International Journal of
Financial Studies

MDPI

Article

Stock Price Manipulation: The Role of Intermediaries

Hammad Siddiqi

Faculty of Business, Economics, and Law, The University of Queensland, Brisbane 4072, Australia; h.siddiqi@uq.edu.au

Received: 5 September 2017; Accepted: 23 October 2017; Published: 25 October 2017

Abstract: We model a scenario in which there are three types of investors: fundamentalists, speculators, and trend-followers and an intermediary who cares about his reputation. Fundamentalists are rational investors with long horizons who are interested in the dividend stream. Speculators are rational investors who have short horizons and are interested in profiting from short-term price movements or capital gains. Trend-followers are behavioral investors who extrapolate price trends, and, consequently, are late entrants in the market. We show that an informed intermediary (broker) can manipulate demand (consequently stock price) without losing his reputation when there is information asymmetry. We also show that there is a trade-off between broker level competition for reputation and market liquidity. Broker level competition checks manipulation, but it adversely affects market liquidity.

Keywords: stock price manipulation; broker manipulation; broker competition; heterogeneous investors; fundamentalists; speculators; trend-follower

JEL Classification: C72; D80; G10; G20

1. Introduction

Trend-followers are investors who extrapolate price trends. Academic research on trend-followers is mostly concerned with measuring the profitability of trend-following strategies (see Cheung 1997; Menkhoff and Schlumberger 1995; Levich and Thomas 1993; Sweeny 1986 among others). These studies have found mixed evidence about the profitability of trend-following. Whether trend-following is profitable or not is controversial, as it has a direct bearing on whether or not markets are efficient. If trend-following is profitable, it is a violation of a weak form of market efficiency (which says that past price data contains no useful information about future prices). Even though the profitability of such strategies is controversial, there is no controversy about the existence of trend-followers in financial markets. In fact, the popularity of trend-following is very high among practitioners. As one example, Taylor and Allen (1992) show that over 90% of dealers in the London foreign exchange market also use trend-extrapolation to make short-term forecasts apart from other methods.

In this article, we show that if trend-followers are present, and investors have different investment horizons, a coordination game is created in which short horizon investors want to coordinate with long horizon investors. The coordination game allows an informed third party (broker) to manipulate equilibrium outcomes without losing credibility with respect to accurate forecasting. Furthermore, there is a trade-off between broker level competition needed to check manipulation and market liquidity. If competition exceeds a certain threshold, liquidity is negatively affected.

In stock markets (emerging markets in particular), the issue of stock price manipulation by intermediaries often arises. Numerous accounts of emerging stock markets today share this concern. Khwaja and Mian (2005) use a unique trade level dataset to show that when market intermediaries (brokers) in a Pakistani stock exchange trade on their own behalf, they earn at least 50 to 90 percentage points higher annual returns and these abnormal returns are earned at the expense of outside investors.

Zhou and Mei (2003) note that the China's worst stock market crime was the result of a scheme implemented in collusion with brokers. They argue that manipulation by brokers is common in many emerging stock markets. Khanna and Sunder (1999), in a case study of the Indian stock market, states that "brokers were often accused of collaborating with the company owners to rig share prices in pump and dump schemes". Furthermore, according to a survey conducted by the Times of India in October 2005, a majority of market participants in India believe that brokers manipulate prices. In fact, in 2005, the Securities and Exchange Board of India barred 11 brokers for engaging in price manipulation.

A number of studies have examined the issue of stock price manipulation by speculators who are not in the role of intermediaries. Allen and Gale (1992) show that it is possible for an uninformed trader to manipulate prices if the investors attach a positive probability to the manipulator being an informed player. Jarrow (1992) and Hart (1977) have analyzed manipulation in a dynamic asset pricing context and show that, under certain conditions, speculators can make profits. However, a theoretical framework for understanding manipulation when the manipulator is in the role of an intermediary is lacking, even though anecdotes abound. Consequently, a key question remains unanswered. Reputation is a key asset in a market where brokers compete for business. How can manipulating brokers, if they indeed manipulate, maintain their credibility?

In this article, we present a model, in which people have different investment horizons. There are three types of investors; fundamentalists, speculators, and trend-followers. Fundamentalist investors have long horizons. They trade on the basis of superior information and intend to stay in the market long enough for the superior information to reflect in the company's profitability. That is, they invest in the stocks for the associated dividend stream. Speculators have short investment horizons. They trade stocks with an objective of profiting from short-term capital gains. Trend-followers are investors who enter the market late, extrapolate price trends, and trade accordingly. We show that, if each type is uninformed about the types of other investors, then an informed broker can manipulate equilibrium outcomes without losing credibility. We also show that there is a trade-off between broker level competition needed to check manipulation, and market liquidity. If competition exceeds a certain threshold, liquidity is negatively affected.

Our model uses a modification of a three-player coordination game framework developed in Jung (2009a). Jung (2009a) models an arms race scenario in which media has power to influence outcomes. However, as shown in Jung (2009b), the idea underlying Jung's model is general; if there is a coordination game between two parties with asymmetric information, then a third party with powers to reduce asymmetry can manipulate equilibrium outcomes. Here, we apply this idea to financial markets and study a coordination game between investors with different investment horizons and different times of entry, and with an intermediary with powers to reduce asymmetry through signaling. The key is to realize that if brokers care about their credibility and investors know that, then, in an apparent defiance of intuition, brokers get to manipulate without losing credibility.

In the basic model, there are four players, an investor labeled investor 1, another investor labeled investor 2, an investor labeled trend-follower, and a stock broker. There is a positive probability that investor 1 has superior information. Similarly, there is a positive probability that investor 2 has superior information. If an investor has superior information then he or she trades accordingly and is a fundamentalist investor with a long horizon. However, if he or she does not possess superior information, then he or she is a speculator who wants to profit from short-term capital gains. We assume that investors agree over the interpretation of superior information. That is, if both investor 1 and investor 2 receive superior information, they interpret it identically.

A trend-follower is an investor who enters the market late. He enters after both investor 1 and investor 2 have made their investment choices. If he sees a trend, he extrapolates, and trades accordingly. If he does not see a trend, he abstains from the market. Since a speculator has a short investment horizon, he wants the trend-follower to enter the market as he then gets a better price. As the trend-follower enters when he sees a trend, the speculator wants to create a trend by coordinating his demand level choices with the other investor. This creates a coordination game.

In our model, each investor knows his type (speculator or fundamentalist) but neither investor 1 nor investor 2 observe the types each other; however, the broker observe the types of both investors. The broker, whose primary preference is to preserve his credibility (which will be lost if either investor determines that the broker has lied), sends a signal in the form of a publicly available research report. The research report forecasts a bullish, bearish, or a neutral market. The report is read by each investor as providing a signal about the other investor. A bullish signal is read by investor 1 as implying that investor 2 will invest with optimism, a bearish signal as implying that investor 2 will invest with pessimism, and a neutral signal indicating that investor 2 will invest with caution. Investor 2 also reads the report in the same fashion as providing a signal about investor 1.

Conditional on maintaining his credibility (by correctly forecasting the direction of the market), the broker wants to manipulate demand. After the signal has been received and has become public knowledge, both types of investors choose their demand levels simultaneously. The main result is that if neither investor has superior information, then the broker can manipulate demand in equilibrium while maintaining credibility.

The model is then enriched to allow for competition between brokers and to allow for a specific broker bias. Conditions are specified under which manipulation is mitigated. We find that there is a trade-off between broker level competition and market liquidity. Competition checks manipulation, but it adversely affects market liquidity.

2. The Basic Model

There are four players: investor 1, investor 2, trend-follower and a stock broker. Each investor can choose from any of the following demand levels: investing with optimism (I), investing with caution (C), and investing with pessimism (N). I > C > N. Investor 1 and investor 2 know their own types. Investor 1 can be optimistic, neutral, or pessimistic. Similarly, investor 2 can be optimistic, pessimistic, or neutral. The optimistic type has superior information that the market will go up so it prefers to choose I. The pessimistic type has superior information that the market will go down so it prefers to choose N. Optimistic and pessimistic types are fundamentalists with long horizons. The neutral type does not have superior information either way and is a speculator with a short horizon, who prefers to coordinate his demand level choices with the other investor in order to create a trend for the trend-follower to extrapolate. If the trend-follower enters the market, the speculator exits with gains. If the trend-follower abstains from the market, the speculator suffers losses upon exit. The trend-follower only enters when he sees a trend.

The general notation scheme used in this paper to describe the utilities of investor 1 is: $U_{1(investor\ type)}\ Investor1choice,\ Investor2choice$. That is, the utility of optimistic type of investor 1 if he chooses I and investor 2 chooses C is given by: $U_{1(Optimist)}IC$. The following inequalities describe the preference of optimistic and pessimistic types of investor 1:

$$U_{1(Optimist)}I(.) > max\Big\{U_{1(Optimist)}C(.), U_{1(Optimist)}N(.)\Big\} \tag{1}$$

$$U_{1(Pessimist)}N(.) > max\Big\{U_{1(Pessimist)}C(.), U_{1(Pessimist)}I(.)\Big\} \tag{2}$$

These inequalities show that the optimistic type of investor 1 prefers to choose the demand level I irrespective of what investor 2 does and the pessimistic type of investor 1 prefers to choose the demand level N irrespective of what investor 2 does. The fact that the investor 1 is optimistic or pessimistic implies possession of superior information. Consequently, investor 1 acts in accordance with superior information. Superior information is reflected in the company's profitability in the long run. An investor with superior information is a fundamentalist who is in the market with a horizon long enough for the superior information to reflect in the company's profitability.

The following inequality describes the primary preference of neutral type of 1 (a speculator):

$$\begin{array}{c} min\Big\{U_{1(Neutral)}CC,\ U_{1(Neutral)}NN,\ U_{1(Neutral)}II\Big\} > \\ min\Big\{U_{1(Neutral)}CN, U_{1(Neutral)}CI, U_{1(Neutral)}NC, U_{1(Neutral)}NI, U_{1(Neutral)}IC, U_{1(Neutral)}IN\Big\}. \end{array} \quad (3)$$

This inequality shows that a neutral type of 1 (a speculator) prefers outcomes in which it successfully matches the demand level choices of investor 2 over outcomes in which the choices are not matched. A neutral type of investor 1 does not have superior information about the market going either way. Consequently, he is a speculator with a short horizon. He wants to coordinate his demand level choices with the other investor in order to create a trend for the trend-follower to follow. If he is successful, then the trend-follower will enter the market and extrapolate the trend providing a profitable exit to the speculator.

Investor 2 has the same preferences as investor 1:

$$U_{2(Optimist)}I(.) > max\Big\{U_{2(Optimist)}C(.), U_{2(Optimist)}N(.)\Big\} \quad (4)$$

$$U_{2(Pessimist)}N(.) > max\Big\{U_{2(Pessimist)}C(.), U_{2(Pessimist)}I(.)\Big\} \quad (5)$$

$$\begin{array}{c} min\Big\{U_{2(Neutral)}CC,\ U_{2(Neutral)}NN,\ U_{2(Neutral)}II\Big\} \\ > min\Big\{U_{2(Neutral)}CN, U_{2(Neutral)}CI, U_{2(Neutral)}NC, U_{2(Neutral)}NI, U_{2(Neutral)}IC, U_{2(Neutral)}IN\Big\} \end{array} \quad (6)$$

The probability of either investor being optimistic is $o \in (0,1)$, of being pessimistic is $p \in (0,1)$, and the probability of being neutral is $1 - o - p$.

The trend-follower, if he does not enter the market, gets a utility of 0. He only enters if he sees a trend (both investors choosing the same action):

$$\begin{array}{c} min\{U_{Follower}IIEnter, U_{Follower}CCEnter, U_{Follower}NNEnter\} > 0 \\ > max\left\{\begin{array}{c} U_{Follower}ICEnter, U_{Follower}INEnter, U_{Follower}CIEnter, \\ U_{Follower}CNEnter, U_{Follower}NIEnter, U_{Follower}NCEnter \end{array}\right\} \end{array} \quad (7)$$

where $U_{Follower}IIEnter$ is the utility to the trend-follower if investor 1 plays I, investor 2 plays I, and the trend-follower plays Enter. Other utilities are similarly read.

The game proceeds as follows:

Stage Zero: Nature chooses the types of investor 1 and investor 2. Only the investor concerned and the broker detect the types. That is, each investor knows his own type, but not the type of the other investor. Broker knows the types of both investors. Superior information is interpreted identically by both investors. That is, if both investors have superior information, they cannot have different types.

Brokers have access to client level transaction data and they interact with a large number of investors. This superior position is captured in our model by assuming that the broker observes the types of both investors.

Stage One: The broker publishes a research report, which forecasts the direction of the market: bullish (I), bearish (N), or neutral (C). Each investor takes this report as a signal about the other investor's intention. Bullish means that the other investor will be choosing the demand level I, bearish means that the other investor will be choosing the demand level N, and neutral implies the demand level choice of C by the other investor.

Stage Two: Both investor 1 and investor 2 simultaneously make their demand level choices by choosing between the options I, C, or N.

Stage Three: Trend-follower decides whether to Enter (E) or Abstain (A).

Regarding broker preferences, the broker has a primary preference for maintaining his credibility in the eyes of investors and a conditional preference for manipulating demand. The broker will lose credibility if he fails to correctly forecast the actions of investors.

The following inequality describes the broker's primary preference for credibility:

$$min\{U_BIII, U_BCCC, U_BNNN\} > max\left\{\begin{array}{c} U_BIIN, U_BICN, U_BICI, U_BINI, U_BCIC, U_BCNC, U_BNIN, \\ U_BNCN, U_BINI, U_BIIC, U_BICC, U_BINC, U_BCII, U_BCNI, \\ U_BCCI, U_BCNN, U_BCCN, U_BCIN, U_BNNI, U_BNCI, U_BNNI, \\ U_BNIC, U_BNCC, U_BNNC \end{array}\right\} \quad (8)$$

Here, U_BICI is the payoff to the broker if he signals I, investor 1 plays C, and investor 2 plays I. Other entries in the above inequality are similarly read. Thus, if the broker forecasts a bullish market, it would not lose credibility if both investors choose I (that would push prices up resulting in a bullish market). Similarly, if a bearish outlook is forecasted, then the credibility is preserved if both investors choose N (that would push prices down resulting in a bearish market). In addition, if the prediction is neutral, then credibility is maintained if both investors choose C.

It is important to note that instead of expressing results in terms of demand level choices, we could just as easily work with prices. All one has to do is note that since number of shares outstanding is exogenously fixed; therefore, fluctuations in prices are only caused by fluctuations in aggregate demand. We refrain from doing that since it would only add a layer of complexity without changing the results.

In the absence of the broker, it is easy to see that there are three pure strategy Nash equilibria: if neither investor has superior information (both investors are speculators), they both play I, both play C, and both play N, respectively, in three different equilibria. If at least one investor has superior information, they both play I if information is optimistic, and both play N if information is pessimistic. The trend-follower enters the market in all three equilibria. How does introducing the broker in this game change the outcomes? Theorem 1 provides an answer.

It is clear that any situation in which investors do not pay attention to the broker's signal cannot be pure strategy equilibrium because the broker cares about his credibility. His concern for credibility guarantees that he will be signaling truthfully if either investor has superior information, which has a non-zero chance of happening.

Theorem 1. *Pure-strategy Perfect Bayesian equilibria exist and, in the absence of superior information, the broker can manipulate equilibrium outcomes without losing credibility with respect to accurate forecasting.*

Proof. There are a number of pure-strategy Perfect Bayesian equilibria. One is shown below:

$$\left[\begin{array}{c} Broker : \{I|Optimist, C|Neutral, N|Pessimist\} \\ Investor\ 1\ (Neutral) : \{I|I, C|C, N|N\} \\ Investor\ 1\ (Optimist) : I \\ Investor\ 1\ (Pessimist) : N \\ Investor\ 2\ (Neutral) : \{I|I, C|C, N|N\} \\ Investor\ 2\ (Optimist) : I \\ Investor\ 2\ (Pessimist) : N \\ Chartist : Enter \end{array}\right] \quad (A)$$

In this equilibrium, the broker signals I if at least one investor is optimistic, N if at least one investor is pessimistic, and C if none of them have superior information.

There are two additional equilibria in which the broker signals I and N, respectively, if neither investor has superior information:

$$\begin{bmatrix} Broker: \{I|Optimist, I|Neutral, N|Pessimist\} \\ Strategies\ of\ other\ players\ the\ same\ as\ in\ equilibrium\ (A) \end{bmatrix} \quad \text{(B)}$$

$$\begin{bmatrix} Broker: \{I|Optimist, N|Neutral, N|Pessimist\} \\ Strategies\ of\ other\ players\ the\ same\ as\ in\ equilibrium\ (A) \end{bmatrix} \quad \text{(C)}$$

Since the broker moves first, he can manipulate the equilibrium outcomes by forcing equilibrium of his choice if neither investor has superior information. For example, if he wants a bullish market, he can signal I and force equilibrium (B). On the contrary, if he desires a bearish market, he can signal N and force equilibrium (C). □

It is easy to see how a manipulation scheme can work. Suppose both investor types are neutral, that is, neither investor has superior information. Suppose that the broker wants the stock price to rise (he may have taken a long position on his own account), he will signal I (bullish report) and in the outcome both investor 1 and investor 2 will play I. In contrast, if the broker wants the stock price to fall (due to a short position), he will signal N (bearish report) and in the outcome both investor 1 and investor 2 will play N. This is consistent with Khwaja and Mian (2005), a study that uses a unique trade level dataset to show that when market intermediaries (brokers) in a Pakistani stock exchange trade on their own behalf, they earn at least 50 to 90 percentage points higher annual returns and these abnormal returns are earned at the expense of outside investors (trend-followers in our case).

Brokers make more money when people invest more in the market. Arguably, brokers have a bias. They want more investment to come into the market. Next, we introduce this bias in the model. Specifically, conditional on successfully meeting his preference, the broker prefers an outcome in which more investment comes into the market. Consequently, another restriction is added to the broker's preference in addition to inequality (8):

$$U_B III > U_B CCC > U_B NNN \quad (9)$$

How does this bias change equilibrium? The following corollary to Theorem 1 provides an answer.

Corollary to Theorem 1. *Pure-Strategy Perfect Bayesian equilibria exist in which, in the absence of superior information, the broker can manipulate demand to get his favorite outcome without losing credibility with respect to accurate forecasting.*

Proof. By inspection, we arrive at the following equilibria:

$$\begin{bmatrix} Broker: \{I|Optimist, I|Neutral, N|Pessimist\} \\ Investor\ 1\ (Neutral): \{I|I, C|C, N|N\} \\ Investor\ 1\ (Optimist): I \\ Investor\ 1\ (Pessimist): N \\ Investor\ 2\ (Neutral): \{I|I, C|C, N|N\} \\ Investor\ 2\ (Optimist): I \\ Investor\ 2\ (Pessimist): N \\ Chartist: Enter \end{bmatrix} \quad \text{(D)}$$

$$\begin{bmatrix} Broker : \{I|Optimist, I|Neutral, N|Pessimist\} \\ Investor\ 1\ (Neutral) : \{I|I, I|C, N|N\} \\ Investor\ 1\ (Optimist) : I \\ Investor\ 1\ (Pessimist) : N \\ Investor\ 2\ (Neutral) : \{I|I, I|C, N|N\} \\ Investor\ 2\ (Optimist) : I \\ Investor\ 2\ (Pessimist) : N \\ Chartist : Enter \end{bmatrix} \quad \text{(E)}$$

$$\begin{bmatrix} Broker : \{I|Optimist, I|Neutral, N|Pessimist\} \\ Investor\ 1\ (Neutral) : \{I|I, N|C, N|N\} \\ Investor\ 1\ (Optimist) : I \\ Investor\ 1\ (Pessimist) : N \\ Investor\ 2\ (Neutral) : \{I|I, N|C, N|N\} \\ Investor\ 2\ (Optimist) : I \\ Investor\ 2\ (Pessimist) : N \\ Chartist : Enter \end{bmatrix} \quad \text{(F)}$$

In these equilibria, if investor types are neutral, the broker always signals I and both investors play I in response. Hence, the broker gets his favorite outcome in the absence of superior information. □

3. Broker Competition

The basic model shows that the broker can manipulate equilibrium outcomes. What will happen if competition among brokers is introduced in the model? Will competition mitigate broker manipulation? In this section, we show that it does. However, there is a trade-off between competition and market liquidity. Competition checks manipulation but at the expense of market liquidity.

We allow broker competition in the model in the form of a second broker. In the modified model, there are five players; two brokers (broker 1 and broker 2), investor 1, investor 2, and trend-follower. The game proceeds as follows:

Stage Zero: Nature chooses the types of investor 1 and investor 2. As before, an investor can be optimistic or pessimistic if he has superior information. Investors interpret information identically. That is, if both have superior information, they cannot have different types. Only the investor concerned and the two brokers observe the types.

Stage One: Broker 1 publishes a research reports that forecasts the direction of the market and is either bullish (I), bearish (N), or neutral (C). As before, this report is read by each investor as a signal about the intended demand level choice of the other investor.

Stage Two: Broker 2 also publishes a report that is similarly read by each investor.

Stage Three: Both investors simultaneously choose I, C, or N.

Stage Four: Trend-follower decides whether to Enter or Abstain.

Regarding brokers' preferences, just like in the basic model and the broker bias model, the primary preference of the brokers is to preserve their credibility. The conditional preference of the brokers depends both on broker bias as well as broker competition. The investors, if they pay attention to brokers' signals, are additionally assumed to be conservative meaning that if the signals conflict then the lesser signal will be followed by them. As an example, if broker 1 signals I and Broker 2 signals C, then an investor, if he decides to pay attention to the signals, will act on C. The following cases describe relevant cases of broker competition:

3.1. Severe Competition

In this type of competition, each broker prefers an outcome in which its prediction holds true, whereas the prediction of the other broker is wrong; even if it means that as the result of conflicting signals from the brokers, the investors will choose the lowest demand level N. Conditional on maintaining credibility, the following inequality describes the relevant cases for Broker 2:

$$\begin{aligned} min\{U_{Broker2}ICC, U_{Broker2}INN, U_{Broker2}CNN, U_{Broker2}CII, U_{Broker2}NII,\ U_{Broker2}NCC\} > \\ max\{U_{Broker2}III, U_{Broker2}CCC, U_{Broker2}NNN\}. \end{aligned} \tag{10}$$

Here, $U_{Broker2}ICC$ is the utility to broker 2 if broker 1 signals I, broker 2 signals C, and the investors play C. That is, the prediction of broker 2 holds true, whereas the prediction of broker 1 turns out to be false. Other entries in (10) are read similarly. This inequality shows that if the broker moving second can choose between two types of outcomes, type 1 being outcomes in which broker 2 is correct and broker 1 is incorrect, and type 2 being outcomes in which both are correct, then it will choose type 1 even if it leads to lower investment in the market.

The following inequality describes the relevant cases for broker 1:

$$\begin{aligned} min\{U_{Broker1}CIC, U_{Broker1}NIN, U_{Broker1}NCN, U_{Broker1}ICI, U_{Broker1}INI, U_{Broker1}CNC\} \\ > max\{U_{Broker1}III, U_{Broker1}CCC, U_{Broker1}NNN\} \end{aligned} \tag{11}$$

Here, $U_{Broker1}CIC$ is the payoff to broker 1 if he signals C, broker 2 signals I and the investors play C. That is, the prediction of broker 1 holds true, whereas the prediction of broker 2 turns out to be false.

3.2. Moderate Competition

In this type of competition, each broker prefers an outcome in which his own prediction turns out to be correct, whereas the prediction of the other broker turns out to be incorrect provided that the investors do not choose the lowest demand level N in equilibrium. That is, each broker wants a minimum of C from the investors to remain in the market. This is in contrast with severe competition in which each broker is willing to tolerate even the lowest demand level (N) for the sake of proving the other broker wrong.

The following inequalities describe the relevant cases:

$$min\{U_{Broker2}ICC, U_{Broker2}CII, U_{Broker2}NCC, U_{Broker2}NII\} > max\{U_{Broker2}III, U_{Broker2}CCC\}, \tag{12}$$

$$min\{U_{Broker2}III, U_{Broker2}CCC\} > max\{U_{Broker2}INN, U_{Broker2}CNN, U_{Broker2}NNN\}, \tag{13}$$

$$min\{U_{Broker1}CIC, U_{Broker1}ICI, U_{Broker1}CNC, U_{Broker1}INI\} > max\{U_{Broker1}III, U_{Broker1}CCC\}, \tag{14}$$

$$min\{U_{Broker1}III, U_{Broker1}CCC\} > max\{U_{Broker1}NIN, U_{Broker1}NCN, U_{Broker1}NNN\}. \tag{15}$$

3.3. Broker Bias

The following inequalities describe the possible cases of broker bias (more investment is preferred to less investment) conditional on maintaining credibility:

$$min\{U_{Broker1}III, U_{Broker1}ICI, U_{Broker1}INI\} > max\{U_{Broker1}CIC, U_{Broker1}CCC, U_{Broker1}CNC\}, \tag{16}$$

$$min\{U_{Broker1}CIC, U_{Broker1}CCC, U_{Broker1}CNC\} > max\{U_{Broker1}NIN, U_{Broker1}NCN, U_{Broker1}NNN\}, \tag{17}$$

$$min\{U_{Broker2}III, U_{Broker2}CII, U_{Broker2}NII\} > max\{U_{Broker2}ICC, U_{Broker2}CCC, U_{Broker2}NCC\}, \tag{18}$$

$$min\{U_{Broker2}ICC, U_{Broker2}CCC, U_{Broker2}NCC\} > max\{U_{Broker2}INN, U_{Broker2}CNN, U_{Broker2}NNN\}. \tag{19}$$

Here, $U_{Broker1}ICI$ is the utility to broker 1 if broker 1 signals I, broker 2 signals C, and investors plays I. Similarly, $U_{Broker2}CII$ is the utility to broker 2 if broker 1 signals C, broker 2 signals I and

investors play I. These inequalities show that conditional on maintaining his credibility, each broker prefers an outcome in which more investment comes into the market.

The broker bias inequalities directly contradict the severe competition inequalities. In addition, the broker bias inequalities 18 and 16 contradict the moderate competition inequalities 12 and 14, respectively. Thus, there are four possible cases; competition is severe and it dominates bias, competition is moderate and it dominates bias, bias dominates severe competition, and bias dominates moderate competition. The following theorem describes the main result of this section:

Theorem 2. *If competition between brokers is moderate and it dominates broker bias, then there is a unique Pure-Strategy Perfect Bayesian equilibrium, in which, in the absence of superior information, brokers cannot manipulate equilibrium outcomes.*

Proof. Start by proposing the following strategy for the neutral types of investor 1 and investor 2:

$$\{I|II,N|NN,C|IC,C|CI,N|NI,N|IN,N|NC,N|CN,C|CC\}$$

In this strategy, if both broker 1 and broker 2 send the same signal, I, N, or C, investors plays I, N, or C, respectively. However, if the signals are in conflict, lesser investment signal is followed (as investors are assumed to be conservative). That is, if broker 1 signals I but broker 2 signals C, then investors play C (third entry in the above set).

In order to figure out the best response of broker 1, consider the following:

Broker 1 has 27 possible strategies. Its primary preference of credibility eliminates 24 of them leaving only three strategies that are not dominated. These three strategies are:

$$\{I|optimistic, I|neutral, N|pessimistic\}$$

$$\{I|optimistic, C|neutral, N|pessimistic\}$$

$$\{I|optimistic, N|neutral, N|pessimistic\}$$

If nature picks both investors' types to be neutral, broker 1 cannot report I since broker 2 will then report C since in moderate competition $U_{Broker2}ICC > U_{Broker2}III$. Consequently, investors will play C and broker 1 will lose its credibility. Similarly, if investors are neutral, broker 1 cannot report N since broker 2 will then report N also, resulting in both investors choosing the lowest demand level N. In moderate competition, brokers prefer that at least some investment (at least C) from investors remain in the market. This guarantees that if broker 1 signals C, then broker 2 will also signal C. This leaves only one possible strategy for broker 1 that can be played in pure strategy equilibrium:

$$\{I|optimistic, C|neutral, N|pessimistic\}$$

Given the strategies of the other three players, the best response of Broker 2 is to signal C if investors' types are neutral and broker 1 has signaled C or I, since, in moderate competition, $U_{Broker2}CCC > U_{Broker2}CNN$ *and* $U_{Broker2}ICC > U_{Broker2}III$.

The best response strategy of broker 2 is:

$$\{I|optimistic\ I; N|pessimistic\ N, C|neutral\ C, C|neutral\ I, N|neutral\ N\}$$

It is straightforward to see that the proposed strategies for investors are the best responses to each other as well as to broker 1 and broker 2. Hence, the strategy profile considered constitutes Nash equilibrium.

To see that this equilibrium is unique: Since brokers' primary preference is credibility, they will always report truthfully if nature chooses at least one investor's type to be either optimistic or pessimistic. This means that any strategy in which investors ignore broker signals cannot be played in

pure-strategy equilibrium simply because it cannot be the best response when nature picks at least one investor's type to be either optimistic or pessimistic. This observation combined with the conservative nature of investors' limits their strategy space to a singleton. □

In this equilibrium, in the absence of superior information (when investors are neutral), both brokers signal C. Hence, there is no false signaling by the brokers. This result illustrates that competition is a market based check on brokers stopping them from manipulating the market. Depth in market for intermediation services has an important role in mitigating manipulation. In a shallow market for intermediation services, it is easier for brokers to collude and limit competition.

Theorem 3. *If bias dominates competition, then, in the absence of superior information, the brokers get their favorite outcome.*

Proof. If investors are neutral, broker 1 will signal I and broker 2 will follow suit since, when bias dominates,

$$U_{Broker1}III > U_{Broker1}CCC > U_{Broker1}NNN \text{ and } U_{Broker2}III > U_{Broker2}CCC > U_{Broker2}NNN$$

□

When bias dominates competition (moderate), there is false signaling in equilibrium allowing brokers to get their favorite outcome. This is in contrast with a situation in which moderate competition dominates bias. In that situation, there is no false signaling in equilibrium.

In our model, moderate competition is an endogenous check on manipulation by intermediaries. However, too much competition is bad for market liquidity as Theorem 4 shows.

Theorem 4. *If competition is severe and it dominates bias then, in the absence of superior information, both investors choose the lowest demand level. Hence, liquidity is the lowest in this case.*

Proof. If investors are neutral, it follows directly from severe competition inequalities that broker 1 will signal N and broker 2 will also signal N since if either broker signals anything else, he will lose his credibility. Both the investors will play N (the lowest demand level). □

Theorems 2–4 show that there is a trade-off between market liquidity and competition among brokers. As Theorem 2 shows, moderate competition between brokers to establish a superior reputation is good as it is an endogenous check on manipulation. This comes at the expense of liquidity because when competition is weak (that is, when bias dominates competition), highest demand level is chosen by the investors as Theorem 3 shows. However, too much competition (severe competition) lowers market liquidity even further because investors choose the lowest demand level as Theorem 4 shows. It is easy to see that the results extend to the case when brokers move simultaneously rather than in sequence.

Often, competition among brokers is presented as being always good for market liquidity as it lowers transaction costs. However, our model indicates another way of thinking about liquidity. There appears to be a trade-off between broker competition and market liquidity (jointly read Theorems 2–4). Moderate competition is good as it indeed checks manipulation (Theorem 2 shows this); however, too much competition between brokers to establish their reputation is bad for market liquidity (Theorem 4 shows this).

3.4. How Do Trend-Followers Survive?

A relevant question is how trend-followers survive in the market? Our framework provides two ways of understanding their continued existence. We do not provide a formal proof as proving the survival of trend-followers is beyond the scope of this paper; however, we provide a plausible argument: firstly, if there is superior information, then a trend-follower is trading in the right direction.

He will be making less profits then fundamentalists and speculators as he is a late entrant in the market; however, as he trades in the right direction when there is superior information, he may make some profits. The profits may be enough to overcome his losses when there is no superior information and market manipulation. Secondly, there may be even later entrants in the market such as momentum investors who only enter if they see a "momentum in the market". In our framework, this can be achieved by adding another player, who only enters if investor 1, investor 2, and trend-follower choose I or if all of them choose N. In this case, it is rational for trend-follower to enter and choose I if both investors have chosen I, and, similarly, it is rational for him to enter and choose N, if both investors choose N.

4. Conclusions

Stock price manipulation by brokers is an issue that frequently raises its head, especially in less developed or emerging markets. However, the lack of an appropriate theoretical framework has left a number of questions unanswered. In particular, how can brokers not lose credibility if they indeed are engaged in manipulation? Presumably, loss of reputation or credibility would hamper their ability to continue to manipulate.

In this paper, we present a simple framework that provides an initial answer to these questions. Interestingly, we find that it is the brokers' concern for credibility that allows them to manipulate while maintaining credibility. Indeed, brokers can manipulate when the investors are rational (fundamentalists and speculators) if trend-followers are also present. We also find that increasing broker level competition to check manipulation may be a double edged sword. On the one hand, moderate levels of competition check manipulation. On the other hand, if competition for reputation is severe, it hurts market liquidity.

The game investigated here is a one-shot game. A repeated game is likely to have a much richer set of equilibria and more involved strategies including bluffing. This is a natural subject for future research.

Conflicts of Interest: The author declares no conflict of interest.

References

Allen, Franklin, and Douglas Gale. 1992. Stock Price Manipulation. *The Review of Financial Studies* 5: 503–29. [CrossRef]

Cheung, Yin Wong. 1997. The Performance of Trading Rules on Four ASIAN Currency Exchange Rates. *Multinational Finance Journal* 1: 1–22. [CrossRef]

Hart, Oliver D. 1977. On the Profitability of Speculation. *The Quarterly Journal of Economics* 91: 579–97. [CrossRef]

Jarrow, Robert A. 1992. Market Manipulation, Bubbles, Corners, and Short Squeezes. *Journal of Financial and Quantitative Analysis* 27: 311–36. [CrossRef]

Jung, Michael Hanjoon. 2009a. Information manipulation through the media. *Journal of Media Economics* 22: 188–210. [CrossRef]

Jung, Michael Hanjoon. 2009b. Who benefits from a sender's credibility concern, the sender or a receiver? *Economics Letters* 105: 204–7. [CrossRef]

Khanna, T., and S. Sunder. 1999. *A Tale of Two Exchanges*; Harvard Business School Case Study.

Khwaja, Asim, and Atif Mian. 2005. Unchecked intermediaries: Price manipulation in an emerging stock market. *Journal of Financial Economics* 78: 203–41. [CrossRef]

Levich, Richard M., and Lee R. Thomas. 1993. The significance of technical trading rules in the FX market: A bootstrap approach. *Journal of Money and Finance* 12: 451–74. [CrossRef]

Menkhoff, Lukas, and M. Schlumberger. 1995. Persistent profitability of technical analysis on foreign exchange markets? *Banca Nazionale del Lavoro, Quarterly Review* 193: 189–214.

Sweeny, Richard J. 1986. Beating the foreign exchange market. *Journal of Finance* 41: 163–82. [CrossRef]

Taylor, Mark, and Helen Allen. 1992. The use of Technical Analysis in the foreign exchange market. *Journal of International Money and Finance* 11: 304–14. [CrossRef]

Zhou, Chunsheng, and Jianping Mei. 2003. Behavior Based Manipulation. Working Paper. Available online: https://ssrn.com/abstract=1299470 (accessed on 4 September 2017).