"A DISCUSSION OF CORRECT MEASURES OF INFORMATION ASYMMETRY"

by

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A DISCUSSION OF CORRECT MEASURES OF INFORMATION ASYMMETRY:
The Example of Myers and Majluf's Model or the Importance of the Asset Structure of the Firm

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Comments welcome

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ABSTRACT

This paper shows that measures of information asymmetry ought to be event-specific and model-specific in order to design correct tests of alternative models of information asymmetry. It shows that the traditional measures volatilities, or residual volatilities, are not necessarily correct. The paper presents a correct measure of information asymmetry for the analysis of the equity issue process in the context of Myers and Majluf's models. This measure is a function of the asset structure of the firm, and captures the volatility of the assets in place only. Some empirical evidence suggests that the distinction can matter empirically.

INTRODUCTION

In recent years, the differences in information among several groups have received increased attention in the finance literature. Corporate finance discusses the asymmetry in information between the managers of the firm and the market. For example, Ross (1977) and Miller and Rock (1985) point out the influence of information asymmetry on the financial policy of the firm, and Myers and Majluf (1984) model the importance of information asymmetry for the equity issue process. Many models have expanded on these early papers.[1] In order to test empirically the predictions of the various models, a measure of information asymmetry is needed. Previous studies (e.g. Masulis and Korwar (1986), Bhagat, Marr and Thompson (1985)) have used the volatility of the stock or the residual volatility for their empirical tests of models of information asymmetry without formal justifications of these measures.

The paper shows that the traditional measures are not always correct. It chooses to focus on one specific model, the Myers and Majluf model, for several reasons: first, the theoretical discussion suggested in the paper for alternative measures of information asymmetry needs to be model specific, then, the Myers and Majluf model is often referred to explicitely in the type of empirical tests this paper discusses.[2] Furthermore, the Myers and Majluf model is based on the asset structure of the firm, which gives an interesting base for the discussion of the characteristics of the information asymmetry of the firm.

Section I explicits the required characteristics for correct measures of information asymmetry. Secction II checks whether several variables are or are not theoretically correct measures of information asymmetry in the context of Myers and Majluf model. It shows that the volatility or the residual volatility of the firm is not correct. It suggests an alternative measure of information asymmetry, the volatility of the assets in place of the firm. Section III discusses the relevance of the theoretical caveats for empirical work. It emphasizes especially the required conditions for the traditional measures to be good empirical proxies and presents some empirical results consistent with the analysis. Section IV concludes the paper by giving general implications of this model-specific discussion. It also mentions some directions for future research.

I. REQUIRED CHARACTERISTICS FOR A MEASURE OF INFORMATION ASYMMETRY

The behavior of a firm in a world of information asymmetry can differ from the behavior of an otherwise identical firm in a world of symmetric information: it can have a different value, follow a different stochastic process and make different investment, financing and reporting decisions. Similarly, if all firms are not subject to the same level of information asymmetry, the behavior of a given firm can be a function of its level of information asymmetry. It would be useful to find one or several variable(s) summarizing the degree of information asymmetry faced by a given firm at a given point in time to predict the magnitude of the effects created by its level of information asymmetry. Possibly, some variable could capture the concept

of information asymmetry satisfactorily for some applications, but not for some others. In this sense one needs to specify the intended uses of the chosen measures.

This paper suggests a correct measure of information asymmetry for the empirical analysis of the equity issue process from the perspective of Myers and Majluf model. I note the information asymmetry IAE, with E expliciting the special case of equity issue taken into consideration. More specifically, the measures of information asymmetry are to be related to two **observable** events in the equity issue process: 1) the market-adjusted abnormal return of the firm observed at the equity issue announcement and 2) the magnitude of the information released by the announcement. These two events are traditional in the financial economics literature and have been the topics of numerous studies, for equity issues, but also for dividends, repurchases or any corporate restructurations. [3] Everything else constant, the existence and magnitude of these two events are considered driven by the existence and magnitude of information asymmetry. When the decision to issue equity reflects some of the managers-specific information as in the Myers and Majluf model, a correct measure of information asymmetry should be monotonically negatively related to the magnitude of the abnormal return at the equity issue announcement. It should also, all other things equal, be decreased by the transfer to the market of some of the managers-specific information created at the equity issue announcement.

II. MEASURES OF INFORMATION ASYMMETRY IN MYERS AND MAJLUF MODEL

Myers and Majluf show that the existence of information asymmetry between the managers of the firm and the market can create an economic loss in the value of the firm. Their model can also be used to study several **observable** (then empirically testable) differences between the behavior of the firm in a world of information asymmetry and the behavior of the firm in a world of information symmetry. It can be used to predict the magnitude of the proportional drop in price observed at the equity issue

announcement and of the change in uncertainty in the assets of the firm before and after the announcement, as a function of several input variables. This is shown below. This section shows by simulated examples how the structure of the assets of the firm fundamentally influences the process of issuing equity under asymmetric information and how as a consequence the structure of the assets of the firm determines the correct measures for IAE. The Myers and Majluf issue and invest model separates the total assets of the firm (V) into two groups: the assets in place of the firm (A), not influenced by the decision to issue and invest, and the growth opportunity (B), only available to the firm if the firm issues an amount I. The conclusion of the simulations is that the volatility of the assets in place is a correct measure of IAE but that the total volatility of the firm is not. First, some intuition is provided by highlighting the different roles of the assets in place and of the growth opportunity in the dynamics of the equity issue process. Then simulated results are discussed.

A) Intuitive justification for $^{\sigma}A/\overline{A}$ as a measure of IAE

In Myers and Majluf model, the managers use their superior information about the assets of the firm to maximize the value of the firm to the old stockholders. Managers know a and b, the realized values of A and B respectively, when they decide to issue, but the market only knows the bivariate distribution of A and B at that time. When new shares are issued, a part of the issue (and thus a part of A and B) goes to new shareholders. New shareholders are afraid that the managers issue equity not only because they need to finance the new project B, but because they want to enrich the old shareholders at the expense of the new shareholders by selling overpriced securities before the bad news about A leaks out. As a result of this, the new shareholders will rationally protect themselves by discounting all new issues. All other things equal, the more a is worth, the less likely the firm is to issue, since the old shareholders can keep a to themselves instead of sharing it with the new shareholders. On the other hand, the more b is worth, the more likely the firm is to issue, since the old shareholders can share b instead of losing it. [4] When a firm announces a new issue, the market knows that this decision is created by a mixture of "unfavorable" news for a and "favorable" news for b. All other things equal,

the market will impose a higher discount on the shares of the firm when the bad news concerning a is likely to be greater. This happens when the distribution for A is less centralized, i.e. when the volatility of A is higher. In the extreme case where A is constant, i.e. when its standard deviation is zero, no bad news about A could be hidden and the market will impose no discount on the shares of the firm. In this case, the firm will always issue, and both the ex-ante loss in the value of the firm and the drop in the value at the equity issue announcement are zero. The issue announcement brings no information in this case. No similar result, however, holds for the volatility of B: there can still exist an ex-ante loss in value and a drop in price at the announcement of the equity issue even if B is known (see Myers-Majluf (1984), p. 201 for a proof of this for the loss). This shows that A and B, and their respective volatilities, play different roles in the issue and invest decision. Therefore, intuitively, the volatility of A and the volatility of B should not be aggregated into the total volatility of the firm when measuring the IAE.

B) Simulated Results

As no closed-form solution exists for commonly assumed distributions in finance, I simulate the dynamics of the Myers and Majluf model for the case where the assets of the firm have initially a bivariate lognormal distribution in a world of symmetric information (indicated by the superscript ^{s}). The algorithm I use is an extension of the algorithm used by Myers and Majluf. The inputs to each simulation are $\overline{A}^s$, σ_A^s, $\overline{B}^s$, σ_B^s, ρ^s, and I, i.e. the mean and standard deviation of the assets in place, the mean and standard deviation of the growth opportunity, the correlation between A and B and the required amount of new equity. The algorithm computes the issue/non issue region, the new dynamics of A, B and V under asymmetric information, before and after the issue decision, and the proportional drop at the equity issue announcement. The simulations have been performed over a wide set of parameter values. The parameter set has been chosen in order to include all realistic cases. [5]

[Insert Table I here]

Over the whole parameter space, all other things equal, an increase in the volatility of the assets in place implies an increase in the proportional drop at the equity issue announcement and a decrease in the probability of the issue. Table I represents the proportional drop versus the volatility of the assets in place for several series. It can be seen that the drop at the issue announcement is negligible for low values of $\sigma_A/\overline{A}$ (e.g. $\sigma_A/\overline{A} = .10$). As $\sigma_A/\overline{A}$ increases, the drop increases. In the simulations, no other volatility is unambiguously related to the size of the proportional drop at the equity issue announcement. I chose to emphasize the fact that the total volatility of the market value of the firm does not qualify, i.e., does not necessarily increase the drop, because this measure is readily available from trading data, and is used in several papers. [6] Table II gives two examples where an increase in the total volatility of the market value of the firm implies a decrease in the proportional drop at the equity issue ($.22 < .29$ but $.04 > .01$ and $.32 < .36$ but $.02 > .01$). This typically happens when B/A is high.[7] [8]

[Insert Table II here]

Over the whole parameter space, the volatility of the assets in place conditional on the firm deciding to issue is lower than the volatility of the assets in place before the decision. Table III gives several representative examples. On the other hand, the volatility of the market value of the firm does not necessarily decrease after the announcement. Intuitively this happens because the growth opportunity is undertaken once the firm issues equity; the standard deviation of the growth opportunity can be fairly high and can increase the total uncertainty of the firm. Table IV provides two examples where the announcement of the decision to issue **increases** the volatility of the market value of the firm ($.25 > .24$, $.31 > .29$). [10] [11] [12]

[Insert Table III and Table IV here]

III. IMPLICATIONS FOR EMPIRICAL ANALYSES

A. Required characteristics of proxies for IAE

There is only manager-specific uncertainty in Myers and Majluf model. The empirical tests, however, will be run with data for which there exists also another type of uncertainty, the uncertainty shared by the managers of the firm and the market, for example uncertainties related to the general economy or to exchange rates, or to specific industries. The empiricist is confronted to a double requirement for its proxies of IAE: they should only concern the assets in place and they should not incorporate any of the uncertainty shared by the managers of the firm and the market.

B. Importance of the distinction between assets in place and total assets

Section II has shown that the volatility for the total assets of the firm is not theoretically correct for the analysis of the equity issue process, in the context of the Myers and Majluf model. However, the approximation may be more acceptable in some cases than in others. One would then expect empirical results to be better in these cases. The Myers and Majluf model makes a distinction between the assets in place and the growth opportunity. That distinction has proved to be important for the measure of IAE. In the context of their model, the growth opportunity represents a project with a positive net present value that is completely lost if the firm does not issue equity at this point in time. The magnitude and the nature of the project can vary widely. [13] When B is defined as the value lost if the firm does not issue new equity **now**, B can be fairly small in many cases. Then the value of the firm is approximately equal to the value of the assets in place, and the volatility of the firm can be approximately equal to the volatility of the assets in place.

More formally:

$$\left(\frac{\sigma_V}{\overline{V}}\right)^2 = \left(\frac{\sigma_A}{\overline{A}}\right)^2 \left(\frac{\overline{A}}{\overline{V}}\right)^2 + 2\rho \frac{{}^{\rho}A}{\overline{A}} \frac{{}^{\sigma}B}{\overline{B}} \frac{\overline{A}}{\overline{V}} \frac{\overline{B}}{\overline{V}} + \left(\frac{\sigma_B}{\overline{B}}\right)^2 \left(\frac{\overline{B}}{\overline{V}}\right)^2 \tag{1}$$

or

$$\left(\frac{\sigma_V}{\overline{V}}\right)^2 - \left(\frac{\sigma_A}{\overline{A}}\right)^2 = 2\rho \frac{{}^{\sigma}A}{\overline{A}} \frac{{}^{\sigma}B}{\overline{B}} \frac{\overline{A}}{\overline{V}} \frac{\overline{B}}{\overline{V}} + \left(\frac{\sigma_B}{\overline{B}}\right)^2 \left(\frac{\overline{B}^2}{\overline{V}}\right) - \left(\frac{\sigma_A}{\overline{A}}\right)^2 \left(\frac{2\overline{A}\overline{B} + \overline{B}^2}{\overline{V}^2}\right) \tag{2}$$

this shows that $\sigma_V/\overline{V}$ is a perfect measure for $\sigma_A/\overline{A}$ when $\rho = 1$ and $\sigma_B/\overline{B} = \sigma_A/\overline{A}$. Other combinations of the parameters can also justify the equivalence between $\sigma_V/\overline{V}$ and $\sigma_A/\overline{A}$, as for example a low ratio $\overline{B}/\overline{V}$. All other things equal, equation (2) goes to zero when $\overline{B}/\overline{V}$ goes to zero. The case of ρ equal to zero and $\sigma_A/\overline{V}$ equal to $\sigma_B/\overline{B}$ could be hard to find and hard to prove. The case of $\overline{B}/\overline{V}$ small can at least be checked, even if only with a small level of precision. So in the case of $\overline{B}/\overline{V}$ small, the empiricist might prefer proxies that are easy to estimate over short periods of time and easy to estimate with precision, and that handle well the separation between total uncertainty of the firm and information asymmetry, over proxies that focus on the separation between assets in place and growth opportunities but are much harder to estimate. This justifies the use of "traditional" proxies of information asymmetry used or suggested in the literature like the residual volatility of the stock, the intensity of trading, the magnitude of the bid-ask spread, the intensity of insiders trading, the dispersion of analysts forecasts or the (lack of) intensity of public announcements.

The relevance of the distinction between the total information asymmetry and the information asymmetry for the assets in place only can be tested empirically. Two types of tests are possible. The first type of test consists in finding proxies for IAE respecting the assets in place/growth opportunity distinction and comparing the results obtained with more traditional proxies. Unfortunately, such proxies are very hard to find. [15] The

second type of test uses traditional proxies and compare their behavior in several subsamples: if Myers and Majluf model is true and if the ratio $\overline{B}/\overline{V}$ can be adequately measured, the proxies should capture the consequences of the existence of information asymmetry much better when $\overline{B}/\overline{V}$ is low than when it is high. The results of such a test are provided below.

C. Some empirical evidence

This section tests whether, all other things equal, an increase in IAE increases the drop observed at the equity issue announcement for two "traditional" measures of information asymmetry, σ_ϵ^2 and Dnban. σ_ϵ^2 is the variance of the stock return. It recognizes that the information asymmetry is a subset of the total uncertainty of the firm, from which it deducts all the market uncertainty, obviously shared by the managers of the firm and by the market. Dnban is a dummy variable describing the informational environment of the firm. It is set equal to one (zero) when the firm has on average relatively few (many) announcements made to the market. It captures the idea that, all other things equal, the information asymmetry is high (low) when there exists few (many) announcements made about a firm. Both measures have no reason to be related to the assets in place of the firm only, so they will perform better in the low $\overline{B}/\overline{V}$ subsample if Myers and Majluf model holds and if the distinction assets in place and total assets matters. Table V presents the results of the cross-sectional regression of the market-adjusted two-day abnormal return at the equity issue announcement by IAE, the relative size of the equity issue (RSIZE) and two control variables, the relative importance of the growth opportunity (RMEBE), for the subsamples for high and low RMEBE for a total sample of 197 industrial firms. The relative importance of the growth opportunity for a firm is approximated by the ratio of the market value of the equity of the firm to the book value of the firm, in the spirit of Tobin's Q-ratio. [16] [17]

[Insert Table V here]

Table V shows that in the case of a low RMEBE, i.e. in the case where the empirical proxies come closest to the theoretically correct measure of IAE,

the cross-sectional variations in IAE explain very well the cross-sectional variations in the reaction at the equity issue announcement. IAE is the best explanatory variable and the t-statistics for two mesures of IAE, σ_ϵ , and DNBAN are negative and significant respectively at the 1% and the 5% level in one-tailed tests. The constant is even not significant, which is an unusual result for this type of study. [18] On the other hand, only the constant is significant for the subsample of firms with high RMEBE and the proxies for IAE explain absolutely nothing in this case. Also, the abnormal return at the equity issue announcement is significantly higher (i.e. the drop is lower), at the 5% level, for firm with high RMEBE. [19] Overall, the results show that the distinction between information asymmetry for the assets in place only and for the total value of the firm matters in some cases. [20] [21] The evidence is especially compelling when one considers how hard it is to capture empirically the concept of growth opportunity and the ratio $\overline{B}/\overline{V}$.

IV. CONCLUSION

This paper offers a correct measure of information asymmetry for the study of the equity issue process in the context of the Myers and Majluf model. It shows by simulations that a correct measure of information asymmetry is a function of the volatility of the assets in place of the firm only. Its dependence on the assets structure of the firm reflects the importance of the asset structure throughout Myers and Majluf model. [22] The simulations also show that an "obvious" candidate, the volatility (or the residual volatility) of the firm does not qualify as an unambiguously correct measure of information asymmetry in this context. Furthermore, both theoretical and empirical evidence show that the distinction matters. The results of this paper should be used to understand better the limitations of traditional proxies and use them better. In this case, the tests can be improved either by finding more correct proxies for IAE, i.e. more directly related to the assets in place of the firm only, or by limiting the use of more the traditional proxies to the cases where the approximation is the most valid, i.e. when $\overline{B}/\overline{V}$ is low. Further tests could try to approximate the growth opportunity with more precision. For example Williamson (1981) or Long

and Malitz(1983) discuss the problem and suggest some alternative estimations of $\overline{B}/\overline{V}$. Also, Servaes (1988), Lindenberg and Ross (1981), Lang, Stulz and Walkling (1989) define alternative measures of Tobin's Q that could be used in this context.

The paper discusses a very precise problem: it specifies the event (equity issue announcement), the model (Myers and Majluf model) and even the tests (cross-sectional variation in the reaction at equity issue and pre-post comparisons of the level of information asymmetry). However this result indicates that in general measures of information asymmetry ought to be event-specific and model-specific in order to design correct and precise tests of alternative models of information asymmetry. Now, with the expansion of theoretical and empirical work, the case for the relevance of information asymmetry in general, especially for the equity issue process, need not be defended any more, but we need to know which modelling approach is the most productive in specific cases. [23] Up to now the difference among different models based on information asymmetry was done through other implications of the models not by a specific measure of the information asymmetry relevant in that model. [24] The time has come to design more precise tests to differentiate among alternative modelling approach. This paper shows a direction for future tests.

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FOOTNOTES

1. Since then more complex models have been suggested. The models of Krasker(1985), John and Williams (1985), Viswanathan (1986), Bradford (1987), Ambarish, John and Williams(1987), Narayanan (1988), Korajcyk, Lucas and McDonald (1988) extend Myers and Majluf framework in several directions.

2. See for example Masulis and Korwar (1986, p. 114) or Bhagat, Marr and Thompson (1985). Masulis and Korwar find non-significant results, Bhagat, Marr and Thompson find significant results (with the correct signs).

3. The studies analyze the abnormal return at the announcements, the changes in abnormal returns of future announcements, the relationship to ex post changes in earnings (see for example Healy and Palepu (1988)).

4. This can easily be seen in the figure 1, page 199, of Myers and Majluf article.

5. Here are the elements of the parameter set: The assets in place are used as a reference point; they always have a mean $\overline{A} = 100$.The amount of new equity needed to finance the new project, I, varies between 1 and 100 (i.e. between 1 percent and 100 percent of the mean value of the assets in place), in increments of 10. the expected value of the growth opportunity, $\overline{B}^s$, varies between .01 and 50 (i.e. between 1 percent and 50 percent of I or between .01 percent to 50 percent of A), in increments of 5. $\sigma_A/\overline{A}$ varies between 5 percent and 50 percent, in increments of 10 percent. $\sigma_B^s/\overline{B}^s$ is chosen so that, once the project has been implemented (i.e. once I has been invested), it varies between .25 and 4 times $\sigma_A/\overline{A}$. The correlation between A and B varies between 0 and .9, in increments of .1 .

6. I also replicate Myers and Majluf results that σ_A is the only volatility systematically (positively) related to the loss in the value of the firm created by the existence of information asymmetry (and not $\sigma_v/\overline{v}$ or $\sigma_B/\overline{B}$.

7. The same results obtain for $\sigma_A, \sigma_A/\overline{A}$, or any positive function of these variables. I present the result for the volatility σ_A/A and σ_V/V to be independent of the size of the firm.

8. Similarly, no systematic behavior can be observed for σ_B or $\sigma_B/\overline{B}$, σ_V, or $\sigma_V/\overline{V}$.

9. Same comments as in footnotes 7 and 8.

10. The results shown in this section are distribution specific. However, some more extreme examples and counterexamples exist when A and B follow binomial distributions (see Dierkens 1988).

11. The presentation in this section is made for an unlevered firm. The results are easily extended to the case of a firm with riskless debt.

12. It can also be shown that $\sigma_A/\overline{A}$ is more stable through time than $\sigma_V/\overline{V}$: the dynamics of the model in a world of asymmetric information forces any measure of dispersion related to the growth opportunities to be unstable in time (see Dierkens (1988)). This is also an advantage for an empirical proxy when it is estimated by its past behavior over a period of time.

13. B can be a strategic investment, the usual meaning of the term growth opportunity, for example an investment in the development of a new technology, but it can also represent a favorable change in the debt/equity ratio of the firm, or the implementation of some improvements to the existing machines of the firm. If the firm can issue and invest later if it decides not to issue now, b represents the loss of value asociated with delaying the project. If the firm can finance the project with sources other than an equity issue, b is the additional cost of that financial source over the equity issue. The "assets in place" include all the assets of the firm that are not influenced by the decision to issue, possibly including some expansion plans that can be financed immediately by internal resources or are planned for later periods.

14. Exceptions could be cases of pure expansion of the firm.

15. Dierkens (1988) discusses some of the problems. She suggests a proxy, more specifically related to the assets in place of the firm, the average surprise at earnings announcements. The empirical results, however, are not better for this proxy, probably because it was estimated over too long a time period (five years).

16. The simulations of Myers and Majluf model have shown that RSIZE and RMEBE should decrease (increase) AREI.

17. The sample of 197 equity issue announcements has been constructed in a traditional way, e.g. with no joint announcement of mergers, earnings, dividends, or other financial changes on the days of the equity issue announcements. It only considers industrial firms and has a standard time and industry clustering. The total sample reaction at the equity issue announcement(average market-adjusted two-day abnormal return of -2.4, 80 % negative) is fully consistent with the existing literature (see Bhagat, Marr and Thompson (1985), Asquith and Mullins(1986), Masulis and Korwar (1986), Mikkelson and Partch (1986)). Even the non-significance of the relative size of the issue has been noted before. (The sample is described in further details elsewhere).

18. The sign for RMEBE is not consistent with Myers and Majluf theory in the subsample of firms with low RMEBE.

19. This result is also consistent with the model of Ambarish, John, and Williams (1987)

20. The effect is not observable continuously: I have not found a continuously decreasing t-statistics for decreasing levels of RMEBE by separating the subsample in 5 or 10 subsamples.

21. σ_ϵ^2 is significantly decreased by the equity issue announcement, however, at the same level (i.e. with no significant difference at usual level of significance) for high RMEBE and for low RMEBE firms.

22. The importance of the asset structure is even more extreme in some other models, such has Ambarish, John and Williams (1987), where the equity issue announcement implies negative abnormal return when the manager-specific information concerns primarily the assets in place but positive when the manager-specific information concerns primarily the opportunities to invest, whereas the equity issue announcement is always negative in Myers and Majluf model. Such models will of course also have strong implications for the correct measures of information asymmetry.

23. Although several (non mutually exclusive) explanations have been provided for the average negative stock price reaction at the equity issue announcement, theories of information asymmetry seem the most consistent with the evidence (see Smith (1986) for a general overview).

24. For example Myers and Majluf model implies a lower drop in stock price at the issue announcement of securities of lower risks, contrary to Miller and Rock model. There is a general tendency for this to be observed (Compare the reaction at the issue announcement of equity, preferred stocks (Linn and Pinegar (1988)), convertible debt (Mikkelson and Partch,(1986)). Also Bruner (1988) shows that mergers happen in order to prevent the potential loss in the value of the firm for projects-rich but cash-poor firms as predicted by Myers and Majluf model.

Table I
The volatility of the assets in place increases the drop

Simulated series showing that, all other things equal, an increase in the volatility of the assets in place, monotonically increases the proportional drop observed at the announcement of the new equity issue and monotonically decreases the probability of issue.

	$\overline{B}^s = 10$, I = 50	$\overline{B}^s = 20$, I = 50	$\overline{B}^s = 10$, I = 75
$\sigma_A/\overline{A}$)	DROP(%) (PROB(%))	DROP(%) (PROB(%))	DROP(%) PROB(%))
.10	0 (99)	0 (99)	0 (99)
.20	3 (85)	0 (99)	4 (81)
.30	7 (71)	0 (97)	13 (59)
.40	14 (62)	4 (91)	24 (45)
.50	23 (54)	10 (85)	35 (36)
.60	30 (49)	16 (79)	43 (31)
1.00	52 (39)	35 (66)	62 (28)

DROP is proportional drop in the value of the firm, V, at the equity issue announcement.
PROB is the probability of the firm deciding to issue and invest.
σ_A is the standard deviation of the assets in place.
I is the amount of new equity required to finance the new project.
$\overline{B}^S$ is the mean of the growth opportunity under symmetric information.

The assets in place, A^s , and the growth opportunity, B^s , follow a bivariate lognormal distribution under symmetric information.
The mean of the assets in place is 100.
The standard deviation of the growth opportunity under symmetric information is 1.5.
The correlation between the assets in place and the growth opportunity under symmetric information is 0.

Table II
The total volatility may decrease the drop

Two simulated lognormal examples where an increase in the volatility of the firm implies a decrease in the proportional drop at the equity issue announcement.

	$\overline{B}^S$	$\sigma_A^S/\overline{A^S}$	$\sigma_B^S/\overline{B}^S$	ρ^S	$\sigma_V/\overline{V}$	DROP
Example 1	10	.20	4.4	0	.29	1%
	10	.25	1.0	0	.22	4%
Example 2	25	.30	.9	.5	.36	0%
	25	.40	.2	.5	.32	2%

For X in (A, B, V),
$\sigma_X^S/\overline{X}^S$ is the coefficient of variation (volatility) of X under symmetric information.
σ_X/X is the coefficient of variation (volatility) of X under asymmetric information.

$\sigma_V/\overline{V}$ is endogeneous.

V is the value of the firm under asymmetric information.
The assets in place, A, and the growth opportunity, B, follow a bivariate lognormal distribution under symmetric information.
The mean of the assets in place is 100.
The amount of new equity required to finance the new project is 50.
$\overline{B}^S$ is the mean of the growth opportunity under symmetric information.
ρ^S is the correlation between the values of the assets in place and the equity issue announcement.

Table III
Equity Issue announcements decrease the volatility of the assets in place

	$\overline{B}^S$	$\sigma_B^S/\overline{B}^S$	I	$\sigma_A/\overline{A}$	$\sigma_A/\overline{A} \mid I$
Example 1	10	1.2	50	.20	.16
Example 2	4	3	20	.50	.16
Example 3	.2	5	20	.05	.03
Example 4	.1	2	1	.20	.14
Example 5	20	.5	90	.20	.18

For X in (A, B),
σ_X^S is the standard deviation of X under symmetric information.
$\sigma_X/\overline{X} \mid I$ is the coefficient of variation (or volatility) of X conditional on the firm deciding to issue equity, under asymmetric information. $\sigma/\overline{X} \mid I$ is endogeneous.

The assets in place, A, and the growth opportunity, B, follow a bivariate lognormal distribution under symmetric information.
The mean of the assets in place is 100.
The correlation between the values of the assets in place and the growth opportunity under symmetric information is 0.
$\overline{B}^S$ is the mean of the growth opportunity uncer symmetric information.
I is the amount of new equity needed to finance the new investment.

Table IV
Equity issue announcements may increase the total volatility

Two simulated examples where the volatility of the firm conditional on the firm deciding to issue and invest is higher than the volatility of the firm before the announcement of the issue.

	I	$\sigma_B^S/\overline{B}^S$	$\sigma_A/\overline{A}$	$\sigma_V/\overline{V} \mid I$	$\sigma_A/\overline{A} \mid I$	
Example 1	90	2.0	.20	.29	.31	.15
Example 2	50	4.4	.20	.29	.31	.16

For X in (A, B, V),
$\sigma_X/\overline{X}^S$ in the coefficient of variation (volatility) of X under symmetric information.
σ_X/X is the coefficient of variation (volatility) of X under asymmetric information.
$\sigma_X/\overline{X} \mid I$ is the coefficient of variation (volatility) of X conditional on the firm deciding to issue equity, under asymmetric information.

σ_V, and $\sigma_V/\overline{V} \mid I$ are endogeneous variables, but σ_A is equivalent to σ_A^2

The assets in place, A, and the growth opportunity, B, follow a bivariate lognormal distribution under symmetric information.
the mean of the assets in place is 100.
The mean of the growth opportunity under symmetric information is 10.
The correlation between the assets in place and the growth opportunity under symmetric information is 0.
V is the value of the firm under asymmetric information.
I is the amount of new equity required to finance the new project.

Table V
Impact of information asymmetry on the drop

OLS estimates of the coefficients from the cross-sectional regressions:

$$\text{AREI}_i = a_0 + a_1 \text{ IAE} + a_2\text{RSIZE} + a_3\text{RMEBE}_i + \epsilon_i$$

for 197 primary seasoned equity issues offered between 1980 and 1983, divided in 2 subsamples of high and low RMEBE (1) (2), with low (high) RMEBE proxying for better (worse) approximation of IAE by σ_ϵ^2.
(t-statistics are given in parentheses)

For Low RMEBE					
Measures of IAE	CONSTANT	IAE	RSIZE	RMEBE	R^2
σ_ϵ^2:	-.008	-16.350	.029	.010	6.2%
	(.58)	(−2.85)***	(.78)	(-1.22)	
Dnban	-.013	-.010	.033	.011	3%
	(.96)	(−2.17)**	(.84)	(-1.92)	
For High RMEBE					
Measures of IAE	CONSTANT	IAE	RSIZE	RMEBE	R^2
σ_ϵ^2	-.032	5.780	.007	.002	≤ 0
	(−3.55)***	(0.54)	(.19)	(1.50)	
Dnban:	-.027	-.005	.023	.002	≤ 0
	(−3.31)***	-.62	(.60)	(1.47)	

(1) The subsample of low (high) RMEBE has 99 (98) observations.

(2) The average AREI is -.027 (-.020) for the subsample of firms with low (high) RMEBE, with a t-statistics on the difference of the means of −2.17*2

R^2 is adjusted for the number of degrees of freedom.
*** and ** indicate that the t-statistic is significant at the 5

AREI is the market-adjusted two-day abnormal return at the equity issue annoucement.

IAE is the degree of information asymmetry.

σ_ϵ is the residual standard deviation of the daily stock returns estimated by the market model for the year preceding the equity issue announcement.

Dnban is a dummy variable set equal to 1 when the firm has 16 or less announcements listed in the **WSJI** for the year of the equity issue announcement.

RSIZE is the number of shares to be issued based on the first announcement of the equity issue divided by the number of shares outstanding at the time of the annual earnings before the equity issue announcement.

RMEBE is the ratio of the market value of the equity divided by the book value of the equity at the last annual earnings announcement before the equity issue announcement.

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