

Stock Prices and Business Investment

BY YARON LEITNER

Is there a link between the stock market and business investment? Empirical evidence indicates that there is. A firm tends to invest more when its stock price increases, and it tends to invest less when the price falls. In this article, Yaron Leitner discusses existing research that explains this relationship. One question under consideration is whether the stock market actually improves investment decisions.

Empirical evidence points to a link between the stock market and the amount of money firms spend on investment. A firm tends to invest more after the price of its stock increases, and it tends to invest less after the price falls. Investment could be in capital (for example, buying machines or buying a new plant) or in research and development (for example, developing a new drug).

Recent research has tried to come up with theoretical explanations and test them empirically. One important issue is whether the stock market actually improves investment decisions. This might be the case, for example,

if the firm's stock price tells the firm something about the profitability of its investments — which might be the case if market participants have useful information or knowledge that the firm does not have. Interestingly, recent research has also suggested that while informed participants make prices more informative and therefore improve the firm's investment decisions, informed participants might also attempt to manipulate a firm's investment policies.

THE STOCK MARKET CAN GUIDE INVESTMENT DECISIONS

Stock Prices Reflect Investors' Information About the Firm. Investors hold stocks because they expect to obtain dividends and/or make capital gains. When investors expect future profits to be high, they pay more to hold the stock; when investors expect profits to be low, they pay less. Investors do not know what future profits will be, but they can collect pieces of

information that may help them assess the firm's value. For example, investors can look at the firm's financial statements as well as the financial statements of other firms in the industry. They can collect information about the firm's technology, the demand for its products, and its competitive environment. They can also look at other macroeconomic indicators; for example, a strong GDP report might strengthen investors' beliefs that demand for the firm's products is going to be solid. Using these pieces of information, each investor can come up with his own assessment of the firm's value. The stock price reflects these assessments.

When new information arrives, prices adjust. For example, the stock price of a biotech firm will rise after it announces that it passed the initial tests for approval of a new drug, and the price is likely to fall if the firm gets involved in a lawsuit. Passing the initial tests means that the firm is likely to generate more profits, and therefore, investors are willing to pay more to hold the stock. In contrast, being involved in a lawsuit means that the firm is likely to generate less profits, and therefore, investors are willing to pay less.

Investors May Have Information the Firm Does Not Have. Some of the information that investors have may be publicly available (for example, the firm's financial statements). However, some investors may have information no one else has.

Consider the following example: A large hedge fund, Short-Term Management (STM), hires a group of analysts whose job is to help choose which



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stocks to buy. These analysts carefully study the demand for a firm's products (for example, who will use a new drug) as well as the firm's position relative to its competitors'. The firm can also hire its own analysts, but since the firm is not in the business of choosing stocks, the cost of having its own group of analysts may outweigh the benefits.

STM may have a better assessment than the firm (as well as other investors) of the future demand for the firm's products and the firm's position relative to its competitors'. This assessment is called *private information*. In other words, private information refers to the data that STM's analysts gather as well as to their analysis of these data. The private information STM has allows it to evaluate the firm better than anyone else.¹

How could STM use its private information to make a profit? Very simple: If STM thinks the firm's stock is undervalued (that is, the firm's prospects are better than those reflected in the current price), it will buy the stock; if the stock is overvalued, STM will sell it. STM may not be correct all the time. After all, no one can fully predict the future. But STM may be correct on average; that is, the number of times it makes a correct decision (buy an undervalued stock or sell an overvalued stock) will be higher than the number of times it makes mistakes. This will allow STM to make a profit even after paying its analysts' wages.

To keep its information advantage, STM will try to hide its information. However, once STM trades, its information (or at least part of it)

¹ The fact that some investors (like STM) have better information than the firm in some respects does not mean that they have better information in all respects. For example, STM may know more about the demand for the firm's products, but the firm may know more about the technology it uses. In other words, the firm may also have some private information.

gradually becomes reflected in prices. STM's buy orders (positive information) will tend to push the price up, and its sell orders (negative information) will push the price down.

In particular, suppose someone had to guess whether STM has positive information or negative information by looking at aggregate buy and sell orders. Any order could come either from STM or from some other investors who do not have private information. The other investors buy

When some investors have better information than the firm, the firm can use the stock price as a guide in its investment decisions.

and sell not because they have private information but for other reasons; for example, they need to rebalance their portfolio or buy a new house. Now suppose you see that there are many more buy orders than sell orders. A buy order increases the chance that STM has positive information; after all, STM buys only in this case. Similarly, a sell order increases the chance that STM has negative information. Thus, buy orders move the price up, and sell orders move the price down.²

The Information in Prices Can Help the Firm Make Investment Decisions. When some investors have better information than the firm, the firm can use the stock price as a guide in its investment decisions.

Consider the following example. Suppose a firm wants to expand its business overseas, which requires an upfront investment of \$1 million. The firm does not know whether demand

² There is an extensive literature that studies the way prices adjust to information. Two of the earlier theoretical contributions are the paper by Albert Kyle and the paper by Lawrence Glosten and Paul Milgrom.

for its products will be high or low, but it knows that if the demand is high, the investment will yield a gross return of \$6 million (that is, a profit of \$5 million), and if the demand is low, the investment will yield a gross return of zero (that is, a loss of \$1 million). Should the firm make this investment?

If the firm knew for sure that demand was going to be high, it would make the investment; if it knew for sure that demand was going to be low, it would not. However, the firm does

not have that information. Suppose that the only thing the firm knows is that there is a 50-50 chance for high or low demand. This means that if the firm invests, on average, it would earn a profit of \$2 million ($\frac{1}{2} \times 5 - \frac{1}{2} \times 1 = 2$). Therefore, without further information, the firm will make the investment — and this will be the right decision, given the information the firm had at the time it invested.

Now go back to STM and its team of analysts. Once they learn that the firm is considering expanding its business overseas (say, the firm announced it), they work day and night and eventually conclude that the investment is not likely to generate anything. They advise STM's senior management to sell the stock, and when STM does so, the price goes down.

The firm does not have STM's information, but when the firm sees that its price goes down, it may infer that STM does not think that the investment is likely to succeed. The firm can use this information and forgo the investment. Assuming that STM's analysts are correct, the firm saves \$1 million.

The Value of Information. The fact that the firm can use the information in stock prices increases its value. In the example above, the firm can avoid making a bad investment if it learns that demand is low. The firm will invest only if it learns that demand is high. This strategy gives an expected profit of \$2.5 million ($(1/2 * 5 + 1/2 * 0) = 2.5$). Remember, if the firm makes the investment without knowing what demand will be (that is, without looking at the price), its expected profit is only \$2 million. Therefore, STM's trading activities increase the value of the firm by \$1/2 million. The information is valuable because it helps the firm make better investment decisions.

Empirical Evidence. If firms learn from stock prices, changes in stock prices are more likely to affect investment when the stock price contains more private information, that is, when prices are more likely to reflect the trading activities of investors like STM. The logic is simple: If investors like STM trade based on their private information, the firm can learn from prices, and price changes affect future investment decisions. On the other hand, if there are no investors like STM who trade based on private information, the firm cannot learn from prices, and price changes do not affect investment.³

Qi Chen, Itay Goldstein, and Wei Jiang provide empirical evidence that supports the view that firms learn from stock prices when they make their investment decisions. They show that

³ There may be a relationship between price changes and investment even when the price contains no private information. For example, a strong GDP report may move up prices as well as investment. In this case, the firm does not need to rely on prices for its investment; it can look directly at the GDP report. But when the price contains private information, the relationship between prices and investment is likely to be stronger.

a firm's investment is indeed more sensitive to its stock price when the price reflects more private information. A key to their analysis is determining when stock prices contain more private information. Chen, Goldstein, and Jiang use two measures and find that the implication holds for both. To learn more, see *Measures of Private Information*.

STOCK MARKET AFFECTS FIRM'S ABILITY TO FINANCE INVESTMENTS

In the previous section, we focused on a firm that was considering an investment opportunity (a business expansion). The problem was that the firm did not know whether the investment was profitable. In this section, we consider a similar situation but assume that the firm knows whether its investment is profitable. Now the problem is that the firm may find it too expensive to finance its investment because the stock price does not reflect the investment's true prospects.

Stock Prices May Not Reflect the Firm's True Value. A firm's stock price reflects two things. The first is the firm's (true) prospects, that is, the expected cash flows the firm is going to generate from its operations. The value of these cash flows in today's terms is the firm's *fundamental value*. The second — called the *nonfundamental component* — reflects factors that affect the price but that have nothing to do with the firm's prospects. An example is investor sentiment (that is, the market mood): Low sentiment pushes prices down; high sentiment pushes prices up.⁴ In a world without

⁴ In 1996, former Federal Reserve Chairman Alan Greenspan used the phrase "irrational exuberance" to describe the market mood at that time. This phrase was also the title of a 2000 book by Yale economics professor Robert Shiller, who argued that the stock market had indeed become dangerously overvalued.

frictions — for example, all investors have the same information and same assessments of the firm's profitability — the stock price would equal the fundamental value because otherwise investors could make "free money" by buying undervalued stocks and selling overvalued stocks. But when there are frictions, as happens in reality, the stock price may sometimes deviate from its fundamental value.

When Prices Do Not Reflect Fundamentals, Equity Financing May Be Too Costly. Consider a firm with a profitable investment opportunity. How can the firm finance its investment? If the firm has a lot of cash, it can finance its new investment using internal funds. For example, if the firm keeps most of its profits rather than distributing them as dividends, the firm is likely to have enough cash to finance profitable investment opportunities that come its way. However, when the firm does not have enough cash at hand, it needs to raise money from an external source. It can do so either by borrowing (issuing debt) or selling more shares of stock (issuing equity).

Issuing equity is sometimes the only option. In particular, lenders, who want to get their money back, may be willing to lend only to the point where the risk of default is not too high. In addition, lenders often require collateral, and the firm may not have enough of it. Therefore, a firm that has already borrowed a lot (up to its limit) and that has no stockpile of cash can finance a new investment only if it issues equity. We will refer to such a firm as "equity dependent" because its ability to finance a new investment depends on its ability to issue a new equity.

Before making the investment, an equity-dependent firm must consider two things. First, it needs to consider the "stand-alone" value of the investment, that is, the value of the

Measures of Private Information

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he finance literature has come up with two measures to assess the amount of private information in stock prices. Qi Chen, Itay Goldstein, and Wei Jiang showed that their results hold for both measures.

The first measure, developed by Richard Roll, is based on what economists call firm-specific variation. The idea is as follows. The price of a given stock often changes because of market-related and industry-related events. For example, release of a GDP report is likely to affect the prices of most stocks. But a stock's price also moves because of events unique to the firm, for example, the firm's plans to acquire a new plant. Roll's measure calculates how much of the overall variation in the firm's stock price is attributable to firm-specific rather than economy- or industry-wide factors. The measure is higher when the firm's stock price is more likely to move because of firm-specific events, rather than economy-wide or industry-wide events.*

Focusing on firm-specific variation as a measure of trade based on private information makes sense because market- and industry-related price movements are likelier to reflect public information, that is, information available to all. Indeed, Roll showed that firm-specific variation is largely unassociated with public news releases and argued that firm-specific variation mainly reflects trading by investors with private information (for example, STM). Roll mentioned that there might be another explanation, namely, that firm-specific variation simply reflects noise, for example, factors unrelated to fundamentals. However, empirical evidence documented since then provides strong support to the hypothesis that firm-specific variation reflects more private information than noise. For example, Artyom Durnev, Randall Morck, Bernard Yeung, and Paul Zarowin showed that firm-specific variation is highly correlated with stock prices' ability to predict firms' future earnings.

The second measure, developed by David Easley, Nicholas Kiefer, and Maureen O'Hara, captures the probability that a trade will come from a trader who has private information. The measure is based on a model where some individuals have private information and some do not. The first group of traders is called informed and the second uninformed. Informed individuals trade only on days on which they receive private information (that is, they privately learn something about the firm). They

trade in order to profit from their private information; they buy if they receive good news about the firm and sell if they receive bad news. The uninformed trade every day, and their trading activity does not reflect any information regarding the firm; for example, they buy and sell to rebalance their portfolios.

To calculate the probability of a trade by an informed investor, we first need to fit the model to the data. In particular, we can look at daily order flows over some period (say, a year) and then use statistical methods to estimate the probability that a given order comes from an informed trader.

The estimated probability (of informed trading) is low when the number of buy and sell orders does not fluctuate much from one day to another. In contrast, when there are large fluctuations in order flows, the estimated probability of informed trading is high. Intuitively, if the number of uninformed investors is high (so the probability of informed trading is low), there is no reason to expect that all of them will decide to buy or that all of them will decide to sell on the same day. Instead, we can expect that the number of uninformed investors who decide to buy will be roughly the same on any given day and so will the number of investors who decide to sell. Therefore, we will not see large fluctuations in order flows, and the estimated probability of informed trading will indeed be low. In contrast, when there are large fluctuations in order flows, the estimated probability of informed trading is high because under the model above, large deviations from the "normal" order flow indicate that it is likely that trades are coming from investors who have received private information; for example, on a day on which informed investors receive good news about the firm, they will all buy, and the number of buy orders on that day will be larger than normal.

Finally, note that, in principle, the two measures above may reflect not only the trading activity of investors like STM but also the trading activity of the firm's managers, who may also have superior information regarding some aspects of the firm. If this were the case, the measure above may capture information that the firm already knew, which is not consistent with the idea that the firm learns from prices. Chen, Goldstein, and Jiang validate their results by performing some tests that suggest that while the two measures may reflect some information the firm already knew, it also reflects information the firm did not know.

* To calculate this measure, one needs to run a regression where a firm's return is explained by the return on the market and by the return on the industry to which the firm belongs. The measure is estimated by $1-R^2$, where R^2 is R-square from the regression. In other words, R^2 is the share of variation in stock returns that can be explained by general (market) or industry-wide factors, and what's left over ($1-R^2$) measures private information.

investment if the firm had the cash to finance it. Second, given that the firm is equity dependent, it needs to take into account the cost of issuing equity. In particular, if the stock price equals the firm's fundamental value, the firm knows that it is selling the stock for what it is worth. But if the firm believes that its stock is undervalued (its price is less than the fundamental value), the firm knows that it is losing money when it sells its stock. In other words, the firm receives less than what the stock is really worth. In this case, a firm may decide to forgo some investments, even though the firm would make the investments if it had its own money. In other words, an equity-dependent firm may decide to forgo its investment because the cost of issuing new shares is too high compared with the revenues the firm expects to obtain from the new investment.⁵

Empirical Evidence. The discussion above implies that the investment of equity-dependent firms will be more sensitive to the nonfundamental component in stock prices than the investment of firms that are less equity dependent. In particular, an equity-dependent firm will tend to invest less when its stock price is below the fundamental value, that is, when the nonfundamental component is negative. This occurs not because investment opportunities change but because

⁵ Issuing equity may raise another problem: If the firm knows more than its investors, investors may fear that the firm is selling equity not because it needs to finance a profitable investment but because the firm thinks that its stock is overvalued. Therefore, once the firm decides to sell more shares, investors may pay even less than what the initial price was. According to the pecking order theory, the firm will issue equity only as a last resort. In particular, a firm that needs to raise money will do it in the following order: First, the firm will use its internal funds, then it will borrow; only after it has borrowed as much as it can will it issue equity. To learn more about the pecking order theory, read the paper by Stewart Myers.

an undervalued stock increases the cost of obtaining the money the firm needs for its investment.

Malcolm Baker, Jeremy Stein, and Jeffrey Wurgler found empirical evidence consistent with the implication above. A challenging issue in their analysis was how to measure the nonfundamental component in stock prices. Baker, Stein, and Wurgler tried to tackle this issue by looking at the actual return on the stock in the long term; specifically, they looked at returns over the three years subsequent to the investment. Their idea is that the firm expected these returns when it considered its investment and that the firm used these returns to determine whether its stock was under- or overvalued. Of course, the firm did not and could not know for sure how future returns would turn out. However, using future returns as a proxy for the firm's expected returns is a way for the authors (and us) to have a reasonable estimate of what the firm might have had in mind. Using this logic they find that the investment of equity-dependent firms is indeed more sensitive to the nonfundamental component in stock prices than the investment of firms that are less equity dependent.⁶

Lenders Also Look at Stock Prices. Stock prices may also affect the cost of borrowing. In particular, potential lenders (banks) can learn from stock prices just as the firm in the previous section did. Banks can then use the information in stock prices to evaluate a loan.⁷ When stock prices reflect fundamentals, there is no problem: Banks have correct information about the firm, and a firm with a

⁶ To determine how equity dependent a firm is, Baker, Stein, and Wurgler construct an index. According to the index, a firm is more equity dependent if it has borrowed a lot; it is less equity dependent if it has higher operating cash flows or higher cash balances or if it pays higher dividends.

profitable investment opportunity can raise money because the stock price reflects that. But if the price does not reflect fundamentals, a firm with a good investment opportunity may need to forgo it. In particular, when banks see that the stock price is low, they may wrongly conclude that the firm's prospects are not so good, and therefore, they may be unwilling to lend, or they may agree to lend only at a very high interest rate.⁸

TRADERS CAN MANIPULATE INVESTMENT DECISIONS

We have seen that the stock market may affect investment decisions because it provides information both to the firm that makes the investment and to those who provide the money for the investment. Itay Goldstein and Alexander Guembel developed a model to show that while this may improve investment decisions, it may also open the door for manipulation.

Let's go back to the example where a firm was considering an investment opportunity (\$1 million payment upfront, which results in either a \$5 million profit or a \$1 million loss). Suppose the firm does not know whether the investment will succeed or fail, but STM does. As we saw earlier, STM can use its private information to

⁷ Indeed, widely used measures of default risk (for example, Altman's Z-Score) include the firm's stock price. The Z-score was developed in 1968 by Edward Altman for forecasting the probability that a company will enter bankruptcy within a two-year period. The Z-score combines five common business ratios, one of which is the ratio between the market value of equity and the book value of debt. (The market value of equity is the stock price times the number of shares outstanding.) Banks and industrial companies regularly use updated and refined proprietary versions of Altman's Z-score model.

⁸ In this section we focused on the case where prices that do not reflect fundamentals make it hard for a firm to finance its project. Prices that do not reflect fundamentals would also make it hard for the firm in the previous section to learn from prices.

make a profit by buying undervalued stock and selling overvalued stock. If STM does so, the stock price reflects STM's private information and can help the firm make better investment decisions. In particular, a price decline indicates to the firm that STM thinks the investment is a failure, and the firm can save money by not investing.

Goldstein and Guembel show that an investor like STM may choose to trade even if it has no information at all.⁹ In this case, the only purpose of STM's trade is to manipulate the firm's investment decisions and make money out of it. In particular, they assume that sometimes STM has private information about the firm and sometimes it does not. They show that STM may choose to trade not only in the first case but also in the second case.

Manipulation Is Possible Through Short Sales. When STM has no information, it can make a profit by *short selling* the stock. Short selling means that an investor (in our case, STM) borrows the stock from someone else and sells it. Then, at a later date, the investor buys the stock and returns it to whomever he borrowed it from. In other words, a short seller sells a stock that he does not own. Short selling might be a good strategy if one expects prices to fall. In this case, the short seller can make a profit by buying the stock at a lower price than the price at which he sold the stock.

But why should STM expect to be able to buy the stock at a lower price? The main idea is as follows: By selling the stock, STM drives down the price. The firm infers that the lower price may indicate that STM thinks the firm's investment is likely

⁹ Goldstein and Guembel use the word *speculator* to refer to an investor like STM, which may or may not have private information.

to fail. Therefore, the firm does not invest. This by itself reduces the value of the firm and the price of the stock even further, thereby allowing STM to buy the stock at a lower price than it initially sold it for. In other words, initially, investors thought the firm had an investment expected to yield a profit of \$2.5 million, so they were willing to pay more to hold the stock. Once they learn the firm is not making the investment, they are willing to pay less and the price of the stock falls.

You might ask: What's so special about STM? Why can't anyone follow the same strategy and make a profit? The logic is as follows: For the average investor, who never has private information, short selling is a recipe for losing money because the average investor competes with investors, like STM, who are likely to be better informed. Since the more informed investors make money, the less informed lose. Remember, there must be an investor on the other side of each of STM's trades. However, for an investor like STM, short selling can be a winning strategy *even when it has no private information about the stock*. The reason is that only STM knows whether it does or does not have information — and this by itself is a very important piece of information. In other words, STM has an information advantage not only when it has private information about the firm but also when it does not. In the first case, it knows whether the investment will succeed or fail. In the second case, it does not know that, but it knows that no one else knows. In contrast, the average investor, who never obtains private information, always needs to take into account the possibility that he or she is trading with another investor (STM) with better information.

To summarize, by short selling, an investor can manipulate the stock price and the firm's investment deci-

sions. Indeed, many firms complain about short sales, arguing that they may be manipulative and therefore costly to shareholders. For example, in a letter to the Securities and Exchange Commission (SEC), Medzone International Inc. claims that "short-selling... and other actions that have served to limit our access to capital, diminished or suppressed the value of our shares... This short selling has proven extremely detrimental to our company and our shareholders."¹⁰

One of the interesting features of the model above is that manipulation is profitable only through short sales. In particular, STM can profit by selling the stock initially and buying it later, but STM cannot profit from doing the opposite, that is, buying first and selling later. The reason is that if STM trades when it has no information, the trades distort prices as well as the firm's investment decisions. In particular, STM's selling the stock leads to a price decline and an inefficient decrease in investment; STM's buying the stock drives the price up, leading to an inefficient rise in investment. In both cases, the firm makes a wrong investment decision, and the stock price falls at a later time to reflect that. In other words, regardless of whether STM manipulates by buying or selling, the price eventually drops. This means that STM can profit only if it sells initially.

Finally, note that even though manipulation distorts investment

¹⁰ This example is provided by Goldstein and Guembel. The letter can be found at <http://www.sec.gov/rules/concept/s72499/marshal2.txt>. Regulatory bodies (for example, the SEC in the United States) have introduced restrictions such as the "up-tick" rule on short sales. According to the up-tick rule, established by the SEC, every short-sale transaction must be entered at a price that is higher than the price of the previous trade. The up-tick rule prevents short sellers from adding to the downward momentum when the price of an asset is already experiencing sharp declines.

decisions, which is bad for the firm, overall, the stock market produces better decisions, which is good for the firm. Otherwise, the firm would have ignored the information in the stock price. In other words, if the firm (or other investors) knew that the stock market reflects wrong information too often, they would have ignored it when they made their decisions. However, if the price usually reflects correct information and only seldom reflects incorrect information (which is the case if STM is likely to have private information), the firm as well as investors would consider the price when they make their decisions.

CONCLUSION

Stock prices may affect investment decisions because they provide information to firms about the profitability of their investment opportunities. Stock prices may also affect firms' ability to finance new investments. In particular, when prices do not reflect fundamentals, a firm with a profitable investment opportunity may need to forgo it.

We have also seen that while short selling may make stock prices more informative about the firm's prospects and therefore may improve the firm's investment decisions, the ability to short sell may also open the

door to manipulation. In particular, by short selling a stock, an investor with no information may cause a firm to believe that its investment is likely to fail. This may cause the firm to forgo some profitable investment opportunities. The SEC administers regulations concerning short sales. For example, the SEC does not permit short sales when a stock price is falling. Much of the discussion about regulation of short sales centers on the tradeoff between making stock prices more informative and the danger of manipulation. The work discussed in this article can help clarify the terms of this tradeoff. 

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