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CONSERVATISM BIAS CAN CAUSE ASSET PRICE OVERREACTION IN A COMPETITIVE SECURITIES MARKET

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Abstract

In the literature, it is not uncommon to view conservatism bias as a cause of asset price underreaction to new information, however, so far, no paper has suggested that conservatism bias could also cause asset price overreaction to new information. This paper constructs an equilibrium model of a competitive securities market to explain that conservatism bias is capable of generating asset price overreaction in addition to underreaction to new information.

Keywords: conservatism bias, asset price overreaction and underreaction to new information, behavioural model, competitive securities market.

Conservatism Bias Can Cause Asset Price Overreaction in a Competitive Securities Market

In recent empirical finance literature, a large body of articles have identified asset price underreaction to new information with some attributing conservatism bias to the cause of asset price underreaction to new information. The phenomenon of conservatism was identified in experiments by Edwards (1968), who analyzed a subject's reaction to new evidence relative to that of an idealized rational Bayesian. He found that an individual updated his or her posteriors in the correct direction, but not far enough relative to rational Bayesian. Barberis et al. (1998) suggest that investors exhibit conservatism and that they underreact to new information by not updating their beliefs adequately due to their conservatism biases. In their paper, investors' conservatism bias is the driving force for the asset price underreaction to new information to occur. In the literature, it is not uncommon to view conservatism bias as a cause of asset price underreaction to new information. Furthermore, no paper has suggested that conservatism bias can lead the asset price to overreact to new information.

This paper explores theoretically how conservatism bias can cause asset price overreaction in addition to underreaction to new information. Note that this paper does not attempt to explain the empirical anomaly of asset price underreaction or overreaction to new information. Instead, it focuses on demonstrating that conservatism bias is capable of generating asset price overreaction to new information in the competitive securities market. Specifically, this paper builds a one period equilibrium model of a competitive security market with two types of assets: A risk-free asset and a risky asset. The payoff for the risk-free asset is always one and the payoff for the risky asset is unknown. Before any trading takes place, an information signal about the risky asset's payoff is revealed to all traders. There are three types of traders in the market: Rational traders, conservatism traders, and noise traders. Rational traders and conservatism traders have the same prior beliefs about the mean and variance of risky asset's payoff. However, relative to rational traders, conservatism traders are slow to update their prior beliefs after receiving new information. Noise or liquidity traders are assumed to exist to provide liquidity to the market. In other words, their total demand for the risky asset is assumed to be random.

In this competitive securities market, if conservatism traders trade on the opposite direction to rational traders or trade on the same direction to rational traders but do so less aggressively, then the asset price underreaction to new information will occur. However, depending on whether noise traders are net buyers or sellers of the risky asset and on the realization of the information signal, conservatism traders can trade on the same side of the market as rational traders, and do so more aggressively. This results in the occurrence of the risky asset price overreaction to new information.

For the sake of the following discussion, an information signal is defined as good news (bad news) if it is above (below) the expected payoff of the risky asset. Furthermore, based on how far the information signal is above (below) the expected payoff of the risky asset, good news (bad news) is classified into three types of good news (bad news): Mildly good news (mildly bad news), very good news (very bad news), and extremely good news (extremely bad news). Among the three types of good news (bad news), the closest to the expected payoff of the risky asset is mildly good news (mildly bad news), while very good news (very bad news) is the second closest to the expected payoff of the risky asset, and extremely good news (extremely bad news) is the furthest from the expected payoff of the risky asset.

Due to their conservatism biases, conservatism traders have a lower (higher) conditional mean about the risky asset's payoff than rational traders when an informational signal indicates good news (bad news); and furthermore, conservatism traders always have a higher conditional variance about the risky asset's payoff than rational traders regardless of the informational signal being good news or bad news.

If the noise traders are net sellers of the risky asset, the risky asset price underreacts to all types of good news. This is true because, in the case of noise traders being net sellers of the risky asset, in responding to all types of good news, rational traders view the risky asset as undervalued and consequently buy the risky asset (due to rational traders having a higher conditional mean about the risky asset's payoff than conservatism traders). On the other hand, conservatism traders can either buy or sell the risky asset. If conservatism traders do buy the risky asset, they will not take as big a position as rational traders do. This is true because conservatism traders have a smaller conditional mean and a bigger conditional variance about the risky asset's payoff than rational traders. Therefore, regardless of conservatism traders buying or selling the risky asset, the risky asset price will not go as high as it would, if there were an absence of conservatism traders. This is the asset price underreaction to all good news.

However, if noise traders are net buyers of the risky asset, the risky asset price can overreact to some types of good news and underreact to others. Specifically, in the case of noise traders being net buyers of the risky asset, conservatism traders always sell the risky asset in responding to all types of good news. This is true because conservatism traders have a smaller conditional mean about the risky asset's payoff than rational traders, as a result, conservatism traders view the risky asset as overvalued. But conservatism traders can sell the risky asset more or less aggressively than rational traders do, depending on the type of good news. On the other hand, rational traders trade differently in response to different types of good news. In responding to mildly good news, rational traders view the risky asset as overvalued and sell the risky asset, but conservatism traders sell the risky asset less aggressively than rational traders. Consequently, the risky asset price will not be driven as low as it would if there were an absence of conservatism traders. In this case, the risky asset price underreacts to the mildly good news. However, conservatism traders will sell the risky asset more aggressively than rational traders, if the information signal suggests very good news better than the mildly good news.[1] It is conservatism traders' aggressively selling the risky asset on the same side of the market as rational traders that drives the risky asset price lower than if there were an absence of conservatism traders. This is the risky asset price overreaction to this type of good news.

If the information signal suggests extremely good news while noise traders are net buyers of the risky asset, rational traders (who have a much higher conditional mean about the risky asset's payoff than conservatism traders) will view the risky asset as undervalued and buy the risky asset, but conservatism traders will still sell the risky asset in responding to the extremely good news. Here, conservatism traders' trading the risky asset on the opposite direction to rational traders causes the risky asset price underreaction to the extremely good news.

Similar intuitions apply to how the risky asset price reacts to bad news. Hence, if noise traders are net buyers of the risky asset, the risky asset price underreacts to all types of bad news. However, if noise traders are net sellers of the risky asset, the risky asset price can overreact to some types of bad news and underreact to others.

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[1] The reason that conservatism traders sell the risky asset from less to more aggressively as the information signal changes from mildly good news to very good news is as follows: due to their conservatism biases, in responding to good news, conservatism traders have a smaller conditional mean and bigger conditional variance about the risky asset's payoff than rational traders. These two factors affect the conservatism traders' demand for risky asset on the opposite directions. The net impact of these two factors on the demand for the risky asset from conservatism traders relative to the demand for the risky asset from rational traders depends on the realization of the information signal. If the information signal is mildly good news, conservatism traders take a smaller short position for the risky asset than that taken by rational traders. If the information signal is very good news, conservatism traders take a bigger short position than that taken by rational traders.

Asset price overreaction to new information is also well documented in a large body of empirical work along with asset price underreaction to new information. Asset price underreaction and overreaction to new information are regarded as anomalies. They are not consistent with efficient market theory nor can they be explained by rational asset pricing theory in the literature. A few of articles with behavioral models have addressed this issue. These articles use psychological evidence (namely, behavioral biases) to explain asset price underreaction and overreaction to new information. For example, Daniel et al. (1998) use overconfidence and self-attribution biases to explain the causes of market underreaction and overreaction. In other words, self-attribution bias can raise investors' confidence through the confirmation of their private information or past success. This increased confidence pushes the prices of the past winning stocks above their fundamental values. This delayed overreaction provides an opportunity for momentum strategies to profit, which eventually is reversed as prices revert to their fundamentals.

Barberis et al. (1998) have built a model based on behavioral biases (namely, conservatism bias and representativeness heuristic). In their model, the occurrence of asset price underreaction to new information is due to investors' conservatism biases; and their result of asset price overreaction to new information is driven by investors' representativeness heuristic. Hong and Stein (1999) interpret the short-term stock price underreaction as a result of the slow diffusion of information across the population, and asset price overreaction as due to the technical traders' extrapolation based on past prices, which pushes prices of past winning stocks above their fundamental values. As a result, return reversals occur when prices eventually revert to their fundamentals.

Douks and McKnight (2005) test the investors' conservatism bias-based model of Barberis et al. (1998) and the gradual-information-diffusion model of Hong and Stein (1999) in a sample of 13 European stock markets during the period 1988 to 2001. Their findings from the tests confirm that the momentum profit comes from (i) the gradual dissemination of firm-specific information and (ii) investors' failure to update their beliefs sufficiently when they observe new public information. Jegadeesh and Titman (2001) also examine the predictions of recent behavioral models. Their empirical findings are consistent with the prediction of behavioral models, including the conservatism bias-based model of Barberis et al. (1998). However, they also pointed out the weakness of those results. That is, the evidence of negative postholding period returns tends to depend on the composition of the sample, the sample period, and in some instances, whether the postholding period returns are risk-adjusted.

The remainder of this paper consists of three sections. The next section describes the model. Section 3 presents how the asset price reacts to new information. The concluding remarks are in Section 4.

The Model

To illustrate the asset price reacts to new information in a competitive securities market, an extension to Grossman and Stiglitz (1980) is used. Specifically, consider a one-period competitive securities market with one risk-free asset and one risky asset. The payoff for the risk-free asset is always one and the payoff for the risky asset is a random variable, denoted as θ, realized at the end of the time period. There are potentially three types of investors in the market: Rational traders, conservatism traders, and noise/liquidity traders. Noise/liquidity traders are assumed to exist to provide liquidity to the market. All traders do not know the risky asset's payoff θ in the beginning of the time period when they trade, but they have prior knowledge about the risky asset's payoff being normal distribution with mean $\bar{\theta}$ and standard deviation σ_θ. In the beginning of the time period before they trade, each trader receives a signal about the risky asset's payoff. This signal is modelled by the following equation:

$$S = \theta + \epsilon, \tag{1}$$

where the residual error ϵ is normally distributed with mean zero and standard deviation of σ_ϵ; furthermore, ϵ is independent of θ. Since θ and ϵ are independent and normally distributed, rational traders update their expectations of the mean and standard deviation for the risky asset's payoff according to the following:

$$E_r(\theta \mid S) = \bar{\theta} + \frac{\sigma_\theta^2}{\sigma_\theta^2 + \sigma_\epsilon^2}(S - \bar{\theta}), \tag{2}$$

and

$$\mathrm{Var}_r(\theta \mid S) = \sigma_\theta^2 - \frac{\sigma_\theta^4}{\sigma_\theta^2 + \sigma_\epsilon^2} = \frac{\sigma_\theta^2 \sigma_\epsilon^2}{\sigma_\theta^2 + \sigma_\epsilon^2}, \tag{3}$$

respectively, where subscript r indicates a rational trader. See the Appendix for the derivation of Equations (2) and (3).

Conservatism traders are slow in updating their beliefs about the mean and variance of the risky asset's payoff. So, their conditional mean and variance for the payoff of the risky asset are modelled as the summation of their prior knowledge plus the partial adjustment towards the rational traders' conditional mean and variance of the risky asset's payoff. In other words, conservatism traders' conditional mean and variance for the risky asset's payoff are

$$E_c(\theta \mid S) = \bar{\theta} + m(E_r(\theta \mid S) - \bar{\theta}) = \bar{\theta} + \frac{m\sigma_\theta^2}{\sigma_\theta^2 + \sigma_\epsilon^2}(S - \bar{\theta}), \tag{4}$$

and

$$\mathrm{Var}_c(\theta \mid S) = \sigma_\theta^2 + m(\mathrm{Var}_r(\theta \mid S) - \sigma_\theta^2) = \sigma_\theta^2 - \frac{m\sigma_\theta^4}{\sigma_\theta^2 + \sigma_\epsilon^2}, \tag{5}$$

respectively, where subscript c indicates a conservatism trader and m is an adjustment parameter and $m \in (0, 1)$. The closer to one is the adjustment parameter m, the less is the conservatism bias. If the adjustment parameter is one, then conservatism traders become rational traders. On the other hand, the closer to zero the adjustment parameter m, the more severe is the conservatism bias.

Note that the conditional variance of the risky asset's payoff is always bigger for conservatism traders than the one for rational traders. Depending on the sign of $S - \bar{\theta}$ or the realization of the informational signal, the conditional mean of the risky asset's payoff for conservatism traders may be bigger or smaller than that for rational traders.

The initial wealth for each trader is assumed to be w. Since the risk-free asset has a constant payoff, the gain or loss for each trader is coming from his or her trading on the risky asset. In this competitive market, each trader takes the risky asset price as given. Denote the risky asset price as p and the demand for risky asset by trader $i\,(i = r, c)$ as X_i. Hence, trader i's wealth $(i = r, c)$ at the end of the time period (denoted as w_i) is the summation of his or her initial wealth and profit from trading the risky asset in this period. That is, $w_i = w + X_i(\theta - p)$. Each trader is assumed to have an exponential utility function. That is, for trader $i\,(i = r, c)$, $U(w_i) = -e^{-aw_i}$, where $a > 0$ and a is the coefficient of absolute risk aversion. With normality assumption, for trader $i\,(i = r, c)$ to choose the demand to maximize his or her exponential utility function is equivalent to solving the following equation:

$$\max_{X_i} E_i(w_i \mid S) - \frac{a}{2}\mathrm{Var}_i(w_i \mid S),$$

$$\text{s.t.} \quad w_i = w + X_i(\theta - p).$$

This, together with Equations (2), (3), (4), and (5), implies that the demand function for rational trader can be computed as

$$X_r = \frac{\overline{\theta} + \eta(S - \overline{\theta}) - p}{a\sigma_\theta^2(1 - \eta)}, \tag{6}$$

where $\eta = \dfrac{\sigma_\theta^2}{\sigma_\theta^2 + \sigma_\epsilon^2} < 1,$ and the demand function for conservatism traders can be computed as

$$X_c = \frac{\overline{\theta} + m\eta(S - \overline{\theta}) - p}{a\sigma_\theta^2(1 - m\eta)}. \tag{7}$$

Among a population of rational traders and conservatism traders, λ denotes the fraction of this population being rational traders and $1 - \lambda$ denotes the fraction of this population being conservatism traders. The supply of the risky asset is assumed to be zero. The risky asset price is computed as the solution to the equation of market demand for risky asset to the market supply of the risky asset.

Noise traders' net demand for the risky asset is assumed to be a random variable (denoted as x) with mean zero and standard deviation σ_x.

Using Equations (6) and (7), the risky asset price is computed from the market clearing condition described below:

$$\lambda\frac{\overline{\theta} + \eta(\theta + \epsilon - \overline{\theta}) - p}{a\sigma_\theta^2(1 - \eta)} + (1 - \lambda)\frac{\overline{\theta} + m\eta(\theta + \epsilon - \overline{\theta}) - p}{a\sigma_\theta^2(1 - m\eta)} + x = 0.$$

That is,

$$p = \frac{-(\overline{\theta} + ax\sigma_\theta^2)(1 - \eta)(1 - m\eta) + S\eta(m(\eta - 1) - \lambda(1 - m))}{\eta - 1 + \lambda\eta(m - 1)}. \tag{8}$$

Note that, Equation (8) implies that $E(p) = \bar{\theta}$. This further implies that $E(X_i) = 0$ for $i = r, c$. Using Equations (6), (7), and (8), the demand function for rational traders and conservatism traders can be computed as the following, respectively,

$$X_r = \frac{1}{a\sigma_\theta^2(\eta - 1 + \lambda\eta(m-1))}\left(ax\sigma_\theta^2(1 - m\eta) - \eta(1-m)(1-\lambda)(S - \bar{\theta})\right), \tag{9}$$

And

$$X_c = \frac{1}{a\sigma_\theta^2(\eta - 1 + \lambda\eta(m-1))}\left(ax\sigma_\theta^2(1 - \eta) + \lambda\eta(1-m)(S - \bar{\theta})\right). \tag{10}$$

The purpose of this paper is to see whether conservatism bias will cause the risky asset price to underreact or overreact to new information contained in the signal, for this reason, the following definition is introduced: A signal is defined as good news if $S \geq \bar{\theta}$, otherwise, it is defined as bad news.

Furthermore, the risky asset price underreaction to new information is defined as the risky asset price being lower (higher) in responding to new information than what it would be if the market consisted of only rational traders $(\text{i.e., } \lambda = 1,\ m = 1)$ buying (selling) the risky asset. Similarly, the risky asset price overreaction to new information is defined as the risky asset price being higher (lower) in responding to new information than what it would be if the market consisted of only rational traders $(\text{i.e., } \lambda = 1,\ m = 1)$ buying (selling) the risky asset.

Note that, in this paper, the terms “asset” and “asset price” refer, respectively, to the risky asset (instead of the risk-free asset) and the risky asset price (instead of the risk-free asset price). The following section describes how the asset price responds to new information.

The Asset Price Overreaction and Underreaction

to New Information

The results of this section suggest that conservatism bias can cause asset price overreaction in addition to underreaction to new information. This result contrasts with the common view in the literature that conservatism bias causes only asset price underreaction to new information (see Barberis et al. (1998)).

To simplify the analysis to be conducted below, the following equations are first computed, from Equations (8), (2), and (4), as the following, for $m \in (0, 1), \lambda \in (0, 1),$ and $\eta < 1,$

$$p - E_r(\theta \mid S) = \frac{\eta - 1}{\eta - 1 + \lambda\eta(m - 1)}\left(ax\sigma_\theta^2(1 - m\eta) - \eta(1 - m)(1 - \lambda)(S - \overline{\theta})\right), \tag{11}$$

and

$$p - E_c(\theta \mid S) = \frac{m\eta - 1}{\eta - 1 + \lambda\eta(m - 1)}\left(ax\sigma_\theta^2(1 - \eta) + \lambda\eta(1 - m)(S - \overline{\theta})\right). \tag{12}$$

In addition, taking derivative of Equation (10) results in the following equation:

$$\frac{dX_c}{dm} = \frac{\lambda\eta(\eta - 1)(ax\sigma_\theta^2 - S + \overline{\theta})}{a\sigma_\theta^2(\eta - 1 + \lambda\eta(m - 1))^2}. \tag{13}$$

Notice from Equations (9) and (10), that if there is no noise traders in the market, due to their conservatism bias, conservatism traders always trade on the opposite direction to their rational trading counterparties. Hence, the risky asset price will always underreact to new information.

With the existence of noise traders, conservatism traders do not always trade on the opposite direction to their rational counterparties. Here, depending on the realization of the information signal received by traders, conservatism traders and rational traders can trade on the same side of the market against noise traders. For this reason, based on how far the good news is above the expected payoff of the risky asset, good news is further classified as mildly good news if $\bar{\theta} \leq S < \bar{\theta} + a|x|\sigma_\theta^2$; very good news if $\bar{\theta} + a|x|\sigma_\theta^2 \leq S < \bar{\theta} + \frac{a|x|\sigma_\theta^2(1 - m\eta)}{\eta(1 - m)(1 - \lambda)}$, where $\frac{1 - m\eta}{\eta(1 - m)(1 - \lambda)} > 1$; and extremely good news if $S \geq \bar{\theta} + \frac{a|x|\sigma_\theta^2(1 - m\eta)}{\eta(1 - m)(1 - \lambda)}$. Similarly, based on how far the bad news is below the expected payoff of the risky asset, bad news is further defined as mildly bad news if $\bar{\theta} - a|x|\sigma_\theta^2 \leq S < \bar{\theta}$; very bad news if $\bar{\theta} - \frac{a|x|\sigma_\theta^2(1 - m\eta)}{\eta(1 - m)(1 - \lambda)} \leq S < \bar{\theta} - a|x|\sigma_\theta^2$; and extremely bad news if $S < \bar{\theta} - \frac{a|x|\sigma_\theta^2(1 - m\eta)}{\eta(1 - m)(1 - \lambda)}$.

The following discusses all the scenarios regarding how the risky asset price react to different types of good news and bad news, along with noise traders being net buyers or sellers of the risky asset. It begins with analyzing how the asset price reacts to different types of good news.

(i) When noise traders are net sellers $(\text{i.e., } x < 0)$ of the asset, for all types of good news $(S \geq \bar{\theta})$, the asset price is priced below rational traders' conditional mean of the asset's payoff (from Equation (11)). This implies that rational traders are buying the asset (due to Equation (6)). On the other hand, conservatism traders can either trade on the opposite direction to rational traders or trade on the same side of the market as rational traders. If conservatism traders trade on the opposite direction to rational traders, then the asset price will underreact to the good news. If conservatism traders trade on the same side of the market (or buy the asset) as rational traders, then based on Equation (13), $\frac{dX_c}{dm} > 0$; hence, $X_c < X_r$ for $x < 0$ and $S > \bar{\theta}$. This means that conservatism traders do not take as big a buying position as rational traders. Consequently, the asset price cannot go as high as the one for the market with only rational traders. Here, the asset price underreacts to the good news.

However, if noise traders are net buyers of the asset, conservatism traders always sell the asset in response to all types of good news. Here, conservatism traders may sell the asset more or less aggressively than do rational traders, depending on the type of good news. Also, in this case, rational traders respond differently to different types of good news. The detailed discussions are presented below.

(ii) When noise traders are net buyers of the asset, for the mildly good news contained in the information signal $(\text{i.e., } \overline{\theta} < S < \overline{\theta} + ax\sigma_{\theta}^{2})$, the asset is priced above the conservatism traders' conditional mean of the asset's payoff (based on Equation (12)). In other words, conservatism traders are selling the asset (from Equation (7)). Since Equation (13) implies that $\frac{dX_c}{dm} < 0$ for a mildly good news, it follows that $X_c > X_r$. In this case, both conservatism traders and rational traders are selling the asset, however, conservatism traders are selling the asset less aggressively, in the sense that conservatism traders take a smaller selling position than that taken by rational traders. This prevents the asset price from going as low as the one for the market with only rational traders. This is asset price underreaction to the mildly good news.

(iii) When noise traders are net buyers, for very good news contained in the information signal $\left(\text{i.e., } \overline{\theta} + ax\sigma_{\theta}^{2} < S < \overline{\theta} + \frac{ax\sigma_{\theta}^{2}(1 - m\eta)}{\eta(1 - m)(1 - \lambda)}, \text{ where } \frac{1 - m\eta}{\eta(1 - m)(1 - \lambda)} > 1\right)$, the risky asset is priced above both the conditional mean of the asset's payoff for rational traders and conservatism traders (based on Equations (11) and (12)). This means that both rational traders and conservatism traders are selling the risky asset (from Equations (6) and (7)). In this case, both rational traders and conservatism traders think that the risky asset is overvalued and consequently, they sell the risky asset to noise traders. Furthermore, since Equation (13) implies that $\frac{dX_c}{dm} > 0$ for $S > \overline{\theta} + ax\sigma_\theta^2$, it follows that $X_c < X_r$. This implies that while both rational traders and conservatism traders are selling the asset, it is the conservatism traders' aggressively selling the asset (relative to rational traders) that pushes the asset price lower than what it would be if they were absent from the market. This is asset price overreaction to the very good news.

(iv) When noise traders are net buyers and traders receive a signal suggesting extremely good news $\left(\text{i.e., } S > \overline{\theta} + \frac{ax\sigma_\theta^2(1 - m\eta)}{\eta(1 - m)(1 - \lambda)}\right)$, Equations (6), (7), (11), and (12) imply that rational traders are buying the asset and conservatism traders are selling the asset. Hence, conservatism traders' trading on the opposite direction to rational traders prevents the asset price from rising as high as the one for the market with only rational traders. This is asset price underreaction to extremely good news.

If the information signal suggests bad news, depending on whether noise traders are net buyers or sellers of the asset, rational and conservatism traders respond differently to different types of bad news. A detailed discussion follows.

(v) If noise traders are net buyers of the asset, for all types of bad news contained in the signal, the asset is priced above rational traders' conditional mean of the asset's payoff (from Equation (11)). Hence, rational traders are selling the asset (due to

Equation (6)). Since Equation (13) implies that $\frac{dX_c}{dm} < 0$ in this case, it follows that $X_c > X_r$. This implies that by taking a smaller selling position than that taken by rational traders or by taking a buying position, conservatism traders cause the asset price not to go as low as the one for the market with only rational traders. This is asset price underreaction to all bad news.

However, if noise traders are net sellers of the asset, conservatism traders always buy the asset in responding to all types of bad news. Here, conservatism traders may buy the asset more or less aggressively than do rational traders, depending on the type of bad news. Hence, the asset price may overreact to one type of bad news and underreact to other types of bad news. See below for the detailed analysis.

(vi) When noise traders are net sellers $(\text{i.e., } x < 0)$ and traders receive mildly bad news $(\text{i.e., } \overline{\theta} + ax\sigma_{\theta}^2 \leq S < \overline{\theta})$, based on Equation (12), the asset is priced below the conservatism traders' conditional mean of the asset's payoff. This means that conservatism traders are buying the asset (due to Equation (7)). Since Equation (13) implies that $\frac{dX_c}{dm} > 0$, it follows that $0 < X_c < X_r$. This means that rational traders are buying the asset as well. However, by taking a smaller buying position than that taken by rational traders, conservatism traders prevent the asset price from going as high as it would in the absence of conservatism traders. In this case, the asset price underreacts to the mildly bad news.

(vii) When noise traders are net sellers $(\text{i.e., } x < 0)$ and traders receive very bad news $(\text{i.e., } \overline{\theta} + \frac{ax\sigma_\theta^2(1 - m\eta)}{\eta(1 - m)(1 - \lambda)} \le S < \overline{\theta} + ax\sigma_\theta^2)$, based on Equation (12), the asset is priced below the conservatism traders' conditional mean of the asset's payoff. This means that conservatism traders are buying the asset (due to Equation (7)). Since $\overline{\theta} + \frac{ax\sigma_\theta^2(1 - m\eta)}{\eta(1 - m)(1 - \lambda)} \le S < \overline{\theta} + ax\sigma_\theta^2$, Equations (6) and (11) imply that rational traders are buying the asset as well. In this case, both rational traders and conservatism traders think that the risky asset is undervalued and, hence, they both buy the asset from noise traders. Since Equation (13) implies that $\frac{dX_c}{dm} < 0$, it follows that $X_c > X_r$. By taking a bigger buying position than that taken by rational traders, conservatism traders push the asset price higher than that for the market with only rational traders. The asset price overreacts to very bad news.

(viii) When noise traders are net sellers $(\text{i.e., } x < 0)$ and traders receive extremely bad news $(\text{i.e., } S < \overline{\theta} + \frac{ax\sigma_\theta^2(1 - m\eta)}{\eta(1 - m)(1 - \lambda)})$, based on Equation (11), the asset is priced above the rational traders' conditional mean of the asset's payoff. This means that rational traders are selling the asset (from Equation (6)). Furthermore, Equations (7) and (12) imply that conservatism traders are buying the asset. By trading on the opposite direction to rational traders, conservatism traders prevent the asset price from going as low as in the market with only rational traders. Hence, the asset price underreacts to the extremely bad news.

Note that the cases discussed above are classified based on the realization of informational signal and whether noise traders are net buyers or sellers. There are no probabilities attached to those cases. Therefore, the cases where the asset price overreaction to new information occurs is quite plausible.

The above analysis is summarized in Table 1 (a) and Table 1 (b). The results are formally stated in the following proposition.

Table 1 (a). Responses of rational and conservatism traders to good news

Noise traders	Net seller	Net buyer		
good news	all good news	mildly good news	very good news	extremely good news
rational traders	buy	sell	sell	buy
conservatism traders	sell or buy less aggressively	sell less aggressively	sell more aggressively	sell
asset price reaction to good news	underreaction	underreaction	overreaction	underreaction

Table 1 (b). Responses of rational and conservatism traders to bad news

Noise traders	Net seller	Net seller		
bad news	all bad news	mildly bad news	very bad news	extremely bad news
rational traders	sell	buy	buy	sell
conservatism traders	buy or sell less aggressively	buy less aggressively	buy more aggressively	buy
asset price reaction to bad news	underreaction	underreaction	overreaction	underreaction

Proposition 1. *In a competitive securities market with noise traders, asset price does not always underreact to new information. The asset price could potentially overreact to good news or bad news. Specifically,*

(i) *when noise traders are net sellers, the asset price underreacts to all good news*;

(ii) *when noise traders are net buyers, the asset price underreacts to mildly good news and extremely good news*; *but overreacts to very good news*;

(iii) *when noise traders are net buyers, the asset price underreacts to all bad news*;

(iv) *when noise traders are net sellers, the asset price underreacts to mildly bad news and extremely bad news*; *but overreacts to very bad news*.

As can be seen from all above analysis, conservatism bias is the cause for the asset price to underreact or overreact to new information. And furthermore, more conservatism bias and/or larger subpopulation of conservatism traders (i.e., smaller m and smaller λ) can only exaggerate the impact of conservatism bias in the same direction as it was with larger values of the parameters m and λ. As a result, asset price underreaction or overreaction to new information become more severe.

Concluding Remarks

This paper constructs an equilibrium model of a competitive securities market to explain that conservatism bias can cause asset price overreaction in addition to underreaction to new information. In the literature, it is not uncommon to view conservatism bias as a cause of asset price underreaction to new information, however, so far, no paper has suggested that conservatism bias could also cause asset price overreaction to new information. This paper illustrates how conservatism bias produces asset price overreaction to new information. In this paper, asset price overreaction occurs as a result of conservatism traders trading on the same side of the market as rational traders and, at the same time, trading more aggressively than do rational traders due to their conservatism biases. This happens only in the market with noise traders. Without the presence of noise traders, conservatism bias causes only asset price underreaction to new information. Note that this paper does not attempt to explain the empirical anomaly of asset price underreaction or overreaction to new information. Instead, it focuses on demonstrating that conservatism bias is capable of generating asset price overreaction to new information in the competitive securities market.

References

Barberis, N., Shleifer, A. and Vishny, R. (1998). A model of investor sentiment. Journal of Financial Economics, 49, 307-343.

Daniel, K., Hirshleifer, D. and Subrahmanyam, A. (1998). Investor psychology and security market under-and overreactions. Journal of Finance, 53, 1839-1886.

Douks, J. and McKnight, P. (2005). European momentum strategies, information diffusion, and investor conservatism. European Financial Management, 11(3), 313-338.

Edwards, W. (1968). Conservatism in Human Information Processing, in B. Kleimutz, ed.: Representation of Human Judgement. John Wiley and Sons, New York.

Fischer, P. E. and Verrecchia, R. E. (1999). Public information and heuristic trade. Journal of Accounting and Economics, 27(1), 89-124.

Grossman, S. J. and Stiglitz, J. E. (1980). On the impossibility of informationally efficient markets. American Economic Review, 70(3), 393-408.

Hirshleifer, D. and Luo, G. Y. (2001). On the survival of overconfident traders in a competitive securities market. Journal of Financial Markets, 4(1), 73-84.

Hoel, P. G. (1962). Introduction to Mathematical Statistics. New York.

Hong, H. and Stein, J. C. (1999). A unified theory of underreaction, momentum trading and overreaction in asset markets. Journal of Finance, 54, 2143-2184.

Jegadeesh, N. and Titman, S. (2001). Profitability of momentum strategies: An evaluation of alternative explanations. Journal of Finance, 56(2), 699-720.

Luo, G. Y. (1999). The evolution of money as a medium of exchange. Journal of Economic Dynamics and Control, 23, 415-458.

Taylor, P. and Jonker, L. (1978). Evolutionarily stable strategies and game dynamics. Mathematical Biosciences, 40, 145-156.

Weibull, J. W. (1995). Evolutionary Game Theory. MIT Press, Cambridge.

Appendix

Derivation of Equations (2) and (3)

Notice that $S = \theta + \epsilon$, where θ is normally distributed with mean $\overline{\theta}$ and standard deviation of σ_θ and ϵ is also normally distributed with mean zero and standard deviation of σ_ϵ; furthermore, θ and ϵ are independent. Hence, the following are true,

(1) S and θ are jointly normal distributed;

(2) $\mathrm{Var}(S) = \sigma_\theta^2 + \sigma_\epsilon^2$;

(3) $\mathrm{Cov}(\theta, S) = \sigma_\theta^2$.

Result (3) comes from the following:

$$\mathrm{Cov}(\theta, S) = E[(\theta - \overline{\theta})(S - \overline{S})] = E(\theta S) - \overline{\theta}^2 = E(\theta(\theta + \epsilon)) - \overline{\theta}^2 = E\theta^2 - \overline{\theta}^2 = \sigma_\theta^2.$$

With the results (1), (2), and (3), Equations (2) and (3) follow from a proposition stated below. If the random variables X^* and Y^* are jointly normally distributed, then

$$E(X^*|Y^* = Y) = EX^* + \frac{\mathrm{Cov}(X^*, Y^*)}{\mathrm{Var}(Y^*)}(Y - EY^*) \text{ and } \mathrm{Var}(X^*|Y^* = Y) =$$

$$\mathrm{Var}(X^*) - \frac{[\mathrm{Cov}(X^*, Y^*)]^2}{\mathrm{Var}(Y^*)}$$ (see Hoel (1998), p.200).

■