Guru Analysts' Conflicts of Interest and IPOs Underpricing via Overvaluation

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Abstract

In the context of "hot" IPOs markets, the large participation of unsophisticated retail investors offers to sell-side guru analysts a substantial influence on initial market valuation of firms going public, due to divergence of opinions under short-sell constraints. As a result, gurus are directly or indirectly subjected to pressures from head-to-head competing clients endowed with conflicting interests as regards initial stock prices and performance-measurement horizon. Indeed, Firm's insiders and privileged investors favor an initial stock price overvaluation that induces underpricing: the resulting information momentum generates additional demand and supports short/mid-term performance until the expiration of the lock-up period. At the contrary, long-term investors favor initial fair valuation that supports long-term performance of IPOs.

Thanks to a delegated common agency game under moral hazard and incomplete contracting, we endogenize the influence of environment variables on conflicts outcome as regards market initial valuation. We demonstrate first that the risk of underpricing through overvaluation depends crucially on the extent of the relative pricing preferences of opposite financial interests at stake in the IPO process. Thus, the more the potential profit from underwriting activities exceeds potential brokerage commissions, the more the bank favors issuers over investors, and the more likely initial market overvaluation is. Consequently, to protect unsophisticated retail investors unable to de-biais guru's recommendations, we introduce in a second time a regulator in the framework of a simultaneous intrinsic relationship, which suffers from overvaluation on the one hand, and is allowed to take costly judicial proceedings to penalize banks on the other hand. We then show that coercive regulation greatly mitigates damaging conflicts outcomes as regards IPOs' long-term underperformance when short-term focus is strong, even if it induces free-riding behaviors among fair-valuation partisans.

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1 ISSUE:

"Hot" IPO markets and Sell-Side Research's inherent exposure to conflicts of interest: from underpricing *via* market overvaluation to IPOs long-term underperformance.

Question:Why didn't Wall-Street realize that Enron was a fraud?
Answer: Because Wall-Street relies on stock analysts. These are people who do research on companies and then, no matter what they find,even if the company has burned to the ground,enthusiastically recommend that investors buy the stock.
Dave Barry, Humor Columnist

Financial markets have exhibited in recent years concomitantly a stock price bubble on new technologies, fuelled by overoptimist sell-side analysts' recommendations, and a high level of underpricing on issuing markets. As the bubble crashed, less sophisticated retail investors lost a lot of money, a large part of which was aiming at financing long term projects as children education or retirement. The reliability and honesty of information intermediaries, such as sell-side financial analysts, have then been questioned, and affairs have revealed poor management and even exploitation of conflicts of interest by prestigious investment banks[1]. The coercive intervention of a Regulator may thus be desirable to protect unsophisticated investors from professionals manipulations.

1.1 When Gurus make IPOs markets

Information is the crucial feature of modern capital markets. However, collecting, processing and analyzing the huge amount of available information and raw data, including issuers' disclosure statements and statistics released by governments or private sources, is far too complex and costly for most investors. As a result, research analysts constitute a fundamental interface

[1]However, this issue is not exactly new, as "banksters" ' exploitation of conflicts of interest before the stock market crash of 1929, and the vote of the Glass-Steagall Act, remind us.

between firms and investors, both retail and institutional. They play a key role that cannot be ignored as regard financial intermediation. Thus, investors, and more especially less sophisticated retail investors, often regard analysts as "truth tellers" experts that provide important sources of processed information about the securities they cover, and rely on their advice.

Both regulators and academics have emphasized the power that analysts can have on stock price, especially when the recommendations are widely disseminated through media. Thus, according to the SEC's 2001 investor alert "analyzing analyst recommendations" cited by [Boni and Womack, 2002], "the mere mention of a company by a popular analyst can [...] cause its stock rise or fall -even when nothing about the company's prospects of fundamentals recently have changed". Empirical investigations "documents [thus] a substantial impact of recommendations on stock prices, both in the short run and for weeks after analysts' changes recommendations". For instance, [Womack, 1996] supports the significant impact of addition to and removal from a analyst "buy list"[2] on both price and volume.

In this context, the existence of equity research's potential biases [3] raise substantial questions as regards the perception of biases by investors. According to pools reported in [Boni and Womack, 2001], professional money managers or buy-side analysts are supposedly able to de-bias the analysts' optimistic bias largely documented in the empirical literature[4]. However, as reported by [Michaeli and Womack, 1999], the fact that underwriters' analysts' recommendations are not completely discounted as the evidence suggest they should be, puts forward that retail investors are not able to de-bias biased recommendations. Thus, Jon D. Markman, managing editor at MSN MoneyCentral Investor, advances that "the real skinny is that virtually no one who matters in the investment industry – which is to say, portfolio managers at large pension, mutual and hedge funds – ever took nine-tenths of research reports seriously. Only the public did". If professionals understand pressures and incentives to filter and de-bias recommendations, [Boni and Womack, 2002] advances in the same vein that less sophisticated retail investors "have less appreciation for the subtleties of these pressures, incentives and resulting biases". The

[2] we note that according to the analysts' unwritten "code language", "hold" recommendations are interpreted as "sell" recommendations -see for instance [Boni and Womack, 2001] or [IOSCO-OICV, 2003].

[3] due for instance to exposure to conflicts of interest

[4] see *infra*

intervention of a Regulator can thus be desirable to distribute the burden of biased research among participants[5].

As a consequence, guru analysts can "make the market" if and only if the impact of less sophisticated retail investors on this stock price is the determining factor of this stock price[6]. Such a market configuration can occur under [Miller, 1977]'s hypothesis of dispersion of investors' opinion in the presence of short-sale constraints. According to Miller, *optimistic* investors make then the price, and overvaluation occurs. [Boehme and Danielsen, 2005] find robust evidence of significant overvaluation for stocks that are subject to both conditions simultaneously. Thus, given that shares in "hot" post-IPO markets are specially costly to short-sell[7], a guru analyst's recommendations, by fuelling the likely optimism of less sophisticated retail investors, can significantly influence the market price.

Given the influence of analysts on price in the context of IPOs, equity research's exposure to conflicts of interest raises substantial questions as regards its implications on IPOs pricing and post-IPOs market valuation. We propose first to describe interests at stake as a firm goes public, before declining subsequent pressures on analysts to enlighten the impact of conflicts of interest on (post-) IPOs pricing.

1.2 IPOs in "hot" market conditions

An initial public offering (IPO) is a company's first sale of stock to the public. Securities offered in an IPO are often, but not always, those of young, small companies seeking outside equity capital and a public market for their stock.

An IPO is mainly characterized by two prices. The issue price is the price at which the firm first sells stocks to investors on the primary market. For a given volume of issued securities, the bigger is the issue price, the bigger is the cash obtained by the firm to finance its development. The second IPO's characteristic price is the first trading price that reveals the market value of the IPO (on the secondary market). Underpricing an IPO is then issuing securities at less

[5] We may also suggest to educate individual investors to increase public awareness of biased research. We yet question the efficiency of such a policy that requires the plain participation and awareness of occasional unsophisticated investors, which are the first to be manipulated in hot periods.

[6] or if other parties at stake have interest in letting the guru makes the market.

[7] small numbers, retail ownership, high demand for borrowing because of overvaluation (self-fulling mechanism), ...

than their market value. In such as case, the first trading price is bigger than the issue price. Thus underpricing does not mean undervaluation: as underpricing can be seen in the difference between the offer price and the price of the first trade, even if the offer price is a fair or overvalued price, a bigger first trading price entails underpricing. Thus, [Derrien, 2005] shows that in "hot" market conditions, "IPOs can be overpriced and still exhibit positive initial return".

The different economic actors at stake naturally do not exhibit the same preferences as regards the (relative) value of IPOs characteristic prices and implied underpricing (since assuming a given offer price, underwriting increases with the first trading price). We propose to analyze each actors preferences as regards first trading price and underwriting.

Since underpricing is "money left on the table" by the issuing firm, the latter as legal entity does not favor it. Indeed, it could have obtained more cash from issued securities by offering shares on the primary market at a bigger issue price, without endangering the issue success.

As regards investment performance, the empirical literature on IPOs' performance tends to show that IPOs generally exhibit impressive short/mid-run performance supported by underpricing. However their long-run performance is not as impressive. Explanations are twofold. As regards short/mid-term performance, the idea is that underpricing the issue induces a large initial run-up in the stock price. This noteworthy initial return particularly attracts interest from non-lead underwriter's research analysts and the media. The attention of more investors is then drawn to the stock thanks to this enhanced coverage. And finally short/mid-term investors exploit this additional demand to obtain a better price when they sell shares at short/mid-term. However, if underpricing can maximize short/mid-term investors wealth, it induces an opportunity cost to the firm. According to [Ritter, 1991], resulting wasted financial resources, and at least postponed investment opportunities, explain IPOs' long-run underperformance. This long-run underperformance. is all the more serious for issued securities bought on the overvalued secondary market. Thus IPOs tend to underperform various benchmarks over the subsequent three to five years ([Foerster, 2001]). We propose consequently to classify rational investors in four main groups according to their investment horizon. Firm's insiders, "friendly" institutional investors, short/mid-term investors and long-term investors.

As regards insiders first, [Aggarwal and Womack, 2002] develop and successfully test[8] a model in which owner-managers of issuing firms strategically underprice IPOs to maximize personal wealth from selling shares at lockup[9] expiration. As described *supra*, the idea is that underpricing attracts more investors' interest by enhanced coverage, and insiders exploit this additional demand to obtain a better price when they sell shares at the expiration of the lockup period. However, underpricing also induces an opportunity cost to the insiders' firm. In our model, we take into account the owner-manager's trade-off between its personal benefit resulting from the "information momentum", and the opportunity cost for the firm in terms of resources, by setting a reservation offer price. The latter bounds insiders' propensity to put their personal interest before the firm's interest.

Second, "friendly"[10] institutional investors benefit from a privileged access to issued securities at the offer price, offered by the underwriting bank to support business relations. Those investors have preferences aligned on insiders' ones: they profit from the impressive short-term performance due to underpricing, and do not bear poor long-term performance of IPOs by "flipping". (See for instance [Krigman and Womack, 1999]).

Third, short/mid-term investors do not benefit from a privileged access to the primary market, and thus have to pay first trading prices. However, given their investment term, they also do not support poor long-term performance. Consequently, as last three investors types, they benefit from the positive impact of underwriting on short/mid-term performance.

Finally, long-term investors are assumed to apply "classic" long-term passive investment strategies: they "blindly" follow their benchmarks and reallocate their portfolios to take into account changes in indexes composition. For instance, as shares are issued[11], index weighting changes. Long term passive investors have then to reallocate their portfolio to realign on their benchmark. They thus acquire new listed shares at the market price and support long-term IPOs underperformance, all the more that market price are overvalued.

To put in a nutshell, we put forward that insiders, "friendly investors", and short/mid-

[8] on a sample of IPOs in the 1990s

[9] The lockup is a contractual agreement between the underwriter and the issuing firm, or a regulatory requirement, prohibiting the sell of shares by insiders for a period after an IPO (six months in average in the USA).

[10] as they are sometimes called in the theoretical literature.

[11] or as insiders' shares are sold at the lockup expiration

term investors present aligned preferences: they benefit from underpricing, even due to initial market overvaluation, as underpricing boosts short/mid-term IPOs performance. At the contrary, long-term investors exhibit radically opposed interests as they are interested in long-term IPOs' performance, which is all the more poor that initial market prices are overvalued.

Finally, the underwriter is the last non-regulatory economic actor directly interested in IPOs pricing. According to [Cliff and Denis, forthcoming in 2005], underwriters might benefit from underpricing in two main ways. First, underwriting investment bank can keep up good business relations with favored clients, by allocating to them more underpriced IPOs, which offer subsequent initial abnormal returns. Second, since lead underwriters are primary market makers ([Ellis and O'Hara, 2000]), the investment bank can profit from the positive correlation between underpricing and future trading volumes ([Krigman and Womack, 2001]).

To conclude, the analysis of the preferences of different economic actors at stake emphasizes a clear divide in preferences as regards first market valuation: if shares buyers logically favor fair valuation, shares sellers benefit from overvaluation. Given the significant impact of guru analyst on market price in the context of "hot" IPOs market[12], each group of actors with aligned preferences has interest to incite the guru analyst to serve its own interest. We propose consequently to analyze to what extent the guru analyst's behavior is determined by conflicting groups' interests.

1.3 Sell-Side Research inherent exposure to conflict of interest.

According to [Crockett, Harris, Mishkin and White, 2004], *"conflicts of interest arise when a financial service provider, or an agent within such a service provider, has a multiple interest which create incentives to act in such a way to misuse or conceal information needed for the effective functioning of financial market".* Indeed, providing multiple financial services to benefit from synergies and economies of scope, notably as regards information production, engenders endogenously potential costs: it creates an "opportunity for exploiting the synergies or economies of scope by inappropriately diverting some of their benefits".

The term "analyst" encompasses individuals with varying functions within the securities

[12] allowed by a "large [less sophisticated] individual investor's demand [inducing][...] high IPO prices, large initial returns, and poor long-run performance", as documented by [Derrien, 2005].

industry, which are generally classified into one of three broad categories depending on the nature of their employment. According to their type, analysts are differently confronted with conflicts of interest, which can interfere with the accuracy and the objectivity of their analysis. Interests of independent analysts, which sell their research (subscription,...), and those of buy-side analysts, working for money managers trading for their own investment accounts or on behalf of others, are generally perceived to bear less severe risks of preferences misalignment with those of their hierarchies and clients ([IOSCO-OICV, 2003]). We will consequently focus on sell-side analysts, which are typically employed in the research department of full-service investment firms[13].

Concerns about sell-side analysts' independence and objectivity result from six main sources we can categorize, following [Boni and Womack, 2002], as internal pressures, pressures from firms' management, pressures from institutional investors clients, conflicts resulting from analysts' personal investments, analysts' "cognitive failures" and influence of peers. We neglect the last source of concern[14] to focus on former ones. We propose, through a review of literature, to document the equity research's inherent exposure to conflicts of interest and its consequences on IPOs pricing and performance

Analysts are subjected to pressures exerted by the different players whose utility depends on analysts' recommendations. We focus on these different types of pressures by following the categories defined in [Boni and Womack, 2002].

Internal pressures arise because full-service investment firms, as financial intermediaries, often undertake many, potentially conflicting, roles.

As pointed out in [Crockett et al., 2004], the conflict of interest that raises the greatest concern occurs between underwriting and brokerage, since investments banks serve in such case two *a priori* conflicting client groups (issuing firms and investors). Issuers and short-term investors benefit from optimistic analyses, while long-term investors look for unbiased recommendations. According to the relative extent of the potential profit generated by each of these two activities,

[13] According to the OICV-IOSCO, the generic term "full-service investment firms" is intended to refer to entities that provide a variety of financial or financial-related services to client as banking groups ([IOSCO-OICV, 2003], p. 2, footnote 2).

[14] since our model encompasses a unique analyst and thus does not explain interactions between them.

financial firms are tempted to act to the advantage of one of both client groups. When the potential profit from underwriting greatly exceeds brokerage commissions, investment banks have strong short-term incentives to favor issuers over investors[15]. They thus reduce the risk to loose profitable corporate clients to competitors[16], all the more easily that long-term investors profit at short-term from overvaluation, before suffering from often-underestimated future ineluctable market corrections. As a result, analysts in investment banks may distort their research to please issuers, so that produced information may loose reliability and deteriorates efficiency of securities market.

However, conflicts do appear even within the brokerage department. Thus, if [Boni and Womack, 2002] admit that broker may be theoretically considered as financial intermediaries, the authors advance that broker are primarily "marketers, earning commissions and fees the more transactions they facilitate between buyers and sellers". Conflicts of interest are then ineluctable: "while investors would probably prefer research analysts to be "truth tellers", issuers prefer research analysts to be marketers". Given the fact that investors are reluctant to pay for research on the one hand, and that underwriting fees tends to offset brokerage commissions on the other hand, the primacy of investors' over borrowers/issuers' interest is quite not credible. Moreover, as reported in [Boni and Womack, 2002], the SEC also notes that analysts can be encouraged to write "positive" recommendations that "can trigger higher trading volumes, resulting in greater commissions". Indeed, if "buy" recommendations tend to encourage broker's clients to perform trades, many of them are reluctant or are unable to shell short. Thus, "unless the client already owns the stock, "sell" recommendation[s] are less likely to generate trading commission[s]". Thus, Jon D. Markman, managing editor at MSN MoneyCentral Investor, reveals to us that "analysts at the major brokerages for years have been looked down upon by institutional investors as sales support staff, a pack of kids with fancy college degrees who provided little more than PR material for the retail brokerage and investment banking teams. If they were called 'promoters' rather than 'analysts', the public would have had a better idea of their role in the retail investment ecosystem". Incentives to write "positive" recommendations are moreover reinforced in the

[15] [Boni and Womack, 2002] note that "facing the rise in competition from discount brokers and electronic trading, banks rely increasingly more on corporate financing revenues and investment banking fees that on brokerage commissions to make profit"

[16] especially for future Seasoned Equity Offering (SEA), as documented by [Cliff and Denis, forthcoming in 2005]

context of IPOs since underpricing implied by overvaluation allows to favor preferred "friendly" investors.

To put it in a nutshell, the source of equity research's exposure to conflicts of interest is mainly twofold. First, according to [Crockett et al., 2004], an underlying problem of appropriateness of the analyst production, due to information (at least partial) revelation through trading, makes the sale of this not-purely-private good difficult. This obstacle is reinforced by the difficult assessment of analysts' performance, since the forecast accuracy of fundamental values does not guarantee the success at stocks picking. This double problem makes difficult to price analyst work, so that reports are generally provided for free to brokerage clients ([Dugar and Nathan, 1995]), all the more that [Michaeli and Womack, 1999] reveals that customers do not trade at firms providing them with information they rely on. As a result, research is often considered as overhead generating little direct profit. Consequently investment banks have recourse to equity research as a " marketing tool " to make it pay.

The rationality of this criterion is twofold ([Crockett et al., 2004]). First, analysts' reputation is important for attracting and retaining brokerage customers. Second, it is an essential marketing tool for investment banks in the IPO market. Indeed, analysts' capacity to " make the market " is generally a crucial criterion in the firm's choice of the underwriting bank, and the latter's support is often considered as part of an implicit understanding between underwriters and issuers. In the same vein, after-IPO recommendations impact crucially on further business relationships between the issuer and the underwriter.

Consequently, as "marketing tool" for departments serving clients with conflicting interests, equity research faces strong potential conflicts of interest. For instance analysts could be tempt to issue excessively bullish opinions to maintain business relationships with formers issuers or attract new ones. The conflict will be most pregnant with danger when underwriting is highly profitable relative to brokerage. In such a case, "the short-term payoff for an analyst may outweigh the benefits of investing in a long term reputation in a soaring market".

Beside internal pressures, a second and crucial source of pressure on analysts independence and objectivity results from *firms' management* as analysts perform their "information dissemination tasks". According to [Michaeli and Womack, 1999], the latter ones consist in collecting new information (on the industry or individual stock from customers, suppliers and firms managers), incorporating it in their recommendations, and providing recommendations and financial models through oral or written reports to customers and media. However the collection of critical new information from firms themselves enables management of covered companies to pressure analysts. Thus, in case analysts do not cooperate, they face the risk of being deprived of future communication opportunities with insiders. As a result, analysts necessarily cooperate to guaranty superior access to management. [Lim, 2001] shows thus that "optimal forecasts with minimum expected error are optimistically biased". It is worth noticing that the introduction by the SEC of the Regulation Fair Disclosure ("RegFD") in October 2000, aiming at eliminating selective disclosure between individual investors and securities professionals, should have mitigated these means of pressure. Indeed, by eliminating the disclosure of *material* non-public information to only analysts and institutional investors, the RegFD tempers the risk of discrimination between analysts. However the release of other technically nonmaterial information, such as strategic or long-term plans, highly valued by investors and hence analysts, is not protected by the RegFD. Firms can thus still "strategically dole out most valuable information only to [analysts] who cooperate with management optimistic forecasts" as pointed out by [Boni and Womack, 2002]. This pressure is particularly penalizing as regard analysts' independence, even more so because it may have been reinforced in recent years through the increasing recourse to stock-option to remunerate firms' management.

Moreover, in the context of a firm going pubic, we notice that analysts are also often led to boost stock price by "buy" recommendations just before the lock-up expiration to please insiders: private equity holders[17] benefit thus from advantageous stock price to sell their pre-IPO owned stocks.

"Friendly" or short-term *institutional investors* themselves are a potential source of pressure on analysts. Indeed, [Boni and Womack, 2002] emphasize that analysts may renounce to issue a "negative" recommendation for fear that its adverse effect on an institutional client's portfolio lead him to cease business relations and recourse to another broker. This pressure is all the more

[17] By private equity holders, we refer to the firm's insider, the firm's clients or even the analyst that "may own significant positions in the companies [he] covers", according to the OEIA Investor Alert cited in [Boni and Womack, 2002]. The analyst faces then conflicts resulting from itd personal investments.

significant that money managers elaborate industry rankings[18] that affect directly analysts' compensation and future money flows towards brokerage houses. However, long-term institutional investors, favoring unbiased recommendations, have also access to similar means of pressure.

Finally, as reported by [Boni and Womack, 2002], analysts are also confronted to "*cognitive failures*" such as[19] the so-called "inside view" described by [Kahnema and Lovallo, 2993]. Thus, [Michaeli and Womack, 1999] advance that analysts participating in corporate financing deals are incapable of analyzing it objectively because of their personal involvement in the project.

These pressures on analysts tends to optimistically bias their forecasts, all the more seriously that analysts' compensation is not set appropriately. Indeed, compensating for the lack of information on analysts' remuneration, [Hong and Kubik, 2003] study the determinants of downward and upward analysts' mobility between 1983 and 2000. They find that besides forecasts accuracy, optimism contributes positively to carriers, all the more that covered stocks are underwritten by their own banks, and that the considered period is the stock market boom of the late 1990s.

Analysts' optimistic bias and the predominance of "buy" recommendations (see for instance [Anderson and Schack, 2002] or [Rajan and Servae, 1997]) are well documented in the literature. This over-optimism is partially explained by common pressures on sell-side analysts: "access cost" to firms' management, or censoring behavior of research directors that dislike issuing negative recommendations to avoid hurting institutional clients. Many prefer indeed dropping coverage rather than continuing to analyze objectively poor performing companies, so that the analyzed sample is upward distorted. However [Hong and Kubik, 2003] argues such bias does not account for "the differences in optimism between analysts" working for underwriting and non-underwriting banks, and the optimistic trend in the stock market boom". These differences in optimism are also documented by [Michaeli and Womack, 1999]. By comparing non-underwriter versus underwriter analysts's recommendations, they indeed show the latter outperform largely the former in the long-term (for a 12-month period).

[18] for instance, *Institutional Investor* publishes each year the "All-American Research Team" composed by the "podium" of the year.

[19] According to [Boni and Womack, 2002], analysts also face "overreaction to information shocks", however our model does not include this bias.

[Shiller, 2000] interprets such forecasting and recommendations biases as obvious evidence of conflicts of interest. If the perception of conflicts exploitation increases during bearish stock market periods, as guilty parties are actively researched, we should however notice that bullish periods exhibit higher potentiality of conflicts of interests as underwriting professional fees become predominant relatively to brokerage commissions. (See [Crockett et al., 2004] for the exuberant bull market of 1928-9 (p. 1), [Michaeli and Womack, 1999] for the 1990s).

1.4 Modeling conflicts of interest impact on overvaluation risk

In the context of financial markets dominated by financial intermediaries whose lifeblood is information, theoretical and empirical[20] studies as regards information transmission and analysts' forecasts related issues have obviously received a lot of attention. The bulk of the theoretical literature extensively investigates the "standard" relationship between an investor and an analyst/adviser. Works in this vein are mainly concerned by information transmission in the framework of incentives alignment bias ([Krishna and Morgan, 2000] or [Morgan and Stocken, 2003]), reputational cheap-talk ([Ottaviani and Sorensen, 1999], [Levy, 2000] or [Levy, 2002]) or forecasting contest in pre-specified rules such as winner-take-all tournaments ([Ottaviani and Sorensen, 2003]).

However, to our knowledge, the impact of the analyst's environment on the outcome of the inherent conflict of interest he is confronted with, has not be modelled. In our paper, we develop a theoretical model, reproducing (or compatible with) pressures exerted on sell-side analysts, that enlightens the link between the relative power of financial interests generated by underwriting and brokerage activities, and analysts' effort to make market price incorporates reliable information. This delegated common agency model under moral hazard offers valuable insights to help to explain observed substantial underpricing and surprising investment recommendations in "hot" IPOs market.

We then recourse to the common-agency literature as underlying framework, and combine the

[20] Empirical works enlightened issues as regard accuracy of information production (for instance [Francis, Hanna and Philbrich, 1997]), exploitation of forecast by investors ([Francis and Soffer, 1997]), analyts' compensation and reputation ([Hong and Kubik, 2003]), forecasting biais ([Hong and Kubik, 2003]), and existence of conflicts of interests ([Shiller, 2000],[Michaeli and Womack, 1999]), or information disclosure by management....

latter to some stylized facts generally accepted by the empirical literature on financial markets and analysts. The literature on common agency under moral hazard finds its origin in the seminal paper of [Bernheim and Whinston, 1986]. As summarized in [Martimort, 2004], in such common agency games, "several principals offer non cooperatively contribution schedules to a single decision-maker. The latter chooses first which offers to accept, and, second, which decision should be taken. The schedule offered by each principal stipulates how much that principal is ready to pay for a given value of that decision". In [Bernheim and Whinston, 1986], the agent chooses the probability distribution of a unique output facing competitive incentives of several principals with misaligned preferences. [Dixit, 1996] introduces multitasking through a risk-adverse common exponential-utility agent under Gaussian hazard with continuous effort by extending [Holmström and Milgrom, 1991]. Since them, numerous economic fields in political science and political economy have been explored thanks to application of these papers. This paper belongs to this research trend as we investigate a still unexplored[21] economic field from a moral hazard common agency angle. However we depart noticeably from previous works in other domains, since modeling a research team entails incomplete contracts restrictions. We thus adapt the methodological framework first introduced by [Martimort, 2004] in a political science context, and extend him to envisage regulatory measures to limit potential hazardous consequences of sell-side research's conflicts of interests. [Martimort, 2004] studies the endogenous formation of interest groups willing to impact on a political reform vote. He first demonstrates the efficiency of equilibria under complete contracting: all principals are endogenously active at equilibrium and contribute through truthful schedules. However, assuming incomplete contracting by restricting principals' contribution to cases in which the outcome they favor happens, equilibrium is no longer efficient and free-riding can arise.

We depart from [Martimort, 2004] by introducing a new type of principals, a Regulator, whose means of interventions differ. At the difference of other principals limited by incomplete contracts ruling out negative incentives in a delegated agency context, he is notably allowed to impose sanctions in the framework of an intrinsic relationship. Moreover, unlike political science applied to vote, case in which efficiency means that equilibrium reflects preferences of all agents, our regulatory approach adopts a quite different standpoint. Indeed, the regulator

[21] to our knowledge

is legally endowed with own particular means of actions to try to impose his preference. Our problematic will therefore induce quite different developments, interpretations, conclusions, and recommendations.

The paper is organized as follows. In Section 2, we adapt [Martimort, 2004] to model a research process, contributing or not to overvaluation, as a delegated common agency game under moral hazard. In Section 3, we analyze the impact of restrictions on contribution schedules on market valuation. In Section 4, we introduce a Regulator in the previous framework. Section 5 briefly concludes. Proofs are relegated in Appendix.

2 MODEL: Endogenization of guru equity research inherent conflicts of interest outcome, and desirable coercive regulation to protect naive retail traders.

In the light of previous empirical findings, we propose to endogenize the outcome of equity research's inherent conflicts of interest as regard IPOs' initial market valuation. With this aim in view, we have recourse to a stylized but insightful common agency game under moral hazard, combining delegated (following [Martimort, 2004]) and intrinsic agency relationships.

We thus model pressures on guru analysts, exerted by different economic actors at stake in an IPO process, to align the first trading price with their preferences (see section 1.2). Generally speaking, we divide pressures into two groups as regards their performance horizon. Some pressures are exerted by the representative firms' insider and the "friendly[22]" representative short/mid-term informed investor in favor of underpricing through overvaluation and short/mid-term performance. Opposite pressures are exerted by the representative long-term informed investor in favor of fair valuation and long-term performance.

[22] benefiting from a priority access to the primary market

2.1 Framework assumptions

We confine ourselves to the primary and secondary market of a firm going public in the context of a "hot" IPOs market.

$H1$. Following [Miller, 1977], we assume short-sale constraints and potential divergence of opinions allowing overvaluation[23], even in presence of a representative informed investor.

$H2$. For tractability and exposure reasons, the first trading market price is described by two states of nature: fair valuation and overvaluation.

$H3$. An investment bank's "guru" sell-side analyst, which is torn between the research department and the underwriting department, is subjected to conflicts of interest as regards initial market valuation.

$H4$. Two groups of active players tends to influence initial market valuation through pressures on the guru: the representative firms' insider and the representative "friendly" short/mid-term informed investor in favor of underpricing through overvaluation in the first hand, and the representative long-term informed investor in favor of fair valuation and long-term performance in the other hand. Finally, a representative unsophisticated retail investor blindly follows the guru's recommendations, and leads the market towards overvaluation if the guru's recommendations are not "truth telling" enough (according to $H1$).

$H5$. In the absence of equity research, all information available to the unsophisticated investor is produced by the representative firm going public (annual reports,) and is naturally upward biased or at least presented in a favorable light. For instance, annual reports emphasize positive elements while reporting succinctly, evasively, or even diverting attention from negative ones. As a consequence, given $H1$, the market is overvalued for certain in the absence of equity research.

$H6$. The market initial valuation on that stock is manipulated by the "guru" analyst, blindly followed by the unsophisticated uninformed investor. At a increasing convex cost $\psi(e) > 0$ verifying Inada conditions on $[0, 1]$, the guru makes a hidden effort e at performing and

[23]because of a unsophisticated representative retail investor blindly following potentially optimist guru's recommendations

disseminating objective research. As a result, the stock is fair valued with a probability e, and overvalued with a probability $1-e$. Exerting effort $e>0$ costs $\psi(e)>0$ to the sell-side analyst. Several explanations support this assumption. First, performing research and convincing the market of results pertinence is resources- and time-consuming. Second, the empirical literature shows that analysts' overoptimism impacts positively on carrier, especially when firms are clients of their own banks' underwriting department (see [Hong and Kubik, 2003] for instance). As a result, contributing to fair valuation induces a cost in terms of professional promotion. Finally, for a given offer price, a fair valued first trading price greatly undermines underpricing, whereas underpricing contributes to the underwriter remuneration (see.1.2).

The variable e can also be interpreted as the proportion of retail investors reached and convinced by the analysts' argument. The cost of diverting unsophisticated investors from ambient optimism fulfilled by the financial community in hot markets is consequently marginally increasing.

$H7$. Following section 1.2, each group of interest tries to incite the guru to lead the market towards the initial valuation it prefers. They exert pressures either via the brokerage, or the underwriting department.. To reproduce empirical findings, we naturally use an incomplete contract approach (section III), ruling out negative incentives, and allowing positive incentives by making the continuation of commercial relationships depends on the market valuation realization.

$H8$. A regulator, suffering from overvaluation (long-term retail investors protection, misallocation), and defending the representative unsophisticated investor with bounded rationality that is institutionally unable to influence the guru but blindly follows him, can undertake costly judicial proceedings to impose a fine to the guru in case of overvaluation, at a increasing convex cost of the fine absolute value (deeper investigations, better prosecutors, ...).

Notation 1 *We have recourse to the decoration "$\bar{\cdot}$ " to describe the value of a variable in case of event "fair valuation", and "$\underline{\cdot}$" in case of event "overvaluation".*

2.2 Preferences

Both groups i of Principals go to the *delegated* common guru analyst: the representative long-term investor ($i = I$) on the one hand, and the so-called representative Firm's insider ($i = F$) on the other hand, made up by the representative owner-manager and the representative "friendly" short/mid-term investor. Principals i get the payoff $\widetilde{S}_i$ and give the conditional transfer $\widetilde{t}_i$ according to which valuation event happens. They are endowed with conflicting interests: I favors fair valuation while F prefers overvaluation. It results in a head-to-head competition among opposite investment bank's client groups to influence the guru analyst as regards the fixing of the first trading price VM.

For a given issue price V_o, empirical literature shows that IPOs' short/mid-term[24] return depends positively on the positive initial return $\frac{VM}{V_o}$ resulting form underpricing. Consequently, despite the Principal F does not sell shares at the first trading price but at short/mid-term price, his short/mid-term utility depends crucially on underpricing. Thus, Principal F's short/mid-term utility can be assessed by the difference $VM - V_0$ between the first trading price and the issue price. Since the underwriter and the insider (owner-manager) both favor underpricing (see 1.2), we assume the offer price V_o is fixed at the insider reservation price VF, which reflects the insider's trade off between his own interest and the firm interest. Finally, Principal F's payoff $VM - VF$ is increasing in the first trading price VM.

Whereas the Principal F favors overvaluation since he sells shares, the Principal I favors fair valuation since he buys shares at the market price VM, according to its reservation price VI. Its short/mid-term utility is then described by the difference $VI - VM$ between its reservation price and the effective first trading price. However, since the Principal I favors long-term, its payoff has also to encompass a "long-term utility" term δ. Following empirical findings, we retain that long-term performance depends negatively on underpricing due to overvalued short-term trading price. We consequently assume $\underline{\delta} = 0$ in case on initial overvaluation since the long-term investor does not loose money relatively to the benchmark, but does not benefit from a performing benchmark in such a case. However, we assume $\overline{\delta} \geq 0$ in case on initial fair valuation since the long-term investor does benefit from a performing benchmark. We note that $\overline{\delta}$[25] is all

[24] and especially at the expiration of the lock-up period
[25] sum of discounted investment gains

the more considerable that long-term invested money is substantial and/or the horizon of return distant in time.

Following $H2$, we assume for tractability and exposure reasons a two-state first trading market price $VM \in \left\{\overline{VM}, \underline{VM}\right\}$. The guru either favors insiders F and targets the initial market price at Principal I's reservation price $\underline{VM} = VI$, or he favors the long-term investor I and targets the initial market price at Principal F's reservation price $\overline{VM} = VF$, with $\overline{VM} = VF < \underline{VM} = VI$. Since $\overline{S}_I = VI - \overline{VM} + \overline{\delta}$, $\underline{S_I} = VI - \underline{VM} + \underline{\delta}$, $\overline{S}_F = \overline{VM} - VF$, and $\underline{S_F} = \underline{VM} - VF$, Principals' gross payoffs are thus:

$$
\begin{array}{l|c|c|}
 & \text{fair valuation} & \text{overvaluation} \\
\hline
\text{Principal } I \text{ (LT Investor)} & \overline{S}_I = VI - VF + \overline{\delta} & \underline{S}_I = 0 \\
\hline
\text{Principal } F \text{ (Insider)} & \overline{S}_F = 0 & \underline{S}_F = VI - VF \\
\hline
\end{array}
\tag{1}
$$

Both principals $i = I, F$ get finally the expected net payoff

$$
\forall i, \quad U_i = E\left[\widetilde{S}_i - \widetilde{t}_i \mid e\right] = e * \left[\overline{S_i} - \overline{t}_i\right] + (1-e) * \left[\underline{S}_i - \underline{t}_i\right] \tag{2}
$$

Given the conditional transfers paid by both principals, the delegated common agent gets, by exerting effort $e \in [0,1]$, the expected utility:

$$
U = E\left[\sum_{i=I,F} \widetilde{t}_i \mid e\right] - \psi\left(e\right). \tag{3}
$$

We assume the cost function $\psi : [0,1] \to [0, +\infty[$ is an increasing, convex, with positive third derivative, and respects the Inada conditions ($\psi'(0) = 0$, $\psi'(1) = +\infty$) to insure interior solutions.

2.3 Timing

1. Principals offer non-cooperatively their contribution schemes $\left\{\left(\overline{t}_i, \underline{t}_i\right)\right\}_{i \in \{I,F\}}$.
2. The guru analyst determines the subset of contract he should accept. However he can choose not to contract at all and gets the outside option payoff we normalize to 0.

3. The guru analyst chooses his effort (e).

4. Finally, the valuation event happens: market price is either fair-valued, with probability e, or overvalued, with probability $1-e$. Principals get their payoffs and conditional transfers are exchanged.

2.4 Benchmark: Complete contracting in absence of Regulator

First, we assume effort is observable (first best). Following [Martimort, 2004], we determine the first-best socially optimal action e^*_{FB} with observable action and "merged" principals in absence of regulation[26]:

$$e^*_{FB} = \arg\max_{e\in[0,1]} E\left[\sum_{i=I,F} \widetilde{S}_i \mid e\right] - \psi(e) \tag{4}$$

It appears that a positive effort is induced as long as principals favoring fair pricing have a greater valuation for it that principals favoring overvaluation, i.e. that $\bar{S}_I > \underline{S}_F$. At the contrary, when principals favoring fair pricing have the same or a smaller valuation for it that principals favoring overvaluation, the socially optimal effort is at a corner $e^*_{FB} = 0$ and overvaluation is certain.

Proof. As $E\left[\sum_{i=I,F}\widetilde{S}_i\right]$ is linear in e and $\psi(e)$ convex in e, $E\left[\sum_{i=I,F}\widetilde{S}_i\right] - \psi(e)$ is concave in e. Indeed, $\frac{\partial^2}{\partial e^2}E\left[\sum_{i=I,F}\widetilde{S}_i\right] - \psi(e) = -\psi''(e) < 0$. Then e^*_N solves $\frac{\partial}{\partial e}E\left[\sum_{i=I,F}\widetilde{S}_i\right] - \psi(e) = 0 \Leftrightarrow \overline{\delta} = \psi'(e^*_{FB})$. Since we assume that $\forall e > 0$, $\psi'(e) > 0$ and $\psi'(0) = 0$, then $e^*_{FB} > 0$ if $\overline{\delta} > 0$, and $e^*_{FB} = 0$ if $\overline{\delta} = 0$. ■

We notice that the concept of "socially optimal action" do not refer to any "moral" understanding. It only describes the action that would be taken if merged principals gave incitations to the agent, in the framework of a classic principal-agent relationship. Thus, we already have the intuition this effort would not satisfy a regulator favoring fair market valuation, i.e. investor protection and efficient financing through capital markets.

[26] Indeed, [Martimort, 2004] does not consider the intervention of a regulator.

Second, we assume effort is no more observable (second best). In a more general setting of complete contracting with a finite number of Principals (in absence of Regulator), [Martimort, 2004] demonstrates first that whether all principals participate at the equilibrium of the delegated common agency, the common agent always chooses an socially efficient action (Proposition 1, p. 13). Second, he shows that Principals are all active at equilibrium. When Principals' interests are congruent, each of them gets a positive payoff by making the common agent *residual claimant,* and the common agent gets zero rent (Proposition 2, p. 14). Finally, with two Principals having conflicting interests, the common gets a positive rent as well, since he can play one principal against the other (Proposition 3, p. 15). Thus, with complete contracting, "first, the equilibria [...] remain efficient, i.e. there is neither free-riding nor wasteful competition among principals. Second, all principals find it worth to intervene when they are unrestricted in the kind of contributions they can offer". The equilibria are *truthful* in the sense each Principal makes a "marginal" contribution equal to his own relative valuation between alternative outcomes. Thus, the effort chosen by the agent at equilibrium is efficient from the point of view of the "society", i.e. of merged Principals.

In our framework of two conflicting Principals I and F, applying [Martimort, 2004]'s Proposition 3,

3 Incomplete contracting and Conflicting interests

To reproduce empirical findings, we restrain the set of contracts available to both conflicting principals (the informed investor I and the insiders F): we have recourse to an incomplete contract approach ruling out negative incentives. We thus capture the idea that principals cannot punished the agent through a negative transfer[27]. However, principals can provide positive incentives by making the continuation of commercial relationships[28] depends on the market valuation realization.

Due to these constraints, the long-term investor I, interested in long-term performance and thus supporting initial fair valuation, offers a contribution $\bar{t}_I \geq 0$ ($\underline{t}_I = 0$ resp.), when the market

[27] A negative payoff would be refused in a delegated common agency framework where the agent chooses with whom he contracts.

[28] new trades at the brokerage, or new deals at the underwriting departments.

is initially fair valued (overvalued resp.). At the contrary, insiders F, favoring overvaluation due to short/mid-term investment horizon, offers a contribution $\underline{t}_F \geq 0$ ($\bar{t}_F = 0$ resp.) when market prices are upward biased (fair valued resp.).

3.1 In the absence of regulation

3.1.1 Program of the common agent

The delegated common agent maximizes his expected utility under his individual rationality constraint. His program is

$$(P_A) \qquad \underset{e \,\in\, [0,1]}{Max}\, U_A = E\left[\sum_{i=I,F} \widetilde{t}_i \mid e\right] - \psi(e) \tag{5}$$

$$\text{subject to } (IR_{A:}) \quad : \qquad U_A = e * \bar{t}_I + (1-e) * \underline{t}_F - \psi(e) \geq -K \tag{6}$$

We note K the unsinkable costs of stopping activity, due to reputation effects, breach of contracts or commercial relation breaking-offs...

As (P_A) is concave in e, since $\psi(e)$ is convex, the common agent's incentive constraint is

$$(IC_A): \qquad \bar{t}_I - \underline{t}_F = \psi'(e) \tag{7}$$

3.1.2 Program of the Investor favoring fair valuation (Principal I)

The investor P_I offers a contract $(\bar{t}_I, \underline{t}_I = 0)$ maximizing his expected payoff, under the common agent's incentive constraint (7) and the acceptance by the agent of his own offer.

The contract is accepted if the common agent's gets a better expected utility by contracting with both principals, rather than with the firm's insider only. Thus

$$U_A^{LL} \geq \underset{e \,\in\, [0,1]}{Max}\, U_{A,\{F\}} = (1-e) * (\underline{t}_F) - \psi(e), \tag{8}$$

with the agent's effort given by (7).

The program of Principal I becomes then

$$(P_I): \quad \underset{\{e,\, \bar{t}_I\}}{Max} \quad U_I = e * \left(\bar{S}_I - \bar{t}_I\right) \qquad (9)$$
$$\textit{subject to } (7) \textit{ and } (8)$$

3.1.3 Program of the Firm's insider favoring overvaluation (Principal F)

The insider P_F offers a contract $(\bar{t}_F = 0, \underline{t}_F)$ maximizing his expected payoff, under the common agent's incentive constraint (7) and the acceptance by the agent of his own offer.

The contract is accepted if the common agent's gets a better expected utility by contracting with both principals, rather than with the investor only. Thus

$$U_A^{LL} \geq \underset{e\, \in\, [0,1]}{Max}\, U_{A,\{I\}} = e * \bar{t}_I - \psi(e) \qquad (10)$$

with the agent's effort still given by (7).

The program of Principal F becomes then

$$(P_F): \quad \underset{\{e,\, \underline{t}_F\}}{Max} \quad U_F = (1-e) * (\underline{S}_F - \underline{t}_F) \qquad (11)$$
$$\textit{subject to } (7) \textit{ and } (10)$$

3.1.4 Conflicts of interest outcome in the absence of regulator

Proposition 2 *Assuming that principals have conflicting preferences and that* $(1-e).\psi^{'}(e^*)$ *is concave in* e[29]*.*

If the environment parameters are such the insider, favoring overvaluation, dominates the investor, in the sense that $\bar{S}_I < \underline{S}_F - \psi^{''}(e^*)$*, the investor endogenously prefers not to go to the research team. Consequently, the agent does not exert effort (*$e^* = 0$*) and overvaluation is certain. However this case is ruled out since* $\bar{S}_I - \underline{S}_F = \overline{\delta} \geq 0$

If the investor, favoring fair valuation, dominates the insider, in the sense that $\bar{S}_I > \underline{S}_F - \psi^{''}(e^*)$,

[29] to insure firm's program concavity. This condition holds for numerous functions ψ responding to initial assumptions. It always holds when ψ is a quadratic cost function (but Inada conditions then do not hold when $e \to 1^-$)

i.e. $\overline{\delta} \geq 0$, *the equilibrium effort* e^* *solves:*

$$\bar{S}_I - e^*.\psi^{''}(e^*) - Max\left[\underline{S}_F - (1-e^*).\psi^{''}(e^*)\ \ ,0\right] = \psi'(e^*) \tag{12}$$

In this case, the insider (P_F) *intervenes as a brake to fair valuation realization, as long as his valuation for overvaluation exceeds the marginal agency cost he pays to the agent, i.e. as long as* $\underline{S}_F \geq (1-e^*) * \psi^{''}(e^*)$.

Proof. See Appendix (5.1). This proposition is a slight generalization of [Martimort, 2004]'s Proposition 5. ■

According to the relative extent of the potential incomes the bank gets by acting to the advantage of one of its client groups, the bank will favor one Principal over the other. **Since the bank's potential incomes provided by principals are directly linked to their potential gains obtained by influencing the agent, the relative importance $\overline{\delta}$ of these potential gains is determinant as regards the issue of the conflicts of interests**. When the potential fees from underwriting (Insider P_F) equal brokerage commissions (Investor P_I), the bank is strongly incited to favor issuers over investors. As a result, the investment bank's sell-side analyst distorts his research and communication to please issuers, and the information he produces and disseminates only slightly fights firms' naturally upward biased financial communication. At the contrary, in the opposite polar case, it is not worth Firm's while to try to influence the research team when his valuation for overvaluation does not exceed the marginal agency cost to pay to the agent. When principals' potential gains are not too different, both principals intervene at equilibrium. The countervailling power of the Insider P_F acts like a brake to fair valuation supported by Investor's contribution.

To put it in a nutshell, the more insiders benefit from overvaluation, or similarly the less money is long-term invested, the more a Regulator, favoring fair valuation by assumption, is willing to intervene in favor of fair valuation threatened by insiders. We thus introduce a Regulator, suffering from overvaluation, but allowed to penalize the research team in case of overvaluation.

3.2 Intervention of a Regulator favoring fair valuation.

A demonstrated in the previous section, unsophisticated retail investors give the guru analyst a considerable influence on the IPO's initial market pricing due to divergence of opinions in presence of short-sell constraints. As a result, investment banks' client try to divert this influence on the underpricing level to their their own financial interest as regards the IPO performance horizon. These findings naturally raise the question of introducing a Regulator favoring fair valuation by assumption. This regulator, suffering from initial overvaluation (misallocation of resources, market inefficiency), and defending the representative unsophisticated retail investor's long-term savings performance[30], can undertake costly judicial proceedings to impose a fine to the guru in case of overvaluation, at a increasing convex cost of the fine absolute value (deeper investigations, better prosecutors, ...).

However, introducing a new actor obviously modifies the initial actors' best response. We thus have to analyze new behaviors induced by the intervention of the Regulator. Whether both initial principals are still involved in a *delegated* common agency game with the common agent[31], the regulator enters a *intrinsic* relationship in the sense the agent only way to refuse a contract proposed by the Regulator, i.e. a regulation, is not to play at all.

3.2.1 Regulator's preferences

We focus on a natural penalizing regulation compelling the agent to pay a sanction $\mid \underline{p} \mid$ when overvaluation occurs. The Regulator imposes a special contract ($\bar{p} = 0, \underline{p} < 0$) on the agent that cannot refuse it without refusing all others contracts (*intrinsic* relationship). We assume the regulator, protecting investors, suffers from overvaluation ($\underline{S}_R < 0$), and can penalize the agent when price are upward biased. But he cannot benefit from the monetary value of sanctions, which directly go to government's budget (as actually). Moreover, we also assume the Regulator incurs a cost $\rho(\underline{p})$ to impose a sanction $\underline{p}$, increasing with the sanction absolute value. This is explained by the fact that imposing heavy fines requires to draw up a time- and money-consuming sound file.

[30] that is institutionally unable to influence the guru but blindly follows him

[31] The common agent optimally chooses a subset of contracts.

Regulator's expected payoff is then:

$$U_R = E\left[\widetilde{S}_i \mid e\right] - \rho(\underline{p}) = (1-e) * \left[\underline{S}_R - \rho(\underline{p})\right] \tag{13}$$

3.2.2 Timing of the game including the Regulator

1. Principals and regulator offer non-cooperatively their contribution schemes $\left\{\left(\bar{t}_i, \underline{t}_i\right)\right\}_{1 \leq i \leq n}$ and $\underline{p}$ respectively.

2. The guru analyst determines the subset of contract he should accepts (delegated part of the game), except for the intrinsic regulatory contract it cannot refuse. However, he can choose not to play at all and gets a outside option payoff we normalize to $-K < 0$ (sunk costs to cease business).

3. The guru analyst optimally determines is effort level (e).

4. Finally, the valuation event happens: market price is either fair-valued, with probability e, or overvalued, with probability $1-e$. Principals get their payoffs and conditional transfers are exchanged.

3.2.3 Program of the common agent

The delegated common agent maximizes his expected utility under his individual rationality constraint. His program is

$$\left(P_A^{with\ R}\right) \qquad \underset{e \in [0,1]}{Max} \quad U_A^{with\ R} = E\left[\sum_{i=I,F} \widetilde{t}_i + \widetilde{p} \mid e\right] - \psi(e) \tag{14}$$

$$\text{subject to } \left(IR_A^{with\ R}\right) \quad : \quad U_A^{with\ R} = e * \bar{t}_I + (1-e) * \left(\underline{t}_F + \underline{p}\right) - \psi(e) \geq -K \tag{15}$$

As $\left(P_A^{with\ R}\right)$ is concave in e, since $\psi(e)$ is convex, the common agent's incentive constraint is

$$FOC_A^{with\ R}: \qquad \bar{t}_I - \underline{t}_F - \underline{p} = \psi'(e). \tag{16}$$

By playing a best-response to simultaneous principals' contributions, he gets the expected utility

$$U_{A\_BR}^{with\ R} = R(e) + \underline{t}_F + \underline{p} \tag{17}$$

with $R(e) = e\psi'(e) - \psi(e)$ positive, increasing and convex since $R(0) = 0$, $R'(e) = e\psi''(e) > 0$ and $R''(e) = e\psi'''(e) + \psi''(e) > 0$.

Proof. Direct by introducing (16) in $U_A^{with\ R}$. ■

The common agent' individual rationality constraint ($IR_A^{LL\ ,\ with\ R}$) can then be reformulated as follows:

$$\left(IR_A^{LL,\ conflict}\right): \quad U_{A\_BR}^{with\ R} = R(e) + \underline{t}_F + \underline{p} \geq -K \tag{18}$$

3.2.4 Program of the Investor favoring fair valuation (Principal I)

The investor P_I offers a contract ($\bar{t}_I, \underline{t}_I = 0$) maximizing his expected payoff, under the common agent's incentive constraint (16) and the acceptance by the agent of his own offer given the intrinsic regulation.

The contract is accepted if the common agent's gets a better expected utility by contracting with both principals, rather than with the Insider only, under regulatory requirements. Thus

$$U_{A\_BR}^{with\ R} \geq \underset{e\ \in\ [0,1]}{Max}\, U_{A,\{F,R\}} = (1-e) * \left(\underline{t}_F + \underline{p}\right) - \psi(e), \tag{19}$$

with the agent's best response effort given by (16).

Investor's individual rationality constraint is then $IR_I^{LL,\ conflict}$

$$\begin{array}{lll} \left(IR_I^{LL,\ conflict}\right): & \bar{t}_I - \underline{t}_F - \underline{p} > 0, & \text{if } \underline{t}_F + \underline{p} \geq 0 \\ \left(IR_I^{LL,\ conflict}\right): & IR_A^{LL\ ,\ with\ R} & \text{if } \underline{t}_F + \underline{p} < 0 \end{array} \tag{20}$$

Proof. See Appendix (5.2). ■

We notice that the Regulator's intervention facilitates the Investor' participation at the equilibrium. Indeed, the more severe the equilibrium sanction $\underline{p} < 0$ is, the more easily the investor satisfies his individual rationality constraint. Thus, as long as $\underline{t}_F + \underline{p} \geq 0$, a more severe sanction relaxes $\bar{t}_I > \underline{t}_F + \underline{p} \geq 0$. Moreover, as this condition also implies a positive effort through the agent incentive constraint (16), we can deduce that the existence of positive equilibrium effort implies that the common agent has accepted the contract ($\bar{t}_I \geq 0, \underline{t_I} = 0$) offered by the Investor.

When sanctions are so severe that $\underline{t}_F + \underline{p} < 0$, i.e. when penalties more than offset positive transfers from the Insider in case of overvaluation, the investor's contract is always accepted if the agent participates ($IR_A^{LL\ ,\ with\ R}$)[32]. In such a case, as we assumed $\bar{t}_I \geq 0$ for incomplete contracting reasons, $\bar{t}_I > \underline{t}_F + \underline{p}$ is necessarily satisfied, and equilibrium effort is positive.

To resume, finding a positive equilibrium effort entails that the investor's contract ($\bar{t}_I \geq 0, \underline{t_I} = 0$) had been accepted by the delegated agent.
The program of Principal I becomes then

$$\begin{array}{c} \left(P_I^{with\ R}\right): \quad \underset{\{\ e,\ \bar{t}_I\}}{Max} \quad U_I^{with\ R} = e * \left(\bar{S}_I - \bar{t}_I\right) \\ subject\ to\ (16)\ and\ (20) \end{array} \tag{21}$$

Lemma 3 *Given other players' equilibrium transfers ($\bar{t}_F = 0, \underline{t_F} \geq 0$) and ($\overline{p} = 0, \underline{p} \leq 0$), the Investor induces the effort e solving*

$$FOC_I^{with\ R} \begin{cases} \bar{S}_I - \bar{t}_F - \underline{p} = \psi'(e) + e.\psi'' e & if \quad \bar{S}_I - \bar{t}_F - \underline{p} \geq 0 \\ e = 0 & otherwise \end{cases} \tag{22}$$

as long as the agent accepts his contract (i.e. if $\bar{t}_I - \underline{t}_F - \underline{p} > 0$ in case of $\underline{t}_F + \underline{p} > 0$, if the agent participates in case of $\underline{t}_F + \underline{p} \leq 0$) thanks to the optimal incomplete contract ($\bar{t}_I \geq 0, \underline{t_I} = 0$) with $\bar{t}_I = \bar{S}_I - e^*.\psi''(e)$.

Proof. See Appendix (5.3) ■

3.2.5 Program of the Firm's insider favoring overvaluation (Principal F)

The Insider P_F offers a contract ($\bar{t}_F = 0, \underline{t_F}$) maximizing his expected payoff, under the common agent's incentive constraint (16) and the acceptance by the agent of his own offer given the intrinsic regulation.

The contract is accepted by the common agent if the later gets a better expected utility by contracting with both principals, rather than with the investor only, under regulatory require-

[32] We note that if the agent participates, he makes a positive effort as regard its his incentive constraint, since $\bar{t}_I - \underline{t}_F - \underline{p} \geq 0$ is guaranted by $\bar{t}_I > 0$ and $\underline{t}_F + \underline{p} < 0$).

ments. Thus

$$U_{A\_BR}^{LL,\, with\ R} \geq \underset{e\,\in\,[0,1]}{Max}\, U_{A,\{I,R\}} = e * \bar{t}_I + (1-e) * \underline{p} - \psi(e) \tag{23}$$

with the agent's effort still given by (16). We demonstrate in Appendix (5.3) that only non-negative Insider's contributions satisfy this participation constraint

$$\left(IR_F^{LL,\, with\ R}\right): \quad \underline{t}_F \geq 0 \tag{24}$$

Program of Principal F becomes then

$$\begin{array}{ll} (P_F): & \underset{\{e,\,\underline{t}_F\}}{Max} \quad U_F^{with\ R} = (1-e) * (\underline{S}_F - \underline{t}_F) \\ & \qquad \textit{subject to } (16) \textit{ and } (23) \end{array} \tag{25}$$

Lemma 4 *Given other players' equilibrium transfers* $(\bar{t}_I \geq 0, \underline{t_F} = 0)$ *and* $(\overline{p} = 0, \underline{p} \leq 0)$*, the Insider induces the effort* e *solving*

$$\underline{S}_F - \bar{t}_I + \underline{p} = -\psi'(e) + (1-e) * \psi''(e) \tag{26}$$

as long as $\underline{t}_F \geq 0 \Leftrightarrow \underline{S}_F \geq (1-e) * \psi''(e)$ *through the contract* $(\bar{t}_F = 0, \underline{t_F} \geq 0)$ *with* $\underline{t}_F = \underline{S}_F - (1-e) * \psi''(e)$*, if the following SOC is verified:*

$$\psi''(e) \geq \frac{1-e}{2} * \psi'''(e) \tag{27}$$

Proof. See Appendix (5.3). ■

3.2.6 Program of the Regulator favoring fair valuation (Principal R)

The Regulator R imposes a contract $(\bar{p} = 0, \underline{p} \leq 0)$ on the guru analyst. The cost of applying a penalty $\underline{p}$ is positive, increasing in the absolute value of the sanction, and convex. Thus $\rho:]-\infty, 0] \rightarrow]+\infty, 0]$, with $\rho' < 0$, $\rho'(0) = 0$, and $\rho'' > 0$. Inada conditions hold to guaranty interior solution ($\rho'(0) = 0$, $\rho'(-\infty) = \infty$).

The regulator is engaged in a intrinsic relationship with the common agent. His requirement has therefore to satisfy agent's global participation constraint (18), given contributions offered by other Principals. Otherwise the agent does not participate and effort is de facto nul.

The program of Principal R is then

$$(P_R): \quad \underset{\{e,\, \underline{p}\}}{Max}\,(1-e)*\left[\underline{S}_R-\rho(\underline{p})\right]$$
$$subject\ to\ (16)\ and\ (18)$$

Lemma 5 *Given other players' equilibrium transfers* $(\bar{t}_I \geq 0, \underline{t_I}=0)$ *and* $(\bar{t}_F=0, \underline{t_F}\geq 0)$*, the Regulator induces a positive effort solving*

$$\begin{aligned}&-\underline{S}_R+\rho(\bar{t}_I-\underline{t}_F-\psi'(e))+(1-e)*\psi''(e)*\rho'(\bar{t}_I-\underline{t}_F-\psi'(e))=0\\&subject\ to\ (18)\end{aligned}$$

through the contract $(\overline{p}=0, \underline{p}\leq 0)$*, if the following SOC is verified:*

$$\psi''(e)\leq\frac{1-e}{2}*\left[\psi'''(e)-\psi''(e)^2*\frac{\rho''(\bar{t}_I-\underline{t}_F-\psi'(e))}{\rho'(\bar{t}_I-\underline{t}_F-\psi'(e))}\right]$$

Proof. See Appendix (5.4) ■

To illustrate the effect of introducing a regulator, we propose to use *infra* the quadratic cost $\rho :]-\infty,0] \rightarrow]0,+\infty]\,,\ \underline{p}\rightarrow\frac{dp^2}{2}$, with $d>0$, to describe regulation costs. As a result, the couples $(\underline{p},e^*)$ satisfying the Regulator's FOC are described by the following equation:

$$\underline{p}=-(1-e)*\psi''(e)+\sqrt{(1-e)^2*\psi''(e)^2+\frac{2\underline{S_R}}{d}}$$

We then demonstrate that the regulator does not accept equilibrium effort inferior to $e_{\min}$, which increases with the social cost of overvaluation ($\searrow \underline{S_R}$), and decreases with the regulation implementing cost ($\nearrow d$).

Proof. See Appendix 5.4.2 ■

3.2.7 Conflicts of interest outcome when a regulator watches over fair valuation

As $\psi'' > 0$, $\rho' < 0$ and $\rho'' \geq 0$, Insider's and Regulator's SOC are compatible and e must satisfy following SOC:

$$\underbrace{0 \leq}_{SOC_F} \psi''(e) - \frac{1-e}{2}\psi''' \leq \underbrace{\frac{1-e}{2} * \psi''(e)^2 * \frac{\rho''(\left[\bar{S}_I - e.\psi''(e)\right] - Max\left[\underline{S}_F - (1-e).\psi''(e)\ ,0\right] - \psi'(e))}{-\rho'(\left[\bar{S}_I - e.\psi''(e)\right] - Max\left[\underline{S}_F - (1-e).\psi''(e)\ ,0\right] - \psi'(e))}}_{SOC_R}$$

Example 6 *For instance, both SOC are satisfied* $\forall e \in [0,1]$ *for* $\rho(e)$ *a quadratic cost function, with* $\psi(e) = e * \ln(1-e)$ *or* $\psi(e) = \frac{(1-e)}{2} * H(e)$ *with* $H(e)$ *the classical entropy function measuring the cost of information.*

Proposition 7 *The unique perfect Nash equilibrium* e_R^* *solves:*

$$\begin{aligned}\underline{S}_R = &\ \rho\left(\left[\bar{S}_I - e_R^*.\psi''(e_R^*)\right] - Max\left[\underline{S}_F - (1-e_R^*).\psi''(e_R^*)\ ,0\right] - \psi'(e_R^*)\right) \\ &+ (1-e_R^*).\psi''(e_R^*).\rho'\left(\left[\bar{S}_I - e_R^*.\psi''(e_R^*)\right] - Max\left[\underline{S}_F - (1-e_R^*).\psi''(e_R^*)\ ,0\right] - \psi'(e_R^*)\right)\end{aligned}$$

and exceeds e^**, the unique perfect Nash equilibrium of the game without Regulator.*

Proof. See Appendix (5.5) ■

This result draws our attention on two main points.

First, the shape of the regulator's cost $\rho(\cdot)$ necessary to implement the regulation, and the social cost $\underline{S}_R$ of overvaluation ($\underline{S}_R \leq 0$), are determining as regards the conflict-of-interest outcome. The smaller the regulation implementing cost is, and/or the greater the social cost of overvaluation is, the smaller is the risk of overvaluation. Moreover, in the presence of regulation implementing costs, the Regulator is not constrained by the agent's global participation constraint. Indeed, since the agent is penalized in only one of both states, implementing the penalty necessary to violate the agent's global individual rationality constraint would be to costly $(\rho(\cdot)'' > 0)$[33]. However, if regulation was freely implemented, the Regulator would have to care not to prevent the agent from playing. In such a case, regulation would have the opposite

[33] All the more so because the regulator free-rides on the positive incentives given the investor to cut proceedings costs.

effect that the expected one. Indeed, without research, overvaluation would be certain.

Example 8 *To derive illustrative closed-form solutions, we use quadratic costs and focus on interior solutions. We assume* $\rho(\underline{p}) = \frac{d}{2}\underline{p}^2$ *and* $\psi(e) = \frac{c}{2}e^2$*. Consequently* e_R^* *solves a second order polynomial. One of its real positive root satisfies the common agent participation constraint, the other not. The equilibrium effort is then*

$$e_R^* = \frac{14\,c + 8\,\overline{\delta} - 2\sqrt{4.c.(c-\overline{\delta}) + \overline{\delta}^2 + \frac{30}{d}\underline{S}_R}}{30c} \tag{28}$$

This solution notably allows to illustrate the impact of regulation-implementation cost (d). Indeed, as $\underline{S}_R \leq 0$*, an increase in implementation costs d reduces* e_R^**. Moreover, we note that the more damaging overvaluation is (*$\underline{S}_R \leq 0$*), the higher the effort (notably induced by the regulation) is.*

Second, whether environment parameters are such that fair valuation is more appreciated by the Regulator that the Investor, we demonstrate that the latter intervenes less often than in the absence of the Regulator. Indeed, Regulator's intervention implies free-riding within the group favoring fair valuation. However, if this should or should not be the case, insiders are no more able to rule out investors at the equilibrium. Regulation prevents market valuation not to reflect long-term investors's preferences for fair valuation.

3.3 Results

Thanks to a common agency game under moral, we study the impact of financial interests' horizon on the sell-research inherent conflict of interest outcome as regards underpricing via overvluation in "hot" IPOs markets.

3.3.1 In the absence of coercive regulation.

At the first best (merged principals, no hidden action), in the absence of regulator, the guru analyst's optimal social effort is logically positive if and only if the preference for fair valuation of the representative informed investor exceeds the preference for overvaluation of issuing firm's insiders. The risk of initial market overvaluation is thus all the more serious that the prospect of short/mid-term performance due to underpricing via overvaluation prevail against the prospect of long-term underperformance.

At the second best, the informed long-term investor and the insiders compete through binding promises of business relationships continuation, conditional on ex-post market valuation (delegated common agency). According to the relative extent of the potential profit the bank gets by acting to the advantage of one of its both client groups, the guru will favor one Principal over the other. And since the bank's potential income provided by principals directly depends on their expected potential gains obtained by influencing the agent, the relative importance of these potential gains is determinant as regards the issue of the conflict of interests. The more money is long-term invested, the less likely is IPO initial overvaluation.

When the investor's preference for fair valuation does not exceed excessively the insiders' preference for overvaluation, both principals intervene at equilibrium, the countervailing power of insiders acting like a brake to fair valuation supported by the informed investor contribution. The more potential fees from underwriting (insiders) exceeds brokerage commissions (investor), the more the bank is strongly incited to favor issuers over investors, and the more the guru distorts the market equilibrium to please issuers. At the contrary, it could be not worth insiders' while to try to influence the guru when his preference for overvaluation does not exceed the marginal agency cost to pay to the agent (opposite polar case).

We thus demonstrate that the risk of overvaluation is either smaller or bigger than the first best risk, according to relative preferences of both conflicting clients. Indeed, at the first best, principals' merger guaranty that preferences of each principal are taking into account at the equilibrium. However, at the second best, depending on whether the representative insider endogenously considers his participation worthy or not, the latter does or not counteract pro-effort incentives given by the investor. If the insider does not favor sufficiently overvaluation (relatively to the informed investor's preferences for fair valuation) to participate, the overvaluation risk drops, i.e. the equilibrium effort rises, despite the introduction of agency costs. In such a case, coercive regulation is not required to protect uniformed investors since sufficient money is long-term invested. However, if the insider favors sufficiently overvaluation (relatively to the informed investor's preferences for fair valuation) to participate, agency costs induce a rise in the overvaluation risk: attention paid to short/mid-term performance handicaps IPOs' long-term performance In such a case, we face the issue of protecting the representative unsophisticated investor with bounded rationality (representing naive uniformed retail investors), victim of blindly following the guru's biased recommendations.

3.3.2 Introduction of a coercive regulation.

We consequently introduce a third principal implementing a natural penalizing regulation, based on costly judicial proceedings in case of initial overvaluation. The bank is then simultaneously engaged in a delegated agency relationship with the insider and the informed long-term investor, and a intrinsic relationship with the regulator, whose regulation cannot be refused without refusing all contracts. We then demonstrate that 1) the overvaluation risk is always smaller as a Regulator participates to this " market pricing game ", and 2) the smaller the regulation implementing cost is, and/or the greater the social cost of initial overvaluation is, the smaller is the equilibrium risk of overvaluation. Protection of unsophisticated investors extols then the virtues of penalizing regulations, even if the latter entail free-riding behaviors among fair-valuation partisans.

4 Conclusion

Conflicts of interests are the inherent price to pay to benefit from information synergies, allowed by multiple-financial-services firms. We focus on conflicts of interests faced by sell-side analysts in the area of research and underwriting as firms are going public in a hot IPOs market context. In the framework of a delegated common agency under moral hazard, we analyze the impact of environment variables on conflicts outcome as regards IPOs market initial valuation. When the potential fees from underwriting greatly exceed brokerage commissions, we show that research team has such a strong incentive to favor issuers over investors, that the latter prefer not to recourse to research and market overvaluation predominates. However, the introduction of a regulator, allowed to penalize banks, greatly tempers damaging conflicts-of-interests outcomes as regards market valuation, even if it introduced free riding among actors favoring fair valuation.

Our results rely on the key assumption that unsophisticated retail investors are unable to de-biased firms' gross information and sell-side research guru analyst. Following [Miller, 1977]'s hypothesis and subsequent empirical supporting findings, naive investors' amateurism gives thus influence on price to the guru. As a result, besides banks's desire to maintain and build their reputation, or legal sanctions, present policy aiming at educating retail investors should mitigate conflicts of interest impact when some banks choose to take the risk to exploit conflicts, despite risks on reputation and legal sanctions. An interesting extension would be to accurately model the bank's trade-off as regards short-term profit of exploiting conflicts, legal or/and reputation risks and ability to investors to be-biased recommendations. This question awaits for further research.

5 Appendix

5.1 Incomplete contracting without regulator

This case is a particular and much simpler case that "incomplete contracting with a Regulator". Proofs as regards the determination of the equilibrium condition are direct by eliminating all references to the regulator in following proofs.

We only propose to demonstrate the existence and uniqueness of the perfect Nash equilibrium solving the following equation:

$$f(e^*) = \bar{S}_I - e^*.\psi^{''}(e^*) - Max\left[\underline{S}_F - (1-e^*).\psi^{''}(e^*)\ ,0\right] - \psi'(e^*) = 0.$$

By assumption, $e \in [0,1]$. We shall then demonstrate that f has a unique root on $[0,1]$. First we remind that our previous assumptions on ψ imply that, $\forall e \in [0,1]$, $(1-e).\psi^{''}(e)$ is increasing with e[34], and $\lim_{e\to 1^-} (1-e).\psi^{''}(e) = \infty$. As a consequence, if $\underline{S}_F \leq \psi^{''}(0)$, $\forall e \in [0,1]$, $Max\left[\underline{S}_F - (1-e^*).\psi^{''}(e^*)\ ,0\right] = 0$ and $f'(e) = \bar{S}_I - e^*.\psi^{''}(e^*) - \psi'(e^*)$. Then, as $f(0) = \bar{S}_I \geq 0$, $\lim_{e\to 1^-} f(e) = -\infty$, and f monotonously decreasing, there is a unique Nash equilibrium.

If $\underline{S}_F > \psi^{''}(0)$, $f(e) = (\bar{S}_I - \underline{S}_F) + (1-2e^*).\psi^{''}(e^*) - \psi'(e^*)$ as long as $\underline{S}_F - (1-e^*).\psi^{''}(e^*) > 0$, i.e. as long as $e < e_{threshold}$, and $f(e) = \bar{S}_I - e^*.\psi^{''}(e^*) - \psi'(e^*)$ otherwise. Consequently,

[34] in other words: $\frac{\partial}{\partial e}(1-e).\psi^{''}(e) = -\psi^{''}(e) + (1-e) * \psi^{'''}(e) < 0$.

$\forall e < e_{threshold}$, $f'(e) = (1-2e^*).\psi'''(e^*) - 3\psi''(e^*)$, and $f'(e) = -2.\psi''(e^*) - e.\psi'''(e^*) < 0$ otherwise. Thus f is potentially increasing for e small but is necessarily decreasing for $e > \frac{1}{2}$, even if $\frac{1}{2} < e_{threshold}$, since $\forall e > \frac{1}{2}$, $(1-2e^*).\psi'''(e^*) < 0$. Then, if $f(0) = \bar{S}_I - \underline{S}_F + \psi''(0) \geq 0$, there exists necessarily a unique Nash equilibrium since $f(0) \geq 0$, f is potentially increasing for e small and necessarily decreasing for $e \geq \frac{1}{2}$ and $\lim_{e \to 1^-} f(e) = -\infty$. If $f(0) = \bar{S}_I - \underline{S}_F + \psi''(0) < 0$, it depends on the absolute value of $f(0)$ and on the relative shapes of ψ'' and ψ''' that play on the potential increasing part of f for e small. Generally speaking, three cases are possible: no root, one unique root or two roots. We restrict ourself to parameters value such as $f(0) \geq 0$ to avoid this discussion that requires to define ψ.

5.2 Investor's program when a regulator intervenes

5.2.1 Participation constraint

We demonstrate that $U_{BR}^{LL,\ with\ R} \geq \underset{e\ \in\ [0,1]}{Max} U_{\{F,R\}} = (1-e) * \left(\underline{t}_F + \underline{p}\right) - \psi(e)$ is equivalent to

$$\begin{cases} \left(IR_I^{LL,\ conflict}\right): & \bar{t}_I - \underline{t}_F - \underline{p} > 0, \quad \text{if } \underline{t}_F + \underline{p} \geq 0 \\ \left(IR_I^{LL,\ conflict}\right): & IR_A^{LL\ ,\ with\ R} \qquad \text{if } \underline{t}_F + \underline{p} < 0 \end{cases} \tag{29}$$

In a first time, we must determine the value of the r.h.s. of the inequality. In a second time, we solve the inequatity.

If $\underline{t}_F + \underline{p} > 0$, $U_{\{F,R\}}$ is decreasing in e, and $e^* = \arg \underset{e\ \in\ [0,1]}{Max} U_{\{F,R\}} = (1-e) * \left(\underline{t}_F + \underline{p}\right) - \psi(e) = 0$. Therefore $U_{BR}^{LL,\ with\ R} \geq \underline{t}_F + \underline{p} \Leftrightarrow R(e) \geq 0 \Leftrightarrow e \geq 0 \Leftrightarrow \bar{t}_I - \underline{t}_F - \underline{p} > 0$ because of (16).

If $\underline{t}_F + \underline{p} < 0$, $U_{\{F,R\}} = (1-e) * \left(\underline{t}_F + \underline{p}\right) - \psi(e) \leq 0$. Investor's participation constraint is then satisfied if $U_{BR}^{LL,\ with\ R} \geq 0$ (sufficient condition), i.e. if agent's participation constraint holds (18).

5.2.2 The Investor's program

Optimal induced effort is obtained by taking the FOC of the concave combination of the agent's incentive constraint (16) and the investor's expected payoff $U_I^{with\ R} e * \left(\bar{S}_I - \bar{t}_I\right)$.

$$\begin{array}{lll}\left(P_I^{with\ R}\right)' & : & \underset{e}{Max} \quad V_I^{with\ R} = e * \left(\bar{S}_I - \underline{t}_F - \underline{p} - \psi'(e)\right) \\ FOC_I^{with\ R} & : & \frac{\partial}{\partial e} V_I^{with\ R} = 0 \Leftrightarrow \psi'(e) + e\psi''(e) = \bar{S}_I - \underline{t}_F - \underline{p} \\ SOC_I^{with\ R} & : & \frac{\partial^2}{\partial e^2} V_I^{with\ R} \leq 0 \Leftrightarrow -2\psi''(e) - e\psi'''(e) \leq 0\end{array}$$

As $\forall e \in [0,1]$, $\psi''(e) \geq 0$ and $\psi'''(e) \geq 0$, the SOC is always satisfied.

Since $\forall e \in [0,1]$, $\psi'(e) + e\psi''(e) \geq 0$, we note that the investor induces a positive effort as long as $\bar{S}_I - \underline{t}_F - \underline{p} \geq 0$.

Combining the investor's FOC and the agent's incentive constraint (16), it comes

$$\left\{\begin{array}{ll} FOC_I^{with\ R}: & \bar{S}_I - e\psi''(e) = \underline{t}_F + p + \psi'(e) \\ FOC_A^{with\ R}: & \bar{t}_I = \underline{t}_F + \underline{p} + \psi'(e). \end{array}\right. \Leftrightarrow \bar{t}_I^* = \bar{S}_I - e^*\psi''(e^*) \tag{30}$$

5.3 Insider's program when a regulator intervenes

Remark 9 MeanValueTheorem
If f is continuous on $[a, b]$ and differentiable on $]a, b[$, then there exists a number c in $]a, b[$ such that

$$f(b) - f(a) = f'(c) * (b - a) \tag{31}$$

Notation 10 *We note $\phi = \psi'^{-1}$ and $R(e) = e * \psi'(e) - \psi(e)$. $R(e)$. $R(e)$ is positive, increasing and convex since $R(0) = 0$, $R'(e) = e\psi''(e) > 0$ and $R''(e) = e\psi'''(e) + \psi''(e) > 0$.*

Lemma 11 *We show that $\frac{\partial}{\partial x} R(\phi(x)) = \phi(x) \in [0,1]$*

Proof. $R(\phi(x)) = \phi(x) * \psi'(\phi(x)) - \psi(\phi(x))$
Then $\frac{\partial}{\partial x} R(\phi(x)) = \phi'(x) * \psi'(\phi(x)) + \phi(x) * \phi'(x) * \psi''(\phi(x)) - \phi'(x) * \psi'(\phi(x)) = \phi(x) * \phi'(x) * \psi''(\phi(x))$.
First, $\phi(x) = \psi'^{-1}(x) \Leftrightarrow \psi'(\phi(x)) = x$, so that $\psi''(\phi(x)) = \phi'(x) * \psi''(\phi(x)) = 1$. Thus

$\psi''\left(\phi(x)\right) = \frac{1}{\phi'(x)}$. It follows:

$$R'(\phi(x)) = \frac{\partial}{\partial x}R(\phi(x)) = \phi(x) * \phi'(x) * \psi''\left(\phi(x)\right) = \phi(x) * \phi'(x) * \frac{1}{\phi'(x)} = \phi(x). \tag{32}$$

Second, as $\psi' = [0, 1[\rightarrow [0, +\infty[$, then $\phi = \psi'^{\,-1} : [0, +\infty[\rightarrow [0, 1[$. Then $0 \leq \phi(x) < 1$. ■

5.3.1 Insider's participation constraint

We shall demonstrate that the participation constraint $U_{BR}^{LL,\, with\ R} \geq \underset{e\,\in\,[0,1]}{Max}\, U_{A,\{I,R\}} = e * \bar{t}_I + (1-e) * \underline{p} - \psi\left(e\right)$ is equivalent to $\underline{t}_F \geq 0$.

Using the notation $\phi = \psi'^{\,-1}$, it comes

$$U_{BR}^{LL,\, with\ R} \geq \underset{e\,\in\,[0,1]}{Max}\, U_{A,\{I,R\}} = e*\bar{t}_I + (1-e)*\underline{p} - \psi\left(e\right) \Leftrightarrow \underline{t}_F + R(\phi(\bar{t}_I - \underline{t}_F - \underline{p})) \geq R(\phi(\bar{t}_I - \underline{p})). \tag{33}$$

Let suppose $t_F \leq 0$**.** If $\underline{t}_F \leq 0$, then $\bar{t}_I - \underline{t}_F - \underline{p} > \bar{t}_I - \underline{p} > 0$. As $R(\phi(x))$ is continuous and differentiable on $[\bar{t}_I - \underline{p}\,,\, \bar{t}_I - \underline{t}_F - \underline{p}]$, according to the Mean-Value theorem (31), there exists a number c in $[\bar{t}_I - \underline{p}\,, \bar{t}_I - \underline{t}_F - \underline{p}]$ such that

$$\begin{aligned}
(33) \quad &\Leftrightarrow \quad R(\phi(\left[\bar{t}_I - \underline{t}_F - \underline{p}\right])) - R(\phi(\left[\bar{t}_I - \underline{p}\right])) = R'(\phi(c)) * \left(\left[\bar{t}_I - \underline{t}_F - \underline{p}\right] - \left[\bar{t}_I - \underline{p}\right]\right) \\
&\Leftrightarrow \quad R(\phi(\left[\bar{t}_I - \underline{p}\right])) - R(\phi(\left[\bar{t}_I - \underline{t}_F - \underline{p}\right])) = R'(\phi(c)) * \underline{t}_F
\end{aligned} \tag{34}$$

Using lemma (11), $\underline{t}_F \leq 0$, and the fact that $R(\phi(x)$ is increasing since (11), (34) entails:

$$R(\phi(\left[\bar{t}_I - \underline{p}\right])) - R(\phi(\left[\bar{t}_I - \underline{t}_F - \underline{p}\right])) \geq \underline{t}_F \Leftrightarrow \underline{t}_F + R(\phi(\left[\bar{t}_I - \underline{t}_F - \underline{p}\right])) \leq R(\phi(\left[\bar{t}_I - \underline{p}\right])) \tag{35}$$

This later inequality is in contradiction with (33). Thus $\underline{t}_F \leq 0$ does not satisfy the insider's participation constraint.

Let suppose $t_F \geq 0$**.** If $t_F \geq 0$, then $0 < \bar{t}_I - \underline{t}_F - \underline{p} < \bar{t}_I - \underline{p}$. As $R(\phi(x))$ is continuous and differentiable on $[\bar{t}_I - \underline{t}_F - \underline{p}\,,\, \bar{t}_I - \underline{p}]$, according to the Mean-Value theorem (31), there exists a number c in $[\bar{t}_I - \underline{t}_F - \underline{p}\,,\, \bar{t}_I - \underline{p}]$ such that

$$\begin{aligned} (33) \quad &\Leftrightarrow \quad R(\phi(\left[\bar{t}_I - \underline{p}\right])) - R(\phi(\left[\bar{t}_I - \underline{t}_F - \underline{p}\right])) = R'(\phi(c)) * \left(\left[\bar{t}_I - \underline{p}\right] - \left[\bar{t}_I - \underline{t}_F - \underline{p}\right]\right) \\ &\Leftrightarrow \quad R(\phi(\left[\bar{t}_I - \underline{p}\right])) - R(\phi(\left[\bar{t}_I - \underline{t}_F - \underline{p}\right])) = R'(\phi(c)) * \underline{t}_F \end{aligned} \tag{36}$$

Using lemma (11), $\underline{t}_F \geq 0$, and the fact that $R(\phi(x)$ is increasing since (11), (34) entails:

$$R(\phi(\left[\bar{t}_I - \underline{p}\right])) - R(\phi(\left[\bar{t}_I - \underline{t}_F - \underline{p}\right])) \leq \underline{t}_F \Leftrightarrow \underline{t}_F + R(\phi(\left[\bar{t}_I - \underline{t}_F - \underline{p}\right])) \geq R(\phi(\left[\bar{t}_I - \underline{p}\right])) \tag{37}$$

Thus (33) is always satisfied if $\underline{t}_F \geq 0$. Consequently,

$$U_{A\_BR}^{LL,\, with\ R} \geq \underset{e \,\in\, [0,1]}{Max}\, U_{A,\{I,R\}} \Leftrightarrow \underline{t}_F \geq 0 \tag{38}$$

5.3.2 Insider's program

Optimal induced effort is obtained by taking the FOC of the program of the Insider maximizing its expected payoff $(1-e) * (\underline{S}_F - \underline{t}_F)$, given others' optimal transfers $\bar{t}_I$ and $\underline{p}$, when the Agent responds optimally to incitations (16). We shall verify ex-post the insider's participation constraint (23).

$$\begin{aligned} (P_F') : \quad &\underset{\{e,\, \underline{t}_F\}}{Max}\, U_F^{with\ R} = (1-e) * (\underline{S}_F - \underline{t}_F) \\ &subject\ to\ (16) : \quad \bar{t}_I - \underline{t}_F - \underline{p} = \psi'(e) \end{aligned} \tag{39}$$

By substitution, it comes

$$\underset{e}{Max} \quad V_F^{with\ R} = (1-e) * \left(\underline{S}_F - \bar{t}_I + \underline{p} + \psi'(e)\right) \tag{40}$$

This program has to be concave in order to use the first order approach.

$$\frac{\partial V_F^{with\ R}}{\partial e^2} = (1-e) * \psi'''(e) - 2\psi''(e) \leq 0 \Leftrightarrow \psi''(e) \geq \frac{1-e}{2}\psi'''(e) \tag{41}$$

We must therefore verify that equilibrium effort satisfies $\psi''(e) \geq \frac{1-e}{2}\psi'''(e)$.

In such cases, the FOC implies

$$\underline{S}_F - \bar{t}_I + \underline{p} = -\psi'(e) + (1-e) * \psi''(e) \tag{42}$$

as long as the participation constraint is satisfied ($\underline{t}_F^* \geq 0 \Leftrightarrow \underline{S}_F \geq (1-e^*) * \psi''(e^*)$) and the program is concave in e ($\psi''(e^*) \geq \frac{1-e^*}{2}\psi'''(e^*)$). Whereas the latter condition is easily satisfied, the former one determines whether the insider will or not give incentives to the agent to support overvaluation..

Finally, by injecting FOC in (16), we get the insider's optimal transfer.

$$\underline{t}_F^* = \underline{S}_F - (1-e^*).\psi''(e^*) \text{ as long as } \underline{t}_F \geq 0, \text{ 0 otherwise (not active at equilibrium).} \tag{43}$$

Remark 12 *The fact that ψ must simultaneously verify Inada conditions (more specially $\lim_{e\to 1}\psi'(e) = +\infty$), and the Insider's SOC, limits the number of potential functions. We observe however that $\lim_{e\to 1}\frac{1-e}{2} = 0$, facilitating $\psi''(e) \geq \frac{1-e}{2}\psi'''(e)$ for e sufficiently high. For instance, the function $\psi(e) = -e * ln(1-e)$ meets all conditions required in this paper.*
By dropping Inada conditions at $e = 1$, and focussing on inner solution, we enlarge noticeably the domain of potential functions and we allow more particularly quadratic cost functions.

5.4 Regulator's program

5.4.1 Program

$$\underset{\{e,\, \underline{p}\}}{Max} \quad U_R = (1-e) * \left[\underline{S}_R - \rho(\underline{p})\right] \tag{44}$$

$$subject\ to:$$

$$\begin{cases} (IC_A^{with\ R}): & \bar{t}_I - \underline{t}_F - \psi'(e) = \underline{p} \\ (IR_A^{LL,with\ R}): & V_R = (1-e) * \underline{S}_R - (1-e) * \rho(\bar{t}_I - \underline{t}_F - \psi'(e)) \geq -K \end{cases} \tag{45}$$

We shall verify $(IR_A^{LL,with\ R})$ ex-post. After substitution of $(IC_A^{with\ R})$ for $\underline{p}$ in U_R according to the first order approach, we determine the optimal level of effort as regard the Regulator's preferences by the FOC:

$$V\,'_R = \frac{\partial V_R}{\partial e} = 0 \Leftrightarrow -\underline{S}_R + \rho(\bar{t}_I - \underline{t}_F - \psi'(e)) + (1-e) * \psi''(e) * \rho'(\bar{t}_I - \underline{t}_F - \psi'(e)) = 0. \quad (46)$$

To be concave in e, the Regulator's program must satisfy the following CSO condition:

$$\begin{aligned} V\,''_R = \frac{\partial^2 V_R}{\partial e^2} \leq 0 \Leftrightarrow & -2 * \psi''(e) * \rho'(\bar{t}_I - \underline{t}_F - \psi'(e)) \\ & + (1-e) * \left[\psi'''(e) * \rho'(\bar{t}_I - \underline{t}_F - \psi'(e)) - \psi''(e)^2 * \rho''(\bar{t}_I - \underline{t}_F - \psi'(e))\right] \leq 0 \end{aligned}$$

The Regulator's program is concave if and only if

$$\psi''(e) < \frac{1-e}{2} * \left[\psi'''(e) - \psi''(e)^2 * \frac{\rho''(\bar{t}_I - \underline{t}_F - \psi'(e))}{\rho'(\bar{t}_I - \underline{t}_F - \psi'(e))}\right] \quad (47)$$

5.4.2 Illustration

For tractability reasons, we propose to use *infra* the quadratic cost $\rho :]-\infty, 0] \to]0, +\infty]$, $\underline{p} \to \frac{dp^2}{2}$, with $d > 0$, to describe regulation costs. As a result, the couples $(\underline{p}, e^*)$ satisfying the Regulator's FOC are described by the following second-order polynomial in $\underline{p}$:

$$\underline{p}^2 + 2(1-e).\psi''(e).p - \frac{\underline{\underline{S_R}}}{d} = 0.$$

Let determine the sign of the determinant, i.e. the sign of $\Delta(e) = (1-e)^2 * \psi''(e)^2 + \frac{2\underline{\underline{S_R}}}{d}$.

By hypothesis, $\frac{2\underline{\underline{S_R}}}{d} \leq 0$. Moreover, by posing $f(e) = (1-e)^2 * \psi''(e)^2$, we get $f'(e) = (1-e).\psi''(e) * \left[-\psi''(e) + (1-e).\psi'''(e)\right]$. By assuming that, $\forall e \in [0,1]$, ψ verifies $-\psi''(e) + (1-e).\psi'''(e) \geq 0$ and $\lim_{e \to 1^-} -\psi''(e) + (1-e).\psi'''(e) = +\infty$, we get, $\forall e \in [0,1]$, $f(e) \geq 0$, since $f(0) = 0$, and $f'(e) \geq 0$. Moreover, since $\frac{2\underline{\underline{S_R}}}{d} \leq 0$ and $\lim_{e \to 1^-} -\psi''(e) + (1-e).\psi'''(e) = +\infty$ entailing $\lim_{e \to 1^-} f(e) = +\infty$, $\exists!\, e_{\min}$ solving $\Delta(e) = (1-e_{\min})^2 * \psi''(e_{\min})^2 + \frac{2\underline{\underline{S_R}}}{d} = 0$. Because of $\frac{2\underline{\underline{S_R}}}{d} \leq 0$, it is straightforward that $e_{\min}$ increases with the social cost of overvaluation ($\searrow \underline{\underline{S_R}}$)

and decreases with the regulation implementing cost ($\nearrow d$). Thus, $\forall e > e_{\min}$, $\Delta(e) > 0$ and we find both following real roots:

$$\underline{p} = -(1-e) * \psi''(e) \pm \sqrt{(1-e)^2 * \psi''(e)^2 + \frac{2\underline{S_R}}{d}}$$

Let write $\underline{p}_1 = -(1-e) * \psi''(e) + \sqrt{(1-e)^2 * \psi''(e)^2 + \frac{2\underline{S_R}}{d}}$ and $\underline{p}_2 = -(1-e) * \psi''(e) - \sqrt{(1-e)^2 * \psi''(e)^2 + \frac{2\underline{S_R}}{d}}$.

By noticing that $\lim\limits_{e \to 1^-} \underline{p}_1 = 0$, $\lim\limits_{e \to 1^-} \underline{p}_2 = -\infty$, $e \geq e_{\min} \geq 0$ and $\underline{p}(e_{\min}) = -(1-e)*\psi''(e) < 0$, we get the general shape of the optimal relation between $\underline{p}$ and e[35].

As the Regulator does not profit financially from the penalty, but indirectly through its impact on the equilibrium effort, and that implementing a penalty is costly, the Regulator chooses $\underline{p}$ according to $\underline{p}_1(e)$, since $\forall e > e_{\min}$, $0 > \underline{p}_1(e) > \underline{p}_2(e)$. We also notice that using $\underline{p}_1(e)$ to determine the equilibrium effort facilitates the satisfaction of the Regulator's CSO ($\psi''(e) \leq \frac{1-e}{2} * \left[\psi'''(e) - \psi''(e)^2 * \frac{1}{\underline{p}}\right]$ with $\rho(\underline{p})$ quadratic). Indeed, as $0 > \underline{p}_1(e) > \underline{p}_2(e)$, then $-\frac{1}{\underline{p}_1(e)} > -\frac{1}{\underline{p}_2(e)}$ and $\frac{1-e}{2} * \left[\psi'''(e) - \psi''(e)^2 * \frac{1}{\underline{p}_2}\right] \leq \frac{1-e}{2} * \left[\psi'''(e) - \psi''(e)^2 * \frac{1}{\underline{p}_1}\right]$.

5.5 Proof of Proposition 2

If a perfect Nash equilibrium exists, it solves simultaneously all Principals' FOC, given the Common Agent Incentive Constraint:

$$\begin{cases} FOC_I^{with\ R}: & \bar{t}_I = \bar{S}_I - e_R^*.\psi''(e_R^*) \\ FOC_F^{with\ R}: & \underline{t}_F = \max\left[\underline{S}_F - (1-e_R^*).\psi''(e_R^*), 0\right] \\ FOC_R^{with\ R}: & -\underline{S}_R + \rho(\underline{p}) + (1-e_R^*).\psi''(e_R^*).\rho'(\underline{p}) = 0 \end{cases}$$
$$given \quad FOC_A^{with\ R}: \quad \bar{t}_I - \underline{t}_F - \underline{p} = \psi'(e_R^*)$$

[35]The equilibrium effort naturally results from all principals' incitations.

By substitution, we get:

$$g(e_R^*) = -\underline{S}_R + \rho(\bar{S}_I - e_R^*\psi''(e_R^*) - \max\left[\underline{S}_F - (1-e_R^*).\psi''(e_R^*), 0\right] - \psi'(e_R^*))$$
$$+ (1-e_R^*).\psi''(e_R^*).\rho'(\bar{S}_I - e_R^*\psi''(e_R^*) - \max\left[\underline{S}_F - (1-e_R^*).\psi''(e_R^*), 0\right] - \psi'(e_R^*)) = 0$$

Can we found $e_R^* \in [0,1]$ solving $g(e_R^*) = 0$ and satisfying simultaneously the second order conditions and the agent's individual rationality constraint?

5.5.1 First, we determine necessary conditions such as $\exists!\ e_R^* \mid g(e_R^*) = 0$, with $g(e_R^*)$ the previous piecewise function.

$$\begin{aligned} g'(e_R^*) &= \frac{\partial g(e_R^*)}{\partial e^*} = \rho'(f(e_R^*)) * \left[f'(e_R^*) + (1-e_R^*).\psi'''(e_R^*) - \psi''(e_R^*)\right] + \rho''(f(e_R^*)) * f'(e_R^*) * (1-e_R^*).\psi''(e_R^* \\ \text{with}\quad f(e_R^*) &= \bar{S}_I - e_R^*\psi''(e_R^*) - \max\left[\underline{S}_F - (1-e_R^*).\psi''(e_R^*), 0\right] - \psi'(e_R^*) \end{aligned}$$

We emphasize that $f(e_R^*)$ is the penalty that the regulator has to implement so that the common agent plays e_R^* as the rational investor's and the rational insider's payoffs are $\bar{S}_I$ and $\underline{S}_F$.

Let note $e_{threshold}$ the effort solving $\underline{S}_F - (1-e_{threshold}).\psi''(e_{threshold}) = 0$.

Case 1 If $e_R^* > e_{threshold}$, then $\underline{S}_F - (1-e_R^*).\psi''(e_R^*) \leq 0$ and $\max\left[\underline{S}_F - (1-e_R^*).\psi''(e_R^*), 0\right] = 0$. Consequently:

$$f(e_R^*) = f^{\,+}(e_R^*) = \bar{S}_I - e_R^*\psi''(e_R^*) - \psi'(e_R^*) \quad \text{and} \quad f'(e_R^*) = f^{\,+\,\prime}(e_R^*) = -e_R^*\psi'''(e_R^*) - 2\psi''(e_R^*).$$

$$\begin{aligned} \forall e_R^* &> e_{threshold}, \\ f^{\,+}(e_R^*) &\leq 0 \quad if \quad \bar{S}_I \leq e_R^*\psi''(e_R^*) + \psi'(e_R^*) \quad \text{and} \quad \lim_{e\to 1^-} f^{\,+}(e_R^*) = -\infty \\ f^{\,+\,\prime}(e_R^*) &\leq 0 \quad \text{and} \quad \lim_{e\to 1^-} f^{\,+\,\prime}(e_R^*) = -\infty \end{aligned}$$

Developed form:

$$
\begin{aligned}
g^{+}(e_R^*) &= -\underline{S}_R+\rho(\bar{S}_I-e_R^*\psi''(e_R^*)-\psi'(e_R^*))+(1-e_R^*)\,.\psi''(e_R^*)\,.\rho'(\bar{S}_I-e_R^*\psi''(e_R^*)-\psi'(e_R^*))=0.\\
g^{+\prime}(e_R^*) &= \tfrac{\partial g^{+}(e_R^*)}{\partial e^*}= \begin{array}{l}\rho'(\bar{S}_I-e_R^*\psi''(e_R^*)-\psi'(e_R^*))*\left[(1-2e^*)\psi'''(e_R^*)-3\psi''(e_R^*)\right]\\ \quad+\rho''(\bar{S}_I-e_R^*\psi''(e_R^*)-\psi'(e_R^*))*\left[-2\psi''(e_R^*)-e_R^*\psi'''(e_R^*)\right]*(1-e_R^*)\,.\psi''(e_R^*)\end{array}
\end{aligned}
$$

Assuming $\rho:\underline{p}\rightarrow\frac{dp^2}{2}$, it comes:

$$
\begin{aligned}
g^{+}(e_R^*) &= -\underline{S}_R+\frac{d}{2}\left[\bar{S}_I-e_R^*\psi''(e_R^*)-\psi'(e_R^*)\right]^2+(1-e_R^*)\,.\psi''(e_R^*)*d.\left[\bar{S}_I-e_R^*\psi''(e_R^*)-\psi'(e_R^*)\right]=0.\\
g^{+\prime}(e_R^*) &= \tfrac{\partial g^{+}(e_R^*)}{\partial e^*}= \begin{array}{l}d*\left[\bar{S}_I-e_R^*\psi''(e_R^*)-\psi'(e_R^*)\right]*\left[(1-2e^*)\psi'''(e_R^*)-3\psi''(e_R^*)\right]\\ \quad+d*\left[-2\psi''(e_R^*)-e_R^*\psi'''(e_R^*)\right]*(1-e_R^*)\,.\psi''(e_R^*)\end{array}
\end{aligned}
$$

Case 2 If $e_R^*<e_{threshold}$, then $\underline{S}_F-(1-e_R^*).\psi''(e_R^*)>0$, and $\max\left[\underline{S}_F-(1-e_R^*).\psi''(e_R^*),0\right]=\underline{S}_F-(1-e_R^*).\psi''(e_R^*)$. Consequently:

$$
\begin{aligned}
f(e_R^*) &= f^{\,-}(e_R^*)=\bar{S}_I-\underline{S}_F+(1-2e^*)\,\psi''(e_R^*)-\psi'(e_R^*)\\
\text{and}\quad f'(e_R^*) &= f^{\,-\prime}(e_R^*)=(1-2e^*)\,\psi'''(e_R^*)-3\psi''(e_R^*)\,.
\end{aligned}
$$

$$
\begin{aligned}
\forall e_R^* \;\in\; & [0,e_{threshold}]\,,\\
& f^{\,-}(0)=\bar{S}_I-\underline{S}_F+\psi''(0)\quad\text{with } f^{\,-}(0)\leq 0 \text{ if } \bar{S}_I+\psi''(0)\leq\underline{S}_F \text{ (high insider's payoff)}\\
& f^{\,-\prime}(e_R^*)\text{ potentially increasing when } e \text{ small, certainly decreasing for } e>\frac{1}{2}
\end{aligned}
$$

Developed form:

$$g^{-}(e_R^*) = -\,\underline{S}_R + \rho(\bar{S}_I - \underline{S}_F + (1-2e^*)\,\psi''(e_R^*) - \psi'\,(e_R^*))$$
$$+\,(1-e_R^*)\,.\psi^{''}\,(e_R^*)\,.\rho'(\bar{S}_I - \underline{S}_F + (1-2e^*)\,\psi''(e_R^*) - \psi'\,(e_R^*)) = 0$$

$$g^{-}{}'(e_R^*) = \frac{\partial g^{-}(e_R^*)}{\partial e^*} = \begin{array}{l} \rho'(\bar{S}_I - \underline{S}_F + (1-2e^*)\,\psi''(e_R^*) - \psi'\,(e_R^*)) * \left[(2-3e^*)\psi'''\,(e_R^*) - 4\psi''\,(e_R^*)\right] \\ +\,\rho''(\bar{S}_I - \underline{S}_F + (1-2e^*)\,\psi''(e_R^*) - \psi'\,(e_R^*)) * \left[-3\psi''\,(e_R^*) + (1-2e^*)\,\psi'''\,(e_R^*)\right] * (1-e_R^*)\,.\psi''(e \end{array}$$

Assuming $\rho : \underline{p} \rightarrow \frac{dp^2}{2}$, it comes:

$$g^{-}(e_R^*) = -\,\underline{S}_R + \frac{d}{2}\left[\bar{S}_I - \underline{S}_F + (1-2e^*)\,\psi''(e_R^*) - \psi'\,(e_R^*)\right]^2$$
$$+\,(1-e_R^*)\,.\psi^{''}\,(e_R^*) * d.\left[\bar{S}_I - \underline{S}_F + (1-2e^*)\,\psi''(e_R^*) - \psi'\,(e_R^*)\right] = 0$$

$$g^{-}{}'(e_R^*) = \frac{\partial g^{-}(e_R^*)}{\partial e^*} = \begin{array}{l} d * \left[\bar{S}_I - \underline{S}_F + (1-2e^*)\,\psi''(e_R^*) - \psi'\,(e_R^*)\right] * \left[(2-3e^*)\psi'''\,(e_R^*) - 4\psi''\,(e_R^*)\right] \\ \quad +\, d * \left[-3\psi''\,(e_R^*) + (1-2e^*)\,\psi'''\,(e_R^*)\right] * (1-e_R^*)\,.\psi''(e_R^*) \end{array}$$

Continuity and differentiability in $e_{threshold}$. Since $e_{threshold}$ is defined as solving $\underline{S}_F - (1 - e_{threshold}).\psi''\,(e_{threshold}) = 0$, $g^{-}(e_{threshold}) = g^{+}(e_{threshold})$ and as $\frac{\partial\left[\underline{S}_F - (1-e).\psi''(e)\right]}{\partial e}\,(e_{threshold}) = \frac{\partial\, 0}{\partial e} = 0$, we get $g^{-}{}'(e_{threshold}) = g^{+}{}'(e_{threshold})$. Consequently, $g(e)$ is continuous and differentiable on $[0,1]$.

Existence of a root We assume $\rho()$ is such that $-\underline{S}_R + \rho(\bar{S}_I - \underline{S}_F + \psi''(0)) \geq -\psi^{''}\,(0)\,.\rho'(\bar{S}_I - \underline{S}_F + \psi''(0))$, so that:

$$g^{-}(0) = -\underline{S}_R + \rho(\bar{S}_I - \underline{S}_F + \psi''(0)) + \psi^{''}\,(0)\,.\rho'(\bar{S}_I - \underline{S}_F + \psi''(0)) \geq 0$$

We also assume that

$$\lim_{e \to 1^-} g^{+}(e_R^*) = -\underline{S}_R + \rho(\bar{S}_I - e_R^*\psi''(e_R^*) - \psi'\,(e_R^*)) + (1-e_R^*)\,.\psi^{''}\,(e_R^*)\,.\rho'(\bar{S}_I - e_R^*\psi''(e_R^*) - \psi'\,(e_R^*)) = -\infty$$

We then need the following lemma:

Lemma 13 *If $f(t)$ is defined, increasing and positive on $[c, 1^-]$, with $f(c)$ finite and $\lim_{t \to 1^-} f(t) = +\infty$, then $\lim_{t \to 1^-} \ln f(t) = +\infty$.*
Consequently:

$$\lim_{t \to 1^-} \ln f(t) = +\infty \quad \Rightarrow \quad \lim_{x \to 1^-} [\ln f(t)]_c^x = +\infty \quad \Rightarrow \quad \lim_{x \to 1^-} \int_c^x \frac{f'(t)}{f(t)} dt = +\infty$$

If $\int_c^x \frac{f'(t)}{f(t)} dt$ is divergent and tends to $+\infty$ as x tends to 1^-, then $\frac{f'(t)}{f(t)}$ is also divergent and tends to $+\infty$ as t tends to 1^-. Consequently, $\forall t$ sufficiently high in $[c, 1^-]$, $f'(t) > f(t)$.

Given our assumptions on $\rho()$ and $\psi()$, and notably the relative growth properties of ψ given Inada condition when $e \to 1$ (cf. previous lemma), continuity and differentiability of $g(e_R^*)$ on $[0, 1]$, and properties of $g'(e_R^*)$ on $[0, 1]$, we get:

$g(e_R^*)$ is continuous and differentiable on $[0, 1[$

$g^-(0) \geq 0$

$\lim_{e_R^* \to 1^-} g^+(e_R^*) = -\infty$

$g'(e_R^*)$ is potentially positive for e small, then negative and tends to $-\infty$

Consequently, $\exists!\ e_R^* \in [0, 1] \mid g^+(e_R^*) = 0$.

5.5.2 Second, we demonstrate that the presence of a regulator induced a more intense effort ($e_R^* \geq e^*$)

We remind that e^* and e_R^* are defined as solving $f(e^*) = 0$ and $g(e_R^*) = 0$. According to previous results, we find out simple conditions such as e^* and e_R^* are unique. We shall now prove by contradiction that $e_R^* < e^*$ is impossible, implying that $e_R^* \geq e^*$.

If $e_R^* < e^*$, then $f(e_R^*) \geq 0$, and $g(e_R^*) = -\underline{S}_R + \rho(f(e_R^*)) + (1 - e_R^*) .\psi''(e_R^*) .\rho'(f(e_R^*)) > 0$

since $\forall \underline{p} \geq 0$, $\rho' \left(\underline{p}\right) \geq 0$.by assumption and other rhs terms are positive. To resume

$$e_R^* < e^* \Rightarrow g(e_R^*) > 0 \text{ with } e_R^* \mid g(e_R^*) = 0 : \quad \textit{contradiction}$$

As we know that e^* and e_R^* are unique and that $e_R^* < e^*$ is impossible, then $e_R^* \geq e^*$.

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