
[b] EIV adjustment term (c) = 0.023
[c] EIV adjustment term (c) = 0.005
[d] EIV adjustment term (c) = 0.082