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Should Insider Trading be Prohibited when Share Repurchases are Allowed?[*]

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Abstract

This paper considers share repurchases as the way long-term shareholders preserve their ability to use corporate information for speculative purposes when insider trading regulation is enforced. This use of corporate information increases the adverse selection losses of short-term shareholders. Thus, buy-back programs reduce their incentive to invest in stocks that back the most productive technology, leading to a socially inefficient equilibrium. It follows that insider trading should not be banned when share repurchases are allowed. More generally, the paper argues that the regulation of insider trading and repurchases can not be considered in isolation, and analyzes their interplay.

JEL classification: G18, G14, D82, K22
Keywords: insider trading, buyback, liquidity, securities regulation, corporate information

1 Introduction

The legal arguments for a ban on insider trading are converging to the view that inside information is a property of the corporation and insider trading is akin to theft (Bhattacharya and Daouk, 2002).[1] Economists (King and Roëll, 1988; Dow and Rahi, 2003; Easterbrook and Fischel, 1991) also contend that insider traders misappropriate corporate property because the insiders profit from information even though they do not have property rights over it. Consistent with this view, this paper models inside information as a corporate asset which is used by the firm. It may thus choose to disclose information to market participants or to keep it secret. Moreover, the company may perform open market share repurchases in order to correct misvaluation. We study these alternative corporate information policies, in the polar cases when insider trading is legal or is effectively prohibited, so as to assess the benefits of insider trading regulation.

The existing literature finds that insider trading should be regulated when the adverse selection losses caused to investors in the stock market exceed improvements in firm interim investment choice (Bernhardt, Hollifield and Hughson, 1995; Leland, 1992) or in risk sharing among investors (Bhattacharya and Nicodano, 2001) brought about by insider trading. In order to single out the incremental contribution of our model, we do not consider these potential sources of benefits, as there is neither interim investment nor risk aversion. Hence, insider trading should reduce welfare, and its regulation be beneficial. On the contrary, we show that banning insider trading is welfare diminishing.

Indeed, long term shareholders, who are assumed to be in control of corporate policies and to observe inside information, would trade on it when insider trading is unrestricted. This is mostly profitable to them when the company refrains from both repurchasing shares and disclosing information to the market, implying that these do not become the corporate information policies. The equilibrium policy shifts instead to stock repurchases when insider trading is effectively banned. Share repurchases become the way long-term shareholders preserve their ability to use corporate information so as to maximize the value of their stockholdings. This new allocation of corporate information worsens the welfare of the short-term shareholders, who suffer from adverse selection losses when trading in the marketplace. Their losses increase because the firm – being a monopolistic information trader – worsens the negative externality on market liquidity. Thus, open-market share repurchases reduce their incentive to invest in stocks that back the most productive technology, leading to a socially inefficient equilibrium. It follows that insider trading should not be banned when open market

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[1]U.S. courts increasingly rely on the *misappropriation theory* to decide insider trading cases (Lehn, 1989). This holds that an individual violates Rule 10b-5 of the 1934 Securities and Exchange Act if he or she knowingly trades on information that is used without the consent of its source.

share repurchases are allowed.

More generally, this paper argues that regulation of trading by corporate insiders can not be designed independently from that of share repurchases. For instance, a ban on share repurchases coupled with insider trading restrictions would improve on welfare, by eliminating all sources of adverse selection and preserving short-term traders' incentives to invest in stocks. However, we observe that share repurchase (SR) programs are usually not banned, and their use is instead spreading in several countries, as regulators recognize that they may be useful for substituting cash dividend payouts, modifying capital structure, implementing stock option plans and providing price stabilization.[2] While acknowledging these objectives for SR, regulators explicitly recognize and worry about the "privileged informational position of the issuer" when share repurchase programs are implemented (see OICV-IOSCO, 2004, p.10-12). Other indicators support our focus on firms' superior information when repurchasing shares. Firstly, it has been found that firms usually repurchase stock in order to take advantage of potential undervaluation and that there are significant positive abnormal returns several years after repurchase announcements (Dittmar, 2000; Ikenberry et al., 1995, 2000; Mitchell and Stafford, 2000). Secondly, Barclay and Smith (1988) find wider bid ask spreads for firms planning and announcing share repurchases, implying that market liquidity worsens. Brockman and Chung (2001) and Ginglinger and Hamon (2006) show that the adverse selection component of the bid-ask spread increases substantially during repurchase periods, while Chung et al. (2007) find that stock repurchases are associated with positive subsequent returns. All these evidences are consistent with the hypothesis of information-based buy-backs.[3] An alternative solution would be to subject share repurchases to insider trading regulation. This is the case in some jurisdictions, whereas others do not enforce restrictions on information-based share repurchases. Against this background, this paper compares the welfare consequences of banning insider trading when the issuer is either allowed to trade on inside information or subject to a less stringent ban than other insiders. Our analysis also quantifies the gains from banning information-based share repurchases when insider trading is prosecuted.

In our model, we focus on share repurchases performed through open market trading by the company. This is the most common mechanism used by companies because it gives them flexibility as to the timing, price and size of repurchases.[4] The term

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[2]See OICV-IOSCO (2004, p.3). The relative importance of these goals are debated in a large empirical literature, see Dittmar (2000) and Grullon and Michaely (2004) as well as references therein.

[3]Cook et al. (2004) find an increase in liquidity associated with actual repurchases. This difference may be due to sample selection: they cover 64 repurchases which are voluntarily reported by the issuer, while other analyses deal with exchange-collected data. Chung et al. (2007) also find lower spreads when the firm repurchases on a second trading line – which has no other buyer than the firm itself.

[4]Stephens and Weisbach (1998) report that they constitute 90% of total repurchases performed in the U.S..Studies of alternative mechanisms include Brennan and Thakor (1990) analysis of self tender

"stock repurchase" indicates in the model both the buying and the selling of own shares by the company. Indeed only a few jurisdictions, including the U.S., treat the selling of repurchased shares as a new distribution subject to a prospectus offering or require cancellation of repurchased shares. Several others permit an issuer to sell its own shares held "in treasury" before, during, and after a stock repurchase plan (OICV-IOSCO, 2004, p.7,8,9).

Our argument for unrestricted insider trading hinges on larger losses hitting short-term shareholders when the firm is repurchasing shares. We show that this argument does not hold only when the ownership of firms is potentially diffuse, i.e. the share of short-term investors in the economy is large.[5] In such firms, insiders are too few to compete very aggressively relative to the case of the monopolist firm. Moreover, profits from share repurchases are almost entirely paid back to short-term shareholders, thus causing them little loss. This implication highlights the difference between a firm, that distributes to its shareholders profits from buybacks, and insider traders that appropriate all the profits. When the share of short-term investors in the economy is small, firms ownership is concentrated. Companies may reduce adverse selection losses to short-term shareholders by disclosing inside information. However, disclosure in our setting is never a corporate policy, unless we drop the realistic assumptions that long-term shareholders determine corporate choices and that they cannot commit to disclosure.[6] Indeed, if liquidity traders have already invested in the risky asset, disclosure redistributes resources to liquidity traders, thus reducing long-term shareholders' welfare. When, instead, liquidity investors would prefer not to invest in the risky asset, voluntary disclosure may increase the welfare of every market participant by encouraging liquidity investors to enter the stock market. However, we show that voluntary disclosure is not an equilibrium outcome. With mandated disclosure our conclusion that insider trading should be unregulated when open market share repurchase are allowed holds true, unless announcements occur without delays. Otherwise, information-based share repurchases would again substitute for insider trading, increasing short-term shareholders losses.

Our paper thus delivers new insights by considering insider trading, stock repurchases and disclosure as competing uses of corporate information. This new approach straddles three branches of research. Earlier literature on information production and dissemination acknowledges that valuable information is produced by firms and could

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offers and Peyer and Vermaelen's (2005) empirical investigation of privately negotiated SR.

[5]Diffuse corporate ownership is not common outside Anglo-saxon countries, as companies – especially smaller ones – usually have concentrated ownership (see Becht et al., 2002, and references therein).

[6]Independent board members, that represent non-controlling shareholders' preferences, are typically a minority. Moreover, their appointment by controlling shareholders often weakens their incentives to vote against them. Similarly, short-term shareholders do not usually participate in shareholders' meetings. See Becht et al., 2002.

voluntarily be disclosed (Diamond, 1985; Fishman and Hagerty,1989). It further suggests that intermediaries have an incentive to sell or trade on information (Allen, 1989, 1990; Admati and Pfleiderer, 1986, 1988a). But it does not consider inside information as a corporate asset, and the associated opportunity for firms themselves to trade on inside information. Seminal papers on share repurchases treat them as an alternative to dividends for paying out corporate profits (Miller and Modigliani, 1961; Bhattacharya, 1979). Barclay and Smith (1988) consider that they can generate adverse selection costs in the stock market. However, in their model share repurchase programs are still considered as a distribution policy rather than a corporate information policy.[7] Recently, Oded (2005) shows that a good firm can signal its value to the market by announcing share repurchases precisely because buybacks generate adverse selection losses. In this paper we take these information-based repurchases as given, and ask what they imply for insider trading regulation. Finally, the insider trading literature does not represent an insider trader as appropriating a corporate asset. Khanna et al. (1994) implicitly assume that inside information is a corporate asset, by allowing the controlling shareholder to implicitly sell inside information to a manager for insider trading purposes. They also emphasize that short-term shareholders anticipate their adverse selection losses when deciding whether to invest in the risky asset, as we do. However, they study the interplay of financial analysis, insider trading and production, while we emphasize the link between insider trading, stock repurchases and disclosure.

A key insight, driving our result on welfare reducing insider trading regulation, is that a monopolistic information trader minimizes the leakage of information through prices. This is due to Admati and Pfleiderer (1988), by whom we also borrow the modelling of the trading subgame. In a dynamic setting, Holden and Subrahmanyam (1992) analysis supports their results. On the contrary Back, Cao and Willard (2000) argue that this is not the case when traders' signals are diverse, as they will trade less aggressively recognizing their incentive to reduce competition. In the case of insiders, however, the signal of the traders will be (close to) perfectly correlated, leading to the same type of insight obtained in the static setting.

The rest of this paper is organized as follows. The next section reports on some features of share repurchase regulation. Section 3 presents the model. Section 4 describes the equilibrium allocation and the welfare analysis. Section 5 examines alternative securities regulations. Section 6 presents an extended time line and ownership structure. In Section 7 we discuss the empirical implications. Section 8 concludes.

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[7]Brennan and Thakor (1990) make a related point. They observe that repurchases oblige shareholders to trade in order to obtain a desired level of dividends. In doing so, smaller less informed shareholders run the risk of partial expropriation by better informed shareholders who prefer repurchases over cash distribution.

2 Regulating Open-Market Share Repurchases

Buyback regulation aims at preventing price manipulation: to this goal, a maximum fraction of outstanding shares should be bought back at a price not exceeding an average of past prices. A second objective appears to be the protection of stakeholders other than shareholders. Indeed, shares should be bought back out of distributable profits only. These provisions have been present for a long time in several jurisdictions. A more recent regulatory concern relates to the use of privileged information by the issuer, which is what we focus on. Companies are required to disclose price sensitive information in sixteen countries, which were in charge of a survey conducted by IOSCO on the regulation of share repurchases. This organization recognizes that disclosure of price sensitive information "on a full and prompt basis should certainly go some way towards reducing the likelihood that a company will be holding a significant informational advantage [...] while in the course of purchasing its own shares" (OICV-IOSCO, 2004, p.10). In particular, regulators are able to sanction an issuer that repurchased shares, if subsequently it became clear that it had failed to make required disclosures ahead of those purchases.

Open market share repurchases are usually subject to insider trading prohibition and general antifraud provisions. For instance, in the US they are subject to Rule 10b-5 since 1942, like corporate insiders. However, subjecting firms to stringent insider trading regulation may turn out involving a straight prohibition on all share repurchases, because "companies generally tend to hold some information advantage over potential counterparties" (OICV-IOSCO, 2004, p.11). This is why regulation is often not strict. For instance, internal projections and other forms of soft information – that are typically produced within the firm – are not considered legally material in the US even though they may be important and of great interest to investors (Fried, 2005). "Materiality" of non public information is the feature obliging insiders to refrain from trading in the firm's shares. A partial remedy to loose regulation may consist of a temporary freeze-out provision mandating a suspension of buybacks at times when the information asymmetry between the firm and investors is expected to be more intense. This provision has been adopted in Quebec, Ontario, France and Singapore among others.[8] Freeze-outs are typically imposed prior to mandated firm announcements of price sensitive information.

Another problem of implementation is that firm insider trading can hardly be distinguished from a firm correcting stock misvaluation. Indeed, both firms would purchase shares when price is below expected future value. Empirical research clearly indicates that companies buy after prices decrease (Ikenberry et al., 2000; Zhang, 2005; Ginglinger and Hamon, 2006) or at the lowest possible cost (Brockman and

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[8]Actual compliance to freeze-out in France is investigated by Ginglinger and Hamon (2006). The value of repurchased shares during freeze-out periods is 6% of the total repurchased.

Chung, 2001). The short-term market response to actual share repurchases is often moderate (Ikenberry et al., 2000; Zhang, 2005; Ginglinger and Hamon, 2006) but is significantly positive in the longer run, as mentioned in the previous paragraph. While some researchers interpret these transactions as correcting misvaluations, Brockman and Chung (2001) conclude that "managers use their private information to their advantage, as well as to the advantage of buy-and-hold shareholders". A judge is likely to encounter a similar interpretation dilemma. These practical difficulties may be the reason why some jurisdictions use safe harbour provisions: Italy explicitly excludes share repurchases from insider trading regulation, provided that they are carried out according to the European Union guidelines (art. 183 TUF 2004-parte V titolo 1bis).

Last but not least, a necessary condition for being able to assess any type of violation is reporting and record-keeping of trades executed in the course of the share repurchase programme. Interestingly, corporate insiders in the US had to report their trades to the SEC under Rule 16(a) of 1934, whereas firms were not required to indicate how many shares they had actually repurchased until 2003. The reporting of trades is an important tool used by the SEC in order to enforce rule 10b-5 (Fried, 1998). Thus, the SEC did not have a key enforcement tool against information-based buybacks until 2003.[9] After that date, there is still a discrepancy in reporting requirements, as firms must disclose the total number of shares repurchased and the average price paid for those shares in their quarterly public filings, whereas corporate insiders must report by the tenth of each month.[10] It follows that trading by corporate insiders was, and still is to a lesser extent, subject to a more stringent ban than information-based share repurchases. This situation is not peculiar of the US. Out of the 16 countries of the IOSCO survey, only nine responded to questions concerning specific SR reporting requirements. It resulted that three of these, Germany, Spain and Brazil, had no such rules. Among the thirteen emerging markets that also responded to the survey, only five have specific record keeping requirements for SR transactions. On the contrary, in France there is a detailed database of the stock exchange authority including trading dates, number of shares acquired and price paid per share. This makes it possible to assess compliance to regulation (Ginglinger and Hamon, 2006).

Against this background, our analysis begins assuming that share repurchases are unregulated, and analyzes welfare when insider trading is banned. Implications of this analysis hold true when information-based share repurchases are restricted, but less severely than corporate insider trading. Later, we proceed to assess gains from regulating share repurchases as strictly as corporate insider trading. Finally, we investigate the effects of mandated disclosure of private information by the issuer.

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[9]Compliance to antimanipulation guidelines was equally unverifiable, as convincingly argued by Cook et al. (2003).

[10]Furthermore, corporate insiders can be prosecuted also on the basis of Rule 16(b) dating back to 1934, which does not apply to issuers and does not require the proof of materiality of information.

Table 1: Classification of corporate policies

$cp = \{0, 0\}$:	secrecy
$cp = \{1, 0\}$:	open-market share repurchases
$cp = \{0, \bar{d}\}$:	disclosure
$cp = \{1, \bar{d}\}$:	disclosure and open-market share repurchases

3 The Model

There are two types of agents: long-term investors and liquidity traders. At time 0, they can store their unit endowment, with no depreciation. Alternatively, they can become shareholders by investing it in a risky, long-term technology with expected return $\bar{q} > 1$. In what follows we denote with n^* (m^*) the number of long-term investors (liquidity traders) and with n (m) the number of investors who become long-term shareholders (liquidity shareholders). Let us finally define $N^* = m^* + n^*$ and $N = m + n$ as the total number of investors and shareholders, respectively.

Liquidity traders, $m^* > 1$, know that they will be hit by an endowment shock in the future: if they invest in the risky technology at time 0, they will inelastically supply (or demand) an unknown amount of shares at time 2. These investors are similar to the "discretionary" liquidity traders of Admati and Pfleiderer (1988b). They have discretion only ex-ante, in choosing whether to invest their endowment at positive return and bear future trading costs or store it with zero net return. On the contrary, long-term shareholders, who will manage the company and observe inside information, will be able to trade shares only if it pays them to. They can also decide whether to trade on inside information, provided that insider trading regulation is not enforced. So, let us define $j(e)$ as the number of insider traders conditional on insider trading regulation, where the variable c indicates whether that regulation is enforced ($e = 1$) or not ($e = 0$):

$$j(e) = \begin{cases} \in [0, n] & \text{if} \quad e = 0 \\ 0 & \text{if} \quad e = 1 \end{cases} \tag{1}$$

In our setting corporate assets include inside information. This is a noisy signal $q + \vartheta$ of liquidation value, which is costlessly produced within the firm between $t = 1$ and $t = 2$, where $q \sim \mathcal{N}\left(\bar{q}, \sigma_q^2\right)$, $\vartheta \sim \mathcal{N}\left(0, \sigma_\vartheta^2\right)$ and $\mathbb{C}\text{ov}\left(q, \vartheta\right) = 0$. Hence, long-term shareholders must decide, with no possibility of commitment, the corporate

Table 2: Sequence of events

Time 0: n^* long-term and m^* liquidity investors invest their unit endowment either in the risky technology, with expected return $\bar{q} > 1$, or in the risk-free asset.

Time 1:   Long-term shareholders choose the allocation of rights over inside information, through corporate policy decision.

Time 2:   Corporate policy is carried out, liquidity shocks are realized and stock trading takes place.

Time 3:   Risky technology return, q, is realized and distributed together with profits from stock repurchases.

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information policy[11]. The policy set, $\mathcal{CP}$, is a finite set of four elements defined by two components: $cp = \{k, d\}$. The first one defines whether the company carries out open-market share repurchases ($k = 1$), thus becoming an informed speculator. The second one indicates truthful disclosure to the market ($d = \bar{d}$) or secrecy ($d = 0$). In case of disclosure, we assume that the signal can be costlessly transmitted to the public, who know the distribution of payoffs and signals and hence the reliability of information. However, there exists a strictly positive probability, $1 - \bar{d}$, that liquidity shocks are realized before disclosure. This is because time necessarily elapses between information production and its transmission – at least the time for preparing the public statement[12]. As a consequence, the choice between disclosure and secrecy turns out to be equivalent to the choice between the two probabilities. A classification of corporate policies is summarized in Table 1.

At time 2, inside information is distributed according to previous decisions and asset trading takes place. The sequence of events is summarized in Table 2, whereas the extensive form of the game is presented in the Appendix.

3.1   The trading subgame

In this section we determine equilibrium stock price, P, and the value of a right to trade on inside information, π, conditional on corporate information policy. We start

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[11]Within this setting we do not have to face any delegation problem, which, instead, may arise if liquidity shareholders had the majority. Thus, as in Brennan and Thakor (1990), we avoid relying on an arbitrarily assumed objective function of a manager. In our model this would be a useless complication, since our focus is not managerial incentives, as in Fischer (1992).

[12]We are not referring here to postponements decided by the firm for strategic reasons, such as those related to proprietary information, but to technical delays.

by addressing the case when corporate information does not reach the market through a public announcement.

The trading structure is as follows. Risk-neutral speculators can borrow at zero interest rate and submit orders to a market-maker, who also receives price-inelastic orders from liquidity shareholders. As in Admati and Pfleiderer (1988a), the market-maker infers information from the order flow and prices the security so as to obtain zero expected profits. In such a setting a rational speculator enters the market only when he is better informed than the market-maker (AP, 1988a, p.98). In our model this is the case only for long-term shareholders and for the company.

Let $x = \beta(q + \vartheta - \bar{q})$, where β is a constant to be determined, be the orders submitted by an informed speculator who maximizes his expected trading profits given his information. Each liquidity trader submits a market order $\xi_i \sim \mathcal{N}(0, \sigma_\xi^2)$, which is i.i.d across i and independent from other random variables. Net liquidity orders are equal to z, where $\sigma_z^2 = m\sigma_\xi^2$. The market-maker sets a price equal to the expected liquidation value conditional on his information, which consists of inference from the total order flow ω and of corporate information released by the company. The total order flow ω is the sum of the orders placed by the liquidity traders, the company ($k \in \{0, 1\}$) and the $j(e)$ insiders:

$$
\begin{aligned}
\omega &= z + (k + j(e))x \\
&= z + (k + j(e))\beta(q + \vartheta - \bar{q})
\end{aligned}
\tag{2}
$$

The price set by the market-maker is given by:

$$
P = \mathbb{E}(q|\omega) = \bar{q} + \lambda\omega
\tag{3}
$$

where λ is a non-stochastic constant to be determined. This pricing function is based on the maintained assumption that stocks are traded net of the right to per-share profit deriving from share repurchases. All initial shareholders are thus entitled to the per-share profit from share repurchases at the final date. This assumption allows to preserve the linearity of the equilibrium and to treat symmetrically liquidity traders irrespective of the sign of their liquidity shocks. As will become clear in the Subsection 3.3 and 4, our results derive from the presence of adverse selection losses for liquidity traders. Such losses would still be present in the alternative setting where rights to profits from SR are sold, provided that an equilibrium with partial revelation exists.

PROPOSITION 1: *The unique linear Nash equilibrium is given by the two equilibrium coefficients:*

$$
\beta = \left(\frac{\sigma_z^2}{(k + j(e))(\sigma_q^2 + \sigma_\vartheta^2)} \right)^{\frac{1}{2}}
\tag{4}
$$

$$\lambda \quad = \quad \frac{(k + j(e))\beta\sigma_q^2}{(k + j(e) + 1)\sigma_z^2} \tag{5}$$

Proof: See Admati and Pfleiderer (1988a, p.99).

Equation (5) shows that the responsiveness of price to the order flow is directly proportional to (i) the intensity of informed traders' reaction to their private signal, $(k + j(e))\beta$; (ii) the relative responsiveness of the order flow to both asset liquidation value and liquidity shocks, as summarized by the ratio σ_q^2/σ_z^2. The parameter λ is Kyle's (1985) measure of market illiquidity.

We can now determine the value to a risk-neutral speculator of the right to trade on inside information. This is equal to the expected difference in profits from trading with and without such information. But no-information profits are nil: in fact, only speculators who are better informed than the market-maker trade. We therefore obtain:

$$\pi = \mathbb{E}\left[\max_x \mathbb{E}\left[(q - P)\,x | q + \vartheta\right]\right] \tag{6}$$

where price depends on x as shown by Equations (2) and (3). Using Equations (2) - (5), the equilibrium value of the right for one speculator, when information is not disclosed to the market prior to trading, is equal to:

$$\pi\,(k + j(e), m) = \lambda\left(\frac{m\sigma_\xi^2}{k + j(e)}\right) \tag{7}$$

This value falls if the variance of liquidity trading is lower, because the market-maker is able to make more precise inference from the order flow. It is inversely related to $(k + j(e))$ in that competitive speculators do not restrict their orders enough so as to prevent more information to leak through the order flow[13]. Indeed, it is also true that the total value of trading profits to speculators, $(k + j(e))\pi(k + j(e), m)$, decreases as their number, $(k + j(e))$, grows.

If information reaches the market before trading occurs, then the market maker is informed as the speculators, who therefore decide not to enter the market. It follows that the right to trade on information has no value.

Hence, the value of the right to trade for a speculator conditional on corporate policy is equal to $(1 - d)\pi$. In fact we get back to Equation (7) if corporate information policy is secrecy. If the firm chooses a disclosure policy, instead, profits will be reduced to $(1 - \bar{d})\pi$, where $\bar{d}$ is the probability that announcement happen before trading.

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[13]Clearly $\pi(0, m) = 0 \ \ \forall\, m \geqslant 0$.

3.2 The allocation of inside information by the company

We now turn to the allocation of inside information that the shareholders elect at time 1. Since long-term shareholders hold the majority, they will choose that corporate policy ($cp \in \mathcal{CP}$) that maximizes their expected payoff, and then each initial shareholder will receive a share $1/N$ of corporate profits. In order to compute shareholders' payoffs in different scenarios, we determine corporate distributions that are associated to each information allocation.

LEMMA 1: *The per-share profit deriving from corporate information policy, $\varphi(k)$, is equal to:*

$$\varphi(k) = \begin{cases} 0 & \text{if} \quad k = 0 \\ \frac{(1-d)\pi(1+j(e),m)}{N} & \text{if} \quad k = 1 \end{cases} \tag{8}$$

Profits from corporate policy are positive only if the company trades on its private information. Therefore, if corporate policy is share repurchases, total receipts are equal to trading profits when there are $1 + j(e)$ information traders competing in the market, i.e. the company and $j(e)$ insider traders. These are then distributed to the N shareholders.

3.3 Ex-ante investment choice

The value of corporate information to each long-term shareholder, who is also an insider trader, is non-negative under any corporate information policy. Indeed, he gets trading profits from both corporate share repurchases and insider trading (when this is unregulated). Thus, each long-term shareholder expected payoff, conditional on investing in the risky asset (denoted by subscript r), turns out to be:

$$\mathbb{E}_r(W_L) = \bar{q} + (1 - d)[\pi(k + j(e), m)] + \varphi(k) \tag{9}$$

This always exceeds one, which is the payoff of storing the unit endowment. This is the reason why all long-term investors become shareholders. Thus, $n = n^*$.

Short-term investors (liquidity traders) may instead suffer from adverse selection losses coming from either open-market stock repurchases or insider trading or both. Since the market-maker obtains zero profits, expected trading gains to informed speculators equal expected losses by liquidity traders. Hence, each liquidity shareholder's expected payoff conditional on holding one unit of the risky technology must be calculated net of expected per-capita trading losses and gross of profits from corporate information trading:

$$\mathbb{E}_r(W_S) = \bar{q} - (1 - d)\pi(k + j(e), m)\left[\frac{(k + j(e))}{m}\right] + \varphi(k) \tag{10}$$

In order to invest in the risky technology, short-term investors' expected payoff must be no lower than one ($\mathbb{E}_r(W_S) > 1$), which is the payoff conditional on storing the unit endowment. This condition is satisfied whenever

$$\bar{q} - 1 > L(k, d, j(e), m) \tag{11}$$

where $L()$ is the net expected loss, defined as the expected per-capita trading losses net of profits from corporate information trading. If this inequality is not satisfied, they do not enter the stock market ($m = 0$) and consequently there is underinvestment ($N < N^*$) in the risky technology.

Finally, aggregate welfare is defined as the weighted sum of the investors' unconditional expected payoffs:

$$\mathbb{E}(W) \equiv n^* \mathbb{E}(W_L) + m^* \mathbb{E}(W_S) \tag{12}$$

4 Equilibrium and Welfare Analysis

4.1 Insider trading regulation not enforced

In this Subsection we solve the model, assuming that insider trading regulation is not enforced in the market ($e = 0$). So, we have to find which corporate policy is chosen at time 1, knowing that every long-term shareholder can potentially become an insider trader.

PROPOSITION 2: *If insider trading regulation is not enforced, the equilibrium corporate policy is secrecy, $cp^* = \{0, 0\}$. Every long-term shareholder becomes insider trader, $j(0) = n^*$, and the number of short-term shareholders is equal to*

$$m = \begin{cases} m^* & \text{if} \quad \bar{q} - 1 > L(0, 0, n^*, m^*) \\ 0 & \text{otherwise} \end{cases} \tag{13}$$

Proof: See the Appendix.

We present here the logic of Proposition 2. Since corporate policy is chosen by long-term shareholders, they try to minimize the revelation of private information to the market. Hence, disclosure is always dominated by secrecy. Moreover, insider traders would obtain a higher payoff, with respect to the equilibrium one, if they acted cooperatively, that is if they chose to both refrain from insider trading and carry out open-market stock repurchases. In this way, they would exploit the advantage of one monopolistic information trader, who minimizes the leakage of information through prices, as in Admati and Pfleiderer (1988). However, the strategy *no insider trading*

associated to open-market stock repurchases as corporate policy is not a credible one, thus causing the equilibrium strategy to be *insider trading*. This being the case, they prefer to choose secrecy as corporate policy, because the benefits from a lower competition in the market more than compensate the costs from not receiving any profit from share repurchases. Finally, liquidity traders invest in the risky asset if and only if the expected excess return exceeds their adverse selection losses.[14]

4.2 Insider trading regulation enforced

Let us now consider the case in which insider trading is banned ($e = 1$). This implies that there are no insider traders, $j(1) = 0$, if enforcement is perfect:

PROPOSITION 3: *If insider trading regulation is enforced, the equilibrium corporate policy is open-market stock repurchases, $cp^* = \{1, 0\}$. Moreover, the number of short-term shareholders is equal to*

$$m = \begin{cases} m^* & \text{if} \quad \bar{q} - 1 > L(1, 0, 0, m^*) \\ 0 & \text{otherwise} \end{cases} \tag{14}$$

Proof: See the Appendix.

In this case insider trading regulation prevents long-term shareholders from individually using their private information for speculative purposes. However, the regulation paradoxically make it possible for them to collude with each other by carrying out open-market repurchases. The stock market is therefore characterized by a single speculator, that is the company. Finally, liquidity traders choose to invest in the risky technology if and only if their adverse selection losses more than offset by the expected excess return.

4.3 Welfare comparison

In order to evaluate the effectiveness of insider trading regulation, we must compare aggregate welfare with and without insider trading regulation.

LEMMA 2: *The equilibrium aggregate welfare turns out to be*

$$\mathrm{E}(W) = \begin{cases} N^* \bar{q} & \text{if} \quad m = m^* \\ n^* \bar{q} + m^* & \text{if} \quad m = 0 \end{cases} \tag{15}$$

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[14]We are assuming that shareholders' meetings choose share repurchases. This is the case in European countries. However – in certain jurisdictions including the U.S. – a decision of the board is sufficient. It is easy to show that equilibria do not change when a subset of long-term shareholders choose on behalf of others as well.

Proof: See the Appendix.

The *first best* level of welfare, $N^*\bar{q}$, obtains if all investors enter the stock market. This ensures that all endowments are invested in the risky technology, which dominates the riskless one ($\bar{q} > 1$). Trading losses to one type of trader do not matter for social welfare as they are offset by gains to the others. Hence, for a welfare comparison we need to order short-term investors' expected losses, $L(0, 0, n^*, m^*)$ and $L(1, 0, 0, m^*)$.

PROPOSITION 4: *Let us define $\mu \equiv m^*/N^*$. (i) If $\mu < \mu'$, then the enforcement of insider trading regulation increases liquidity traders' expected losses and lowers aggregate welfare for intermediate values of the risky asset return. For other values, it leaves them unaffected. (ii) If instead $\mu \geqslant \mu'$, then the enforcement of insider trading regulation may be welfare improving.*

Proof: See the Appendix.

Results concerning aggregate welfare, in case (i), can best be understood by focusing on three different levels of the risky asset excess return.

$(\bar{\mathbf{q}} - \mathbf{1}) > \mathbf{L}(\mathbf{1}, \mathbf{0}, \mathbf{0}, \mathbf{m}^*)$ If the excess return is sufficiently high, then liquidity traders invest in the risky asset – being more than compensated for adverse selection losses irrespective of insider trading regulation.

$(\bar{\mathbf{q}} - \mathbf{1}) < \mathbf{L}(\mathbf{0}, \mathbf{0}, \mathbf{n}^*, \mathbf{m}^*)$ If the excess return is sufficiently low, then liquidity traders do not invest in the risky asset irrespective of insider trading regulation.

Thus, in these two cases insider trading regulation turns out to be welfare neutral, having no impact on liquidity investors choice.

$\mathbf{L}(\mathbf{0}, \mathbf{0}, \mathbf{n}^*, \mathbf{m}^*) < (\bar{\mathbf{q}} - \mathbf{1}) < \mathbf{L}(\mathbf{1}, \mathbf{0}, \mathbf{0}, \mathbf{m}^*)$ In this intermediate region liquidity traders' investment decision changes depending on the enforcement of insider trading regulation. Without regulation, liquidity traders are still compensated enough for adverse selection losses when investing in the risky asset. Consequently the economy reaches the maximum welfare level (*first best*). With regulation, liquidity traders stay out of the market because their anticipated trading losses – should they invest in the risky asset – increase. Indeed, the monopolistic use of private information by the company, which is a consequence of the regulation, reduces the leakage of information through prices.

In this region, insider trading regulation imposes an underinvestment cost, equal to $m^*(\bar{q} - 1)$, lowering aggregate welfare. The boundaries of this area are portrayed in Figure 1. The region widens as both the variance of the liquidity shocks and the precision of inside information increase, because a monopolistic trader is able to exploit both of them better than competing insiders.

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For insider trading regulation to reduce welfare, the proportion of liquidity investors must not exceed a certain threshold (μ') ensuring that liquidity shareholders' net losses are lower under IT than SR. This is more likely the smaller their share of profits deriving from SR, which obtains the lower their relative number μ. The threshold μ' is increasing in n^* (see the Appendix). The reason is that more competition among insiders leads to lower trading losses to liquidity investors. In order to appreciate this restriction, consider the case of small firms (i.e. $N^* = 30$). Then m^*/N^* should not exceed 50%. However, for middle-size companies ($N^* = 543$), m^*/N^* can be as large as 80.67, and for very large firms ($N^* = 1066$) the threshold is 84.53.

Insider trading regulation – and the associated shift to SR as corporate policy – may be beneficial for economies with a large share of liquidity investors ($\mu \geqslant \mu'$). In this case (case (ii) of Proposition 4) liquidity investors, conditionally on becoming shareholders, value more the fact of receiving profits from share repurchases than minimizing aggregate losses through competing insiders. This becomes obvious if they own 100% of shares, as all their trading losses are paid back to them. But it holds true for all $\mu \geqslant \mu'$. If the excess return to the risky technology is neither too low nor too high, specifically if $L(1, 0, n^*, m^*) < (\bar{q} - 1) < L(0, 0, 0, m^*)$, then enforcing insider trading regulation improves on welfare by inducing investment into the productive asset. In what follows, we name concentrated (diffuse) ownership a situation in which $\mu < \mu'$ ($\mu \geqslant \mu'$).

Proposition 4 pins down a difference between insider trading and information-based SR. Insider traders appropriate profits from an asset of the corporation, while the firm returns profits to shareholders. However, when ownership is concentrated, SR may imply welfare-reducing redistribution among shareholders. Therefore, the answer to the question "should insider trading be prohibited when share repurchases are allowed?" is negative, unless ownership is diffuse. The first two columns of Table 3A, which presents the equilibrium aggregate welfare and information allocation when corporate ownership is concentrated, clearly display this result. Insider trading regulation is welfare reducing because it makes insider traders commitment to collude with each other credible. Thus, SR become the way to obtain monopolistic insider profits. For this reason liquidity traders, who are the crucial players for achieving full investment in the market, prefer to be the trading counterpart of competing insider traders rather than of a monopolistic one.

As mentioned in Subsection 3.1, we treat company purchases and sales symmetrically throughout: both yield a constant dividend $\varphi(k)$ to initial shareholders irrespective of the sign of their liquidity shocks. Losses to short-term shareholders only stem from lower market liquidity associated to asymmetric information, as represented by the second term on the right-hand side of Equation (10). However, liquidity shareholders may get no dividend from share repurchases when selling and a higher dividend

when buying according to Fried (2005).[15] If we allow for such an asymmetry, then our results are likely to be strengthened if short-term shareholders are net buyers (net sellers) and $\mu \geqslant \mu'$ ($\mu < \mu'$), because they gain more (less) from SR.

5 Expanding Securities Regulation

Below we investigate whether other types of securities regulation may solve the underinvestment problem associated with adverse selection.

5.1 Ban on share repurchases

We first consider the introduction of a ban on (information based) open-market share repurchases. This implies that the parameter k is exogenously set to zero, so that long-term shareholders can only choose d.

PROPOSITION 5: *If insider trading regulation is not enforced, a ban on open-market stock repurchases is never welfare improving. Secrecy is the equilibrium corporate policy, $cp^* = \{0, 0\}$, every long-term shareholder becomes insider trader, $j(0) = n^*$ and the number of short-term shareholders is equal to*

$$
m = \left\{ \begin{array}{ll} m^* & \text{if} \quad \bar{q} - 1 > L(0, 0, n^*, m^*) \\ 0 & \text{otherwise} \end{array} \right. \tag{16}
$$

Proof: According to Proposition 2, long-term shareholders would never choose SR as corporate policy. Hence, a ban on SR can not alter the equilibrium outcome.
Q.E.D.

A comparison between the first and the third column in Tables 3A and 3B shows that stock repurchase regulation is not able to increase aggregate welfare.

Let us now consider the scenario in which insider trading and information-based share repurchase regulations are implemented together.

PROPOSITION 6: *If both insider trading and open-market repurchases regulations are enforced, secrecy or disclosure can both be equilibrium corporate policies, $cp^* = \{0, d\}$. Liquidity traders always invest in the risky technology, $m = m^*$. The first best is attained for every level of the risky return.*

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[15]Fried (2005) describes a buyback as equivalent to a two-step transaction: non-selling shareholders buy stock directly from selling shareholders and the firm issues a dividend to non-selling shareholders only.

Proof: Long-term shareholder are indifferent between secrecy and disclosure if they can not exploit corporate private information for speculative purpose. Since this double regulation neutralizes all the potential speculators (both insider traders and the company), liquidity traders' adverse selection losses collapse to zero. The last part of the proposition is obtained through straightforward algebra.   Q.E.D.

This proposition connects our study to earlier analyses of insider trading, which do not consider adverse selection losses from stock repurchases. In such a setting there are no benefits from insider trading, hence regulating it turns out to be welfare efficient. However this scenario without information-based share repurchases is not realistic for all jurisdictions, as discussed in Section 2. On the contrary, most countries mandate ex-ante disclosure of private information, which we now analyze.

5.2   Mandated disclosure

Mandatory disclosure of private information implies that the parameter d is exogenously set to $\bar{d}$, so that long-term shareholders can only choose whether to carry out open-market repurchases.[16]

PROPOSITION 7: *If disclosure is mandatory but insider trading regulation is not enforced, long-term shareholders choose not to carry out open-market share repurchases, $cp^* = \{0, \bar{d}\}$. All of them become insider traders, $j(0) = n^*$, and the number of short-term shareholders is equal to*

$$m = \begin{cases} m^* & \text{if} \quad \bar{q} - 1 > L(0, \bar{d}, n^*, m^*) \\ 0 & \text{otherwise} \end{cases} \tag{17}$$

This regulation leads to a welfare improvement.

Proof: The first part of the proposition is just a particular case of Proposition 2, where now long-term shareholders can not choose d. Nevertheless the conclusions are equivalent, as can be easily derived from the Proof of Proposition 2 in Appendix. The second part is instead due to the presence of a positive probability, $\bar{d}$, that corporate information reaches the market before trading takes place. For this reason short-term investors, facing lower expected trading losses, invest in the risky technology for a larger number of values of the risky return.   Q.E.D.

Regulators do recognize that disclosure of information should reduce the likelihood that a company will be holding a significant informational advantage when purchasing

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[16]Ex-post disclosure of actual buyback transactions is required in some countries. In our static setting it has no effect on the equilibrium. Results in Huddart et al. (2001) suggest that it would change the issuer's trading strategy in a multiperiod setting with long-lived information.

its own shares (OICV-IOSCO, 2004). The following proposition concerns whether such a disclosure policy would enhance welfare when accompanied by a ban on insider trading.

PROPOSITION 8: *If disclosure is mandatory and insider trading regulation is enforced, long-term shareholders choose to carry out open-market share repurchases, $cp^* = \{1, \bar{d}\}$. The number of short-term shareholders turns out to be equal to*

$$m = \begin{cases} m^* & \text{if} \quad \bar{q} - 1 > L(1, \bar{d}, 0, m^*) \\ 0 & \text{otherwise} \end{cases} \tag{18}$$

If $\mu < \mu'$ the combination of the two regulations is always sub-optimal relative to mandated disclosure alone. If instead $\mu \geqslant \mu'$ the double regulation may be welfare improving.

Proof: The first part of the proposition draws upon the Proof of Proposition 3 in the Appendix. The second part obtains through straightforward algebra and the insight of Proposition 4. It relies on the fact that liquidity traders' expected loss is higher (lower) – if insider trading regulation is enforced – when the proportion of short-term shareholders is low (high). Q.E.D.

Thus, when ownership structure is concentrated, a stricter regulation (disclosure plus insider trading regulation) is less effective than a softer one (only mandated disclosure) in raising the investment in the risky technology by liquidity traders, as shown by the last two columns in Table 4. On the contrary, a stricter regulation may be welfare improving when companies are characterized by diffuse ownership since liquidity shareholders receive most of the profits from share repurchases.

6   Timing and Ownership Structure

We now propose an extended time line of the model in which at time $t = -1$ an entrepreneur, who owns the risky technology, sets corporate information policy before selling shares to long- and short-term traders. The entrepreneur aims at maximizing the expected cash flow. This is equivalent to choosing a corporate policy and a price such that the number of traders who invest in the firm at $t = 0$ is maximized for any value of the risky asset excess return.[17] This is attained for a disclosure policy, $cp = \{0, \bar{d}\}$, that lowers the probability that insider traders obtain speculative profits. However, this cannot be an equilibrium corporate policy at $t = 1$ because long-term shareholders will be able to change allocation of rights over inside information. Liquidity traders anticipate that disclosure will not be part of the corporate policy when

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[17]We assume away price discrimination because the law mandates equal treatment of shareholders.

trading takes place. Hence, the welfare implications of this setting remain equal to those characterizing our initial model.

The reason why a different initial owner can not alter previous results and eliminate the inefficiency caused by insider trading regulation lies in the absence of a credible commitment device. As a matter of fact, the entrepreneur's ex-ante incentives and long-term shareholders' ex-post incentives differ.[18] The former dictate a disclosure policy in order to attract more liquidity traders towards the risky technology. The latter command a secrecy or a share repurchase policy in order to maximize their speculative profits. Clearly, this failure to achieve an efficient outcome is due to the inability of liquidity shareholders to control corporate assets.

We may expect agents to find way to avoid this Coasian failure, that is to prevent long-term shareholders from changing the corporate policy once they become entitled to do it. A possible device consists in a veto rule adopted by the entrepreneur. Such a rule must explicitly state in the corporate statute that the policy chosen at $t = -1$ by the entrepreneur can not be modified afterwards without the consent of short-term shareholders. The equilibrium with veto rule entails disclosure of information and minimizes profits to insiders. Insider trading regulation can then be welfare increasing since the veto rule is equivalent to a ban on share repurchases.

7   Discussion and Empirical Implications

Our model does not solve for the optimal regulatory design. However Table 3 can be used to make inferences in this respect. A double regulation (both IT and SR regulations) achieves the first best investment level for any corporate ownership structure, as it completely eliminates adverse selection losses related to asymmetric information. The second best obtains with no regulation when the proportion of liquidity investors in the economy is low (Table 3A), and with IT regulation only when such proportion is high (Table 3B). The choice between double and second best regulation depends on the magnitude of unmodelled enforcement costs relative to the enforcement benefits, if the regulator cares about welfare. In both ownership scenarios the benefits are equal to $m^*(\bar{q} - 1)$, but they obtain only if the excess return on the risky technology is low – making it more likely that costs of double regulation exceed its benefits.

The model indicates that, in a second best, regulators enforce no regulation when corporate ownership is concentrated, while they enforce an insider trading ban when ownership is diffuse. This implication may explain the puzzling evidence in Bhattacharya and Daouk (2002) who observe that IT is not prosecuted in several coun-

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[18]The same conclusion holds for the case in which long-term shareholders own the risky technology at $t = -1$ and sell shares to liquidity traders.

tries, even if it appears to raise the cost of capital by 5%. Our model suggests that the increase in the cost of capital might be larger under IT regulation, if corporate ownership in those countries is concentrated, as firms adopt SR shifting the economy from a second to a third best investment level. In the same vein, we may rationalize why regulation of IT and SR was largely asymmetric in the US until 2003 - as described in Section 2. This situation may correspond to a second best regulation, as corporate ownership in the US is diffuse.

We may also use this analysis to asses the gains from regulating also share repurchases when insider trading prosecution is taken as given. According to our model corporate structures characterized by concentrated ownership ($\mu < \mu'$) gain the most. This is so because the underinvestment area (i.e. the partition of the excess return such that short-term investors do not invest) reaches its maximum extension with sole insider trading regulation. In diffuse ownership structure ($\mu \geqslant \mu'$), instead, insider trading regulation already contributes to shrink the underinvestment area. Therefore, the benefit from adding SR regulation is lower. This alternative perspective may provide a rationale for the softer shift to SR regulation in the US than in France.

Taking regulation as given, the model predicts that firms use share repurchases in countries where or in years when insider trading regulation is stricter. Some stylized facts could be considered as broadly consistent with these implications. Bhattacharya and Daouk (2002, p.100) mention that share repurchases in emerging markets were minor – and these are countries where insider trading bans were largely unenforced. Grullon and Michaely (2002) report that US share repurchases rose from 4.8% of total earnings in 1980 to 41.8% in 2000. They show that the passing of safe harbour provisions in 1982, protecting firms against manipulation charges, did spur share repurchases. However they do not check for a separate effects of the 1984 Insider Trading Sanctions Act and of the 1986 Insider Trading and Securities Fraud Enforcement Act, which would be more interesting for our purposes. Interestingly, though, Jagannathan et al. (2000) report that repurchase announcements grew at a compounded rate of 23% per year from 1985 to 1996 in the US. Lasfer (2000) describes the taking off of repurchasing activity in EU countries, but does not relate it to the 1991 adoption by member countries of the EU Directive on Insider Trading.

8   Concluding Remarks

Bhattacharya and Daouk (2002) wonder why insider trading regulation is not enforced in several countries, even if insider trading appears to raise the cost of capital by 5%. We suggest that the increase in the cost of capital might be larger, unless ownership of companies in those countries is diffuse. Indeed, misappropriation of corporate information by insider traders appears to be welfare increasing in our paper

when ownership is concentrated, as firms will otherwise adopt information-based share repurchase programs which increase short-term shareholders' trading losses.

In countries where ownership of companies is concentrated, we highlight that a ban on insider trading may help the financing of companies only if information-based open-market share repurchases are also curbed. This may be achieved by subjecting buybacks to equally stringent insider trading laws.

Our setting deliberately ignores interim investment and risk aversion in order to emphasize the interplay between insider trading and corporate information policy. Including the reaction of firm investment and production to the information content of prices should not change our insights, as insider trading is based on information produced within the firm, hence already embedded in firm real choices. Only if information unknown to managers were disseminated by trading, then it could benefit corporate investment choices – as observed by Leland (1992).

The introduction of risk aversion would reinforce or weaken the result that a ban on insider trading is welfare reducing when SR are allowed, to the extent that information dissemination improves (Bhattacharya and Nicodano, 2001) or worsens (Medrano and Vives, 2004) risk sharing. More importantly, a monopolistic trader – such as the issuer – may be able to better distribute risk among shareholders than the uncoordinated shareholders by themselves, as Admati and Pfleiderer (1990) suggest. However, this demanding extension is left for further work.

Appendix

Proof of Proposition 2: We consider a three stage game. In the first stage both long-term (LT) and short-term (ST) investors decide whether to invest in the risky asset (*investment subgame*), in the second and third ones long-term shareholders choose respectively the corporate policy (*information policy subgame*) and whether to enter the stock market as insider traders (*trading subgames*). The following graph represents the extensive form of the game, where for simplicity we omit the investment choice by long-term investors (since I will turn out to be a dominant strategy) and the *information policy* and *trading subgames* when short-term investors decide not to invest (NI) in the risky asset. Indeed, if this is the case the payoff in any possible node is always equal to 1 for short-term investors and $\bar{q}$ for long-term investors.
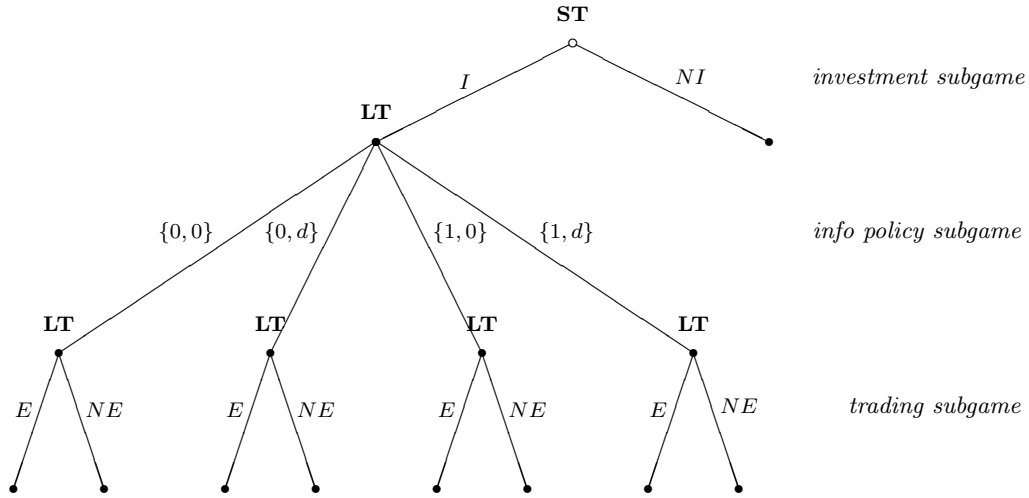
Since the game is solved by backward induction, let us first consider the four *trading subgames*, one for each alternative information allocation. In all *trading subgames* the strategic set of each insider trader consists in two strategies: Enter, NotEnter (the market). Here we prove that, whatever is the strategic choice of $n-1$ insiders and the information allocation, the optimal strategy of the n-th insider is to Enter the market.

$cp = \{0, d\}$ We analyze first the two subgames associated with either secrecy ($d = 0$) or disclosure ($d = \bar{d}$).

		$n-1$	
		E	**NE**
n-th	**E**	$(1-d)\pi(n^*, m)$; $(1-d)\pi(n^*, m)$	$(1-d)\pi(1, m)$; 0
	NE	0 ; $(1-d)\pi(n^*-1, m)$	0 ; 0

Since both a secrecy and a disclosure policies do not provide any profit from share repurchases to shareholders, the strategy NotEnter leads always to a zero payoff, while the strategy Enter guarantees a non-negative payoff. The following payoffs matrix clearly shows that for the n-th insider Enter is a dominant strategy, for $m \geqslant 1$. Hence, the Nash equilibrium of these subgames is such that every insider enters the market. Moreover, they obtain $(1-d)\pi(n^*, m)$ as trading profit.

$cp = \{1, d\}$ Next we analyze the case of buy-backs, coupled with either secrecy or disclosure.

		$n-1$	
		E	**NE**
n-th	**E**	$(1-d)\pi(1+n^*, m)\frac{N+1}{N}$; $(1-d)\pi(1+n^*, m)\frac{N+1}{N}$	$(1-d)\pi(2, m)\frac{N+1}{N}$; $(1-d)\pi(2, m)\frac{1}{N}$
	NE	$(1-d)\pi(n^*, m)\frac{1}{N}$; $(1-d)\pi(n^*, m)\frac{N+1}{N}$	$(1-d)\pi(1, m)\frac{1}{N}$; $(1-d)\pi(1, m)\frac{1}{N}$

If share repurchases are part of the corporate information policy, Enter is still a dominant strategy for the n-th insider for $m \geqslant 1$. However, since this result is less straightforward than the previous one, let us compare the n-th insider's payoffs (given by the sum of distributions of corporate profits from share repurchases and of insider trading profits), associated to the strategies of the other $n-1$ insiders. If the latter decide to enter the market, the strategy Enter is the best response for the n-th insider if:

$$(1-d)\pi(1+n^*, m)\frac{N+1}{N} \quad > \quad (1-d)\pi(n^*, m)\frac{1}{N} \tag{A1}$$

$$\frac{\sqrt{n^*+1}}{\sqrt{n^*}(n^*+1)}(n^*+2) \quad < \quad n^* + m + 1 \tag{A2}$$

Let us define the l.h.s. of the above inequality as $F(n^*)$ and the r.h.s as $G(n^*, m)$. Thus, we have to prove that $F(n^*) < G(n^*, m)$ $\forall$ $n^*, m \geqslant 1$. Let us consider the following three steps:

(i) we prove that $F(n^*) < G(n^*, 1)$ $\forall$ $n^* \geqslant 1$:

$$\begin{array}{rcl}\frac{\sqrt{n^*+1}}{\sqrt{n^*}(n^*+1)}(n^*+2) & < & n^*+2 \\[2mm] \frac{1}{\sqrt{n^*}\sqrt{n^*+1}} & < & 1\end{array} \tag{A3}$$

which is always true for $n^* \geqslant 1$.

(ii) we prove that $G(n^*, m) < G(n^*, m')$ $\forall$ $n^* \geqslant 1$, $m < m'$: straightforward.

(iii) we can conclude that $F(n^*) < G(n^*, 1) < G(n^*, m)$ $\forall$ $n^*, m \geqslant 1$.

Since the above inequality is true for every $n \geqslant 1$, then the strategy Enter is still the best response if $n-1$ insiders decide not to enter the market:

$$(1-d)\pi(2, m)\frac{N+1}{N} \quad > \quad (1-d)\pi(1, m)\frac{1}{N} \tag{A4}$$

Again, the Nash equilibrium of these subgames is such that every insider enters the market. In this case each obtains $(1-d)\pi(1+n^*,m)\frac{N+1}{N}$ as trading profit.

In order to determine the equilibrium of the *information policy subgame*, we just need to compare the payoffs associated to the Nash equilibria of the four *trading subgames*. It can be seen that $d = \bar{d}$ reduces (or at most leaves unchanged) all payoffs. Hence long-term shareholders choose $d = 0$. For this reason we can focus on the remaining corporate policies, secrecy and open-market repurchases. Secrecy is the equilibrium corporate policy if:

$$\pi(n^*,m) > \pi(1+n^*,m)\frac{N+1}{N} \tag{A5}$$

$$\frac{\sqrt{n^*+1}(n^*+2)}{\sqrt{n^*}(n^*+1)} > \frac{n^*+m+1}{n^*+m} \tag{A6}$$

Let us define the l.h.s. of the above inequality as $F(n^*)$ and the r.h.s as $H(n^*,m)$. Thus, we have to prove that $F(n^*) > H(n^*,m) \quad \forall \ n^*, m \geqslant 1$. As before, let us consider three steps:

(i) we prove that $F(n^*) > H(n^*,1) \quad \forall \ n^* \geqslant 1$:

$$\begin{array}{ccc} \frac{\sqrt{n^*+1}(n^*+2)}{\sqrt{n^*}(n^*+1)} & > & \frac{n^*+2}{n^*+1} \\ \sqrt{n^*+1} & > & \sqrt{n^*} \end{array} \tag{A7}$$

which is always true for $n^* \geqslant 1$.

(ii) we prove that $H(n^*,m) > H(n^*,m') \quad \forall \ n^* \geqslant 1, \ m < m'$:

$$\frac{\partial H}{\partial m} = -\frac{1}{(n^*+m)^2} < 0 \qquad \forall \ n^*, m \geqslant 1 \tag{A8}$$

(iii) we can conclude that $F(n^*) > H(n^*,1) > H(n^*,m) \quad \forall \ n^*, m \geqslant 1$. Therefore, $cp^* = \{0,0\}$.

Finally, we need to determine the equilibrium of the *investment subgame*. Long-term investors always decide to Invest since it is a dominant strategy. The investment choice by short-term investors, instead, depends on the cutoff value $L(0,0,n^*,m^*)$, given $\{n^*, m^*, e, \sigma_q^2, \sigma_\xi^2, \sigma_\vartheta^2\}$. If $(\bar{q}-1)$ exceeds $L(0,0,n^*,m^*)$, then there exist an equilibrium characterized by $\{k = 0; \ d = 0; \ N = N^*; \ e = 0\}$. So, the m^*-th liquidity trader invests in the risky technology if m^*-1 do, since excess payoff exceeds expected adverse selection losses coming from insider trading.[19] If, instead, $(\bar{q}-1)$ is lower than $L(0,0,n^*,m^*)$, the unique equilibrium is characterized by $\{k = 0; \ d = 0; \ N = n^*; \ e = 0\}$ and there is underinvestment in the stock market $(m = 0)$. Q.E.D.

Proof of Proposition 3: Let us consider the same game as before: the *information policy subgame* does not change, while the four *trading subgames* disappear. Indeed the strategic set

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[19]The equilibrium could be not unique because $L(k,d,j(e),m)$ is decreasing in m. Indeed, it does not pay a liquidity trader to invest in the risky technology if others do not even if $\bar{q}-1 > L(0,0,n^*,m^*)$, unless $\bar{q}-1$ also exceeds $L(0,0,n^*,1)$. If we add this restriction, this well-known multiplicity problem disappears.

in each *trading subgame* is now a singleton because the strategy Enter is eliminated by insider trading regulation. Therefore, the two stage game collapses to the *information policy subgame*, in which long-term shareholders choose the optimal corporate policy.

In order to determine the equilibrium of the *information policy subgame*, cp^*, we compare the payoffs associated to the four degenerate subgames. If corporate policy is secrecy or disclosure of private information, long-term shareholders gain zero profits, because they "waste" their private information. On the contrary, with share repurchases, they are able to exploit their private signal and per-capita profits from share repurchases are equal to $(1-d)\pi(1,m)\frac{N+1}{N}$. Again, long-term shareholders choose $d=0$ and therefore we conclude that $cp^* = \{1,0\}$.

Since the stock market is characterized by no insider trading and open-market share repurchases is the equilibrium corporate policy, liquidity traders' investment decision is driven by the following cutoff value for the risky technology excess return: $L(1,0,0,m^*)$. If $(\bar{q}-1)$ exceeds $L(1,0,0,m^*)$, then there exist an equilibrium characterized by $\{k=1;\ d=0;\ N=N^*;\ e=1\}$.[20] If, instead, $(\bar{q}-1)$ is lower than $L(1,0,0,m^*)$, the unique equilibrium is characterized by $\{k=1;\ d=0;\ N=n^*;\ e=1\}$ and there is underinvestment in the stock market $(m=0)$. Q.E.D.

Proof of Lemma 2: We first show that, given equilibrium outcomes, $\mathbb{E}(W|m)$ is independent of insider trading regulation.

$$\mathbb{E}(W|m=m^*) = \begin{cases} n^*[\bar{q}+\pi()] + m^*[\bar{q} - \frac{n^*}{m^*}\pi()] = N^*\bar{q} & \text{if } e=0 \\ n^*[\bar{q}+\varphi(1)] + m^*[\bar{q} - \frac{1}{m^*}\pi + \varphi(1)] = N^*\bar{q} & \text{if } e=1 \end{cases} \quad \text{(A9)}$$

$$\mathbb{E}(W|m=0) = n^*\bar{q} + m^* \quad \forall\, e \quad \text{(A10)}$$

Equations (A9) and (A10) can be rewritten, in compact form, as:

$$\mathbb{E}(W|m) = n^*\bar{q} + m^* + m(\bar{q}-1) \quad \forall\, e \quad \text{(A11)}$$

Thus, it follows that

$$\mathbb{E}(W) = n^*\bar{q} + m^* + \Pr(m=m^*) \cdot m^*(\bar{q}-1) \quad \text{(A12)}$$

where $\Pr(m=m^*)$ is a degenerate probability since

$$\Pr(m=m^*) = \Pr(\bar{q} > L() + 1) = \{0,1\} \quad \text{(A13)}$$

Q.E.D.

Proof of Proposition 4: Part (i) requires that $L(0,0,n^*,m^*) < L(1,0,0,m^*)$, while part (ii) requires that $L(0,0,n^*,m^*) \geqslant L(1,0,0,m^*)$. So, let us find the proportion of liquidity shareholders, defined as μ', such that $L(0,0,n^*,m^*) = L(1,0,0,m^*)$. This equality implies:

$$\begin{aligned} \pi(n^*,m^*)\left(\frac{n^*}{m^*}\right) &= \pi(1,m^*)\left(\frac{1}{m^*} - \frac{1}{N^*}\right) \\ \frac{1}{\sqrt{n^*(n^*+1)}}\left(\frac{n^*}{m^*}\right) &= \frac{1}{2}\left(\frac{n^*}{m^* N^*}\right) \\ N^* &= \frac{\sqrt{n^*(n^*+1)}}{2} \end{aligned} \quad \text{(A14)}$$

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[20]Again, we could have multiple equilibria because $L(k,d,j(e),m)$ is decreasing in m. If we add the restriction, $\bar{q}-1 > L(1,0,0,1)$, the equilibrium becomes unique.

Let us define the RHS of the last equality as a function of n^*: $f(n^*) = \sqrt{n^*}(n^* + 1)/2$. Since we consider only strictly positive values of n^*, then $f(n^*)$ is invertible in the domain $\mathbb{R}_{++}$:

$$f^{-1}(N^*) = \frac{(A-1)^2}{3A} \tag{A15}$$

where $A \equiv \left(1 + 54N^{*2} + 6N^*\sqrt{3 + 81N^{*2}}\right)^{1/3}$. The threshold value μ' can be expressed a function of N^* or n^*:

$$\mu' \equiv \begin{cases} g(N^*) = 1 - \frac{f^{-1}(N^*)}{N^*} & \text{with} \quad \frac{\mathrm{d}g}{\mathrm{d}N^*} > 0 \\[2ex] h(n^*) = 1 - \frac{n^*}{f(n^*)} & \text{with} \quad \frac{\mathrm{d}h}{\mathrm{d}n^*} > 0 \end{cases} \tag{A16}$$

Hence, if $\mu < \mu'$ then $L(0, 0, n^*, m^*) < L(1, 0, 0, m^*)$. If instead $\mu \geqslant \mu'$ the inequality sign reverses. Q.E.D.

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Table 3: Insider trading (IT) and share repurchases (SR) regulations

Panel A and B show equilibrium information allocations and aggregate welfare associated with securities regulation and ownership structure (μ). The first column of each panel highlights the three partitions of the risky asset excess return, generated by short-term shareholders' loss functions. The other columns represent four possible combinations of regulations: $e = 1$ ($e = 0$) means that insider trading regulation is (not) enforced. SR regulation indicates a ban on share repurchases. The shaded area represents the partitions of the excess return in which full investment is reached in the market. When only insider trading regulation is enforced, the underinvestment area widens (shrinks) if corporate ownership is concentrated (diffuse). When both regulations are implemented full investment is attained in every partition, for any ownership structure.

Panel A $\quad - \quad \mu < \mu'$

| IT regulation	$e = 0$	$e = 1$	SR regulation $e = 0$	SR regulation $e = 1$
Info. Allocation	$cp^* = \{0,0\}$	$cp^* = \{1,0\}$	$cp^* = \{0,0\}$	$cp^* = \{0,d\}$
$L(1,0,0,m^*)$	$N^*\bar{q}$	$N^*\bar{q}$	$N^*\bar{q}$	$N^*\bar{q}$
$L(0,0,n^*,m^*)$	$N^*\bar{q}$	$n^*\bar{q}+m^*$	$N^*\bar{q}$	$N^*\bar{q}$
	$n^*\bar{q}+m^*$	$n^*\bar{q}+m^*$	$n^*\bar{q}+m^*$	$N^*\bar{q}$
$\bar{q}-1$	SECOND BEST			FIRST BEST

Panel B $\quad - \quad \mu \geqslant \mu'$

IT regulation	$e = 0$	$e = 1$	SR regulation $e = 0$	SR regulation $e = 1$
Info. Allocation	$cp^* = \{0,0\}$	$cp^* = \{1,0\}$	$cp^* = \{0,0\}$	$cp^* = \{0,d\}$
$L(0,0,n^*,m^*)$	$N^*\bar{q}$	$N^*\bar{q}$	$N^*\bar{q}$	$N^*\bar{q}$
$L(1,0,0,m^*)$	$n^*\bar{q}+m^*$	$N^*\bar{q}$	$n^*\bar{q}+m^*$	$N^*\bar{q}$
	$n^*\bar{q}+m^*$	$n^*\bar{q}+m^*$	$n^*\bar{q}+m^*$	$N^*\bar{q}$
$\bar{q}-1$		SECOND BEST		FIRST BEST

		Mandated Disclosure	
IT regulation	$e = 0$	$e = 0$	$e = 1$
Info. Allocation	$cp^* = \{0,0\}$	$cp^* = \{0,\bar{d}\}$	$cp^* = \{1,\bar{d}\}$
$L(1,0,0,m^*)$	$N^*\bar{q}$	$N^*\bar{q}$	$N^*\bar{q}$
$L(1,\bar{d},0,m^*)$	$N^*\bar{q}$	$N^*\bar{q}$	$N^*\bar{q}$
$L(0,0,n^*,m^*)$	$N^*\bar{q}$	$N^*\bar{q}$	$n^*\bar{q}+m^*$
$L(0,\bar{d},n^*,m^*)$	$n^*\bar{q}+m^*$	$N^*\bar{q}$	$n^*\bar{q}+m^*$
	$n^*\bar{q}+m^*$	$n^*\bar{q}+m^*$	$n^*\bar{q}+m^*$
$\bar{q}-1$	SECOND BEST		
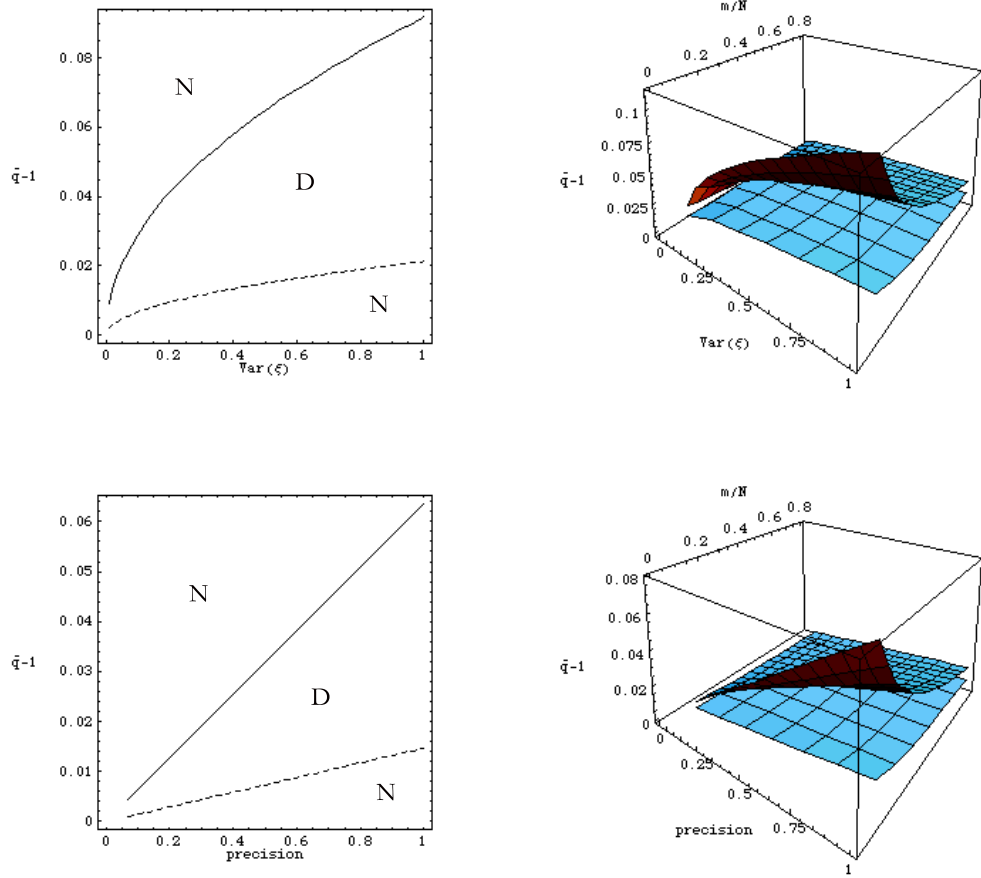
Figure 1: Partitions of the risky asset excess return (case $\mu < \mu'$)

hese graphs show how the three partitions of the excess return, $\bar{q} - 1$, respond to variations in liquidity shock variance, σ_ξ^2, signal precision, defined as $\sigma_q^2/\sqrt{\sigma_q^2 + \sigma_\theta^2}$, and proportion of liquidity shareholders, m^*/N^*, when the ownership structure is concentrated. They also highlight when insider trading regulation is welfare neutral (N) or diminishing (D). The higher is the variance of liquidity shocks, the higher is the range of the excess return whereby full investment is not reached if insider regulation is enforced (upper row). The same relation holds for the signal precision (lower row). The relation is reversed for the proportion of liquidity shareholders: this is so because total adverse selection losses are "paid" by a larger number of shareholders. In the first row of graphs we set $\sigma_q^2 = 0.5$ and $\sigma_\theta^2 = 0.1$; in the second one $\sigma_\xi^2 = 0.2$.

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