Investor’s Cognitive Bias and Stock Misvaluation

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Abstract: This article seeks to measure stock misvaluation following (Rhodes-Kropf, et al., 2005) and examine its relation to stock return. This model presents a new measure to investigate investors’ over- and under-reaction for individual stocks and industries. The results show that there are both overreaction and under-reaction in Tehran stock Exchange. Based on the misvaluation factor, portfolios are formed and the properties of stocks with different degrees of misvaluation are investigated. The evidence is consistent with the argument that stock misvaluation is caused by Investor’s Overconfidence, Representativeness Bias and Anchoring. It is also found out that there is relationship between misvaluation factor measure and factors like past stock return, price, firm size, B/M and stock liquidity degree.

Key words: Cognitive psychology, stock misvaluation, overreaction, under-reaction, cognitive bias.

INTRODUCTION

In recent decade, some of modern finance assumptions have been debated in behavioral finance studies. One of them is investors’ rationality. The economic principle suggests that individuals are rational in obtaining information and they tend to seek information without any bias and integrate the information in forming an investment strategy that may yield better investment performance. On the contrary, some studies suggest that stock price is determined by mental factors rather than fundamental variables. The behavioral finance literature assumes that investors are subject to behavioral and cognitive biases and attempts to explain the way investors determine asset prices and returns based on those biases. It is well accepted that decision makers are often influenced by multiple psychological biases that distort their decision making and economic outcomes (Barber and Odean 2001, 2002; Kahneman and Riepe, 1998; Raghunathan and Corfman, 2006). A cognitive bias is the human tendency to make systematic errors in certain circumstances based on cognitive factors. Such biases can result from information processing and are related to human psychology. There are several evidences that show the investors who are subject to cognitive biases do not interpret the information correctly and overreact or under-react to the new information. Individuals tend to overly rely on specific information and anchor on one trait or pieces of information when making decisions. Representativeness bias and conservatism bias are proposed by (Barberis, et al., 1998) as the causes of investors’ misvaluation. They assume that investors always infer an incorrect earnings process on the basis of recent evidence. Representativeness bias occurs when a received signal is confirming preceding ones and it results in investors’ over-reaction. In other words, it is the tendency of individuals to classify things into discrete groups based on similar characteristics. But if the received information contradicts previous signals, conservatism bias causes the investors under-reaction. Representativeness can lead investors to incorrectly extrapolate existing trends and cause overreaction, which reverses at a later date once incorrect conclusions are proven false (Dannel, et al., 1998). A string of good earnings announcements inclines the investors to incorrectly conclude a trendy performance and thus causes an excessive stock price increase. In behavioral finance models and empirical works, the pattern of past performance is an important driver of representativeness and conservatism bias. (Tversky and Kahneman, 1974) note that consistency of past data affects the formation of categories because people expect that a sequence of events will represent the essential characteristics of that process even when the sequence is short.

Decision makers are often disposed to the confirmation bias and depreciate information that opposes their beliefs (Festinger, 1957, McMillan and White, 1993; Nickerson, 1998; Raghunathan and Corfman, 2006). This indicates that, when decision makers process information, they often discount disconfirming evidences while selecting and emphasizing confirming ones. Confirmation bias leads to investor’s overconfidence.

Overconfident investors are known to trade more frequently and have negative abnormal returns amongst stock market traders, especially when they are less experienced yet successful (Odean, 1998; Barber and Odean, 2001).

The goal of this paper is to provide evidence on existence of misvaluation in TSE using a methodology developed by Rhodes-Kropf, Robinson, and Viswananathan (RKRV, 2005) that decomposes market to book ratios
into misvaluation and growth option components. This methodology uses an accounting multiples approach to
break M/B ratios into three components: Firm-specific error, time series sector error, and long-run value-to-book. Since estimating firm and industry misvaluation is essential to the research goal, the tests of the behavioral
view focus on potential misvaluation as reflected in the firm-specific error component of M/B.

The reminder of the paper is organized as follows. In the next section, studies relating to stock valuation
and cognitive biases are reviewed. Then, the sample selection procedure, the data and research methodology are
described. The last sections present the study findings and concludes.

**Literature Review:**

(Daniel, et al., 1998) argue that overconfident investors tend to overestimate the precision of their private
information and they overreact after receiving good news and underreact after bad ones.

(Hong and Stein, 1999) classify investors into two groups. News watchers base their action on information
and under-react to new information. Momentum traders, in contrast, extrapolate past sequences of price changes
and try to arbitrage but only through simple momentum strategies that ultimately leads to an overreaction.

(Mullainathan, 2001) assumes that individuals are not Bayesian because they think in discrete categories
and thus assume the most representative scenario, ignoring plausible alternative state of world.

(Wesley, et al., 2001) examines a central psychological bias, representativeness, which underlies many
behavioral finance theories. According to this bias, individuals form predictions about future outcomes based on
how closely past outcomes fit certain categories. By using accounting performance and testing the idea that
investors misclassify firms and thus make biased forecasts, he finds evidence of short-term accounting
momentum, consistent with the idea that investors fail to immediately incorporate new information.

(Rhodes-Kropf, et al., 2005) develop a decomposition that breaks M/B into three components to test this
suggestion that valuation errors affect merger activities. They find that misvaluation which could be the result of
behavioral anomaly or due to asymmetric information between informed insiders and the rest of the market,
drives mergers and it affects who buys whom and combines with neoclassical explanations to explain aggregate
merger activities.

(Hertzel, et al., 2006) examine the extent to which investment opportunities and mispricing motivates
equity issuance decisions and contributes to low post-issue stock returns. By using Rhodes-Kropf methodology,
they find that issuing firms are both overvalued and have greater growth opportunities. These firms invest more
aggressively in capital expenditures and R&D.

(Kaestner, 2006) studies investor’s miss-reaction to unexpected earnings. His study results suggest that
investors simultaneously exhibit short-term under-reaction to earning announcements and long-term
overreaction to past highly unexpected earnings. He shows that a potential explanation for the reported
overreaction phenomenon is the representativeness bias.

(Hirshleifer and Jiang, 2008) form a misvaluation factor (UMO) based on firms equity financing activities
and completely conditional on management activities. They find that insiders who have superior information of
the firm true value, tend to issue equity when they feel that stocks are overvalued and to repurchase when undervalued.

(Chang and Yan Luo, 2009) find that the misvaluation measure has incremental explanatory power for
future returns and stock under- and overvaluation could be result from investors overreacting to negative and
positive news, respectively.

(Ling, et al., 2010) show that anchoring bias has significant economic consequences for the efficiency of
financial markets. They find that analysts make optimistic (pessimistic) forecasts when a firm’s forecast EPS is
lower (higher) than the industry median.

(Park, et al., 2010) study how information from virtual communities influences investors’ trading decisions
and investment performance. They find investors seek information that confirms their prior beliefs and this
confirmation bias make them more overconfident and affect their investment performance.

**Data And Methodology:**

The sample includes stocks listed on Tehran Stock Exchange (TSE) in the period of 1998-2007. Only firms
which are listed before 1998, have all of accounting information needed, their leverage ratios are less than one
or greater than zero and do not have negative B/M are kept in the sample. Based on these conditions, 127 firms
are chosen as the sample.

Main testable hypothesis are motivated by the literature on the recent evidence on investors behavior who
are subject of cognitive biases from the behavioral finance literature. The behavioral finance literature has long
argued that investors adhere excessively to previously formed beliefs in spite of new information (Lord, et al.,
1979; Ko and Hansch, 2008). This behavior generates under- and overreaction to new information.

Based on above arguments, this study seeks to examine if there is overreaction or under-reaction in TSE
and then investigate the biases which lead to them if there is any. To calculate the misvaluation measure for
each firm considering its industry, (Rhodes-Kropf, et al., 2005) methodology is followed. In this approach, such
a measure is derived based on publically available financial statements at the individual stock level. According to RKRV, misvaluation is the difference between firm market value (M) and its true value (V). Therefore a firm market to book ratio should be broken into two components: market value to true value, M/V, and true value to book, V/B. Thus, the following algebraic identity can be used to decompose the M/B ratio:

\[ M - B = (M - V) + (V - B) \]

Where M is market value, B is book value and V is some measure of fundamental or true value, all expressed in logarithms. If markets make mistakes in estimating discounted future cash flows or markets do not have all the information known by managers, then M/V captures the part of M/B and the is associated with misvaluation. If the market price does not reflect true value, then ln (M/V) will be positive in times of overvaluation and negative in times of under-valuation. The misvaluation factor measure directly measures the consequences of the investors’ trading activities influenced by behavioral biases which is one of RKRV methodology advantages.

RKRV separate ln (M/B) into three components: (1) the difference between observed price and a valuation measure that reflects time-t fundamentals (firm-specific error), (2) the difference between valuation conditional on time-t fundamentals and a firm-specific valuation that reflects long-run value (time-series sector error), and (3) the difference between valuation based on long-run value and book value (long-run value to book). Decomposing the market to book ratio, relies on determining an estimate of firm value, v, which RKRV use three different models. The models differ only with respect to the accounting items that are included to the accounting information vector. To save space, we focus on the third model which includes book value, net income and market leverage ratio:

\[
M_{ij} = \beta_{0j} + \beta_{1j} \times B_{ij, t-1} + \beta_{2j} NI_{ij, t-1} + \beta_{3j} I_{(-0)} NI_{ij, t-1}^+ + \beta_{4j} LEV_{ij, t-1} + \varepsilon_{ij, t1}
\]

Where i stands for an individual firm, j is the industry to which the firm belongs and t is the end of each year. M is firm’s market value and B is the book value of common equity that both are in natural log terms. NI_{ij, t-1} stands for the log of the absolute value of net income and I is a dummy that equals one when net income is negative and equals zero when net income is positive. Thus, if a firm in an industry is penalized for having negative net income, I’s coefficient will be negative. LEV is the leverage ratio calculated as one minus common equity over total assets. The difference between M and its fitted value from the above equation, \( \hat{M} \), is defined as firm-level misvaluation by RKRV. \( \hat{M} \), which is derived from firm i’s fundamental variables and the pricing benchmark of the industry j, will be close to the true value of the firm i.

\[ M_{ij} = M_{ij} - \hat{M}_{ij} \]

If MISV is highly positive, it will indicate overvaluation while a highly negative MISV shows undervaluation. Stocks with MISV closed to zero are considered as properly priced.

**Empirical Findings:**

This section presents results from estimating MISV following RKRV methodology and the properties of the firms with different degrees of misvaluation. These results are shown in table 1 and 2. Table 1 reports the distribution of firm level misvaluation across industries.

<table>
<thead>
<tr>
<th>Industry</th>
<th>MISV</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Products</td>
<td>0.00</td>
<td>-2.66408</td>
<td>2.57997</td>
</tr>
<tr>
<td>Automobile Products</td>
<td>0.00</td>
<td>-2.03167</td>
<td>2.26686</td>
</tr>
<tr>
<td>Mineral Products</td>
<td>0.00</td>
<td>-3.01807</td>
<td>3.06451</td>
</tr>
<tr>
<td>Basic Metal</td>
<td>0.00</td>
<td>-1.39627</td>
<td>2.45785</td>
</tr>
<tr>
<td>Plastic</td>
<td>0.00</td>
<td>-1.48308</td>
<td>1.80468</td>
</tr>
<tr>
<td>Equipment</td>
<td>0.00</td>
<td>-2.43883</td>
<td>2.21494</td>
</tr>
<tr>
<td>Metal Products</td>
<td>0.00</td>
<td>-2.50656</td>
<td>1.80662</td>
</tr>
<tr>
<td>Food Products</td>
<td>0.00</td>
<td>-1.69802</td>
<td>1.60190</td>
</tr>
<tr>
<td>Others</td>
<td>0.00</td>
<td>-1.76086</td>
<td>3.03464</td>
</tr>
</tbody>
</table>

The mean of MISV is almost zero for each industry. The information in the table shows that investors overreact or under-react to the information and they do not price the stocks properly. It is also found that over-
and under reaction occur in all the industries with different properties. So, in this section, stocks are grouped at the end of each year based on the misvaluation measure and investigate their characteristics. A is the portfolio with negative MISV and B is the portfolio with positive MISV. The results are reported in table 2.

Table 2: characteristics of the misvaluation portfolios.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>A-B</th>
<th>t-stat</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RET-t-1</td>
<td>2.07</td>
<td>3.2</td>
<td>-1.13</td>
<td>6.17</td>
<td>0.000</td>
</tr>
<tr>
<td>RET-t-2</td>
<td>2.2</td>
<td>4.64</td>
<td>-2.45</td>
<td>5.34</td>
<td>0.000</td>
</tr>
<tr>
<td>RET-t-3</td>
<td>2.55</td>
<td>4.33</td>
<td>-1.78</td>
<td>3.16</td>
<td>0.002</td>
</tr>
<tr>
<td>ΔEPS</td>
<td>-161.99</td>
<td>4.06</td>
<td>-165.06</td>
<td>-2.29</td>
<td>0.023</td>
</tr>
<tr>
<td>ME</td>
<td>209264</td>
<td>146472</td>
<td>62790</td>
<td>5.79</td>
<td>0.000</td>
</tr>
<tr>
<td>B/M</td>
<td>1.229</td>
<td>0.305</td>
<td>0.924</td>
<td>12.9</td>
<td>0.000</td>
</tr>
<tr>
<td>PRICE</td>
<td>3012</td>
<td>13597</td>
<td>-16525</td>
<td>8.68</td>
<td>0.000</td>
</tr>
<tr>
<td>LIQ. DEGREE</td>
<td>158</td>
<td>121</td>
<td>37</td>
<td>-2.89</td>
<td>0.004</td>
</tr>
<tr>
<td>AGE</td>
<td>12</td>
<td>14</td>
<td>-2</td>
<td>-2.39</td>
<td>0.017</td>
</tr>
</tbody>
</table>

The first three rows of the table show the average return of t-1, t-2 and t-3. As it is seen, in these periods, A has the lowest return while B earns the highest returns. The return difference between the two groups is significant at 1% level. By moving from t-3 to t-1, the average return is decreasing in A but increasing in B. As returns are often used to measure news, it seems that undervalued stocks are associated with bad news and overvalued ones with good news. The difference between EPS in current year and previous year is reported in row 4. This difference is negative for A but positive for B. The percentage of negative ΔEPS in each misvaluation group is also calculated. It is lower in B. Rows 1 to 5 together confirm that undervalued firms are more associated with bad news and have a higher chance of receiving negative signals. This can be because of representativeness bias and confirmation bias. In behavioral finance models and empirical work, the pattern of past performance is an important driver of representativeness bias. As a result, people gather evidence and recall information from memory selectively and interpret it in a biased way. Investors infer an incorrect earnings process on the basis of recent evidence. A string of good earnings announcements inclines the investors to incorrectly conclude a trending performance and thus causes an excessive stock price increase. Stocks which have a poor performance and received bad news recently (stocks in A), are undervalued because investors tend to overreact to similar information according to representativeness bias. They also tend to favor information that confirms their preconceptions regardless of whether the information is true. Confirmation bias contributes to investors’ overconfidence and overreaction to private information which results in misvaluation. Stock prices overshoot following good signals and drop following bad ones. Row 6 and 7 show that average firm size is higher in B while B/M is lower. It means that overreaction occur in the firms that are larger in size but have lower B/M. This can be related to the systematic patterns in growth and profitability which can be the main sources of risk. One reason for the difference between firm book value and firm market value is that investors notice to the firm past growth rate and thus, are optimist to the firms with past good performance and pessimist to the firms with past weak performance. Investors’ optimism and pessimism bias leads to their centralization on one or two probabilities and ignoring the others. So they misvalue the firms. Average monthly prices during the previous 12 month are reported in row 8. Some studies use the price as a proxy for liquidity (Chang, et al., 1998). Rows 8 to 10 suggest that A stocks are illiquid but B stocks are liquid. If low liquidity leads to determining arbitrage activities and stock misvaluation, both portfolios should be illiquid, which contradicts the evidences in rows 8 and 9. Row 10 presents the firm age which is calculated as the number of years since the first appearance in TSE. Portfolio A firms are younger than B implying that younger firms are more undervalued. Younger firms have less historical data but the information about old firms is more accessible and they are overvalued. This issue refers to information accessibility which is a key concept in heuristics. People overvalue the events which more appear in the news. Information of these events is kept in the mind well and people recall them more easily when they want to make a decision.

Summary and Conclusions:

Many studies about investor’s behavior rely on some form of the representativeness heuristic which can lead investors to form biased expectations. This paper used regression techniques to measure stock misvaluation by following the Rhodes-Kropf approach which is based on the financial information of individual firms of each industry. The advantage of this approach is that it uses the accounting information which is used directly by investors when making decision. Then, portfolios were contrasted based on misvaluation degree and the relation between MISV factor and some firm properties was tested. The findings suggest that the firms with smaller size,
higher B/M, weak return in past, negative ΔEPS, lower liquidity and lower age were undervalued. These findings imply that some investors’ biases like representativeness bias and confirmation bias could affect firm valuation. These biases strengthen investors’ prior beliefs and make them optimistic or pessimistic as well as overconfident.

These results can provide guidance to investors. To be unbiased in information acquisition and processing, investors should expose themselves to both confirming and disconfirming information, objectively assess the relevance and veracity of new information and integrate all the information before making a decision.

REFERENCES