Financing Innovation: Is Transparency a Two-Edged Sword?

Oved Yosha[*]

Tel Aviv University, CEPR, and CESifo

April 2003

Abstract

Does greater transparency obstruct or promote innovative activity? To address this issue, a regime where innovators have a choice between operating in a transparent and in a confidential manner is contrasted with a regime where secrecy is always maintained. A central result is that there are (simple and intuitive) circumstances such that a regime with transparency generates less innovation, and (equally simple and intuitive) circumstances where such a regime might generate more innovation. The analysis also has interesting implications for the subsidization of innovative activity. Circumstances are identified such that a *subsidy to innovation cum confidentiality* succeeds in drawing in high quality innovators that would otherwise be deterred from innovating.

JEL classification: D82, G14, G18, G28, G32, K22, O16, O32, O34.
Keywords: Disclosure, pre-emptive innovation, confidential financing, subsidizing innovation, R&D.

---

[*]Address for correspondence: Oved Yosha, Berglas School of Economics, Tel Aviv University, Tel Aviv, 69978 Israel, e-mail: yosha@post.tau.ac.il, Tel. 972–3–6409715/7242, Fax. 972–3–6409908.

1 Introduction

The importance of technological progress for economic growth has led economists to study the circumstances that facilitate innovation. The question addressed in this paper is whether greater transparency obstructs or promotes innovative activity. Such activity is often carried out by small young potential entrants to industries where established firms already operate (see Hall 2002). Gilbert and Newbery (1982, p.514) argue that threat of entry induces incumbents to take "early, or preventive, actions [that] may lower the returns to poential competitors." Such actions might consist of preemptive invention and then "shelving" of the invention, neither using it nor licensing it to others;[1] see also Reinganum's (1983) influential paper.

This highlights the importance of *secrecy*. Innovators should be able to operate "away from the public eye" for a sufficiently long time to allow them to take incumbents by surprise. In turn, this raises the issue of *financing*. When innovative activity is financed with internal funds, there is a good chance that secrecy can be maintained. Details regarding the nature of innovative activity, or even the sheer engagement in such activity, need not be disclosed. If internal funds are not available but external private financing is obtained (e.g., from a wealthy investor or a venture capital firm), it is still possible to maintain a reasonable degree of confidentiality. But often, innovators must seek external financing on a stock exchange. Indeed, a large proportion of firms traded on NASDAQ-type exchanges are engaged in R&D.[2] Such financing involves issuing securities to the public at large, and for well-known reasons of investor protection, it requires *transparency*.

The need for transparency creates a conflict. Before issuing a security on a stock exchange, a firm is required to submit a registration statement to the authorities which includes the exact amount raised, the planned use of the proceeds, information about the firm's history, existing business, and plans for the future. Furthermore, the firm is required to file periodic financial statements, and to report monthly any "significant" events. The

---

[1]Gilbert and Newbery (1982, p.514) give as example the case of SCM Corporation that sought damages from Xerox Corporation on these grounds.

[2]This is consistent with Allen's (1993) theory that stock market financing is better suited to finance innovation due to the wide "diversity of opinion" on arm's length securities markets. Blass and Yafeh (2001) and Pagano et al. (1999) provide empirical evidence that supports this view.

reports are filed and can be inspected by the public. The disclosed information may induce competitive disadvantage, especially for innovative firms. For example, Easterbrook and Fischel (1991, p.310) write that "a new product might be profitable if built in secrecy, stealing a march on rivals; if the rules require advance disclosure, rivals' responses make the project less attractive." Stevenson (1980, p.7) writes that "business firms are primarily concerned about the effect the release of secret information would have on their competitive positions. That the concern is great is evidenced by the enormous amount of resources corporations expend to protect the confidentiality of information they consider 'competitively sensitive.' " There is ample anecdotal and historical evidence, described in detail in the next section, that the need for stock market financing and the associated release of proprietary information creates a strong conflict for business firms. The concern is that firms who must rely on stock market financing will refrain from engaging in innovative activity for fear of triggering a response from incumbents.

This logic is not restricted to technological innovation, and applies to financial innovation and entry to new markets. The following excerpt from a recent speech by Alan Greenspan is instructive:[3]

"...let us consider now another aspect of market regulation efforts: transparency. There should not be much dispute that markets function best when the participants are fully informed. Yet, paradoxically, the full disclosure of what some participants know can undermine incentives to take risk, a precondition to economic growth. No one can deny that fully informed market participants will generate the most efficient pricing of resources and the most efficient allocation of capital. Moreover, it could be argued that, if all information held by individual buyers or sellers became available to all participants, the pricing structure would more closely reflect the underlying balance of supply and demand. Thus full information would appear to be the unambiguous objective. But should it be? Take, for example, the real estate developer who conceives of an innovative project that will significantly raise the value of the land on which it will be situated—provided that the site possesses suitable characteristics. Suppose further that it is costly for the developer to determine whether a given site is suitable. If he or she discovers a suitable site and is able to quietly purchase the land from its current owners without revealing the value of the project, the developer makes a substantial profit, and the community overall presumably benefits from improved land use. But what if, before the purchase of the land, the developer was required to disclose his or her purchase intentions and, in particular, the value enhancement created by the project? The sellers then seeing the bigger picture would elevate their offers sufficiently high to extract the full value of the innovation from the developer. Under these circumstances, would any projects go forward? Clearly not, because developers would be unwilling to bear the cost of

---

[3]Remarks by Chairman Alan Greenspan Before the Society of Business Economists, London, U.K. September 25, 2002: "Regulation, Innovation, and Wealth Creation" (available at: $http : //www.federalreserve.gov/BoardDocs/Speeches/2002/200209252/default.htm$).

evaluating potential sites knowing that they would reap none of the benefit of discovering suitable ones. A requirement for fuller disclosure of the potential, heretofore undiscovered value of the land would engender neither more disclosure nor improved land use. An example more immediate to current regulatory concerns is the issue of regulation and disclosure in the over-the-counter derivatives market. By design, this market, presumed to involve dealings among sophisticated professionals, has been largely exempt from government regulation. In part, this exemption reflects the view that professionals do not require the investor protections commonly afforded to markets in which retail investors participate. But regulation is not only unnecessary in these markets, it is potentially damaging, because regulation presupposes disclosure and forced disclosure of proprietary information can undercut innovations in financial markets just as it would in real estate markets. ..."

Greenspan continues, explaining that participants in competitive markets seek innovations that yield above-normal returns (quasi-monopoly rents). He then adds:

"To require disclosure of the structure of the innovative product either before or after its introduction would immediately eliminate the quasi-monopoly return and discourage future endeavors to innovate in that area. The result is that market imperfections would remain unaddressed and the allocation of capital to its most-productive uses would be thwarted. ... Regulators may not always be able to differentiate easily between secrecy to protect intellectual property and secrecy to deceive or to commit outright fraud. Yet a supervisory system must make that distinction as best it can. There is nothing unusual about making difficult tradeoffs in regulation. In fact, it is the rule rather than the exception for most regulatory regimes—whether in the financial or nonfinancial sectors of our economies. ..."

I contribute to the analysis of this regulatory dilemma—transparency versus secrecy— with a "game of persuasion" model in the spirit of Grossman and Hart (1980), Grossman (1981), and Milgrom (1981). The focus is on the tension between potential innovators and an incumbent.[4] The framework has features similar to Gilbert and Newbery (1982) and Reinganum (1983). It builds on Yosha (1995), but unlike that paper, the response of the incumbent firm is allowed to be sufficiently strong so that some potential innovators do not enter the market. I then contrast the equilibrium in a regime where innovators have a choice between operating in a transparent and in a confidential manner with a regime where secrecy is always maintained. A central result is that there are (simple and intuitive) circumstances such that a regime with transparency generates less innovation, and (equally simple and intuitive) circumstances where such a regime might generate more innovation. The model also has interesting implications for the subsidization of innovative activity. In particular, assuming that the government cannot distinguish between high amd low quality

---

[4]This does not exactly correspond to the examples in Alan Greenspan's speech, but the basic tradeoff is very similar.

innovators, I identify circumstances when subsidization succeeds in drawing in high quality innovators that would otherwise be deterred from innovating, and circumstances when subsidization only serves as a transfer to innovators without affecting the average quality of innovation.

In the next section I present anecdotal evidence that indicates clearly that disclosure regulations associated with stock market financing induces competitive disadvantage. The basic model is presented in Section 3, the comparison between a regime of transparency and a regime of secrecy is presented in Section 4, the analysis of subsidization schemes is performed in Section 5, and Section 6 concludes the paper.

2   Competitive Disadvantage Induced by Transparency

The kind and amount of information disclosed. In most countries, firms wishing to raise money on public securities markets are required to disclose a substantial amount of information. In the U.S. for example, firms are required by the Securities and Exchange Commission (SEC) to submit for approval a registration statement. An abridged version of the approved registration statement, known as a prospectus, has to be distributed to all purchasers of the security and to all those who were offered to purchase the security through the mail. The issuing firm is also required to file balance sheets and profit and loss statements for prior years, certified by independent public accountants. Furthermore, the firm is required to file quarterly earnings reports, various annual reports, and to report monthly any "significant" events. All the reports are filed with the SEC and can be inspected by the public.[5]

The information which firms are required to disclose is often quite sensitive. The SEC requires registrants to disclose "unusual risks and uncertainties" and the status of major projects that have a documented effect on performance. The latter requirement is particularly relevant for the question addressed in this paper as it includes the status of R&D projects and plans for expansion into new product lines or new markets. Moreover, the SEC requires disclosure of information such as the location and character of principal plants and

---

[5]Benston (1976), pp.14–29.

properties, intangible assets such as patents, trade marks, franchises, and goodwill, investments in affiliates, deferred R&D expenses, receivables from trade customers, defense and other long term contracts, cash on hand and unrestricted demand deposits, inventories by major classes, sales, income and expenses by line of business, advertising costs, R&D costs, and a description of the principal products and services and changes in products, services, markets, competitive conditions, and methods of distribution since the beginning of the year.[6] It should also be noted that "the SEC is much more than a repository for prospectuses and periodic reports." It serves as an enforcement agency with respect to the disclosure regulations, undertaking "investigations, administrative proceedings, civil cases, and injunction actions. Cases that require criminal prosecution are referred to the Justice Department."[7]

Strategic versus technological information. The need for confidentiality was recognized by the Securities Exchange Act of 1934.[8] "In order to protect trade secrets and processes, the Act provides that such secrets and processes need not be revealed in any report. Furthermore, the issuer may object to the public disclosure of any information contained in any report, and such information must be withheld from publication unless the Commission considers that public interest requires its disclosure."[9] Therefore, during a public offering of securities sensitive *technological* information can be withheld, whereas sensitive *strategic* information, of the kind described in the previous paragraph, cannot be kept confidential.[10]

Protecting the process of innovation. Secrecy is necessary to protect the *process* of innovation. "Even if it were demonstrable that the patent system provided thoroughly adequate incentives for innovation, it is unlikely that the same amount of time and money would be expended on research and development if firms were forced to carry out all such

---

[6]Benston (1976), pp.56–68.

[7]Benston (1976), p.24.

[8]The Securities Act of 1933 and the Securities Exchange Act of 1934 form the foundations of the current disclosure policy in the U.S. The purpose of the 1933 Act, also known as the "Truth in Securities Act," was to require full disclosure of information relating to new issues. The 1934 Act requires a continuing disclosure as long as the security is traded on a public market. See Meyer (1934) and Benston (1976).

[9]Meyer (1934), p.20.

[10]See Stevenson (1980) for an extensive discussion of various types of sensitive strategic information.

activities with their competitors looking over their shoulders. Although it is obviously not patentable, even knowledge about research failures can be useful to others, since it may suggest novel lines of approaching a problem and at least permits avoidance of the same mistakes."[11]

Dasgupta and David (1987, p.533) observe that "the mere disclosure that a problem is solvable . . . may serve to channel inventive resources in directions that increase the likelihood that a substitute (or, worse still, a superior solution) will be found." They go on to tell that by the close of 1947, perhaps twenty five organizations were engaged in research on semiconductors. The Bell Laboratories group which discovered the point contact transistor in late December of that year, faced a conflict between the desire to disclose (establishing the scientific priority of the inventors), and the reluctance to inform the competitors that a discovery was made.[12]

The following example is provided by Choi (1991). In January 1986 two scientists at IBM, Bendorz and Müller, discovered a ceramic substance that induces superconductivity at -397°F. Until this discovery superconducting compounds needed to be cooled to -460°F, and progress in the field was so slow that many scientists had given up hope. The discovery in and of itself is of no commercial value, as -397°F is still too cold for any practical applications. It sparked, though, intensive research efforts on the part of scientists worldwide. It seems that Bendorz and Müller wanted to avoid this spillover. Choi quotes from the *Boston Globe*: "They made no announcement and did not even tell other IBM laboratories. Instead they submitted a modest scientific paper to an obscure German journal . . . that would remain unread by most physicists . . . in order to work in peace."[13] Their plan failed, as two laboratories noted their paper and confirmed their result.

These anecdotes suggest that although specific technological details of an innovation or a new product can be kept confidential during the process of a public offering of securities, the mere disclosure that the innovation is near completion or the new product is about to be launched, can be damaging.[14]

---

[11]Stevenson (1980), pp.9–10.

[12]See also Dasgupta and David (1987), footnote 2.

[13]October 15, 1987, p.20.

[14]The following observation by Green and Scotchmer (1990) captures the value of confidentiality to firms

Protecting information about operations. Production-cost figures, work force statistics, and sales figures also constitute sensitive strategic information. "When the Federal Trade Commission began to take steps a few years ago to require some firms to report their assets, revenues, costs, and profits for each product line they manufactured, the reaction of business was swift and predictably outraged. Line-of-business reporting, according to a top executive of du-Pont, 'could lead other companies to concentrate on our most profitable lines.' The president of the Automobile Manufacturers Association said: ' The disclosure of detailed financial data by a company would enable competitors to determine its points of weakness and strength. The competitors could then avoid a competitor's strengths and exploit its weaknesses.' "[15]

Another interesting example is a lawsuit[16] where "the plaintiffs sought to use the Freedom of Information Act to get access to the cost-accounting disclosure statements that government contractors are required to file with the Cost Accounting Standards Board. The statements in question are a qualitative description of the cost-accounting *methods* used by a firm. They call for descriptions of the approaches used by a firm in accounting for inventories, in charging for direct labor, and in computing depreciation. They do not include actual cost figures, or, in fact, any numerical data of any significance, and therefore might be thought not to be of particular competitive sensitivity. Nevertheless, when the plaintiffs asked to see these statements, the firms that supply them complained vigorously. Their principal objection, repeated in a large number of affidavits filed in the lawsuit, boiled down to a fear that other firms might be able to use the relatively innocuous information contained in these statements to obtain an advantage in bidding on later contracts."[17]

The Comptroller of General Motors once argued that the "analysis of the information contained in the disclosure statement, together with quantitative information contained in

---

engaged in R&D races. They point out that filing for patent protection entails disclosure of technical information which might help competitors in their research efforts. As a result, firms may be reluctant to file for patent protection and in some cases may suppress small technical advances. The analysis in Aoki and Spiegel (1999) is also consistent with the idea that disclosure induces competitive disadvantage. In their model, public disclosure of patent applications leads to fewer applications and fewer innovations. They qualify the result by observing that, in their model, for a given number of innovations, disclosure enhances the probability that inventions will reach the market.

[15]Stevenson (1980), p.10.

[16]Petkas vs. Staats, 501 F.2d 887 (D.C. Cir. 1974).

[17]Stevenson (1980), pp.34–35.

prior bids on government contracts, could enable a competitor to obtain cost information which a competitor could utilize to its advantage in other procurement."[18]

The following quotation appeared in the January 1985 proxy statement of Crystal Tissue Company, a manufacturer of wrapping tissue: "Since the tissue paper business is highly competitive, marketing strategies are crucial, and profit margins are difficult to maintain, the detailed financial and business information (including copies of material contracts) which Crystal is required to make publicly available as a reporting company can be used to the detriment of Crystal by competitors and in dealings and negotiations with suppliers and customers." (Pincus 1990, p.13.)

The following argument was used by A. H. Belo Corp. (owner of the *Dallas Morning News*) against a minority shareholder proposal that it become a publicly listed company: "The company maintains that publishing information required of public companies by the SEC would put it at a severe competitive disadvantage, since the data would be available to its main competitor, the Dallas Times Herald, which is owned by Times Mirror Co., Los Angeles. Belo maintains that because it is significantly smaller than Times Mirror, financial disclosures required by the SEC would reveal too much of the inner workings. Times Mirror owns several major papers and can group its newspaper financial data for reporting purposes. By contrast, the Dallas Morning News is the only major newspaper property of Belo."[19] This statement is interesting because it highlights an important asymmetry between small and large firms: Large firms are better able to mask sensitive details when disclosing information.

The South Korean experience. Rice (1990) studies an interesting "natural experiment" in South Korea's stock market during the seventies. In 1970 a reform program was first laid out, consisting mainly of financial disclosure requirements and regulation for publicly traded companies similar to that in the U.S. In 1975, as a result of a general reluctance on the part of Korean firms to go public (despite incentives such as preferential tax treatment), the Korean government forced a number of firms to do so.

---

[18]Stevenson (1980), p.35.

[19]The example is provided by Foster (1980), p.524. The quotation is from *The Wall Street Journal*, December 1978, p.11.

Litigation. The reluctance to disclose information was manifested by a wave of litigation following the enactment of the 1933 and 1934 disclosure Acts. In Fiscal Year 1936 objections to public disclosure of 966 items of information were made by 631 issuers, in connection with applications for registration of securities on national securities exchanges. 218 issuers filed objections to disclosure in connection with annual reports. In some cases confidential treatment was granted, whereas in others it was not. The denials gave rise to litigation in 21 cases. Petitions were filed in several Circuit Courts of Appeal, "for the most part relating to sales and itemized break-down of the cost of sales."[20] More objections to disclosure were made in subsequent years, and some of those denied were petitioned in Court, although the numbers were substantially lower than in 1936. Most of the objections were dismissed on the motion of the petitioners. In the remaining petitions the action of the Commission was affirmed by the Court. By Fiscal Year 1941 no new petitions were filed.[21]

My conclusion from this evidence, albeit anecdotal, is that business firms are indeed concerned about the effect the disclosure of private information would have on their competitive positions. I now turn to the analysis of a model where some profitable projects which would have been undertaken in a confidential, relationship financing regime, are not undertaken in a regime involving public disclosure of information. The analysis is carried out in a highly stylized model that does not purport to be comprehensive; only the features which are essential for the question at hand are spelled out. Despite its simplicity, it provides useful insights.

3 The Basic Model

Description of the model. There are two firms. Firm A is an established incumbent and firm B is a smaller innovative potential competitor.[22] Firm B can undertake an innovative project which requires an initial outlay. It can use confidential financing (by using internal

---

[20]See the Second Annual Report of the Securities and Exchange Commission, Fiscal Year ended June 30, 1936, page 25, and pages 138-9 for a list of cases. The quotation is from page 138.

[21]Various Annual Reports of the Securities and Exchange Commission, Fiscal Years 1937-1941.

[22]This set-up resembles that in Gilbert and Newbery (1982) where the incumbent is a monopoly and the potential entrant is in the process of developing a substitute product, and in Reiganum (1983) where the potential entrant (the "challenger") is engaged in a cost reducing innovation.

funds, or external funds supplied by a wealthy investor or a venture capitalist), or financing on a stock exchange (in the form of debt or equity). Before making the decision whether to undertake the project and how to finance it, firm B observes the realization s of the random variable $\tilde{s}$ that contains information about the "quality of the innovation," and affects the profits of both firms. We refer to such a firm as being of type s. Firm A does not observe s, and has a prior, atomless, distribution of $\tilde{s}$ on $[\underline{s}, \bar{s}]$, with a strictly increasing c.d.f., which is known to firm B.

First, firm B decides whether to innovate (and enter the market) or not innovate (and not enter the market). The decision of a firm of type s not to innovate is denoted $b(s) = OUT$. If firm B decides to innovate and enter the market, it must decide how to finance the innovative activity. Firm A observes firm B's decisions regarding entry and choice of financing source. The decision of a firm of type s to innovate and use confidential financing is denoted $b(s) = IN/CONF$, where $CONF$ stands for "confidential." Obtaining financing on a stock exchange entails disclosure of s, and lying is not possible because s is verifiable by the SEC.[23] Thus, if firm B decides to raise money on a stock exchange, firm A learns s. The decision by firm B of type s to innovate and raise money on a stock exchange is denoted $b(s) = (IN/TRANSP, s)$, where $TRANSP$ stands for "transparent."[24]

Based on firm B's observed action, firm A forms a conjecture (a belief) regarding the set of types to which firm B belongs. Firm A's beliefs as a function of firm B's action are summarized by the following map, denoted $C(b)$:

$$
\begin{aligned}
C(IN/TRANSP, s) &= \{s\}, \\
C(IN/CONF) &= \{s \in [\underline{s}, \bar{s}] \mid b(s) = IN/CONF\}, \\
C(OUT) &= \{s \in [\underline{s}, \bar{s}] \mid b(s) = OUT\}.
\end{aligned}
$$

These beliefs determine firm A's expectation of firm B's type, as a function of firm B's observed action, denoted

$$\hat{s}(b) = E[\tilde{s} \mid \tilde{s} \in C(b)], \tag{1}$$

---

[23]To ensure truthful disclosure, it is sufficient that s be verifiable by the SEC only ex-post, and that lying at the financing stage entails ex-post disciplinary action that is sufficiently painful.

[24]It is also assumed that fraud (raising money but not innovating) is impossible.

i.e.,

$$\hat{s}(IN/TRANSP, s) = s\,,$$

$$\hat{s}(IN/CONF) = E[\tilde{s}|\tilde{s} \in C(IN/CONF)]\,,$$

$$\hat{s}(OUT) = E[\tilde{s}|\tilde{s} \in C(OUT)]\,.$$

Equipped with these beliefs, firm A chooses a preemptive damage reducing action, $a(\hat{s}) \in [\underline{a}, \bar{a}]$, that affects the profits of both firms. This action is costly for A and causes damage to B.

The damage (including the cost of preemptive action a) to firm A's profits, as a function of a, is

$$(a - k)s - g(a), \tag{2}$$

where $k > \bar{a}$ is a constant and $(a - k)s < 0$ represents "direct damage" that decreases with a, and $g(a)$, a strictly convex function, represents "cost" that increases with a. Notice that, for any $a \in [\underline{a}, \bar{a}]$, the damage to firm A's profits increases with firm B's type. Firm A selects a to minimize the expected damage, based on its belief regarding firm B's type. Therefore, its objective function can be written as

$$(a - k)\hat{s} - g(a), \tag{3}$$

where $\hat{s}$ is as defined in (1). It is straightforward to show that firm A's preemptive action increases with it's expectation of firm B's type:

$$a'(\hat{s}) > 0\,. \tag{4}$$

If it innovates, the profits of firm B of type s when firm A's preemptive action is a are

$$h(a) + ms\,, \tag{5}$$

where $m > 0$ is a constant, and $h'(\cdot) < 0$. Namely, firm B's profits increase with its type and decrease with the strength of firm A's action. Firm B chooses IN as long as profits are positive.

Consider the derivative with respect to s of firm B's profits when firm A knows s and

tailors its preemptive action accordingly:

$$h'[a(s)] \, a'(s) \, + \, m \, . \tag{6}$$

The second term, m, is positive reflecting the increase in firm B's profits with its type (i.e., with the quality of the innovation) for a given premptive action on the part of firm A. As $h'[\cdot] < 0$ by assumption, and $a'(\cdot) > 0$ by equation (4), the first term in (6), $h'[a(s)] \, a'(s)$, is negative reflecting both the decrease in firm B's profits with the strength of firm A's preemptive action and the greater strength of this action for higher values of s.

A priori, the net effect of s on firm B's profits could go either way depending on the relative magnitude of $h'[a(s)] \, a'(s)$ and m. I consider two benchmark cases: One where firm A's preemptive action is tailored to deter entry of low s types (they cause less damage to firm A but are easy to deter), the other where firm A's preemptive action is tailored to deter entry of high s types (they cause greater damage but are harder to deter):

Case I. This case is characterized by the following assumption: For all s,

$$h'[a(s)]a'(s) \, + \, m \, > \, 0 \, , \tag{7}$$

and there is $s^* \in (\underline{s}, \bar{s})$ such that

$$h[a(s)] \, + \, ms \, < \, 0 \quad \text{for} \quad s < s^* \, ; \tag{8}$$

see Figure 1a. The interpretation is that firm A finds it optimal to deter entry only of minor innovations, while deterring entry of major innovations is too costly.[25] For concreteness, we assume that $s^* < E\tilde{s}$, but this has no bearing on the qualitative nature of the results.

Case II. This case is characterized by the following assumption: For all s,

$$h'[a(s)] \, a'(s) \, + \, m \, < \, 0 \, , \tag{9}$$

---

[25]Technically, a sufficient condition for this is that $h'[\cdot]$ is very small, i.e., action a is not very effective in reducing damage. Then, if the cost function, $g(\cdot)$, is sufficiently convex, it is too costly for firm A to choose a strong preemptive action that would be necessary to deter entry of major innovations.

and there is $s^{**} \in (\underline{s}, \bar{s})$ such that

$$h[a(s)] + ms < 0 \quad \text{for} \quad s > s^{**};\qquad(10)$$

see Figure 1b. The interpretation is that firm A finds it optimal "not to waste too many resources" to fight minor innovations, but fights major innovations very strongly and successfully.[26] For concreteness, we assume that $s^{**} > E\tilde{s}$, but this has no bearing on the qualitative nature of the results.

Both cases will be studied.[27] Summarizing, firm B observes s, and then chooses $b(s)$ (whether to innovate, and how to finance the innovation). Firm A observes b, updates its prior regarding firm B's type, and chooses a. Then firm B's innovation takes place (conditional on entry), and s becomes publicly known. Finally, profits are realized. Because firm A's preemptive action increases with its belief about s, firm B would like to reveal low realizations of $\tilde{s}$ ("bad news") and to conceal high realizations of $\tilde{s}$ ("good news").

Definition of equilibrium. An equilibrium consists of a decision rule $b(s)$ for every type of firm B, beliefs $C(b)$ by firm A regarding firm B's type as a function of firm B's action, and an action choice rule for firm A, $a(\hat{s})$, as a function of its beliefs regarding firm B's type, such that firm A chooses its action optimally given firm B's entry and financing decision, firm B chooses its entry and financing decision optimally given firm A's optimal response, and such that firm A's beliefs regarding firm B's type are correct.

Remark. The setup is also applicable to innovative activity which is not technological in nature. For example, we can think of s as the profitability of operating in a new market—a particular niche or geographical region—with which firm B is well acquainted. If firm B discloses that it plans to use the proceeds of the securities offering to expand productive capacity, or reveals that it is planning to do so soon (this kind of information is disclosed in the prospectus of a public offering of securities), firm A concludes that profitability in

---

[26]Technically, this happens if $h'[\cdot]$ is large enough.

[27]Yosha(1995) restricts attention to a case similar to *Case I*, with the only difference being that firm B's profits are positive for all s and all a so that the issue of entry deterrence does not arise. The main focus in that paper is on the implications of the cost differential between the two modes of financing, an issue that is not central for this paper and is disregarded here.

the new market is high, and diverts resources to compete with firm B in this market.

Equilibrium. Each of the cases presented above has a unique equilibrium displayed in Figures 1a and 1b, respectively.

Case I. The wavy schedule in Figure 1a represents the payoff to firm B if it chooses $IN/TRANSP$, in which case firm A's action is tailored optimally against firm B's true type. In the unique equilibrium of the model, types $s \in [\underline{s}, s^*)$ choose OUT, while the rest choose $IN/TRANSP$, and type $\bar{s}$ is indifferent between $IN/TRANSP$ and $IN/CONF$. The straight line represents the payoff to firm B if it chooses $IN/CONF$, in which case firm A's action is tailored against the average type that chooses $IN/CONF$, namely, against type $\bar{s}$. Because $h[a(s)] < h[a(\bar{s})]$ for all $s < \bar{s}$, the straight line lies strictly below the wavy schedule, except at $\bar{s}$ where they intersect. Because $h'[a(s)] \, a'(s) < 0$ for all s, the straight line is steeper everywhere.

The intuition and proof for no type (except perhaps type $\bar{s}$) choosing $IN/CONF$ is that the set of types that raise money confidentially cannot contain more than one type. If it did, then types in this set with below average quality would resent being treated as the average type in the set, and would prefer to raise money on a stock exchange, credibly disclosing their true type and inducing a weaker action on the part of firm A. The single type which constitutes this set is $\bar{s}$. Suppose not, namely that some $s' < \bar{s}$ is the type that raises money confidentially. Then types $s > s'$ would prefer to mimic type s' and raise money confidentially in order to induce a weaker action on the part of firm A.

The following interpretation of the result is of interest. SEC monitored disclosure financing constitutes a costless and credible channel of communication between firm B and firm A. The existence of such a channel of communication is a two edged sword. If firm B turns out to be of high type, it would rather conceal this fact from firm A, but the existence of a credible and costless channel of communication prevents it from doing so. If firm B turns out to be of low type, it would like to inform firm A of this fact. The existence of a credible, costless, and perfectly *legal* channel of communication, enables firm B to "collude" with firm A by credibly communicating this information, inducing firm A to take a weaker pre-emptive action.[28]

Case II. By an analogous logic, the situation described in Figure 1b is the unique equilibrium of the model: Types $s \in [\underline{s}, s^{**}]$ choose $IN/TRANSP$ and the rest choose OUT. The choice OUT by firm B of high type is sustained by firm A's beliefs regarding firm B's type if $IN/CONF$ is observed. When firm A believes that only very high types "dare" to deviate and choose $IN/CONF$, it will choose a vigorous action when it observes such a deviation. This threat makes it optimal for firm B of high type to remain OUT. For example, the beliefs $C(IN/CONF) = [s_0, \bar{s}]$, implying $\hat{s}(IN/CONF) = \hat{s}_0$, sustain the equilibrium strategies. More generally, beliefs of the form $C(IN/CONF) = [s_1, \bar{s}]$ where $s_1 > s_0$, implying $\hat{s}(IN/CONF) > \hat{s}_0$ sustain the same equilibrium strategies. (Such beliefs result in a payoff to firm B, as a function of its type, described by one of the dotted lines.)

In both cases, the equilibrium captures quite well a situation where a small innovative firm is convinced that if the (big and established) incumbent learns that the firm is planning to expand, the incumbent will react. Having deeper pockets, the incumbent may win the fight. Anticipating this, some small firms prefer not to expand. In *Case I* these are the low quality innovators whereas in *Case II* these are the high quality innovators.

I now turn to the analysis of the main questions posed in the introduction. First, I ask whether suppressing the ability to disclose information credibly enlarges or reduces the set of types that choose OUT. Next, I ask whether subsidizing innovative activity by small young firms (firm B in the model) succeeds in drawing in types who otherwise choose OUT.

4 Is Transparency A Two-Edged Sword?

It might be argued that a regime with transparency, namely, when a credible channel of information disclosure (backed by the SEC) is available, facilitates entry deterrence and suppresses innovation. First, incumbents can tailor more precisely their preemptive action against those types that choose the option of external financing cum disclosure. Second, by *not* choosing this avenue, and choosing confidential financing instead, entrants reveal

---

[28]The argument is related, more generally, to the debate on whether transparency facilitates collusion. See Schultz (2001) for an interesting analysis, and references therein. Also related is the literature on information sharing in oligopoly. See, for example, Vives (1990) and references therein.

that they are of "high type" inducing a vigorous preemptive action. Without the *option* of external financing cum disclosure, confidential financing would not reveal any private information regarding the entrants' quality of innovation. Thus, abolishing the option of external financing cum disclosure might result in less entry deterrence and more innovative activity by entrants.

I turn to the analysis of this conjecture in the framework of the model developed in the previous section.. Figures 2a and 2b display, for *Case I* and *Case II*, respectively, the equilibrium in a regime without transparency, that is, when external financing cum disclosure is not possible (no information can be credibly disclosed). Thus, the only options that are open to firm B are OUT and $IN/CONF$.

Case I. The dashed lines in Figure 2a represent the payoffs to firm B under a regime with transparency. These are the same exact payoffs displayed in Figure 1a, and s^* is the cut-off value of s such that types lower than s^* choose OUT while the rest choose $IN/TRANSP$.

We turn to a regime without transparency. In the unique equilibrium of the model, types $s \in [\underline{s}, s_1)$ choose OUT, while the rest choose $IN/CONF$. The average type that chooses $IN/CONF$ is $\hat{s}_1$. The solid line represents the payoff to firm B if it chooses $IN/CONF$ while firm A's action is tailored optimally against the average type that chooses $IN/CONF$.

To compare the equilibrium across the two regimes, notice that because the wavy dashed schedule and the solid line must intersect at $\hat{s}_1$, which is the mean of the set of types that choose $IN/CONF$, $[s_1, \bar{s}]$, it must be that $s_1 > s^*$. (The proof is as follows. By construction, the solid line crosses the horizontal axis at s_1. If, by way of contradiction, s_1 were smaller than s^* the solid line would intersect the wavy dashed schedule to the left of s_1 and $\hat{s}_1$ would not be the mean of the set of types that choose $IN/CONF$, $[s_1, \bar{s}]$.)

Therefore, in a regime with transparency, the availability of a credible channel of information disclosure (backed by the SEC) induces more innovation. The reason is that types in $[s^*, s_1)$ can credibly convey their type to firm A through the disclosure channel, attracting "moderate fire." In a regime without transparency these firms would have to face a more vigorous preemptive action tailored for the average type that chooses $IN/CONF$, rendering entry (and innovation) unprofitable.

Thus, under the assumptions of *Case I,* the conjecture that transparency suppresses

innovation is false. Instead, it facilitates "collusion" in the sense that low quality innovators can credibly convey their type to firm A, inducing more entry.

Case II. The dashed lines in Figure 2b represent the payoffs to firm B under a regime with transparency. These are the same exact payoffs displayed in Figure 1b, and s^{**} is the cut-off value of s such that types lower than s^{**} choose $IN/TRANSP$ while the rest choose OUT.

We turn to a regime without transparency. There is a continuum of equilibria, depending on firm A's beliefs regarding the set of types that choose $IN/CONF$. Suppose first that $h[a(E[\tilde{s}])] \geq 0$. Then, there are three kinds of equilibria, illustrated by the solid lines in Figure 2b. In the first, denoted I, all types choose $IN/CONF$ and innovate, firm A tailors its loss preventing action against the average type, $a(E[\tilde{s}])$, and because $h[a(E[\tilde{s}])] \geq 0$, all firm B types find it profitable to enter. In the second, denoted II, types in $[s_2, \bar{s}]$ choose $IN/CONF$ and innovate, and firm A tailors its loss preventing action against the average type in this set, $a(\hat{s}_1)$. In the third, denoted III, firm A tailors its loss preventing action against a high type, e.g., $a(\hat{s}_1)$, and no type enters. If $h[a(E[\tilde{s}])] < 0$, then only equilibria of the second and third kind are possible.

Thus, under the assumptions of *Case II,* it is not possible to formulate a clear-cut prediction regarding the effect of moving from a regime with transparency to a regime without transparency. The analysis illustrates that such a change of regime might generate an inferior outcome. If firm A believes that only "high quality types" would choose $IN/CONF$ in a regime without transparency, its preemptive action is tailored for these types, and few or no types enter.

The overall impression is that the analysis does not support the conjecture that transparency suppresses innovation. If anything, the opposite is true (see *Case I*). Is there a fallacy in Greenspan's agument regarding the potential damage of disclosure for entrepreneurial activity? At least in the specific situation modeled here, his argument is not complete as he ignores the classic Milgrom-Grossman-Hart unraveling argument (the beliefs of oponents when they see that information has been withheld.) This logic is highly relevant for the Research and Development context we are studying, as it is very likely that incumbents watch closely the actions of potential entrants and can detect that "something

is cooking" yet details are not being disclosed. Of course, there are many situations when such inference is not possible, in which case the argument developed here does not apply.

5 Subsidizing the Entry of Innovators

We turn to an analysis of various subsidization policies, whose common goal is to induce more types to enter the market, and innovate. Many government subsidization policies for innovative activity are independent of the source of financing (e.g. the R&D tax credit in the U.S.). The analyis below reveals that it may make sense to condition the subsidy on the source of financing. The major finding is that there are circumstances that make it desirable to adopt an elitistic policy, subsidizing only innovative activities which are financed *confidentially,* inducing entry of high s firms. Thus, although the subsidy per firm required to draw a high s firm into the market may be high, the total expenditure on subsidy payments need not be as high.

These circumstances are those described in *Case II,* namley, when the pre-emptive action of the incumbent is tailored against the high s innovators. For the sake of completeness, and to adhere to the order of presentation in previous sections, I will first analyze *Case I* and then proceed to study *Case II* and present the main result.

Case I.

Subsidizing $IN/TRANSP$ or IN. It turns out that subsidizing all entry cum transparent financing and subsidizing all entry yields analogous results. The effect of this subsidization policy is illustrated in Figure 3a. The dashed lines represent the payoffs to firm B without a subsidy, as in Figure 1a, with types $s \in [\underline{s}, s^*)$ choosing OUT and the rest choosing $IN/TRANSP$.

A subsidy to $IN/TRANSP$ shifts up the payoff function for $IN/TRANSP$ by the amount of the subsidy. A subsidy to IN shifts up both payoff functions, for $IN/TRANSP$ and $IN/CONF$ (not shown). In both cases, the equilibrium remains unique, and the set of types that choose OUT shrinks to $[\underline{s}, s_3)$, with all types who enter choosing $IN/TRANSP$. The case for subsidizing innovation here depends on how socially valuable are the low s innovations that are drawn in as a result of the subsidy.

Subsidizing $IN/CONF$. Consider Figure 3a'. The dashed lines represent the payoffs to firm B without a subsidy, as in Figure 1a, with types $s \in [\underline{s}, s^*)$ choosing OUT and the rest choosing $IN/TRANSP$.

The straight solid line represents the payoff to firm B, cum subsidy, $S(s_4)$, from choosing $IN/CONF$. In the unique equilibrium, the set of types that choose OUT is determined by the intersection of the wavy dashed line and the horizontal axis, and remains unchanged, $[\underline{s}, s^*)$. Types $s \in [s^*, s_4)$ enter choosing $IN/TRANSP$, and types $s \in [s_4, \bar{s}]$ enter choosing $IN/CONF$.[29] Thus, the subsidy does not enhance the set of types that innovate. It only induces a shift of high s types from transparent financing to confidential financing.[30]

Case II.

Subsidizing $IN/TRANSP$ or IN. Consider Figure 3b. The dashed lines represent the payoffs to firm B without a subsidy, as in Figure 1b, with types $s \in [\underline{s}, s^{**})$ choosing $IN/TRANSP$ and the rest choosing OUT. The equilibrium is sustained by beliefs by firm A that a type choosing $IN/CONF$ belongs to the set $[s_0, \bar{s}]$ with mean $\hat{s}_1$.

A subsidy to $IN/TRANSP$ shifts up the payoff function for $IN/TRANSP$ by the amount of the subsidy. A subsidy to IN shifts up both payoff functions, for $IN/TRANSP$ and $IN/CONF$. (In the latter case, it is assumed that the subsidy is small enough so that the $IN/CONF$ payoff schedule cum subsidy remains below the horizontal axis.) In both cases, the equilibrium remains unique, and the set of types that choose OUT shrinks to $[s_5, \bar{s}]$, with all types who enter choosing $IN/TRANSP$.

The equilibrium is sustained by beliefs by firm A that a type choosing $IN/CONF$ belongs to the set $[s_0, \bar{s}]$ with mean $\hat{s}_1$. As in *Case I,* the justification for subsidizing innovation here depends on how socially valuable are the low s innovations that are drawn in as a result of the subsidy.

---

[29]Such an equilibrium can be constructed for any cut-off value of s (that is greater than s^*.) The construction proceeds as follows. Choose some $s > s^*$, say s_4. Draw a straight line with slope m that intersects the wavy dashed line at s_4. Compute the mean of the interval $[s_4, \bar{s}]$, $\hat{s}_4$, and draw a straight line with slope m that intersects the wavy dashed line at $\hat{s}_3$. The vertical distance between these straight lines with slope m is the subsidy, $S(s_4)$, that sustains the equilibrium.

[30]This may have welfare consequences, as it affects the expenditure of firm A on pre-emptive action. It may have implications for investor protection (confidentiality versus transparency), but such considerations are beyond the scope of this study.

Subsidizing $IN/CONF$***.*** This is the most interesting case, where subsidizing innovation is very much justified. Consider Figure 3b'. The dashed lines represent the payoffs to firm B without a subsidy, as in Figure 1b, with types $s \in [\underline{s}, s^{**})$ choosing $IN/TRANSP$ and the rest choosing OUT. The equilibrium is sustained by beliefs by firm A that a type choosing $IN/CONF$ belongs to the set $[s_0, \bar{s}]$ with mean $\hat{s}_1$.

The straight solid line represents the payoff to firm B, cum subsidy, $S(s_6)$, from choosing $IN/CONF$. In the unique equilibrium, the set of types that choose $IN/TRANSP$ remains unchanged, $[\underline{s}, s^{**})$. Types $s \in [s^{**}, s_6)$ choose OUT, and types $s \in [s_6, \bar{s}]$ enter choosing $IN/CONF$. It is essential that the subsidy be large enough so that the $IN/CONF$ payoff schedule cum subsidy crosses the horizontal axis.[31]

The subsidy enhances the set of types that innovate, drawing in high s types. It is paid only to those who choose confidential financing. (In practical terms, this can be implemented by supporting venture capital backed start-ups that have not yet gone public.) Summarizing the main insight: *When pre-emptive action by incumbents is tailored against high quality innovators, driving them out of the market, a subsidy to innovation cum confidential financing succeeds in drawing in these high quality innovators.* Confidentiality allows the very best innovators (types $s > \hat{s}_3$) to "hide" behind the "average type," $\hat{s}_3$, of the group choosing confidential financing against which the incumbent tailors its pre-emptive action. In this case, the analysis supports Mr. Greenspan's conjecture that lack of transparency may promote the incentive to innovate.

6 Summary

The regulatory dilemma, transparency versus secrecy in the financing of innovation, was analyzed with a "game of persuasion" model. The model exhibits tension between a potential innovator and an established incumbent, and the question addressed was whether greater transparency obstructs or promotes innovative activity. To address this issue, a

---

[31]Such an equilibrium can be constructed for any cut-off value of s (that is greater than s^{**}.) The construction proceeds as follows. Choose some $s > s^{**}$, say s_6. Draw a straight line with slope m that intersects the horizontal axis at s_6. Compute the mean of the interval $[s_6, \bar{s}]$, $\hat{s}_6$, and draw a straight line with slope m that intersects the wavy dashed line at $\hat{s}_6$ (the thin solid straight line in Figure 3b'). The vertical distance between the two solid straight lines with slope m is the subsidy, $S(s_6)$, that sustains the equilibrium.

regime where innovators have a choice between operating in a transparent and in a confidential manner was contrasted with a regime where secrecy is always maintained. It might be argued that a regime with transparency facilitates entry deterrence and suppresses innovation because incumbents can tailor more precisely their preemptive action against innovators who are forced to reveal proprietary information in the process of obtaining external financing. Without the *option* of external financing cum disclosure, confidential financing would not reveal any private information.

Yet, the analysis revealed that there are circumstances when a regime with transparency induces *more*, not less innovation. The reason is that in such a regime entrants can credibly convey private information to incumbents through the disclosure channel, attracting "moderate fire." In a regime without transparency these firms would have to face a more vigorous pre-emptive action tailored for the "average" potential innovator rendering entry (and innovation) unprofitable.

The second issue studied was whether subsidizing innovation is effective in inducing entry and innovation, especially entry of high quality innovators. The main finding is that when pre-emptive action by incumbents is tailored against high quality innovators, driving them out of the market, a subsidy to innovation cum confidential financing succeeds in drawing in high quality innovators. The reason is that confidentiality allows the very best innovators to "hide" behind the "average type" of the group that opts for confidential financing against which the incumbent tailors its pre-emptive action. This result is consistent with Mr. Greenspan's conjecture that lack of transparency may increase the incentive to innovate.

References

Allen, F. (1993), "Stock Markets and Resource Allocation," *in* Mayer C. and X. Vives, eds., *Capital Markets and Financial Intermediation*, Cambridge and New York: Cambridge University Press.

Aoki, R. and Y. Spiegel (1999), "Public Disclosure of Patent Applications, R&D, and Welfare," mimeo., University of Auckland and Tel Aviv University.

Benston, G. (1973), "Required Disclosure and the Stock Market: An Evaluation of the Securities Exchange Act of 1934," *American Economic Review*, 63, 132–155.

Blass, A. and Y. Yafeh (2001), "Vagabond Shoes Longing to Stray: Why Foreign Firms List in the United States.," *Journal of Banking and Finance*, 25, 555–572.

Choi, J. (1991), "Dynamic R&D Competition under "Hazard Rate" Uncertainty," *The RAND Journal of Economics*, 22, 596–610.

Dasgupta, P. and P. David (1987), "Information Disclosure and the Economics of Science and Technology," in G. Feiwel ed., *Arrow and the Ascent of Modern Economic Theory*, New York: New York University Press.

Easterbrook, F. and D. Fischel, (1991), *The Economic Structure of Corporate Law*, Cambridge, Mass. and London: Harvard University Press.

Gilbert, R. and D. Newbery (1982), "Preemptive Patenting and the Persistence of Monopoly," *American Economic Review*, 72, 514–526.

Green, J. and S. Scotchmer (1990), "Novelty and Disclosure in Patent Law," *The RAND Journal of Economics*, 21, 131–146.

Grossman, S. (1981), "The Informational Role of Warranties and Private Disclosure about Product Quality," *Journal of Law and Economics*, 24, 461–483.

Grossman, S. and O. Hart (1980), "Disclosure Laws and Takeover Bids," *Journal of Finance*, 35, 323–334.

Hall, B. (2002), "The Financing of Research and Development," *Oxford Review of Economic Policy*, 18, 35–51.

Milgrom, P. (1981), "Good News and Bad News: Representation Theorems and Applications," *Bell Journal of Economics*, 12, 380–391.

Pincus, K. (1990), *Reporting Requirements under the Securities and Exchange Act of 1934 as They Affect Small Businesses: Defining the "Small Public Company,"*, Research Report no.5, SEC and Financial Reporting Institute, University of Southern California.

Pagano, M., Roell, A. and J. Zechner (1999), "The Geography of Equity Listing: Why do European Companies List Abroad?" mimeo., University of Salerno, Princeton University, and University of Vienna.

Reinganum, J. (1983), "Uncertain Innovation and the Persistence of Monopoly," *American Economic Review*, 73, 741–748.

Rice, E. (1990), "Firms' Reluctance to Go Public: The Deterrent Effect of Financial Disclosure Requirements," mimeo., Harvard University.

Schultz, C. (2001), "Transparency and Tacit Collusion," Discussion Paper 2001–04, Centre for Industrial Economics, Institute of Economics, University of Copenhagen.

Stevenson, R. (1980), *Corporations and Information*, Baltimore and London: The Johns Hopkins University Press, New-York: Free Press.

Vives, X. (1990), Trade Association Disclosure Rules, Incentives to Share Information, and Welfare, *The RAND Journal of Economics*, 21, 409–430.

Yosha, O. (1995), "Information Disclosure Costs and the Choice of Financing Source," *Journal of Financial Intermediation*, 4, 3–20.

Figure 1a. The equilibrium when the incumbent (firm A) deters entry only of minor innovations by the potential entrant (firm B).

B's payoff, IN/TRANSP:
$$h(a(s)) + ms$$

s*

B's payoff, IN/CONF:
$$h(a(\overline{s})) + ms$$

$\underline{s}$

$\overline{s}$

OUT

IN/TRANSP

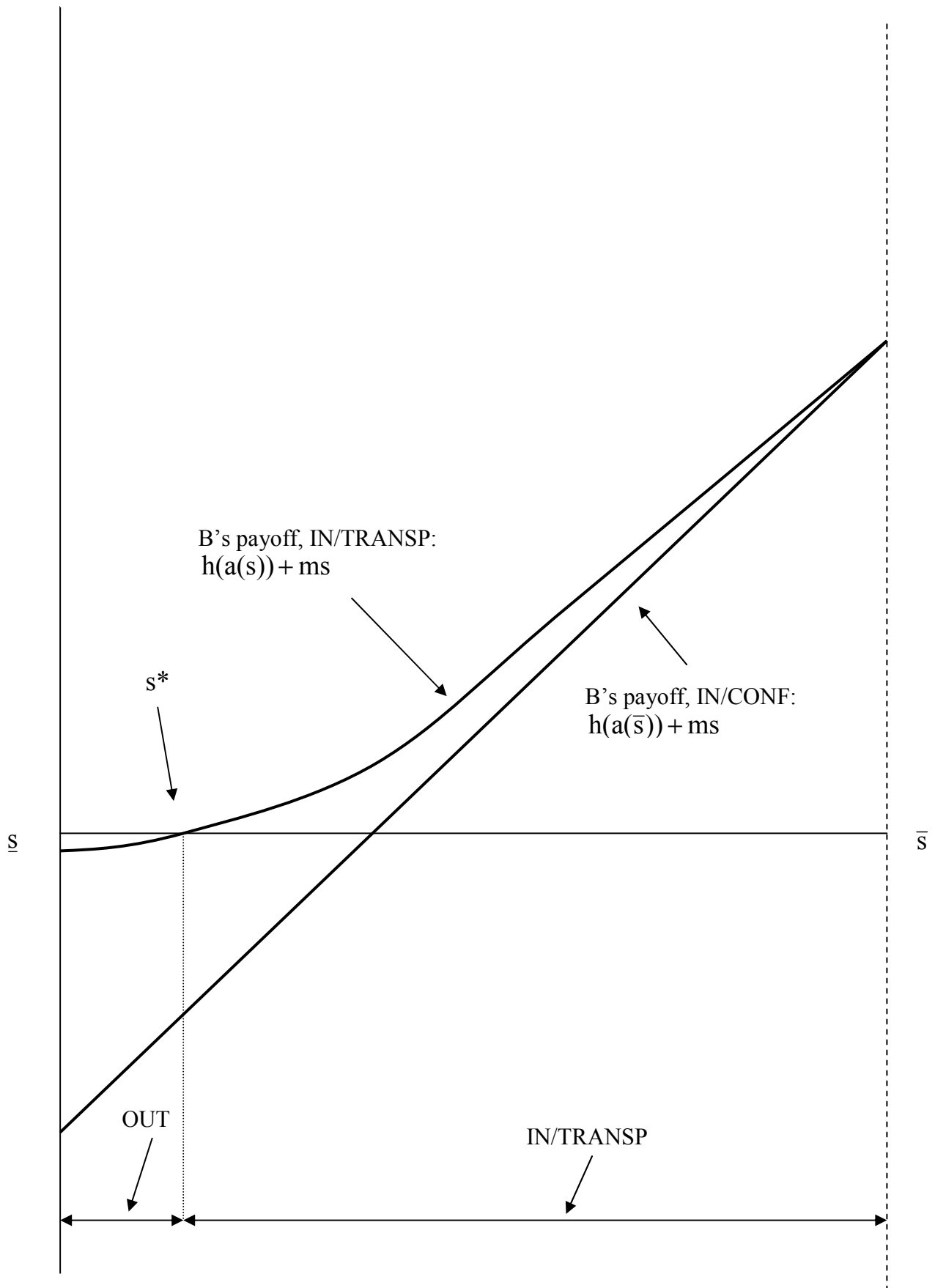Figure 1b. The equilibrium when the incumbent (firm A) deters entry only of major innovations by the potential entrant (firm B).

B's payoff, IN/TRANSP:
$h(a(s)) + ms$

s^{**}

s_0 $\hat{s}_0$

$\underline{s}$

$\overline{s}$

$h(a(s_0)) + ms$

B's payoff, IN/CONF:
$h(a(\hat{s}_0)) + ms$

$h(a(\overline{s})) + ms$

IN/TRANSP

OUT

Figure 2a. Comparing a regime with and without transparency when the incumbent (firm A) deters entry only of minor innovations by the potential entrant (firm B).

B's payoff in a regime without transparency:

$$h(a(\hat{s}_1)) + ms$$

s^*

s_1

B's payoffs in a regime with transparency, for IN/TRANSP (top schedule) and IN/CONF (see Figure 1a).

$\underline{s}$

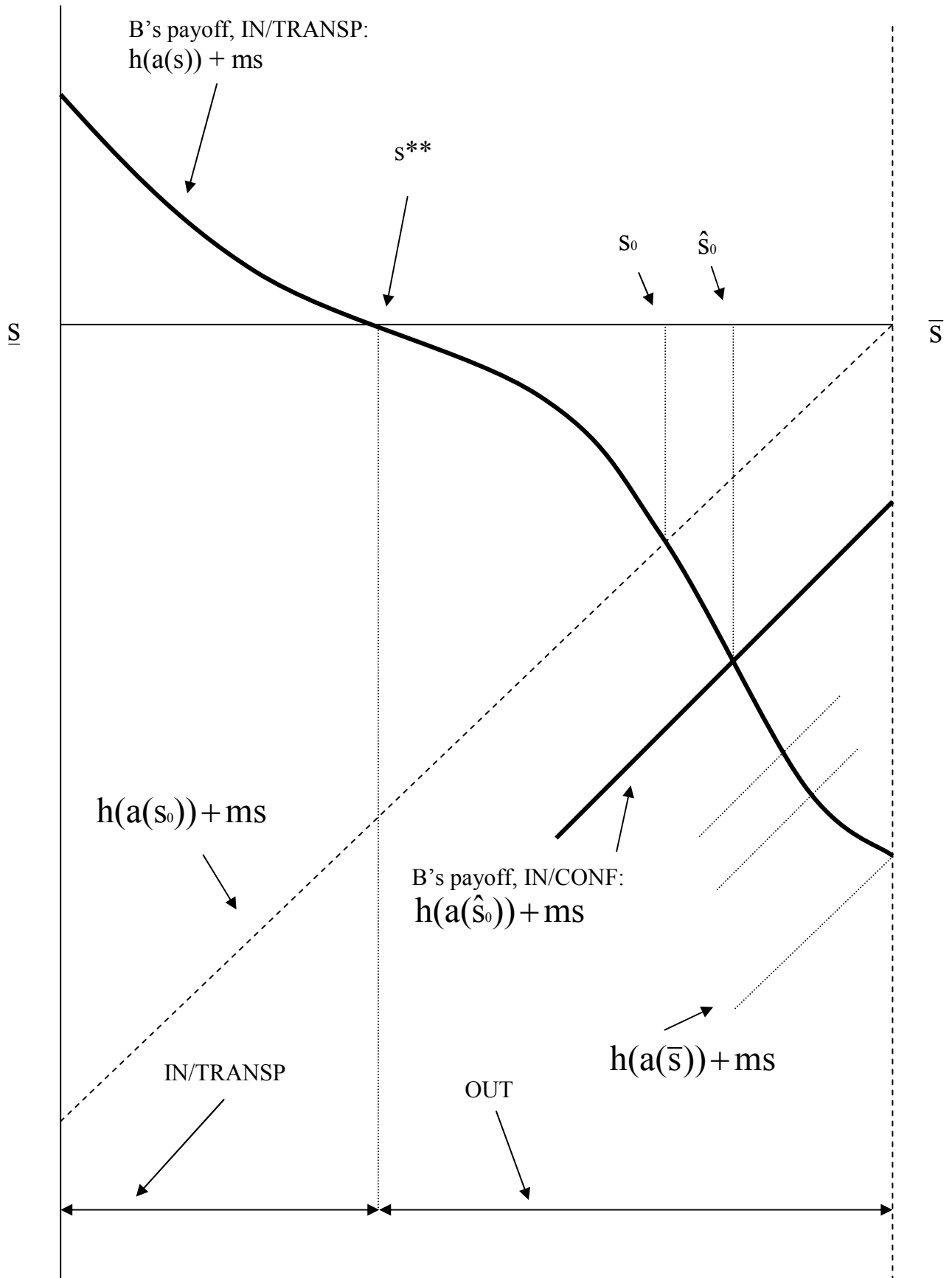$\hat{s}_1$

$\overline{s}$

OUT

IN/CONF
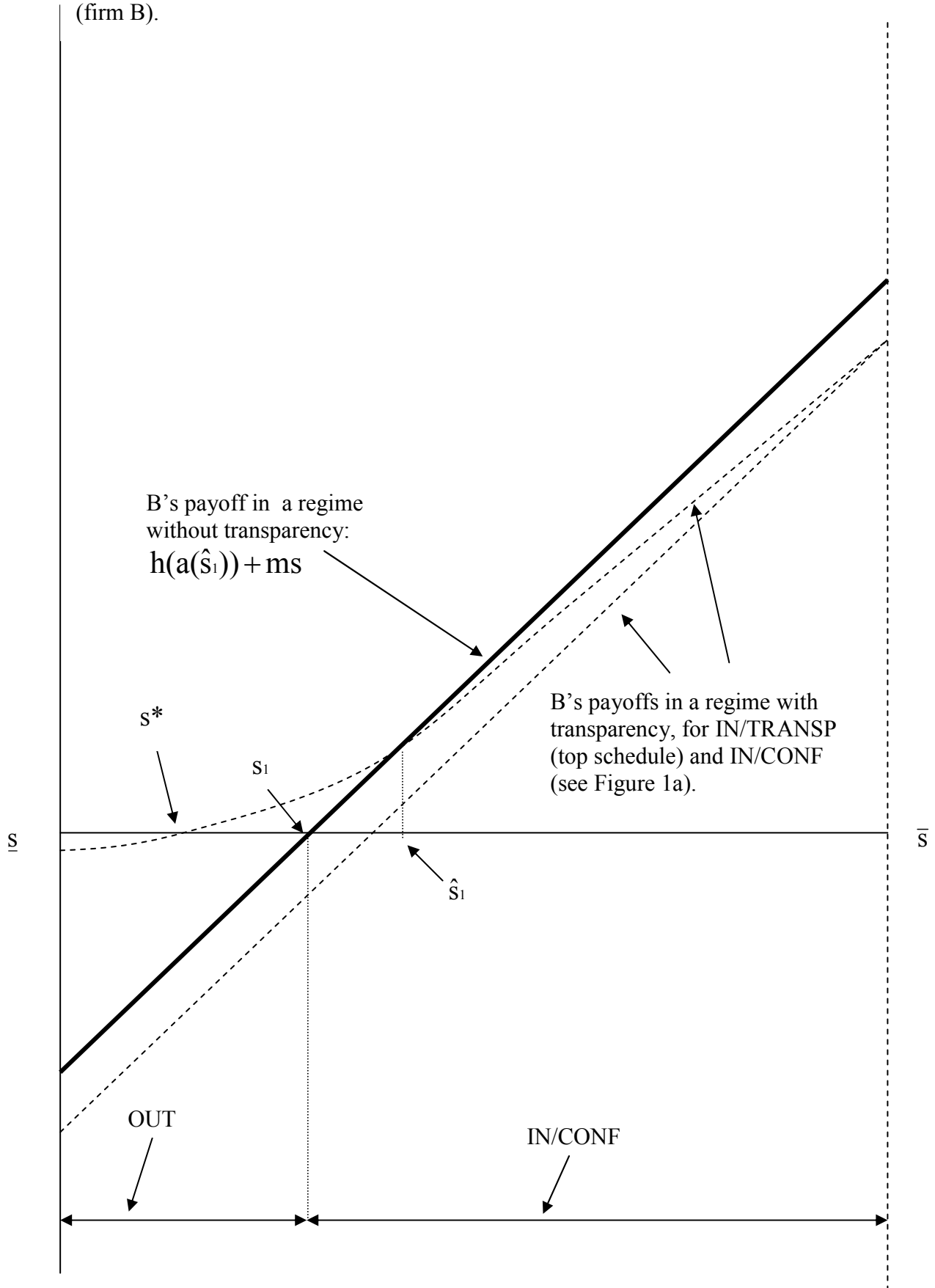
Figure 2b. Comparing a regime with and without transparency when the incumbent (firm A) deters entry only of major innovations by the potential entrant (firm B).

I. B's payoff in a regime without transparency:
$$h(a(E[\tilde{s}])) + ms$$

II. B's payoff in a regime without transparency:
$$h(a(\hat{s}_2)) + ms$$

s_0

$\hat{s}_0$

$E[\tilde{s}]$

S**

$\underline{s}$

$\bar{s}$

s_2

$\hat{s}_2$

$h(a(s_1)) + ms$

III. B's payoff in a regime without transparency:
$$h(a(\hat{s}_0)) + ms$$

B's payoffs in a regime with transparency, for IN/TRANSP (see Figure 1b).

I. IN/CONF

II. OUT

II. IN/CONF

III. OUT

Figure 3a. Subsidy to entry cum transparent financing (or entry in general) when the incumbent (firm A) deters entry only of minor innovations by the potential entrant (firm B).

B's payoff,
IN/TRANSP:
$h(a(s)) + ms$
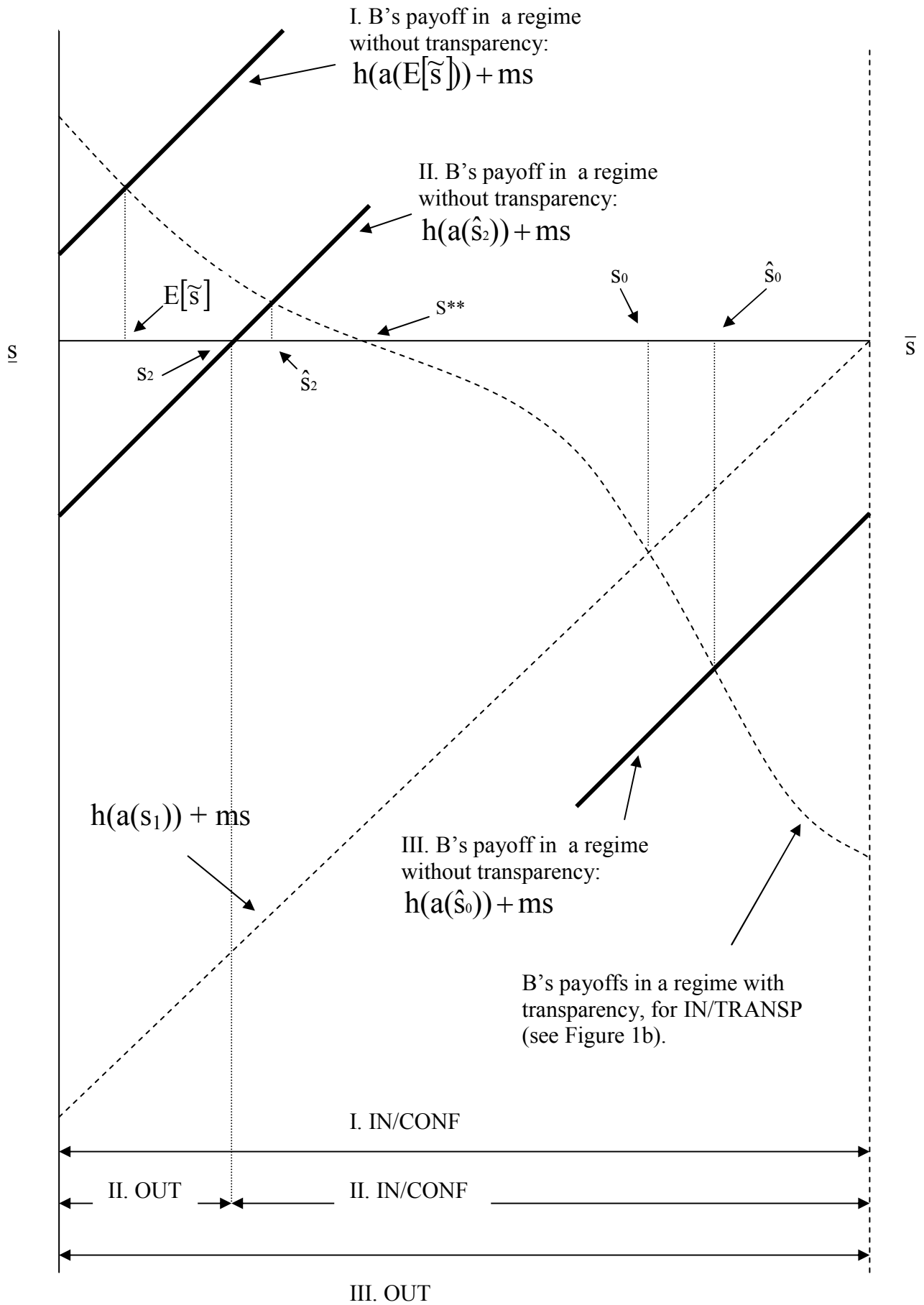
Subsidy

B's payoff, IN/TRANSP cum subsidy:
$h(a(s)) + ms + Subsidy$

s^*

s_3

B's payoff, IN/CONF:
$h(a(\overline{s})) + ms$

$\underline{s}$
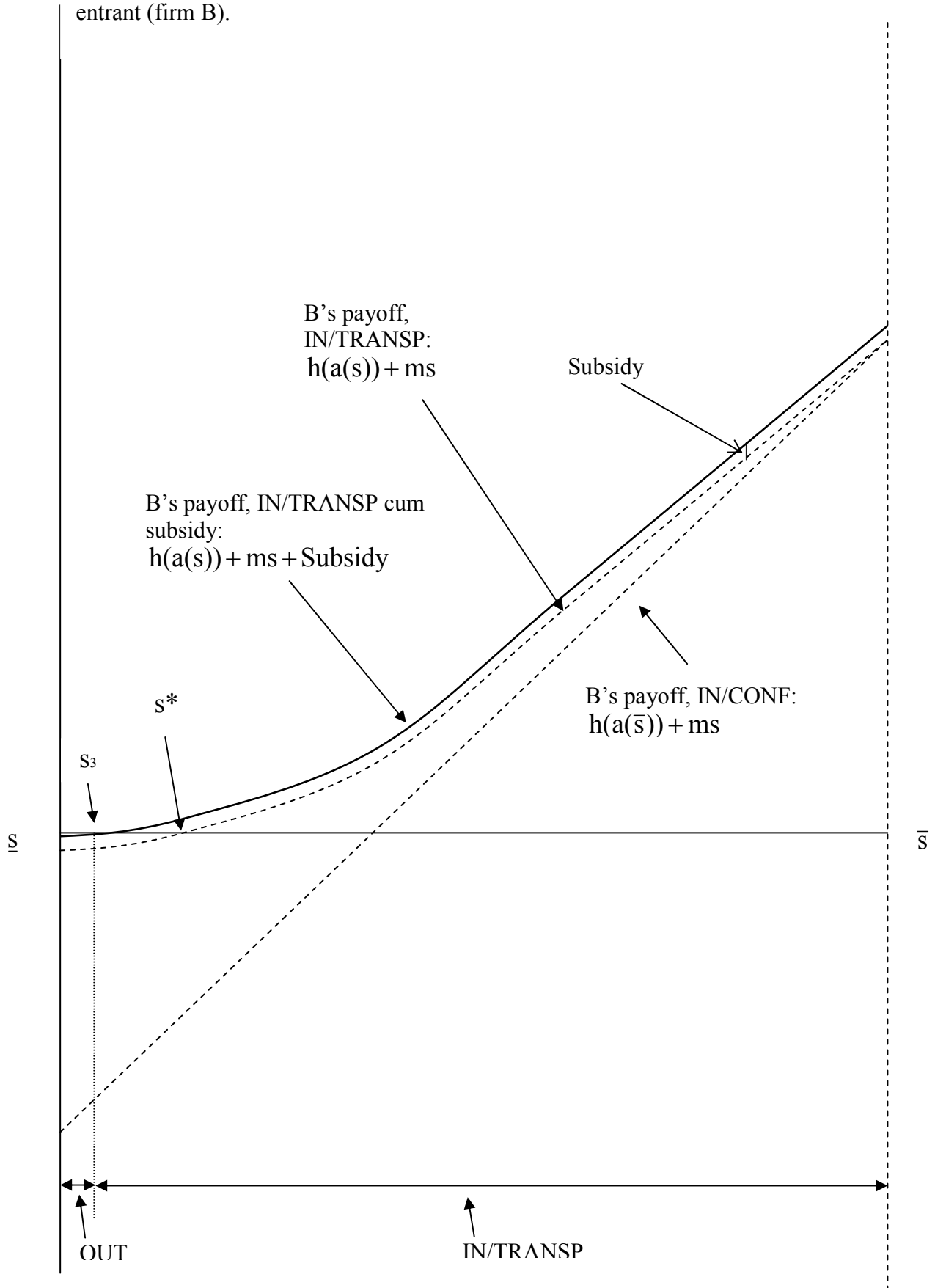
$\overline{s}$

OUT

IN/TRANSP

Figure 3a'. Subsidy to entry cum confidential financing when the incumbent (firm A) deters entry only of minor innovations by the potential entrant (firm B).

B's payoff, IN/CONF cum subsidy:
$$h(a(\hat{s}_4)) + ms + S(s_4)$$

$S(s_4)$

$$h(a(\hat{s}_4)) + ms$$

s^*

B's payoff, IN/TRANSP:
$$h(a(s)) + ms$$

$\underline{s}$

$\bar{s}$

s_4

$\hat{s}_4$

$$h(a(\bar{s})) + ms$$
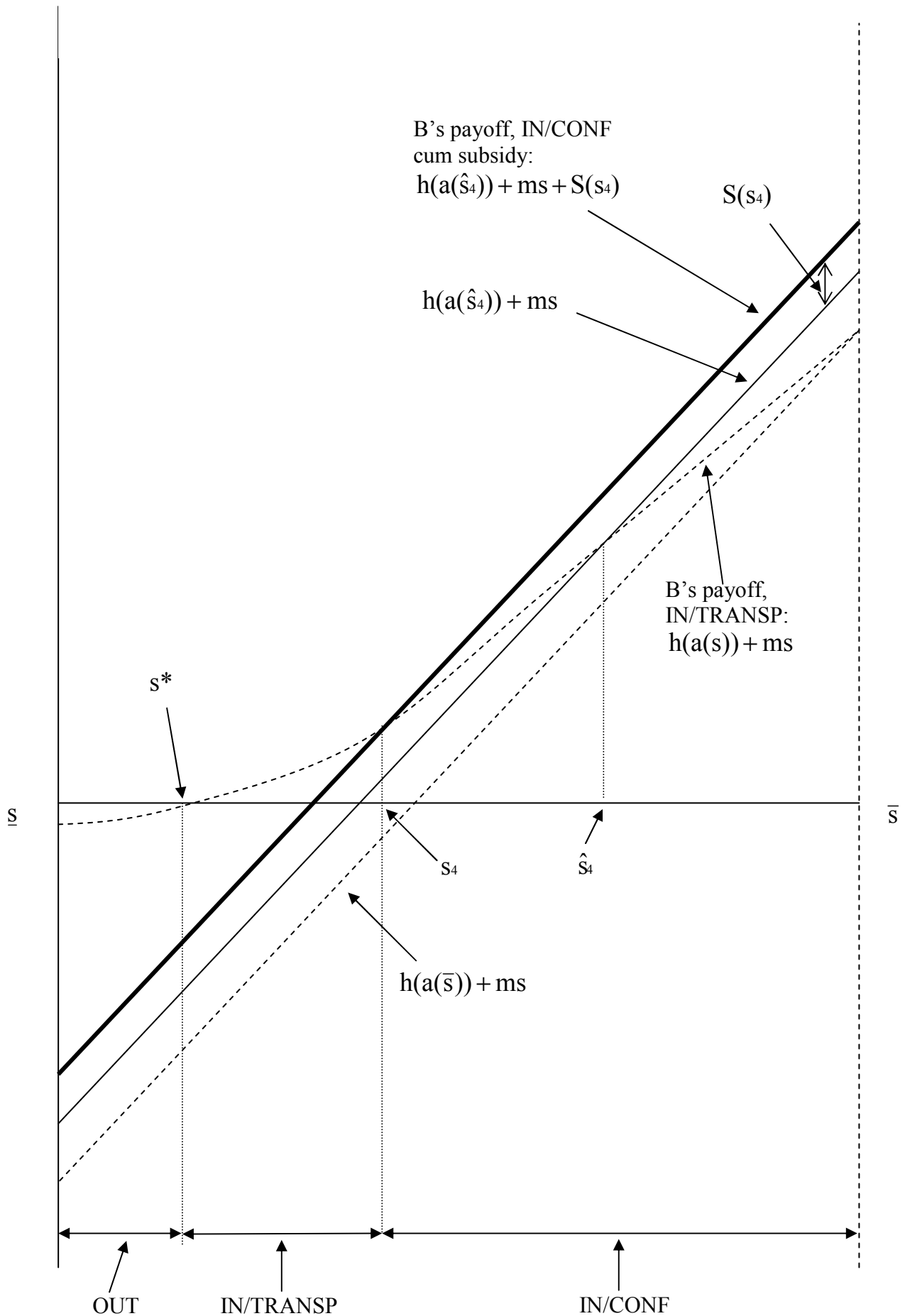
OUT   IN/TRANSP   IN/CONF

Figure 3b. Subsidy to entry cum transparent financing (or entry in general) when the incumbent (firm A) deters entry only of major innovations by the potential entrant (firm B).

Subsidy

B's payoff, IN/TRANSP cum subsidy:
$$h(a(s)) + ms + Subsidy$$

s_5 s_0 $\hat{s}_0$

$\underline{s}$ $\bar{s}$

s**

B's payoff, IN/CONF cum subsidy:
$$h(a(\hat{s}_0)) + ms + Subsidy$$

$h(a(s0)) + ms$

B's payoff, IN/CONF:
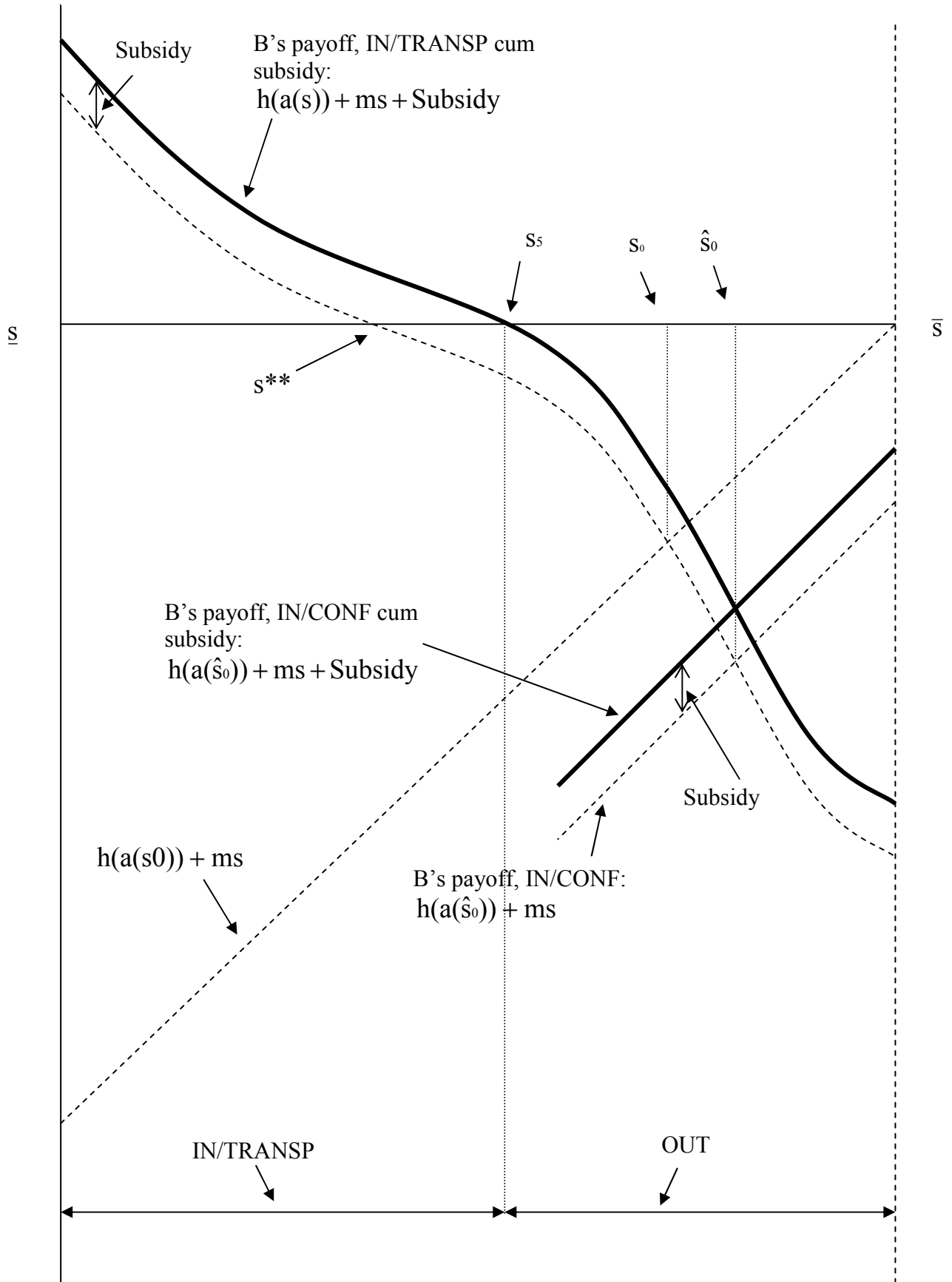$$h(a(\hat{s}_0)) + ms$$

Subsidy

IN/TRANSP

OUT

Figure 3b'. Subsidy to entry to entry cum confidential financing when the incumbent (firm A) deters entry only of major innovations by the potential entrant (firm B).

B's payoff, IN/TRANSP:
$h(a(s)) + ms$

s_6 s_0 $\hat{s}_6$ $\hat{s}_0$

$\underline{s}$

s^{**}

$\bar{s}$

B's payoff, IN/CONF cum subsidy:
$h(a(\hat{s}_6)) + ms + S(s_6)$

$S(s_6)$

$h(a(s_0)) + ms$

$h(a(\hat{s}_0)) + ms$

$h(a(\hat{s}6)) + ms$

IN/TRANSP

OUT

IN/CONF