Department: *Economia e Finanza – Financial Economics*
Subject: *Advanced Microeconomics*

DUAL TRACK SELL-OUT: SIGNALING THROUGH IPO AND UNDERPRICING.

Advisor:
Prof. Gian Luigi Albano

Candidate:
Andrea Siri 640971

Co-Advisor:
Prof. Giovanni Ponti

Academic Year: 2012/2013

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Abstract

Recent empirical analyses suggest the existence of a new exit strategy for private companies' owners: the *dual track sell-out*. This paper aims to understand whether this strategy involves signals and why some firms undertake it more than others. I build a model depicting how going public and *underpricing* arise also as a response to asymmetric information. Target firms and market's characteristics influence both signaling choices in equilibrium and conditions under which going public costs are offset by its benefits. It is shown that signaling plays a relevant role, answering why most firms dual tracking are characterized by valuation uncertainty.

Key words: *Initial Public Offering, underpricing, signaling, asymmetric information.*

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1. Introduction.

Most financial literature studied IPOs as instruments of fund raising, but recent empirical research started focusing on other rationales. Among these, IPOs have been recognized to be a step that managers of private firms undertake before selling their company.[1] The name of this procedure is *dual track sell-out*. Although going public is costly, there exist several advantages stemming from this strategy, such as enhanced visibility, higher bargaining power and cheaper information available to market players. Nonetheless *dual track sell-out* is not undertaken by all companies alike. M&A transactions in which the target is a newly listed company are usually characterized by remarkable uncertainty. Furthermore the value extractable by acquirers usually derives from exploiting target unique resources rather than from cost synergies, which in turn would be more easily assessable.

The model developed in this paper shows how asymmetric information reinforces the necessity to go public. Target companies are framed in a market characterized by imperfect information where there is a potential buyer. They can decide either to stay private or to go public at a fixed cost. If firms choose to undertake the IPO, they can decide whether and how much to *underprice* the issue at a proportional cost. Model outcomes depend on buyer's beliefs and on actions' costs and benefits. At any cost level better quality companies are more prone to dual track than worse ones, and the higher the quality the larger the level of *underpricing* observed in the public market.

The target choice can be so sensitive to information related issues that procedures as complex as IPOs can be driven by reasons different from the ones

[1] Soumendra and Jindra (2012) find that, on a sample of 6076 IPOs between 1980 and 2006, 15% of the newly listed companies became acquisition targets.

conventionally accepted. Companies suffering valuation distortions due to asymmetric information should be aware of the self-selection benefits given by instruments commonly designed for other scopes. On the counterpart side, buyers facing valuation uncertainty due to lack of information can take advantage from the observation of these unconventional signals. Public investors, which are eventually used as a mean of signaling, must consider the financial implications of this alternative way of facing companies undertaking IPOs. They can benefit from both excessive *underpricing* and subsequent takeover premia. Strategies as going public can be used to achieve a multitude of goals, reason why a deeper analysis of dual tracking is necessary to permit interested actors to understand what moves to make in this context.

2. Literature Review.

Whereas IPOs viewed as a signal is a recent concept, the *Underpricing puzzle*[2] has inspired a vast literature. In a study relying on US data of the last 30 years it was found that the average "*first day return*" of IPOs was of 17%.[3] The first two hypotheses to explain relied on asymmetric information, either between issuers and underwriters (Baron 1982) or among investors (Rock 1987). The former asserts that price is manipulated in order to reward underwriters for their better information on investors' demand whereas the latter states that *underpricing* arises in situations where informed and uninformed investors coexist. The informed agents are aware of the issue quality before buying it, causing expected losses to uninformed ones, who will obtain shares only in "bad IPOs". Asymmetric information was also theorized by Allen and Faulhaber (1988) and Welch (1989). Unlike the above mentioned hypotheses, *underpricing* is analyzed as a tool used by firms to signaling quality. Both papers argue that

[2] Underpricing is usually defined as the gap between the market price obtained in the market and the issuing price. The existence of it is puzzling because it corresponds to "money left on the table" by companies.
[3] Data taken from Ritter, Jay. 2011. "Initial Public Offering: Underpricing Statistics Through 2011".

underpricing firm's initial offering adds sunk costs that prevent low quality firms from imitating, asserting that only good companies are able to recover unproductive losses when performance is realized.

Recent empirical papers focus on the analysis of the dual tracking phenomenon, stressing the higher quality of the companies undertaking it and the presence of asymmetric information. Unlike traditional funding oriented IPOs, the process of going public is studied as a strategic device for owners to turn company status into public. Reuer and Shen (2003), state that divestiture via IPO is more likely when buyer valuation of targets suffers information asymmetries too costly to be avoided. Empirical evidence suggests that dual tracking is more widely used in those industries with strong spatial scattering and in those firms embedded with a high level of intangible assets. Capron and Shen (2007) analyze how lack of information about private targets increases acquirers' risks into M&A transactions and conclude that acquirers prefer to bid public companies when entering a new business. Ragozzino and Reuer (2007) studied how IPOs can diminish adverse selection by means of credible signals, stating that private market ones may not be reliable enough. Ragozzino (2011) again analyzes the relationship between IPO's signals as, indeed, *underpricing*, and relates them to the geographic distance of a successive acquirer, finding a correlation between these two. In their analysis on harvest strategies Brau, Sutton and Hatch (2010) compare companies dual tracking with privately sold ones. The former are more often venture capital backed, framed in a bubble market and slightly larger[4] and they usually belong to the high-tech industry. Braun, Lehmann and Schwerdfeger (2011) study German M&A market and find that acquisitions of newly listed targets are considered by the investors

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[4] The reasons for these three features are respectively: Venture Capitalists are willing to exit the business and take advantage of dual tracking benefits; during bubble years the optimism among investors may ease public issuances; larger companies are able to exploit economies of scales in offer costs.

as R&D investments, because reckoned as alternative to internal growth. Analyzing acquisition premia, Reuer, Tong and Wu (2012) find that being public benefits those targets whose acquirers belong to a different industry. Soumendra and Jindra (2012) examine newly listed company and conclude that acquisition targets are at least as good performers as those which have kept growing internally and that targets acquired shortly after listing show larger *underpricing* in high industry acquisition activity periods.

3. The Model.

3.1 The Private Market.

Assume that in the market there exists a population of private companies and that the quality of these follows a continuous distribution. Every type would like to sell-out and leave the business and the probability with which an agent will show interest into acquiring a company in the private market is defined by α. This is a one-stage game, hence the expected payoff of any seller is determined by a linear combination of the value obtained by the acquisition with the stand-alone value attained by continuing the firm's activity. Let us define K_i the stand-alone payoff of firm i and V_i the price that the acquirer would be willing to pay for the target if she knew the type with certainty. The value V_i does not have to reflect precisely the stand-alone value of the company plus all the synergies attainable from the transaction, because this would assume either that the seller is endowed with all the bargaining power or that there are at least two bidders with equal characteristics in a first-price auction. Nonetheless V_i is a price reflecting large part of them, since, in most industries, whenever the M&A transaction is not a "merger of equals", the premium paid by an acquirer reflects most of the synergies extractable. Consequently, define ξ_i the quality of target i and assume ξ distributes as a uniform with x and y respectively worst and best type:

(I) $\xi_i \sim U[x, y]$

Now define V_i and K_i of the private market as follows:

(II) $V_i = v\xi_i$ and $K_i = kx = K$ with $v > k$

By the assumptions stated so far, if both parties were perfectly informed about sellers' type, targets would obtain a first-best payoff given by:

(III) $\alpha V_i + (1-\alpha)K \qquad \forall i$

Let us assume that the main problem for the private companies is finding resources to deploy for their business. Hence when no transaction happens the stand-alone value is the same for all types and by assumption (II) this amount corresponds to the least quality one. The rationale behind this assumption will become clearer when the public market framework is introduced. When acquisition takes place, instead, better targets will be offered higher prices reflecting larger values stemming from their higher quality. This feature is reflected in the fact that:

(IV) $\xi_i > \xi_j \Leftrightarrow v\xi_i > v\xi_j \Leftrightarrow V_i > V_j$

Introducing asymmetric information, assume that targets know their own type while the buyer does not. The only common information is the uniform distribution of quality. The acquirer is no longer able to ascertain the true value and has to offer a common price that would prevent her from expected losses. The price determined in the pooling equilibrium framework is (see Appendix A):

(V) $\overline{P} = E(V_i) = \dfrac{v(y+x)}{2}$

Notice that in this equilibrium there is no adverse selection, since (II) holds and $\overline{P}$ is always greater than K.

3.2 The Possibility of Going Public.

Let us introduce the choice to launch an Initial Public Offering before being acquired, completing the so called *dual track sell-out* procedure. The game is still one-stage, therefore public payoffs are directly comparable with private ones. As it is in reality, undertaking an IPO implies a significant cost, represented by underwriter fees, disclosing procedures and a minimum level of *underpricing*[5] of the stock issued. Define this cost c. Besides, the price the buyer is willing to pay does not change since acquisition benefits are assumed not to vary.[6] There are three main differences between the public and the private market framework: a higher acquisition probability, the possibility to excessively *underprice* the stock issuance and a change in the stand-alone value due to the results obtained by investing the IPO proceeds.

First of all define β as the new probability with which a potential buyer shows interest in acquiring the targets and assume:

(VI) $\beta > \alpha$

Pagano, Panetta and Zingales (1998) study the ownership turnover phenomenon comparing private and public markets, finding out that the likelihood with which companies are acquired almost doubles within three years since when the IPO is launched. Also Shen and Capron (2007) state that private market is less visible to companies that are interested in an acquisition deal. They argue that data about public targets are easier to obtain because of mandatory information that must be audited and

[5] This level of *underpricing* is not the one that will be used in the model. The model variable can be interpreted as "excessive *underpricing*" that is not related to the one necessary for the initial stock to be sold.

[6] Given the possibility of a higher number of bidders and lower discount factors in the public market, it would have been reasonable to assume $V_i^{PB} > V_i^{PR}$. Nonetheless the model equilbria would have not been relevantly affected.

disclosed to stockholders and thanks to larger analysts' coverage. Running an IPO generates a consistent amount of advertisement, by means of either road shows or underwriter activity. The latter, which is usually an investment bank, can circulate the information that the firm is on sale and, as it often happens, can propose the deal to some of its clients in the future.

The second main difference is that in the IPO issuance the company has an instrument of signaling. Higher quality targets can excessively *underprice* their stock issuance in order to add enough sunk costs that may prevent lower quality ones from mimicking such behavior. Define the variable cost due to *undepricing* as:

(VII) $c(\theta_i, u_i) = \theta_i u_i \qquad \forall i$

(VIII) $\theta_i = q(N - \xi_i) \qquad$ with $\qquad N > y$

where u_i is the level of *undepricing* chosen by company i, and θ_i is the marginal cost paid for an additional unit of u_i. The linear cost function differs for the several types, penalizing worse ones. N is assumed to be larger than y because we shall assume that *underpricing* is a costly choice also for the best type. This model is structured similarly to Spence (1973) education model, where workers were obtaining different wages depending on their level of education. The difference among workers was their ability to study, whereas here the difference stems from the ability to recover an unproductive loss due to "money left on the table" by means of *underpricing*. It is implicit that better companies will be able to overcome these costs with a smaller impact than lower quality ones. In fact, more profitable firms can bear the burden of excessive costs with more ease than the ones whose business is less capable of generating income.

The third difference between the private and the public market regards the stand-alone value. The new stand-alone value is now different for the several types and depends on their quality:

(IX) $K_i = k\xi_i$

The change is due to the investment of the IPO proceeds collected. Higher quality companies will use the money collected to undertake better projects. Payoffs in the public market are now given by:

(X) $\beta P + (1-\beta)K_i - c - c(\theta_i, u) \qquad \forall i$

where P is to be determined in equilibrium and will depend on buyer's beliefs. If there was no asymmetric information in the public market, the first best payoffs obtained by targets would be (X) with $P = V_i$ for company i and 0 *underpricing* costs.

3.3 The Separating Equilibrium in the Public Market.

Let us now construct the separating equilibrium in the public market where better targets can differentiate themselves from worse ones. Assume that the buyer updates its beliefs monotonically such that:

(XI) $u_i > u_j$ when $\xi_i > \xi_j$ and hence $P(type = i \mid u = u_i) = 1$

For this equilibrium to hold, type i must choose an *underpricing* level that makes her better off than undertaking other feasible actions. Besides, any other type must be worse off by choosing player i action rather than its own. Assuming (XI) to hold, let us analyze the incentive compatibility constraints for two subsequent types, i and j, with $\xi_i - \xi_j = \varepsilon > 0$:

(XII) $\beta V_i + (1-\beta)K_i - c - c(\theta_i, u_i) \geq \beta V_j + (1-\beta)K_i - c - c(\theta_i, u_j)$

(XIII) $\beta V_j + (1-\beta)K_j - c - c(\theta_j, u_j) \geq \beta V_i + (1-\beta)K_j - c - c(\theta_j, u_i)$

These conditions are the incentive compatibility constraints that make type i better off by choosing u_i rather than u_j, but at the same time u_i is large enough to be unappealing for type j. The interval within which (XII) and (XIII) are both satisfied (see Appendix B) is:

$$\textbf{(XIV)}\quad u_i - u_j \in \left[\frac{\beta(V_i - V_j)}{\theta_j}, \frac{\beta(V_i - V_j)}{\theta_i}\right] \Leftrightarrow u_i - u_j \in \left[\frac{\beta v(\xi_i - \xi_j)}{q(N-\xi_j)}, \frac{\beta v(\xi_i - \xi_j)}{q(N-\xi_i)}\right]$$

The *undepricing* level depends linearly on the probability of being acquired in the public market β, mainly because the benefit of signaling is just partial, since with complementary probability $1-\beta$ the company will not receive any acquisition offer. Besides, both boundaries are affected by the difference in quality $\xi_i - \xi_j$. The larger the gap the higher the opportunity cost that better types incur in not signaling and receiving a worse type offer. Moreover, when the difference in quality is larger, also the hypothetical benefit from mimicking increases, making more expensive signal necessary. The difference between the lower and the upper bound is determined by the marginal costs of signaling. *Underpricing* must be low enough for type i to take advantage from type revelation, hence the lower the marginal cost $\theta_i = q(N - \xi_i)$ the looser the upper constraint. Besides, it must be high enough to prevent type j from pooling. Likewise, the lower bound has an inverse relation with the marginal cost of mimicking $\theta_j = q(N - \xi_j)$. As it is standard in the signaling literature, let us use the *intuitive criterion* concept theorized by Cho and Kreps (1987) to select a unique equilibrium, and in particular the least costly one: the buyer never assigns positive probability to actions that would never be undertaken by company j. Therefore the difference between the two signaling levels is:

(XV) $(u_i - u_j) = \dfrac{\beta v(\xi_i - \xi_j)}{q(N-\xi_j)} = \dfrac{\beta v \varepsilon}{q(N-\xi_j)}$

By taking the limit for $\varepsilon \to 0$ we obtain the following differential equation:

(XVI) $du = \dfrac{\beta v d\xi}{q(N-\xi)}$

Assume for the moment that all types are inside the public market. This means that the worst type doing dual tracking has quality x. The company with worst quality will *underprice* 0 since she does not need to differentiate from any worse type. Using the fact that $u_x = 0$ and solving (XVI), type i will *underprice* (see Appendix C):

(XVII) $\int_{u_x}^{u_i} du = \int_{x}^{\xi_i} \dfrac{\beta v}{q(N-\xi)} d\xi \Leftrightarrow u_i = \dfrac{\beta v}{q} \log\left(\dfrac{N-x}{N-\xi_i}\right)$

Notice that u_i collapses to 0 when $\xi_i = x$ confirming that no *underpricing* is observed in the worst type. u_i increases with ξ_i, meaning that higher types *underprice* more, consistently with buyer's beliefs. These results are linked to the Spence game with continuous types. Nonetheless, in this model the fully revealing equilibrium holds only if all companies have also incentive to do dual track, meaning that public payoffs for all types must dominate private market ones. Analyzing the new dynamics of the private market, assume IPO itself being a signal at cost c. For the previous equilibrium to hold also the following participation constraint must be satisfied:

(XVIII) $\beta V_x + (1-\beta)K_x - c > \alpha V_x + (1-\alpha)K_x$

We still assume prices to be monotone: if the amount offered by the potential buyer to the worst type in the public market is V_x, the price obtainable in the private market cannot be larger than that. Condition (XVIII) implies that the worst type is better off by dual tracking even though the action does not contribute to its quality revelation. If

(XVIII) holds, also all the types with quality higher than x are better off by dual tracking rather than staying private because the incentive compatibility constraints must hold in equilibrium (see Appendix D). Therefore (XVIII) is a sufficient condition for the equilibrium just described to hold.

Define c_x the value of c that makes (XVIII) hold with equality:

(XIX) $c_x = (\beta - \alpha)(V_x - K_x) = x(\beta - \alpha)(v - k)$

We can affirm that for $c \le c_x$ the following equilibrium holds: *all types go public; every type is paid its true value: type i is paid* V_i*; the underpricing level of type i is* $u_i = \frac{\beta v}{q}\log\left(\frac{N-x}{N-\xi_i}\right)$*; buyer beliefs are such that if a company is public and underprices* u_i*, that company is type i with probability 1; the price offered in the private market is* V_x. When c is above this threshold, some of the worst types would be better off choosing to stay private, changing the equilibrium dynamics.

3.4 The Semi-Pooling Equilibrium.

The analysis will now focus on how the equilibrium configurations change as the fixed cost c present in the market varies. In the equilibrium discussed so far all types were incentivized to go public and benefit from both quality revelation and higher acquisition probabilities. In the equilibria in which c is above c_x dynamics slightly change. A fraction of types, the lower quality ones, will reckon dual tracking too expensive and will decide to remain private. Buyer beliefs update through Bayes rule and the price offered in the private market is driven by worse quality companies. On the other hand the types deciding to dual track will still *underprice*. Nonetheless every type will rely on this signal less the smaller the portion inside the public market.

Let us define c_{ξ_j} the cost level at which type j with quality ξ_j is indifferent between dual tracking and staying private. This means that at c_{ξ_j} every type with quality above or equal to ξ_j will be public, whereas all the types below choose to remain private. Therefore at c_{ξ_j} the price offered by the buyer in the private market is updated through Bayes rule (see Appendix E):

$$\textbf{(XX)} \quad P_j = E(v\xi \mid \xi < \xi_j) = v\frac{\xi_j + x}{2}$$

Notice that this price increases in ξ_j. The larger ξ_j the better the quality of the types in the private market, and therefore higher prices will be offered. But at which value of c_{ξ_j} does this situation arise? At c_{ξ_j} type ξ_j is indifferent between dual tracking and staying private, meaning that ξ_j is the worst type inside the public market. As in the former equilibrium in which every type was inside the public market and x was not signaling, type ξ_j will *underprice* 0 and will anyway be able to differentiate from types whose quality is worse than ξ_j. Hence, the condition under which the situation just described holds is:

$$\textbf{(XXI)} \quad \beta v\xi_j + (1-\beta)k\xi_j - c_{\xi_j} = \alpha vP_j + (1-\alpha)kx$$

Combining (XX) and (XXI), c_{ξ_j} becomes a function of ξ_j:

$$\textbf{(XXII)} \; c_{\xi_j} = \beta v\xi_j - \alpha v\frac{\xi_j + x}{2} + (1-\beta)k\xi_j - (1-\alpha)kx$$

Of course, substituting $\xi_j = x$, the c_x obtained is exactly the one of (XIX) (see Appendix F). The derivative of (XXII) with respect to quality ξ_j is:

(XXIII) $$\frac{dc_{\xi_j}}{d\xi_j} = (\beta - \frac{\alpha}{2})v + (1-\beta)k > 0$$

We can notice that c_{ξ_j} increases with ξ_j meaning that the higher the quality the larger the c threshold at which the company will decide to remain private.

Having defined c_{ξ_j} for any hypothetical type j, we can proceed to analyze the behavior of the companies still dual tracking and compute the portion of them. As afore mentioned, at c_{ξ_j} the worst type doing dual tracking has quality ξ_j. Being j already able to differentiate itself by going public, no further costs are going to be added through *underpricing*. Nonetheless, for types of quality better than ξ_j the reasoning developed in the situation in which all the types were dual tracking remains unchanged: (XV) and (XVI) are still valid. The only difference that arises is due to the fact that now 0 *underpricing* is no longer associated with quality x but with quality ξ_j. Hence, the new *underpricing* level observed for every $\xi_i \geq \xi_j$ is (see Appendix G):

(XXIV) $$\int_{u_j}^{u_i} du = \int_{\xi_j}^{\xi_i} \frac{\beta v}{q(N-\xi)} d\xi \Leftrightarrow u_i = \frac{\beta v}{q} \log\left(\frac{N-\xi_j}{N-\xi_i}\right)$$

Comparing (XVII) and (XXIV) it can be noticed that, since $\xi_j \geq x$, signal expense is lower for every type. Anyway we should not be deceived by this finding. In reality higher quality companies are already paying a c that is not sustainable by the lower quality ones, and therefore the added sunk costs deriving from *underpricing* are relevant only within targets that are dual tracking. As previously mentioned, while c_{ξ_j} increases in ξ_j, the higher the quality of the worst target dual tracking the lower u_i for any type:

(XXV) $$\frac{du_i}{d\xi_j} = -\frac{\beta v}{q(N-\xi_j)} < 0$$

For any level of c there exists a fraction of firms dual tracking. This portion is 1 whenever $c \leq c_x$, but it decreases with c when fixed costs are above this threshold. Define c_y the cost at which the best type is indifferent between dual tracking and remaining private. Using (XXII):

(XXVI) $$c_y = \beta vy - \alpha v \frac{x+y}{2} + (1-\beta)ky - (1-\alpha)kx$$

Above this threshold no type will dual track, and therefore the pooling equilibrium defined in section 3.1 is completely restored. This means that when $c \to c_y$ the number of types dual tracking must collapse to 0. Define ρ the fraction of types dual tracking. Since at any c_{ξ_j} there corresponds a ξ_j and we assumed that quality is distributed as a uniform:

(XXVII) $$\rho = \frac{y-\xi_j}{y-x}$$

This definition of ρ is consistent with the reasoning so far explained since:

(XXVIII) $$c_{\xi_j} \to c_x \Leftrightarrow \xi_j \to x \Leftrightarrow \rho \to 1$$

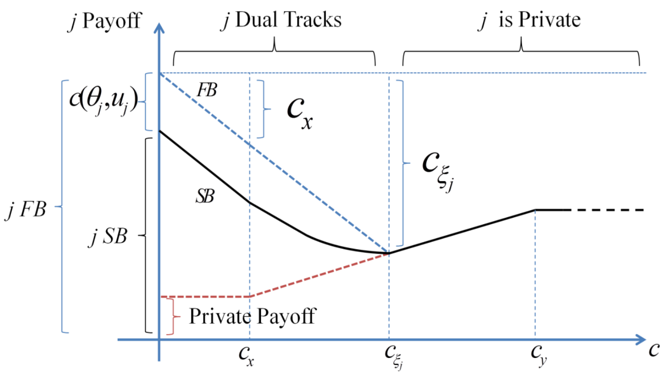
(XXIX) $$c_{\xi_j} \to c_y \Leftrightarrow \xi_j \to y \Leftrightarrow \rho \to 0$$

which is exactly what we have previously forecasted. Whenever c is smaller than or equal to c_x every type is dual tracking and ρ is 1. When c is above c_y, instead, no type will dual track, and the equilibrium found is the same described in the situation in which only the private market choice is available to target companies.

For $c_x \leq c \leq c_y$ the following equilibrium holds: $\rho = \frac{y-\xi_j}{y-x}$ *types go public; only public types are paid their true value: type i is paid* V_i; *the level of underpricing of* *type i is* $u_i = \frac{\beta v}{q} \log\left(\frac{N-\xi_j}{N-\xi_i}\right)$; *buyer beliefs are such that if a company is public and underprices* u_i, *that company is type i with probability 1; the price offered in the private market is* $P_j = v\frac{\xi_j + x}{2}$; *at every* ξ_j *corresponds a* c_{ξ_j} *level.*

At $c > c_y$ the private market equilibrium holds: *no type goes public; no type is paid its true value but the median type; buyer beliefs are such that all companies are in the private market; the price offered in the private market is* $\overline{P} = v\frac{x+y}{2}$.

As shown in the description of model equilibria, there is a direct relationship between c levels and information revelation. The lower the fixed costs the larger the number of targets being paid their true price, since more companies dual track. When c is too high, instead, and in specific above c_y, no information is revealed since no company can afford the cost of going public. When analyzing targets' payoffs, larger cs generate two main effects: a lower *underpricing* for any public type, caused by the smaller number of targets dual tracking, and a larger pooling price paid to private ones, due to the fact that companies with better quality decide to remain private. Let us analyze how a generic type j payoff varies at different c levels.



Graph 1. Type j ***payoff at any*** c ***level (see Appendix H).***

As shown in Graph 1, j payoff decreases in c up to c_x, since fixed costs are such that no type is better off by remaining private. When $c_x < c \leq c_{\xi_j}$ the effect is ambiguous because increasing c causes *underpricing* to decrease, eventually becoming 0 at c_{ξ_j}. For c above c_{ξ_j} target j payoff is determined in the private market and it unambiguously increases the larger the fixed costs, because, as aforementioned, larger cs correspond to higher pooling prices offered.

3.5 Comparison with Perfect Information.

Having analyzed types' behavior under different levels of fixed costs, let us examine the implications of asymmetric information in this model. In the case of perfectly informed agents, seller choices would have been between:

(XXX) $$\beta v\xi_j + (1-\beta)k\xi_j - c \quad \text{and} \quad \alpha v\xi_j + (1-\alpha)kx$$

because in both markets all targets are paid their true value and no *underpricing* is observed.[7] From (XXX), threshold c'_{ξ_j} is different from c_{ξ_j}, the one computed under asymmetric information:

(XXXI) $$c'_{\xi_j} = v(\beta-\alpha)\xi_j + (1-\beta)k\xi_j - (1-\alpha)kx$$

In order to understand which threshold is larger, take $c_{\xi_j} - c'_{\xi_j}$:

(XXXII) $$c_{\xi_j} - c'_{\xi_j} = -\alpha v\frac{\xi_j + x}{2} + \alpha v\xi_j = \frac{\alpha}{2}v(\xi_j - x) \geq 0$$

From (XXXII) we can see that, even though there is no difference for $\xi_j = x$, the threshold under asymmetric information is larger than the one under perfectly informed agents. This happens for all parameter values. A higher threshold means that at the same level of c, the fraction ρ of companies dual tracking under asymmetric information is

[7] *Underpricing* is used only as a signal and it does not give any benefit to targets but type revelation.

larger, leading to the conclusion that dual tracking is more widely used in a situation of higher uncertainty. From (XXXII) we can also notice that the difference depends positively on v, suggesting that there is more value in revealing information when targets can attain higher prices from acquisition.

3.6 M&A Waves: High Acquisition Periods.

In the last part of the former chapter we saw that a larger v causes the difference between perfect and asymmetric information threshold to be wider. M&A waves are usually triggered either by technological shocks or by better investment opportunities, suggesting an increase in the prices paid by acquirers. Nonetheless, by assuming that in high acquisition periods the better value extractable by a potential buyer is reflected in a rise of v would imply that high quality targets would benefit more than low ones, since $V_i = v\xi_i$ and $\frac{dV_i}{dv} = \xi_i$. In order to avoid this problem, let us assume that larger values extractable are the same for every type. If companies are acquired during M&A waves the price the acquirer is willing to pay is increased by $W_i = W$ for every i. How is any c_{ξ_j} threshold affected? Call $c^h_{\xi_j}$ the new threshold that arises in high acquisition periods. Using condition (XXI) the new value is:

(XXXIII) $$c^h_{\xi_j} = \beta v \xi_j - \alpha v \frac{\xi_j + x}{2} + (1-\beta)k\xi_j - (1-\alpha)kx + \beta W - \alpha W =$$

$$= c_{\xi_j} + (\beta - \alpha)W$$

Since $(\beta - \alpha)W > 0$, the difference between $c^h_{\xi_j}$ and c_{ξ_j} is positive. From (XXXIII) we can conclude that under high acquisition periods more targets dual track. Regarding *underpricing*, whereas there is no direct effect because βW would be added on both sides of (XIII), there exists an indirect effect. All else equal, M&A waves induce a larger number of firms to dual track, causing all *underpricing* levels observed to be higher.

4. Empirical Connections.

Divesture via IPO advantages can be split into two categories: direct advantages deriving from a public status and indirect advantages given by signaling opportunities available during the IPO procedure.

The former ones mainly rely on the amount and on the quality of information flows produced in the public market. Public companies are continuously monitored by dispersed shareholders and financial markets, whereas mandatory information must be audited and disclosed to stockholders, media and regulators. Furthermore corporate governance standards are tighter, because of fixed organizational rules and due to the presence of Code of Conducts. These characteristics influence the riskiness perceived by potential acquirers, who may feel more confident to attach lower discount rates, ending up valuing the business more than how it would have been estimated in the private market. Empirical evidence shows that average acquisition premia are larger in the public market compared to private ones (Brau, Sutton and Hatch 2010). Besides, publicly accessible information eases possible acquisitions, increasing the probability of a takeover offer (Pagano, Panetta and Zingales 1998). In a private framework, instead, an acquirer will undertake the process of acquisition only once enough private information is obtained (Capron and Shen 2007).

Indirect advantages instead rely on quality revelation achievable either through IPO alone or by adding *underpricing*. In most of the empirical studies which had focused on the dual tracking phenomenon one common feature is present in the firms acquired shortly after listing**:** high uncertainty about company valuation. This characteristic justifies the presence of asymmetric information and, as the model shows, suggests that the *dual track sell-out* is more common under uncertain environments because of its signaling function.

Analyzing recent empirical papers it becomes clear how asymmetric information is relevant for the dual tracking decision. The first example applies to companies with large values dependent on intangible assets. Acquisition value stems from better employability of intangible resources otherwise not exploitable and on perceived growth opportunities rather than from assets in place and business model employed (Ragozzino and Reuer 2007). Reuer and Shen (2003) findings confirm the former view, pointing chemical and allied products, electronic and electrical equipments and R&D intensive industries to be the ones mostly implementing the dual tracking strategy. Braun and Lehman (2011) analysis of the German market leads to the conclusion that in R&D oriented industries these kinds of transactions are commonly considered as internal R&D investments. The common key characteristics of these new enterprises are specific human-capital and technological know-how. Other kinds of deals that arise when the target company has gone public lately are those related to business-wise or geographical distance of acquirers. When a company wants to enter new businesses, extra value from acquisitions can be reflected in the possibility to obtain a "ticket to play" in such activity. Buyers are more likely going to buy private targets when making an acquisition within the same industry, whereas they will buy public ones when targeting different firms, due to their difficult valuation. The reasoning holds also when buyers are entering a geographically new market. Acquirers may prefer to buy private targets for local search but they will buy public ones for companies geographically distant, due to a higher uncertainty (Capron and Shen 2007). Ragozzino and Reuer

(2011) study the connections between the IPO procedure and acquirer geographical distance, observing that farther targets are more affected by information asymmetries and that there is a relevant role for signaling. Findings just discussed share the idea that buyers face difficulties valuing targets either because of industry nature or because of acquirer's inexperience.

Most empirical papers suggest IPO alone as a sufficient signal, regardless of the possibility to *underprice*. Soumedra and Jindra (2012), who furthermore conclude that newly listed firms acquired are good performers, find that targets have significantly larger *underpricing* in time of high acquisition industry, while under normal conditions dual tracking firms experience *underpricing* levels in line with the ones observed in companies going public for other reasons, suggesting that there exists a rationale for signaling combinations. M&A waves are usually triggered by technology shocks and better investment opportunities, increasing the potential value extractable through acquisitions. Every c threshold analyzed in the model positively depends on acquisition values, and, as analyzed in 3.6, higher acquisition prices lead more targets to dual track. This behavior is compatible with Soumendra and Jindra findings, since equilibria with larger fractions of companies dual tracking are characterized by higher *underpricing* levels.

5. Theoretical Predictions.

As discovered by analyzing the model, equilibrium predictions hinge on company variables and on IPO costs. The full revelation equilibrium prevails when all firms find dual tracking beneficial and every company but the worst *underprice* the public issuance. The scenario changes when some targets can take advantage of the public status but others cannot. Full information revelation is achieved only by those targets undertaking the IPO, whereas in the private market more and more companies pool when going public costs increase. Inside the public market, higher types *underprice* more, but the smaller the portion of firms dual tracking the lower the *underpricing* level of every target. In particular, we have seen that the smaller the costs related to the IPO signal the higher the *underpricing* that must be paid to be able to differentiate, because more targets will be able to benefit from dual tracking. The private market equilibrium analyzed in the very first section prevails when costs are relatively too high with respect to companies' fundamentals and when no firm can take advantage of quality revelation. It is a question for further empirical research to understand which equilibrium is more representative in the various situations.

6. Conclusions.

IPO implies more than just fund raising: it is a strategic decision. In a world of imperfect markets, perfect contracts cannot be stipulated. Dual tracking and *underpricing* are not the only signals available to private companies. Nonetheless the main goal of this work was to understand whether dual tracking could be effectively considered a valuable signal and if excessive *underpricing* was justifiable as a complementary instrument.

Market and firm related characteristics influence the benefits achievable through the dual tracking procedure. Although there exist direct advantages attainable by changing target status from private to public, IPO itself plus issuance *underpricing* are shown to be also responses to asymmetric information, causing companies framed within uncertain environments to be more prone to dual track. The validity as a signal increases with the costs to be sustained. Larger levels of *underpricing* arise when the costs of going public are not sufficient to prevent worse types from dual tracking. In other words the revelation effectiveness of the IPO procedure depends on its feasibility and *underpricing* can be considered as a signal reinforcement.

Dual tracking decision does not rely only on public status benefits. A self-selection process allows those actors who are framed in uncertain environments to benefit also from quality revelation. Gains belong to both better targets, since uncertainty favors poor companies and damage good ones, and buyers who become more confident of their valuations. Any company choice should be analyzed under several lights in order to capture its assessment drivers and very often, for decisions as largely analyzed as undertaking Initial Public Offerings, any interested party can easily oversee key elements that would totally change the meaning behind those actions.

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Appendix A.

The pooling price paid in equilibrium by the acquirer is the expected value of V_i :

(A.I) $\overline{P} = E(V_i) = vE(\xi_i) = vE(\xi_i) =$

$$= v\int_x^y \frac{\xi_i}{(y-x)} d\xi = \frac{v}{2(y-x)}\left(\xi_i^{\,2}\right]_x^y =$$

$$= \frac{v(y-x)(y+x)}{2(y-x)} = \frac{v(y+x)}{2}$$

Appendix B.

Following (XI):

(B.I) $\beta V_i + (1-\beta)K_i - c - c(\theta_i, u_i) \geq \beta V_j + (1-\beta)K_i - c - c(\theta_i, u_j)$

$$\beta v\xi_i + (1-\beta)k\xi_i - c - q(N-\xi_i)u_i \geq \beta v\xi_j + (1-\beta)k\xi_i - c - q(N-\xi_i)u_j$$

$$\beta v\xi_i - q(N-\xi_i)u_i \geq \beta v\xi_j - q(N-\xi_i)u_j$$

$$(u_i - u_j) \leq \frac{\beta v(\xi_i - \xi_j)}{q(N-\xi_i)}$$

Developing (XII) instead:

(B.II) $\beta V_j + (1-\beta)K_j - c - c(\theta_j, u_j) \geq \beta V_i + (1-\beta)K_j - c - c(\theta_j, u_i)$

$$\beta v\xi_j + (1-\beta)k\xi_j - c - q(N-\xi_j)u_j \geq \beta v\xi_i + (1-\beta)k\xi_j - c - q(N-\xi_j)u_i$$

$$\beta v\xi_j - q(N-\xi_j)u_j \geq \beta v\xi_i - q(N-\xi_j)u_i$$

$$(u_i - u_j) \geq \frac{\beta v(\xi_i - \xi_j)}{q(N-\xi_j)}$$

Notice that since $\xi_i > \xi_j$:

(B.III) $\dfrac{\beta v(\xi_i - \xi_j)}{q(N-\xi_j)} \leq \dfrac{\beta v(\xi_i - \xi_j)}{q(N-\xi_i)}$

Appendix C.

Solving the differential equation (XVI) for any type i we obtain:

(C.I) $du = \frac{\beta v d\xi}{q(N-\xi)} \Leftrightarrow \int_{u_x}^{u_i} du = \int_{x}^{\xi_i} \frac{\beta v}{q(N-\xi)} d\xi \Leftrightarrow$

$$\Leftrightarrow u_i - u_x = \int_{x}^{\xi_i} \frac{\beta v}{q(N-\xi)} d\xi = \frac{\beta v}{q} \int_{x}^{\xi_i} \frac{1}{N-\xi} d\xi = -\frac{\beta v}{q} \log(N-\xi_i) + \frac{\beta v}{q} \log(N-x) =$$

$$= \frac{\beta v}{q} \log\left(\frac{N-x}{N-\xi_i}\right)$$

And since $u_x = 0$:

(C.II) $u_i = \frac{\beta v}{q} \log\left(\frac{N-x}{N-\xi_i}\right)$

Appendix D.

The worst quality type payoff in the public market is:

(D.I) $\beta V_x + (1-\beta) K_x - c$

First of all we must make sure that all the incentive compatibility constraints are satisfied. Given that the relationship between type i and j payoffs described in (XII) and (XIII) holds, take a hypothetical type r such that $\xi_j - \xi_r = \varepsilon > 0$ and therefore $\xi_i > \xi_r$. Furthermore, by the equilibrium described:

(D.II) $u_j - u_r = \frac{\beta v(\xi_j - \xi_r)}{q(N-\xi_r)}$

The following incentive compatibility constraints for i and r must be satisfied:

(D.III) $\beta v\xi_i + (1-\beta)k\xi_i - c - q(N-\xi_i)u_i \geq \beta v\xi_r + (1-\beta)k\xi_i - c - q(N-\xi_i)u_r$

(D.IV) $\beta v\xi_r + (1-\beta)k\xi_r - c - q(N-\xi_r)u_r \geq \beta v\xi_i + (1-\beta)k\xi_r - c - q(N-\xi_r)u_i$

Meaning that:

(D.V) $\dfrac{\beta v(\xi_i - \xi_r)}{q(N-\xi_r)} \leq u_i - u_r \leq \dfrac{\beta v(\xi_i - \xi_r)}{q(N-\xi_i)}$

Let us show $u_i - u_r \leq \dfrac{\beta v(\xi_i - \xi_r)}{q(N-\xi_i)}$ first. Using (XV) and (D.II):

(D.VI) $u_i - u_r \leq \dfrac{\beta v(\xi_i - \xi_r)}{q(N-\xi_i)} \Leftrightarrow u_i - u_j + \dfrac{\beta v(\xi_j - \xi_r)}{q(N-\xi_r)} \leq \dfrac{\beta v(\xi_i - \xi_r)}{q(N-\xi_i)} \Leftrightarrow$

$$\Leftrightarrow \frac{\beta v(\xi_i - \xi_j)}{q(N-\xi_j)} + \frac{\beta v(\xi_j - \xi_r)}{q(N-\xi_r)} \leq \frac{\beta v(\xi_i - \xi_r)}{q(N-\xi_i)} \Leftrightarrow$$

$$\Leftrightarrow \frac{\beta v(\xi_i - \xi_j)}{q(N-\xi_j)} + \frac{\beta v(\xi_j - \xi_r)}{q(N-\xi_r)} < \frac{\beta v(\xi_i - \xi_j)}{q(N-\xi_j)} + \frac{\beta v(\xi_j - \xi_r)}{q(N-\xi_j)} = \frac{\beta v(\xi_i - \xi_r)}{q(N-\xi_j)} < \frac{\beta v(\xi_i - \xi_r)}{q(N-\xi_i)}$$

and we see that, the IC represented in (D.III) is slack. To demonstrate $u_i - u_r \geq \dfrac{\beta v(\xi_i - \xi_r)}{q(N-\xi_r)}$ we still use (XV) and (D.II):

(D.VII) $u_i - u_r \geq \dfrac{\beta v(\xi_i - \xi_r)}{q(N-\xi_r)} \Leftrightarrow u_i - u_j + \dfrac{\beta v(\xi_j - \xi_r)}{q(N-\xi_r)} \geq \dfrac{\beta v(\xi_i - \xi_r)}{q(N-\xi_r)} \Leftrightarrow$

$$\Leftrightarrow \frac{\beta v(\xi_i - \xi_j)}{q(N-\xi_j)} + \frac{\beta v(\xi_j - \xi_r)}{q(N-\xi_r)} \geq \frac{\beta v(\xi_i - \xi_r)}{q(N-\xi_r)} \Leftrightarrow$$

$$\Leftrightarrow \frac{\beta v(\xi_i-\xi_j)}{q(N-\xi_j)}+\frac{\beta v(\xi_j-\xi_r)}{q(N-\xi_r)}>\frac{\beta v(\xi_i-\xi_j)}{q(N-\xi_r)}+\frac{\beta v(\xi_j-\xi_r)}{q(N-\xi_r)}=\frac{\beta v(\xi_i-\xi_r)}{q(N-\xi_r)}$$

and it is showed that also the IC represented in (D.IV) is slack. The reasoning made above can be repeated and applied to all types.

After the demonstration above, we can compare the actual payoff of a hypothetical type i with one obtained by mimicking x:

(D.VIII) $\beta V_i+(1-\beta)K_i-c-c(\theta_i,u_i)>\beta V_x+(1-\beta)K_i-c$

But for construction $K_i>K_x$, and we can say that:

(D.III) $\beta V_x+(1-\beta)K_i-c>\beta V_x+(1-\beta)K_x-c$

Therefore condition (XVIII) is sufficient condition for all the types to be willing to dual track.

Appendix E.

Buyer updates its beliefs through Bayes rule, and will offer:

$$\textbf{(E.I)}\ P_j = E(\xi_i \mid \xi_i < \xi_j) = \frac{\int_x^{\xi_j} \frac{\xi}{y-x} d\xi}{F(\xi_j)} = \frac{\int_x^{\xi_j} \frac{\xi}{y-x} d\xi}{\int_x^{\xi_j} \frac{1}{y-x} d\xi} = \frac{\xi_j^{\,2} - x^2}{2(\xi_j - x)} = \frac{\xi_j + x}{2}$$

Appendix F.

The cost function is:

$$\textbf{(F.I)}\ c_{\xi_j} = \beta v \xi_j - \alpha v \frac{\xi_j + x}{2} + (1-\beta) k \xi_j - (1-\alpha) k x$$

Substituting $\xi_j = x$:

$$\textbf{(F.II)}\ c_x = \beta v x - \alpha v \frac{x + x}{2} + (1-\beta) k x - (1-\alpha) k x = x(\beta - \alpha)(v - k)$$

Appendix G.

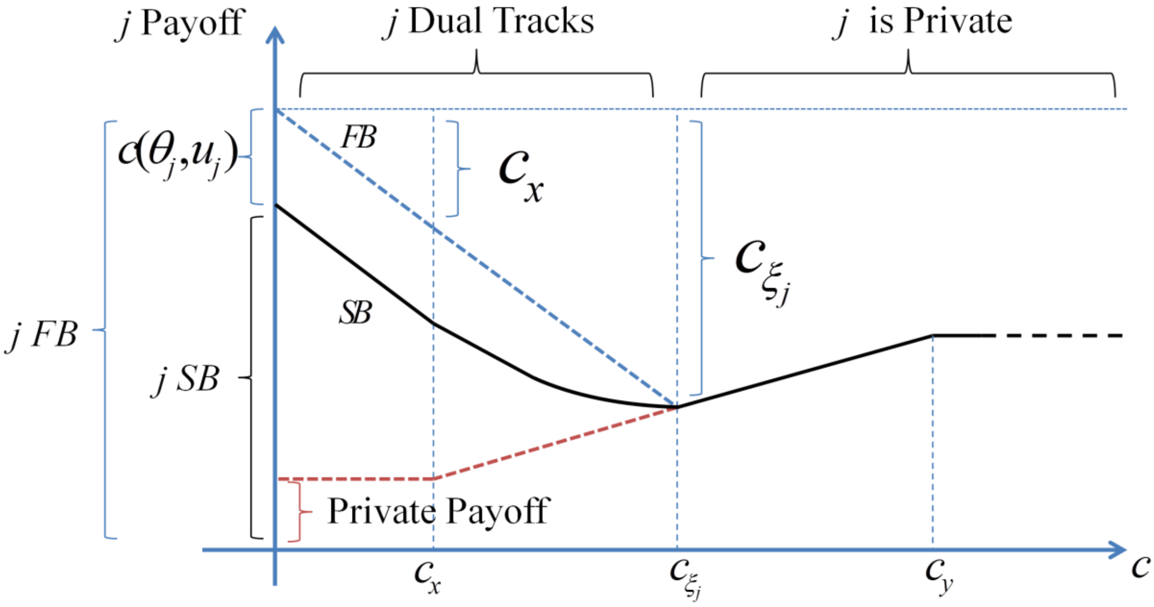
Replicating the same reasoning as in appendix C:

$$\textbf{(G.I)}\ du = \frac{\beta v d\xi}{q(N-\xi)} \Leftrightarrow \int_{u_j}^{u_i} du = \int_{\xi_j}^{\xi_i} \frac{\beta v}{q(N-\xi)} d\xi \Leftrightarrow u_i - u_j = \frac{\beta v}{q} \log\left(\frac{N-\xi_j}{N-\xi_i}\right)$$

And since u_j is 0, the solution is:

$$\textbf{(G.II)}\ u_i = \frac{\beta v}{q} \log\left(\frac{N-\xi_j}{N-\xi_i}\right)$$

Appendix H.



Graph 1. Type j payoff at any c level.