REVIEWS IN ADVANCE

The Real Effects of Financial Markets

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Abstract

A large amount of activity in the financial sector occurs in secondary financial markets, where securities are traded among investors without capital flowing to firms. The stock market is the archetypal example, which in most developed economies captures a lot of attention and resources. Is the stock market just a sideshow or does it affect real economic activity? In this review, we discuss the potential real effects of financial markets that stem from the informational role of market prices. We review the theoretical literature and show that accounting for the feedback effect from market prices to the real economy significantly changes our understanding of the price formation process, the informativeness of the price, and speculators' trading behavior. We make two main points. First, we argue that a new definition of price efficiency is needed to account for the extent to which prices reflect information that is useful for the efficiency of real decisions (rather than the extent to which they forecast future cash flows). Second, incorporating the feedback effect into models of financial markets can explain various market phenomena that otherwise seem puzzling. Finally, we review empirical evidence on the real effects of secondary financial markets.

1. INTRODUCTION

One of the most important topics in financial economics is whether financial markets have an effect on the real economy. This question has become particularly relevant in the light of the recent financial crisis. An important line of research, exemplified by Bernanke & Gertler (1989) and Kiyotaki & Moore (1997), studies how adverse selection or moral hazard problems affect primary financial markets by limiting the ability of entrepreneurs and firms to raise external capital. This in turn constrains real investment, and so frictions in primary financial markets end up reducing real economic activity.

However, there is an important feature of real-world financial markets that is missing in this line of research, namely that a large fraction of activity occurs in secondary financial markets, in which securities are traded among investors, without any capital flowing to firms. The archetypal example of a secondary market is the stock market, in which capital flows to a firm only when it issues shares, but most of the time, trading is conducted between investors and does not involve the firm at all. In this sense, derivative markets are almost always secondary, and there is a large amount of activity in secondary bond markets as well. In most developed economies, substantial resources are devoted to secondary markets such as the stock market. However, in the line of research mentioned above, the operation of secondary financial markets has either no effect on the real economy, or else affects the real economy only to the extent to which ex post liquidity affects firms' cost of capital in primary markets.

How can one explain the attention devoted to secondary financial markets? Why do managers constantly track the performance of their firms' stocks? Why does the press so frequently report the developments in the stock market? Can this be rationalized in a world where secondary market prices are passive (i.e., epiphenomenal), in that they merely reflect expectations about future cash flows and do not affect them, as in many economic models, including most of those used in the asset pricing literature? Similarly, is it plausible that secondary market prices are purely passive, and have no effect on real decisions, given that a vast empirical literature documents how much information prices contain about future cash flows?

In our view, treating secondary market prices as a sideshow is a mistake. Instead, we argue that one should take seriously the idea that secondary market prices have an effect on real economic activity. Because secondary financial markets do not lead to any direct transfer of resources to the firm, prices in these markets have real consequences only if they affect the actions of decision makers in the real side of the economy (henceforth, real decision makers). We can think of three reasons for which this may occur. We argue that all of them originate from the informational role of prices.

First, real decision makers learn new information from secondary market prices and use this information to guide their real decisions. The idea is very natural, going back to Hayek (1945), who argued that prices are a useful source of information. A financial market is a place where many speculators with different pieces of information meet to trade, attempting to profit from their information. Prices aggregate these diverse pieces of information and ultimately reflect an accurate assessment of firm value. Real decision makers (such as managers, capital providers, directors, customers, regulators, employees, etc.) will learn from this information and use it to guide their decisions, in turn affecting firm cash flows and values (Baumol 1965). Ultimately, the financial market has a real effect due to the transmission of information.

Some readers may wonder if it is plausible that real decision makers learn from prices. They are closer to the firm than market traders, and so one might expect them to have better information. However, this logic is incomplete. The assumption needed for financial markets to have a real effect via the transmission of information is not that real decision makers are less informed than traders, but only that they do not have perfect information about every decision-relevant factor, and so outsiders may possess some incremental information that is useful to them. Thus, real decision makers may be the most informed agents in the economy about the firm, but there are still aspects about which they can learn from outsiders. This is for two reasons. First, although an individual speculator may be less informed than the manager, the market aggregates the information of many speculators who collectively may be more informed (Grossman 1976, Hellwig 1980). Second, optimal real decisions depend not only on internal information to the firm (about which the manager may be more informed), but also on external information, such as the state of the economy, the position of competitors, the demand by consumers, etc. Indeed, Allen (1993) convincingly argues that the usefulness of market information has increased as production processes have become more complex.

Consider, for example, a firm manager, who is arguably the individual most informed about the firm's fundamentals. The manager announces an acquisition bid for another firm. This decision is often made after undertaking substantial internal analysis and seeking the external counsel of investment banks, to assess whether the value of the target to the acquirer exceeds the offer price. As is well known, this assessment is based on assumptions with a high degree of uncertainty. In particular, the desirability of the deal depends on many factors other than the acquirer's fundamentals and about which the acquirer may be less than fully informed—such as the stand-alone value of the target, the likely synergies between the acquirer and the target, and the future prospects of the industry (which affects whether it is optimal for the acquirer to expand via acquisition). Hence, it is entirely plausible that, among the many speculators who trade in the stock market, some have insights into the proposed deal that were missed by the manager and his advisors. If participants trade on this information, their insights will be reflected in the price. Hence, when a manager announces an acquisition and the market responds negatively, he may learn from this response and cancel the deal. Empirical evidence on this channel was presented by Luo (2005).[1] Similarly, early empirical evidence in the IPO literature (see Jegadeesh, Weinstein & Welch 1993 and Michaely & Shaw 1994) found support for models in which outsiders know more than insiders about the value of the firm.[2]

More generally, managers may learn from prices when making other decisions, such as investment, as shown by Chen, Goldstein & Jiang (2007) and Bakke & Whited (2010). Moreover, decision makers other than managers are further removed from the firm and also lack decision-relevant information. Thus, they are even more likely to use the information contained in market prices to guide their actions, which affect the firm's cash flows and values. Credit-rating agencies are known to be influenced by stock prices, and their decisions have a large effect on the availability of credit to the firm. Regulators, who take

[1] As an analogy, assume that there exist stock prices on individual researchers, which reflect the views of the general profession. If a researcher's stock price fell upon starting a new project, many such researchers would choose to abandon the project.

[2] Many theories in the IPO literature are based on the assumption that stock-market participants have information about some aspects of the firm that is not available to the firm's managers. See, for example, Rock (1986); Benveniste & Spindt (1989); Benveniste & Wilhelm (1990); and Biais, Bossaerts & Rochet (2002).

actions that affect firm cash flows (most prominently, in the case of banks), follow market prices very closely (e.g., Feldman & Schmidt 2003 and Burton & Seale 2005), and recent proposals in the light of the crisis advocate increasing the reliance on market prices even further (e.g., Flannery 2009, McDonald 2010, and Hart & Zingales 2011). Similarly, employees and customers may base their decisions on whether to work for the firm or buy its products on information they glean from the market.

Second, even if decision makers do not learn from market prices, they care about market prices because they are party to contracts that are contingent on market prices. This is most relevant for firm managers, whose compensation is tied to the firm's share price. Then, the manager's incentives to take real actions will depend on the extent to which they will be reflected in the stock price. If the stock price is not closely tied to firm value, but instead driven by noise, the manager has weak incentives to exert costly effort to improve the firm's fundamental value.

Importantly, even though this second channel does not involve active learning from the price, it is ultimately similar to the first channel, in that market prices end up having a real effect due to their informational role. The reason that contracts are conditioned on prices to begin with is most likely due to their informational role. Shareholders choose to solve agency problems with the firm's manager by tying his compensation to the stock price, because they believe that the stock price contains information about firm value. If prices were uninformative, shareholders would not tie managerial compensation to stock prices, and so managers would not care about them.

Third, another possibility, favored by proponents of behavioral finance, is that secondary market prices have a real effect on economic activity because real decision makers irrationally follow the price and use it as an anchor. Although we do not deny that irrationality exists, the ultimate source of the effect is likely to be the informational role of prices. Presumably, the reason that real decision makers look at the price, rather than other public signals, is that the price often contains information. There may be overreaction due to bounded rationality, but the informational content is key for some reliance on the price to arise. Even fully rational learning from the price can lead to inefficient decisions, given that price changes sometimes arise from nonfundamental shocks (such as price pressure caused by fire-sales), which real decision makers may misinterpret as arising from fundamental shocks.[3]

In this review, we survey models that feature a feedback effect from financial markets to the real economy due to the informational role of prices. Unlike the traditional approach, where prices only reflect expected firm cash flows, in these models prices both affect and reflect firm cash flows. George Soros, a prominent trader, has termed this feature "reflexivity," and summarized it as follows: "In certain circumstances, financial markets can affect the so-called fundamentals which they are supposed to reflect."[4] In reviewing the theoretical literature, we show that accounting for the feedback effect from market prices to the real economy significantly changes our understanding of the price formation process, the informativeness of the price, and speculators' trading behavior.

We make two main points. First, if one accepts the idea that secondary prices have an effect for informational reasons, it follows that the traditional definitions of price efficiency need to be augmented. In particular, although financial economists typically study whether

[3]In contrast, it is quite possible for fluctuations in primary financial prices to have an effect, even if these fluctuations come solely from irrationality on the part of investors (see the survey of Baker & Wurgler 2012).

[4]This quote is taken from a testimony given by George Soros before Congress in 1994.

prices forecast future cash flows, a potentially more important question to ask is whether prices accurately convey information about underlying economic state or choice variables that are important for real efficiency. We show that the two notions often diverge in models with feedback effects. (This point goes back to Hirshleifer 1971; Bresnahan, Milgrom & Paul 1992; and Dow & Gorton 1997.) In particular, market prices may convey less useful information to decision makers than traditional notions of market efficiency would suggest. In addition, the extent to which prices reveal information about an underlying state variable depends critically on how decision makers will use this information. When using the information in the price, decision makers might harm the informativeness of the price with respect to the variable they wish to learn. Second, we discuss the implications of the informational feedback from financial markets to real activities for various topics of research in finance and in particular show how it generates natural explanations of phenomena—such as manipulative short selling, the asymmetric dissemination of bad news and good news, financial-market runs, information-based trading, and the presence of noncontrolling blockholders—that otherwise seem puzzling.

The remainder of the review is organized as follows. Section 2 describes models of learning by decision makers from market prices. Section 3 describes models in which financial markets have real consequences due to their incentive effect. Section 4 discusses the implications of feedback from financial markets to real activity for various research topics in financial economics. Section 5 reviews empirical evidence on the real effect of secondary financial markets. Section 6 concludes.

2. LEARNING BY DECISION MAKERS

A central topic in financial economics is price efficiency, which is defined as the extent to which market prices are informative about the value of traded assets. Financial economists often argue that price efficiency is desirable because market prices guide real decisions (such as investment). Thus, informative prices enable superior decision-making: Price efficiency promotes real efficiency. For example, Fama & Miller (1972, p. 335) note: "(an efficient market) has a very desirable feature. In particular, at any point in time market prices of securities provide accurate signals for resource allocation; that is, firms can make production-investment decisions ...." This idea is quite natural: If prices are efficient and aggregate information from various sources, then decision makers in the real sector, who are likely to be only partially informed, will wish to learn from prices. This idea goes back to Hayek (1945), who argued that prices are a useful source of information. There is vast empirical literature documenting the informational content of prices. Strikingly, market prices contain information even about events far removed from firm cash flows: Roll (1984) shows that futures markets improve weather forecasting relative to traditional meteorological forecasts, while a large literature on prediction markets (see Wolfers & Zitzewitz 2004) shows that markets provide the most efficient mechanism for predicting election outcomes. As argued in the introduction, there are many types of decision makers who can potentially learn from prices: managers, regulators, capital providers, customers, employees, etc. The assumption is not that these agents (in particular, managers) are less informed overall than speculators, but simply that speculators have some information that they do not have.

However, theoretical research on financial markets traditionally treats the real side of the firm as exogenous. A large literature, starting from the seminal papers by Grossman &

Stiglitz (1980), Hellwig (1980), Admati (1985), Glosten & Milgrom (1985), and Kyle (1985), analyzes models in which informed speculators trade on their information about firm value and studies the extent to which their information is incorporated into prices—i.e., whether prices are efficient. Given that firm value in these papers is typically exogenous to trading in the financial market, these models do not allow us to study how real efficiency is affected by price efficiency.

An exception is the early literature on the desirability of insider trading. Fishman & Hagerty (1992); Leland (1992); Khanna, Slezak & Bradley (1994); and Bernhardt, Hollifield & Hughson (1995) present models where different types of speculators—insiders and outsiders—trade on their information. On the one hand, limiting insider trading reduces price efficiency, given that information possessed by insiders is no longer impounded into prices. On the other hand, it also reduces adverse selection and thus encourages outsiders to trade on their information, increasing price efficiency. Hence, there is a trade-off with respect to the effect of insider trading on price efficiency. In these models, real decision makers learn from the price, and so the implications of the effect of insider trading on price efficiency are automatically translated into implications on real efficiency.

Similarly, Boot & Thakor (1997) and Subrahmanyam & Titman (1999) use the feedback effect to rationalize a firm's choice to issue publicly traded securities, rather than receiving private financing (e.g., from a bank). In these models, public trading allows the firm to infer information from its stock price and use it to improve its real decisions. Foucault & Gehrig (2008) extend this reasoning to explain the decision of a firm to cross-list its shares in two different markets: Cross-listing enables the firm to obtain more precise information from the stock market and improve the efficiency of its investment decisions.

However, the link between price efficiency and real efficiency turns out to be more complicated, as was shown by Dow & Gorton (1997). They study a model where managers learn from prices. There are two equilibria. In the first equilibrium, speculators produce information and trade on it, so that their information is incorporated in prices. Managers then base investment decisions on prices. In the other equilibrium, speculators do not produce information, and investments are not made (because their unconditional NPV is negative). Technically, in this second equilibrium, prices are efficient since they fully reflect the fact that investment is not going to occur. However, real efficiency is low, given that the market does not provide information to guide real investment decisions. Hence, price efficiency does not necessarily imply real efficiency.

We can express the tension between price efficiency and real efficiency as follows. The traditional focus of price efficiency is whether the price of a given security accurately predicts the future value of that security. However, what matters for real efficiency is whether the price reveals information necessary for decision makers to take value-maximizing actions. To distinguish the two notions, we refer to the traditional notion—forecasting firm value—as forecasting price efficiency (FPE), and we term the extent to which prices reveal the information necessary for real efficiency as revelatory price efficiency (RPE). Dow and Gorton's point is that it is quite possible for prices to be efficient in the forecasting sense, but not in the revelatory sense. Revelatory price inefficiency immediately generates real inefficiency. In contrast, forecasting price inefficiency affects real inefficiency only to the extent to which it is related to revelatory price inefficiency.[5]

[5] Although RPE is necessary for real efficiency, it is not sufficient. For example, firms may fall short of real efficiency simply because limited enforceability makes it impossible for shareholders to force a manager to take a particular action.

The papers discussed above assume that decision makers lack information about state variables whose realization affects the value-maximizing action. Thus, in our definition of RPE, the information necessary for decision makers to take value-maximizing actions is information about these state variables. Here, the distinction between RPE and FPE is reminiscent of Hirshleifer's (1971) distinction between discovery and foreknowledge. Discovery is important to uncover unknown information that can guide decision making, whereas foreknowledge is information about something that will be found out eventually, and hence learning it early has no real implications. Hirshleifer (1971) emphasizes that foreknowledge has no social value, whereas discovery is valuable, and argues that economic forces do not guarantee optimal information production. Looking ahead to the next section, agency problems sometimes imply that the information necessary for real efficiency is instead information about the privately observable actions of decision makers, and RPE relates to how accurately prices reveal these actions.

The literature has identified at least three distinct ways by which RPE can fail in the case that state variables are unobserved by decision makers.

First, assume there is perfect FPE, in that the security price perfectly aggregates all information currently available to market participants. RPE commonly fails if expected firm value is nonmonotonic in the state variable under the efficient decision. To see this, observe that in this case, real efficiency and FPE imply the price is nonmonotonic in the state variable. But then a given price level can be associated with multiple different realizations of the state variable, and so RPE fails. Such nonmonotonicity can arise when the decision maker would like to take a corrective action that increases firm value when the state variable falls below a certain threshold. For example, a board of directors may fire a badly performing manager, a private-equity fund may buy out an underperforming firm, or the government may provide assistance to an underperforming bank. Bond, Goldstein & Prescott (2010) analyze equilibrium outcomes in this case. They show that to achieve the desirable outcome, the decision maker cannot fully rely on the information in the price, but must have some independent information of his own. In the context of monetary policy, Bernanke & Woodford (1997) observe that a similar problem constrains inflation targeting. Sundaresan & Wang (2011) analyze the implications for the reliance on contingent capital with market triggers.

Second, as in Dow & Gorton (1997), RPE can fail because a firm's response to the information conveyed in prices may destroy speculators' incentives to collect information in the first place. In their model, this occurs when a firm interprets security prices as being random and hence uninformative, and so does not invest; but then foreseeing no investment, speculators do not find it profitable to collect information, ensuring that prices are indeed uninformative. Bresnahan, Milgrom & Paul (1992) present a milder version of this general argument: Speculators may have stronger incentives to collect information about the future value of a firm's assets in place than about cash flows that a firm's current actions can affect. Dow, Goldstein & Guembel (2011) show how a similar mechanism can amplify bad economic shocks. Bad shocks directly reduce firms' investments, and this reduces speculators' incentives to produce information. As a result, firms' investments decline further and so do their values (due to a decrease in the amount of available information), amplifying the original shock. Faure-Grimaud (2002) and Lehar, Seppi & Strobl (2008) study another effect: If a regulator acquires information from market prices, his incentives to acquire distinct information by himself are reduced, and so for some parameter values, the regulator's total information (from all sources) is reduced.

Third, even if speculators receive information costlessly, RPE may fail if prices do not efficiently aggregate speculators' diverse pieces of information. This possibility is analyzed by Bond & Goldstein (2011), who characterize circumstances under which the act of using prices as an input to economic decisions reduces RPE. The decision maker's reliance on market prices affects speculators' incentives to trade on their information, in light of the traditional trade-off they face between risk and return. The extent of information aggregation also affects the traditional notion of FPE, but the two efficiency measures do not coincide. Bond & Goldstein's analysis highlights another dimension of RPE: Even if a decision maker could increase RPE by committing to completely ignore security prices, he would prefer instead to put some weight on security prices. The reason is that RPE is a relevant metric only if prices are actually used in making decisions. Hence the appropriate welfare measure must combine RPE with the extent to which prices are actually used in decisions.

In summary, the papers above explain why market prices may convey less useful information to decision makers than is commonly assumed to be the case when markets are efficient in the traditional sense; in our terminology, RPE may fail even when FPE holds. In addition, they show that the extent to which prices reveal information about an underlying state variable depends critically on the uses to which the information will be put by decision makers. When using the information in the price, decision makers might harm the informativeness of the price with respect to the variable they wish to learn.

Whereas the above discussion focuses on the effect of financial markets on production efficiency, a distinct welfare effect of financial markets relates to the possibility of sharing consumption risk. Under some circumstances, increases in RPE lead to a reduction in risk-sharing possibilities, due to what has been dubbed the Hirshleifer (1971) effect: One cannot insure against shocks after their realization has become public. Dow & Rahi (2003) develop a full welfare analysis of the effect of informed trading, considering both production and consumption effects.

3. IMPROVED INCENTIVES

A second channel through which financial markets may have real effects is by affecting a decision maker's incentives to take real decisions. This effect was first discussed by Baumol (1965), and an early formalization can be found in Fishman & Hagerty (1989). In their paper, a manager chooses the firm's investment level, which is unobservable to investors. By assumption, the manager's aim is to maximize the firm's share price. If the share price perfectly reflected expected cash flows, the manager would choose the efficient investment level, i.e., equate the marginal benefit of investment to its marginal cost. However, given that the investment choice is unobservable to market participants, prices do not reflect expected cash flows: An investment that raises expected cash flows by \$1 augments the expected share price by less than \$1. Consequently, the manager underinvests. If price efficiency increases, the price more closely reflects the fundamental value of the firm and thus the benefits of any investment that the manager has undertaken. This reduces the underinvestment problem and increases real efficiency. Fishman & Hagerty use this insight to examine a firm's incentives to disclose information and thereby affect price efficiency.

In the incentives channel, decision makers such as the manager do not learn from prices. Instead, prices affect the manager's incentives as his contract is tied to them. Thus, in our

definition of RPE, the information that the price must reflect for the manager to take value-maximizing actions is information about his actions. Put differently, the greater the extent to which the stock price reflects the manager's actions, the greater his incentives to take desirable actions and avoid undesirable ones. Thus, the role played by RPE in the two channels is subtly different. In the incentives channel, RPE affects the decision maker's incentives to take the efficient action. In the learning channel, RPE affects his ability to take the efficient action, by revealing to him what the efficient action is. As in Section 2, RPE and FPE here need not coincide. Paul (1992) theoretically demonstrates that efficient markets (i.e., markets that exhibit FPE) weight information according to the informativeness about asset value, whereas for optimal incentives, information should be weighted according to its informativeness about the manager's actions. That FPE and RPE diverge is illustrated by Singh & Yerramilli (2010), who show that certain types of transparency simultaneously increase FPE but decrease RPE.

A limiting case of Paul (1992) is that speculators have no information about the manager's actions. Stein (1989) analyzes a model of this type and shows that even when financial markets are efficient in the traditional (FPE) sense, managers who seek to maximize the stock price have the incentive to take non-value-maximizing actions—in his model, earnings manipulation—that are not observed by the market. Again, the real inefficiency reflects a failure of RPE. In the same vein, Brandenburger & Polak (1996) show that managers who seek to maximize the stock price have the incentive to ignore their own (superior) information about the best decision, and follow the market priors, again leading to non-value-maximizing actions. Aghion & Stein (2008) make a related point, showing that managers will choose to pursue the strategy expected by the market.

The above papers generally take as exogenous the dependence of the manager's contract on the stock price. Holmstrom & Tirole (1993) endogenize this dependence by solving for the optimal contract between shareholders and the manager. In such a case, changes in stock-market efficiency have a second effect, in that they affect the equilibrium contract, and thus the extent to which the manager cares about the price. In Holmstrom & Tirole, when price efficiency increases, the stock price provides a less noisy signal of firm value. Thus, if the manager is risk averse, it is optimal to increase the weighting of the contract on the stock price relative to nonprice measures of performance, such as accounting profits. Simply put, shareholders pay the manager according to the stock price, given that it reflects firm value. Hence, it is effectively shareholders (the principal) rather than the manager (the agent) who learn from stock prices. This endogenous response of the contract amplifies the effect of price efficiency on real efficiency in their model. Separately, there are several other potentially important reasons why the manager may care about the stock price, which is essential for the incentives channel to operate. For example, shareholders may have short horizons themselves and hence want to incentivize the manager with contracts that depend on the short-term share price. Alternatively, the manager may care about the short-term share price due to takeover threats, reputational considerations, or expecting to sell his own shares in the short run.

In all the papers mentioned above, the decision maker is the manager of a firm. In common with the learning channel discussed in Section 2, stock-market efficiency may also affect the actions of other decision makers. For example, Faure-Grimaud & Gromb (2004) show that an increase in RPE raises the incentives of a blockholder to take a value-augmenting action, the benefits of which may not materialize until after a liquidity shock forces the blockholder to sell.

4. IMPLICATIONS FOR FINANCIAL MARKETS AND CORPORATE FINANCE

Considering a feedback effect from financial markets to firms' real decisions generates an array of implications for the study of financial markets and corporate finance. Often, phenomena that are believed to be puzzling can be rationalized in a model in which financial markets have real effects. We frequently draw a distinction from the traditional view of security prices, in which cash flows affect prices, but prices have no effect on cash flows. Our focus here is on models that exhibit endogenous feedback, i.e., via learning and/or incentives. Several papers in the literature generate related implications based on models with exogenous feedback, i.e., where firm value or the firm's investment decision is assumed to be mechanically tied to the price (see Khanna & Sonti 2004 and Ozdenoren & Yuan 2008).

4.1. Manipulative Short Selling

Regulators and firm managers are often concerned about manipulative short selling in financial markets, whereby speculators drive down the price of a stock by short selling. Such concerns have led to restrictions on short selling activities in different countries and at different points in time. These concerns, however, are difficult to rationalize in a traditional model of financial markets. First, in such a model, the stock price has no real effect, so there is no reason to be concerned about artificially low stock prices. Second, it is often hard to generate manipulation as an equilibrium phenomenon, given that price impact will cause a manipulator to sell at a low price and buy at a high price and hence lose money overall (Jarrow 1992).

Goldstein & Guembel (2008) consider a model where the manager of the firm learns from the stock price about the profitability of an investment project. Due to this feedback effect, manipulation arises as an equilibrium phenomenon. A speculator realizes that if she drives the stock price down, even when she has no information, the manager might cancel the investment, given that he thinks that the price decrease may have been due to negative information. Given that the cancelation is based on no actual information, it reduces firm value, allowing the speculator to profit from her short position. Interestingly, the effect cannot work in the opposite direction. If the speculator buys without information, she causes overinvestment, which is also bad for firm value, and so she loses from her long position.

Related to the distinction made earlier between RPE and FPE, this paper also shows that the feedback effect can hamper the ability of decision makers to learn from the price about their optimal decision. Here, the feedback effect generates the manipulative motive that makes it hard to infer the profitability of the investment from the price. Khanna & Mathews (2012) allow a large blockholder to counter the manipulators' strategies and identify more precisely when such manipulative strategies are likely to succeed.

4.2. Limits to Arbitrage

In standard trading models in which firm value is exogenous, speculators can make profits by trading on their information. Existing papers have identified limits to such arbitrage activities, typically based on exogenous forces such as trading restrictions or agency problems between the speculator and her own investors. Edmans, Goldstein & Jiang (2012a)

show that the informational role of prices generates a limit to arbitrage that arises endogenously as part of the trading process. Consider a speculator who has negative information about firm prospects. If she short sells, this lowers the stock price. The manager will observe the reduced stock price and infer that firm prospects are poor. Consistent with the models in Section 2, this may lead him to take corrective action, such as reducing investment. Downsizing the firm in response to poor firm conditions is efficient and improves the firm's fundamental value, reducing the profitability of the speculator's short position. Thus, the speculator may refrain from short selling in the first place.

Interestingly, this feedback-driven limit to arbitrage is asymmetric: It deters informed selling, but encourages informed buying. Trading on information in either direction increases price informativeness and thus firm value, through guiding the manager's action. This reduces the profitability of a short position, but increases the profitability of a long position. This asymmetry originates from a similar force to the one present in Goldstein & Guembel (2008): In the presence of feedback, a speculator who short sells benefits from hurting the firm, but loses from helping it. However, whereas Goldstein & Guembel (2008) highlight that the feedback effect can lead an uninformed speculator to short sell, Edmans, Goldstein & Jiang (2012a) highlight that it may deter an informed speculator from short selling.

4.3. The Survival of Irrational Traders

An important question in asset pricing is whether irrational traders can survive in the long run. Under the traditional view, irrational traders, who trade based on considerations unrelated to firms' fundamentals, will lose money and hence disappear from the market over time. Hence, markets will be populated only by rational traders, and so prices will be efficient, correctly reflecting firms' fundamentals. However, as pointed out by Hirshleifer, Subrahmanyam & Titman (2006), when prices affect firms' cash flows, this traditional view no longer holds. Irrational traders can end up making a profit because their trades on nonfundamental considerations end up affecting firms' cash flows in a way that allows them to make a profit on their trades. Importantly, prices may appear efficient based on traditional definitions, given that there are no profit opportunities left for rational traders to exploit, but prices and real investments are different from what they would have been in the absence of irrational traders and feedback. This again demonstrates that traditional definitions of market efficiency may lack relevance when feedback from prices to decisions is important.

4.4. Runs in the Financial Market

Another type of market behavior that is puzzling under the traditional view is a self-reinforcing run on a stock, where many investors seek to sell a stock because other investors are also selling. Although many commentators believe that such runs are commonplace, they are hard to explain in traditional models. The reason is that self-reinforcing selling can occur only if selling exhibits strategic complementarity (i.e., the gain is larger when more people sell). However, traditional forces in financial markets generate strategic substitutability: Due to the price mechanism, when speculators sell, the price goes down, increasing the incentive for other speculators to buy, rather than sell. Goldstein, Ozdenoren & Yuan (2011b), building on Goldstein, Ozdenoren & Yuan (2011a), show that strategic complementarities arise if capital providers base their decision on how much capital to provide

to the firm on its stock price. The reason is that if many other speculators sell, the fall in the share price leads to a reduction in financing and hence to a fall in firm value. This can create trading frenzies that resemble run phenomena.

4.5. Information-Based Trade

A long-standing puzzle in financial economics is the apparent existence of trade for purely informational reasons. When cash flows are exogenous, no-trade theorems (see Milgrom & Stokey 1982) imply that such trade is impossible, and so the only way to generate trade is to assume that some people trade for noninformational reasons (e.g., noise traders are present). However, Bond & Eraslan (2010) show that trade based purely on informational differences can arise when decision makers observe the terms of trade (such as volume or price) and use the information revealed to make real decisions that affect the cash flows of the asset being traded.

4.6. Governance Through Financial Markets and the Value of Blockholders

The traditional view of blockholders is that they exert governance through direct intervention in a firm's operations, otherwise known as voice. However, for this to happen, blockholders need to have sufficient control rights to be able to intervene. The incentives channel studied in Section 3 shows that blockholders can exert governance even in the absence of control rights. By gathering and trading on private information—known as governance through trading or exit[6]—they increase price informativeness and thus the manager's incentives to take actions that improve firm value.

A central question is whether blockholders have a special role in such informed trading compared to other investors. Edmans (2009) analyzes the link between block size, information acquisition incentives, and informed trading. In the presence of short-sale constraints, a trader with a zero position has little incentive to acquire information, because if she receives a negative signal, she cannot trade on it. Up to a point, the larger one's stake, the more one can sell upon a negative signal and thus the greater the incentives to gather the signal to begin with. However, if the block becomes too large, liquidity becomes a constraint, and so the blockholder cannot sell her entire stake upon a negative signal. Thus, the optimal block size is finite.

The particular managerial agency problem examined by Edmans (2009) is that managers may behave myopically, and in this context he shows how blockholders, by increasing price efficiency, can help augment long-term investment. In a contemporaneous paper, Admati & Pfleiderer (2009) study a different specification of the firm's agency problem, and show that, although the blockholder alleviates the agency problem of the manager taking a bad action (e.g., shirking), she can sometimes make it more difficult to motivate the manager to take a good action (e.g., exerting effort).

Goldman & Strobl (2012) study a different aspect of blockholder behavior. When blockholders' time horizons are shorter than project horizons, they have the incentive to try to manipulate short-term share prices upwards. A manager who is himself compensated on the basis of short-term share prices then responds by extending the time

[6]The survey of McCahery, Sautner & Starks (2011) shows that exit is the leading governance mechanism used by institutions.

horizon of the project. Consequently, the combination of short horizons for both blockholders and managers can, counterintuitively, end up inducing managers to extend project time horizons.

Viewing governance as occurring through financial markets, rather than the exercise of control, in turn has new implications for the optimal blockholder structure. In voice theories, a single large blockholder is optimal, as she has strong incentives to engage in costly intervention; breaking up the block into multiple units weakens voice due to the free-rider problem. However, Edmans & Manso (2011) show that if governance occurs through exit, multiple small blockholders can be optimal. The same free-rider problems that hinder voice actually enhance exit: Given that multiple blockholders cannot coordinate to limit their orders and maximize combined trading profits, they trade competitively, impounding more information into prices. The optimal number of blockholders is thus a trade-off between the positive effect on exit and the negative effect on voice.

Blockholder models also make precise a potential cost of price efficiency. Maug (1998) studies a blockholder who is considering a value-adding intervention. Due to the free-rider problem, her stake in the firm may be insufficient to induce her to bear the costs of intervention. However, she can profit from intervention through a second source: the ability to buy additional shares at a price that does not fully reflect the benefits of her intervention. Consequently, lower price efficiency (i.e., when the stock price does not reflect future actions) facilitates blockholder intervention, raising real efficiency. In a similar vein, Kyle & Vila (1991) and Kahn & Winton (1998) show that when the price impact of trades is lower—often associated with low price efficiency—there is more blockholder formation in the first place. This in turn improves real efficiency as the blockholder subsequently engages in intervention.

4.7. Optimal Disclosure Policy

A key topic in accounting and finance is the extent to which firms should disclose their private information to the market. The question of whether disclosure has real effects is of particular importance in the accounting literature (see Kanodia 1980 for an early example). The idea that market prices provide information and incentives to decision makers provides a natural way to think about the real effects of disclosure. The literature has identified the following effects.

In Fishman & Hagerty (1989), which we reviewed earlier, disclosure ties stock prices more tightly to managerial actions, which enhances investment efficiency at the firm level. However, Kanodia & Lee (1998) point out a disadvantage of disclosure. The firm's cash flows are affected by both an observable managerial action and an unobservable shock. In the absence of disclosure, the stock price fully reflects the action; if the manager discloses the shock, the stock price reflects the shock also and is thus less closely linked to the manager's action. Consequently, disclosure reduces real efficiency. This is another example of a case in which the efficiency measures RPE and FPE behave very differently.

More recently, Bond & Goldstein (2011) show that a benefit of disclosure is that it reduces the uncertainty that traders are exposed to, encouraging them to trade more aggressively on their information, and so enables the firm to learn from the market more effectively. However, when the information available to the firm is correlated with the information available to traders, disclosure reduces speculators' informational advantage, and so they trade less aggressively, reducing the ability of the firm to learn. Overall,

disclosure is beneficial when it involves dimensions of information that speculators do not have access to, but may be harmful otherwise. Gao & Liyang (2011) study a different trade-off, whereby the disclosure of information by the firm is beneficial because it reduces the adverse selection in the financial market, but costly given that it discourages speculators from producing their own information, and so the firm learns less. Langberg & Sivaramakrishnan (2010) study a third trade-off, based on the idea that the disclosure of information by the firm is the trigger for feedback from the market. The benefit in disclosing is then the ability to gain feedback from the market, while the cost is that it makes the manager appear uninformed (as he is seeking feedback).

4.8. Security Design

Considering the effect of market information on real investment decisions can have important implications for the firm's choice of capital structure. In a model of primary markets, Fulghieri & Lukin (2001) challenge the conclusion of the pecking-order theory by Myers & Majluf (1984), according to which firms will issue debt rather than equity, because the former is less information sensitive and thus subject to fewer adverse selection costs. Fulghieri & Lukin note that because equity is more information sensitive, its issuance encourages speculators to acquire more information. This in turn reduces information asymmetry between the market and the firm, rendering equity sometimes preferable.

Chang & Yu (2010) study a related problem in a model of secondary markets. Informed speculators create a benefit because the firm can learn from their information when making an investment decision. However, this comes with a cost, due to the adverse selection between informed speculators and uninformed investors, which increases the firm's cost of capital. As a result, the firm will design its capital structure to increase information production when it can benefit more from market information. The firm does this by increasing leverage, which makes equity more information sensitive and enables informed speculators to profit more when they trade equity. Hennessy (2009) studies a similar trade-off, but endogenizes noise trading. This leads to different implications for the optimal capital structure. Informed traders can no longer profit by trading on the most information-sensitive security, given that noise traders will refrain from trading it. Hence, the way to generate market information is to create a debt security that is risky enough to enable speculators to make a profit, but not too risky so that noise traders still trade in it.

5. EMPIRICAL EVIDENCE

We now turn to empirical evidence of the real effects of secondary financial markets. Identifying this real effect is a challenging task. It is obviously not sufficient to regress investment (or other real variables) on stock prices and controls, for at least two reasons. First, a positive relation between stock prices and investment does not imply causality from the former to the latter: It could arise from an omitted variable that affects both or from reverse causality. Second, even assuming a causal explanation, it may result from mechanisms other than the learning or incentives channels, such as a primary-markets explanation.

One approach in the literature is to conduct cross-sectional analyses showing that the real effect is greater in exactly those firms where theory would predict that the learning or incentive channels are likely to be stronger. This can shed light on the mechanism behind the feedback effect and also address endogeneity concerns. For example, showing that the

correlation between prices and real decisions is stronger when the price contains information not available to managers suggests that causality is likely to go from prices to real decisions.

An important case in which decision makers may learn from prices is in the evaluation of merger opportunities, as discussed in the introduction. If a manager encounters a negative market reaction after announcing an acquisition, he will likely realize that there is a collective view that the acquisition is value destroying and may cancel it. In an early paper, Jennings & Mazzeo (1991) do not find evidence consistent with this hypothesis. In a more recent paper, Luo (2005) uses new test specifications closer to the underlying theory, combined with a much larger sample, and finds support for this hypothesis. He shows that in those cases where learning is most likely, i.e., when the deal is reversible and when the market most plausibly has information that the manager does not, the probability of cancellation is much higher after a low announcement return. Kau, Linck & Rubin (2008) extend his analysis and show that such learning is more likely when governance mechanisms are in place to reduce the agency problem between the manager and the shareholders.

Chen, Goldstein & Jiang (2007) study all investments. They show that the sensitivity of investment to price (or Tobin's Q) is stronger when there is more private information injected into the price in the trading process (based on market microstructure measures). This information is not related to proxies of managerial information, and so their result suggests that managers glean new information from the price and use it in their investment decisions. Bakke & Whited (2010) demonstrate that the effect of price informativeness on the sensitivity of investment to Q continues to hold when correcting for measurement error in Q. However, the relation between the sensitivity of investment to price and a measure of capital constraints, which was documented earlier by Baker, Stein & Wurgler (2003), ceases to hold when this correction is in place. Foucault & Fresard (2011) show that the sensitivity of investment to price is higher for firms that trade in two markets, especially if they can glean more new information from prices. Relatedly, Durnev, Morck & Yeung (2004) show that price informativeness is positively related to the efficiency of real investment, which is consistent with both the learning and incentives channels.[7]

Kang & Liu (2008) directly examine the incentives channel. Consistent with theory, they show that the extent to which CEO compensation is based on market prices is positively related to measures of price informativeness. Ferreira, Ferreira & Raposo (2011) posit that, if price informativeness increases managerial incentives, there is less need for other disciplinary mechanisms such as board monitoring. Consistent with this hypothesis, they find a negative relation between price informativeness and board independence. With regard to the incentives of other decision makers such as blockholders, Norli, Ostergaard & Schindele (2010) show that liquidity increases the likelihood of contested proxy solicitations and shareholder proposals, consistent with Maug's (1998) predictions.

To further address causality concerns, several recent papers have used exogenous shocks to market liquidity (a driver of price efficiency) to analyze the real effect of financial markets. Fang, Noe & Tice (2009) demonstrate a causal effect of liquidity on firm value (as measured by Tobin's Q) using the natural experiment of decimalization: In 2001, the US stock exchanges moved from tick sizes of 1/16 to one cent, leading to an exogenous

[7]Another approach is to compare the investment behavior of public and private firms. However, it is difficult to use this approach to distinguish between different channels. Examples of such papers include Mortal & Reisel (2012) and Asker, Farre-Mensa & Ljungqvist (2011).

increase in liquidity. They find a positive effect, consistent with both the learning and incentive channels. This effect of liquidity on firm value is particularly strong for firms with high managerial incentives, consistent with the incentive channel in particular. Bharath, Jayaraman & Nagar (2012) show that positive shocks to liquidity (e.g., decimalization) improve firm value, particularly for firms with larger block ownership. As predicted by the incentives channel, the impact of liquidity shocks on the blockholder-firm value association is increasing in managerial incentives.

Whereas Fang, Noe & Tice (2009) and Bharath, Jayaraman & Nagar (2012) study the impact of financial markets on firm value in general, other papers investigate the effect of financial markets on specific channels through which financial markets can increase firm value. Jayaraman & Milbourn (2011) demonstrate that CEO incentives are increasing in liquidity, using stock splits as an instrument for liquidity. Edmans, Fang & Zur (2012) show that liquidity increases the likelihood of a hedge fund acquiring a block in a firm to begin with. Conditional upon acquiring a block, liquidity induces the blockholder to choose governance through exit rather than voice. They use decimalization to document causal effects, and both of these effects are stronger for firms with higher managerial incentives. Kim & Kang (2011) use decimalization to show that liquidity leads to a more negative relationship between R&D and the probability of CEO firing, consistent with the hypothesis that liquidity causes the benefits of R&D to be more closely incorporated into stock prices.

The previous papers study the real effects of a shock to liquidity, which affects the efficiency of prices. As discussed in Sections 2 and 3, price efficiency matters for both the learning and incentive channels. Another approach is to identify a shock to the level of prices, which is related to the learning channel in particular.[8] This is the approach of Edmans, Goldstein & Jiang (2012b), who study the impact of a firm's market price on the likelihood that it will receive a takeover bid. Although it is commonly believed that firms, which trade at a discount to fundamental value, attract acquirers, it is difficult to detect this relation in the data, given that stock prices are endogenous and incorporate the anticipation of future takeovers. Edmans, Goldstein & Jiang address this issue and identify a negative causal effect of prices on takeover activity, using mutual fund redemptions caused by investor withdrawals to identify an exogenous shock to market prices. This effect could arise from a learning channel if target shareholders learn the value of their firm from the stock price and are willing to sell their shares at a price that is close to that—thus, the market price is not a sideshow but affects the price that they are prepared to accept in a takeover. This assumes that they are unable to disentangle a stock price decline caused by mutual fund redemptions from one that is driven by information.

Finally, although all the papers mentioned above test the extent to which markets affect real economic activity, an important avenue for future empirical research to explore is how feedback from prices to cash flows affects the price formation process. The papers reviewed in Sections 2, 3, and 4 make numerous theoretical predictions. In a recent paper, Davis, Korenok & Prescott (2011) provide a first step in this direction by performing a lab experiment to test the predictions of Bond, Goldstein & Prescott (2010) and Sundaresan & Wang (2011). They find results broadly consistent with the theory.

[8]Under the learning channel, the level of prices reveals information about an underlying state and drives a real decision; by contrast, in the incentives channel, it is only the informativeness of prices rather than their level that is relevant.

Before concluding this section, it is worth revisiting the well-known study of Morck, Shleifer & Vishny (1990, MSV). MSV investigate whether stock returns (CAPM alphas) predict investment, at both an individual firm level and at the aggregate level.[9] Consistent with the learning channel laid out above (the active informant in MSV's terminology), MSV find that stock returns are a positively significant predictor of investment in all specifications, both economically and statistically, and that this significance is robust to the addition of firm fundamentals (cash flow and sales) as controls. However, the increment in R^2 that results from adding stock returns, when the investment regression already contains firm fundamentals, is low. Thus, the authors conclude that the economic significance of the market is limited and that it is somewhat of a sideshow.

The published discussions by Matthew Shapiro and James Poterba, included at the end of the review, highlight potential issues with the empirical results presented in MSV; and using a different methodology, Barro (1990) finds that stock-market changes have a strong effect on investment. Moreover, even taking MSV's results at face value, it is not clear that they imply that the market is a sideshow, for three main reasons. First, the results have no implications for the incentives channel discussed in Section 3. Under this channel, the level of investment is increasing in the informativeness, rather than level, of stock prices. Second, MSV's empirical design cannot detect important examples of the learning channel. For example, if a firm announces a takeover, its stock price subsequently falls, and then the manager cancels the takeover leading to a stock price recovery, the MSV approach would find no abnormal return and no change in investment. Third, MSV's preferred R^2 measure does not capture the possibility that when firms do learn from the prices, the improvement in efficiency is very large. Instead, the relatively small change in R^2 merely shows that most of the time firms do not respond to abnormal stock returns over and above their response to changes in fundamentals. However, it is possible that the times firms do respond to price changes are particularly important—for example, if they cut investment when the return will be disastrously low. By analogy, most of the time an airline pilot may learn nothing from his instrument panel over and above what he can see with his eyes. Thus, in a regression analysis of pilot actions, the increment in R^2 of including instrument readings in addition to visual evidence would be small. However, if the instrument panel occasionally enables the pilot to avoid a crash, it is very far from being a sideshow. Consistent with the idea that stock price changes have a large effect, MSV's results imply that a one standard-deviation change in three-year alphas is associated with 31% higher investment growth, even after controlling for their measures of firm fundamentals, which is economically significant compared to the mean (median) three-year investment growth of 48% (10%) (see MSV's table 1 and regression 2.3).

6. CONCLUSION

Over the past twenty years, a sizeable literature has emerged to analyze the ways in which secondary financial markets affect the real economy. The literature is both theoretical and empirical, and lies at the intersection of corporate finance, asset pricing, and market

[9] MSV also study the effect of stock returns on financing (debt and equity issuance). This is the primary-markets channel that is outside the scope of this review. The results are similar to the investment regressions in MSV. For other papers that study the real effect of financial markets through the primary-markets channels, see Baker, Stein & Wurgler (2003); Gilchrist, Himmelberg & Huberman (2005); Derrien & Kecskes (2013); and Grullon, Michenaud & Weston (2011).

microstructure. In this review we have sought to synthesize some of the main themes and insights of the literature; although we have made every effort to survey the literature widely, it is also inevitable that our synthesis reflects our own research on the topic.

Overall, we make two main points. First, precisely because the question of the real effects of financial markets combines aspects of various subspecialties in finance, it is necessary to augment the traditional notion of price efficiency—what we have termed here as forecasting price efficiency—to take into account whether prices reveal the information necessary for real efficiency; in our terminology, does revelatory price efficiency hold? Second, taking seriously the real effect of financial markets helps shed light on a range of phenomena that otherwise appear puzzling. Again, this is a consequence of combining insights from various fields: Blockholding patterns, traditionally a corporate finance topic, make more sense once asset pricing considerations are added; and trading frenzies, traditionally an asset pricing topic, make more sense once corporate finance considerations are added.

We began the survey by drawing a distinction between research on the real effects of primary versus secondary financial markets. Looking ahead to future research, there is potential gain from combining the two approaches. First, the channels of amplification studied by Bernanke & Gertler (1989) and Kiyotaki & Moore (1997) in the context of primary financial markets are developed in models where the need for collateral constrains borrowing but with symmetric information about collateral value, whereas the models of secondary financial markets that we reviewed here build on asymmetric information. Introducing asymmetric information into models of primary financial markets may enrich these models and potentially strengthen the quantitative effects that they generate. Second, primary financial markets and secondary financial markets are sometimes blended in real-world situations, creating room for models that combine the two approaches. For example, consider financial institutions that hold stocks of firms traded in the secondary market and use them as collateral when borrowing from other financial institutions. Here, trading in secondary markets and the collateral channel in primary markets work together to generate the overall effect of financial markets on the real economy.

Another direction for future research is to incorporate the feedback effect reviewed in this article into traditional asset pricing models to explain patterns in stock returns. In a contemporaneous survey, Kogan & Papanikolaou (2012) review a literature that attempts to explain patterns in stock returns based on firm behavior. This literature, however, is based on a world of symmetric information where the secondary financial market is essentially a sideshow that has no effect on the firm. It would be interesting to introduce the feedback effect reviewed here into these models.

Finally, the literature reviewed in this article is still in its early stages. There is substantial scope for further research to advance our understanding of the implications of the feedback loop between financial markets and the real economy, whereby financial markets affect and reflect the events in the real economy. As we argued in this review, this has implications for regulation of banks and firms, for managerial behavior and corporate governance, and for many other aspects of financial economics. We hope that our review will help stimulate this research going forward.

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