Macroeconomic Variables versus Differences between Market Prices and Fundamental Values

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Abstract

Penman and Sougiannis (1998) consider that price deviations from fundamental value are model estimation errors, while Barberis et al. (1998) suggest that these deviations are due to psychological factors that affect investor reaction to information. In this paper, we use the valuation model proposed by Barberis (1998) and data from the London Stock Exchange in order to calculate the fundamental value of a stock and then examine whether the differences between predicted and real stock prices are due to macroeconomic fundamentals or psychological factors. On the whole the results show that these differences between predicted and real stock prices are explained by important macroeconomic variables as well by the sentiment of investors.

JEL Classification: G1.

Keywords: Valuation model, investor sentiment, macroeconomic variables.
1. Introduction

Barberis et al. (1998) present a parsimonious model of investor sentiment that is in accordance with the empirical evidence in the theory of investor underreaction and overreaction phenomenon to a series of announcements (good and bad news) (see Bernard and Thomas, 1989; Chan, Jegadeesh, Lakonishok, 1997; Chopra, Lakonishok, Ritter, 1992; De Bondt and Thaler, 1985; Ikenberry, Lakonishok, Vermaelen, 1995; La Porta, 1996; among others). Their model involves a representative agent and a random walk as the true process for earnings. In this model the price of a security should be determined by the discounting of earnings, i.e. \( \frac{N_t}{d} \), where \( N_t \) is earnings at time \( t \) and \( d \) is the discount rate.

In the Barberis et al. model, the price deviates from the correct fundamental value because the investor does not use the true (random walk) model to forecast earnings, but rather some combination of two alternative models that are described in the paper. In their model, they propose a formula for the price of a security that has two factors and a very simple interpretation: the first factor \( \frac{N_t}{d} \) is the price that would obtain if the investor used the true random walk process to forecast earnings. The second factor provides the difference between the market price and the estimated fundamental value. They also explore the range of values for which their price function exhibits both underreaction and overreaction phenomenon to earnings announcements.

The implication is that, in the Barberis et al. (1998) model, price deviations from fundamental value are not treated as model estimation errors (as proposed by Penman and Sougiannis (1998)) but rather as deviations that are due to psychological factors that affect investor reaction to information. An important related question is then,
whether investor psychology, that drives price deviations away from fundamental values, is itself related or affected by economic conditions or not. This paper explores this issue further by employing standard security valuation techniques in order to estimate the deviation of actual prices from fundamental values, and then examines whether these deviations are related to fundamental macroeconomic variables.

The objective of this paper is to use the valuation model proposed by Barberis (1998) in order to calculate the fundamental value of a stock and then examines whether the differences between predicted and real stock prices are explained by key macroeconomic factors and psychological factors that affect investor reaction to information, using data from the London Stock Exchange. This is precisely the motivation of this paper: We aim to test empirically these differences that calculated by the Barberis valuation model and then examine whether the price deviations from fundamental value are not treated as model estimation errors as proposed by Penman and Sougiannis (1998) but rather as deviations that are due to psychological factors as well as to macroeconomic conditions. The rest of the paper is organised as follows: section 2 reviews the literature, section 3 describes the research design and data section 4 presents the methodology, section 5 presents the empirical findings and section 6 concludes the paper.

2. Literature review

Recent empirical research in finance has focuses on the theory of underreaction and overreaction. The underreaction evidence shows that over horizons of perhaps 1-12
months, security prices underreact to news (as earnings announcement). As a consequence, news is incorporated only slowly into prices. In other words, the stocks underreact to the good news (in earnings announcement that is higher than expected), a mistake which is corrected in the following period, giving a higher return at that time. The overreaction evidence shows that over longer horizons of perhaps 3-5 years, security prices overreact to consistent patterns of news pointing in the same direction. That is, securities that have had a long record of good news tend to become overpriced and have low average returns afterwards. Differently stated, securities that appeared to have a good performance, receive extremely high valuations, and these valuations on average return to the mean. The idea here is simply that after a series of announcements of good news, the investor becomes overly optimistic that future news announcements will also be good and hence overreacts, sending the stock price to high levels. Subsequent news announcements are likely to contradict his optimism, leading to lower returns. We could define that overreaction occurs when the average return following not one but a series of announcements of good news is lower than the average returns following a series of bad news announcements. The above evidence presents a challenge to the efficient markets theory because it suggests that in a variety of markets, sophisticated investors can earn superior returns by taking advantage of underreaction and overreaction without bearing extra risk. This evidence also presents a challenge to behavioral finance theory because early models do not successfully explain the facts. The challenge is to explain how investors might form beliefs that lead to both underreaction and overreaction (Barberis et al. (1998)).

De Bondt and Thaler (1985) examine whether the overreaction hypothesis is predictive. They are based on monthly return data for New York Stock Exchange
covering the period between January 1926 and December 1982. Their empirical evidence are in accordance with the overreaction hypothesis. More specifically, they realize that portfolios of stocks with extremely poor returns over the previous five years significantly outperform portfolios of stocks with extremely high returns, even though risk adjustments have been taken place. They conclude, that the presence of estimations errors in the stock markets caused by investor overreaction, could explain the large difference in returns between winners and losers. Zarowin (1990) reestimates De Bondt and Thaler’s evidence on stock market overreaction controlling for size differences between winners and losers. He realizes that, the tendency of losers to outperform is not due to the overreaction hypothesis, but to the tendency of losers to be smaller sized firms than winners. He also finds, that in equal size companies, there is no important evidence that there is a difference between losers and winners. He concludes that the winners outperform losers in periods when winners are smaller than losers. Chopra et al. (1992) are based on monthly data of the NYSE covering the period between 1926 to 1986. Their empirical results show the existence of an important overreaction effect in the stock market even after adjusting for size and beta. In portfolios formed on the basis of prior five years returns, extreme prior losers outperform extreme prior winners by 5%-10% per year during the subsequent five years. Their empirical evidence also show that the overreaction effect is statistically more important for smaller firms than for larger firms.

Bernard and Thomas (1989) use a sample of 84,792 firm quarterly data for NYSE/AMEX, for the period of 1974-1986 and try to discriminate between two alternative explanations for post earnings announcements drift: a failure to adjust abnormal returns fully of risk and a delay in the response to earnings reports. They
find that their empirical results cannot reconciled with arguments built on risk miss-
measurement but are in accordance with a delay price response. In addition, Inkebery
et al. (1995) test a long-run firm performance following open market repurchase
announcements and examine whether undervaluation is the only reason motivating
share repurchases. They use a sample of 1.239 repurchases between 1980 to 1990, by
firms which shares are traded on the NYSE, ASE or NASDAQ sorting firms on the
basis of book to market ratios. Their empirical results show that for undervalued
stocks, the effect of repurchasing own shares by the firms has an important value
(45.3%). On the other hand, the empirical findings show that for repurchases
announced by overvalued stocks, where undervaluation is less likely to be an
important motive, no positive drift in abnormal returns is observed.

Barberis et al. (1998) examine a parsimonious model of investor sentiment that is in
accordance with the empirical evidence in the theory of investor underreaction and
overreaction phenomenon to a series of announcements (good and bad news). In this
model, the price of a security is produced by two factors. According to the first factor,
the price of a security should be determined by the discounting of earnings i.e. \( N_t/d \),
where \( N_t \) is earnings at time \( t \) and \( d \) is the discount rate. Thus, the first factor is the
price that would obtain if the investor used the true random walk process to forecast
earnings. The second factor express the difference between the market price and the
estimated fundamental value. They also explore the range of values for which their
price function exhibits both underreaction and overreaction phenomenon to earnings
announcements. According to this model, the price of a security is determined by the
following equation:
\[ P_t = \frac{N_t}{d} + y_t \quad (1) \]

where \( P_t \) is the price per share at time \( t \), \( N_t \) is the earnings at time \( t \), \( d \) is the discount rate and \( y_t \) is the shock to earnings at time \( t \), which can take one of two values \( +y \) or \(-y\).

### 3. Research Design and Data

Based on the theory, proposed by the Barberis et al. (1998) model, the price deviations from fundamental value are not treated as model estimation errors but rather as deviations that are due to psychological factors that affect investor reaction to information, there is need to examine whether investor psychology that drives price deviations away from fundamental values, is itself related or affected by economic conditions or not. The main objective of our empirical analysis is to use the valuation model proposed by Barberis (1998) in order to calculate the fundamental value of a stock and then examines whether the differences between predicted and real stock prices are explained by key macroeconomic factor and psychological factors that affect investor reaction to information, using data from the London Stock Exchange. If that were to be the case, our empirical valuation model constructed to include as independent variables macroeconomic and psychological factors and as a dependent variable the differences between predicted and real stock prices. The main hypothesis we aim to test is whether the differences between predicted and real stock prices are related not only to investor psychology that drives price deviations away from fundamental values but also affected by economic conditions. If the former is true, the
implication would be that the differences between predicted and real stock prices are explained also by key macroeconomic factors. If the alternative hypothesis is true we would infer that the above differences are not explained by important macroeconomic variables.

Our empirical analysis is based on time-series data from the London Stock Exchange, available from Datastream, covering the period between 1983 and 2007. The data is expressed in nominal values and annual frequency. Our sample includes companies from the FTSE 100 index that have been traded continuously in the stock market during the examined period.

4. Methodology and Definition of Variables

4.1 Definition of Variables

The Dependent Variable.

The Differences (DIF). DIF is the differences between the fundamental values predicted by the Barberis (1998) valuation model and the real stock prices in the stock market. So for the construction of the dependent variable, we calculate these differences for each separate company at time $t$ and then we take the average value of all differences for all firms for every year of the period examined.
More specifically, in order to calculate the fundamental value (of each company of FTSE 100) at time $t$ proposed by the Barberis (1998) valuation model, we discount the earnings at time $t$ (based on the risk-free rate as a discount rate) using yearly data for the period 1983-2007. More specifically, we use the following formula:

$$P_t = \frac{N_t}{d} \quad \text{where} \quad P_t \quad \text{is the price per share at time} \quad t, \quad N_t \quad \text{is the earnings at time} \quad t, \quad d \quad \text{is the discount rate.}$$

**The Independent Variables.**

**The Balance of Payments (BALOFPAY).** BALOFPAY is the balance of payments of the British economy for every year of the examined period.

**The Consumer Confidence (CONF).** CONF is the consumer confidence of the British economy for every year of the examined period.

**The Consumer Price Index (CPI).** CPI is the consumer price index of the British economy for every year of the period under examination.

**The Deficit (DEF).** DEF the public deficit of the British economy for every year of the period under examination.

**The Economic Sentiment (SENT).** SENT is the economic sentiment of the British economy for every year of the examined period.

**The External Debt (EXDEBT).** EXDEBT is the external debt of the British economy for every year of the examined period.

**The Exchange rate (UKTOEURO).** UKTOEURO is the Exchange rate between UK pound and EURO for every year of the examined period.
The **Exchange rate (UKTOUS)**. UKTOUS is the Exchange rate between UK pound and US dollar for every year of the examined period.

The **Gross Domestic Product (GDPCON)**. GDPCON is the gross domestic product in constant prices of the British Economy for every year of the examined period.

The **Gross Domestic Product (GDPCUR)**. GDPCUR is the gross domestic product, using current prices, of the British Economy for every year of the examined period.

The **Gross Debt (DEBT)**. DEBT is the gross debt of the British Economy for every year of the examined period.

The **Industrial Production (INDPROD)**. INDPROD is the industrial production of the British Economy for every year over the time period examined.

The **Real Effective Exchange Rate (EFFECTIVE)**. EFFECTIVE is the real effective exchange rate for every year of the examined period.

The **Inflation (INF)**. INF is the inflation rate of the British Economy for every year over the time period examined.

The **Money Supply (SUPPLY)**. SUPPLY is the money supply of the British Economy for every year of the examined period.

The **Ten Year Bond (TENYEAR)** TENYEAR is the ten year bond of the British Economy for every year of the examined period.

The **Three Month Treasury Bill (THREEMonth)**. THREEMONTH is the three month treasury bill of the British Economy for every year of the examined period.

### 4.2 Methodology

Methodologically, we use a time-series analysis and we regress the following econometric model:
\[ DIF_t = \alpha + \beta_1 \text{INDPROD}_t + \beta_2 \text{GDPCON}_t + \beta_3 \text{UKTOUS}_t + \beta_4 \text{SENT}_t \\
+ \beta_5 \text{SUPPLY}_t + \beta_6 \text{CONF}_t + \beta_7 \text{EXTDEBT}_t + \varepsilon_t \]  

(2)

where \( DIF_t \) is the differences at time \( t \), \( \text{INDPROD}_t \) is the industrial production at time \( t \), \( \text{GDPCON}_t \) is the gross domestic product at time \( t \), \( \text{UKTOUS}_t \) is the exchange rate between the UK pound and the US dollar at time \( t \), \( \text{SENT}_t \) is the sentiment of investors at time \( t \), \( \text{SUPPLY}_t \) is the money supply at time \( t \), \( \text{CONF}_t \) is the consumer confidence at time \( t \), \( \text{EXTDEBT}_t \) is the external debt at time \( t \) and \( \varepsilon_t \) is the unobserved remainder.

5. Empirical Findings

Table 1 presents the descriptive statistics of the variables used in our study. As we can see from this table, the average \( DIF \) is -3.94 with a standard deviation of 216.38. The average \( \text{GDPCON} \) is 1,012,799, a value that is higher than the average of \( \text{INDPROD} \) (95.74). The average \( \text{UKTOUS} \) is a very low value (0.60). In addition, the average of \( \text{SENT} \) is 103.13, while the average of \( \text{CONF} \) is a negative value (-7.51). Finally, the average price of \( \text{SUPPLY} \) and of \( \text{EXTDEBT} \) is a very high positive value, 534566.8 and 2029712 respectively.

The price deviations from fundamental values is a very important issue in the theory of valuation. In this paper we use average deviations of all firms at time \( t \) for every
year for the period 1983-2007. We observe that these deviations are very volatile especially during the sub period of 1994-2004. Of course the volatility of these deviations in this specific period can easily be explained by the following reasons: the overvalue appreciation of the stock market, the doc com bubble and the telecommunications crash.

In order to construct the above econometric model we follow the methodology of general to specific. More specifically we regress the dependent variable on several independent variables that represent key macroeconomic and psychological factors of the British economy. At every estimation step we exclude the non significant explanatory variable. We continue our estimations until we reach a specification in which all explanatory variables are statistically significant. Table 2 reports the results.

The results of the estimation of equation (2) above are presented in table 2. The explainability of the model is significant bearing in mind that the key macroeconomic and psychological factors explain a large portion of the variability of the dependent variable (93%). The results show that key independent variables such as the industrial production, the gross domestic product, the exchange rate between the UK pound and the US dollar, the external debt and the money supply represent important determinants of the differences between predicted and real stock prices. The main question of our analysis, i.e., whether the differences between predicted and real stock prices are affected by economic conditions is upheld by the data. One possible explanation for this conclusion is that the discounted earnings valuation model that proposed by Barberis (1998) is misspecified and does not incorporate the impact of important macroeconomic factors. In addition, variables such as, the consumer
confidence and the economic sentiment of investor explain a large portion of the variability of these differences. So the second question of our analysis, i.e., whether the differences between predicted and real stock prices are affected by the sentiment of investors is also upheld by the data. These results confirm the theory proposed by the Barberis valuation model that price deviations from fundamental value are treated as deviations that are due to psychological factors that affect investor reaction to information. The F-statistic of the model has a value of 43.28 with a probability value of 0.00. The Durbin-Watson statistic and the Residual Sum of Squares have a value of 2.64 and 43,424.43 respectively. The results also show that all explanatory variables are statistically significant and have the expected sign.

6. Conclusions

We use the valuation model proposed by Barberis et al. (1998) in order to calculate the fundamental value of a stock and then examine whether the differences between predicted and real stock prices are explained by key macroeconomic factors and psychological factors that affect investor reaction to information, using data from the London Stock Exchange S.A., covering the period between 1983 and 2007.

Our empirical findings are supportive of our original question of whether investor psychology, that drives price deviations away from fundamental values, is itself related or affected by economic conditions. More specifically, the results show that key macroeconomic variables such as the industrial production, the gross domestic product, the exchange rate between the UK pound and the US dollar, the external debt
and the money supply, represent important determinants of the differences between predicted and real stock prices. One possible explanation for this conclusion is that the valuation model proposed by Barberis (1998) is misspecified and does not incorporate the impact of important macroeconomic factors. In addition, variables such as, the consumer confidence and the economic sentiment of investor explain a large portion of the variability of these differences. This second conclusion is consistent with behavioural finance theory. The idea, that sophisticated investors can earn superior returns by taking advantage of undrreaction and overreaction without bearing extra risk, is confirmed by the empirical findings (see Bernard and Thomas, 1989; Chan et al. 1997; Chopra et al. 1992; De Bondt and Thaler, 1985; Ikenberry et al. 1995; La Porta, 1996; Barberis et al. 1998). The explainability of the model is significant bearing in mind that the key independent variables explain 93% of the variability of the dependent one. Based on the above results we could conclude that the price deviations from fundamental value are not treated as model estimation errors as proposed by Penman and Sougiannis (1998) but rather as deviations that are due to psychological factors as well as to macroeconomic conditions.
References


Table 1
Descriptive statistics of variables

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<tbody>
<tr>
<td></td>
<td>DIF</td>
<td>INDPROD</td>
<td>GDPCON</td>
<td>UKTOUS</td>
</tr>
<tr>
<td>Mean</td>
<td>-3.94</td>
<td>95.74</td>
<td>1012799</td>
<td>0.60</td>
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<tr>
<td>Median</td>
<td>45.33</td>
<td>99.20</td>
<td>979148.5</td>
<td>0.61</td>
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<tr>
<td>Maximum</td>
<td>276.84</td>
<td>104.20</td>
<td>1322842</td>
<td>0.70</td>
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<tr>
<td>Minimum</td>
<td>-656.12</td>
<td>81.30</td>
<td>762353.0</td>
<td>0.50</td>
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<tr>
<td>Std. Dev.</td>
<td>216.38</td>
<td>6.66</td>
<td>174153.4</td>
<td>0.06</td>
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<tr>
<td></td>
<td>SENT</td>
<td>EXTDEBT</td>
<td>SUPPLY</td>
<td>CONF</td>
</tr>
<tr>
<td>Mean</td>
<td>103.13</td>
<td>2029712</td>
<td>534566.8</td>
<td>-7.51</td>
</tr>
<tr>
<td>Median</td>
<td>102.95</td>
<td>154692</td>
<td>471124.5</td>
<td>-4.76</td>
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<tr>
<td>Maximum</td>
<td>126.20</td>
<td>5612719</td>
<td>1068371</td>
<td>3.18</td>
</tr>
<tr>
<td>Minimum</td>
<td>80.20</td>
<td>574801</td>
<td>199423</td>
<td>-20.40</td>
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<td>Std. Dev.</td>
<td>10.23</td>
<td>1406951</td>
<td>255231.3</td>
<td>6.73</td>
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</table>

Notes to table 1:
DIF: The differences between the fundamental values that predicted by the Barberis (1998) valuation model and the real stock prices at the stock market.
INDPROD: The industrial production.
GDPCON: The gross domestic product in constant prices.
UKTOUS: The Exchange rate between the UK pound and the US dollar.
SENT: The economic sentiment of investors.
EXTDEBT: The external debt.
SUPPLY: The money supply.
CONF: The consumer confidence.
Table 2

Do Key Macroeconomic and Psychological factors explain the Differences between Predicted and Real stock prices

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Model</th>
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<tr>
<td>CONSTANT</td>
<td>-105.29</td>
</tr>
<tr>
<td></td>
<td>(-0.21)</td>
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<tr>
<td>INDPROD</td>
<td>-20.70</td>
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<tr>
<td></td>
<td>(-3.12)**</td>
</tr>
<tr>
<td>GDPCON</td>
<td>0.00</td>
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<td></td>
<td>(4.99)**</td>
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<tr>
<td>UKTOUS</td>
<td>1146.18</td>
</tr>
<tr>
<td></td>
<td>(4.55)**</td>
</tr>
<tr>
<td>SENT</td>
<td>-11.11</td>
</tr>
<tr>
<td></td>
<td>(-5.49)**</td>
</tr>
<tr>
<td>EXTDEBT</td>
<td>-0.00</td>
</tr>
<tr>
<td></td>
<td>(-3.18)**</td>
</tr>
<tr>
<td>SUPPLY</td>
<td>-0.00</td>
</tr>
<tr>
<td></td>
<td>(-3.06)**</td>
</tr>
<tr>
<td>CONF</td>
<td>12.40</td>
</tr>
<tr>
<td></td>
<td>(3.22)**</td>
</tr>
</tbody>
</table>

F-statistic 43.28

Prob(F-statistic) 0.00

$R^2$ 0.93

RSS 43,424.43

D-W 2.64
Notes to Table 2:
***, ** and * denote statistical significance at the 1, 5 and 10 per cent levels, respectively.
INDPROD: the industrial production
GDPCON: the gross domestic product in constant prices
UKTOUS: the exchange rate between the UK pound and the US dollar
SENT: the economic sentiment of investors
EXTDEBT: the external debt
SUPPLY: the money supply
CONF: the consumer confidence