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Information Disclosure in Financial Markets

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ABSTRACT

Information disclosure is an essential component of regulation in financial markets. In this article, we provide a cohesive analytical framework to review cer financial markets affects market quality, information production, efficiency of real investment decisions, and traders' welfare. We use our framework to add conventional wisdom that disclosure improves market quality in an economy with exogenous information. Second, we illustrate that disclosure can crowd o overall market-quality implications are subtle and depend on the specification of information-acquisition technology. Third, we review how disclosure affec financial markets are not just a side show, as real decision makers can learn information from them to guide their decisions. Last, we discuss how disclosure changing trading opportunities and through beauty-contest motives. Overall, our review suggests that information disclosure is an important factor for und that there are several trade-offs that should be considered in determining its optimal level.

Keywords

disclosure (/search?option1=pub_keyword&value1="disclosure"), **market quality (/search?option1=pub_keyword&value1="market quality")**, **crowding-out effect (/sea effect")**, **learning from prices (/search?option1=pub_keyword&value1="learning from prices")**, **real efficiency (/search?option1=pub_keyword&value1="real efficiency" option1=pub_keyword&value1="welfare")**

1. INTRODUCTION

Disclosure of information in financial markets is at the forefront of regulatory efforts to improve financial market quality and stability. **Greenstone, Oyer & V** passage of the Securities Act of 1933 and the Securities Exchange Act of 1934, the federal government has actively regulated US equity markets. The centerp financial information." Recently, these efforts have been very prominent, with the Sarbanes–Oxley Act of 2002 and the Dodd–Frank Act of 2010 emphasizing the Sarbanes–Oxley Act was passed "to protect investors by improving the accuracy and reliability of corporate disclosures made pursuant to the securities Stat. 745).

Disclosure regulation comes in different forms and affects different activities. Over time, firms have increasingly been required to disclose information abou reports to their investors. Similarly, investors are required to disclose information about their holdings in firms that might pertain to activism, intentions of a ultimately affect firm value. Moreover, improved quality of public information is also achieved by increasing the reliability of credit ratings and by greater di information. Recently, following the financial crisis of 2008, governments increased the amount of disclosure available about banks by conducting annual s This has led to significant public debate (**Goldstein & Sapra 2013**).

The academic literature is quite ambiguous about the effects of disclosure and its overall desirability. It is well understood that disclosure can potentially pr field in financial markets, it can increase market liquidity and market efficiency and can decrease the cost of capital for firms. However, much has been writt disclosure, which occur because of the crowding out of private information production, the destruction of risk-sharing opportunities, and the promotion of of new regulations related to disclosure in recent years, researchers have been delving more and more into the topic, trying to understand the pros and con optimal level of disclosure in terms of promoting market quality and social welfare? What types of disclosure are most beneficial? In what circumstances is d

Our goal in this review is to present the main forces that have been put forward in the discussion on the effects of disclosure in financial markets. As this is a model that has been used extensively in the literature on information and disclosure in financial markets, and we show how the main forces are manifested researchers who wish to build on existing theories in developing new ones, testing existing empirical implications, or understanding ongoing policy debates

extant disclosure literature (some excellent surveys include those of **Dye 2001**, **Verrecchia 2001**, **Kanodia 2006**, **Leuz & Wysocki 2008**, and **Kanodia & Sap**
forces within a cohesive analytical framework, so that the pros and cons of disclosure can be more easily sorted out and evaluated for different environmen

The structure of this review is as follows. Section 2 presents the basic framework for studying information and disclosure in financial markets, building on th **(1980)**, and **Verrecchia (1982a)**. We show basic results demonstrating how increased precision of public information, which is achieved via enhanced disclo That is, we show that disclosure increases liquidity and market efficiency and decreases the cost of capital and return volatility. These results capture the us disclosure.

In Section 3, we extend the basic framework to endogenize the acquisition of private information by market participants, building on work by **Verrecchia (1** the basic argument that increased disclosure leads to crowding out of private-information acquisition. This implies that the effect of disclosure on market q endogenized and that it depends on the amount of information being disclosed, on the information-acquisition technology, and on the measure of market

Although the analysis in Sections 2 and 3 considers measures of market quality, these measures do not translate easily into a clear objective function to tell the framework, reviewing papers that emphasize the role of the financial market in producing information that guides decisions on the real side of the econ feedback effect, which is reviewed by **Bond, Edmans & Goldstein (2012)**. This enables the analysis of optimal disclosure in light of its effect on the efficienc **Han, Tang & Yang 2016**). An interesting dimension revealed by papers in this realm of work is that the type of information being disclosed is key in determir **2015**, **Goldstein & Yang 2016**).

Finally, Section 5 considers extensions of the basic framework that allow us to study the effect of disclosure on the welfare of investors in financial markets a Whereas the traditional view is that disclosure enhances the welfare of investors, a classic result by **Hirshleifer (1971)** shows that disclosure destroys risk-sh More recently, **Kurlat & Veldkamp (2015)** suggested a reduction in trading opportunities as another way in which disclosure's effects can be negative. Anot harmful because of beauty-contest incentives, leading all investors to want to do the same thing. In such a case, greater precision of public information leac welfare (**Morris & Shin 2002**).

2. A BASIC MODEL OF INFORMATION AND DISCLOSURE

We introduce a basic framework that enables us to discuss the various effects of disclosure in financial markets in a unified way. We rely on the noisy rationa a workhorse model that has been used extensively in the literature on information and disclosure in financial markets. The model we describe in this sectio **(1980)**, **Hellwig (1980)**, and **Verrecchia (1982a)**. The model has the traditional CARA-normal feature; that is, traders have constant absolute risk aversion (C normally distributed.

2.1. Setup

There are two dates, t=1 and t=2. At date 1, two assets are traded in a competitive financial market: a risk-free asset and a risky asset. The risky asset is usua be a different asset, e.g., a corporate bond. The risk-free asset has a constant value of 1 and is in unlimited supply. The risky asset pays an uncertain cash flo is normally distributed with a mean of 0 and a precision (reciprocal of variance) of τ_v—that is, $\tilde{v} \sim N(0, \tau_v^{-1})$, with τ_v>0. [1] The risky asset is traded at an endo

There are three types of traders in the financial market: informed traders, uninformed traders, and liquidity traders. The first two types of traders have CARA coefficient of γ>0. They can represent individuals or institutions who trade the risky asset. The total mass of the first two types of traders is 1, with a fraction being uninformed traders. Prior to trading, informed trader i observes a private signal $\tilde{s}_i$, which contains information about the fundamental value $\tilde{v}$ of the r

$$\tilde{s}_i = \tilde{v} + \tilde{\varepsilon}_i, \quad \text{with } \tilde{\varepsilon}_i \sim N(0, \tau_\varepsilon^{-1}) \text{ and } \tau_\varepsilon > 0,$$

where $(\tilde{v}, \{\tilde{\varepsilon}_i\}_{i\in[0,\mu]})$ are mutually independent. For now, we take both μ and τ_ε as exogenous. We endogenize them later.

A common way to introduce disclosure into this model is to add a public signal $\tilde{y}$ as follows:

$$\tilde{y} = \tilde{v} + \tilde{\eta}, \quad \text{with } \tilde{\eta} \sim N(0, \tau_\eta^{-1}) \text{ and } \tau_\eta \geq 0$$

(see, e.g., **Diamond 1985**; **Verrecchia 2001**; **Morris & Shin 2002**; **Hughes, Liu & Liu 2007**; **Lambert, Leuz & Verrecchia 2007**). For example, $\tilde{y}$ can be though future prospects or as economic statistics published by government agencies, central banks, or other parties (e.g., credit rating agencies). The precision τ_η c value of τ_η signifying that $\tilde{y}$ is more informative about the asset cash flow $\tilde{v}$ (i.e., signifying more disclosure). More disclosure can be achieved by making mor accurate data. (We assume that traders can costlessly interpret the public signal $\tilde{y}$. Some studies have considered settings in which traders can only extract processing abilities can be different; see, e.g., **Indjejikian 1991**, **Pagano & Volpin 2012**, **Di Maggio & Pagano 2017**.) Much of our analysis is concerned with that we focus on the effect of ex ante disclosure quality, in the sense of an improvement in the precommitted precision of public information. We do not add whether to disclose based on their signal, which involves a signaling effect. There is a large literature that addresses these issues (see, e.g., **Grossman 1981**;

Acharya, DeMarzo & Kremer 2011; **Guttman, Kremer & Skrzypacz 2014**). Also note that public information in **Equation 2** represents disclosure about fun literature on market transparency, which explores the effect of disclosing information about trading positions and prices (see, e.g., **Madhavan 1995**; **Pagan** **Neuberger & Viswanathan 1999**; **Huddart, Hughes & Levine 2001**; **Easley, O'Hara & Yang 2014**; for a discussion of the interactions between disclosure of trading process, see **Di Maggio & Pagano 2017**).

Liquidity traders, also called noise traders in the literature, demand $\tilde{x}$ units of the risky asset, where $\tilde{x} \sim N(0, \tau_x^{-1})$, with $\tau_x \in (0, \infty)$, is independent of other s randomness that makes the rational-expectations equilibrium partially revealing, which is crucial to sustaining trading in equilibrium. In the baseline mode We endogenize it later. Note that there are various ways to endogenize noise trading in asymmetric information models, such as endowment shocks (e.g., **D** investment opportunities (e.g., **Wang 1994**; **Easley, O'Hara & Yang 2014**).

2.2. Equilibrium

The equilibrium requires that (*a*) informed and uninformed traders choose investments in assets to maximize their expected utility conditional on their resp the public signal $\tilde{y}$, and (for informed traders) the private signal $\tilde{s}_i$; (*b*) the markets clear so that the demand for the risky asset equals the exogenous supply rational expectations in the sense that their beliefs about all random variables are consistent with the true underlying distributions and equilibrium behavio

Constructing a noisy REE boils down to solving a price function that depends on the public information $\tilde{y}$, informed traders' private information $\tilde{s}_i$, and nois terms $\tilde{\varepsilon}_i$ in the private signals $\tilde{s}_i$ wash out, and thus we conjecture that the price $\tilde{p}$ is a function of $(\tilde{y}, \tilde{v}, \tilde{x})$. The literature focuses on a linear price function of t

$$\tilde{p} = p_0 + p_y \tilde{y} + p_v \tilde{v} + p_x \tilde{x},$$

where the *p*-coefficients are endogenously determined in equilibrium. Here we restrict our attention to this form.

Informed trader *i* has an information set $\{\tilde{y}, \tilde{s}_i, \tilde{p}\}$. The CARA-normal setup implies that the demand function of informed trader *i* is

$$D_{\mathrm{I}}(\tilde{y}, \tilde{s}_i, \tilde{p}) = \frac{E(\tilde{v}|\tilde{y}, \tilde{s}_i, \tilde{p}) - \tilde{p}}{\gamma \mathrm{Var}(\tilde{v}|\tilde{y}, \tilde{s}_i, \tilde{p})}.$$

For trader *i*, the information contained in the price is equivalent to the signal $\tilde{s}_p$:

$$\tilde{s}_p \equiv \frac{\tilde{p} - (p_0 + p_y \tilde{y})}{p_v} = \tilde{v} + \rho^{-1}\tilde{x}, \quad \text{with } \rho = \frac{p_v}{p_x},$$

which is normally distributed, with mean $\tilde{v}$ and precision $\rho^2\tau_x$. Applying Bayes' rule to compute the conditional moments in the demand function, we can o

$$D_{\mathrm{I}}(\tilde{y}, \tilde{s}_i, \tilde{p}) = \frac{\tau_\varepsilon \tilde{s}_i + \tau_\eta \tilde{y} + \rho^2\tau_x \tilde{s}_p - (\tau_v + \tau_\varepsilon + \tau_\eta + \rho^2\tau_x)\tilde{p}}{\gamma}.$$

Similarly, an uninformed trader has an information set $\{\tilde{y}, \tilde{p}\}$, and we can compute this trader's demand function for the risky asset as follows:

$$D_{\mathrm{U}}(\tilde{y}, \tilde{p}) = \frac{E(\tilde{v}|\tilde{y}, \tilde{p}) - \tilde{p}}{\gamma \mathrm{Var}(\tilde{v}|\tilde{y}, \tilde{p})} = \frac{\tau_\eta \tilde{y} + \rho^2\tau_x \tilde{s}_p - (\tau_v + \tau_\eta + \rho^2\tau_x)\tilde{p}}{\gamma}.$$

The market-clearing condition is

$$\int_0^{\mu} D_{\mathrm{I}}(\tilde{y}, \tilde{s}_i, \tilde{p})\mathrm{d}i + (1-\mu)D_{\mathrm{U}}(\tilde{y}, \tilde{p}) + \tilde{x} = Q.$$

To derive the equilibrium price function, we insert **Equations 5 and 6** into **Equation 7** to solve the price in terms of the public signal $\tilde{y}$, the fundamental $\tilde{v}$, a conjectured price function in **Equation 3** to obtain a system defining the unknown *p*-coefficients.

Solving this system yields the following result: For any $\mu \in [0, 1]$ and $\tau_\varepsilon \geq 0$, there exists a unique partially revealing noisy REE, with price function of the form

$$p_0 = \frac{-\gamma Q}{\mu\tau_\varepsilon + \tau_v + \tau_\eta + \rho^2\tau_x}, \quad p_y = \frac{\tau_\eta}{\mu\tau_\varepsilon + \tau_v + \tau_\eta + \rho^2\tau_x},$$
$$p_v = \frac{\mu\tau_\varepsilon + \rho^2\tau_x}{\mu\tau_\varepsilon + \tau_v + \tau_\eta + \rho^2\tau_x}, \quad p_x = \frac{\rho\tau_x + \gamma}{\mu\tau_\varepsilon + \tau_v + \tau_\eta + \rho^2\tau_x},$$

with $\rho = \mu\tau_\varepsilon/\gamma$.

2.3. Market Quality and Disclosure

The effect of disclosure is often understood by examining different measures of market quality. We now define four common measures, explain their origins disclosure.

2.3.1. Market liquidity.

Market liquidity refers to a market's ability to facilitate the purchase or sale of an asset without drastically affecting the asset's price. The literature has used
inversely measure market liquidity: A smaller p_x means that liquidity trading $\tilde{x}$ has a smaller price impact, and thus the market is deeper and more liquid. Fo

$$\text{Liquidity} \equiv \frac{1}{p_x}.$$

This measure of market liquidity is often referred to as **Kyle's (1985)** lambda.

The illiquidity measure p_x can also be linked to another often used measure, the bid-ask spread. Suppose that a liquidity trader comes to the market with a
expects on average to fulfill this order at an ask price quoted by the market, $\text{Ask} \equiv E(\tilde{p}|\tilde{x} = +1) = p_0 + p_x$. Similarly, if the liquidity trader wants to sell an orde
the order at a bid price $\text{Bid} \equiv E(\tilde{p}|\tilde{x} = -1) = p_0 - p_x$. As a result, the bid-ask spread is

$$\text{Bid-ask spread} = \text{Ask} - \text{Bid} = 2p_x.$$

Thus, p_x is indeed positively associated with the bid-ask spread.

From **Equation 8**, we know that disclosure improves market liquidity; that is, $\partial \text{Liquidity}/\partial \tau_\eta > 0$. Intuitively, more precise public information implies that the
traders trade more aggressively against liquidity traders. As a result, changes in liquidity trading are absorbed with a smaller price change.

2.3.2. Market efficiency.

Market efficiency, also called price efficiency or informational efficiency, concerns how informative the prevailing market prices are about the future values
promoting market efficiency is that it is believed to be a good proxy for real efficiency, by which more information in prices about underlying values improve
this statement. In the literature (e.g., **Vives 2008**, **Peress 2010**, **Ozsoylev & Walden 2011**), researchers measure market efficiency using the precision of the
its price, [3] that is,

$$\text{Market efficiency} \equiv \frac{1}{\text{Var}(\tilde{v}|\tilde{p})}.$$

Given that $\tilde{v}$ and $\tilde{p}$ are normally distributed, $1/\text{Var}(\tilde{v}|\tilde{p})$ is positively related to the correlation coefficient $\text{Corr}(\tilde{v}, \tilde{p})$ between $\tilde{v}$ and $\tilde{p}$, that is,

$$\frac{1}{\text{Var}(\tilde{v}|\tilde{p})} = \frac{\tau_v}{1 - [\text{Corr}(\tilde{v}, \tilde{p})]^2}.$$

For this reason, one can also use $\text{Corr}(\tilde{v}, \tilde{p})$ to measure market efficiency (e.g., **Goldstein & Yang 2014**).

Using **Equation 8**, we can show that disclosure improves market efficiency, that is, $\partial[1/\text{Var}(\tilde{v}|\tilde{p})]/\partial \tau_\eta > 0$. Intuitively, more public information before the price
information into the price through updating traders' forecasts about the asset payoff. This implies that the price tracks fundamental value more closely.

2.3.3. Cost of capital.

In this one-period model, the return on the risky asset is $\tilde{v} - \tilde{p}$, as at date 2, the uncertainty is resolved and the asset price is its fundamental value $\tilde{v}$. The exp
capital on the risky asset (e.g., **Easley & O'Hara 2004**; **Hughes, Liu & Liu 2007**; **Lambert, Leuz & Verrecchia 2007**). A lower cost of capital benefits the issue
security at a higher price.

From **Equation 8**, we have

$$E(\tilde{v} - \tilde{p}) = \frac{\gamma Q}{\mu \tau_\varepsilon + \tau_v + \tau_\eta + \left(\frac{\mu \tau_\varepsilon}{\gamma}\right)^2 \tau_x}.$$

Thus, the cost of capital $E(\tilde{v} - \tilde{p})$ is positively affected by risk aversion γ and asset supply Q in the numerator. This is because traders are willing to pay a lowe
hold more of the asset on average, so the risk they have to bear is higher. The expression in the denominator is equal to

$$\frac{\mu}{\text{Var}(\tilde{v}|\tilde{y}, \tilde{s}_i, \tilde{p})} + \frac{1 - \mu}{\text{Var}(\tilde{v}|\tilde{y}, \tilde{p})},$$

which is inversely related to the average risk perceived by traders per unit of the security. When the perceived risk goes up, the cost of capital also increases.
affecting the perceived risk: A higher level of disclosure lowers the cost of capital by lowering traders' average risk; that is, $\partial E(\tilde{v} - \tilde{p})/\partial \tau_\eta < 0$.

2.3.4. Return volatility.

Return volatility $\sigma(\tilde{v} - \tilde{p}) = \sqrt{\text{Var}(\tilde{v} - \tilde{p})}$ is another measure that attracts attention from academics and regulators. Using **Equation 8**, we can show that disclo
This is because more public information improves market efficiency, which thus brings the asset price $\tilde{p}$ closer to the fundamental $\tilde{v}$.

2.3.5. Summary.

To summarize the results discussed thus far, we can see that for a given fraction μ of informed traders and a given precision of their information τ_ε, disclosu increases market liquidity and market efficiency and decreases the cost of capital and return volatility. This is the conventional wisdom that is often put forv improving the functioning of the financial market. This is consistent with many academic papers (e.g., **Diamond & Verrecchia 1991**; **Verrecchia 2001**; **Easle Leuz & Verrecchia 2007**; **Gao 2008**) and with the logic behind recent regulatory acts, such as the Sarbanes–Oxley Act of 2002 and the Dodd–Frank Act of 20

3. INFORMATION ACQUISITION AND CROWDING-OUT EFFECT

In Section 2, both the fraction μ of informed traders and the precision τ_ε of informed traders' private information were exogenous. In this setup, disclosure v quality, as it enabled more information to get into prices, improving market liquidity, market efficiency, etc. However, a natural question is: How do changes which is central to financial markets? Beginning to think about the effects of disclosure more broadly, various researchers have endogenized the variables μ in the market (e.g., **Verrecchia 1982b**; **Diamond 1985**; **Kim & Verrecchia 1994**; **Gao & Liang 2013**; **Colombo, Femminis & Pavan 2014**). One key finding in weaken the incentives of traders to become informed and/or to acquire more precise information. In other words, public information crowds out the produc potentially reverse the direct effect of disclosure on some market-quality variables. In this section, we augment the baseline model in Section 2 with inform

3.1. Setup

We add an information-acquisition date, t=0, to the baseline model in Section 2. The information-acquisition technology closely follows **Grossman & Stiglit** exists a unit mass of identical CARA traders. Trader i can become informed by paying a cost to acquire a private signal $\tilde{s}_i$ in the form of **Equation 1**, which has acquisition cost $C(\tau_{\varepsilon i})$ has two parts [5] : a fixed cost $c_F \geq 0$ and a variable cost $c_V(\tau_{\varepsilon i})$, where $c_V(\cdot)$ is an increasing, smooth, and convex function satisfying c_V institutions, and their information-acquisition activities typically involve both a fixed cost (such as the overhead cost of establishing a research department) to produce financial reports). In equilibrium, an endogenous fraction μ of traders decide to acquire private information, and these traders become the infor show that the informed traders choose the same precision level τ_ε in equilibrium, and thus the economies at dates 1 and 2 are the same as in the baseline n

The equilibrium in this extended economy consists of an information-acquisition equilibrium at date 0 and a noisy REE at date 1. The noisy REE at date 1 is s information-acquisition equilibrium at date 0 is characterized by (a) an intensive margin, τ^*_ε—how precise is the information that informed traders acquire? decide to become informed? In the literature, researchers have either fixed $\mu^*=1$ and considered the crowding-out effect of disclosure on τ^*_ε (e.g., **Verrecchi** crowding-out effect on μ^* (e.g., **Diamond 1985**). As we show below, both settings can naturally emerge endogenously in our setup and may have different ir

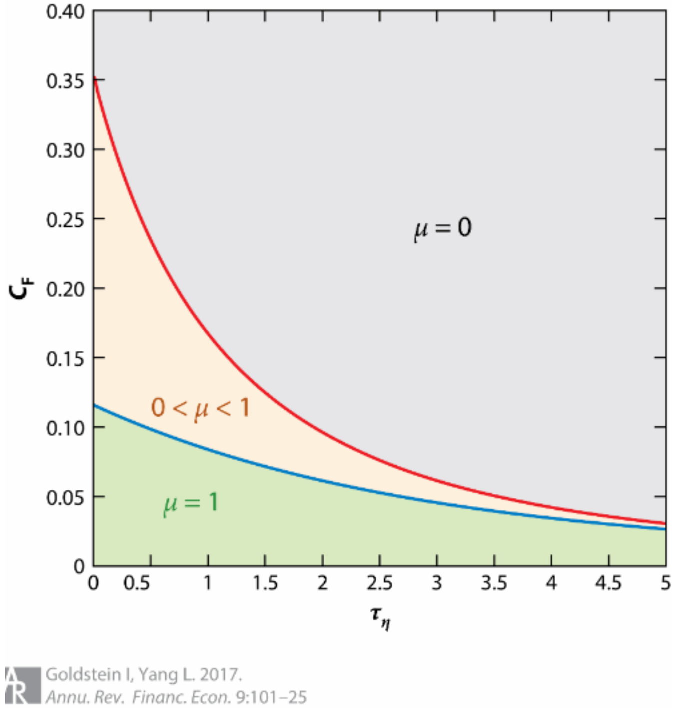
Let us consider a particular trader i. Suppose that a fraction μ of traders are informed and acquire signals with precision τ_ε. When trader i stays uninformed, expected utility (certainty equivalent) at the trading stage. When trader i decides to become informed and acquire a private signal with precision $\tau_{\varepsilon i}$, we use utility. Note that in $CE_I(\tau_{\varepsilon i};\tau_\varepsilon,\mu)$, trader i can only choose $\tau_{\varepsilon i}$ and will take (τ_ε,μ) as given. Following an argument similar to that of **Grossman & Stiglitz (19** analyze equilibrium outcomes.

Three types of information-acquisition equilibriums arise. First, when c_F, the fixed cost of information acquisition, is sufficiently small, all traders become ir by **Verrecchia (1982b)**. Here, $CE_U(\tau^*_\varepsilon,1) \leq CE_I(\tau^*_\varepsilon;\tau^*_\varepsilon,1)$, so traders choose to become informed when all others are informed, and the precision of informa $\partial CE_I(\tau^*_\varepsilon;\tau^*_\varepsilon,1)/\partial\tau_{\varepsilon i}=0$. Second, when c_F takes an intermediate value, an intermediate proportion of traders choose to become informed: $\mu^* \in (0,1)$. The eq traders indifferent between producing the equilibrium amount of information and remaining uninformed, $CE_U(\tau^*_\varepsilon,\mu^*)=CE_I(\tau^*_\varepsilon;\tau^*_\varepsilon,\mu^*)$, and by a first-order chosen optimally, $\partial CE_I(\tau^*_\varepsilon;\tau^*_\varepsilon,\mu)/\partial\tau_{\varepsilon i}=0$. It turns out that in equilibrium, the precision of information produced τ^*_ε is independent of disclosure quality τ_η, **Diamond (1985)**. Finally, when c_F is sufficiently large, no trader chooses to become informed, which is guaranteed by the condition $CE_U(0,0) \geq \max_{\tau_{\varepsilon i}} CE_I(\tau_{\varepsilon i}$

Figure 1 graphically illustrates these equilibrium outcomes. For this illustration, we assume that the variable cost function takes a quadratic form, $c_V(\tau_{\varepsilon i})=($ $=\gamma=Q=1$ and k=0.1. The figure plots the regimes of equilibrium types in the parameter space of (c_F,τ_η). Generally speaking, as c_F and τ_η become larger, an e feature is a reflection of the crowding-out effect, which we explain in more detail in Section 3.2.1.

Figure 1

Equilibrium types in the economy with endogenous information acquisition. This figure plots the equilibrium types in the space of (τ_η, c_F), where parameter τ_η controls the disclosure quality and param cost of information acquisition takes a quadratic form, $c_V(\tau_{\varepsilon i})=(k/2)\tau^2_{\varepsilon i}$. The parameter values are $\tau_v=\tau_x=\gamma=Q=1$ and k=0.1.



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3.2. The Effect of Disclosure

We now reexamine the effect of disclosure when private information is endogenous.

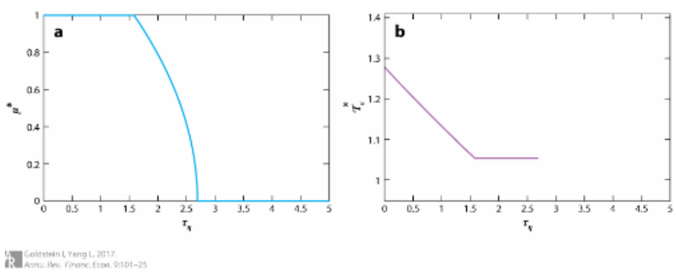
3.2.1. The crowding-out effect on private information.

The results below follow directly from the equilibrium analysis in Section 3.1 and demonstrate the crowding-out effect. First, when all traders are informed, τ^*_ε decreases with increasing quality of public information τ_η. Second, when an intermediate fraction of traders choose to become informed, so that $\mu^*\in(0$ public information τ_η (in this case the precision τ^*_ε is unaffected). These two results reproduce the crowding-out effects studied by **Verrecchia (1982b)** and public information and private information are about the same random variable $\tilde{v}$, they are substitute, and thus additional public information motivates tra activities either in the form of producing less-precise private information or in the form of becoming uninformed.

In **Figure 1**, we can see how an increase in disclosure makes it more likely that we should move to an equilibrium with a smaller fraction of informed trader parameters, illustrating the crowding-out effect more directly. We now also set c_F=0.07. We plot the equilibrium fraction μ^* of informed traders and the equ functions of the precision τ_η of public information. We see that globally, both μ^* and τ^*_ε weakly decrease with τ_η. Starting from low disclosure, all traders ch disclosure reduces the precision of their information. Then, at some point, the fraction of informed traders starts decreasing as disclosure continues to impr produced privately in the market. Hence, public disclosure clearly crowds out private information. We now examine the effect that this has on the measures

Figure 2

The crowding-out effect. This figure plots (*a*) the equilibrium fraction μ^* of informed traders and (*b*) the equilibrium precision τ^*_ε of informed traders' private information against the disclosure quality τ_η $c_V(\tau_{\varepsilon i})=(k/2)\tau^2_{\varepsilon i}$. The parameter values are $\tau_v=\tau_x=\gamma=Q=1$, $c_F=0.07$, and $k=0.1$.



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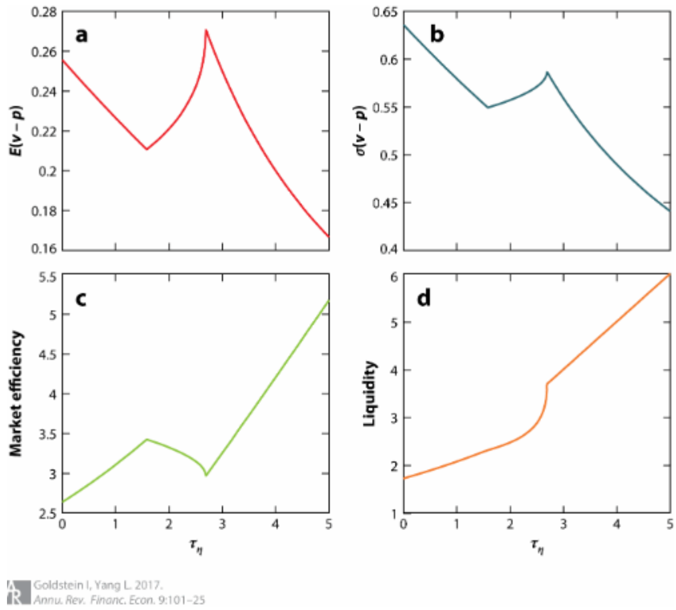
3.2.2. Effect on market quality.

In Section 2, disclosure had an unambiguous effect on four measures of market quality—market liquidity, market efficiency, cost of capital, and return volat two. However, things ought to be more complicated once we consider the crowding-out effect on private information. We use **Figure 3** to demonstrate the c private information adjusts endogenously on the basis of the analysis above. **Figure 3** uses the same parameter values as does **Figure 2**. It turns out that th the results depend on whether crowding out happens in the extensive margin (as in **Diamond 1985**) or the intensive margin (as in **Verrecchia 1982b**) and o

Figure 3

The effect of disclosure on an economy with endogenous information acquisition. This figure plots (*a*) the cost of capital $E(\bar{v}-\bar{p})$, (*b*) return volatility $\sigma(\bar{v}-\bar{p})$, (*c*) market efficiency $1/\mathrm{Var}(\bar{v}|\bar{p})$, and variable cost of information acquisition takes a quadratic form, $c_V(\tau_{\varepsilon i})=(k/2)\tau^2_{\varepsilon i}$. The parameter values are $\tau_v=\tau_x=\gamma=Q=1$, $c_F=0.07$, and $k=0.1$.



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Let us consider the effect of disclosure τ_η on the cost of capital $E(\bar{v}-\bar{p})$. Recall that without considering private information to be endogenous, disclosure h **3** shows that, in the presence of endogenous private information, there are three different regimes. First, when τ_η is small, $E(\bar{v}-\bar{p})$ decreases as τ_η increases increasing τ_η, which corresponds to the work of **Verrecchia (1982b)**. Here, the crowding out of private information happens in the intensive margin. The de disclosure increases the risk faced by traders, pushing to an average increase in the cost of capital, but this is not strong enough to overcome the direct redu Second, when τ_η takes intermediate values, $E(\bar{v}-\bar{p})$ starts to increase with τ_η. Here, $\mu^*\in(0,1)$ decreases with τ_η and τ^*_ε is fixed, which corresponds to the w happens in the extensive margin. Now the decrease in private information as a result of increased disclosure is sufficiently strong that the cost of capital inc effect. Hence, the indirect effect of crowding out on the extensive margin is more powerful in this regime. Third, when τ_η is high, $E(\bar{v}-\bar{p})$ decreases with incr affects private information, and only the direct reducing effect of disclosure on the cost of capital is present. [6] Overall, we see that the crowding out of privat disclosure no longer has a uniformly negative effect on the cost of capital, so the total effect must be evaluated more carefully and depends on the exact inf

Considering the effect of disclosure on market efficiency and return volatility, we can see effects very similar to those described above for the cost of capital monotonically increasing in disclosure. Here, the crowding-out effect of private information does not interfere with the positive direct effect that disclosure effect partly benefits market liquidity, as it weakens adverse selection induced by private information.

4. DISCLOSURE AND REAL EFFICIENCY

The above analysis has shown the effect that disclosure has on four commonly mentioned variables that capture different dimensions of market quality. We these measures when we consider only its direct effect, but then showed that disclosure tends to crowd out private-information production and, as a result One issue with the above analysis is that these measures do not translate easily into a clear objective function that will help us tell when disclosure is desira

In this section we address this issue and extend our basic framework, reviewing papers that have attempted to pin down optimal disclosure policy with a cl here emphasize the role of the financial market in producing information and in guiding the decisions on the real side of the economy, e.g., investment deci **Hayek (1945)**, who argued that prices are an important source of information because they aggregate information from many market participants. There is this market feedback effect; a recent survey is provided by **Bond, Edmans & Goldstein (2012)**. The papers reviewed here explore optimal disclosure policy, information provided by the market and the efficiency of the investment decisions that are guided by the market. This, of course, is related to the concept o should be clear from the analysis here, market efficiency and real efficiency are not always aligned. The latter refers to the efficiency of the market in reveali the economy. Real efficiency is what the models here feature, based on an objective function developed from first principles. For a broader discussion, see they make between forecasting price efficiency and revelatory price efficiency.

4.1. Crowding-Out Effect and Optimal Disclosure Policy

The crowding-out effect reviewed in Section 3 suggests that disclosure can reduce the amount of private information in the price. Thus, if a firm manager tri out effect tends to harm the manager's learning quality. However, as we reviewed in Section 2, disclosure can benefit the firm by lowering the cost of capita study the resulting trade-off to examine the optimal disclosure policy of a firm. We now present an extension of our CARA-normal setup that captures their t

We extend the model in Section 3 to include another active player (the firm) and an intermediate date ($t = 1\frac{1}{2}$). We interpret the traded risky asset as the ass information $\tilde{s}_F = \tilde{v} + \tilde{\varepsilon}_F$, with $\tilde{\varepsilon}_F \sim N(0, \tau_F^{-1})$ and $\tau_F>0$. At the beginning of date 0, the firm chooses a disclosure policy that commits it to disclose a noisy versio form:

$$\tilde{y} = \tilde{s}_F + \tilde{\delta}, \quad \text{with } \tilde{\delta} \sim N(0, \tau_\delta^{-1}) \text{ and } \tau_\delta \in [0, \infty].$$

All of the underlying random variables $(\tilde{v}, \tilde{\varepsilon}_F, \tilde{\delta}, \{\tilde{\varepsilon}_i\}_i, \tilde{x})$ are mutually independent. We can rewrite $\tilde{y}$ in **Equation 12** in the form defined in **Equation 2** by defini $^{-1}\in[0, \tau_F]$. The parameter τ_η still controls the disclosure quality. In particular, when $\tau_\eta=0$, the firm does not disclose any information, and when $\tau_\eta=\tau_F$, the fir

The firm also has a growth opportunity whose productivity is related to $\tilde{v}$. The firm invests in the growth opportunity at $t = 1\frac{1}{2}$, so it can look into the asset p opportunity's cash flow $\tilde{G}$ is realized at date 2, and it takes the following form:

$$\tilde{G} = \sqrt{\Phi}\tilde{v}I - \frac{I^2}{2},$$

where i is the investment made by the firm at $t = 1\frac{1}{2}$ and the parameter $\Phi>0$ captures the size of the growth option. As in the work of **Subrahmanyam & Titn** that the growth opportunity is separate from the asset-in-place and is nontradable, to keep the model tractable. In this extended economy, the firm makes t real-investment decision at $t = 1\frac{1}{2}$. We assume that the firm is risk-neutral and cares about both the asset-in-place and the growth opportunity. To simplify t information acquisition does not incur a fixed cost and that only the variable cost function remains, for instance, $c_V(\tau_{\varepsilon i})=(k/2)\tau^2_{\varepsilon i}$, with $k>0$. All the other fe

The noisy REE in the financial market at date 1 is still characterized as in Section 2, and the information-acquisition equilibrium at date 0 is still characterize the firm. At $t = 1\frac{1}{2}$, the firm has an information set $\{\tilde{s}_F, \tilde{p}, \tilde{y}\} = \{\tilde{s}_F, \tilde{s}_p\}$, where $\tilde{s}_p$ is the market signal given by **Equation 4**. The firm's optimal investment policy opportunity in **Equation 13** given the information available, implying that $I(\tilde{s}_F, \tilde{s}_p) = \sqrt{\Phi}E(\tilde{v}|\tilde{s}_F, \tilde{s}_p)$. Inserting $I(\tilde{s}_F, \tilde{s}_p)$ back into the growth opportunity and ta expected growth value:

$$E(\tilde{G}) = \frac{\Phi}{2}\left(\frac{1}{\tau_v} - \frac{1}{\tau_v + \tau_F + (\tau_\varepsilon/\gamma)^2\tau_x}\right).$$

We can see that the expected growth value increases with the precision $(\tau_\varepsilon/\gamma)^2\tau_x$ of the price signal $\tilde{s}_p$. This is a result of the feedback effect. The firm benefi about the fundamental $\tilde{v}$ because then it can make a more efficient investment decision. By the crowding-out effect, additional disclosure lowers the precisi the price signal $\tilde{s}_p$ less accurate. As a result, disclosure can harm the firm by reducing the value of the growth option.

At $t=0$, the firm chooses an optimal disclosure policy τ_η. Following **Langberg & Sivaramakrishnan (2010)**, we assume that the firm's objective at date 0 is a in-place and its expected growth opportunity value, $\alpha E(\tilde{p}) + (1-\alpha)E(\tilde{G})$, with $\alpha\in(0, 1)$. (For instance, the firm is balancing the interests of its short-term sha term shareholders, who care about the firm's terminal cash flows $\tilde{v} + \tilde{G}$.) Here, the expected price $E(\tilde{p})$ of the asset-in-place is derived from **Equations 3 and** given by **Equation 14**. Then the optimal disclosure policy τ^{opt}_η balances two forces. On the one hand, greater disclosure increases $E(\tilde{p})$ by reducing the unc reducing the cost of capital they impose on the firm. [7] On the other hand, greater disclosure crowds out private information production and so deprives the efficiency of its investment decision and the value of its growth option. As a result, one can show that when Φ/Q is relatively high, that is, when the firm's gr the negative effect of disclosure dominates, and thus the firm chooses to disclose less. This model therefore implies that growth firms are endogenously mo

4.2. Liquidity-Chasing Noise Trading

Another negative effect of disclosure on real efficiency is studied by **Han, Tang & Yang (2016)**. They follow the approach of modeling discretionary liquidity **Admati & Pfleiderer 1988**, **Foster & Viswanathan 1990**) and show that greater disclosure attracts more noise trading. We now modify the model presented

We shut down the information-acquisition activities of the CARA traders at date 0 and endow each of them with a private signal $\tilde{s}_i$ with precision τ_ε. There is are risk-neutral, uninformed, and ex ante identical. [8] These traders are discretionary in the sense that at date 0, each chooses whether to participate in the r loss from trading against informed CARA traders versus an exogenous liquidity benefit B of market participation. If discretionary liquidity trader l decides to where $\tilde{u} \sim N(0, 1)$ and is perfectly correlated across liquidity traders. The equilibrium mass L^* of liquidity traders participating in the market determines the r $=L^{*2}$. All other features of the model in Section 4.1 are unchanged.

We now characterize the market participation equilibrium of discretionary liquidity traders at date 0. At that point, discretionary liquidity trader *l* faces the f
exogenous benefit $B>0$, which represents the exogenous liquidity needs. Second, because liquidity traders are trading against informed CARA traders, they
the expected utility of participating in the market for discretionary liquidity trader *l* is

$$W(L;\tau_\eta) = B + E[\tilde{u}\cdot(\tilde{v}-\tilde{p})] = \underbrace{B}_{\text{liquidity benefit}} - \underbrace{p_x(L;\tau_\eta)\times L}_{\text{trading cost}}.$$

Here, *l* is the mass of liquidity traders choosing to participate in the market and $p_x(L;\tau_\eta)$ is given by **Equation 8**, with $\tau^{-1}_x=L^2$. Note that, given market liqui
because when more liquidity traders participate, they exert stronger price pressure, given that they trade in the same direction. In equilibrium, an endogeno
the market, while the rest choose not to. Hence, L^* is determined by the indifference condition: $W(L^*;\tau_\eta)=0$.

Equation 15 shows that discretionary liquidity traders have incentives to chase market liquidity. That is, if a change in the trading environment improves m
being equal, expected trading losses decrease and discretionary liquidity traders are more likely to participate in the market. As disclosure promotes marke
discretionary liquidity traders to choose to participate in the market; that is, $\partial L^*/\partial\tau_\eta>0$.

Disclosure also affects real efficiency through affecting the firm's learning from the price. By observing the price $\tilde{p}$, the firm obtains a signal $\tilde{s}_p$ with a precisi
of noise trading is given by $\tau_x=1/L^{*2}$, which implies that the precision of the information in the price decreases as the level of disclosure increases: $\partial[\tau_\varepsilon/(\gamma L^*$
additional liquidity trading and, as a result, the price reveals less fundamental information, thereby reducing real efficiency.

4.3. Multiple Dimensions of Disclosure

The models discussed in Sections 4.1 and 4.2 highlight the negative real-efficiency effects of disclosure. Two recent papers, by **Bond & Goldstein (2015)** and
presence of multiple dimensions of information, the real-efficiency implications of disclosure might be different depending on what dimension of informati

Bond & Goldstein (2015) show that a decision maker on the real side of the economy should disclose information about issues on which he or she knows m
which he or she wants to learn from the market. Bond & Goldstein cast their idea in a trading model where the decision maker is the government, which ma
baseline model in Section 2 to illustrate the mechanism. Suppose that the firm's cash flow $\tilde{v}$ at date 2 is given by $\tilde{v}=T+\tilde{v}_B$, where $\tilde{v}_B\sim N(0,\tau_B^{-1})$ with $\tau_B>0$.
government intervention based on its private information and the asset price $\tilde{p}$. For example, one can think of the government bailouts of AIG and Citigroup
additional date, $t=1\frac{1}{2}$, at which the government chooses *T* to maximize

$$E\left[-\frac{(T-\tilde{v}_A)^2}{2}+cT\,\middle|\,\mathcal{I}_G\right],$$

where $\tilde{v}_A\sim N(0,\tau_A^{-1})$ (with $\tau_A>0$), $c>0$ is a constant, and $\mathcal{I}_G$ is the government's information set. As discussed by **Bond & Goldstein (2015)**, this objective func
such as promoting social surplus and maintaining stability in the financial sector.

Note that in this setting, the asset cash flow $\tilde{v}$ is ultimately driven by two underlying random variables, $\tilde{v}_A$ and $\tilde{v}_B$. We assume that the government wants to l
about element $\tilde{v}_B$. For example, $\tilde{v}_A$ determines the benefit from intervention, as it reflects the spillover effect from an individual bank's failure, and this is so
the market. In contrast, $\tilde{v}_B$ is information about the bank's expected direct cash flows, which is information that the government has direct access to. For sim
perfectly and only receives a private signal $\tilde{s}_G$ on $\tilde{v}_A$, where $\tilde{s}_G=\tilde{v}_A+\tilde{\varepsilon}_G$ with $\tilde{\varepsilon}_G\sim N(0,\tau_G^{-1})$ and $\tau_G>0$. Traders have private information on $\tilde{v}_A$ in the form of **Eq**
receives a signal $\tilde{s}_i=\tilde{v}_A+\tilde{\varepsilon}_i$ with $\tilde{\varepsilon}_i\sim N(0,\tau_\varepsilon^{-1})$ and $\tau_\varepsilon>0$. So the asset price $\tilde{p}$ will aggregate private signals $\tilde{s}_i$ and convey information on $\tilde{v}_A$. The government c
aggregation process of the price. Specifically, at date 1 before the financial market opens, the government discloses two public signals, $\tilde{y}_A=\tilde{s}_G+\tilde{\eta}_A$ and $\tilde{y}_B=$
$\tilde{\eta}_B\sim N(0,\tau_{\eta B}^{-1})$ (with $\tau_{\eta B}\in[0,\infty]$). All the underlying random variables $(\tilde{v}_A,\tilde{v}_B,\tilde{\varepsilon}_G,\tilde{\eta}_A,\tilde{\eta}_B,\{\tilde{\varepsilon}_i\}_i)$ are mutually independent.

The price function in the financial market at date 1 takes the form $\tilde{p}=p_0+p_{yA}\tilde{y}_A+p_{yB}\tilde{y}_B+p_v\tilde{v}_A+p_x\tilde{x}$, where the *p*-coefficients are endogenous. At $t=1\frac{1}{2}$, t
$\mathcal{I}_G=\{\tilde{s}_G,\tilde{y}_A,\tilde{y}_B,\tilde{v}_B,\tilde{p}\}$. To the government, the price is still equivalent to the signal $\tilde{s}_p$ as in **Equation 4**, i.e.,

$$\tilde{s}_p=\frac{\tilde{p}-p_0-p_{yA}\tilde{y}_A-p_{yB}\tilde{y}_B}{p_v}=\tilde{v}_A+\rho^{-1}\tilde{x},\quad \text{with } \rho=\frac{p_v}{p_x}.$$

Thus, the government's intervention policy is

$$\begin{aligned}T(\tilde{s}_G,\tilde{s}_p) &= \arg\max_T E\left[-\frac{(T-\tilde{v}_A)^2}{2}+cT\,\middle|\,\tilde{s}_G,\tilde{y}_A,\tilde{y}_B,\tilde{v}_B,\tilde{p}\right]\\ &= E(\tilde{v}_A\,|\,\tilde{s}_G,\tilde{s}_p)+c=\frac{\tau_G}{\tau_A+\tau_G+\rho^2\tau_x}\tilde{s}_G+\frac{\rho^2\tau_x}{\tau_A+\tau_G+\rho^2\tau_x}\tilde{s}_p+c.\end{aligned}$$

The precision $\rho^2\tau_x$ of signal $\tilde{s}_p$ still captures the extra information that the government learns from the market. As in Section 4.1, in equilibrium, the governm
$\rho^2\tau_x$ means that the government is making a more informed intervention decision. In this sense, $\rho^2\tau_x$ is a measure of real efficiency.

Financial trader *i* has an information set $\{\tilde{s}_i, \tilde{y}_A, \tilde{y}_B, \tilde{p}\}$, which is equivalent to $\{\tilde{s}_i, \tilde{y}_A, \tilde{y}_B, \tilde{s}_p\}$. The CARA-normal setup implies that trader *i*'s demand for the risk

$$D(\tilde{s}_i, \tilde{y}_A, \tilde{y}_B, \tilde{p}) = \frac{E[T(\tilde{s}_G, \tilde{s}_p) + \tilde{v}_B \mid \tilde{s}_i, \tilde{y}_A, \tilde{y}_B, \tilde{s}_p] - \tilde{p}}{\gamma \operatorname{Var}[T(\tilde{s}_G, \tilde{s}_p) + \tilde{v}_B \mid \tilde{s}_i, \tilde{y}_A, \tilde{y}_B, \tilde{s}_p]}.$$

Using the expression for $T(\tilde{s}_G, \tilde{s}_p)$ in **Equation 16** and the market-clearing condition, $\int_0^1 D(\tilde{s}_i, \tilde{y}_A, \tilde{y}_B, \tilde{p})\mathrm{d}i + \tilde{x} = Q$, we can solve for $\tilde{p}$ in terms of $(\tilde{y}_A, \tilde{y}_B, \tilde{v}_A, \tilde{x})$. C
function, we then form a system in terms of the *p*-coefficients that characterizes the noisy REE in the financial market.

The key results can be summarized as follows: Disclosing information about $\tilde{v}_A$ harms the government through impairing its learning quality from the price,
government. Intuitively, consider the extreme cases where the government fully discloses one of the signals. (For intermediate cases, the intuition is similar
fully discloses its signal on $\tilde{v}_A$ so that $\tilde{y}_A = \tilde{s}_G$ and $\tau_{\eta A}=\infty$, then $T(\tilde{s}_G, \tilde{s}_p)$ is perfectly known by financial traders, so they will no longer put any weight on their
aggregate $\tilde{s}_i$ anymore and the government learns nothing from the price. Effectively, there is a crowding-out effect, whereby disclosing information about so
this information and reduces the ability of the government to learn from their information. Interestingly, this crowding out does not operate through the inc
in this review, but through the ability to trade on existing information. It is captured by the numerator of traders' demand function (**Equation 17**), as the ava
value of their private information and causes them to trade less aggressively. Second, suppose that the government fully discloses its information on $\tilde{v}_B$ so t
longer need to forecast $\tilde{v}_B$, which lowers the risk they face, making traders trade more aggressively on $\tilde{s}_i$. This effect of reducing uncertainty, originating from
the denominator of their demand function (**Equation 17**), as the reduction in risk incentivizes them to trade more on their information. In consequence, the
information, benefiting the government's learning from the price.

The mechanism in the work of **Goldstein & Yang (2016)** is different and does not rely on risk aversion, as they study an environment in which all players are
determining which information will be reflected by prices is the relative intensity at which agents trade on different pieces of information. Assuming again t
a regular firm could represent the demand for the firm's products and the quality of its production technology, and assuming that agents have access to sig
more precise information on the dimension about which the firm already knows will cause traders to trade more aggressively on the dimension about which
learn more from the price. The opposite will be true if more precise public information is revealed on what the firm is trying to learn; this will crowd out valu
the price, reducing the firm's ability to learn from the price.

There is another important distinction in the work of **Goldstein & Yang (2016)** relative to the literature. In most models discussed above, such as those of **G**
information is disclosed by the real decision maker, so the decision maker does not directly learn from the disclosed information. In some scenarios, this ma
benefit directly from public information disclosed by the government or by other agencies. In these scenarios, disclosure has both a direct effect of providin
indirect effect of affecting price informativeness. The analysis of **Goldstein & Yang (2016)** considers both effects. Paradoxically, for the reason discussed abo
decision maker wants to learn can backfire, as it interferes with the ability of the market to reveal this type of information, attenuating the positive direct eff
very effective at processing information, the indirect effect can be stronger than the direct effect, implying that better disclosure can reduce the overall qual
can harm real efficiency, even though the decision maker directly learns from the public information. [9]

The analysis of multiple dimensions of information can be linked to the debate on the optimal disclosure of stress-test results (for a survey, see **Goldstein &**
regulators to make intervention decisions and for creditors to determine whether to roll over their debt or extend more credit to financial institutions. Howe
results will crowd out information from the financial market. Based on the papers described here, disclosure is undoubtedly beneficial when the stress-test
creditors have a relative informational advantage over the financial market. However, when the stress-test result is about something that the regulator or cr
disclosing such information makes market prices less informative, which can lead to negative efficiency outcomes.

5. INVESTORS' WELFARE

The previous section described the various effects of disclosure on the efficiency of real investment decisions. Another important issue that has to be consid
implications for the welfare of traders in the financial market. As mentioned in Section 2, the usual argument invoked in favor of disclosure is that it improve
effects for investors in financial markets. However, as we discuss in this section, several models in the literature have shown that disclosure can have negativ
warranted to implement "investor protection" regulations that improve disclosure. In the next two subsections, we discuss two families of models that deve

5.1. Destruction of Trading Opportunities

The well-known **Hirshleifer (1971)** effect is a powerful argument against public disclosure of information. The idea is that when traders face idiosyncratic ri
shocks, public disclosure decreases welfare by reducing the risk-sharing opportunities available to traders. More recently, **Kurlat & Veldkamp (2015)** studie
investors. In their setting, investors benefit when they have access to assets with a higher risk and a higher return, and these opportunities are eliminated b
of both channels is that disclosure harms investors through destroying trading opportunities. We now extend the baseline model in Section 2 to illustrate th

For the Hirshleifer effect to arise, we assume that traders trade to share risks rather than to speculate on private information. Specifically, we assume that a
income, $\tilde{q}_i\tilde{v}$, where $\tilde{q}_i \sim N(0, \sigma_q^2)$ with $\sigma_q \geq 0$, and $\tilde{q}_i$ is independent of $\tilde{v}$ and also independent across traders. When trading at date 1, trader *i* knows his or her
information about the asset value $\tilde{v}$. To simplify things further, we assume that there are no noise traders in the model. The other features of the model are
given by **Equation 2**. In this economy, trader *i*'s demand for the risky asset is

$$D_i(\tilde{y}, \tilde{p}) = \frac{E(\tilde{v}|\tilde{y}, \tilde{p}) - \tilde{p}}{\gamma \operatorname{Var}(\tilde{v}|\tilde{y}, \tilde{p})} - \tilde{q}_i.$$

In **Equation 18**, the first term is the demand of a CARA trader without endowment shocks, who is attempting to make a profit on the deviations of prices fro
term is the hedging term capturing trader *i*'s attempt to reduce the endowment risk. Combining **Equation 18** with the market-clearing condition, we can co

$$\tilde{p} = E(\tilde{v}|\tilde{y}) - \gamma \operatorname{Var}(\tilde{v}|\tilde{y})Q.$$

As there is no private information or noise trading, the price depends only on the public signal $\tilde{y}$.

Inserting **Equation 18** into trader *i*'s objective function yields the indirect utility at the trading stage as follows:

$$U_i(\tilde{y}, \tilde{p}, \tilde{q}_i) = -\exp\left(-\underbrace{\frac{[E(\tilde{v}|\tilde{y}) - \tilde{p}]^2}{2\operatorname{Var}(\tilde{v}|\tilde{y})}}_{\text{trading gains}} - \gamma \underbrace{\tilde{p}\tilde{q}_i}_{\text{wealth}}\right).$$

In **Equation 20**, the term $\tilde{p}\tilde{q}_i$ captures the fact that each unit of labor income increases trader *i*'s wealth by the price $\tilde{p}$ of the risky asset, as it has the same ca
$[E(\tilde{v}|\tilde{y}) - \tilde{p}]^2/[2\operatorname{Var}(\tilde{v}|\tilde{y})]$ represents the benefit from trading the risky asset given the trading behavior in **Equation 18**. This term essentially captures the effec

We can use the certainty equivalent $\text{CE} \equiv -(1/\gamma)\log(-E[U_i(\tilde{y}, \tilde{p}, \tilde{q}_i)])$ to study the ex ante utility of trader *i*. To formally see the effect shown by **Kurlat & Veldk**
dropping traders' idiosyncratic endowments and assuming that they simply trade the quantity put on the market by the issuer, that is, $\sigma_q=0$ and $Q>0$. Usin
Equation 20 can be expressed as

$$\frac{[E(\tilde{v}|\tilde{y}) - \tilde{p}]^2}{2\operatorname{Var}(\tilde{v}|\tilde{y})} = \frac{\gamma^2 Q^2}{2}\operatorname{Var}(\tilde{v}|\tilde{y}) = \frac{\gamma^2 Q^2}{2}\frac{1}{\tau_v + \tau_\eta}.$$

Then

$$\text{CE} = \frac{\gamma Q^2}{2}\frac{1}{\tau_v + \tau_\eta},$$

which decreases as disclosure quality τ_η increases. The intuition is as follows: Greater disclosure brings the asset price closer to its fundamental, so traders
limit, if $\tilde{y}$ perfectly reveals $\tilde{v}$, then the risky asset becomes riskless, and traders lose all access to risk in their portfolio. The argument is very simple: If traders
that they derive utility from it, and this utility is lost if we shut down risk by revealing the information publicly. Note that this model takes the perspective of
worse off by greater disclosure quality. One should remember that the issuer could be made better off by disclosure, for several reasons. For example, if the
selling price of the security, then, as discussed in Section 2.3.3, disclosure leads to a lower cost of capital, which in turn benefits the issuer. As the model is n
investors and the welfare gain of the issuer do not cancel out.

Now let us turn off the effect of **Kurlat & Veldkamp (2015)** and demonstrate the Hirshleifer effect; that is, suppose that $\sigma_q>0$ and $Q=0$. In this case, the asse
among themselves to hedge against their endowment shocks. We can compute

$$\text{CE} = \frac{1}{2\gamma}\log\left(1 - \gamma^2\sigma_q^2\frac{\tau_\eta}{\tau_v(\tau_v + \tau_\eta)}\right),$$

which again decreases with increasing τ_η. Intuitively, as traders are risk averse, they benefit from trading risk-sharing contracts that insure against their exp
sharing opportunities, as once the asset value is known, it is no longer possible to insure against its realization.

The Hirshleifer effect suggests that disclosure is unambiguously bad. This is true when there is enough capital in risk-sharing markets to allow them to work
example, the interbank market, which is used to share risk among banks. During the recent financial crisis, when aggregate conditions were bleak, this mar
suffered shortages. This arguably led to market breakdown. **Goldstein & Leitner (2015)** study a model to consider a trade-off between the negative Hirshlei

market breakdown. They find that, in good times, disclosure is undesirable because of the Hirshleifer effect. In bad times, however, some disclosure is nece
characterize optimal disclosure schemes in the spirit of the Bayesian persuasion literature following **Kamenica & Gentzkow (2011)**. Importantly, full disclo
enough to restart the risk-sharing market by separating traders into different groups and excluding some of them from risk-sharing arrangements.

5.2. Coordination and Beauty Contests

Keynes (1936) argues that stock markets share the essence of a beauty contest because the actions of traders are governed not only by their expectations a expectations about what other traders believe. There are many other environments, such as currency attacks or bank runs, in which agents have not only fu these contexts, public disclosure provides more than just information about fundamentals, as it plays a coordination role of informing agents of what other actions of others. This coordination role can be detrimental to efficiency and welfare in the sense that agents place too much weight on the public signal rel planner. In an example described by **Scharfstein & Stein (1990)**, investors' coordination motive originates from a reputation concern—they want to appear are following—but ends up harming the quality of investment and monitoring decisions.

The coordination mechanism and its general implications are best demonstrated by **Morris & Shin (2002)**. We now review their model. To keep consistency in Section 2. The underlying state is given by $\tilde{v}$, which is drawn from an improper uniform prior over the real line (i.e., τ_v=0). There is a continuum [0, 1] of ag denote the action profile over all agents. Agent *i* has access to both a private signal $\tilde{s}_i$ and a public signal $\tilde{y}$, given by **Equations 1 and 2**, respectively.

In the work of **Morris & Shin (2002)**, the beauty-contest motive is directly built into agents' preferences. Specifically, the utility for agent *i* is given by

$$u_i(\tilde{v}, \mathrm{D}) = -(1-b)(D_i - \tilde{v})^2 - b(L_i - \bar{L}),$$

where $b \in (0, 1)$ is a constant, $L_i = \int^1{}_0 (D_j - D_i)^2 \mathrm{d}j$, and $\bar{L} = \int_0^1 L_j \mathrm{d}j$. Hence, the agent has an incentive (with weight $1-b$) to take an action close to the fundame fundamentals are high) and an incentive (with weight b) to take an action close to others' actions (e.g., buy when others are buying). Then the action taken

$$D(\tilde{s}_i, \tilde{y}) = \arg\max_{D_i} E[u_i(\tilde{v}, \mathrm{D}) \mid \tilde{s}_i, \tilde{y}] = (1-b)E(\tilde{v}|\tilde{y}, \tilde{s}_i) + bE(\bar{D}|\tilde{y}, \tilde{s}_i),$$

where $\bar{D}$ is the average action in the population, i.e., $\bar{D} = \int_0^1 D(\tilde{s}_i, \tilde{y}) \mathrm{d}i$. Hence, the agent makes a decision based on the expected level of the fundamental $\tilde{v}$ a Parameter *B* controls the intensity of the beauty-contest motive.

We consider an equilibrium in which each agent follows a linear strategy of the form $D(\tilde{s}_i, \tilde{y}) = \kappa_s \tilde{s}_i + \kappa_y \tilde{y}$, where κ_s and κ_y are endogenous coefficients. Inser find the expression for $D(\tilde{s}_i, \tilde{y})$. We then compare coefficients in this computed expression with those in the conjectured linear strategy to compute κ_s and κ

$$\kappa_s = \frac{\tau_\varepsilon(1-b)}{\tau_\varepsilon(1-b) + \tau_\eta} \quad \text{and} \quad \kappa_y = \frac{\tau_\eta}{\tau_\varepsilon(1-b) + \tau_\eta}.$$

When there is no beauty-contest motive (i.e., when b=0), the weight κ_y that is put on the public signal is based on the precision of the two signals, as in Baye and strengthens (i.e., when B>0 and increases), the weight κ_y on the public signal increases. The reason is that whereas both signals provide information ab additional weight, given that it also provides information about what other agents know, and hence it helps in predicting their actions.

In the work of **Morris & Shin (2002)**, the excessive weight on the public signal harms social welfare, which is defined as the (normalized) average of individu

$$W(\tilde{v}, \mathrm{D}) \equiv \frac{1}{1-b}\int_0^1 u_i(\tilde{v}, \mathrm{D})\mathrm{d}i = -\int_0^1 (D_i - \tilde{v})^2 \mathrm{d}i.$$

A social planner would seek to keep all agents' actions close to $\tilde{v}$. This is because the beauty-contest motive cancels out across individuals and so does not specify the weight that each agent puts on the public signal $\tilde{y}$, that weight would be $\kappa^{opt}{}_y = \tau_\eta/(\tau_\varepsilon+\tau_\eta)$, which is lower than the equilibrium weight κ_y on $\tilde{y}$. T welfare reducing.

The implication is that greater disclosure might harm agents' welfare. Formally, using **Equations 24 and 25**, we can compute the expected welfare in equilib

$$E[W(\tilde{v}, \mathrm{D})|\tilde{v}] = -\frac{\tau_\eta + \tau_\varepsilon(1-b)^2}{[\tau_\eta + \tau_\varepsilon(1-b)]^2}.$$

Direct computation shows that $E[W(\tilde{v}, \mathrm{D})|\tilde{v}]$ is U-shaped in the precision τ_η of public information. Intuitively, releasing public information has two effects on informational role; that is, more public information helps agents to predict the state $\tilde{v}$ more accurately. The negative effect stems from the coordination role information, and this is exacerbated when the public information is more precise. The overall result is that when the public information is sufficiently coarse public information is sufficiently accurate, the positive effect dominates. Hence, increasing the precision of disclosure is desirable when disclosure is alread

We point out that the negative welfare effect of coordination is not general. It follows here because the beauty-contest element in individual utility is of zero other settings, coordination is socially valuable, so welfare necessarily increases with the precision of public information. One such example is investment c positively depends on the aggregate production of all firms in the same industry. **Colombo, Femminis & Pavan (2014)** extend the work of **Angeletos & Pav** private information.

Although **Morris & Shin (2002)** take the beauty-contest motive as given, it is important to ask where this motive might come from. After all, most traditional principles, do not necessarily predict that traders would like to do what other traders do. **Allen, Morris & Shin (2006)** and **Cespa & Vives (2015)** endogenize financial traders. A short-horizon trader has to close his or her investment positions in an asset before its fundamental value is realized, so this trader's payo pay, rather than on how much he or she expects the fundamental value of the asset will be. As in the work of **Morris & Shin (2002)**, public information agair role, because it conveys information about the unknown fundamental value, and a coordination role, because it is common to the information sets of all tra future liquidation value when he or she closes positions.

Gao (2008) uses the setting of **Allen, Morris & Shin (2006)** to examine the implications of disclosure for market efficiency. The setting is an extension of our and hence with two trading periods (t=0 and t=1). The risky asset still pays off $\tilde{v}$ at date 2. Traders' short horizons are characterized by an overlapping-genera the implication of disclosure for market efficiency at date 0. He shows that greater disclosure always drives stock prices closer to the fundamental value anc an endogenous link between the two roles of public information in affecting the trading of date-0 traders. The coordination role occurs because short-horiz traders will use public information because of its information value. When the information value becomes less, traders at date 0 overuse it less because they less. Thus, the coordination role is always secondary to the informational role in terms of market efficiency in the setting of **Gao (2008)**. Note that this result we discuss in Section 5.1, a more informative price may actually harm traders.

Goldstein, Ozdenoren & Yuan (2011) endogenize the beauty-contest motive using a model in which the aggregate trading of currency speculators reveals r decision. The beauty-contest motive arises in their setting because speculators know that a large speculative currency attack has the potential to convince t each speculator would like to second-guess other speculators' actions to better coordinate. As a result, speculators put excessive weight on signals that are setting, the central bank may inadvertently strengthen the coordination motive by releasing more information that becomes common to speculators, which the central bank learns from the attack, leading the bank to make more policy mistakes.

6. CONCLUSION

The analysis provided in this article demonstrates key insights from the literature on how information disclosure in financial markets affects market quality, welfare. As the analysis shows, there are many aspects to consider when evaluating the effects of disclosure and the optimal regulation of the level and forn these effects can be manifested in a cohesive analytical framework that has proven useful in understanding trading and information in financial markets. As regulators to increase market quality, it is important to consider its different implications. We hope that our review will be useful for researchers interested i area and for policy analysis as regulations of market disclosure continue to evolve.

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The authors are not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review.

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