The Relationship of Capital Productivity and Stocks Return

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Abstract: The concept of capital productivity concerns measurement of the management capability in effective use of capital as one of the important and limited resources of the company and it is expected that the shares of companies with high capital productivity also yield higher return. The goal of this study is to examine the relation between capital productivity and stock returns of firms listed in Tehran Stock Exchange. For this aim, the relation between capital productivity and every components of stock return will be examined. The results from testing the hypotheses confirm the relation between capital productivity and firm's stock return. Managers, through higher capital productivity which requires a better use of capital structure and more effective and practical policies, can ultimately create more stock return and provide the investors with a better knowledge of share performance and subsequently development of investment strategies. For testing the hypotheses a sample composed of 95 firms listed in Tehran Stock Exchange have been selected and tested over a period of six months from 2005 to 2010. Due to the fluctuations in years 2005 and 2006 in TSE, we decided to additionally analyze the statistical models of this research over a shorter period from 2007 to 2010 too, and then compare the results with the first time period and examine the impact of market fluctuations in the hypotheses as well. Since the practical approach of this research is examination of the impact of capital productivity on firms' stock return, the impact of capital productivity over every component of stock return has been examined. It resulted in that there is a meaningful relation between capital productivity and firms' stock return and capital productivity has a direct impact on stock return.
[Mousavi Shiri M, Bahmani S, Adabi S, Rakhsha Z. **The Relationship of Capital Productivity and Stocks Return**. *J Am Sci* 2012;8(12):1419-1426]. (ISSN: 1545-1003)**.** http://www.jofamericanscience.org. 191

Key words: Capital productivity, Stock return, ROIC

Introduction

In the field of investment studies and management, the knowledge of concepts and variable that aids the investors to understand the behavior of share value upon which investment strategies are formulated is of vital importance. An investment strategy is a set of rules, processes or a formulated behavior aimed at share selection or investment in portfolio. Recently the concept of productivity in production agents in general and capital productivity in particular have been viewed from this angle by investment researchers.

In addition to researches dedicated to examination and analysis of the relation of this concept with firms' value in capital market (Copeland et al., 1996; Compbell and Shiller, 2001; Holmen et al., 2002; Kitaeva, 2002; Avouyi and Matheron; 2006), some researchers have utilized this factor in share pricing models and have offered pricing models for assets based on productivity index (Balvers and Huang, 2007; Bohm et al., 2008). Although the indices used in these researches have not been the same, a more inclusive look indicates a general undeniable relation between the concept of productivity and firms' value in the capital market. In the researches it's been demonstrated that there's a great difference among various productivity indices in determining stock return, and among productivity indices, capital has a higher power in determining stock return (Davis and Madsen, 2008). Therefore capital productivity is regarded as the key main concept of this research. In regards to the concept of capital productivity what matters is the way capital resource, as one of the vital and limited resources of the firm, is used by the managers in the main operation process of the firm's activities.

The concept of capital productivity

The concept of capital productivity concerns the management capability in effective use of capital as one of the vital and limited resources of the firm and hence it is expected that shares of companies with higher capital productivity yields higher returns too. Nowadays, in all developed or developing countries the importance of capital productivity has been

emphasized as one of the requirements of attaining economic development and competitive advantage in the international arena. That's because in the present world competition on a global scale has developed new aspects and working to achieve higher productivity is one of the main pillars of this competition. Productivity in a general managerial sense is comprised of many indices. Productivity concerns the conditions of utilization of company's resources. Among the most important resources are capital and human resources for each of which relevant indices have been introduced.

In this research capital productivity has been regarded as the main key concept. Nowadays, methods of productivity improvement have been mostly focused on comprehensive productivity. Comprehensive productivity concerns, among others, capital productivity and mostly deals with working capital. The ultimate objective is to reach the highest productivity possible and this means that capital productivity must increase firm's profitability.

In the field of investment studies and management, the knowledge of concepts and variable that aids the investors to understand the behavior of share value upon which investment strategies are formulated is of vital importance. An investment strategy is a set of rules, processes or a formulated behavior aimed at share selection or investment in portfolios. The main goal of investment is to achieve the highest return possible. Investors are looking for standards that can guide them in indicating the investment return.

Many investors are inclined towards investing in more productive companies. Capital productivity impacts the companies' stock return, and the strategy of selecting more productive companies is followed by studying the companies' stock return for selecting appropriate portfolio of investment of more productive companies. What bears importance in capital productivity is how capital is used by firm's managers during the main operational process of the company to create value and naturally to increase stock return.

Productivity is defined in terms of the relation between input and output. The input represents main requirements of production such as capital and human resource.

If we consider capital and total assets as input, capital productivity is brought forth. Under this light, based on the definition of productivity, capital productivity analyzes how capital and assets are utilized

Stock return

Stock return is among important standards for decision-making in exchange market. Stock return includes informational content per se and most of actual and potential investors use this in analysis and predictions.

The decrease in this standard is a warning for the company since it's indication of undesired performance of the company. Capital return in is a propelling force in investment process which creates motivation. That's because return is a part of investment profit, or in other words, the investment reward. In fact, return is the main factor in investors' decision-making. Return is a factor for comparing real profit created by various investments and is necessary for compromising the investment risk.

Stock return is in 3 types: real return, normal return and abnormal return.

Research literature

In recent researches, productivity is among influencing factors in companies' returns that has drawn attention. Generally, various indices have been defined for measuring productivity each of which views productivity from a particular angle. Since recent studies show that among various indices, capital productivity has a greater power in explaining stock return (Davis and Madsen, 2008).

In 1993 Mc Kinsey published a report on the results of an extensive study about the conditions of capital productivity in Germany, Japan and USA. In this study capital productivity have been measured and analyzed on a national and industrial scale. Industrial groups discussed in this research include: automotive industry, food industries, communication retail and electrical industry. The four main conclusions drawn from the findings are as follows:

1- There's no major difference among Germany, Japan and USA with respect to capital productivity.
2- Although the managers from each nationality enjoy the capability needed for filling the divide in capital productivity among them, but the motivation for improvement varies in different countries.
3- There's a positive correlation between capital productivity and human force productivity. Improvement in both has a direct relation with better economic performance.
4- Higher capital productivity leads to higher stock return and more revenues.

Campbell & Shiller (2001) dealt with the concept of productivity and its relation with ratios predicting firm's value. In their research, they examined the human resource productivity and took paid consideration to the ratio of product to person-hour as defined in Robert Gordon's research (2000). They suggest that productivity is another index for determining the value of the firm. Similar results were achieved by Holman et al. (2002). They found a

positive relation between stock return and productivity indices and also showed that stock return maintains its relation after improvement or reduction of productivity for as long as two years later.

Koller et al. (2005), in their pricing book, explain the fundamental differences of ROIC with ROE and ROA and regard that as a better analysis tool and state that ROIC deals with measurement of the main operation of the firm and distinguish it from the impact of non-operational activities and financing methods of the firm and considers them to be misleading factors in correct knowledge of the main operation of the firm and rightly focus on the operational performance of the firm exclusively. Koller introduces ROIC as the right index of capital productivity for knowledge of the essential value of the firm.

Cao et al., (2006) in their research state that when ROIC of a company is high, increase of the company's growth results in increase in company's value and when ROIC is low, the managers through increasing ROIC against growth, can create more value for the company. In other words, increase in ROIC is a higher priority for creating value for the company compared to increase in company's growth.

Avouyi and Matheron (2006) examined the correlation between companies' share value and their productivity in American and European Exchange Markets. Their study period was spanned 1977 to 1985. They concluded that in American Stock Exchange productivity growth rate is correlated with share value. This conclusion was also confirmed for European Stock Exchange but with less clarity compared to American Stock Exchange.

Brown and Rowe (2007) conducted a research among 1000 top companies in American Stock Exchange over the period 1970 to 2005. They showed that capital productivity as indicated by ROIC provides an apt estimate for capital productivity.

Pirjeta and Puttonen (2007) state that share with higher ROIC ratio yield higher productivity and create value advantage. In their research, they take into account variables sale growth, operational profit margin, ROE and ROIC among which ROIC has had a more explanatory power and have proven with more meaningful in different researches.

Davis and Madsen (2008) in their research examined the relation between of different productivity indices with capital productivity. Their research included 80 years of data from 11 developed industrial countries. The research indicates that there's a big difference between different productivity indices in explaining stock return. Among these indices, capital productivity is more competent in explaining stock return.

Hypotheses

In this research we aim to answer these three questions:

1- Is there a meaningful relation between capital productivity and real stock return?
2- Is there a meaningful relation between capital productivity and expected stock return?
3- Is there a meaningful relation between capital productivity and abnormal stock return?

Under the light of above questions, three hypotheses have been formulated:

1- There is a meaningful relation between capital productivity and real stock return.
2- There is a meaningful relation between capital productivity and expected stock return.
3- There is a meaningful relation between capital productivity and abnormal stock return.

Research Methodology

This research is logically inductive, general in data gathering process, and yields practical conclusions, and uses a descriptive and correlative method for gathering and analyzing data.

Pearson correlative analysis and multiple regression models were used in testing the hypotheses. For examination of the regression of capital productivity and stock return components with variables, measurement control and company's financial leverage a following model was formulated:

$$\text{stock return components} = \theta_0 + \theta_1 ROIC_{it} + \vartheta_2 SIZE_{it} + \vartheta_3 LEV_{it} + \varepsilon_{it}$$

Variables, Data, Measuring of Variables

Independent variable: capital productivity (measuring the management capability in efficient use of capital).

In this research variable ROIC (return on invested capital) has been used as an appropriate index of capital productivity and a key tool in choosing shares in portfolios so that companies with higher ROIC are considered efficient and those with lower ROIC are considered inefficient. ROIC ratio compared to other profitability ratios is a better index in evaluation of corporations' performance and in studying how available resources are used and in measuring capital productivity (Koller et al., 2005). In a research done by Brown and Rowe (2007) also this ratio was used as a capital productivity index and was defined as follows:

"Operational profit ratio before accounting and interest according to documented value of debts and

shareholders' dividend with total short-term investment and cash residue at the end of the financial year subtracted."

$$ROIC = \frac{\text{Earnings before Interest \& Taxes}}{\text{Short-term investment and cash residue at the end of the financial}}$$

According to above definition, the advantage of ROIC ration over assets return ratio is due to the fact that in ROIC ratio the amount of invested capital of the company is in mid not total assets. Subtracting cash and near cash resources (short term investments) in ROIC denominator implies the amount of operational income that the company has utilized against each resource unit but is yet to be converted to cash or near cash; that it represents a part of investment. With respect to comparison of RIOC ration with shareholders' stock return we must note that in level of company's leverage, or in other words the financing methods of the company is taken into account, but in ROIC ratio, changes resulting from financing methods are dropped and the competence of company's management in using and utilizing invested assets has been taken into account. In fact the ratio of shareholders' stock return implies that how much return the investor has gained while ROIC ration implies how much the company has gained from its investments.

Dependent variable: stock return. Here three types of returns have been used: normal return, abnormal return, return expected by shareholders (normal).

Stock return:

It represents the total of benefits that is credited to a shareholder during a financial period. In current research three types of returns e.g. real stock return, expected return by shareholders (normal) and abnormal return has been used. In testing the hypotheses of this examination abnormal and real returns have been used.

Real Stock return: this is how normal stock return is measured.

$$R_{i,t} = \frac{P_{it}(1+\alpha+\beta) - P_{i,t-1} + D_{i,t} - C\alpha}{P_{i,t-1}}$$

$R_{i,t}$: Real return stock i on year t $P_{i,t}$: Stock price i on year t

$P_{i,t-1}$: Stock price i on year t-1 $D_{i,t}$: Dividend stock i on year t

α : The percentage of capital increase from receivables and cash contribution of shareholders.

β : The percentage of capital increase from reserves.

C: The nominal payment by investor due to capital increase.

Book value of debt and equity

Return expected by shareholders (normal): For calculating this type of return we use CAPM method. Here's the formula

$$R_e = R_f + \beta(R_m - R_f)$$

R_e :Expected return stock i on year t R_f : Risk free on year t

R_m : Market return on year t

β :Firm risk

This formula is also used for calculating the risk

$$\beta = \frac{cov(R_i R_m)}{\delta_{Rm}}$$

β :Firm risk R_i : Stock return on year t

R_m : Stock return on year t $Cov(Ri, R_m)$: Market and Stock return covariance

σR_m : Market return variance

Abnormal stock return: here's the formula for calculating this type of return:

$$A\ R_{i,t} = R_{i,t} - R_{e.t}$$

$AR_{i,t}$: Abnormal return stock i on year t

$R_{i,t}$:Normal return stock i on year t

$R_{e,t}$: Expected return (normal) stock i on year t

Control variable

In this research 2 types of control variable (e.g. financial leverage and firm size) have been used.

Financial leverage: This shows that some of assets have been financed from debts and equities. This is calculated through the following equation:

$$\text{Financial leverage} = \frac{\text{Total debts}}{\text{Total assets}}$$

Firm size: firm size has been used as one of control variables which is the natural logarithm of total assets.

Total assets[1]Log = Firm size

Statistical Society and Sample

The society under study includes firms listed in Tehran Stock Exchange. Due to the large population of the statistical society, following conditions have been considered for selecting the statistical sample:

1- The firms must have been accepted to the Market since 2005.
2- The firms' equity residue must have been positive.
3- The financial year must end in the month of December.
4- The firms must not be among financial intermediation firms (investment firms).
5- The firms must have a high rate of business activity.
6- They must have not changed their financial year from 2005 to 2010.

Then sampling using an elimination method will be used and the above conditions will be applied.

95 firms within the period 2005-2010 met the conditions above. Therefore the statistical sample of this research is comprised of 95 firms listed in Tehran Stock Exchange.

Results

Description of the characteristic of statistical regression models for each hypothesis:

First Hypothesis: *there's a meaningful relationship between capital productivity and real stock return.*

For examination of this hypothesis we need to test capital productivity regression model and real stock return with presence of variables, size control and firm's financial leverage, hence the following mode is formulated:

$$R_{it} = \theta_0 + \theta_1 ROIC_{it} + \theta_2 SIZE_{it} + \theta_3 LEV_{it} + \varepsilon_{it}$$

If the model above is a meaningful model with an independent variable, it can be accepted that there's a relation between real stock return and capital productivity, therefore the following statistical hypothesis is examined:

$$\begin{cases} H_0: \theta_1 = 0 \\ H_1: \theta_1 \neq 0 \end{cases}$$

In order to test this regression model, with respect to the fact that the foundational conditions of regression model are not met (the residues being normal and with no correlation and with a fixed variance), the model is tested after elimination of useless variables. It should be noted that the regression model is first tested with inclusion of all variables and based on remaining variables, useless variables are identified and eliminated.

Table 1.Variance analyzes

	Sum of Squares	df	Mean Square	F-value	P-value
Model	37.283	3	12.428	33.928	0.000
Residual	204.761	559	0.366		
Total	242.044	562			

Table 2. Estimates of parameters

	Estimate	Std. Error of the Estimate	T-value	P-value
Intercept	-0.239	0.316	-0.756	0.450
Capital Productivity	1.431	0.181	7.925	0.000
Size	0.026	0.050	0.523	0.601
Leverage	-0.364	0.167	-2.184	0.029

Base on table 1 and 2:

$$R_{it} = -0.239 + 1.431 ROIC_{it} + 0.026 SIZE_{it} - 0.364 LEV_{it} + \varepsilon_{it}$$

This model show that increase in capital productivity has a direct impact on real stock return but with respect to probability value of the model (P-value=0.000) and of capital productivity coefficient (P-value=0.000) and in turn comparing it to meaningfulness level (α=0.05) we can accept that zero assumption or the assumption that "there's no meaningful relation between capital productivity and real stock return" is rejected at level of %5 and we can accept the hypothesis with %95 confidence: There's a meaningful relation between capital productivity and real stock return.

Second hypothesis: *There's a meaningful relation between capital productivity and stock return expected by shareholders.*

For examining this hypothesis we need to test capital productivity regression model and the return expected by shareholders with the presence of control variables of firm's size and leverage. Hence the following model must be examined:

$$RE_{it} = \theta_0 + \theta_1 ROIC_{it} + \theta_2 SIZE_{it} + \theta_3 LEV_{it} + \varepsilon_{it}$$

If the model above is a meaningful model with presence of independent variables, it can be accepted that there's a meaningful relation between share expected by shareholders and capital productivity and therefore the following statistical hypothesis must be analyzed:

$$\begin{cases} H_0: \theta_1 = 0 \\ H_1: \theta_1 \neq 0 \end{cases}$$

In order to test this regression model, with respect to the fact that the foundational conditions of regression model are not met (the residues being normal and with no correlation and with a fixed

[1] Logaritm

variance), the model is tested after elimination of useless variables. It should be noted that the regression model is first tested with inclusion of all variables and based on remaining variables, useless variables are identified and eliminated.

Table 3. Variance analyzes

	Sum of Squares	df	Mean Square	F-value	P-value
Model	1.922	3	.641	3.632	.013
Residual	98.787	560	.176		
Total	100.709	563			

Table 4. Estimates of parameters

	Estimate	Std. Error of the Estimate	T-value	P-value
Intercept	0.204	0.219	0.933	0.351
Capital Productivity	-0.395	0.125	-3.163	0.002
Size	0.018	0.035	0.513	0.608
Leverage	-0.081	0.115	-0.703	0.482

Based on above table:

$$RE_{it} = 0.204 - 0.395ROIC_{it} + 0.018SIZE_{it} - 0.081LEV_{it} + \varepsilon_{it}$$

This model show that increase in capital productivity has a direct impact on return expected by shareholders and with respect to probability value of the model (P-value=0.000) we can accept it as meaningful but comparing the capital productivity probability Coefficient (P-value=0.000) with meaningfulness level of α=0.05, we can accept that zero assumption or the assumption that "there's no meaningful relation between capital productivity and expected stock return" is rejected at level of %5 and we can accept the hypothesis with %95 confidence: There's a meaningful relation between capital productivity and real stock return.

But due to the low determination Coefficient of 0.02 this hypothesis is rejected.

Third hypothesis: *There's a meaningful relation between capital productivity and abnormal stock return*.

For examination of this hypothesis we need to test the regression model of capital productivity and abnormal stock return with presence of control variables of firm's size and leverage and therefore a following model is formulated.

If the model above is a meaningful model with presence of independent variables, it can be accepted that there's a meaningful relation between abnormal stock return and capital productivity. Therefore the following statistical hypothesis must be analyzed:

$$\begin{cases} H_0: \theta_1 = 0 \\ H_1: \theta_1 \neq 0 \end{cases}$$

In order to test this regression model, with respect to the fact that the foundational conditions of regression model are not met (the residues being normal and with no correlation and with a fixed

variance), the model is tested after elimination of useless variables. It should be noted that the regression model is first tested with inclusion of all variables and based on remaining variables, useless variables are identified and eliminated.

Table 5. Variance analyzes

	Sum of Squares	df	Mean Square	F-value	P-value
Model	51.436	3	17.145	37.069	.000
Residual	255.779	553	.463		
Total	307.215	556			

Table 6. Estimates of parameters

	Estimate	Std. Error of the Estimate	T-value	P-value
Intercept	-0.318	0.356	0.894	0.372
Capital Productivity	1.802	0.203	8.872	0.000
Size	-0.012	0.057	0.215	0.830
Leverage	-0.250	0.188	-1.325	0.186

$$AR_{it} = -0.318 + 1.802ROIC_{it} - 0.012SIZE_{it} - 0.250LEV_{it} + \varepsilon_{it}$$

Based on above model, increase in capital productivity has a direct impact on abnormal share but with respect to probability value of the model (P-value=0.000) and that of capital productivity Coefficient (P-value=0.000) and comparing it with meaningfulness level of α=0.05, we can accept that zero assumption or the assumption that "there's no meaningful relation between capital productivity and abnormal stock return" is rejected at level of %5 and we can accept the hypothesis with %95 confidence: There's a meaningful relation between capital productivity and abnormal stock return.

Due to market fluctuations in years 2005 and 2006, the hypotheses were also tested during the period 2007-2010 and following results were yielded:

First hypothesis:

Table 7.Variance analyzes

	Sum of Squares	df	Mean Square	F-value	P-value
Model	17.554	3	5.851	16.090	0.000
Residual	135.281	372	0.364		
Total	152.835	375			

Table 8. Estimates of parameters

	Estimate	Std. Error of the Estimate	T-value	P-value
Intercept	0.053	0.394	0.134	0.893
Capital Productivity	0.987	0.233	4.237	0.000
Size	0.008	0.062	0.125	0.900
Leverage	-0.536	0.216	-2.486	0.013

$$R_{it} = 0.053 + 0.987ROIC_{it} + 0.008SIZE_{it} - 0.536LEV_{it} + \varepsilon_{it}$$

Based on above model, increase in capital productivity has a direct impact on real share but with respect to probability value of the model (P-value=0.000) and that of capital productivity Coefficient (P-value=0.000) and comparing it with meaningfulness level of α=0.05, we can accept that zero assumption or the assumption that "there's no meaningful relation between capital productivity and real stock return" is rejected at level of %5 and we can accept the hypothesis with %95 confidence: There's a meaningful relation between capital productivity and real stock return.

Second hypothesis:

Table 9.Variance analyzes

	Sum of Squares	df	Mean Square	F-value	P-value
Model	0.840	3	0.280	2.141	0.095
Residual	48.355	370	0.131		
Total	49.194	373			

Table 10. Estimates of parameters

	Estimate	Std. Error of the Estimate	T-value	P-value
Intercept	-0.134	0.236	0.567	0.571
Capital Productivity	-0.176	0.139	-1.267	0.206
Size	0.063	0.037	1.692	0.092
Leverage	0.058	0.128	0.454	0.650

$$RE_{it} = -0.134 - 0.176ROIC_{it} + 0.063SIZE_{it} + 0.058LEV_{it} + \varepsilon_{it}$$

Based on above model, increase in capital productivity has a negative impact on return expected by shareholders but with respect to probability value of the model (P-value=0.095) it is not a meaningful model but comparing the capital productivity probability Coefficient (P-value=0.206) with meaningfulness level of α=0.05, we can accept that zero assumption or the assumption that "there's no meaningful relation between capital productivity and expected stock return" is not rejected at level of %5 and the hypothesis can't be rejected with %95 confidence: There's no meaningful relation between capital productivity and expected stock return.

Third hypothesis:

Table 11. Variance analyzes

	Sum of Squares	df	Mean Square	F-value	P-value
Model	24.217	3	8.072	17.874	0.000
Residual	167.101	370	0.452		
Total	191.318	373			

Table 12. Estimates of parameters

	Estimate	Std. Error of the Estimate	T-value	P-value
Intercept	0.104	0.439	0.236	0.814
Capital Productivity	1.155	0.260	4.445	0.000
Size	-0.037	0.069	-0.536	0.592
Leverage	-0.627	0.241	-2.605	0.010

$$AR_{it} = -0.104 + 1.155ROIC_{it} - 0.037SIZE_{it} - 0.627LEV_{it} + \varepsilon_{it}$$

Based on above model, increase in capital productivity has a direct impact on abnormal share but with respect to probability value of the model (P-value=0.000) and that of capital productivity Coefficient (P-value=0.000) and comparing it with meaningfulness level of α=0.05, we can accept that zero assumption or the assumption that "there's no meaningful relation between capital productivity and abnormal stock return" is rejected at level of 5% and we can accept the hypothesis with %95 confidence: There's a meaningful relation between capital productivity and abnormal stock return.

All three hypotheses were tested over two time periods and as was evidenced all three models yields similar results over the different periods. This result was concluded that economic fluctuations of 2005 and 2006 didn't have a significant impact on statistical models of the research.

Conclusion

Since the practical approach of this research is examination of the impact of capital productivity on firms' stock returns, the impact of capital productivity on each stock return component was analyzed. The result was that there is a general meaningful relation between capital productivity and firms' stock return and that capital productivity has a direct impact on capital return. The main achievement of this research was learning about the necessity of paying attention to capital productivity and stock return from the perspective of shareholders in Tehran Stock Exchange.

The result from testing of the first hypothesis is that there's a meaningful relation between capital productivity and real stock return. The result from testing the second hypothesis implies that there's no meaningful relation between capital productivity and normal return (as expected by shareholders) and the result from testing the third hypothesis suggests a meaningful relationship between capital productivity and abnormal stock return. Moreover the market fluctuations of years 2005 and 2006 had no impact on the results of tests in the initial time period.

Considerations

1- It is important to note that similar studies in other countries' exchange markets cover a longer period of time. Due to severe fluctuations of share-return-related financial data in years 2003 and 2004, they were not included in the sampling. This made the hypotheses limited to data of a 6-year period which is shorter compared to the time span covered by other researches on capital markets.

2- The existence of interfering variables whose inclusion could alter the results of the research.

3- Knowing that the data collected from financial statement were made without adjustment of the auditor opinion, the impact of auditing reports on research results must be taken into account.

Due to market fluctuations in years 2005 and 2006, the hypotheses of this research were tested over two time periods, 2005-2010 and 2007-2010, so that the impact of these fluctuations over the research hypotheses is examined.

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10/20/2012