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Revised July 1984

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Abstract

A change in auditors is commonly observed in firms which are selling shares nationally for the first time. One impetus for this is said to come from underwriters who advise their clients to switch from a local to a national auditing firm known for higher quality standards in order to receive a higher price for the shares sold. This statement implicitly reflects the belief that the audit quality chosen by a firm's owner will convey to the market something about the firm's intrinsic value. In this paper a model is presented which gives theoretical support to this belief. Under plausible conditions it is shown that owners of firms with higher true value will choose higher quality audits than will those in firms of lower true value. Investors, observing this relation, will then assign higher market values to those firms that choose higher quality audits.

1. INTRODUCTION

A change in auditors is commonly observed in firms which are either going public or raising large amounts of new equity. In a study of auditor choice by firms selling shares nationally for the first time, Carpenter and Strawser (1971) found that those who changed auditors generally switched from a local, or regional, auditor to a national one. They suggested that one impetus for such a move comes from the firm's underwriters who advise their clients to switch to a national auditor known for higher quality standards in order to receive a higher price for the shares sold. This statement implicitly reflects the belief that when a firm sells shares for the first time its true value is imperfectly known by investors and that the audit quality chosen by the firm's owner provides information to the market about that value.

The purpose of this paper is to develop a model to analyze the relation between the chosen level of audit quality and a firm's true value. The main result of this analysis is that owners of firms of higher true value will, in general, choose higher quality audits than will owners of firms of lower true value. This is because owners of firms of high true value will be willing to pay the (presumably higher) cost of a higher quality audit since the audit will likely confirm the firm's high value; in contrast, it will not be worthwhile for firms of low true value to pay the cost of such an audit since it will likely reveal that the firm is actually of low value. As a result of this behavior the audit quality chosen will provide information which investors can use in valuing the firm. The higher the audit quality, the higher will be the market value assigned to the firm by investors.

Audit quality, however, is not the only choice variable that can provide information to investors about the firm's value. Leland and Pyle (1977) show that, under certain conditions, the level of shareholdings retained by the owner can perfectly reveal, or signal, firm value while Ross (1977) and

Bhattacharya (1979, 1980) demonstrate that the same can be true of the amount of debt issued by the firm and the amount of dividends paid, respectively. As is shown in the first part of this paper, the chosen level of audit quality can similarly, in certain cases, perfectly reveal firm value, with the quality level chosen a strictly increasing function of the firm's true value. In reality, though, it is expected that audit quality, along with other financial variables each provides some, but not complete, information about the firm's value. In the latter part of this paper such a case, where audit quality provides imperfect information, is analyzed. It is shown there that, even though a strict relation between audit quality and true firm value does not exist, firms choosing higher quality audits have, on average, higher true values. Although true firm value is not perfectly revealed by the audit quality chosen, market values, however, are still positively related to audit quality.

2. AUDIT QUALITY AS A PERFECT SIGNAL IN THE NEW ISSUES MARKET

Consider an entrepreneur who is the sole owner of a productive opportunity with nonnegative net present value. Exploiting the opportunity requires a current investment of I and will result in a random end of period cash flow \tilde{X} having a present value of v . In order to raise funds for investment and also to diversify his portfolio, the entrepreneur has decided to sell the fraction $1 - \alpha$ of his shares to outside investors. For simplicity it is assumed that there is only one other alternative investment, a riskfree asset, paying zero interest; therefore, the entrepreneur invests any funds raised from the sale of shares in excess of the amount required as input for production into the riskfree asset.

The problem faced by the entrepreneur is that the outside investors do not know the true present value of the future cash flows of the entrepreneur's

firm. If the entrepreneur cannot provide any reliable information to investors as to the firm's true value, the firm will be valued at some level, \bar{v} , reflecting the outside investors' prior beliefs. The entrepreneur will therefore have an incentive to provide such information if it results in a revised firm valuation that is greater than \bar{v} by at least the cost of producing the information. The purpose of the following discussion is to present a model in which the entrepreneur's choice of audit quality for the firm's financial statements may serve as such information.

Denote audit quality by q , where $q = 0$ signifies the lowest level of quality possible and larger values of q signify higher quality.¹ The fee charged by the auditor for an audit of quality level q is given by $e(q) > 0$ where $e'(q) > 0$.² The audited financial statements can be used by investors, along with their prior information, to form an unbiased estimate of firm value, denoted by θ , where the precision of the estimate is a function of the quality of the audit. Specifically, it is assumed here that the estimate is uniformly distributed around the true firm value, v , with upper limit $v + k(q)v$ and lower limit $v - k(q)v$ where $0 \leq k(q) \leq 1$, $k(0) = 1$, and $k'(q) \leq 0$.³ However, as described below, investors will be able to form a more precise estimate of firm value by using as additional information the entrepreneur's choice of audit quality.

¹The quality of any audit is determined by the number and type of tests performed by the auditor as well as the time that the auditor devotes to the tests. See Ng (1978) for a further discussion.

²While no study has formally shown that audit fees increase with audit quality, DeAngelo (1981) argues that audit firm size should be positively related to audit quality. Then, if audit fees are an increasing function of the size of the audit firm, as casual observation suggests, it is reasonable to assume that audit fee and audit quality are positively related.

³The uniform distribution was chosen principally for its mathematical tractability.

The entrepreneur chooses the level of audit quality so as to maximize the expected utility of his end of period wealth. Given θ , q , and the firm's end of period cash flow, x , the entrepreneur's end of period wealth, $W(\theta, q, x)$, can be written as:

$$W(\theta, q, x) = (1-\alpha)v^*(\theta, q) - I - e(q) + \alpha x \quad (1)$$

where $v^*(\theta, q)$ is the market price investors set for the firm's shares based on knowledge of θ and q . Denoting by $U(\cdot)$ the entrepreneur's utility function for end of period wealth and by $E_\theta(\cdot)$ and $E_x(\cdot)$ expectation operators over θ and x , respectively, the entrepreneur's expected utility for any given audit quality, q , can be expressed as:

$$E_\theta[E_x[U(W(\theta, q, x))]] = \int_{v(1-k(q))}^{v(1+k(q))} \frac{E_x[U((1-\alpha)v^*(\theta, q) - I - e(q) + \alpha \tilde{x})] d\theta}{2k(q)v} \quad (2)$$

As the following analysis demonstrates, an equilibrium exists in which the audit quality chosen by the entrepreneur, maximizing (2), provides a perfect signal of the firm's true value. By observing the audit quality chosen, q^* , investors will be able to infer the true value of the entrepreneur's firm through a functional relation denoted here by $v = f(q^*)$.

In order for audit quality to perfectly signal firm value it must be the case that the chosen level of audit quality be a strictly increasing function of firm value. This implies, in particular, that it must be unprofitable for an entrepreneur in a firm of low true value to mimic the signal of an entrepreneur in a firm of higher value by choosing a higher audit quality. In this model the existence of the independent estimate of firm value, θ , keeps entrepreneurs from signalling falsely. If the entrepreneur signals falsely, so that his true firm value, v , is less than the signalled value, $f(q^*)$, there will be

a range of possible values for θ for which outside investors will know that he signalled falsely. Specifically, given the distributional assumption for θ , if the realized θ is less than $f(q^*)(1-k(q^*))$, investors know that the true firm value must be less than $f(q^*)$. It is assumed here that in these instances investors use θ rather than $f(q^*)$ to value the firm.⁴ Because of this the entrepreneur is effectively penalized for signalling too high a firm value. He incurs the additional cost of a higher quality audit in order to signal a higher firm value, but if the realized θ is inconsistent with $f(q^*)$, he will not receive that higher value. As the following proposition demonstrates, this penalty makes it unprofitable to signal falsely, allowing audit quality to perfectly signal firm value.

Proposition 1: If the entrepreneur chooses an audit quality q^* to maximize (2) and outside investors assign a value $v^*(\theta, q^*)$ to the entrepreneur's firm according to the following schedule:

$$v^*(\theta, q^*) = f(q^*) \quad \text{if} \quad \theta \geq f(q^*)(1-k(q^*))$$

$$= \theta \quad \text{if} \quad \theta < f(q^*)(1-k(q^*))$$

where:

$$f(q) = \int_0^q \frac{2e'(y)}{(1+k(y))(1-\alpha)} dy + c,$$

c being a constant, then the q^* chosen by the entrepreneur will be such that $v^*(\theta, q^*) = f(q^*) = v$ for all θ .

⁴Very similar results will be obtained if $\frac{\theta}{1+ak(q^*)}$ is used rather than θ to value the firm, where 'a' is some constant between -1 and +1.

Proof: The proposition will be proven here for the case of a risk neutral entrepreneur. From this it follows directly that it must also hold for a risk averse entrepreneur. Since the optimal solution involves no uncertainty (the firm will be priced at v regardless of the value of θ), if it is chosen by a risk neutral entrepreneur, it must also be chosen by a risk averse one. With risk neutrality and given the valuation schedule as stated in the proposition the entrepreneur's expected utility can be written as:

$$E_{\theta}[E_x[U(W(\theta, q, x))]] = \int \frac{v(1+k(q))}{v(1-k(q))} \frac{(1-\alpha)f(q)}{2k(q)v} d\theta - e(q) - I - E_x(\alpha\tilde{x}) \quad (3a)$$

for all q such that $f(q) < v$;

$$\begin{aligned} &= \int \frac{v(1+k(q))}{f(q)(1-k(q))} \frac{(1-\alpha)f(q)}{2k(q)v} d\theta + \int \frac{f(q)(1-k(q))}{v(1-k(q))} \frac{(1-\alpha)\theta}{2k(q)v} d\theta \\ &\quad - e(q) - I - E_x(\alpha\tilde{x}) \end{aligned} \quad (3b)$$

for all q such that $v < f(q) \leq \frac{v(1+k(q))}{1-k(q)}$;

$$= \int \frac{v(1+k(q))}{v(1-k(q))} \frac{(1-\alpha)\theta}{2k(q)v} d\theta - e(q) - I - E_x(\alpha\tilde{x}) \quad (3c)$$

for all q such that $f(q) \geq \frac{v(1+k(q))}{1-k(q)}$

There are three possible cases. In the first q is so low that investors will never use the estimate, θ , in place of $f(q)$. This is because, with q such that $f(q) < v$, the realized θ will always be at least as great as $f(q)(1-k(q))$ given the distributional assumption on θ . In the second case q

is such that there will be some values of θ (between $v(1-k(q))$ and $f(q)(1-k(q))$) for which the estimate will be used in place of $f(q)$. In the last case q is so high that, even for the highest possible realization of θ , it will be true that $\theta < f(q)(1-k(q))$. The estimate, θ , will then always be used in place of $f(q)$.

To show that the q^* chosen by a risk neutral entrepreneur is such that $f(q^*) = v$ it is sufficient given (3a)-(3c) to show that:

$$(a) \frac{\partial \left[\int_{v(1-k(q))}^{v(1+k(q))} \frac{(1-\alpha)f(q)}{2k(q)v} d\theta - e(q) \right]}{\partial q} \geq 0 \quad \text{for all } q \text{ such that } f(q) < v,$$

$$(b) \frac{\partial \left[\int_{f(q)(1-k(q))}^{v(1+k(q))} \frac{(1-\alpha)f(q)}{2k(q)v} d\theta + \int_{v(1-k(q))}^{f(q)(1-k(q))} \frac{(1-\alpha)\theta}{2k(q)v} d\theta - e(q) \right]}{\partial q} \leq 0 \quad \text{for } q \text{ such}$$

that $f(q) = v$ and less than 0 for all q such that $v < f(q) \leq \frac{v(1+k(q))}{1-k(q)}$,

and:

$$(c) \frac{\partial \left[\int_{v(1-k(q))}^{v(1+k(q))} \frac{(1-\alpha)\theta}{2k(q)v} d\theta - e(q) \right]}{\partial q} \leq 0 \quad \text{for all } q \text{ such that } f(q) \geq \frac{v(1+k(q))}{1-k(q)}.$$

These conditions guarantee that the entrepreneur will gain utility by increasing q until $f(q) = v$ and will lose utility if he increases q further so as to have $f(q) > v$. That those conditions are satisfied is shown in Appendix A.1. Hence, the entrepreneur will choose an audit quality, q^* , such that $f(q^*) = v$. Since this implies that $\theta \geq f(q^*)(1-k(q^*))$ for all possible values of θ , the firm will be valued by investors at v regardless of θ . \square

The entrepreneur chooses his optimal level of audit quality so as to equate the marginal benefit of a further increase in quality, due to an increase in the expected valuation assigned to the firm, with the marginal cost, due to a higher audit fee. Since the marginal cost is the same for all entrepreneurs regardless of true firm value, it is the difference in the marginal benefit which causes entrepreneurs in firms with different true values to choose different levels of audit quality. The valuation schedule $v^*(\theta, q^*)$ is such that the marginal benefit of an increase in audit quality is always at least as great for an entrepreneur in a firm of high value as it is for one in a firm of lower value. Consequently, the audit quality chosen for a high value firm will be greater than that chosen for a lower value firm; audit quality will thereby serve as a perfect signal of firm value.

Because it is the marginal benefit of signalling, rather than the marginal cost, that differs across entrepreneurs, this signalling equilibrium stands somewhat in contrast to that of Spence (1973, 1974). In the context of a labor market Spence shows that with the marginal benefit of acquiring education fixed across workers but the marginal cost lower for the more productive workers, the investment in education made by any worker can perfectly signal his productivity. The equilibrium developed here, however, is closer in nature to that of Guasch and Weiss (1980).⁵ In their model workers pay to be tested by their employer with the result of the test for any worker determining the wage paid to him. How well a worker does on the test is directly related to his productivity. Therefore, workers who perceive their productivity to be higher will be willing to pay more to take the test since the expected benefit to be derived from the test will be greater. As a result of this, the amount paid by a worker to be tested provides a signal to the employer about the worker's perceived productivity.

⁵See Guasch and Weiss (1981) and Weiss (1983) for similar models.

2.1 DISCUSSION

A valuation schedule of the form $f(q) = \int_0^q \frac{2e'(y)dy}{(1+k(y))(1-\alpha)} + c$ results in the entrepreneur truthfully signalling his firm's value through the chosen level of audit quality; the higher the firm value, the greater the audit quality chosen. There are several such equilibrium schedules, one for each feasible value of the constant, c . However, the schedule which is expected to be observed is the one which results in the lowest possible cost for each entrepreneur. This will be where the entrepreneur in the firm with the lowest possible value (in this case, where $v = I$)⁶ chooses the lowest quality audit ($q=0$)⁷. The constant, c , corresponding to this schedule satisfies:

$$f(0) = I = \int_0^0 \frac{2e'(y)dy}{(1+k(y))(1-\alpha)} + c \quad (4)$$

or:

$$c=I \quad (5)$$

This signalling schedule has the desirable property that the form of the entrepreneur's utility function need not be observable by outside investors in order for them to use q to correctly value the firm; only the percent of the firm being sold by the entrepreneur and the precision of the estimate of firm value need be known. However, if outside investors could observe the form of the utility function, an improved signalling schedule (from a risk averse

⁶This is strictly true only if entrepreneurs with nonnegative net present value projects sell shares. Otherwise the lowest possible firm value is 0.

⁷As Riley (1975, 1979) states, the lowest cost, or Pareto dominant, signalling schedule is the only one which "survives plausible experimentation" by market participants. If the entrepreneur of the lowest value firm were to signal more than zero, then outside investors could offer I for firms which do not signal, attracting both firms with value I along with some firms with value greater than I . In a competitive market this situation could not persist.

entrepreneur's viewpoint) could be devised. The reason for this can be understood by noting that, given the valuation schedule derived here, the derivative of a risk averse entrepreneur's expected utility with respect to q is negative at the q which perfectly reveals his firm's value (where $f(q) = v$), while it exactly equals zero for a risk neutral entrepreneur. (See Appendix A.2 for a formal proof.) This is not surprising. A risk averse entrepreneur is hurt more than a risk neutral one when firm value is falsely signalled because of the risk that the realization of $\tilde{\theta}$ will be so low that it is used instead of $f(q)$ to value the firm. Hence, he loses more by increasing q above the point at which $f(q) = v$, where there is some probability of those low θ occurring. Since it is only necessary that the derivative of expected utility with respect to q equal zero at this point in order to deter the entrepreneur from signalling too high a firm value, the marginal benefit of increasing audit quality, and consequently $f'(q)$, can be larger for risk averse entrepreneurs. In other words, the audit quality required to signal the firm's true value can be smaller and still result in a perfectly revealing equilibrium. The entrepreneur would be better off with such a schedule, given that he would be required to spend less on an audit.

Riley (1975) goes further to suggest that under certain conditions even the Pareto dominant equilibrium will not be stable. This will occur if investors offer slightly more than I , $I + \varepsilon$, for firms that do not signal, thereby acquiring not only firms worth anywhere from I to $I + \varepsilon$ but also some firms worth more than $I + \varepsilon$. This unravelling may not occur in the model presented here since such a strategy by investors will also attract some entrepreneurs who have negative net present value projects to sell shares in the marketplace. (See Leland and Pyle for a similar argument.)

Finally, Riley (1979) points out that even if the equilibrium could unravel as described above, it will not if each market participant considers the effect of his actions on the actions of others. In such a situation a "reactive equilibrium" will result. As he shows, the reactive equilibrium will be the Pareto dominant equilibrium.

The optimal q for an entrepreneur depends on two factors: the form of $k(q)$, how the precision of the investors' estimate of firm value varies with audit quality, and α , the entrepreneur's final shareholdings in the firm. As $k(q)$ decreases for each q (that is, precision for a given audit quality becomes greater), $f(q)$ increases for each q . It therefore does not take as high an audit quality to signal any given firm value. This is a reasonable result because, with the precision of the investors' estimate increasing, the probability of an entrepreneur with a low true firm value being caught signalling falsely increases; the cost of signalling falsely therefore rises. Consequently, it will not take as great an expenditure and as high an audit quality for any entrepreneur to successfully differentiate his firm from those with lower true values. Conversely, as α decreases, $f(q)$ decreases for all q . A higher quality audit will be required to signal any given true firm value. This is because the smaller the number of shares the entrepreneur keeps the more he benefits by having a higher assigned firm value. An entrepreneur with a low firm value then has a greater incentive to expend resources for a high quality audit in order to signal a higher firm value. Hence, a greater expenditure and a higher audit quality are required for an entrepreneur to differentiate his firm from those with lower true values.

Because audit quality perfectly reveals firm value in this equilibrium, the outside investors will always value the firm according to the entrepreneur's choice of audit quality, never actually using for valuation the estimate of firm value, θ . No θ will ever be drawn which would indicate to the outside investors that the entrepreneur is signalling a value higher than his firm's true value. That the entrepreneur is never found to be signalling incorrectly raises an interesting question: What should be the value assigned to the firm by outside investors if the entrepreneur's signal is contradicted

by θ ? The equilibrium valuation schedule will clearly be sensitive to the choice. Unfortunately, because no entrepreneur will ever signal a value different from the firm's true value in this equilibrium, this question cannot be answered within this model.

In order to endogenously determine the value to be assigned if the entrepreneur is found to be signalling incorrectly, some feature must be added which makes it possible for a contradiction between the signalled value and the estimate of firm value to arise. For example, in the context of this model, if investors do not always properly observe each entrepreneurs' signal, or, if there are entrepreneurs who do not accurately know the true values of their firms, then the observed signal of an entrepreneur can contradict the investors' estimate of firm value. If the distribution of such errors is known, then an unambiguous valuation can be assigned to a firm when such a contradiction arises. Further, a perfectly revealing equilibrium will still exist, with each entrepreneur signalling his true (or perceived) firm value. In the limit, as the number of errors goes to zero, such a perfectly revealing equilibrium will approach that developed above. This technique is essentially what Guasch and Weiss (1980) use in order to endogenously determine their equilibrium signalling schedule in the context of a labor market. By having workers only imperfectly know their true productivity, a perfectly revealing equilibrium is obtained where workers truthfully signal their perceived productivity through the amount that they are willing to pay to be tested. Because of the imperfect knowledge of his productivity, a worker may still fail the test. However, in this case the expected productivity of the worker can be unambiguously determined by the employer from knowledge of the amount paid and the result of the test.

3. A PARTIALLY REVEALING EQUILIBRIUM

A key feature of the model of the previous section is the distributional assumption that if entrepreneurs from two firms with different true values both choose the same audit quality, there will exist a range of estimates, θ , which could arise only from the firm of lower value. This assumption enables investors to infer, if θ is sufficiently low, that an entrepreneur is signaling a value higher than the true value of his firm and to price the shares accordingly. Given this, entrepreneurs in firms of low true value will not have an incentive to signal a high value, with audit quality consequently providing perfect information. Such a perfectly revealing equilibrium cannot arise, however, if the distributional assumption is changed so that for a given quality audit the range of possible estimates, θ , is independent of the firm's true value (such as when θ comes from an unbounded distribution). To see this, assume that a perfectly revealing equilibrium did exist in this case. This implies that a firm of high true value would be priced solely on the basis of the audit quality chosen regardless of the θ determined by investors given the audited financial statements. However, since the range of θ is the same for both a firm of high and of low true value, the entrepreneur of such a low value firm can choose the same audit quality as is chosen by the entrepreneur for the firm of high value without being detected and obtain a high price for his shares. But this contradicts the assumption of a perfectly revealing equilibrium. With the same audit quality chosen by entrepreneurs of firms with different values, the audit quality cannot perfectly reveal firm value.

The purpose of this section is to present an example which demonstrates that even when the assumptions necessary to attain a perfectly revealing

equilibrium are not satisfied, audit quality may still provide reliable information about the true value of the entrepreneur's firm. Such a situation more closely approximates reality where not only the chosen level of audit quality, but also the choices for other decision variables such as the dividend level and the debt-equity ratio, provide investors with useful, but incomplete, information as to the firm's value.

Consider an economy where all investors, as well as all entrepreneurs, are risk neutral. The true value of any entrepreneur's firm can take on only one of two possible values, v_A or v_B , there being N_A type A firms and N_B type B firms in the economy. Further, there are only two types of auditors, low quality local auditors who charge an audit fee of e_L and high quality national auditors whose fee is e_H , with $e_H > e_L$. To ensure that some entrepreneurs find it profitable to choose the high quality auditor it must also be assumed that $v_A - v_B > e_H - e_L$; that is, that the high quality auditor is not prohibitively costly relative to the low quality one. Given the audited financial statements of a firm of type i , investors can form an estimate, θ , of the firm's true value which is assumed here to be normally distributed with mean v_i and variance σ_H^2 or σ_L^2 depending on whether a high or a low quality audit is performed, where $\sigma_H^2 < \sigma_L^2$. As should be clear from the previous discussion, because of the distributional assumption being made here a perfectly revealing equilibrium cannot exist. But a partially revealing equilibrium, in which audit quality provides some information to investors, will result. This is stated in the following proposition:

Proposition 2: For the economy described in this section a partially revealing equilibrium will exist where:

- (a) entrepreneurs in type A firms choose only the high quality auditor;
- (b) a fraction $\gamma \in (0,1]$ of the entrepreneurs in type B firms choose the low quality auditor with the remainder choosing the high quality auditor;
- (c) the market valuation given to a firm choosing the high quality auditor is greater than that given to a firm choosing the low quality auditor.

Proof: Given (a) and (b), if the low quality auditor is chosen, investors will value the firm at v_B . If the high quality auditor is chosen and θ is the estimate formed, the market price for the firm will be determined by its expected value conditional on this information, as given by:

$$v_H^*(\theta, \gamma) = \frac{v_A N_A g_H(\theta/v_A) + \gamma v_B N_B g_H(\theta/v_B)}{N_A g_H(\theta/v_A) + \gamma N_B g_H(\theta/v_B)} \quad (6)$$

where $g_H(\theta/v_i)$ is the probability density of θ given a true firm value of v_i and given a high quality audit. The market price $v_H^*(\theta, \gamma)$ is a weighted average of v_A and v_B where the weight for v_A (v_B) is a function of the number of entrepreneurs of type A (B) firms choosing the high quality audit and the probability that θ would have arisen from a type A (B) firm. Since $v_H^*(\theta, \gamma)$ is a convex combination of v_A and v_B , part (c) of the proposition follows immediately; $v_H^*(\theta, \gamma) > v_B \forall \theta$. For later reference note also that $v_H^*(\theta, \gamma)$ is an increasing function of θ and a decreasing function of γ . (The proof of this is in Appendix A.3.)

It remains to be shown that given the valuation function $v_H^*(\theta, \gamma)$ the two types of entrepreneurs will behave as stated in the proposition. Note, first, that some entrepreneurs in type B firms must choose the high quality auditor. This is because of the fact that at $\gamma = 0$, $v_H^*(\theta, 0) = v_A$ and because of the assumption that $v_A - e_H > v_B - e_L$. Together they imply that at $\gamma = 0$ the

expected valuation for type B firms net of audit fees will be higher if a high quality audit is chosen. If γ did equal zero, then, entrepreneurs in type B firms would be motivated to choose such an audit. Since $v_H^*(\theta, \gamma)$ is a decreasing function of γ , these entrepreneurs would continue to choose high quality audits until γ reached the point where either:

$$\int_{-\infty}^{\infty} v_H^*(\theta, \gamma) g_H(\theta/v_B) d\theta - e_H = v_B - e_L \quad (7)$$

in which case the entrepreneur of a type B firm will be indifferent between the two audits since they will both provide the same expected valuation net of fees or where:

$$\int_{-\infty}^{\infty} v_H^*(\theta, 1) g_H(\theta/v_B) d\theta - e_H > v_B - e_L \quad (8)$$

in which case all entrepreneurs choose the high quality audit. In either event, since $g_H(\theta/v_A)$ stochastically dominates $g_H(\theta/v_B)$ and because $v_H^*(\theta, \gamma)$ is increasing in θ :

$$\int_{-\infty}^{\infty} v_H^*(\theta, \gamma) g_H(\theta/v_A) d\theta - e_H > v_B - e_L \quad \forall \gamma \quad (9)$$

so that all entrepreneurs in type A firms choose the high quality audit. This completes the proof. \square

In this equilibrium firms are priced using both θ and audit quality. Firms in which low audit quality is chosen are priced at v_B since only type B firms use low quality auditors. Firms in which high audit quality is chosen are priced higher, at some average of v_A and v_B , since high quality auditors will be chosen by entrepreneurs in both types of firms. The specific value assigned will be based on the estimate, θ , and on how likely it is to be realized from a type A as opposed to a type B firm. Since, on average, higher θ 's are more likely to be realized if the firm is of type A, market valuations

will be an increasing function of θ . This implies that entrepreneurs of type A firms will expect to receive a higher valuation than will entrepreneurs of type B firms from a choice of a high quality audit. This explains why entrepreneurs of type B firms can be indifferent between the two types of audits in equilibrium while entrepreneurs of type A firms will strictly prefer the high quality audit.

4. SUMMARY AND CONCLUSIONS

When a new issue is sold, the firm's owners must choose the quality of the audit to be performed on the firm's financial statements. The analysis presented here suggests that not only are the contents of these audited financial statements important for investors in estimating the firm's value, but that also the chosen audit quality provides information as to the firm's true value. In some cases, in fact, the audit quality completely reveals the value of the firm. In other cases, audit quality and the financial statements together provide reliable, but not complete, information as to the firm's value. In both cases, however, the higher the audit quality the greater the value assigned to the firm's shares. This analysis, therefore, gives support to a prevalent belief that the selection of a higher quality national auditing firm rather than a lower quality local one will result in a firm obtaining a higher price for the shares it sells.

Appendix

A.1. Verification of inequalities (a) - (c), p. 6.

Expression (a) is equal to:

$$(1-\alpha)f'(q)-e'(q) \quad (A1)$$

With $f'(q) = \frac{2e'(q)}{(1+k(q))(1-\alpha)}$ and $0 \leq k(q) \leq 1$, by definition, (A1) is equal

to zero for $q = 0$ (when $k(q)=1$) and positive otherwise.

Expression (b) is equal to:

$$\begin{aligned} & \int \frac{v(1+k(q))}{f(q)(1-k(q))} \left[\frac{(1-\alpha)f'(q)}{2k(q)v} - \frac{(1-\alpha)f(q)k'(q)}{2k^2(q)v} \right] d\theta + \frac{(1-\alpha)f(q)vk'(q)}{2k(q)v} \\ & - \frac{(1-\alpha)f(q)}{2k(q)v} [f'(q)(1-k(q))-f(q)k'(q)] + \int \frac{f(q)(1-k(q))}{v(1-k(q))} - \frac{(1-\alpha)\theta k'(q)}{2k^2(q)v} d\theta \\ & + \frac{(1-\alpha)f(q)(1-k(q))}{2k(q)v} [f'(q)(1-k(q))-f(q)k'(q)] - \frac{(1-\alpha)v(1-k(q))(-vk'(q))}{2k(q)v} - e'(q) \end{aligned} \quad (A2)$$

Substituting $f'(q) = \frac{2e'(q)}{(1+k(q))(1-\alpha)}$ and replacing $f(q)$ by $v + d$ where $d > 0$ and simplifying gives:

$$\begin{aligned} & \frac{e'(q)}{k(q)} - \frac{e'(q)}{k(q)(1-k(q))} + \frac{k(q)e'(q)}{1+k(q)} - \frac{de'(q)}{k(q)v(1+k(q))} + \frac{(1-\alpha)d^2k'(q)}{4k^2(q)v} \\ & + \frac{dk(q)e'(q)}{v(1+k(q))} + \frac{(1-\alpha)dk'(q)}{2} + \frac{(1-\alpha)d^2k'(q)}{4v} - e'(q) \end{aligned} \quad (A3)$$

If $d = 0$ (A3) is zero. For $d > 0$ it is negative.

Finally, expression (c) is equal to:

$$\int \frac{v(1+k(q))}{v(1-k(q))} - \frac{(1-\alpha)\theta k'(q)}{2k^2(q)v} d\theta + \frac{(1-\alpha)v(1+k(q))vk'(q)}{2k(q)v} + \frac{(1-\alpha)v(1-k(q))vk'(q)}{2k(q)v} - e'(q) \quad (A4)$$

This simplifies to $-e'(q)$.

This completes the proof. The schedule $f(q) = \int_0^q \frac{2e'(y)dy}{(1+k(y))(1-\alpha)} + c$ results in the entrepreneur signalling his firm's true value.

A.2. Derivative of a risk averse entrepreneur's utility at the q where $f(q) = v$.

At the q where $f(q) = v$ the entrepreneur's utility is:

$$\begin{aligned} & \int \frac{v(1+k(q))}{f(q)(1-k(q))} \frac{E_x[U[(1-\alpha)f(q)-I - e(q) + \alpha\tilde{x}]]}{2k(q)v} d\theta \\ & + \int \frac{f(q)(1-k(q))}{v(1-k(q))} \frac{E_x[U[(1-\alpha)\theta - I - e(q) + \alpha\tilde{x}]]}{2k(q)v} d\theta \end{aligned} \quad (A5)$$

Letting $a = (1-\alpha)f(q) - I - e(q) + \alpha\tilde{x}$ and $b(\theta) = (1-\alpha)\theta - I - e(q) + \alpha\tilde{x}$, the first derivative of the entrepreneur's utility is:

$$\begin{aligned} & \int \frac{v(1+k(q))}{f(q)(1-k(q))} \left[\frac{\frac{\partial EU(a)}{\partial a} [(1-\alpha)f'(q)-e'(q)]}{2k(q)v} - \frac{EU(a)k'(q)}{2k^2(q)v} \right] d\theta \\ & + \frac{EU(a)}{2k(q)v} vk'(q) - \frac{EU(a)}{2k(q)v} [f'(q)(1-k(q)) - f(q)k'(q)] \\ & + \int \frac{f(q)(1-k(q))}{v(1-k(q))} \left[\left[-\frac{EU[b(\theta)]}{2k^2(q)v} \right] k'(q) + \frac{\frac{\partial EU[b(\theta)]}{\partial b(\theta)}}{2k(q)v} (-e'(q)) \right] d\theta \end{aligned}$$

$$\begin{aligned}
& + \frac{EU[b(f(q)(1-k(q)))]}{2k(q)v} [f'(q)(1-k(q)) - f(q)k'(q)] \\
& - \frac{EU[b(v(1-k(q)))]}{2k(q)v} (-vk'(q))
\end{aligned} \tag{A6}$$

With $f(q) = v$ the first derivative simplifies to:

$$\frac{\partial EU(a)}{\partial a} [(1-\alpha)f'(q) - e'(q)] - \frac{EU(a)f'(q)(1-k(q))}{2k(q)v} + \frac{EU[b(f(q)(1-k(q)))]}{2k(q)v} f'(q)(1-k(q)) \tag{A7}$$

Given that the entrepreneur is risk averse so that U is concave,

$$\frac{EU(a) - EU[b(f(q)(1-k(q)))]}{a - b(f(q)(1-k(q)))} > \frac{\partial EU(a)}{\partial a} \tag{A8}$$

Using (A8) the first derivative must be smaller than:

$$\begin{aligned}
& \frac{EU(a) - EU[b(f(q)(1-k(q)))]}{a - b(f(q)(1-k(q)))} [(1-\alpha)f'(q) - e'(q)] - \frac{EU(a)f'(q)(1-k(q))}{2k(q)v} \\
& + \frac{EU[b(f(q)(1-k(q)))]}{2k(q)v} f'(q)(1-k(q))
\end{aligned} \tag{A9}$$

This simplifies to:

$$[EU(a) - EU[b(f(q)(1-k(q)))]] \left[\frac{(1-\alpha)f'(q) - e'(q)}{(1-\alpha)f(q)k(q)} - \frac{f'(q)(1-k(q))}{2k(q)v} \right] \tag{A10}$$

Given the schedule $f(q) = \int_0^q \frac{2e'(y)dy}{(1+k(y))(1-\alpha)} + c$,

$$\frac{(1-\alpha)f'(q) - e'(q)}{(1-\alpha)f(q)k(q)} = \frac{f'(q)(1-k(q))}{2k(q)v} \tag{A11}$$

and (A10) is zero. The valuation schedule $f(q) = \int_0^q \frac{2e'(y)dy}{(1+k(y))(1-\alpha)} + c$ results in a negative derivative of utility with respect to q at the q where $f(q) = v$.

A.3.1 Proof that $\frac{\partial v_H^*(\theta, \gamma)}{\partial \theta} > 0$.

Rewrite $v_H^*(\theta, \gamma)$ as:

$$\begin{aligned} v_H^*(\theta, \gamma) &= \frac{v_B N_A g_H(\theta/v_A) + \gamma v_B N_B g_H(\theta/v_B) + (v_A - v_B) N_A g_H(\theta/v_A)}{N_A g_H(\theta/v_A) + \gamma N_B g_H(\theta/v_B)} \\ &= v_B + \frac{(v_A - v_B) N_A g_H(\theta/v_A)}{N_A g_H(\theta/v_A) + \gamma N_B g_H(\theta/v_B)} \end{aligned}$$

$v_H^*(\theta, \gamma)$ is then increasing in θ if $\frac{N_A g_H(\theta/v_A)}{N_A g_H(\theta/v_A) + \gamma N_B g_H(\theta/v_B)}$

is increasing in θ , or if its inverse, $\frac{N_A g_H(\theta/v_A) + \gamma N_B g_H(\theta/v_B)}{N_A g_H(\theta/v_A)}$,

is decreasing in θ . This inverse is equal to $1 + \frac{\gamma N_B g_H(\theta/v_B)}{N_A g_H(\theta/v_A)}$.

In order to show that $\frac{\partial v_H^*(\theta, \gamma)}{\partial \theta} > 0$ it is now sufficient to show that $\frac{\partial \left[\frac{g_H(\theta/v_B)}{g_H(\theta/v_A)} \right]}{\partial \theta} < 0$.

$$\frac{g_H(\theta/v_B)}{g_H(\theta/v_A)} = \exp \left[-\frac{1}{2} \left(\frac{\theta - v_B}{\sigma_H} \right)^2 + \frac{1}{2} \left(\frac{\theta - v_A}{\sigma_H} \right)^2 \right]$$

$$\frac{\partial \left[\frac{g_H(\theta/v_B)}{g_H(\theta/v_A)} \right]}{\partial \theta} = \exp \left[-\frac{1}{2} \left(\frac{\theta - v_B}{\sigma_H} \right)^2 + \frac{1}{2} \left(\frac{\theta - v_A}{\sigma_H} \right)^2 \right] \times$$

$$\left[-\frac{(\theta - v_B)}{\sigma_H^2} + \frac{(\theta - v_A)}{\sigma_H^2} \right]$$

Since $v_A > v_B$ this derivative is negative. This completes the proof that $\frac{\partial v_H^*(\theta, \gamma)}{\partial \theta} > 0$.

A.3.2 Proof that $\frac{\partial v_H(\theta, \gamma)}{\partial \gamma} < 0$.

$$\begin{aligned} \frac{\partial v_H^*(\theta, \gamma)}{\partial \gamma} &= \frac{v_B N_B g_H(\theta/v_B)}{N_A g_H(\theta/v_A) + \gamma N_B g_H(\theta/v_B)} - \frac{[v_A N_A g_H(\theta/v_A) + \gamma v_B N_B g_H(\theta/v_B)] N_B g_H(\theta/v_B)}{[N_A g_H(\theta/v_A) + \gamma N_B g_H(\theta/v_B)]^2} \\ &= \frac{(v_B - v_A) N_A g_H(\theta/v_A)}{[N_A g_H(\theta/v_A) + \gamma N_B g_H(\theta/v_B)]^2} \end{aligned}$$

< 0

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