The Journal of Behavioral Finance
2007, Vol. 8, No. 4, 209–224



# Information-Adjusted Noise Model: Evidence of Inefficiency on the Australian Stock Market

**Vikash Ramiah and Sinclair Davidson**

*We describe the interaction between noise traders and information traders. We do not assume that information traders are error-free. Instead information traders make mistakes leading to under-reaction and over-reaction. Information traders may even add to pricing errors in the market. These interactions are captured in our information-adjusted noise model. We test our model using data from the Australian Stock Exchange. This market has a continuous information disclosure regime that allows us to determine when information is released to the market. We present evidence consistent with the notion that the market is often informationlly inefficient.*

***keywords:*** *Information traders, Noise Traders, Informational efficiency*

In this paper we describe the interaction between information traders and noise traders. Unlike much of the behavioral finance literature, we do not assume that information traders necessarily return markets to fundamental values. Information traders trade on the basis of information but may well make errors in interpreting that information. Noise traders trade in the absence of information. Information traders may well correct the pricing errors introduced by noise traders—this is just one of the outcomes we describe. On the other hand, information traders may undercorrect or overcorrect noise errors. This gives rise to either underreaction, or overreaction. Furthermore, information traders may make similar errors to noise traders and add to pricing errors on the market and not reduce those errors. The interaction between information traders and noise traders is not likely to be one of information traders mechanistically correcting pricing errors; our Information-Adjusted Noise Model (IANM) captures those subtlies.

The Australian Stock Exchange provides an ideal testing ground for our model. The ASX has a continuous disclosure regime where firms are required to immediately disclose any price relevant information to the market. Our model requires us to "predict" when information traders are likely to be active on the market. We make the assumption that noise traders are continually active in the market, but information traders only trade when information comes to the market. By observing firms making information disclosure we can determine when information traders are likely to be trading. We present evidence that the ASX is often informationally inefficient. Over our sample period we find the efficient markets hypothesis (EMH) is violated on 62.98% of days. The most common violation occurs where information traders add to pricing errors. The second most common violation of information efficiency is underreaction.

In the second section we describe our model, the third section contains our empirical estimates and the fourth section outlines our conclusions.

## Information-Adjusted Noise Model

This section sets out the intuition of the information-adjusted noise model and an empirical analogue of the model. It will also provide a brief differentiation between the efficient market hypothesis in Modern Finance Theory and the efficient market hypothesis in Behavioral Finance theory.

We define information traders as individuals who form expectations on the basis of information and trade on those expectations. We do not assume that information traders are omniscient or that they always form the correct expectations. Our definition of information trader is broader than Shefrin and Statman's [1994] definition. They define an information trader as someone whose subjective beliefs coincide with objective probabilities. To our minds this is an ex post definition of information traders and is likely to occur by chance. Our definition is that traders base their expectations on information but do not always interpret that information correctly. In other words, information traders can make mistakes. Noise traders do not employ information to form their expectations and may trade

**Vikash Ramiah** Senior Lecturer, School of Economics, Finance, and Marketing, RMIT University, 239 Bourke Street, Melbourne, Victoria, 3000, Australia. Tel: 61-3-9925-5828; Fax: 61-2-9925-5986; Email: vikash.ramiah@rmit.edu.au

**Sinclair Davidson** Professor of Institutional Economics, School of Economics, Finance, and Marketing, RMIT University, 239 Bourke Street, Building 108, Melbourne, Victoria, 3000, Australia. Tel: 61-3-9925-5869; Fax: 61-3-9925-5986; Email: sinclair.davidson@rmit.edu.au

for any number of reasons. Information traders only trade in a particular stock when value relevant information has been released to the market. Noise traders, however, can and will trade in any stock on any day. Imagine that on any given day, t, information may be released to the market or not. On those days when no new information comes to market, noise traders will trade amongst themselves. On days that information is released to the market an information event (IE) occurs, and both noise traders and information traders trade. On days that information is not released to the market, only noise traders trade—information traders do not enter the market.

The Modern Finance Theory EMH states that there should be no behavioral errors on the market. In other words, the expected value of any behavioral error given the information set, should be zero, $E(BE_t|\Omega_t) = 0$. The expected change in the behavioral error, given a change in the information set, is a random forecast error, $E(\Delta BE_t|\Delta\Omega_t) = \varepsilon$. In terms of Behavioral Finance, a market is behaviorally efficient when $E(BE_t|\Omega_t) \neq 0$, but $\sum_{i=1}^{\infty} BE_{it} = 0$.[1] The IANM models the random forecast error as follows:

$$\Delta\, BE_{it} = \alpha + \beta\, IE_{it} + \varepsilon_{it} \qquad (1)$$

Where $\Delta BE_{it} =$ is the change in the behavioral error for stock i on day t. IE = an information event, i.e., the arrival of news. We treat this variable as a dummy =1 on days information is released to the market, and = 0 when no information is released to the market. We do not differentiate between "good" or "bad" news. $\alpha =$ the mean change in the behavioral error attributable to noise traders. $\beta =$ the proportion of the mean change in behavioral error attributable to information traders. We assume $\beta \neq 0$.

The IANM has the advantage over other noise trader type models by being able to isolate the impact of noise traders and information traders. In particular, a variable mu ($\mu = \alpha + \beta$) reflects the mean changes in behavioral error caused by noise traders and information traders. If the Modern Finance Theory EMH is true, then $\alpha + \beta = \mu = 0$ and $\Delta BE_{it} = \varepsilon$. If we relax the assumption the Modern Finance Theory EMH is true, then $\alpha + \beta = \mu \neq 0$. We exploit this relationship in order to differentiate between different types of potential market inefficiencies. In an efficient market information traders would quickly correct noise traders pricing errors. This contrarian investment strategy implies $\alpha = -\beta$.

### Noise Trader Risk on Non-information Days

On non-information release days, $IE_{it} = 0$, the IANM will take the following form:

$$\Delta\, BE_{it} = \alpha + \varepsilon_{it} \qquad (1.2)$$

If alpha is zero, then market efficiency does not change. To the extent alpha is not zero the market becomes behaviorally inefficient. We define a positive alpha as Pure Noise. In this situation, noise traders are increasing stock market inefficiency and distorting prices. This argument is consistent with the large literature[2] supporting the notion that traders may drive prices away from fundamental values. A negative alpha could be interpreted as a "Friedman effect." Noise traders in this situation are trading "as if" they were information traders. By reducing the BE, noise traders are trading in the "correct" direction and "returning" the market to fundamental values.

### Noise Trader Risk on Information Days

On the days that information is released, $IE_{it} = 1$, the model will take the form of Equation (1). A significant beta indicates that noise traders and information traders have differential impacts on the market. Beta shows the impact of information traders on the change in behavioral errors and it will show whether information traders increase or decrease the changes in behavioral errors. The interaction of noise traders and information traders will determine the change in BE on any particular day. Finance theory indicates that information traders should follow contrarian strategies to noise traders. To the extent that this does in fact occur $\alpha + \beta = 0$.

### Inefficient Markets

#### Underreaction

Edwards [1968] uses the concept of conservatism to explain underreaction. Conservatism means that human beings slowly adjust their beliefs with respect to new information. Cutler et al. [1989], Andreassen [1987], Jegadeesh and Titman [1993], Rouwenhorst [1998], Chan [1996] and many others[3] demonstrate that underreaction occurs. Our model explains underreaction as follows: The market does not clear all errors. Information comes to the market and information traders realize that the market is trading at noisy levels, and trade to reduce these errors. The information traders trade in the "correct" direction, but fail to eliminate the errors. This underreaction can be differentiated into two components, positive underreaction U (+) and negative underreaction U (−).

The first type of underreaction is positive underreaction, i.e., U (+), and it will occur when alpha is positive and mu is positive as well. There is an error alpha caused by noise traders, and information traders trade to reduce this error. They fail, however, to eliminate the error, and $\alpha + \beta = \mu > 0$.

When alpha is negative (i.e., $\alpha < 0$, a Friedman effect) information traders will reduce this error by a positive beta amount. To the extent that information traders fail to eliminate the error a negative mu will remain.

The conditions that are required for U (+) to prevail on the market can be written as $\mu$, $\alpha > 0$ and $\beta < 0$. The conditions for U (−) can be written as $\mu$, $\alpha < 0$ and $\beta > 0$.

### Overreaction

Frank [1935], Griffin and Tversky [1992], De Long, Shleifer, Summers and Waldmann (DSSW) [1990] and Odean [1998] wrote about the consequences of overconfidence and show that overconfident traders overreact. In our model, overreaction will occur when information traders adopt a Contrarian Investment Strategy and while trading in the "correct" direction, overestimate the magnitude of the errors. Information traders will move prices away from fundamental values. This overreaction can be differentiated into two components, positive overreaction O (+) and negative overreaction O (−).

Negative overreaction occurs when noise traders are increasing noise levels ($\alpha > 0$) and while information traders following a CIS overestimate the magnitude of the errors. Initially the errors are at alpha level and are decreased by beta (which is a greater amount than the initial noise) leading to a negative mu ($\alpha + \beta = \mu > 0$). Positive overreaction is the converse situation where the alpha was negative and information traders overcompensate leading to a positive mu ($\alpha + \beta = \mu > 0$).

The conditions for negative overreaction can be written as $\alpha > 0$, $\mu < 0$ and $\beta < 0$. On the other hand, positive overreaction will prevail if $\alpha < 0$, $\mu > 0$ and $\beta > 0$.

### Information Pricing Error (IPE)

A serious type of market error occurs when information traders fail to adopt a CIS and so increase the noise level in the market. Under these conditions both alpha and beta will have the same sign. We refer to this type of error as Information Pricing Error (IPE). Similarly to overreaction and underreaction there can be two types of Information Pricing Error, which will depend on the sign of alpha. IPE will occur when information traders copy noise traders' trading technique. They behave as noise traders and add to the existing errors.

Positive IPE, IPE (+), occurs when both alpha and beta are positive. As alpha and beta are of the same sign, information traders have failed to adopt a CIS. Consequently, the noise level in the market is increased ($\alpha + \beta > 0$). Negative Information Pricing Error, IPE (−), occurs where alpha is negative and information traders fail to adopt a CIS ($\alpha + \beta < 0$).

For IPE (+) to occur, $\alpha$ and $\beta > 0$ and for IPE (−) $\alpha$ and $\beta < 0$.

**Table 1.** *Summary of Market Effects*

| Effects | | $\alpha$ | $\beta$ | $\mu$ |
|---|---|---|---|---|
| Underreaction | U(+) | > 0 | < 0 | > 0 |
| | U(−) | < 0 | > 0 | < 0 |
| IPE | IPE (+) | > 0 | > 0 | |
| | IPE (−) | < 0 | < 0 | |
| Overreaction | O (+) | < 0 | > 0 | > 0 |
| | O (−) | > 0 | < 0 | < 0 |

### Summary

Studying the component parts of Equation (1) it is possible, on information days, to identify various market effects. For the market to be behaviorally efficient mu should not be statistically significantly different from zero. On those days that it is significantly different from zero it is possible to identify various effects, namely, underreaction, overreaction and IPE. This framework develops a new method of testing whether the market is behaviorally efficient. It is now feasible to check the hypothesis just by testing if mu is statistically different from zero. If mu is not statistically different from zero, it will be possible to conclude that the market is free from errors and thus the market is efficient. In the event that mu is different from zero, this will give rise to either one of the following effects, underreaction [U (+) or U (−)] or overreaction [O (+) or O (−)] or Information Pricing Error [IPE (+) or IPE (−)]. Table 1 summarizes all the different conditions that are required for any of the above effects to hold.

## Data and Empirical Results

The major challenge in testing the IANM is in deriving the behavioral error, and the subsequent changes in behavioral error. In this section, we make use of the CAPM and differing market indices to derive a measure of that error. We then collect data on information releases and relate those information events to the changes in our measure of behavioral error.

### Misspecified CAPM

As the CAPM does not allow for noise traders, it will generate biased estimates. In other words, according to Shefrin and Statman [1994], the CAPM beta will have a noise trader risk component and an efficient beta (i.e., the behavioral beta). Equation (2) shows the excess return CAPM.

$$\tilde{r}_{it} - \tilde{r}_{ft} = \phi_i + \beta_i^c[\tilde{r}_{mt} - \tilde{r}_{ft}] + \tilde{\varepsilon}_{it} \tag{2}$$

where $\tilde{r}_{it}$ is the asset i's return at time t
$\tilde{r}_{ft}$ is the risk free return at time t

$\tilde{r}_{mt}$ is the return on the market at time t
$\tilde{\varepsilon}_{it}$ is the error term
$\phi_i$ is the intercept of the regression equation ($E(\phi_i) = 0$)
$\beta_i^c$ is the CAPM beta

The CAPM beta ($\beta_i^c$) is misspecified and Equation (2) can be rewritten to include noise trader risk (NTR). Equation (3) decomposes the CAPM beta into two components namely the efficient beta ($\beta_i^B$) and the Behavioral Error ($BE_i$). For the purposes of our discussion, we refer to Equation (3) as the Behavioral Asset Pricing Model (BAPM).

$$\tilde{r}_{it} - \tilde{r}_{ft} = \phi_i + (\beta_i^B + BE_i)[\tilde{r}_{mt} - \tilde{r}_{ft}] + \tilde{\varepsilon}_{it} \tag{3}$$

where $\tilde{r}_{it}$, $\tilde{r}_{ft}$, $\tilde{r}_{mt}$, $\tilde{\varepsilon}_{it}$, and $\phi_i$ are defined as per Equation (2)

$BE_i$ is the Behavioral Error, and is expected to be highly correlated with noise trader risk.
$\beta_i^B$ is the efficient beta, i.e. free from noise trader risk
$(\beta_i^B + BE_i)$ is the CAPM beta $\beta_i^C$

The Behavioral Error can be defined as the difference between the CAPM beta and the BAPM beta. Equation (4) shows the relationship between the efficient beta and the CAPM beta.

$$BE_i = \beta_i^C - \beta_i^B \tag{4}$$

Equation (4) implies the BAPM beta is lower than the CAPM beta by the amount of the behavioral error, which is consistent with Shefrin and Statman [1994].

The CAPM beta can be easily estimated using OLS and Equation (2). The behavioral beta, however, is not easily estimated. Shefrin and Statman [1994] provide some guidance in this regard. They argue that a BAPM should use a different proxy for the "true" market portfolio. Hence the BAPM is similar to the traditional CAPM (Equation (2)), with the exception that a different market portfolio proxy is used. This behavioral proxy should capture the noise traders' investment universe and be composed of stocks they prefer. Another way of looking at this is to say that the BAPM is a model based on "sentiment." Lee, Jiang and Indro [2002] show that excess returns are contemporaneously positively correlated with shifts in sentiment. Brown [1999] investigates a direct measure of investor sentiment using data from the American Association of Individual Investors Sentiment Survey. Unfortunately such data are not available in Australia.

## Data

The data used in the tests were taken from DataStream. All listed firms were initially considered for inclusion in the study. Firms that were delisted, suspended, "died" or where no dividend data could be downloaded were removed from the sample. The daily data cover the period June 22, 1998 to December 31, 2002. There were 90 firms that passed the above test; of the 90 firms studied, 46 were selected for further analysis. Data collection and data entry are very long and costly processes, and as a result only a subset (46 firms) of the 90 companies was investigated. Past announcements[4] on each of these individual stocks were downloaded from the Australian Stock Exchange (ASX) on a daily basis for the period 1999-2002. In addition the Dow Jones Interactive database and Lexis Nexis database were used to investigate the dates these items were reported in the media. In essence the tests here can be considered as semi-strong tests of the EMH. Noise Trader Risk was calculated for the periods of 2000-2002, 2000, 2001 and 2002.

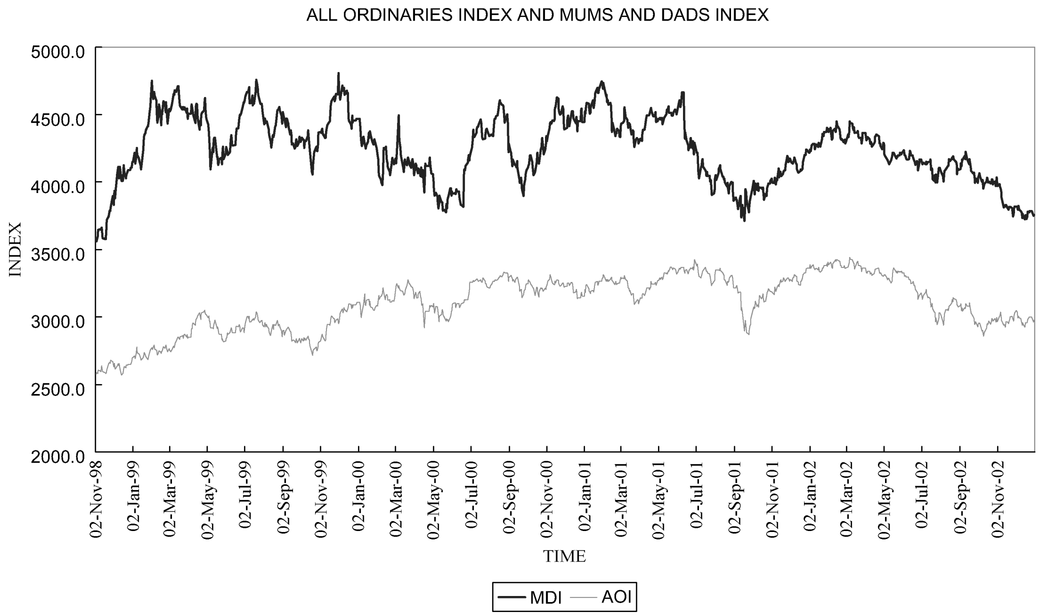
The exclusion of the remaining firms may have resulted in survivorship bias and could probably constitute a downward bias in the beta estimates. This, however, would impact on both the CAPM and BAPM estimates equally and the quality of the results would not be affected.

## Construction of the Behavioral Index

An index that is often employed in the media to denote sentiment is the "Mums and Dads" Index (MDI) developed by Commonwealth Securities (CommSec). We employ this sentiment index as our proxy for the behavioral index. The MDI contains just 10 stocks[5] that are either household names (and some blue-chip companies) or have been subject of demutualization or privatizations. The component stocks are: AMP, Commonwealth Bank, Coles Myer, IAG (ex NRMA), Qantas, Suncorp Metway, TAB, Tabcorp, Telstra and Woolworths. The index got its name as it provided entry point to the share market for many small investors. CommSec constructed this index in 1999 to track the performance of shares held by retail investors.

In order to replicate the MDI, data for the constituent stocks was downloaded from DataStream. The daily market prices (and number of shares) for the 10 firms were downloaded for the period June 22, 1998 to December 31, 2002 with the former as the base period. From June 22, 1998 to August 7, 2000, the index consisted of only nine stocks, as IAG was not listed during that period. All 10 stocks were included for the period August 8, 2000 to December 31, 2002. The inclusion and exclusion of stocks in indices is a problem all indices face and MDI is no different from this perspective. Chow tests were conducted to determine whether

**FIGURE 1**
**Graph of the AOI and MDI**




the inclusion of IAG constitutes a "break point" in the data. The result shows that IAG does not constitute a break point and thus permits the inclusion (exclusion) of IAG.

The MDI was then calculated as per Equation (5).

$$Index_t = \frac{\sum_{i=1}^{10} \left(S_i^* P_{it}\right)}{\sum_{i=1}^{10} \left(S_{i0}^* P_{i0}\right)} * I_o \tag{5}$$

where

$S_i$ is the number of shares outstanding in stock $i$
$S_{i0}$ is the number of shares outstanding at time t = 0
$P_{i0}$ is the price of stock $i$ at time t = 0
$I_0$ is an arbitrary multiplier and is equal to 2500[6]
$i$ is for the 10 companies used in the MDI

To be consistent with the AOI price index, no adjustments were made for dividend distribution, stock splits and right issues in the construction of the MDI.

Figure 1 shows graphs of the All Ordinaries price index and the MDI. It is difficult to (graphically) discern differences in the two indices. The correlation between AOI returns and MDI returns is 0.53.

Table 2 shows the descriptive statistics for the returns on the two different indices. Returns are calculated as the log relatives, $r_{it} = \ln(I_t/I_{t-1})$. In addition to calculating summary statistics for the entire period 1998–2002, annual subperiod summary statistics are also calculated. The difference between the means of the returns, for all the different periods, was tested. Finn and Koivurinne [2000] argue that if it is possible to outperform an index over an extended period, then that benchmark index must be necessarily *ex ante* inefficient. Further, they provide evidence of inefficiency in the AOI. The results here, however, do not appear to indicate that the AOI is inefficient compared to the MDI as the behavioral index return is not statistically higher[7] than the AOI price index return (see Table 2). F-statistics indicate that the variances of the returns on the indices are statistically significantly different (except in 2002). In order to be confident that this result is not simply an artefact of index construction the MDI returns were standardized, i.e., the daily return of the behavioral index was multiplied by mean of the return on AOI and divided by the mean return of the MDI.

The lower variance in the AOI is likely to be attributed to the diversification benefits, i.e., as the number stocks increases variance decreases. Another possible explanation is the irrational behavior of uninformed investors increases volatility. These characteristics, identical mean and higher variance, indicate that the behavioral beta will be lower than CAPM betas.

### Behavioral Error Computation

Daves, Ehrhardt and Kunkel [2000] showed that daily return interval results in the smallest standard error of the beta, i.e., the greatest precision of the beta estimate. Their study also points out that the choice of the estimation period for daily return interval is a dilemma. Levich [1998] recommends a 260-day

**Table 2.** *Descriptive Statistics of the Return on the AOI and Return on the MDI for the Period 1998-2002*

| | **1998-2002** | **1998** | **1999** | **2000** | **2001** | **2002** |
|---|---|---|---|---|---|---|
| | | | Mums And Dads Index | | | |
| Mean | 0.000345 | 0.003665 | 0.000288 | −0.000021 | −0.000202 | −0.000443 |
| Median | 0.000000 | 0.003141 | 0.000014 | −0.000061 | 0.000000 | −0.000619 |
| Standard Deviation | 0.012622 | 0.020517 | 0.012537 | 0.013137 | 0.010728 | 0.007084 |
| Variance | 0.000159 | 0.000421 | 0.000157 | 0.000173 | 0.000115 | 0.000050 |
| Obs | 1181 | 138 | 261 | 260 | 261 | 261 |
| | | | All Ordinaries Index (Price) | | | |
| Mean | 0.000126 | 0.000368 | 0.000544 | 0.000056 | 0.000241 | −0.000466 |
| Median | 0.000030 | 0.000000 | 0.000792 | 0.000208 | 0.000126 | −0.000183 |
| Standard Deviation | 0.008211 | 0.010524 | 0.007826 | 0.008753 | 0.007905 | 0.006856 |
| Variance | 0.000067 | 0.000111 | 0.000061 | 0.000077 | 0.000062 | 0.000047 |
| Obs | 1181 | 138 | 261 | 260 | 261 | 261 |
| | | | Testing if Return on the MDI Differs From Return on the AOI | | | |
| *t*-Test Statistic* | −0.498588 | −1.679747 | 0.279632 | 0.079245 | 0.537022 | −0.035363 |
| *p-Value* | 0.618116 | 0.094146 | 0.779871 | 0.936868 | 0.591482 | 0.971804 |
| | | | Testing if Variance of the MDI Differs From Variance of the AOI | | | |
| *F*-Test Statistic | 2.363003 | 0.263124 | 0.389623 | 0.443938 | 0.542938 | 0.936600 |
| *p*-Value | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000001 | 0.597838 |

*Note:* As returns on MDI and AOI are not independent over the period, the standard errors for the difference between the two means were calculated with the covariance terms.

estimation period based on the Basel Committee beta calculation. Allowing for time-varying betas, we hence use a 260 rolling day window period to estimate daily betas. Each daily beta was calculated using the past 260-day data and rolled forward one day at a time. This method is used to calculate the daily betas for the entire year, and then the beta for the year calculated as an average of the daily betas. The same technique was used to estimate both BAPM and CAPM betas. This technique generates highly correlated and dependent betas, which will bias any statistical testing. Consequently the betas need to be corrected for dependence.

Mitchell [2002] calculates an algebraic formula for the variance of the mean of a set of windowed estimates (for a single company). Let n equal to the number of estimates, and L be the length of the window. If $V_c$ is the sample variance of the windowed estimates, and assuming that the covariance between the estimates of beta is directly proportional to the number of shared observations, then the variance of the mean of these estimates is

$$\mathrm{Var} = \frac{3L(L+1)V_c}{2n^2} + \frac{(n-L)V_c}{n^2} \tag{6}$$

when $n = L$, the actual variance will be reduced to:

$\mathrm{Var} \approx 1.5V_c$

Furthermore as the CAPM betas and the BAPM betas are not independent and the CAPM betas and BAPM betas use the same dependent variables, the standard error will be computed in the following way:

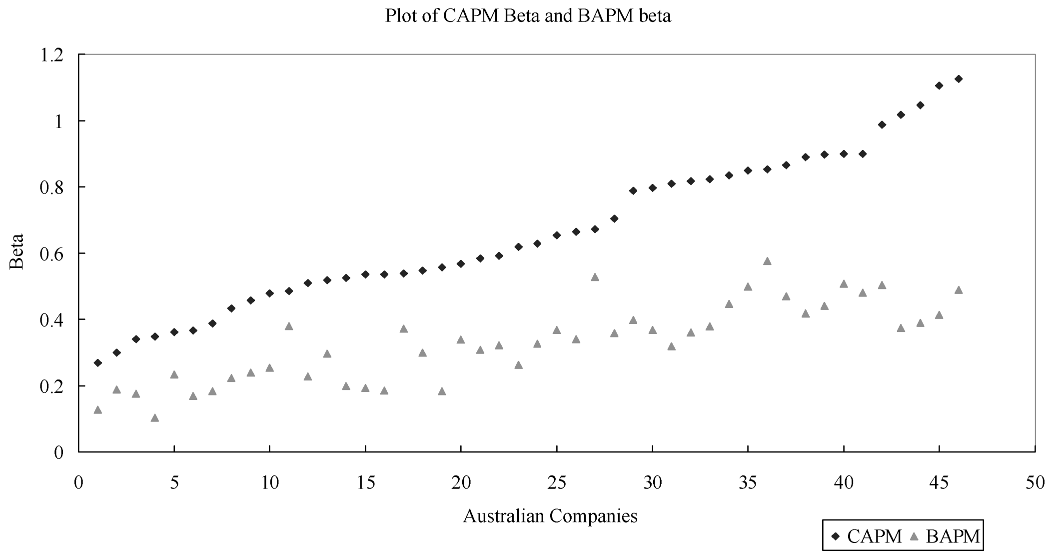
**W** is a matrix that represents the weights of each of the companies, and as there are N companies, and they are all of equal weights, W

$$\mathbf{W} = \left[\frac{1}{N} \cdots\cdots\cdots \frac{1}{N}\right] \qquad \Sigma = \begin{bmatrix} \sigma_1^2 & . & . & . & \sigma_{1,N} \\ \sigma_{1,2} & \sigma_2^2 & & & \\ . & & . & & \\ . & & & . & \\ \sigma_{1,N} & . & . & . & \sigma_N^2 \end{bmatrix}$$

$\Sigma$ is the variance-covariance matrix of a variable across the N different firms. This is a matrix that has the variances of the variable (either BAPM betas, CAPM betas or Behavioral Errors) on each asset down the main diagonal and the covariance's between the firms in the off diagonal positions. The variance of the mean is computed by finding the product of $\mathbf{W}.\Sigma.\mathbf{W}^{-1}$.

We initially provide a visual analysis of our results. We ranked the CAPM betas (for the 1999–2002 period) from smallest to largest and plotted the corresponding behavioral beta in Figure 2. In terms of the discussion we expect the behavioral beta to differ from the CAPM beta. As can be seen from Figure 2, the CAPM beta is usually larger than the BAPM beta, which is consistent with Shefrin and Statman [1994]. Furthermore it appears that the difference between the two models

**FIGURE 2**
**Average BAPM Beta and Average CAPM Beta of 46 Firms for the Period 1999-2002**




is smaller for lower risk companies and increases with the level of risk.

Testing if the behavioral beta values are significantly different from the CAPM beta values is equivalent to testing whether the BEs are significantly different from zero. Table 3 shows that the BEs are not zero in all the different periods and proving that the BAPM beta differs from the CAPM beta. The positive mean values of the BE shown in Table 3 indicate that the BAPM betas are lower than the CAPM betas. The average of the 46 mean CAPM and mean BAPM were tested to see if they were equal to the market beta of one. Both models showed that the averages were below one and the 46 firms were equally weighted.

The empirical evidence shows that the null hypothesis of CAPM betas and BAPM betas being are equal is rejected on a number of occasions. There is a divergence between the two betas suggesting the presence of noise traders. More precisely, the BAPM betas tend to be lower than the CAPM betas and Shefrin and Statman [1994] would suggest that the BAPM betas are more appropriate. The existence of BE also implies that sentiment does affect the Australian market.

**Evidence of Irrationality**

Table 4 shows the mean alpha, mean beta and mean mu across the different firms. Standard errors were adjusted for independence in the computation of the t-statistic. The results show that alpha is positive and significantly different from zero in all the different periods, implying that noise traders were active in the market. Furthermore, MU, the measure of noise trader risk, is positive and significant. On the other hand, information traders (captured by beta) appear to have been active in 2001 only, i.e., this was the only period where they were eliminating the errors. A significant mu can represent either an overreaction or underreaction, or IPE. The firms that displayed inefficiency after information traders' involvement are now investigated on a day-to-day basis and are categorised as either overreaction or underreaction or IPE.

Alpha, beta, mu and the respective t-statistics were computed on a day-to-day basis. Then the sets of conditions summarized in section 2.4.4 were applied to these estimates. These conditions will classify each firm by their respective effects. Table 5, Table 5.1, Table 5.2 and Table 5.3 report the results for the different periods. Table 5 shows the results of the possible effects, i.e., underreaction (positive or negative), IPE (positive or negative) and overreaction (positive or negative) for the period 2000-2002; while the remaining tables, Table 5.1, Table 5.2 and Table 5.3 report the result for 2000, 2001 and 2002, respectively. Table 6 provides a summary of the results.

Over the entire 2000-2002 period, there were 12,273 information days for the 46 companies investigated. This study analyses every single day and checks if the market is efficient, or whether there is some underreaction, IPE or overreaction. Those different effects are then broken down into two parts, namely positive or negative. Table 6 reports the number of O (+), O (−), IPE (+), IPE (−), U (+), U (−) and EMH that have been occurring on the information days. The table also shows the results in the different subperiods.

Overall, the efficient market hypothesis is supported by the data just under 40 percent of the time. Of 12,273 information days, 4,544 days are consistent with the

**Table 3.** *The Descriptive Statistics for the Mean CAPM Beta, Mean BAPM Beta and Mean BE*

| | CAPM BETA | | | | | BAPM BETA | | | | | BE | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Period** | **99-02** | **1999** | **2000** | **2001** | **2002** | **99-02** | **1999** | **2000** | **2001** | **2002** | **99-02** | **1999** | **2000** | **2001** | **2002** |
| Mean | 0.66276 | 0.62247 | 0.58381 | 0.66921 | 0.75643 | 0.33112 | 0.17771 | 0.25806 | 0.34281 | 0.47392 | 0.33164 | 0.44476 | 0.32574 | 0.32640 | 0.28251 |
| Standard Error | 0.08701 | 0.03079 | 0.03242 | 0.09256 | 0.02657 | 0.11966 | 0.03296 | 0.03560 | 0.08685 | 0.05256 | 0.06696 | 0.04772 | 0.02455 | 0.01519 | 0.06700 |
| Median | 0.62354 | 0.63005 | 0.56429 | 0.66559 | 0.71421 | 0.34044 | 0.16617 | 0.25416 | 0.34626 | 0.42134 | 0.32444 | 0.44290 | 0.30148 | 0.30870 | 0.21441 |
| ST. Deviation | 0.59013 | 0.20882 | 0.21986 | 0.62777 | 0.18022 | 0.81157 | 0.22356 | 0.24143 | 0.58907 | 0.35647 | 0.45417 | 0.32368 | 0.16648 | 0.10304 | 0.45441 |
| Kurtosis | −0.86545 | 0.26249 | −0.52823 | −0.62017 | −0.29617 | −0.86260 | 2.13337 | 0.88276 | −0.12314 | 0.27533 | 0.14319 | −0.37311 | 1.32395 | 0.63133 | 4.18863 |
| Skewness | 0.22726 | −0.24407 | 0.32133 | 0.30855 | 0.46618 | 0.03452 | −0.81656 | −0.47292 | 0.29418 | 0.71142 | 0.67055 | 0.35923 | 0.78653 | −0.31183 | 1.61692 |
| Obs | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 |
| T-Stats for Mean = 0 | 7.61712 | 20.21732 | 18.00926 | 7.23008 | 28.46741 | 2.76721 | 5.39115 | 7.24959 | 3.94698 | 9.01702 | 4.95251 | 9.31947 | 13.27022 | 21.48393 | 4.21659 |
| T-Stats for Mean = 1 | −3.87587 | −12.26211 | −12.83876 | −3.57383 | −9.16656 | −5.58984 | −24.94606 | −20.84257 | −7.56664 | −10.00949 | | | | | |

**Table 4.** *The Descriptive statistics for the Mean Alpha, Mean Beta and Mean Mu*

| | ALPHA | | | | BETA | | | | MU | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Period** | **00-02** | **2000** | **2001** | **2002** | **00-02** | **2000** | **2001** | **2002** | **00-02** | **2000** | **2001** | **2002** |
| Mean | 0.22505 | 0.23085 | 0.21428 | 0.23274 | 0.00321 | 0.00399 | 0.00553 | 0.00047 | 0.22624 | 0.23248 | 0.21576 | 0.23341 |
| Standard Error* | 0.01100 | 0.00983 | 0.00240 | 0.00763 | 0.00346 | 0.00272 | 0.00267 | 0.00251 | 0.01157 | 0.01159 | 0.00416 | 0.00833 |
| Median | 0.22696 | 0.18479 | 0.21800 | 0.21765 | 0.00055 | 0.00140 | 0.00062 | 0.00010 | 0.23218 | 0.19301 | 0.22892 | 0.21802 |
| ST. Deviation | 0.07461 | 0.06670 | 0.01625 | 0.05175 | 0.02348 | 0.01845 | 0.01808 | 0.01702 | 0.07846 | 0.07861 | 0.02821 | 0.05650 |
| Obs | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 |
| T-Stats for Mean = 0 | 20.45791 | 23.47307 | 89.41287 | 30.50248 | 0.92625 | 1.46565 | 2.07388 | 0.18731 | 19.55772 | 20.05707 | 51.87418 | 28.01774 |

*Note:* The computation of the standard error and T-statistics were adjusted for interdependence.

**Table 5.** *The Number of Underreaction, IPE and Overreaction for the Period 2000-2002*

| | 2000-2002 | | | | | | | | | 2000-2002 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COMPANIES** | **O(−)** | **O(+)** | **U(+)** | **U(−)** | **IPE (+)** | **IPE (−)** | **EMH** | **Info** | **COMPANIES** | **O(−)** | **O(+)** | **U(+)** | **U(−)** | **IPE (+)** | **IPE (−)** | **EMH** | **Info** |
| AMP DIVR.PR.TRUST | 0 | 6 | 0 | 9 | 0 | 34 | 106 | 155 | HILLS MOTORWAY | 2 | 0 | 14 | 6 | 80 | 8 | 0 | 110 |
| AMP IND. TRUST | 0 | 0 | 3 | 0 | 1 | 0 | 92 | 96 | JUPITERS | 0 | 0 | 88 | 0 | 106 | 0 | 0 | 194 |
| ARMS.JONES OFF. | 0 | 0 | 0 | 0 | 0 | 1 | 12 | 13 | LEND LEASE CORP. | 0 | 0 | 196 | 0 | 168 | 0 | 1 | 365 |
| ANZ | 28 | 21 | 0 | 0 | 3 | 7 | 457 | 516 | MACMAHON HDGS | 0 | 0 | 19 | 0 | 84 | 0 | 23 | 126 |
| AUSPINE | 0 | 3 | 0 | 0 | 0 | 0 | 159 | 162 | MACQUARIE OFF. TR. | 0 | 0 | 177 | 0 | 47 | 0 | 15 | 239 |
| AUST.GAS LIGHT | 119 | 0 | 0 | 0 | 0 | 1 | 238 | 358 | MAYNE NICKLESS | 0 | 0 | 42 | 0 | 215 | 0 | 25 | 282 |
| BRAMBLES IND. | 0 | 255 | 0 | 98 | 30 | 58 | 2 | 443 | MIM | 0 | 0 | 118 | 0 | 159 | 0 | 18 | 295 |
| BRL HARDY | 0 | 27 | 10 | 6 | 41 | 24 | 288 | 396 | NAB | 0 | 0 | 0 | 0 | 154 | 0 | 273 | 427 |
| BHP | 0 | 5 | 0 | 7 | 0 | 0 | 451 | 463 | NEWCREST MNG. | 0 | 0 | 82 | 0 | 4 | 0 | 215 | 301 |
| BURSWOOD | 17 | 0 | 0 | 0 | 0 | 26 | 120 | 163 | OIL SEARCH | 0 | 0 | 142 | 0 | 89 | 0 | 79 | 310 |
| CAPRAL ALUMINIUM | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100 | ORICA | 0 | 0 | 88 | 0 | 46 | 0 | 9 | 143 |
| CARTER H. HARVEY | 6 | 0 | 0 | 0 | 0 | 3 | 86 | 95 | PMP COMM. | 0 | 0 | 36 | 0 | 16 | 0 | 113 | 165 |
| CCI HOLDINGS | 0 | 0 | 0 | 0 | 6 | 2 | 55 | 63 | QBE INSURANCE | 0 | 0 | 130 | 0 | 110 | 0 | 6 | 246 |
| CBA | 0 | 106 | 0 | 6 | 0 | 0 | 515 | 627 | REIN.AUS. | 6 | 0 | 1 | 0 | 50 | 13 | 2 | 72 |
| COCA-COLA AMATIL | 0 | 19 | 0 | 6 | 0 | 0 | 256 | 281 | RIDLEY CORP. | 0 | 0 | 92 | 0 | 41 | 0 | 39 | 172 |
| COLES MYER | 2 | 0 | 0 | 0 | 0 | 2 | 192 | 196 | RIO TINTO | 0 | 0 | 160 | 0 | 480 | 0 | 17 | 657 |
| CSL | 0 | 0 | 267 | 0 | 278 | 0 | 1 | 546 | SABRE GROUP | 0 | 0 | 41 | 0 | 15 | 0 | 6 | 62 |
| CSR | 0 | 0 | 151 | 0 | 149 | 0 | 323 | 623 | SANTOS | 0 | 0 | 206 | 0 | 232 | 0 | 24 | 462 |
| ENERGY DEV. | 0 | 0 | 67 | 0 | 60 | 0 | 47 | 174 | SEVEN NETWORK | 0 | 0 | 84 | 0 | 61 | 0 | 7 | 152 |
| GAZAL CORP. | 0 | 0 | 31 | 0 | 58 | 0 | 0 | 89 | STRATEGIC P. DEV. | 0 | 6 | 11 | 9 | 45 | 5 | 2 | 78 |
| GENERAL PR.TST. | 0 | 0 | 0 | 0 | 142 | 0 | 113 | 255 | TELEVISION & MEDIA | 0 | 0 | 156 | 0 | 61 | 0 | 21 | 238 |
| GOODMAN FIELDER | 0 | 0 | 144 | 0 | 382 | 0 | 1 | 527 | WESTERN METALS | 0 | 0 | 59 | 0 | 159 | 0 | 21 | 239 |
| HARVEY NORMAN | 0 | 0 | 73 | 0 | 70 | 0 | 14 | 157 | TAB LIMITED | 0 | 0 | 155 | 0 | 285 | 0 | 0 | 440 |

**Table 5.1.** *The number of Underreaction, IPE and Overreaction for the Period 2000*

| | 2000 | | | | | | | | | 2000 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COMPANIES** | **O(−)** | **O(+)** | **U(+)** | **U(−)** | **IPE (+)** | **IPE (−)** | **EMH** | **Info** | **COMPANIES** | **O(−)** | **O(+)** | **U(+)** | **U(−)** | **IPE (+)** | **IPE (−)** | **EMH** | **Info** |
| AMP DIVR.PR.TRUST | 0 | 0 | 0 | 0 | 0 | 0 | 37 | 37 | HILLS MOTORWAY | 0 | 0 | 0 | 0 | 27 | 0 | 0 | 27 |
| AMP IND. TRUST | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 17 | JUPITERS | 0 | 0 | 0 | 0 | 33 | 0 | 0 | 33 |
| ARMS.JONES OFF. | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | LEND LEASE CORP. | 0 | 0 | 2 | 0 | 98 | 0 | 0 | 100 |
| ANZ | 0 | 0 | 0 | 0 | 0 | 0 | 103 | 103 | MACMAHON HDGS | 0 | 0 | 19 | 0 | 18 | 0 | 3 | 40 |
| AUSPINE | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 38 | MACQUARIE OFF. TR. | 0 | 0 | 20 | 0 | 13 | 0 | 15 | 48 |
| AUST.GAS LIGHT | 0 | 0 | 0 | 0 | 0 | 0 | 76 | 76 | MAYNE NICKLESS | 0 | 0 | 21 | 0 | 26 | 0 | 0 | 47 |
| BRAMBLES IND. | 0 | 91 | 0 | 2 | 0 | 0 | 1 | 94 | MIM | 0 | 0 | 63 | 0 | 0 | 0 | 0 | 63 |
| BRL HARDY | 0 | 25 | 0 | 0 | 9 | 0 | 75 | 109 | NAB | 0 | 0 | 0 | 0 | 2 | 0 | 85 | 87 |
| BHP | 0 | 0 | 0 | 0 | 0 | 0 | 83 | 83 | NEWCREST MNG. | 0 | 0 | 0 | 0 | 0 | 0 | 49 | 49 |
| BURSWOOD | 0 | 0 | 0 | 0 | 0 | 0 | 34 | 34 | OIL SEARCH | 0 | 0 | 44 | 0 | 1 | 0 | 4 | 49 |
| CAPRAL ALUMINIUM | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 21 | ORICA | 0 | 0 | 3 | 0 | 20 | 0 | 9 | 32 |
| CARTER H. HARVEY | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 20 | PMP COMM. | 0 | 0 | 0 | 0 | 3 | 0 | 27 | 30 |
| CCI HOLDINGS | 0 | 0 | 0 | 0 | 6 | 0 | 5 | 11 | QBE INSURANCE | 0 | 0 | 47 | 0 | 4 | 0 | 2 | 53 |
| CBA | 0 | 0 | 0 | 0 | 0 | 0 | 132 | 132 | REIN.AUS. | 0 | 0 | 0 | 0 | 38 | 0 | 0 | 38 |
| COCA-COLA AMATIL | 0 | 0 | 0 | 0 | 0 | 0 | 52 | 52 | RIDLEY CORP. | 0 | 0 | 1 | 0 | 19 | 0 | 0 | 20 |
| COLES MYER | 0 | 0 | 0 | 0 | 0 | 0 | 41 | 41 | RIO TINTO | 0 | 0 | 18 | 0 | 120 | 0 | 0 | 138 |
| CSL | 0 | 0 | 13 | 0 | 88 | 0 | 0 | 101 | SABRE GROUP | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 10 |
| CSR | 0 | 0 | 70 | 0 | 21 | 0 | 43 | 134 | SANTOS | 0 | 0 | 22 | 0 | 64 | 0 | 0 | 86 |
| ENERGY DEV. | 0 | 0 | 16 | 0 | 0 | 0 | 0 | 16 | SEVEN NETWORK | 0 | 0 | 0 | 0 | 33 | 0 | 7 | 40 |
| GAZAL CORP. | 0 | 0 | 0 | 0 | 17 | 0 | 0 | 17 | STRATEGIC P. DEV. | 0 | 6 | 0 | 6 | 3 | 1 | 2 | 18 |
| GENERAL PR.TST. | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 15 | TELEVISION & MEDIA | 0 | 0 | 37 | 0 | 10 | 0 | 0 | 47 |
| GOODMAN FIELDER | 0 | 0 | 1 | 0 | 99 | 0 | 0 | 100 | WESTERN METALS | 0 | 0 | 31 | 0 | 20 | 0 | 0 | 51 |
| HARVEY NORMAN | 0 | 0 | 16 | 0 | 13 | 0 | 14 | 43 | TAB LIMITED | 0 | 0 | 26 | 0 | 40 | 0 | 0 | 66 |

**Table 5.2.** *The Number of Underreaction, IPE and Overreaction for the Period 2001*

| | 2001 | | | | | | | | | 2001 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COMPANIES** | **O(−)** | **O(+)** | **U(+)** | **U(−)** | **IPE (+)** | **IPE (−)** | **EMH** | **Info** | **COMPANIES** | **O(−)** | **O(+)** | **U(+)** | **U(−)** | **IPE (+)** | **IPE (−)** | **EMH** | **Info** |
| AMP DIVR.PR.TRUST | 0 | 0 | 0 | 0 | 0 | 0 | 47 | 47 | HILLS MOTORWAY | 2 | 0 | 0 | 6 | 17 | 8 | 0 | 33 |
| AMP IND. TRUST | 0 | 0 | 3 | 0 | 1 | 0 | 39 | 43 | JUPITERS | 0 | 0 | 43 | 0 | 4 | 0 | 0 | 47 |
| ARMS.JONES OFF. | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 7 | LEND LEASE CORP. | 0 | 0 | 68 | 0 | 69 | 0 | 0 | 137 |
| ANZ | 0 | 21 | 0 | 0 | 3 | 1 | 186 | 211 | MACMAHON HDGS | 0 | 0 | 0 | 0 | 44 | 0 | 0 | 44 |
| AUSPINE | 0 | 0 | 0 | 0 | 0 | 0 | 59 | 59 | MACQUARIE OFF. TR. | 0 | 0 | 56 | 0 | 31 | 0 | 0 | 87 |
| AUST.GAS LIGHT | 18 | 0 | 0 | 0 | 0 | 0 | 102 | 120 | MAYNE NICKLESS | 0 | 0 | 19 | 0 | 71 | 0 | 25 | 115 |
| BRAMBLES IND. | 0 | 143 | 0 | 0 | 30 | 0 | 0 | 173 | MIM | 0 | 0 | 39 | 0 | 39 | 0 | 18 | 96 |
| BRL HARDY | 0 | 2 | 10 | 1 | 32 | 16 | 156 | 217 | NAB | 0 | 0 | 0 | 0 | 68 | 0 | 82 | 150 |
| BHP | 0 | 1 | 0 | 7 | 0 | 0 | 191 | 199 | NEWCREST MNG. | 0 | 0 | 0 | 0 | 4 | 0 | 91 | 95 |
| BURSWOOD | 15 | 0 | 0 | 0 | 0 | 0 | 53 | 68 | OIL SEARCH | 0 | 0 | 39 | 0 | 4 | 0 | 64 | 107 |
| CAPRAL ALUMINIUM | 0 | 0 | 0 | 0 | 0 | 0 | 40 | 40 | ORICA | 0 | 0 | 27 | 0 | 21 | 0 | 0 | 48 |
| CARTER H. HARVEY | 0 | 0 | 0 | 0 | 0 | 0 | 29 | 29 | PMP COMM. | 0 | 0 | 4 | 0 | 13 | 0 | 62 | 79 |
| CCI HOLDINGS | 0 | 0 | 0 | 0 | 0 | 2 | 32 | 34 | QBE INSURANCE | 0 | 0 | 49 | 0 | 52 | 0 | 4 | 105 |
| CBA | 0 | 106 | 0 | 6 | 0 | 0 | 137 | 249 | REIN.AUS. | 0 | 0 | 0 | 0 | 12 | 1 | 2 | 15 |
| COCA-COLA AMATIL | 0 | 0 | 0 | 0 | 0 | 0 | 112 | 112 | RIDLEY CORP. | 0 | 0 | 35 | 0 | 1 | 0 | 29 | 65 |
| COLES MYER | 2 | 0 | 0 | 0 | 0 | 0 | 74 | 76 | RIO TINTO | 0 | 0 | 142 | 0 | 117 | 0 | 0 | 259 |
| CSL | 0 | 0 | 44 | 0 | 163 | 0 | 0 | 207 | SABRE GROUP | 0 | 0 | 16 | 0 | 4 | 0 | 6 | 26 |
| CSR | 0 | 0 | 81 | 0 | 128 | 0 | 40 | 249 | SANTOS | 0 | 0 | 1 | 0 | 152 | 0 | 24 | 177 |
| ENERGY DEV. | 0 | 0 | 19 | 0 | 12 | 0 | 42 | 73 | SEVEN NETWORK | 0 | 0 | 49 | 0 | 0 | 0 | 0 | 49 |
| GAZAL CORP. | 0 | 0 | 12 | 0 | 26 | 0 | 0 | 38 | STRATEGIC P. DEV. | 0 | 0 | 4 | 3 | 23 | 4 | 0 | 34 |
| GENERAL PR.TST. | 0 | 0 | 0 | 0 | 113 | 0 | 24 | 137 | TELEVISION & MEDIA | 0 | 0 | 76 | 0 | 12 | 0 | 0 | 88 |
| GOODMAN FIELDER | 0 | 0 | 42 | 0 | 154 | 0 | 0 | 196 | WESTERN METALS | 0 | 0 | 12 | 0 | 84 | 0 | 1 | 97 |
| HARVEY NORMAN | 0 | 0 | 38 | 0 | 43 | 0 | 0 | 81 | TAB LIMITED | 0 | 0 | 15 | 0 | 165 | 0 | 0 | 180 |

**Table 5.3.** *The Number of Underreaction, IPE and Overreaction for the Period 2002*

| | 2002 | | | | | | | | | 2002 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COMPANIES** | **O(−)** | **O(+)** | **U(+)** | **U(−)** | **IPE (+)** | **IPE (−)** | **EMH** | **Info** | **COMPANIES** | **O(−)** | **O(+)** | **U(+)** | **U(−)** | **IPE (+)** | **IPE (−)** | **EMH** | **Info** |
| AMP DIVR.PR.TRUST | 0 | 6 | 0 | 9 | 0 | 34 | 22 | 71 | HILLS MOTORWAY | 0 | 0 | 14 | 0 | 36 | 0 | 0 | 50 |
| AMP IND. TRUST | 0 | 0 | 0 | 0 | 0 | 0 | 36 | 36 | JUPITERS | 0 | 0 | 45 | 0 | 69 | 0 | 0 | 114 |
| ARMS.JONES OFF. | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | LEND LEASE CORP. | 0 | 0 | 126 | 0 | 1 | 0 | 1 | 128 |
| ANZ | 28 | 0 | 0 | 0 | 0 | 6 | 168 | 202 | MACMAHON HDGS | 0 | 0 | 0 | 0 | 22 | 0 | 20 | 42 |
| AUSPINE | 0 | 3 | 0 | 0 | 0 | 0 | 62 | 65 | MACQUARIE OFF. TR. | 0 | 0 | 101 | 0 | 3 | 0 | 0 | 104 |
| AUST.GAS LIGHT | 101 | 0 | 0 | 0 | 0 | 1 | 60 | 162 | MAYNE NICKLESS | 0 | 0 | 2 | 0 | 118 | 0 | 0 | 120 |
| BRAMBLES IND. | 0 | 21 | 0 | 96 | 0 | 58 | 1 | 176 | MIM | 0 | 0 | 16 | 0 | 120 | 0 | 0 | 136 |
| BRL HARDY | 0 | 0 | 0 | 5 | 0 | 8 | 57 | 70 | NAB | 0 | 0 | 0 | 0 | 84 | 0 | 106 | 190 |
| BHP | 0 | 4 | 0 | 0 | 0 | 0 | 177 | 181 | NEWCREST MNG. | 0 | 0 | 82 | 0 | 0 | 0 | 75 | 157 |
| BURSWOOD | 2 | 0 | 0 | 0 | 0 | 26 | 33 | 61 | OIL SEARCH | 0 | 0 | 59 | 0 | 84 | 0 | 11 | 154 |
| CAPRAL ALUMINIUM | 0 | 0 | 0 | 0 | 0 | 0 | 39 | 39 | ORICA | 0 | 0 | 58 | 0 | 5 | 0 | 0 | 63 |
| CARTER H. HARVEY | 6 | 0 | 0 | 0 | 0 | 3 | 37 | 46 | PMP COMM. | 0 | 0 | 32 | 0 | 0 | 0 | 24 | 56 |
| CCI HOLDINGS | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 18 | QBE INSURANCE | 0 | 0 | 34 | 0 | 54 | 0 | 0 | 88 |
| CBA | 0 | 0 | 0 | 0 | 0 | 0 | 246 | 246 | REIN.AUS. | 6 | 0 | 1 | 0 | 0 | 12 | 0 | 19 |
| COCA-COLA AMATIL | 0 | 19 | 0 | 6 | 0 | 0 | 92 | 117 | RIDLEY CORP. | 0 | 0 | 56 | 0 | 21 | 0 | 10 | 87 |
| COLES MYER | 0 | 0 | 0 | 0 | 0 | 2 | 77 | 79 | RIO TINTO | 0 | 0 | 0 | 0 | 243 | 0 | 17 | 260 |
| CSL | 0 | 0 | 210 | 0 | 27 | 0 | 1 | 238 | SABRE GROUP | 0 | 0 | 15 | 0 | 11 | 0 | 0 | 26 |
| CSR | 0 | 0 | 0 | 0 | 0 | 0 | 240 | 240 | SANTOS | 0 | 0 | 183 | 0 | 16 | 0 | 0 | 199 |
| ENERGY DEV. | 0 | 0 | 32 | 0 | 48 | 0 | 5 | 85 | SEVEN NETWORK | 0 | 0 | 35 | 0 | 28 | 0 | 0 | 63 |
| GAZAL CORP. | 0 | 0 | 19 | 0 | 15 | 0 | 0 | 34 | STRATEGIC P. DEV. | 0 | 0 | 7 | 0 | 19 | 0 | 0 | 26 |
| GENERAL PR.TST. | 0 | 0 | 0 | 0 | 29 | 0 | 74 | 103 | TELEVISION & MEDIA | 0 | 0 | 43 | 0 | 39 | 0 | 21 | 103 |
| GOODMAN FIELDER | 0 | 0 | 101 | 0 | 129 | 0 | 1 | 231 | WESTERN METALS | 0 | 0 | 16 | 0 | 55 | 0 | 20 | 91 |
| HARVEY NORMAN | 0 | 0 | 19 | 0 | 14 | 0 | 0 | 33 | TAB LIMITED | 0 | 0 | 114 | 0 | 80 | 0 | 0 | 194 |

**Table 6.** *Number of Overreactions, IPE and Underreactions Across the 46 Firms on the Information Days*

| | 2000-2002 | | | 2000 | | | 2001 | | | 2002 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Number** | **Percentage** | **Z-Test**† | **Number** | **Percentage** | **Z-Test**† | **Number** | **Percentage** | **Z-Test**† | **Number** | **Percentage** | **Z-Test**† |
| Overreaction | 628 | 5.12% | 0.588 | 122 | 4.94% | −0.139 | 310 | 6.46% | 4.117* | 196 | 3.92% | −3.953 |
| O (+) | 448 | 3.65% | −7.973 | 122 | 4.94% | −0.139 | 273 | 5.69% | 2.063* | 53 | 1.06% | −27.239 |
| O (−) | 180 | 1.47% | −32.562 | 0 | 0.00% | N/A | 37 | 0.77% | −33.486 | 143 | 2.86% | −9.100 |
| Underreaction | 2990 | 24.36% | 49.970* | 488 | 19.76% | 18.420* | 966 | 20.13% | 26.141* | 1536 | 30.69% | 39.406* |
| U (+) | 2843 | 23.16% | 47.699* | 480 | 19.43% | 18.128* | 943 | 19.65% | 25.543* | 1420 | 28.37% | 36.678* |
| U (−) | 147 | 1.20% | −38.721 | 8 | 0.32% | −40.902 | 23 | 0.48% | −45.336 | 116 | 2.32% | −12.612 |
| Information Pricing Error | 4111 | 33.50% | 66.887* | 846 | 34.25% | 30.634* | 1744 | 36.35% | 45.144* | 1521 | 30.39% | 39.053* |
| IPE (+) | 3927 | 32.00% | 64.117* | 845 | 34.21% | 30.601* | 1712 | 35.68% | 44.363* | 1370 | 27.37% | 35.499* |
| IPE (−) | 184 | 1.50% | −31.914 | 1 | 0.04% | −122.525 | 32 | 0.67% | −36.875 | 151 | 3.02% | −8.202 |
| Total Inefficient Days | 7729 | 62.98% | 133.012* | 1456 | 58.95% | 54.502* | 3020 | 62.94% | 83.104* | 3253 | 65.00% | 88.984* |
| EMH | 4544 | 37.02% | 73.473* | 1014 | 41.05% | 36.424* | 1778 | 37.06% | 45.977* | 1752 | 35.00% | 44.503* |
| Information Days | 12273 | 100.00% | | 2470 | 100.00% | | 4798 | 100.00% | | 5005 | 100.00% | |

*Note:* Significant at 1% Level of Confidence.
† Testing if the proportion is greater than 5% (Z-Statistics).

EMH being 'true' over the period 2000-2002. Noise traders appear to be present in the market 60% of the time. That 60% can be split into 5% overreaction, 25% underreaction and around 35% of IPE.

Any effect that is around 5% could be argued to be simply a TYPE I error, and consequently a test of proportion was carried out to see if the proportion is statistically greater than 5% (TYPE I error). Table 6 shows that the Z-statistics for all the different effects and across the different periods. The Z-statistics reject the hypothesis that our results are due to a TYPE I error.

## Conclusion

The purpose of this paper was to develop a model that captures and explains risk generated by noise traders. The theoretical model (IANM) proposed demonstrates that the aim of this study has been achieved. Furthermore the methodology provides a test of market efficiency.

The results contradict the traditional finance school of thought in various areas but are consistent with the behavioral theories. There is confirmation that noise traders were present in the Australian market in some periods. Their influence on the market took different forms, namely overreaction, underreaction and the IPE. On the other hand, the study of beta confirms the existence of some information trading on the basis of noise.

Another conclusion that can be drawn out of this study is that the Australian traders tend to underreact rather than overreact, implying that the market displays slow adjustments to new information rather than overconfidence.

## Acknowledgements

We thank Pravna Appadoo and Marie-Anne Cam for their research assistance. Previous versions of this paper have been presented at seminars at RMIT University and Politecnico Di Milano. Conference presentations include the Australian Conference of Economists, the Australasian Finance and Banking Conference, the Global Finance Conference and the AIBF Banking and Finance Conference. We thank participants for their comments

## Notes

1. This view is based on Shefrin and Statman's [1994] definition of a market being behaviorally efficient if and only if behavioral errors average to zero and are uncorrelated to wealth.
2. Keynes [1936], Lewellen, Schlarbaum and Lease [1974], Shiller [1979], [1981], [1984], Arrow [1985], Black [1986], Poterba and Summers [1988], Fama and French [1988], DSSW [1990], Shefrin and Statman (1994), Brown [1999] and many others.
3. Bernard [1992], Abarbanell, Bernard and Victor [1992], and Mendenhall and Richard [1991].
4. These announcements include Activities Report; Results of AGM; Annual reports; Employee Share Options; Progress Reports; Asset Acquisitions; Dividend Rate; Changes in Management; Changes in Substantial Shareholding; and any other announcements that might potentially move stock prices.
5. It initially started with 12 stocks but only 10 remained active. The two other stocks (Colonial and Telstra 2) have been absorbed into other components.
6. The arbitrary value of 2500 was chosen for scaling purposes in order for the MDI to be of the same scale as the AOI.
7. Except for 1998.

## References

Abarbanell, J., S. Bernard, and L. Victor. "Test of Analysts Overreaction/Underreaction to Earnings Information as an Explanation for Anomalous Stock Price Behavior." *The Journal of Finance*, 47, (1992), pp. 1181–1207.

Andreassen, P. "On the Social Psychology of the Stock Market: Aggregate Attributional Effects and the Repressiveness of Prediction." *Journal of Personality and Social Psychology*, 53, (1987), pp. 490–496.

Arrow, K. J. "Informational Structure of the Firm." *The American Economic Review*, 75, (1985), pp. 303–308.

Bernard, V. "Stock Price Reactions to Earnings Announcements." In R. Thaler, eds., *Advances in Behavioral Finance*. New York: Russell Sage Foundation, (1992), pp. 303–340.

Black, F. "Noise." *The Journal of Finance*, 3, (1986), pp. 529–543.

Brown, G. "Volatility, Sentiment and Noise Traders." *Financial Analyst Journal*, 2, (1999), pp. 82–90.

Chan, L.N. Jegadeesh, "*Momentum* Strategies." *The Journal of Finance*, 51, (1996), pp. 1681 and J. Lakonishok–1713.

Cutler, D., J.M. Poterba, and L.H. Summers. "What Moves Stock Prices." *The Journal of Portfolio Management*, Spring (1989), pp. 4–12.

Daves, E., and R. Kunkel. "Estimating Systematic Risk: The Choice of Return Interval and Estimation Period. *The Journal of Financial and Strategic Decisions*, 13, (2000).

Daves, P., M., Ehrhardt, and R. Kunkel. "Estimating Systematic risk: The Choice of Return Interval and estimation period." The Journal of Financial and Strategic Decisions, 13, (2000), pp. 7–13.

De Bondt W.F.M., and R.H. Thaler. "Does Stock Market Overreact?" *The Journal of Finance*, 3, (1985), pp. 793–807

De Long, J.B., A. Shleifer, L. Summers, and J.R. Waldmann. "Noise Trader Risks in Financial Markets." *Journal of Political Economy*, 4, (1990), pp. 703–738.

Edwards, W. "Conservatism in Human Information Processing." In B. Kleinmutz, eds., *Formal Representation of Human Judgment*. New York: John Wiley and Sons, (1968), pp. 17–52.

Fama, E.F., and K.R. French. "Permanent and Temporary Components of Stock Prices." *Journal of Political Economy*, 96, (1988), pp. 246–273.

Frank, J.D. "Some Psychological Determinants of the Level of Aspiration." *American Journal of Psychology,* 47, (1935), pp. 285–293.

Griffin D., and A. Tversky. "The Weighting of Evidence and Determinants of Confidence." *Cognitive Psychology*, 24, (1992), pp. 411–435.

Jegadeesh, N., and S. Titman. "Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency." *The Journal of Finance,* 48, (1993), pp. 65–91.

Keynes, J.M. *The General Theory of Employment, Interest and Money*. New York: Harcourt, Brace and Co., (1993).

Lee, W., C. Jiang, and D. Indro. "Stock Market Volatility, Excess Returns, and The Role of Investor Sentiment." *Journal of Banking and Finance*, 26, (2002), pp. 2277–2299.

Levich, M.R. *International Financial Markets, Prices and Policies*. New York: McGraw-Hill International Edition, (1998).

Lewellen, W.G., G.E. Schlarbaum, and R.C. Lease. "The Individual Investor: Attributes and Attitudes." *Journal of Finance,* 29, (1974), pp. 413–433.

Mitchell, H. Personal Communication, (2002).

Mendenhall, R. "Evidence on the Possible Underweighting of Earnings-Related Information." *Journal of Accounting Research*, 29, (1991), pp. 170–179.

Odean, T. "Volume, Volatility, Price, and Profit When All Traders Are Above Average." *The Journal of Finance*, 53, (1998), pp. 1887–1934.

Poterba, J.M., and L.H. Summers. "Mean Reversion in Stock Prices: Evidence and Implications." *Journal of Financial Economics*, 22, (1988), pp. 27–59.

Rouwenhorst, K. G. "International Momentum Strategies." *The Journal of Finance,* 53, (1998), pp. 267–284.

Shefrin, H., and M. Statman. "Behavioral Capital Asset Pricing Theory." *Journal of Financial and Quantitative Analysis*, 29, (1994), pp. 323–349.

Shiller, J.R. "The Volatility of Long-Term Interest Rates and Expectations Models of the Term-Structure." *Journal of Political Economy*, 87, (1979), pp. 1190–1219.

Shiller, J.R. "Do Stock Prices Move Too Much To Be Justified by Subsequent Movements in Dividends?" *American Economic Review*, 71, (1981), pp. 421–436.

Shiller, J.R. "Stock Prices and Social Dynamics." *The Brookings Papers on Economic Activity*, 2, (1984), pp. 457–510.