The Relationship between the Macroeconomic Variables and the Tehran Stock Exchange Market Index
1999 -2009

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ABSTRACT

This thesis empirically investigates the relationship between the macroeconomic variables that affect the stock returns during the years between 1999M1- 2009M6 for the Tehran Stock Exchange (TSE). The Arbitrage Pricing (APT) modelling framework is conducted by assuming the risk factors in the model as observable macroeconomic variables to explain the stock return variations. A multifactor regression model in this framework is employed to show the relevant macroeconomic variables namely: *industrial production, interest rate, inflation, exchange rate and money supply*. The Ordinary Least Square (OLS) technique is applied to test the validity of the model and the relative importance of different variables which may have an impact on the Tehran Stock returns within the Iranian economy. Based on the empirical results estimated, explanatory power supports the view that macroeconomic variables explain a significant part of the observed variations in Tehran Stock Market returns for the sample period. Since the main macroeconomic variables have been taken into account within the model, the estimation results imply that some macroeconomic variables, namely short-term interest rate, money supply, exchange rate and oil production have an influence on Tehran Stock Market returns.

Keywords: APT, CAPM, OLS Analysis, Tehran Stock Exchange, Iranian Economy.

ÖZ

Yapılan bu tez çalışması ampirik olarak Tahran menkul kıymetler borsasındaki hisse seneti getirisi ile makroekonomik değişkenler arasındaki ilişkiyi aylık (1999-1--2009-6) veriler kullanarak ölçmüştür. Bu ilişkiyi ölçerken Arbitraj fiyat teorisi çercevesinde endüstri/sanayi üretim endeksi, kısa dönemli faiz oranı, enflasyon, döviz kuru ve para arzı endekslerinin ne kadar anlamlı olup olmadığına bakılmıştır. En Küçük Kareler tekniği uygulanarak yukarıda belirtilen ilişkinin rolü ölçülmeye çalışılmıştır. Çalışma, ayni zamanda kullanılan ilgili modelin doğruluğunuda ortaya koymaya çalışmıştır. Elde edilen ampirik sonuçlar ışığında, makroekonomik değişkenlerin büyük bir çoğunluğu Tahran menkul kıymetler borsasındaki hisse seneti getirisi anlamlı bir şekilde açıklamıştır. Ampirik sonuçlar ayni zamanda endüstri/sanayi üretim endeksi, kısa dönemli faiz oranı, döviz kuru ve para arzı endekslerinin Tahran menkul kıymetler borsasındaki hisse seneti getirisi üzerinde büyük etkisi olduğunu belirtir.

Anahtar kelimeler: Arbitraj Fiyat Teorisi, Sermaye Aktif Fiyat Teorisi, En Küçük Kareler Yöntemi, Tahran menkul kıymetler borsası, İran Ekonomisi.

To my parents with love

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LIST OF ABBREVIATIONS

APT	Arbitrage Pricing Theory
CAPM	Capital Asset Pricing Model
TSE	Tehran Stock Exchange
GDP	Gross Domestic Production
IRR	Iranian Rial
IMF	International Monetary Fund
IFS	International Financial Statistics
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Square
SML	Security market line
CBI	Central Bank of Iran

Chapter 1

INTRODUCTION

1.1 Brief Introduction

The financial and economic theories suggest that unanticipated movements in systematic economy-wide factors affect financial asset returns such as common stock returns. It is generally agreed that, the future profits of many or all firms, and therefore the prices of their equities are usually considered as responding to economic news. So, the prices of their equities are likely to react to a greater or lesser extent to changes in expectations concerning the prospective state of economy. There is, however, no asset pricing model in which the underlying macroeconomic variables relevant to asset pricing are clearly specified.

The Arbitrage Pricing Theory (APT), first derived by Ross (1976) is one of the asset-pricing models in financial economics that attempts to describe how individual risky assets are priced in equilibrium. It is based on the notion that there are a number of factors that determine asset returns in equilibrium and it assumes that returns are generated by a factor model. As the tests for the APT rely on factor analysis, the questions concerning the number of factors and identification of the systematic economy-wide factors in determination of stock returns do not seem to have been settled yet.

Despite the absence of an asset pricing model that identifies systematic economic-wide factors to determine the stock returns, the relations between macroeconomic variables and stock returns have been examined in recent years. A number of studies such as Chen, Roll and Ross (1986) and Poon and Taylor (1991) used an alternative methodology that does not rely on factor analysis for testing the APT. Their purpose is to determine the pervasive state factors that affect security returns based on economic theory. However the economy-wide factors that are priced in security markets vary from study to study and may not be identical in every country. In addition to this, some previous empirical studies such as Wasterfallen (1989) concludes that only a small proportion of the observed variation in stock returns can be estimated by a number of economic factors.

1.2 Scope and Objectives of This Research

Main objective is to investigate empirically the relationship between Tehran stock market (SSM) returns and its determinants (i.e, several macroeconomic variables) under the multivariate Arbitrage Pricing Theory (APT) framework.

1.3 Methodology of the Research

Ordinary Least Square (OLS) technique was applied to determine the effects of the relevant variables (i.e, inflation, oil price and money supply) on the Iranian stock returns employing monthly data over the period of January 1999 and June 2009 based on Chen, Roll and Rose (1986) APT model.

1.4 Findings of the Study

The finding of this thesis can be summarised as such: while inflation or change in consumer price index has no significant effects on stock returns, short term interest rate, exchange rate, money supply M2 and production index (not as strong as the others), are found to be closely related to the stock returns of Tehran stock market. First, inflation issue can be formulated in a way that it should be compatible with the nature of the Tehran economy. Second, oil production should be developed further to improve the Iranian economy. Especially, policy makers should take oil production industry into consideration as guidance in formulation of future Iranian economic polices because this is comparative advantage of the Iranian economy.

1.5 Structure of the Study

Chapter 1 is introductory part. Chapter 2 explains the review of literate of the concept of the CAPM and the APT that relates macroeconomic variables to stock returns. Chapter 3 contains an overview of Iranian economy and Tehran stock market. In Chapter 4, Data and methodology are described. Chapter 5 presents the regression model and empirical results. In Chapter 6, concluding remarks are presented. Chapter 7 gives some recommendations and suggestions for further studies.

Chapter 2

LITERATURE REVIEW

2.1 Review of Asset Pricing Models

Markowitz (1952) showed exactly how an investor could reduce the standard deviation of portfolio returns by choosing stocks that do not move exactly together. He worked out the basic principles of portfolio construction, which are the foundations of the relationship between risk and return. The two leading models in financial economics that attempt to explain the relationship between risk and asset returns are the *Capital Asset Pricing Model* (CAPM) and the *Arbitrage Pricing Theory* (APT). The simplest form of the asset pricing models is the one-factor Capital determined by the measure of the market price of risk, namely *beta*. The main parameters that the CAPM depends on are the mean and the variance of the returns. The second model, the APT, offers a new approach for explaining the asset prices and states that the return on any risky asset is a linear combination of various common factors, but it dose not explain how many risk factors there are and what the prices of these factors are.

2.2 The Capital Asset Pricing Model

The capital asset pricing model (CAPM) was developed independently by Sharpe (1964), Lintner (1965) and Mossin(1966). The CAPM suggests that the only variables that we need in calculating the expected return on security is are: the risk free rate (a constant), the expected excess return on the market, and the security's

vita (a constant). A similar implication holds for the APT. The expected excess return is a function of the factor loading times the factor premium.

The CAPM describes the relationship between the expected return of an asset and its risk under conditions of market equilibrium in a capital market where all investors undertake optimal portfolio selection by using the Markowitz mean-variance.

2.2.1 Assumptions of the CAPM

The CAPM rests on several assumptions. The most important are as follows:

1. All investors are price-takers; so that, no investor can influence the market price by the scale of his or her own transactions.

2. All investors have homogeneous expectations about asset returns, which means that all investors arrive at similar assessments of the probability distribution of returns expected from traded securities. [it implies that investors will not be trying to beat the market by actively managing their portfolios (Grinblatt and Titman, 1998, p166).

3. All investors are rationally risk-averse individuals whose aim is to maximise the expected utility of their end of period wealth. Therefore, all investors operate on a common single-period planning horizon.

4. Asset markets are frictionless and information is freely and simultaneously available to all investors.

5. Distributions of expected returns are normal.

6. All investors can lend or borrow unlimited amounts of funds at a rate of interest equal to the rate of risk-free securities.

7. Investors pay no taxes on returns and there are no transaction costs entailed in trading securities, so expected return is only related to risk.

8. All securities are highly divisible, i.e. can be traded in small parcels. (Elton and Gruber, 1995, p294-295).

2.2.2 The Market Portfolio

Under these assumptions of the CAPM each investor hold an optimal portfolio and the aggregate of all investors is the market portfolio, which is defined as the portfolio of all risky assets, where the weight on each asset is simply the market value of that asset divided by the market value of all risky assets. In theory, market portfolio consist of all risky assets in the world including financial assets, real estate, human capital and the like, which exist in all the countries of the world.

Moreover, the CAMP requires that in the equilibrium the market portfolio must be an efficient portfolio. One way to establish its efficiency is to argue that if investors have homogenous expectations, the set of optimal portfolios they would face would be using the same values of expected returns, variances and co variances. Therefore, the efficiency of the market portfolio and the CAPM are joint hypothesis and it is not possible to test the validity of one without the other (Roll, 1977). If a market is weak from efficiency, then it is impossible to earn abnormal returns by developing a forecasting model based on past returns. In the context of the capital asset pricing model, an abnormal return in excess of what was expected according to the CAPM equation.

2.2.3 Derivation of the CAPM

The CAPM is a simple linear model that is expressed in terms of expected return and expected risk. The model states that the equilibrium returns on all risky assets are a function of their co variances with the market portfolio.

Under the assumptions of the CAPM, if a risk-free asset exists, every investor's optimal portfolio will be formed from a combination of the market portfolio and the risk-free asset. The precise combination of the market portfolio and the risk-free asset depends on the degree of investor's risk aversion. Since investors can choose the combination of the market portfolio and the risk-free asset, then the equation of the relationship connecting a risk-free asset and a risky portfolio is:

$$E(R_i) = R_f + \frac{E(R_m) - R_f}{\sigma^2_m} \sigma_{im} \qquad (2.1)$$

where

$E(R_i)$:Expected return on i^{th} portfolio.

R_f : Return on the risk free asset

$E(R_m)$:Expected return on market portfolio

σ_{im} : The covariance between asset *i* and the market portfolio

σ^2_m : The variance of the market portfolio

Based on the equation (2.1) the original CAPM equation can be derived as follows:

$$E(R_i) = R_f + [E(R_m) - R_f]\,\beta_i \qquad (2.2)$$

Equation (2.2) is known as Capital Asset Pricing Model and it could be shown graphically as the security market line (SML). The model states that a stock's expected return is equal to the risk-free rate plus a risk premium obtained by the price of risk multiplied by the quantity of risk. In a well-functioning market nobody will hold a security that offers an expected risk premium of less than $[E(R_m)-R_f]\,\beta_i$. If I think $E(R_m) - Rf$ as the market price of risk for all efficient portfolios, than, it represents the extra return that can be gained by increasing the level of risk on an efficient portfolio by one unit. The quantity of risk is often called beta, β, and it is the contribution of asset *i* to the risk of the market portfolio. In other words, it is the correlation of the asset *i*'s return with the return on the market portfolio.

If the beta of an asset is larger (smaller) than 1, then the standard deviation of an asset changes more (less) than proportionately in reaction to changes in market conditions. Thus, an asset whose beta is greater (less) than 1 has a relatively greater (smaller) contribution to the risk of a portfolio. While beta does not measure risk in absolute terms, it is a crucial risk indicator, reflecting the extent to which the return on the single asset moves with the return on the market.

If everyone holds the market portfolio, and if beta measures each security's contribution to the market portfolio risk, then its no surprise that the risk premium demanded by investors is proportional beta. As Grinblatt and Titma (1998, p166) state "the major insight of the CAPM is that the variance of a stock by itself is not an

important determinant of the stock's expected return. What is important is the market beta of the stock, which measures the covariance of the stock's return with the return on a market index, scaled by the variance of that index."

According to the CAPM the total risk of a security could be divided between systematic and unsystemic risk. The systematic risk is the portion of the security's return variance that is explained by market movements such as fiscal changes, swings in exchange rates and interest rate movements. On the other hand, the unsystemic risk is the variability in return due to factors unique to the individual firm, such as R&D achievements and industrial relations problem. The relevant measure of the risk of an asset is its contribution to the systematic risk of an investor's portfolio defined by its beta rather than the inherent variance in the asset's total return.

2.2.4 Restrictions and Extensions of the CAPM

Although not all of the assumptions underlying the derivation of the CAPM conform to reality, they are simplifications that permit the development of the CAPM (Copeland and Weston, 1988, p194). However, it is important to realise that most of these assumptions are merely mathematical identities and they do not reflect or predict the behaviours of investors.

As a consequence, while on the surface the capital asset pricing model appears to be rich in economic content and predictive power, it really makes only one interesting economic prediction: All invests hold portfolios that are on the efficient set, and as a result the market portfolio is itself on the efficient set.

However, most individuals and many institutions hold portfolios of risky assets that do not resemble the market portfolio. Therefore, the incorporation of more realistic assumptions into the model may get better insight into investor behaviour (Elton et al., 1995, p311). Alternative versions of the CAPM have been derived to take into account some of the problems such as the non-existence of a risk-free asset or the imposition of some frictions involving the risky or risk-free assets.

2.2.5 Empirical Tests of the CAPM

When the CAPM is empirically tested, the theoretical CAPM is transformed to the model presented below that involves running a regression. The characteristic of this model is it can not have a negative slope.

$$R_i - R_f = a + b\beta_i + \epsilon_i \qquad (2.3)$$

If the CAPM is correct, then results should find that (Blake, 2000, p496):

1. The intercept a should be Zero
2. The slope coefficient b should equal (R_m-R_f)
3. The relationship should be linear in beta
4. Beta shoud be the only factor that explains the rate of return on a risk asset

The Major empirical tests of the CAPM were published by Black, Jensen and Scholes (1972), Miller and Scholes (1972), Fama and Macbeth (1973), Litzenberger and Ramaswamy (1979) and Gibbons (1982).

Moreover, Fama and French (1992) find no evidence for the correct relationship between security returns and beta over the period 1963-1990 in MYSE. And neither of the UK studies conducted by Beenstock and Chan (1986) and by poon and Taylor (1991) found significant positive relationship between security returns and beta.

2.3 The Arbitrage Pricing Theory

The Arbitrage Pricing Theory (APT) is an alternative model of asset pricing. “The idea that equilibrium market prices ought to be rational in the sense that prices will move to rule out arbitrage opportunities perhaps the most fundamental concept in capital market theory” state Bodie, Kane and Marcus (1996, p291).

This theory being with an analysis of how investors construct efficient portfolios and offers a new approach for explain the asset prices and states that the return on any risky asset is a linear combination of various macroeconomic factors that are not explained by this theory namely. Therefore unlike CAPM model this theory specifies a simple linear relationship between assets, returns and the associated k factors.

There are two empirical testable versions of the APT, I the statistical APT and the macro variable APT. Both of these techniques will be evaluated in this case. However, the macro variable model differs from the statistical factor model mainly because the factors are specified in advance and they are interpretable.

The APT equilibrium rests on investors, ability to construct an arbitrage portfolio by simultaneously holding a short and a long position in two different portfolios which offers positive expected return with zero risk and zero net investment. Grinblatt and Titman (1998, p219) assert “ it is possible to demonstrate that such arbitrage opportunities will exist only if securities returns do not satisfy an equation that

relates the expected returns of securities to their factor betas". This risk-expected return relation is known as the Arbitrage Pricing Theory, Which is formulated by Ross (1976).

2.3.1 The Derivation of the APT

The APT can be seen as a *multi-factor* model in which the returns generating process of the portfolio is a function of several factors. Such a model specifies a simple linear relationship between asset *i*'s returns and the associated *k* factors, which influence its returns, and takes the general form:

$$R_i = E(R_i) + \Sigma \sigma_j \beta_{ij} + \epsilon_I \qquad (2.4)$$

Where,

R_i : The random rate of return on security *i* at the end of the period, $i = 1, \ldots, n$

$E(R_i)$: The expected Rate of return on security I at the beginning of the period,

σ_j : The Zero mean *j*th factor common to the return of all assets under consideration,

β_{ij} : The ith security's return to the *j*th common factor or asset *i*'s factor loading for factor j,

ϵ_i : A random Zero mean noise term for security *i*.

The model says that, at the end of the period asset *i*'s realised return is a linear combination of its expected return, plus realised factor returns, with asset *i*'s specific factor loadings weighted, plus asset *i*'s specific risk component. This is assumed for all assets, $i = 1,\ldots,n$. The theory requires that the number of assets under consideration, n, be larger than the number of factors, *k*, and the noise term, $\in i$, be the unsystematic risk components of risk (Copeland et al., 1988, p219).

The derivation was based on the intuition that in an efficient market, and consistent with market equilibrium, not risk-free arbitrage profit opportunities can exist and only a few common factors are priced for large, well-diversified portfolios. The resulting pricing relation expressed the expected return on an asset *i* in a linear relationship with the k-factor risks s follows:

$$E(R_i) = \lambda_0 + \Sigma \lambda_j \beta_{ij} \qquad (2.5)$$

where,

λ_0 : Expected return on an asset with zero systematic risk,

λ_j : Risk Premium for the *j*th factor in equilibrium.

Roll and Ross (1980, p1079) states that "this pricing relationship is the central conclusion of the APT and it will be the cornerstone of our empirical testing".

2.3.2 Assumptions of the APT

- Asset markets are perfectly competitive and frictionless,

- All investors have homogeneous expectations that returns are generated randomly according to a k-factor model (equation 2.3).

- Investors have monotonically increasing concave utility functions,

- The number of assets existing in the capital market from which portfolios are formed is much larger than the number of factors.

- There are no arbitrage opportunities. (Because the no arbitrage conditions should hold for any subset of securities, it is not necessary to identify all risky assets or a market portfolio to test the APT (Elton and Gruber, 1995, p373)).

- There are no restrictions on short selling. (This assumption is crucial to the equilibrium, as it constitutes one side of the arbitrage portfolio; equally important is the requirement that the proceeds from short selling are immediately available.)

2.3.3 Empirical Tests of the Arbitrage Pricing Theory

There are two empirically testable versions of the APT, the Statistical APT and the Macro variable APT. The Statistical APT first tested by Roll and Ross (1980) involves identifying priced common risk factors and this version of the APT is also known as the factor-loading model.

2.3.3.1 The Number of Risk Factors in the APT

After the initial development of the APT by Ross (1976), the first empirical test of the model is done by Roll and Ross (1980), who use a two-step testing procedure. They examine daily data on 42 groups of 30 securities for the period 1962-72. They employ the maximum likelihood factor analysis to estimate the expected returns and the factor coefficients from time series data on individual asset returns. Then, they use these estimates to test a cross-sectional pricing relationship. They found that at least three but no more than six factors were significant in explaining most of the joint variability in the returns on this group shares.

Kryzanowski and To (1983) test the assumption that security returns are characterised by an explicit underlying factor structure. They use US and Canada stock price data to test the APT. Their study concludes that the number of relevant factors is an increasing function of the size of the group being factored. They observed that while five factors are sufficient to represent the US security returns, Canadian securities required 18-20 factors.

Dhrymes, Fried and Gultekin (1984) re-examine the techniques employed by Roll and Ross (1980) and point out several limitations. First of all, they note that the results for a small portfolio differ from the results for a large portfolio. Second, they assert that the methodology that RR (1980) uses for determining confirmatory

evidence about the number of factors is not appropriate. They find that as the number of securities increases, the number of factors determined also increases, at a 5% level of significance, they find two factors for a group of 15 securities, three factors for a group of 30 securities, four factors for group of 45 securities, six factors for group of 60 stocks, and nine factors for a group of 90 securities.

Roll and Ross (1984) reply to the criticism of Dhrymes, Fried and Gultekin (1984) about the number of factors. They assert " one would expect the number of factors to increase with the sample size because one would expect more potential relationship to arise among the stock but the important point is how many factors are significantly priced by the market in a diversified portfolio".

Cho, Elton and Gruber (1984) support the Roll and Ross study by examining the number of factors in return-generating process that are priced. They note that there are definitely more priced factors influencing stock returns than implied by the CAPM. By employing the same factor analysis, they find five priced factors.

Beenstock and Chan (1986) test the APT using 220 securities in the UK and find that the explanatory power of a twenty factors APT model is significantly greater than a four-factor model.

As can be seen from the result of above empirical studies, there is no consensus about the number of factors in the APT, The contents of factors are examined in the next section, which also deals with the empirical testing of the APT.

2.3.3.2 Factor Identification

Chen, Roll and Ross (1986) test the APT by using macroeconomic data series to explain stock returns. They employ seven macroeconomic variables as the source of systematic risk according to the dividend discount model, which assumes that prices of assets are determined through their expected discounted dividend payments. These variables are industrial production, inflation, risk premium, term structure, market returns, consumption and oil price especially for country such as Iran. Their evidence suggests that consumption; the financial market does not price oil prices and the market index. They note that the market returns explain much of the movements in portfolios but the market betas do not explain cross-sectional differences after the betas of the state variables are included. They conclude (p402) “Stock returns are exposed to systematic news, that they are priced in accordance with their exposures, and that the news can be measured as innovations in state variables whose identification can be accomplished through simple and intuitive financial theory”.

Similar results have been reported by McElroy and Burmeister (1988) who use variables very similar or identical to Chen, Roll and Ross’s variables. Chen and Jordan (1993) compare the factor loading model and the macroeconomic variable model, and also test the validity of the APT. They conclude (p85) “Little is lost in moving from the factor loading model to the macroeconomic variable model and the macroeconomic variable model may turn out to be better when the two are tested against a holdout sample or against a test period. This finding is very promising because the macroeconomic variable model has several advantages, including economically interpretable factors. In addition, no attempt is made in this study to determine the best set of macroeconomic variables or how to best measure the ones

selected, so the possible performance of the macroeconomic variable model is probably understated".

2.4 Comparing the CAPM and the APT

In comparison Ross (1976) argues that the APT is "substantially different from usual mean variance analysis and constitutes a related by quite distinct theory". He suggests there are two main differences between these two models in comparison. First, instead of the explicit modelling of the factors affect actual and expected returns of assets in APT; CAMP focuses on the market portfolio. Second, the fact that in the APT the equilibrium relationship is derived based on a no-arbitrage assumption.

Brealey and Meyer (1999) suggest that the market portfolio that plays such a central role in the capital asset pricing model does not feature in arbitrage pricing theory. Likewise Roll and Ross (1980,p1080) argue, "In CAPM, it is crucial to both the theory and the testing that all of the universe of available assets be include in the measured market portfolio. By contrast, the APT, in principle, is tested by examining only subsets of the set of all returns."

Proponents of the APT argue that the APT was superior to the original CAPM in regard to the following arguments (Copeland et al., 1988, p222):

- While both theories make the realistic assumption that investors prefer more wealth to less and that they are risk averse, the quadratic utility assumption of the original CAPM is much more restrictive.

- The APT dose not requires the assumption of multivariate normal distribution of returns.

- The APT dose not require the existence of the market portfolio therefore the difficulties such as identification of the market portfolio or a suitable proxy and the requirement that it be mean-efficient, are avoided.

- The APT does not require the existence of risk-free asset and a risk less rate at which lending and borrowing are undertaken.

Moreover, Bower and Logue (1984) use utility portfolio returns in the period of 1971-1979, and estimate expected returns by the CAPM and the APT. They state that the APT tends to predict returns better than the CAPM, and this is seen in the explanatory power of the models. The APT shows higher R2 and fits and fits closer to actual returns.

Chen (1983) also performed a direct comparison of the APT and the CAPM. His results show that the CAPM is misspecified and the missing priced information is picked up by the APT factors.

As a result, “if investors are sensitive to more than one type of risk when choosing among portfolios of equal return, then the APT is superior to the CAPM because the CAPM is unidimensional in risk” (Copeland et al., 1988,p224).

Furthermore, although there are various theories that propose links between macroeconomic variables and stock returns [Mandelker and Tandon (1985), Chen,

Roll and Ross (1986), Boudoukh and Richardson (1993)], macroeconomic variables are often used to proxy for pervasive risk factors in the context of APT models. It is important to mention that APT model will be used for the case in chapter 5 due to the strengths mentioned above.

2.5 Literature Review of the Macroeconomic Variables

A number of researches have focused on the role of macroeconomic as a source of financial market volatility. A large number of such studies investigate the impact of macroeconomic news announcements on foreign exchange rates [Almeida, Goodhart and Payne (1998), Andersen and Bollerslev (1998) or Kim (1998)], while others look at the impact of macroeconomic announcements on stock prices [Mitchell and Mulherin (1994)], bond prices [Fleming and Remolona (1997), Jones et al (1994) or Clare et al (1999)], interest rates Becker et al (1995).

Supply and Demand for a currency influenced by a variety of factors, including inflation rate, interest rates, money supply, exchange rates and government intervention. Madura (1995) took three of these factors into consideration namely differential inflation rates, differential interest rates and government intervention.

2.5.1 Inflation

The relation between stock returns and inflation is commonly attributed to the Fisher Hypothesis. Fisher (1930) asserts that the nominal interest rate consists of a real rate plus the expected information rate. Fama and Schwert (1977) generalize the Fisher Hypothesis such that if the market is efficient at time t-1 to t will be the sum of the appropriate equilibrium expected real return and the best possible assessment of the expected inflation rate from t-1 to t.

Lintner (1975) explains the relationship between inflation and stock returns by a company's dependence on outside financing. He points out that even if a company's unit sales growth and real rates of return on operations and assets are fully maintained at a constant level, its dependence on outside financing will necessarily reduce the value of its equity, hence the return realised on its equity during an increase in realised inflation.

Geske and Roll (1983) argue that stock returns are negatively related to contemporary changes in expected inflation because they signal a chain of events that causes monetary expansion. Exogenous shocks in real output, signalled by the stock market, induce changes in tax revenue, in the budget deficit, in government borrowing and in money supply. Rational investors realise these changes and alter the prices of securities accordingly.

Chen, Roll and Rose (1986) define three variables related to inflation, which are expected inflation, the change n expected inflation and unanticipated inflation. They use monthly data and include the change in expected inflation and unanticipated inflation as the explanatory variables on stock returns besides other variables in their

model. Significantly negative relation is found for both inflation variables. Chen and Jordon (1993) find similar results for the same variables.

Kaul (1987) using data from four developed countries, namely the UK, the US, Canada and Germany, identifies the different monetary regimes from the official statements by monetary authorities. He points out the relation between stock returns and inflation systematically varies over time depending on money demand and counter-cyclical money supply effects.

According to Grinblatt and Titman (1998) in an inflationary economic environment the typical expects of both revenues and costs, and thus cash flows are to increase overtime. The nominal discount rates- that is, the rates obtained from the financial markets directly- apply to nominal cash flows, which grow with inflation. However it is possible to forecast inflation-adjusted cash flows, which take out the component of growth due to inflation.

Boudoukh, Richardson and Whitelaw (1994) investigate the cross-sectional relation between the industry sorted stock returns and expected inflation. Using monthly data from 1953-1990 and sorting the firms into 22 industry sectors, they find that the direction of relation between expected inflation and industry groups in linked to cyclical movements in industry output, and specifically, stock returns of cyclical industries co-vary negatively with expected inflation while the non-cyclical industries co-vary positive. They also point out the negative relationship at short horizons and the positive relationship at long horizons.

2.5.2 Exchange Rates

The exchange rate variable that I will evaluate in this thesis will capture the changes in the Iranian Rial value-the currency of Iran (IRR) witch link with the US Dollar to the other currencies such as: German Mark, Japans Yen, and British Pound. The European Euro is become the most important currency to evaluate but it only start recently and the data available are with the other currency that why we will disregard the Euro from the study.

The theory of Purchasing Power Parity (PPP) is regarding to the relationship between inflation and exchange rates. It suggests that the exchange rate will, on average, change by a percentage that reflects the inflation differential between the two countries concern. Consequently, the purchasing power of customers when purchasing goods in their country will be similar to their purchasing power when importing goods from foreign country. Economic globalisation results with the effects of the international activates among all types of businesses.

However, according to Madura (1995) exchange rates do not always change as suggested by PPP theory because other factors that influence exchange rates can distort the PPP relationship. Added to these effects will change the price of the stocks of a firm either it is a multinational company or a domestic firm. Consequently, the effect of changes in exchange rate is more direct in multinational firms rather than domestic firms.

According to perfect purchasing power parity conditions, exchange rates will adjust to reflect relative inflation levels. Since there has been a considerable increase in economic globalisation, all businesses are now affected directly or indirectly from international activities. As a result, Changes in exchange rates affect both multinational firms and domestic firms. The effect on multinational firms is more direct, since a change in exchange rates will be reflected in foreign operations resulting in a loss or a profit if the firm dose not hedge. Besides this, the value of the monetary assets of these firms may be affected indirectly by the exchange rate movements through the changes on aggregate demand or the changes on relative competitiveness of their products with imported goods. All these effects will change the value of the firm, hence the price of its stock.

Jorion (1991) examines the relationship between exchange rates and stock prices using monthly data in the APT framework. He concludes (p.374-375) “It was shown first that US industries display significant cross-sectional differences in their exposure to movements in the dollar. Next, the paper tested whether the currency exposure of US firms was priced in the sense of Ross’s APT. in spite of using relatively powerful statistical techniques, there was little evidence that US investors require compensation for bearing exchange risk.”

Brown and Otsuki (1992) examine the effect of exchange rate changes on stock returns in the context of a multi-period APT model of global equity markets. Using monthly data for 21 national stock markets and employing the non-linear seemingly unrelated regression analysis; they find that exchange rate risk exposure commands a significant risk premium in stock markets. They also indicate that this risk premium change in a predictable fashion through time.

2.5.3 Interest Rate

The relationship between short-term and long-term interest rates or rates of return particularly in the stock market the efficiency of pricing of company securities shows how we can rely on the stock market being able to correctly value a company's shares. Therefore, we are going to look at the Discounted Cash Flow model, which is one of the most widely used stock valuation approaches. This model is based on the idea that the value of stock is equal to the present value of the cash flows expected from the stock by the investors. Discount rate is dependent variable comparison to interest rates.

Madura (1995) suggests that one of the most prominent economic forces driving stock market price is the risk-free interest rate and the relation between interest rate and stock price is not constant over time.

Titman and Warga (1989) used stock returns as predictors of interest rates and find a positive relationship between large stock return and interest rate changes between 1979-1982.

Another theory on the interest rate differential is International Fisher Effect, which depends on the particular time period examined. According to the study of Madura and Nosari on the interest rate differential International Fisher Effect (IFE) is if this theory holds, than a strategy of borrowing on one country and investing the funds in another country should not provide a positive return on average. The reason is that exchange rates should adjust to offset interest rate differentials on the average.

Discounted cash flow model is one of the most widely used stock valuation approaches which is based on the concept that the value of a stock is equal to the present value of the cash flows expected to be received from the stock. Clearly, the discount rate that is related to the interest rate in the market is one of the most important parameters of these approaches. When interest rates change, investors will incorporate these changes in their stock price valuation, therefore, a rise in interest rates will reduce the present value of future cash flows, which investors expect to receive in the form of dividends and capital gains.

Najand and Rahman (1991) using a Generalised Autoregressive Conditional Heteroscedasticity model for the UK, Germany, the US and Canada, find a statistically positive relation between interest rate volatility and stock returns volatility. Asprem (1989) investigates the issue in a macroeconomic variables model for ten European countries and, in general, finds a negative relation between interest rates and stock price.

The relations between the term structure of interest rate and stock returns are examined by Chen, Roll and Ross (1986), Fama and French (1989), Poon and Taylor (1991) and Chen and Jorden (1993). Some of these studies find positive relation and some others find negative relation between the term structure of interest rates and stock return.

2.5.4 Money Supply

The Ministry of Finance controls the Iranian's money supply through the central Bank of the Islamic Republic of Iran who is responsible for the formulation and implementation of monetary and credit policies in accordance with general economic policy of the country.

According to Cooper (1974) Monetary Portfolio Theory suggests that changes in money supply alters the equilibrium position of money, thereby altering the composition and price of assets in an investors portfolio. Additionally change in money supply in real economic variables, such as a decrease in money supply will raise short-term interest rate and decrease expenditures and capital investments, thereby having a lagged influence on stock returns (Rogalski and Vinso, 1977).

According to Brunner (1961) the changes in money supply results in the equilibrium position of money with regard to other assets in the portfolio of investors. Therefore a new equilibrium is reached through both adjustments of proportions of asset portfolios and changes in the prices of various assets.

Asprem (1989) approach to the relation between stock price and macroeconomic variables in ten European countries is providing relation of money supply to stock returns.

Najand and Rahman (1991) use the GARCH model to examine the relationship between volatility of stock returns and volatility of macroeconomic variables for four countries, and find statistically significant positive coefficients for the monetary base.

2.5.5 Industrial Production

In finance theory, investment with higher expected rates of return than the cost of capital is the main determinant of a firm's value. As firms create such investment opportunities, their values, thus, the prices of their stocks will increase. Since security prices are a function of the future cash flow stream, changes in investments with positive net present value of assets.

Industrial production represents the real economic activity. It is widely accepted that stock price are positively related to the level of real economic activity. Fama (1981) investigates the relation among stock returns, real activity, inflation and money. The results of his equations on an annual data show a positive relation between real economic activity and stock returns. Moreover, Fama (1990) regressed the monthly, quarterly and annual growth rate of industrial production on contemporaneous and lagged quarterly real stock returns. He suggests that for longer retune horizons the real activity explains more of return variation.

Schwert (1990) expands the study of Fama by using an additional 65 years of data. Even though he finds that the positive relation between stock returns and future production growth rates in the 1889-1952 period, he concludes that hundred years of data strengthens Fama's conclusions.

James, Koreisha and Partch (1985) using a Vector Autoregressive Moving Average (VARMA) model, and Lee (1992) using multivariate Vector Auto Regression (VAR) analysis find evidence that stock returns are strongly positively correlated with real activity measured by the growth rate of industrial production, and stock market rationally signals or leads changes in real activity.

Chapter 3

AN OVERVIEW OF THE IRANIAN ECONOMY AND TEHRAN STOCK MARKET

3.1 The Tehran Stock Market

The concept of a stock industrialization dates back to 1936 in Iran with the largest and oldest bank in Iran, Bank Melli together with Belgian experts prepared a report detailing the prospects of having an operational stock exchange in Iran. Outbreak of the World War II and other political factors delayed the implementation process until 1967 when the Government revisited the issue and ratified the "Stock Exchange Act". Consequently a small exchange, the Tehran Stock Exchange (the "TSE") began its operations in 1967. What followed was an initial trading in corporate and government bonds. The economic boom in the 1970s led to a pent-up demand for equity. Meanwhile, certain forces were changing the economic backdrop in Iran. The Government was actively involved in grant of shares to employees for large state-owned and family-owned enterprises. Market activity was reaching frenzy with many companies and high net worth individuals vying to participate in the new found wealth associated with the TSE.

Based in Tehran and opened in 1968, The Tehran Stock Exchange (TSE) is Iran's largest stock exchange. As of June 2008, 400 companies, with a market capitalization of US$70 billion were listed on TSE. TSE which is a full member of the World

Federation of Exchanges and a founding member of the Federation of Euro-Asian Stock Exchanges, has been one of the world's best performing stock exchanges in recent years. In the following table, General index, financial index and Industrial as well as 50 top companies indices are displayed between the year 2006 and 2009.

Table: 3.1: TSE Index

Tehran Stock Exchange (TSE) Indices					(1990/91=100)	
				Percentage change		
2006/07		2007/08	2008/09	2006/07	2007/08	2008/09
TEPIX	9,821.0	10,082.0	7,966.5	3.8	2.7	-21.0
Financial index	20,770.4	20,882.6	20,552.8	-0.8	0.5	-1.6
Industrial index	7,751.6	7,967.0	6,172.6	4.4	2.8	-22.5
50 top companies index	695.2	559.2	291.1	-0.3	-19.6	-47.9
Main floor index	9,781.5	9,016.0	6,383.7	7.1	-7.8	-29.2
Secondary floor index	9,164.2	11,046.3	12,563.5	-6.9	20.5	13.7
Source: Securities and Exchange Organization, and the TSE						

Everything came to a stand still after the Islamic Revolution leading in a prohibition against interest-based activities and nationalization of major banks and industrial giants. Mobilization of all resources towards the war effort during the 8-year Iran-Iraq war did not help matters. However, the Government fully embraced economic reforms and a privatization initiative in 1989 with a surge of activity in share activity of many state-owned companies through the defined targets in the first "Five-Year Economic Reform where the Government together with the Parliament defined the economic prospects of the country for the coming five years. Attention to promotion of the private sector and new interest in the TSE brought life back to the market. However, lack of regulation and out-of-date legal framework have led to many crises in the market leading to certain "meltdowns" until today. The market has experienced its share of highs and lows in the past years including topping the World Federation

of Exchanges' list in terms of performance in 2004 to tumbling down to last place in 2007 due to political uncertainties in the region.

3.2 Overlook on Tehran Stock Exchange (TSE)

An overlook on Tehran stock market illustrates that it has grown from 6 listed corporations in1967 to 105 companies in 1979 evolution. It is reopened in 1989 after the Iraq war by 54 companies listed. since then it has had dramatic growth number of the companies listed which has reported 330 corporations in the beginning of 2009. The figure 3.1 illustrates the evolution of All Share Price Index for the years between 1999 and 2009. There is an upward trend since 1999 and this means that TSE has always been developing in spite of political and economic sanctions against the current regime.

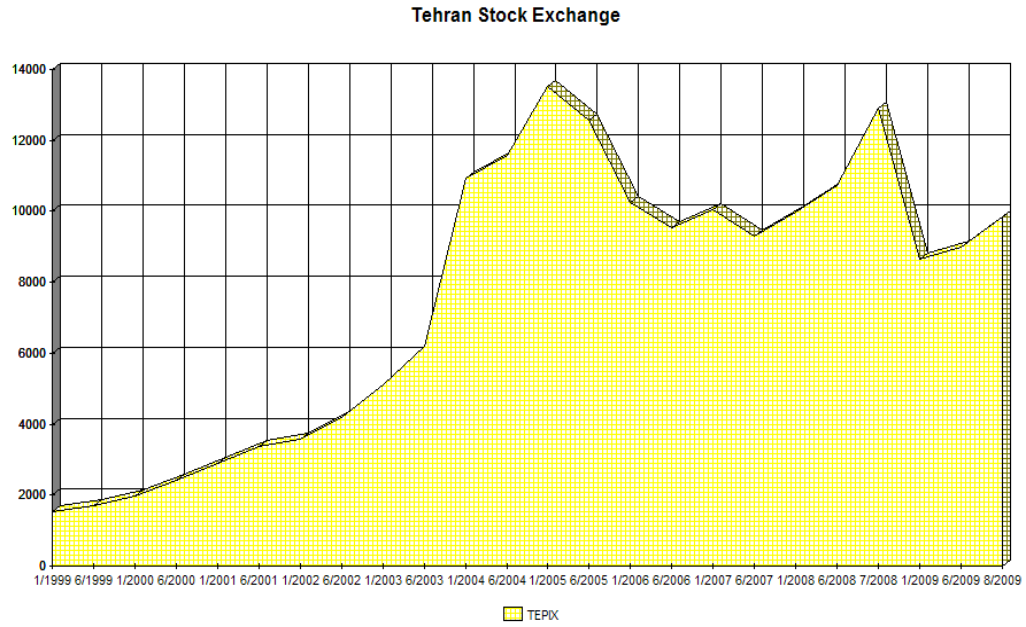

Figure 3.1: TEPIX All Share Price Index, Tehran Stock Exchange (1999-2009)

Tehran stock market had strong fluctuations in recent years. Between 2000-04 TSE indices tripled in number but after President Ahmadinejad’s selection in 2005 it has had a dramatic turn down.

In the first half of 2008/09 a sluggish housing sector led to a massive transfer of liquidity to stock market and positive growth of stock index. In the second half, duo to world crises capital market has been affected and a sharp fall in metal and steel price spillover occurred on Iran economy and led to reductions in metal producer share price therefore decreasing the general indices of TSE.

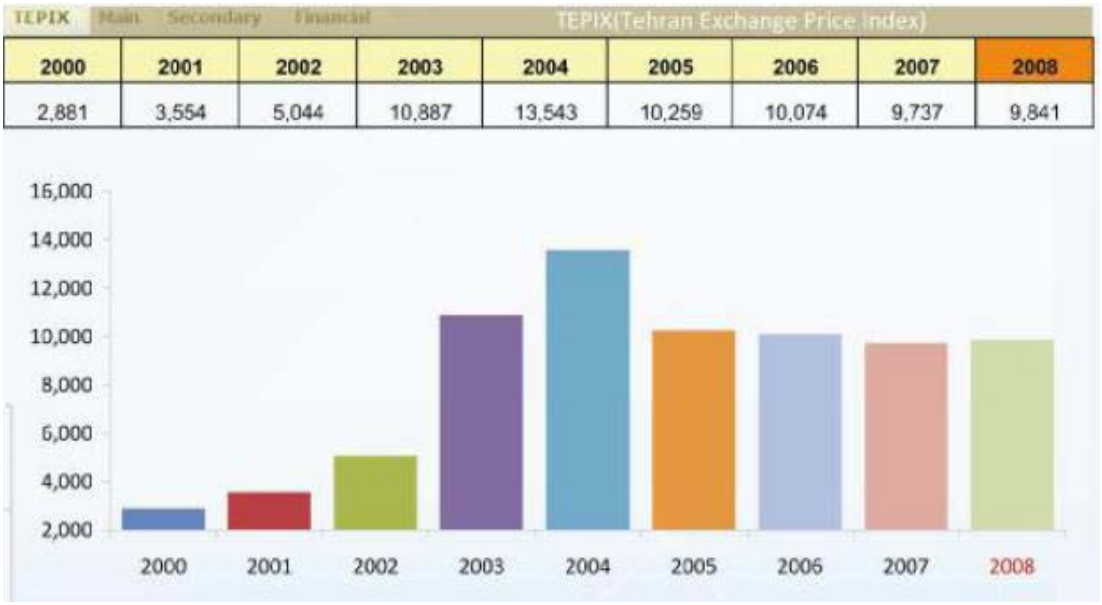

Figure 3.2: TEPIX Tehran exchange price index

3.4 The Iranian Economy

In recent years, the development of the Iranian economy was consistent and very high. Now Iran is the sixteenth largest economy of the world based on purchasing power parity (PPP).Iran is also one of few countries which has not suffered from world economic crises significantly.

3.3.1 Iran's Five "Five Years Economic Development Plans"

As mentioned above, after the Islamic revolution, Iran established "Five years economic development plans". The First Development Plan of the Islamic Republic (1983-88) asserted that its approach were to set up Iran's economic independence

through self-sufficiency in foodstuffs and decreased the dependence on country's oil exports. Iran's first plan focused on: getting higher education, providing the interests of the mostazafin (the disinherited), accomplishing economic independence, provide diversity in economy to achieve independence from gas and oil exports, and developing agriculture. US$166 billion was the budget traced to the first economic plan, however this budget was never allocated because of the Iraq war as war expenses got priority over other government expenditure. Shortfall in the international oil price in 1987 as well affected the first economic plan budgeting.

First economic development plan was revised in 1988 and formulated for post war Iran in 1989-93 by the consideration of a post war construction plan. The first stage of the plan was simplification of the exchange rate and a move in, 1991 from the seven-rate system to a three-rate system. Consistence of official governmental rate, competitive rate and free market rate. This plan emphasized on foundation of industrial infrastructures achieving domestication of productions which intended to reduce dependency on import industrial manufacures.70% of investment in manufacture sector allocated in intermediate goods, 20% for capital goods and 10% for consumer goods.

Table 3.2: Planned and actual Sectoral average annual output growth rate, 1989-93

Sector	Plan	Actual
Agriculture	6.1	5.9
Oil	9.5	8.9
Industry & Mines	15.0	8.7
WGE[a]	9.1	12.7
Construction	14.7	5.5
Services	6.7	7.4
GDP[b]	8.1	7.3
GFCF[c]	11.6	14.1

a) Water, gas, and electricity.
b) Gross domestic product.
c) Gross fixed capital formation.

Source: From Pesaran, 2000, Table 1, p. 67.

The available data allows for comparison between planned and actual growth rates approach in various industry sectors over the relevant period. The actual growth rate achieved is closer to planned growth rate in the first half of period than in the second half.

The **second five-year development plan** ***1995-99*** was launched in 1995. The main objective was to reach managed float exchange rate from unified floating exchange rate. In line with this policy, government tried to encourage foreign trade policy to enforce non-oil exports and promote domestic industries.

Table 3.3: Planned and actual Sectoral average annual output growth rate, 1993-98

Sectors	Plan	Actual
Agriculture	4.3	3.4
Oil	1.6	-10.1
Industry & Mines	5.9	4.8
Services	3.1	4.3
Gross Domestic Product (GDP)	5.1	3.7
Real Gross Domestic Investment	6.2	0.2

Source: Bank Markazi Jomhuri Islami Iran, *Economic Trends*, 2001, Appendix II, p. 24.

As the table illustrates, in the terms of investment, the actual growth rate is consistently shorter than the planned target. In spite of the stated objective of exchange rate unification, it stayed in force in the second plan, until 2002 and it wasn't until the third five years plan that it was implemented effectively.

The **Third Five-Year Plan** (2000-2004) entailed significant attempts for economic reform. In this program government tried to attract foreign investment, therefore moderated trade tax policies. Government introduced several structural reforms. In

March 2002 Iran moved from a multi-tiered exchange rate to unified managed floated exchange rate policy. The exchange rate changes are considered as vehicles for promoting Iran's trading policy. **The fourth five year plan** (2005-2009) obligates the government to stop investing in areas where private sector can take part in. Government companies were also obligated to perform their foreign currency transactions under the Central bank approval.

Iran is now experiencing a transition period by **privatization**. Iran in 2010 started "**fifth five years economic plan"**. According to the **fifth five years economic plan 2010-2015** government has to implement policies outlined in Article 44, to set prices and ceding shares to stock market and public.

3.3.2 The Development of Iranian GDP in Level

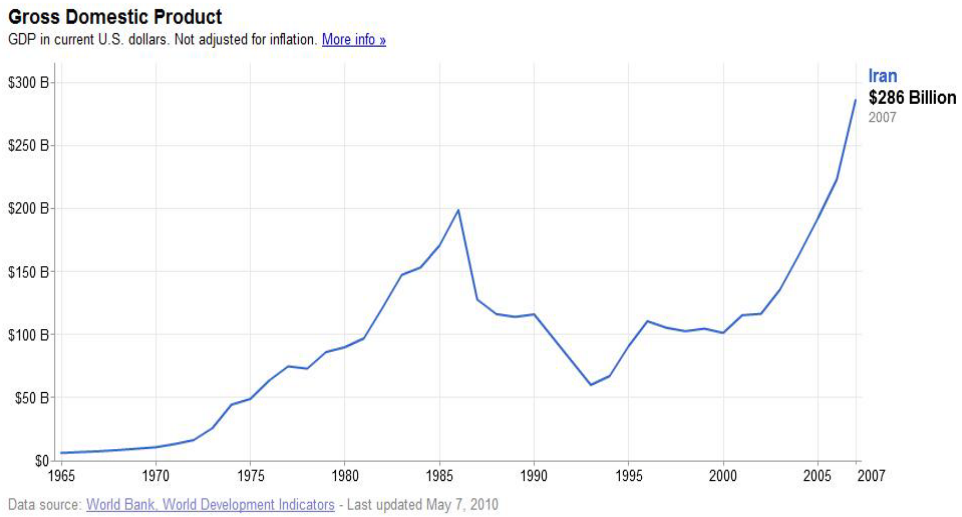

Figure 3.3: Gross Domestic Product 1965-2007

In the last 5 years, despite US and UN sanctions, Iran continues to experience positive rate of growth. Iran's recent economic growth around 5 % for 2008 and 4.6% for 2009. This is attributed largely by IMF to oil windfall as a major source of revenue for country. Oil related real GDP growth has been 2.7%in 2006 and 2.1% for

2007 whereas its non-oil related real GDP growth has been more than 6% for both 2006 and 2007.

3.3.3 The Development of Iranian GDP

Figure 3.4: Gross Domestic Product (Annual Percentage)
(Source: International Monetary Fund - 2009 World Economic Outlook)

In previous decades Iran endured many fluctuations in its economy. During 1960s and 1970s Iran experienced one of the biggest world economy growths, when real economic growth rate has been around 10%. After Iran's 1979 revolution and the Iraq war, Iran faced isolation and international sanctions. Hence Iran's economic growth rate turned negative in 1980s. During 1990s, as the graph shows, Iran experienced upward trend in real economic growth. However in the recent years falling oil prices caused a downtrend in real economy growth.

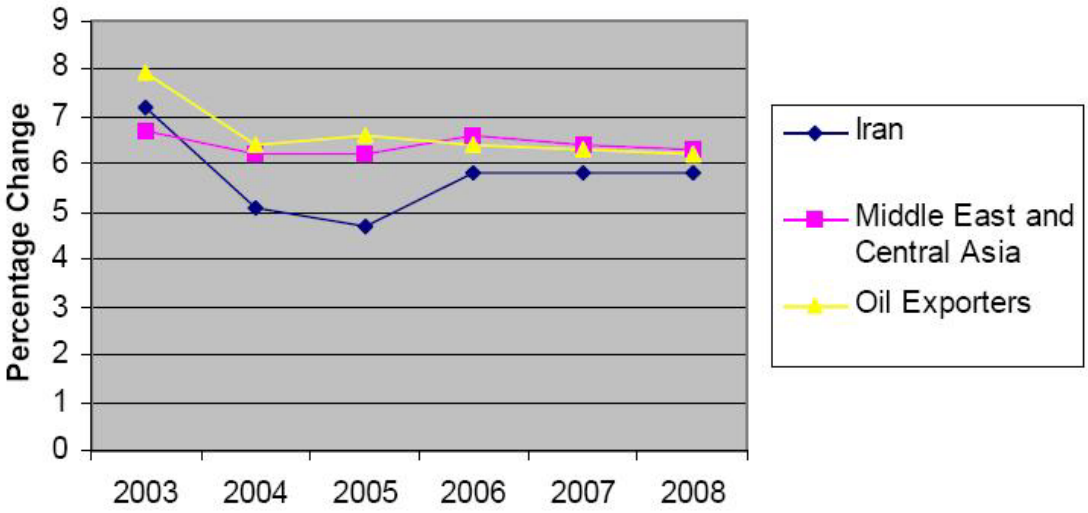

Figure 3.5: GDP Middle East, Central Asia and Iran

In spite of decrease in average economic trend in Middle East, Central Asia and in other oil exporter countries, Iran kept its own upward economic growth based on "sustainable development" policy as can be observed in figure 3.5

3.3.4 Iran Inflation Rate (Consumer Price Index)

Figure 3.6: Inflation, average (Consumer Price)
(Source: International Monetary Fund - 2009 World Economic Outlook)

A glance at the Iranian inflation statistics based on the figure above illustrates feeble inflation figures in 1995. This shows that inflation reached the highest point throughout its economic history due to the changing exchange rate regime. The ratios start with 20.50 in 1980 and decreases to 12.50 in 2009. This inconsistency supports

the empirical results conducted in chapter 5 that inflation has no impact on TSE general index. This may stem from political and economic sanction on Iranian economy. Except 1995, inflation shows almost the same pattern between the years 1980 and 2009.

Chapter 4

DATA AND METHODOLOGY

4.1 The Data

I used monthly data for the sample period of January 1999 (M1) to June 2009 (M6) [see Appendix 1 for the data and its source]. The data series are transformed into rates of change by taking the log differences in each of the series in the form Ln (X_t / X_{t-1}) to generate the unanticipated components (i.e. the first difference of the variable of interest). I adopted the convention that time subscripts apply to the end of the period. The definition and measurement of macroeconomic factors and stock returns used in this thesis are presented in Table (4.1):

Table 4.1: Definition and Measurements of Data Series

Symbol	Variable	Measurement
CPI	Consumer Price Index	$\Delta CPI = (CPI_t - CPI_{t-1}) / CPI_{t-1}$
SIR	Short-term Interest Rates	$\Delta SIR = (SIR_t - SIR_{t-1}) / SIR_{t-1}$
OPI	Oil Price Index	$\Delta OPI = (OPI_t - OPI_{t-1}) / OPI_{t-1}$
FXD	Exchange Rate: US $	$\Delta FXD = (FXD_t - FXD_{t-1}) / FXD_t$
M1	Money Supply	$\Delta M1 = (M1_t - M1_{t-1}) / M1_{t-1}$
M2	Money Supply	$\Delta M2 = (M2_t - M2_{t-1}) / M2_{t-1}$
M3	Money Supply	$\Delta M3 = (M3_t - M3_{t-1}) / M3_{t-1}$
GSI	General Share Index	$\Delta GSI = (GSI_t - GSI_{t-1}) / GSI_{t-1}$

Source: the data set extracted from International Financial Statistics (IFS) covering the first month of 1999 to sixth month of 2009, nearly 132 observations. Table 4.1 illustrate the description and the source of the data.

4.1.1 Stock Data

Two monthly returns data sets used for this study, namely General share index (GSI) and petroleum share index (PSI), are extracted from the International Financial Statistics (IFS), Statistical Abstract, Monthly Data, 2010. The rest shown in the table 4.1 are also taken from the International Financial Statistics (IFS).

4.1.2 Macroeconomic Variables

Numerous theoretical models have been used to establish linkages between asset prices and macroeconomic variables. Most of these models assume the basic valuation formula in the form of,

$$P(t) = Et\sum_{k=0}^{\infty} \frac{D(t+k)}{(1+\delta)^{k+1}}, \qquad (4.3)$$

where,

P (t): Price of a stock at time *t*.

Et : Conditional expectation operator given information available at time *t*.

D (1+k): Net cash flow of the firm available for distribution to shareholders at time *t+k.*

δ : Discount rate.

Any change in an asset's cash flows should have a direct impact on its price. Thus, the asset's expected growth rates that influence its predicted cash flows will affect its price in the same direction. Conversely, any change in the discount rate should inversely affect the asset's price.

A country's stock index therefore is affected by factors that influence its economic growth or bring about changes in its real rate of interest, expected rate of inflation, and risk premium.

Since my purpose is to find out whether the considered macroeconomic variables are important in explaining the Tehran stock market return, I employed exogenous macro variables that affect the future cash flow or the risk adjusted discount factors in Equation (5.1). I used five macroeconomic factors, namely, inflation, interest rate, oil price index, exchange rate and money supply as candidates for systematic risk factors (i.e. factors that may carry risk premium in Tehran stock market. Descriptive statistics of macroeconomic factors are presented in Table (4.1).

The rationale to choose these factors stems from the results of previous studies. For example, we specify some of the factors used by Chen et al. (1986) and also include a number of others that shows previous findings in the UK such as Beenstock and Chan (1988), Cheng (1995) and Pristley (1996).

The macroeconomic variables used in this thesis differ from the previous literature in term of the definition. Most of the previous studies related expected components of macroeconomic variables to expected returns. However, I used the 'rate of change' methodology to generate the unanticipated components. This first difference then enters as an unexpected component in the multi-factor model. The macroeconomic factors used in the model are explained below in more detail.

Industrial Production:

Industrial Production represents the real economic activity. It is widely accepted that there is a positive relationship between the level of real economic activity i.e. industrial production and stock prices. Here, I use oil price index instead of Industrial Production index in this case because production in Iranian economy mostly based

on oil production industry. I expect a positive relationship between oil price index and Tehran stock returns.

Interest Rates:

The change in interest rates will influence the discount rate in Equation (5.1). It may also influence the numerator on the right-hand side of Equation (5.1) because of a firm's financing requirements and debt structure.

In almost all of the previous studies, significant negative relationship between the observed stock market returns and the interest rates has been found. For example, Aspem (1989) investigates the issue in a macroeconomic variable model for ten European countries and, in general, finds a negative relationship between interest rates and stock prices.

I employed Short-term interest rates and hypothesize a negative relationship between Tehran stock returns and interest rates. In the case, I prefer to use short-term interest rate rather than long-term interest on due to the modelling criterion conducted. The APT model was developed to determine the influences in the short-run period; hence short-term interest rate is much more convenient to be used rather than long-term one.

Inflation:

Inflation influences Equation (4.2) through both the expected cash flows and the discount rate. The traditional economic view suggests that the common stocks should serve as hedges against inflation because they represent real assets of firms. The

Fisherian (1930) assumption is that real rates of return are independent of inflationary expectations. The change in CPI is considered as the measure of inflation in this thesis. A negative relationship between change in CPI and Iranian stock returns is expected. Although there is no inflation problem in economy, we use this factor because of our modelling criterion used in this study.

Exchange Rates:

The future cash flows and discount rates of most firms are significantly influenced by the unexpected changes in exchange rates. In my Thesis, exchange rate variable has been constructed in a way to capture the changes in Iranian Rial value of U.S. dollar since they are the most traded currency in the world. I hypothesised that an unanticipated rise in the exchange rates will adversely affect Iranian stock returns.

Money Supply:

M1, M2, and M3 variables represent money supply in the model used. M1 is a narrower measure, consisting mainly of notes and coin in circulation. M2 consists of notes and coin plus demand deposits and time deposits. Finally, M3 (broader measure) consisting of notes and coin in circulation with demand deposits and time deposits, plus foreign currency deposits. It is important to mention that some of money supply (M1, M2 and M3) in the literature can be dropped from the relevant equation due to their insignificance. A positive relationship is expected between money supply variables and stock returns.

4.2 The Method of Estimation:

The regression analysis is used to identify the direction and significance of relations between Iranian stock returns and the macroeconomic factors. The regressions are performed by utilizing the Ordinary Least Square (OLS) and to estimate the regression coefficients i.e. b_i of the model (5.1). Each regression coefficient estimated by OLS coincides with the true value on the average and they have the least possible variance i.e. they are efficient so that regression analysis can produce best linear unbiased estimates (BLUE) (Gujarati, 1999, p.203-206).

The reported results from the estimated model are explained using the followings:

(i) Estimated coefficients (βs),

(ii) t-ratios,

(iii) R^2

(iv) F-statistic.

Beta coefficients corresponding to the macro variables are estimated for the dependent variable.

I have one variable for exchange rate, namely FXD and three variables for money supply i.e. M1, M2 and M3 so I estimated a model for general share index. In the regression equation, I included CPI, STR, OPI, FXD, OPI and M1 (M2 or M3) whilst substituting General share index returns.

The reasoning for doing so is to investigate the effects of different variables in combination with other variables. To test the significance of the individual coefficients, a t-test is performed. If the computed *t* values are larger than the critical value at a given level of significance, then the null hypothesis that the given regression coefficient (risk premium) is not significantly different from zero is rejected i.e. individual risk premium is significant.

The R^2 is used to get the percentage of total variations in General share index returns explained by the macroeconomic variables employed in the multiple regression equation.

Finally, F-test is used to test the overall significance of the model, that is, whether stock returns are linearly related to macroeconomic factors employed.

Chapter 5

THE REGRESSION MODEL AND EMPIRICAL RESULTS

5.1 The Regression Model:

I conducted the model in which Iranian stock returns lead a factor model in the following form:

$$R_{SSE} = \beta_0 + \beta_1 CPI_t + \beta_2 SIR_t + \beta_3 OPI_t + \beta_4 FXD_t + \beta_5 MS_t + \varepsilon_{SSE} \qquad (5.1)$$

where,

R_{SSEt} : Realised return on TSE (Tehran Stock Exchange) at time *t*.

β_0 : Constant.

β_i : Reaction coefficient measuring the change in portfolio returns for a change in risk factor.

CPI: The change in inflation variable at time *t*.

SIR: The change in interest rates variable at time *t*.

OPI: The change in industrial production variable at time *t*.

FXD: The change in exchange rate variable at time *t*.

MS: The change in money supply variable at time *t*.

ε_{SSEt} : The residual error term for SSE at time *t*.

5.2 Analysis of the Test Results

The following issues are checked for our model:

(1) The multicolineartiy between the explanatory variables

(2) The autocorrelation between error terms

(3) The normality of error terms

(4) The heteroscedasticity

5.2.1 Multicolinearity:

As Gujarati (1995:345) describes, “One of the assumptions of the classical linear regression model is that there is no multicolinearity among the explanatory variable, the X’s. Broadly interpreted, multicolinearity refers to the situation where there is either an exact or approximately exact linear relationship among the X variables”.

So, in order to identify whether multicolinearity exist among the variables used for this study, I estimated a correlation matrix for the General share index. Estimated correlation matrixes of the relevant dependent variable and prescribed macroeconomic variables are presented in Table (5.1). Here I expect to get a low correlation among macroeconomic variables, whilst, a high correlation between stock returns and macroeconomic variables.

Table 5.1: Estimated Correlation Matrix for General Share Index

	GSI	**CPI**	**SIR**	**OPI**	**FXD**	**M1**
GSI	1					
CPI	-0.44	1				
SIR	-0.83	0.43	1			
OPI	0.39	-0.21	-0.52	1		
FXD	-0.73	-0.42	-0.09	0.39	1	
M2	0.81	-0.54	-0.08	0.38	0.28	1

Table (5.1) shows that the correlation between the relevant share index and other macroeconomic variables is acceptable.

5.2.2 Autocorrelation:

The problem of autocorrelation arises among the error terms or residuals when they are not independent of each other. The OLS estimators are efficient (i.e. they have minimum variance) and unbiased only when there is no correlation between error terms.

The most popular test for discovering autocorrelation is developed by Durbin Watson, known as the Durbin-Watson *d* statistic. I did test first order autocorrelation by testing the following null hypothesis.

$H_0 =$ No autocorrelation; if $d_U \prec d \prec 4 - d_U$

$H_A =$ Positive autocorrelation; if $\mathrm{d} \prec d_L$

Negative autocorrelation; if $4\text{-}d_L \prec d \prec 4$

Although it is popularly used, one of the disadvantages of the *d* test is that if it falls in region of ignorance where results are inconclusive, we cannot conclude whether or not autocorrelation does exist.

$d_L \le d \le d_U$ and $4 - d_U \prec d \prec 4 - d_L$ are regions of ignorance.

The critical values used in testing the hypothesis are as follows:

	d_L	d_U
%5	1.55	1.80

(where n=126, k=6, computed= 1.89)

Here we compare the computed D-W *d* statistics with the tabular values presented above. At 1% significance level all computed DW *d* statistics of our model are in the $d_U \prec d \prec 4 - d_U$ form, 1.80 <d<4-1.80, which indicates no autocorrelation between residuals. Therefore we accept the null hypothesis of H_0 that there is no first-order autocorrelation.

At 5% significance level, the results show no autocorrelation among the successive residuals taking the form 1.80 <d<4-1.80. The computed *d* statistics of the equation is 1.89. In general, the computed results exhibit that there is no first order autocorrelation among residuals.

5.2.3 Normality

One of the assumptions of the method of OLS is about the probability distribution of residuals. OLS estimators of the regression coefficients are best linear unbiased

estimators if the residuals follow the normal distribution with zero mean and constant variance.

To check this assumption we used the Lagrange Multipliers (LM)[1] test employing the following hypotheses (Greene, 1993, pp.133-134).

$H_0 = u_t = 0$ (Residuals are normally distributed),

$H_a = u_t \neq 0$ (Residuals are not normally distributed).

Our computed value of LM version for normality is CHSQ (2) and the tabular value with two restrictions for significance level of 0.05 is $\chi^2(2) = 5.99147$. Since in both equations the computed value of LM version of normality is smaller than the tabular value, the null hypothesis of normality of the residuals are normally distributed is accepted. X_{NORM} for the regression equation is 1.09 (prob= 0.576).

5.2.4 Heteroscedasticity

Another important assumption of OLS is that residuals have the same variance i.e. they are homocedastic. If this assumption is violated, there is heteroscedasticity. I did test whether residuals have the same variance or not for the regression model. The hypothesis is conducted as follows:

$H_0 = \sigma^2{}_t = \sigma^2$ (Homossedasticity),

$H_a = \sigma^2{}_t \neq \sigma^2$ (Heteroscedasticity).

[1] LM has a chi-squared distribution with degrees of freedom equal to the number of restrictions.

The computed value of LM version for heteroscedascity is CHSQ (1) and the tabular value with one restriction with significance level of 0.05 is $\chi^2 = 3.84146$.

Since in both estimated equations, the computed value of LM version of heteroscedasticity smaller than the tabular value, the null hypothesis of heteroscedasticity is accepted i.e. residuals are normally distributed. X_{HET} for the equation is 2.24 (prob=0.136).

5.3 Empirical Results

The empirical test results have been carried out by using Software-Microfit 4.0 (Pesaran and Pesaran, 1997). Having analysed the misspecification test results for the serial correlation, autocorrelation, normality and heteroscedasticity, I evaluated the results estimated from the regression equations using:

(i) *t*- test (i.e. individual significance test of the estimated coefficients),

(ii) F-test (i.e. overall significance test of the coefficients),

(iii) R^2 (i.e. goodness of fit) values.

The regression results for the pricing relationship between the chosen macroeconomic factors and stock returns are presented in Table (5.2) for the relevant Share Indices. The numbers in parentheses in the same table are *t*-values that used to test the null hypothesis of no significance of the estimated coefficients associated to the macroeconomic variables.

We hypothesize that

$H_0 : \beta_s = 0$ (Not significant)

$H_a : \beta_s \neq 0$ (Significant).

As can be seen in Table (5.2), all the variables used in the relevant equation are statistically significant on the basis of the two-tail *t*-tests at conventional levels except inflation rates or changes in CPI (DLCPI) in the regression equation. The impact of money supply (M1) and short term interest rates seem to be more important than the others in the equation. The results also tell us that variations in DLOPI are significant factors at 10% level of significance. In addition to this, the estimated coefficients of the relevant variables have right signs, as they would be expected.

The other important issue is to test the overall significance in which I utilised F-test. I did test the null hypotheses that employed macroeconomic variables together have an influence on dependent variables as follows:

$H_0 : R^2 = 0$ (Not significant)

$H_a : R^2 \neq 0$ (Significant)

Notes: $F_{k-1,n-k} = F(5,119)$ and the tabulated F-values are as follows: 2.29 at 15% significance level, and 3.17 at 1% significance level.

The calculated F-results are significant (F-cal>F-tab at 1% significance level), i.e., 72.21. I therefore, reject the null hypotheses and accept the alternative hypotheses, which indicate that, the regression equation holds overall significance at 1 percent level.

Having conducted F-test as mentioned above, I did then consider the goodness of fit of estimated multiple regressions (i.e. multiple coefficient of determination R^2). R^2 gives the percentage of the total variation in the dependent variable explained by the explanatory variables in the regression models. The percentage of the total variation in the dependent variable General share index explained by the utilised macroeconomic variables are found reasonably high with the value 75 percent.

Table 5.2: Regression results for the model under inspection

Explanatory variables	Model 1 DLGSI
C	15.86 (14.24)*
DLCPI	-0.38 (-0.53)
DLSIR	-0.10 (-5.61)*
DLOPI	0.16 (1.67)***
DLFXD	-0.30 (-2.05)**
DLM2	0.06 (3.88)*
R^2	0.75
F (5,119)	72.21

Notes: * indicates statistical significance at a 1% (2.67); ** indicate statistical significance at a 5% (1.98), *** indicate statistical significance at a 10% (1.65) and other are not statistically significant at conventional levels.

Finally, in order to get the best model where stock returns can be better explained in Tehran Stock Exchange, the parsimonious procedure is performed to choose most significant *t* values of the relevant variables in the regression equation (see Table 5.3).

General share index estimation results show that there are all statistically significant macroeconomic variables in determining stock returns in Tehran stock exchange (TSE) except, CPI. Therefore, I did run the estimation processes by excluding only CPI and taking other variables in. The results are as follows:

Table 5.3: Significant Variables

Explanatory variables	Model DLGSI
C	15.89 (13.17)*
DLCPI	_____
DLSIR	-0.11 (-5.71)*
DLOPI	0.17 (1.64)***
DLFXD	-0.35 (-2.24)**
DLM2	0.07 (4.01)*
R^2	0.79
F (4,121)	86.71

Notes: * indicates statistical significance at a 1% (2.67), ** indicate statistical significance at a 5% (1.96) and *** indicate statistical significance at a 10% (1.64)

As can be shown in Table (5.3) above for General share index, all is significant at 1% or 5% significance levels; however OPI is significant at 10% significance level. All coefficients have right signs and expected impact.

Table (5.3) also shows how significant these variables are in explaining stock return variations when other variables are not included in the estimation process. 79 % of total variations in General share index explained by utilising all except CPI. The R^2 value is higher in General share index compared to the previous one. Furthermore, the results of the last equation presented above implying that SIR and

M2 seem to have a relatively stronger ability about explaining the stock return variations in TSE compared to the equation utilizing all variables.

Finally, in order for the test of overall significance, I rejected the null hypotheses and an accept the alternative hypotheses at conventional levels which states that our equations hold overall significance since our F-results are higher than the tabulated F-values.

Notes: $F = F_{k-1,n-k}, F(4.121)$ and the tabulated F-values are 2.45 at 5% significance level, 3.48 at 1% significance level.

According to the results in Table (5.2), if consumer price index goes up by 1%, General Share Index (GSI) returns go down by approximately 38 whilst other variables hold constant. Also, 1 percent increase in OPI results in 16% increase in GSI returns. In addition, GSI index increase by nearly 10 when money supply (M1) rises up by 1 percent.

I can conclude that, changes in CPI have not significant negative impact on Tehran stock returns that are traded on the TSE whilst changes in, M2, SIR, FXD and OPI have an influence in explaining the stock return variations in TSE.

Chapter 6

CONCLUSION, POLICY IMPLICATION AND RECOMMENDATION

6.1 Conclusion

In this thesis, I aimed to investigate the empirical relations between Tehran stock market returns and the changes in a number of macroeconomic variables, namely, inflation, interest rate, oil production, exchange rate, and money supply, using multivariate APT. Some macroeconomic variables are important in explaining the variations in the stock market returns in TSE for the period of January 1999-June 2009. We found that short-term interest rate, oil price index, money supply M2 and exchange rate index have statistically significant influence on Tehran stock returns after performed the parsimonious procedure to form best model.

The results from the estimated regression suggest that there is a significant negative relationship between short-term interest rate, exchange rate, and stock market returns whereas changes in money supply M2 and oil production have a positive impact on the stock market returns. In both models, the relationship between changes in Oil price index (OPI) as well as money supply M2 and stock returns are statistically significant and positive. The results from the parsimonious specification of the model suggest the relation between OPI and stock returns is very important for Iranian economy because the economy is mostly based on oil.

Consistent with the expectations and the findings of other studies, Tehran stock market returns and changes in the variable used in this thesis are perfectly associated. The results estimated from the parsimonious specification of the model show that the relations between changes of the relevant variables and stock returns are statistically significant at conventional levels for GSI.

Contrary to the findings for the US, UK and some other countries, my thesis does not provide reasonable support for the view that change in consumer price index has an effect on common stock returns for the period. The variable is found to be negatively insignificant in explaining the variations in Tehran stock market. This may suggest that my findings do not appear to support the view that the stock markets lead to changes in the real economic activity variables.

It is noteworthy that I also found a positive relationship between money supply variables (M1, M3) and stock market returns. The relations, however, were not as strong as possible compared to M2 so I dropped from the relevant model.

As a result, explanatory power reached for the sample period supports the view that macroeconomic variables explain a significant part of the observed variations in Tehran stock market returns for the sample period. Since the main macroeconomic variables have been taken into account in the model, the estimation results imply that some macroeconomic variables, namely short-term interest rate, money supply, exchange rate and oil production have an influence on Tehran Stock Market returns.

6.2 Policy Implications

The finding of this thesis can be summarised as such: while inflation or change in consumer price index has no significant effects on stock returns, short term interest rate, exchange rate, money supply M2 and production index (not as strong as the others), are found to be closely related to the stock returns of Tehran stock market. First, inflation issue can be formulated in a way that it should be compatible with the nature of the Tehran economy. Second, oil production should be developed further to improve the Iranian economy. Especially, policy makers should take oil production industry into consideration as guidance in formulation of future Iranian economic polices because this is comparative advantage of the Iranian economy.

6.3 Recommendation

More advanced time series techniques such as GARCH and ARCH techniques can be applied on the same subject for further studies in order to get more accurate results. The model employed in this study can be developed using the combination of both CAPM and APT models rather than conducting only the one. However, due to availability of the relevant data set and the time limitation, I have been confined to do more solid research on the relevant subject. I recommend that those master students who really want to analyse this subject; they can take those points mentioned above into account.

In my thesis on the Tehran stock market analysis, I can derive a number of implications that may help to improve the performance of the Iranian economy under the inspection of the Tehran stock market. I am aware of the fact that aggregate analysis cannot be used in policy formulation at the micro level but it definitely provides a general guidance in the formulation of industrial policy and macroeconomic policies.

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APPENDICES

Appendix 1: Estimated Correlation Matrix of Variables

	GSI	**CPI**	**SIR**	**OPI**	**FXD**	**M1**
GSI	1					
CPI	-0.44	1				
SIR	-0.83	0.43	1			
OPI	0.39	-0.21	-0.52	1		
FXD	-0.73	-0.42	-0.09	0.39	1	
M2	0.81	-0.54	-0.08	0.38	0.28	1

It is expected to get a low correlation among macroeconomic variables, whilst, a high correlation between stock returns and macroeconomic variables.

Appendix 2: Ordinary Least Squares Estimation:

Original model

Explanatory variables	Model 1 DLGSI
C	15.86 (14.24)*
DLCPI	-0.38 (-0.53)
DLSIR	-0.10 (-5.61)*
DLOPI	0.16 (1.67)***
DLFXD	-0.30 (-2.05)**
DLM2	0.06 (3.88)*
R^2	0.75
F (5,119)	72.21

Notes: * indicates statistical significance at a 1% (2.67); ** indicate statistical significance at a 5% (1.98), *** indicate statistical significance at a 10% (1.65) and other are not statistically significant at conventional levels.

Appendix 3: Second regression model without CPI

Explanatory variables	Model DLGSI
C	15.89 (13.17)*
DLCPI	_____
DLSIR	-0.11 (-5.71)*
DLOPI	0.17 (1.64)***
DLFXD	-0.35 (-2.24)**
DLM2	0.07 (4.01)*
R^2	0.79
F (4,121)	86.71

Notes: * indicates statistical significance at a 1% (2.67), ** indicate statistical significance at a 5% (1.96) and *** indicate statistical significance at a 10% (1.64)