Dynamics of Real Investment and Stock Prices in Listed Companies of Tehran Stock Exchange

Farzad Karimi
Assistant Professor
Department of Management Mobarakeh Branch,
Islamic Azad University, Mobarakeh, Iran

Daryush Foroughi
Assistant Professor
Department of Accounting
University of Isfahan, Iran

Mohammad Reza Ghasemi
Assistant Professor
Department of Accounting Mobarakeh Branch,
Islamic Azad University, Mobarakeh, Iran

Nafiseh Mokhtarian
MA Accounting
Department of Accounting Mobarakeh Branch,
Islamic Azad University, Mobarakeh, Iran

Abstract
Description of the dynamic linkage between business investment and stock market behavior is remarkably important for the investors and policy makers in the market. The present study has been provided with the aim of determination of relation between macro-economical variable of Real investment and stock price amongst the accepted firms in Tehran Stock Exchange. Formation of the national gross capital to the fixed prices was applied as the representation of Real investment, and the stock total price index was used as the representation of stock price. For this purpose, this research has examined relevant seasonal data during 1991-2008 by means of co-integrated technique based upon vector auto regressive method, and has applied vector error correction model to connect variables short term fluctuations to their long term values. Impulse response functions have been used to examine the model responsiveness amount towards short term deviations in the variables (shock) and to determine share of each variable in the variance of dependent variable forecast error, variance decomposition analysis tool has been applied. Research results include evidences on the existence of long term dynamic relation between Real investment and stock total price index, indicating that upon omission of inflation from the investment variable, we will be able to use the same as the base for stock price forecast.

Keywords: Real investment, stock price index, vector auto regressive model

1. Introduction
Economy of a country consists of different sections in which the procedure of connections between these sections determines the economical direction of that country. Capital market, besides money exchange, forms the financial market of the country, are the functions of economy of that country, and difficulties and shortages may occur in their performance in case of lack of logical relation with other sections (Motie, 2010). Iran capital market is practically summarized into the valuable papers exchange. Stock exchange plays an important role in attraction and direction of cash flow and small capitals towards optimized routes. In fact, long term economical growth is not possible without paying attention to investment and influential
factors on investment environment. Capital market affect the efficiency of industrial, agricultural, and servicing sections and the efficiency of the whole economy through influencing on financial instruments and investments on the above sections. In case capital market behaves in a bad way, all the sections might be affected and their movement procedure may be interfered. Capital formed markets are able to provide financial facilities and resources for the applicants and also make available a suitable efficiency through the possibility to transact the companies' intermediate and long term valuable papers (Sadegh Vaziri, 2006). Therefore, stock exchange is considered to be one of the most powerful levers in the economy and acts towards acceleration of industrial development especially in the developing countries. Indeed, it is stated that existence of stock exchange is a vital necessity for economical success of a country. Stock exchange leaves inevitable impacts in the light of increase of productivity and economical and social development targets through concentration of capitals and their optimal allocations. On the other hand, understanding the relation between Real investment and stock exchange behavior is considerably important for the researchers, investors, policy makers, and the government, and can be applied to make correct economical policies, adjust supervision framework for the financial intermediaries, compile monetary and financial policies, and attract cash flow and standstill capitals towards stock exchange market (Laopodis, 2009). As the result, the present study is going to examine the relation between stock price total index as the symbol of the country's capital and Real investment macro factor during 1991-2008 amongst accepted firms in Tehran Stock Exchange, and to evaluate Iran capital market and indicates the aforesaid variable share in stock price total index alterations. Obviously, the results might be used as the guidance for the better financial markets.

2. Theoretical framework
Description of dynamic linkage between Real investment and stock market behavior is very important for the investors and policy makers in the market. Normally, it is claimed that market stock behavior reflects the investors' trust, which affects economical variables as like Real investment. Although this relation was strong in the past, this has become weaker from early 1990s. In other words, market stock changes cannot be related to the equivalent changes in the actual investment (Laopodis, 2009).

Study of investment behavior is considered to be a complicated discussion in economical articles, and numerous models have been introduced in investment related researches while none of these are able to provide general insight on the invested amounts.

Exploration of a dynamic relation based upon fundamental factors may be useful to drive policies related to the market risks as well as other policies. Risk, defined as the probability of not reaching expected efficiency of an investment, is divided into systematic and non-systematic parts. Systematic risk is not reducible and is derived from macro factors as like economical growth, inflation rate, interest rate, and currency rate. Non-systematic risk, reducible, is formed as the result of special micro factors in a company or industry. In order to limit systematic risk, paying attention to the economical variables besides other factors may be of importance (Motie, 2010).

Several studies have done in the field of stock price and investment in developed countries, all bearing discrepant conclusions. For example, Barro (1990) found that changes in the stock real price may determine investment rate alterations better than any other variables. On the other hand, Morch et al. (1990) and Lamont (2000) reached to a negative meaningful time correlation between stock revenue and capital expenditures. Lamont stated that the above negative correlation can be justified with the time delay between decision for commercial investment and actual time for investment. Cochrane (1991) found a positive correlation between stock price and capital expenditures in his research.

The aforesaid studies all have related investment to the fundamental factors as like stock actual price and stock revenue (stock profit). These researches are in contradiction to the recent studies in which non-fundamental factors are effective on determination of investment amount. For instance, Baker et al. (2003) concluded that companies who are using more external resources for the supply of their capital are in fact more dependent on the stock price than other companies. Gilchrist et al. (2005) stated that investors' incongruent and unequal beliefs as well as other limitations may separate their stock from its main value and base. Finally, recent studies for other countries such as Japan and Canada have suggested that commercial fixed capital does not obey the fundamental factors. For example, Chirinko & Schaller (2001)
evaluated commercial investment behavior in the Japanese economy during 1980s and found this figure rising as a bubble in their economy. Similarly, Faroque & Minor (2002), through examination of private commercial investment in Canada, stated that this figure is closer to the investment profitability than the stock exchange value. Recent studies by Laopodis (2009) have also considered a long term period from 1960 to 2005 indicating that a close relationship exists between investment and stock price with an absolutely random procedure during 1960-1990, while the above relation for the years 1990-2005 was broken. However, research results by Arshad & Muhammad (2009) and Alkhudairy (2008) indicate a long term relation between capital outcome and economical major variables. Due to the different results of the aforesaid studies and taking into account the fact that reaching long term and progressive economical growth requires optimal resource allocation in the national economical level, and this issue is not feasible without financial markets assistance especially widespread and efficient capital market, considering capital market as the center for collection of savings and sporadic, discursive and inflation-making cash flow and one of the powerful levers in the country’s economy, and this acts so as the expedite industrial procedures, particularly in developing countries, and economical data are considered to be important resources for the researchers, investors, policy makers, and the government officers, the present study is defining values related to the formation of national gross capital to the fixed prices (as set out in Iran's national accounts) as the Real investment, and index for stock price is defined as a criterion for stock price. In addition, taking into account investment as an independent variable and stock price as a dependent variable, we have examined relationship between variables in Tehran Stock Exchange, so as to use previous research strategies and put their unarranged results into an order and finally provide suitable strategies for developing countries to which less attention has been paid. Indeed, the present study is going to find out that fact that whether decisions made towards investment and changes of this value during time intervals affect the stock price as an economical macro variable. Finding reciprocal effects of these factors may be used as the guidance for investors and policy makers in the market since economical macro investment factors is considered to be one of the influential factors on the stock risk and outcome, and determination of its relation with stock price may be useful to direct some of the policies.

3. Research Methodology
In order to find out relation between variables in this article, Vector Auto Regressive Model (VAR) will be applied, which is a dynamic and suitable model for developing countries. This model provides possibility to examine reciprocal relation between variables since discussion on the Real investment as a macro factor and stock index requires clarifications on the reciprocal relation between these variables. Consideration of research literatures of the stock exchange indicates the existence of "lead" or "lag", i.e. sometimes stock index plays a forecasting role for economical variables and sometimes economical variables may change the stock index. Time series models try to explain behavior of a variable based upon its earlier values (and probably earlier values of other variables we are going to forecast). These models are able to provide such possibility to have an accurate evaluation of the desired variable even in those circumstances where sub-structural economical model is not definite. As Iran is a developing country and its Stock Exchange is not well developed, no optimal theory exists to explain its market coordination. Approximately, time series models are applicable as the initial approximation. In this study, Eviews software is used for the statistical methods and assumptions test is being performed in the certainty level of 95%.

The methodological design of this study will proceed in two different approaches. First, we propose to estimate a simple model to investigate the relationship between gross investment and stock prices, as is defined below:

\[
\Delta \text{inv} = \beta_0 + \sum_{i=1}^{n} \alpha_i \Delta \text{sp}_{t-i} + \beta_1 \text{inv}_{t-i} + \varepsilon_t
\]

In this equation inv and sp are gross investment and stock prices. \(\Delta\) represents changes, and the lagged investment term is included to correct for autocorrelation in the error term, \(\varepsilon_t\). This model will estimate for real magnitudes.

The second approach involves a vector autoregressive (VAR) method which would capitalize on the long-run properties of series. This approach is briefly described below. In view of the evidence of non-stationary
in series, this study will proceed in two steps. The first step is to check for co-integration. When two or more series are integrated in the same order and some linear combination between them is stationary, then a long-run equilibrium relationship exists between the series and they are said to be co-integrated. The second step entails error-correction (e-c) representations and causality tests of the relationships among the co-integrated series. The e-c term captures the partial adjustments a particular variable and provides an appropriate framework for examining the Granger-causality relations between the two.

Following Engle and Granger (1987), two variables, \( X_t \) and \( Y_t \) are said to be cointegrated if their difference, \( E_t = Y_t - bX_t \) is I(0). \( E_t \) is the equilibrium error term and can be estimated as follows:

\[
Y_t = \alpha + \beta X_t + \varepsilon_t
\]

Where \( \beta \) is an estimate of \( b \) and the sum of \( \alpha + \varepsilon_t \) provides an estimate of \( E_t \). Equation (2) can also include a time trend to account for the possibility of trends in the series. To test for co-integration, this study applies the ADF test for seasonal data to the residual series, \( e_t \), from Equation (2). Specifically, the co-integration test is based on the following regression specification:

\[
\Delta e_t = \phi e_{t-1} + \sum_{j=1}^{k} \alpha_j \Delta e_{t-j} + \eta_t
\]

(3)

\( k \) is the number of lagged differences includes to capture any autocorrelation and is selected in order to determine null hypothesis of no serial correlation in the residual of Equation (3). The test entails finding a pseudo t-statistic for the null hypothesis that \( (\phi + \eta) = 0 \). The null hypothesis is rejected when the pseudo t-statistic is negative and greater than the critical value. This would mean that the residuals from Equation (3) are I(0).

In view of the evidence of co-integration, the granger representation theorem suggests that dynamic relationships between the two co-integrated variables can be examined within an e-c framework. The e-c can capture the short- and the long-run equilibrium dynamics between the two time series. Following the Granger representation theorem, two co-integrated variables have the following joint e-c representation:

\[
\Delta INV_t = \gamma_1 + \gamma_2 \eta_{t-1} + \sum_{i=1}^{\eta_1} \lambda_i \Delta INV_{t-i} + \sum_{i=1}^{\eta_2} \mu_i \Delta SP_{t-i} + \varepsilon_t
\]

(4)

\[
\Delta SP_t = \alpha_1 + \alpha_2 \gamma_{t-1} + \sum_{i=1}^{\alpha_1} \nu_i \Delta INV_{t-i} + \sum_{i=1}^{\alpha_2} \tau_i \Delta SP_{t-i} + \eta_t
\]

(5)

Where \( INV_t \) denotes gross investment, \( \gamma, \eta_1, \lambda, \nu_1, \alpha_1 \) and \( \tau \) are parameters to be estimated, and \( \varepsilon_t \) and \( \eta_t \) are stationary random processes describing the error terms. The \( \eta_i (i=1,...,4) \) are the optimal orders of the autoregressive process for a given variable. Finally, the \( \varepsilon_t \) magnitude is the e-c term obtained from the co-integrating Equation (2), so that changes in the INV and SP variables are partly driven by the past value of \( \eta_t \).

Equation (4) and (5) serve as an appropriate framework for evaluating the dynamic short- and long-run interactions between investment and the stock market. Specifically short-run dynamics between any two variables are captured by the \( \eta_1 \) and \( \nu_1 \) coefficients. For instance if one or more of the \( \eta_1 \) coefficient is non-zero and significant, then movements in the stock market will have a short-run effect on investment. Similarly, if one or more of the \( \nu_1 \) coefficient is non-zero and significant, then movements in private investment will have a short-run effect on the stock market. On the other hand, existence of a long-run
relationship between investment and the stock market depends upon the statistical significance of $\beta_1$ and $\beta_2$ coefficients. Given the INV and SP are co-integrated, the $c_t$ term that represents the divergence from the long-run relation must incorporate both variables and either $\beta_1$ or $\beta_2$ are expected to surface as negative and statistically significant. Finally since determining the optimal lag structure of Equation (4) and (5) is a concern in such models, for if the lag structure is mis-specified the empirical results may be biased, the use of Akaike's (1969) final prediction error will be employed.

4. Research findings
Before any analysis, tests have to be done for the variables stationary and degree of their correlation. In this research, Dickey Fuller Test for seasonal data (ADF) is used and variables co-integrated degree is determined based on this test.

Results of this study indicate that variables become stable through one stage subtraction and consequently all of these will have co-integrated degree equal to 1. In order to prevent from omission of data as the result of subtraction, Johansen-Juselius method can be used. However, taking into account existence of only two variables in this study, maximum one co-integrated vector is available.

In the next stage, selection of model lag structure is being made according to the sample size and number of variables. Different criteria are available for the selection of lag optimal order. In this study, Akaike (AIC) and Schwarz (SBC) criteria have been used. Results show that second lag minimizes Schwarz value and the first lag minimizes Akaike value. To select from these criteria, it is necessary to mention that Schwarz criterion follows Parsimony, which addresses parameters scarcity. In the present study, Schwarz criterion has been used and the second lag has been selected as the optimal order.

<table>
<thead>
<tr>
<th>VAR order</th>
<th>SBC</th>
<th>AIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>-609.71</td>
<td>-496.84</td>
</tr>
<tr>
<td>2</td>
<td>-748.16</td>
<td>-671.21</td>
</tr>
<tr>
<td>1</td>
<td>-716.48</td>
<td>-675.44</td>
</tr>
</tbody>
</table>

Source: research findings

Thereafter, Real values are going to be evaluated.

4.1. Results of Vector Auto Regressive Model for the actual values
Forecast results of VAR model for Real investment provided in table 2 indicate that in the first evaluative equation where Real investment has been taken into account as a dependent variable and lag of the Real investment variables and stock price index have been considered as the independent variables and effective on the actual investment, except the second lag of stock price with negative mark showing reverse relation between Real investment and second lag of the stock price, the sign of coefficients related to other variables are all positive and indicating direct relationship between lag of these variables and Real investment variable. Concerning the second evaluative equation i.e. dependence of stock price index variable to the lag of other variables, we have to indicate that according to the signs of evaluated coefficients, the first lag of Real investment and the second lag of stock price index have negative and reverse effects on the stock price index, and increase in these variables will decrease stock price index. In addition, influencing procedure of the other two variables on the stock price index is direct and positive, taking into account the signs of these two coefficients. Likewise, model determination factor indicates suitable explanatory of the evaluated model since determination coefficient of 0.95 indicates that 95% of the changes of the dependent variable are explained by means of independent variables.
Table 2- Forecast results of VAR model for actual investment

<table>
<thead>
<tr>
<th>Dependent variables</th>
<th>Equation for each of the independent variables</th>
<th>RINV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>RINV (-1)</td>
<td>0.472012 (0.11449)</td>
<td>-0.043558 (0.03247)</td>
<td></td>
</tr>
<tr>
<td>RINV (-2)</td>
<td>0.463813 (0.11485)</td>
<td>0.05685 (0.03257)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[4.03827] [4.03827]</td>
<td>[1.74662] [1.74662]</td>
<td></td>
</tr>
<tr>
<td>SP (-1)</td>
<td>0.910582 (0.42420)</td>
<td>1.344333 (0.12029)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[2.14656] [2.14656]</td>
<td>[11.1758] [11.1758]</td>
<td></td>
</tr>
<tr>
<td>SP (-2)</td>
<td>-0.659823 (0.45996)</td>
<td>-0.391493 (0.13043)</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>1174.047 (1447.71)</td>
<td>-60.73247 (410.235)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.81153] [0.81153]</td>
<td>[-0.14804] [-0.14804]</td>
<td></td>
</tr>
</tbody>
</table>

R2 = 0.95

Source: research findings

Impulse response functions have been used in order to consider changes of a variable in the light of reply to the variable response. Response of Real investment variable has had descending but fluctuating procedure as the result of imposed impact through the variables hidden in that. Concerning response of the Real investment variable, as the result of impulse from the stock price index variable, alterations have been completely different with the effects of Real investment on itself.

Chart 1- Impulse response function related to the Real investment variable with relation to the impact imposed to it and to the stock price index

Response to Cholesky One S.D. Innovations ± 2 S.E.

In the next stage, variance analysis tool is being applied. In this function, evaluation error regarding any of the selected variables have been taken into account and then share of all the variables will be calculated in the relevant justification. According to the relevant table, it is suggested that during first stage, one hundred percent of the changes in investment variable is explained by the variable itself, and the role of this variable fades away gradually.

Source: research findings

COPY RIGHT © 2012 Institute of Interdisciplinary Business Research
Table 3- Results of variance analysis function of Real investment variable

<table>
<thead>
<tr>
<th>Period</th>
<th>S.E.</th>
<th>RINV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2432.187</td>
<td>100.00000</td>
<td>0.000000</td>
</tr>
<tr>
<td>2</td>
<td>2753.686</td>
<td>94.80385</td>
<td>5.196154</td>
</tr>
<tr>
<td>3</td>
<td>3234.385</td>
<td>91.74453</td>
<td>8.255471</td>
</tr>
<tr>
<td>4</td>
<td>3580.837</td>
<td>87.40370</td>
<td>12.59630</td>
</tr>
<tr>
<td>5</td>
<td>3928.604</td>
<td>83.84291</td>
<td>16.15709</td>
</tr>
<tr>
<td>6</td>
<td>4243.684</td>
<td>80.31188</td>
<td>19.68812</td>
</tr>
<tr>
<td>7</td>
<td>4546.938</td>
<td>77.13584</td>
<td>22.86416</td>
</tr>
<tr>
<td>8</td>
<td>4835.678</td>
<td>74.16723</td>
<td>25.83277</td>
</tr>
<tr>
<td>9</td>
<td>5114.470</td>
<td>71.44599</td>
<td>28.55401</td>
</tr>
<tr>
<td>10</td>
<td>5383.994</td>
<td>68.93400</td>
<td>31.06600</td>
</tr>
</tbody>
</table>

Source: research findings

4.2. Evaluation of the long term relation between variables
After consideration of variables being affected and effectiveness on each other, we are going to evaluate the long term relation and to extract total vectors. To calculate the above long term relation, existence of co-integrated and number of co-integrated relations between variables can be reached by means of two figures i.e. $\hat{\beta}_{\text{Res}}$ and $\hat{\beta}_{\text{Trm}}$. However, as only two variables have been examined in this study, maximum one co-integrated vector possibly exists. Hence a co-integrated vector is taken into account for the evaluation of long term relation between variables.

Considering a co-integrated vector – in other words existence of a durable linear combination of model variables – vectors are going to be normalized based upon investment variable. In addition, normalized vectors are provided in the following table.

Table 4- Normalized co-integrated vectors

<table>
<thead>
<tr>
<th>Variable</th>
<th>Normalized vector</th>
</tr>
</thead>
<tbody>
<tr>
<td>RINV</td>
<td>1</td>
</tr>
<tr>
<td>SP</td>
<td>-6.39</td>
</tr>
<tr>
<td>C</td>
<td>3121.8</td>
</tr>
</tbody>
</table>

Source: research findings

Taking into account existence of a co-integrated vector and a normalized vector, there is a balance long term relation between variables. The results of this co-integrated vector are given in the above table. Likewise, in the evaluation of vector error correction model, error correction factor is also meaningful and relevant expected sign is (-) equal to -0.03. As this value is negative between 0 and 1, existence of long term balance relation among the studied variables was approved.

5. Conclusions
This paper investigates the linkage between Real investment as a macro-economic variable and total stock price index. For this aim it uses the national gross capital to the fixed prices as the representation of Real investment, and the total stock price index as the representation of stock price. This research has examined relevant seasonal data during 1991-2008 by means of co-integrated technique based upon vector auto regressive method, and has applied vector error correction model to connect variables short term fluctuations to their long term values. Impulse response functions have been used to examine the model responsiveness amount towards short term deviations in the variables and to determine share of each variable in the variance of dependent variable forecast error, variance decomposition analysis tool has been used. Research results include evidences on the existence of long term dynamic relation between Real investment and stock total price index, indicating that upon omission of inflation effects from investment variable, it can be used as a base for stock price forecast. Co-integrated response functions indicate the importance of actual investment. Variance analysis results suggest that during initial stages, alterations in the investment variable are mostly described by the variable itself and the role of that variable fades away gradually.
References


