Insider Holdings and the Pricing of Initial Public Offerings

by

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Working Paper No. 15-81

INSIDER HOLDINGS AND THE PRICING OF INITIAL PUBLIC OFFERINGS

ABSTRACT

For a large sample of initial public offerings of common stock, insider holdings are positively related to market value/book value ratios. Three hypotheses are presented to explain this relation: (i) insider holdings signal relative firm value, (ii) an agency relation is present, so that firms with higher insider holdings have harder-working managers, and are thus worth more, and (iii) small firms with high values have wealthier managers, and these managers do not fully diversify their portfolios, so that the aforementioned statistical finding is merely a "wealth effect." A number of tests are performed on the implications of these hypotheses, with no single hypothesis by itself being fully consistent with the data. Insider holdings do appear to be a signal of firm value, but the wealth effect magnifies the relation. No evidence is found supporting the agency hypothesis.

I. Introduction

When a firm offers stock to the public for the first time, potential investors must evaluate the stock on the basis of an information set which does not include historical prices of the firm's stock, for with initial public offerings there are no previous market prices. Instead, at least for firms with an operating history, the information set contains only such characteristics as the size of the firm, its earnings, sales, etc. One other variable that is observable is the level of insider holdings of common stock. The most obvious empirical regularity is that insider holdings are strongly (positively) related to various measures of relative offering prices.

There are at least three alternative explanations for this observed positive relation between insider holdings and relative firm value. One possible explanation is that insider holdings are a signal of firm value. A second explanation relies on an agency argument: firms with high levels of insider-managerial ownership have higher future cash flows because of the high insider holdings. Yet a third explanation completely reverses the direction of causality of the agency argument. Firms having high valuations may have high insider holdings because the high valuation has made the original shareholders wealthy, and this wealth effect induces the positive relation between insider holdings and relative firm value. The purpose of this paper is to investigate the testable implications of these three alternative but not mutually exclusive

hypotheses in an attempt to determine the relative importance of these three effects.

A number of other authors have looked at insider holdings and/or initial public offerings. Ibbotson, and Ibbotson and Jaffe, examined the returns on initial public offerings of common stock, and found that, on average, they yield positive excess returns when purchased at the offering price. For the sample used in this paper, this is also true. Jaffe's oft-cited paper "Special Information and Insider Trading" investigated the returns on seasoned common stocks when insider holdings changed. Jaffe interprets his finding of a positive relation between changes in insider holdings and stock returns as indicating that managers have insider information that is signaled to the market through changes in their holdings. Downes and Heinkel, in "Signaling and the Valuation of Unseasoned New Issues," find that there is a positive relation between relative offering prices and the fraction of the equity retained by the initial shareholders. As the title of their paper indicates, they accept a signaling explanation for the observed positive association, but they do not investigate the alternative hypotheses presented in this paper.

Downes and Heinkel's findings are consistent with the simple regressions reported in Table 1, where two alternative measures of relative firm value, (the logarithm of) market value to book value of equity ratios, and (the logarithm of) price-earnings ratios, are regressed on the fraction of the post-offering equity retained by the original shareholders α. For both measures of relative offering price, there is a positive relation between firm value and the fraction of post-offering equity retained by the original shareholders. Furthermore, it is a strong relation, for the coefficient estimate of 1.79 on α in the Log MV/Book

regression implies that a one standard deviation increase in α from its mean of 0.72 to 0.81 would increase the (unlogged) MV/Book ratio from its

TABLE 1

SIMPLE REGRESSION RESULTS

	Constant	Alpha	R^2	Sample Size
Log $\frac{MV}{Book}$	0.11 (0.21)	1.79 (0.29)	0.06	559
Log $\frac{Price}{Earnings}$	1.70 (0.17)	1.65 (0.24)	0.08	559

Standard errors in parentheses. Log MV/Book is the natural logarithm of the offering price divided by pre-offering common equity per share. Log Price/Earnings is the natural logarithm of the offering price divided by the most recent annual earnings per share. Alpha is the fraction of post-offering common equity retained by the pre-offering shareholders. Sample selection criteria and further descriptive information are reported below Table 2.

mean of 5.10 to 5.81.[1] A similiarly dramatic effect occurs in the Log P/E regression, where an identical increase in α from 0.72 to 0.81 would increase the (unlogged) price-earnings ratio from its mean of 21.9 to 24.8. Since the qualitative results are the same for both measures of relative firm value, the rest of this paper will report results only for the Log MV/Book specification.

The organization of this paper is as follows. Section II describes the data and confirms that the Table 1 relation is maintained in a multiple regression where other factors affecting relative firm value are taken into account. Sections III, IV, and V respectively present

[1] exp [0.11 + 1.79(0.81)] - exp [0.11 + 1.79(0.72)] = 0.71 = 5.81 - 5.10. Note that exp [0.11 + 1.79(0.72)] $\neq$ 5.10 because E(Log A) $\neq$ Log E(A).

signaling, agency, and wealth effect explanations for the relation, with various tests performed in an attempt to discriminate among the alternative hypotheses. All of the regressions use offering prices in computing market values for these tests, and Section VI examines how sensitive the results are to using after-market prices instead. In so doing, the issue of any systematic mispricing by investment bankers is addressed. In common with Ibbotson, and Ibbotson and Jaffe, it is found that the securities are on average underpriced, but that this underpricing is not systematically related to any of the variables used in this study. Section VII contains a summary and conclusions.

II. Data and the Empirical Relation Between Insider Holdings and Firm Value

An obvious potential problem in interpreting the simple regressions in Table 1 is that many other variables affect firm value, and these other determinants may be correlated with α. Or to phrase things differently, all of the explanations for the positive relation between α and firm values have implicit ceteris paribus clauses that are almost certainly violated in a heterogeneous sample of 559 firm commitment initial public offerings such as used in this paper. The sample is drawn from U.S. Securities and Exchange Commission-registered initial public offerings in the 1965-73 period meeting certain criteria chosen primarily for reasons of data availability. Each of the initial public offerings in the sample had at least $300,000 in gross proceeds raised by the firm and

selling shareholders, where this $300,000 is measured in nominal dollars.[2] Furthermore, each firm met certain requirements listed in detail below Table 2, which have the effect of excluding firms without some operating history.

Even with the smallest and newest firms excluded, however, the heterogeneity of the sample means that a simple regression such as that of Table 1 should be interpreted with care. Consequently, Table 2 presents a multiple regression with Log MV/Book regressed on α and several other variables included to control for other factors affecting relative firm value. Before analyzing the coefficient on α, it is useful to describe these other variables and to interpret the coefficients.

LOG AGE and LOG SALES are both proxies for how well "established" a firm is. The negative coefficients here are probably due in part to the sample selection procedure. Since to be included in the sample, gross proceeds raised from an initial public offering must be at least $300,000 in nominal dollars, small firms are much more likely to be included in the sample population if their market value is relatively high than if relatively low. Essentially all large firms that go public are included in the sample population, however. The coefficients on Log Age and Log Sales probably pick up some of this effect.

AMEXPE, the median PE ratio of the 720 largest market value stocks on the American Stock Exchange immediately before the issue date of each initial public offering, is included to control for differences across

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[2] $300,000 before May, 1971, $500,000 thereafter within the sample. For offerings with gross proceeds below these amounts, firms were allowed to use "Regulation A" offerings by the S.E.C. Regulation A offerings have substantially less costly and less informative disclosure requirements.

TABLE 2

OLS REGRESSION RESULTS, LOG MV/BOOK AS DEPENDENT VARIABLE

	Constant	Alpha	Log Age	Log Sales	AMEXPE	Log Sales Growth	R^2
Log MV/Book	1.91	2.07	-0.12	-0.14	0.03	1.39	0.43
	(0.40)	(0.24)	(0.03)	(0.02)	(0.01)	(0.15)	

Standard errors in parentheses. N = 559 observations. Log MV/Book defined as the natural logarithm of the pre-offering market value of common equity, valued at the offering price, divided by the pre-offering common stockholders' equity for the most recent date available as reported in the prospectus. All offerings are firm commitment initial public offerings from the 1965-73 period satisfying the criteria that the most recent fiscal year's earnings be positive, that the pre-offering book value of equity exceed $500,000 in 1980 dollars, and that the annual sales exceed $1,000,000 in 1980 dollars. These criteria were imposed to reduce the heterogeneity of the sample and avoid outliers among the residuals.

Alpha is a measure of insider holdings, defined as $\alpha \equiv (N_0 - N_s)/(N_0 + N_p)$ where $N_0 \equiv$ number of shares outstanding prior to offering; $N_s \equiv$ number of shares in secondary offering; $N_p \equiv$ number of primary shares offered. Alpha calculated assuming that over-allotment option, if any, is not exercised. Warrants and stock options, if any, are similiarly excluded from calculations unless they are exercised by time of offering. Age ≡ number of years since firm was founded. Age > 3 to be included in sample. Sales ≡ most recent full-year sales reported in prospectus, converted to 1980 dollars using the following factors derived from the U.S. GNP Deflator Index:

1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
2.64	2.60	2.56	2.51	2.43	2.36	2.25	2.15	2.04	1.94	1.86

AMEXPE is the median PE ratio of the 720 largest market-value stocks on the American Stock Exchange at the end of the month before the issue date for each security. Sales Growth Rate ≡ $\frac{1}{2}$ log [$sales_t/sales_{t-2}$], the continuously compounded growth rate of real sales for the 3 years preceding going public for each firm. Log Sales Growth ≡ Log [1 + Sales Growth Rate]. The means and standard deviations of the variables are as follows:

	Log MV/Book	Alpha	Log Age	Log Sales	AMEXPE	Log Sales Growth	Sample Size
Mean	1.40	0.72	2.87	16.81	17.42	0.21	559
	(0.66)	(0.09)	(0.79)	(1.08)	(3.36)	(0.17)	

time in market capitalizations.[3] One would expect that a firm going public would be able to command a higher MV/Book ratio[4] when the market was capitalizing other assets at higher values and the positive coefficient of 0.03 on AMEXPE is consistent with this a priori expectation.

LOG SALES GROWTH serves as a proxy for the growth opportunities of a firm, and thus the positive and highly significant coefficient is as predicted. The variable is constructed by taking the logarithm of one plus the continuously-compounded growth rate of real sales. With a mean value of 0.25 for the continuously-compounded growth rate of real sales, the sample of firms going public is clearly not representative of all firms. (The MV/Book mean of 5.10 is also clearly not representative. A ratio closer to 1 is common for firms listed on the New York Stock Exchange, with values in excess of 2 or 3 rare even during the late 1960s.)

In contrast with the easily-interpreted coefficients on Log Age, Log Sales, AMEXPE, and Log Sales Growth, the strongly positive coefficient on insider holdings, α, is somewhat problematic. The Table 2 results are consistent with those of Downes and Heinkel, who interpret the positive

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[3] As an alternative to the median P/E ratio on the American Stock Exchange, a measure of the market's Tobin-Brainard "Q" was tried as a proxy for the level of the market, where Q is the ratio of the market value to book value for all securities. The existing series on Q appear to suffer from severe problems with non-synchronous data used in their construction, with the result that the simple correlation between MV/Book ratios of initial public offerings and these measures of the market Q is close to zero.

[4] Throughout the paper, the text will refer to MV/Book ratios for expositional convenience, although the regressions are performed with the logarithm of this variable.

coefficient on α as meaning that signaling is occurring.[5] Note that the coefficient estimate of 2.07 implies an even stronger effect than that of Table 1's simple regression, where the coefficient estimate was 1.79.

Other variables certainly could have been included in the Table 2 regressions to increase the explanatory power. Principles of parsimony have persevered, however.[6] With the relation between insider holdings and relative firm value having been fully documented, it is now appropriate to investigate the alternative explanations for its cause in more detail.

II. The Signaling Model

A model in which insider holdings of common stock are a signal of firm value has been presented by Leland and Pyle. Risk-averse insiders, who are assumed to be informed about the firm's future prospects, signal their knowledge by failing to diversify their personal portfolios fully. This lack of diversification signals the information about firm value through insider holdings, since the higher the level of insider holdings, ceteris paribus, the less diversified is the portfolio of an owner-

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[5]Actually Downes and Heinkel use a transformation of α, $\log(1-\alpha) + \alpha$, in their regressions. α and this transformed variable are negatively related, so that the strongly negative coefficient that they find is analagous to the positive coefficient on α reported in Tables 1 and 2. Their motivation for using the non-linear transformation of α is contained in Leland and Pyle, although for the range of α in the sample of their paper, a linear approximation does not fare poorly. Another difference between their paper and the results contained herein is that they use different functional forms and different explanatory variables than used here. The results are robust to these alternative specifications, however. Downes and Heinkel use data from the 1965-69 period comprising the first half of the sample in this paper.

[6]It is worth commenting on two variables not included in the Table 2 regressions. Bhattacharya has suggested that dividend payments may signal relative firm value, while Ross has proposed that capital structure may be a signal. The failure of Downes and Heinkel to find support for either of these hypotheses led to the decision not to pursue either hypothesis in this paper, in light of the difficulties of designing a powerful test of either Bhattacharya's or Ross's model.

manager. With some simplifying assumptions, Leland and Pyle are able to derive a differential equation relating the fraction of the firm retained by insiders, α, to the expected future firm value, μ. The solution to this differential equation, subject to the boundary condition that the investment must have a positive net present value for the owner-entrepreneur to willingly hold a non-diversified portfolio, is given by

$$\mu(\alpha) = I(1+r) + \frac{\text{cov}\ (\tilde{x},\ \tilde{M})}{\sigma_M^2}\left[E(\tilde{R}_M) - r\ \right]V_M - b\sigma_x^2(1-\rho^2)[\alpha + \log(1-\alpha)]. \quad (1)$$

where I is the dollar value of investment, r is the interest rate, $\tilde{x}$ is the unpredictable component of next-period's cash flow with variance σ_x^2, $\tilde{M}$ is next-period's market value with variance σ_M^2, $E(\tilde{R}_M)$ is the expected return on the market portfolio, V_M is the current value of the market, b is the coefficient of risk-aversion of the owner-entrepreneur, and ρ is the correlation coefficient of the project and market returns. Thus, by observing α, investors are able to discern the true value of μ.

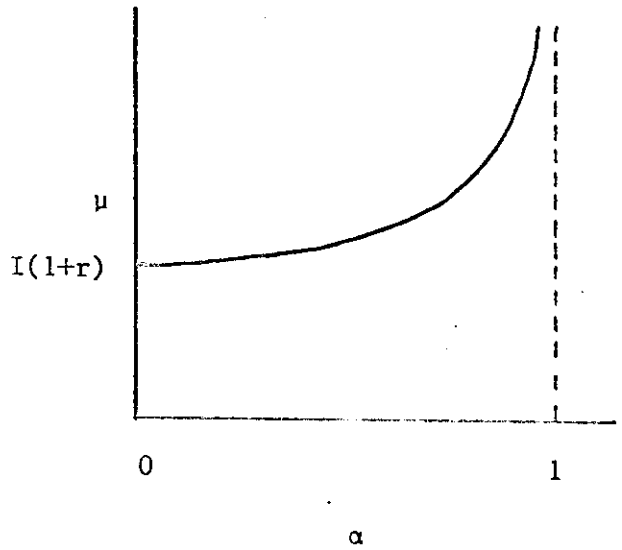

Figure 1 — Graph of equilibrium signaling schedule with relevant boundary condition for Leland-Pyle signaling model relating insider holdings (α) to future firm value (μ). Intercept of I(1+r) drawn assuming covariance term in equation (1) is zero.

Equation (1) is graphed in Figure 1. Equation (1) has three terms: an intercept, a risk premium, and a slope term. The level of investment occurs only in the intercept term, and α is present only in the slope term. Thus, the equilibrium signaling schedule shifts vertically as investment changes. These vertically parallel schedules provide the basis for the strong prediction that, ceteris paribus, as investment increases, the firm value should increase dollar for dollar with investment. (Actually, future firm value increases by $(1 + r)I$, and current firm value changes by this amount discounted to the present.) In particular, if α serves as a signal of firm value, in a multiple regression with the post-offering market value as the dependent variable, an explanatory variable representing investment should have a coefficient of one and α should have a positive coefficient.

In order to test these predictions of the signaling model, a proxy for investment must be chosen. The measure of investment adopted here is the net funds raised by the firm in the initial public offering (i.e., the offering price minus the underwriter's discount, multiplied by the number of shares in the primary offering). While this measure excludes internally-generated funds and debt, it should be noted that the dependent variable is just the post-offering market value of equity alone. While it might be preferable to use the market value of all securities, and compute α accordingly, the firms in the sample tend to have very low post-offering debt-equity ratios, computed using market values. Since investment projects typically involve expenditures over many months, rapidly-growing firms tend to raise new funds in an initial public offering at a point when their "debt capacity" is approached. The proceeds of the primary offering are frequently used to repay short-term

bank debt, and then as additional funds are needed, the bank debt is built up again.

The Leland-Pyle hypothesis can be tested by regressing post-offering market values on α and Investment. However, the sample of 559 firms used here is a heterogeneous mix of firms, violating the implicit ceteris paribus clause. Even when variables such as Log Age, Log Sales, AMEXPE, and Log Sales Growth are included to control for this heterogeneity, a severe heteroskedasticity problem is present when market value is used as a dependent variable. This heteroskedasticity problem was not present in Table 2, where Log MV/Book was the dependent variable.

To control for the heteroskedasticity problem, which causes inefficient parameter estimation, weighted least squares has been employed with post-offering market value regressed on a set of explanatory variables. For each firm, both the dependent variable and all independent

TABLE 3

WEIGHTED LEAST SQUARES TEST OF SIGNALING HYPOTHESIS,
POST-OFFERING MARKET VALUE/PRE-OFFERING BOOK VALUE AS DEPENDENT VARIABLE

($\times 10^7$) Constant / Bk Val	($\times 10^7$) Alpha / Bk Val	($\times 10^6$) Log Age / Bk Val	Sales / Bk Val	($\times 10^5$) AMEXPE / Bk Val	Bk Val / Bk Val	($\times 10^7$) Earnings / Bk Val	Log Sales Growth / Bk Val	Invstmnt / Bk Val	R^2
-2.32	2.47	0.83	-0.13	1.43	0.67	13.75	2.56	3.10	0.65
(0.26)	(0.27)	(0.37)	(0.03)	(0.60)	(0.28)	(0.98)	(1.40)	(0.17)	

Standard errors in parentheses. N = 559. All left- and right-hand side variables divided by pre-offering book value of equity. Numerators of right-hand side variables defined under Table 2, except for Investment and Earnings. Investment ≡ Dollar value of primary offering, net of underwriter's spread, expressed in 1980 dollars. Earnings ≡ Total earnings of firm in most recent fiscal year, expressed in 1980 dollars. Post-offering market value computed using offering price. Coefficient estimates are not appreciably affected by use of after-market prices. Note that coefficient estimate for Constant/Book Value should be interpreted as -2.32×10^7, or -23,200,000.

variables have been divided by the pre-offering book value of equity. (All nominal variables have been converted to 1980 dollars.) If the Leland-Pyle hypothesis that α signals true firm value is correct, then the coefficient on α should be positive and the coefficient on Investment should be (not significantly different from) unity. Table 3 reports the results of this weighted least squares regression. The explanatory variables used include those from Tables 1 and 2, although Log Sales has been replaced by Sales since the dependent variable is no longer in logarithmic form. Additional explanatory variables include the pre-offering book value, the earnings of the firm, and of course investment.

Two coefficients are of interest in Table 3. The coefficient on α is positive, consistent with insider holdings being a signal of firm value. The coefficient of 3.10 on Investment is also positive, but it is more than 12 standard errors above unity, a result that is inconsistent with the equilibrium signaling schedules shifting in a one-for-one manner with investment, as implied by the Leland-Pyle model. While the parameter estimate of 2.47 on α is consistent with α being a signal of firm value, other factors are apparently at work. These other potential factors, which are not mutually exclusive, will now be considered.[7]

III. The Agency Hypothesis

An agency problem exists when it is impossible to monitor costlessly the performance of a manager to whom decision-making authority has been delegated. In contrast to the signaling analysis, where true future firm value μ is independent of the owner-entrepreneur's holdings,

[7]One other point to note is that the post-offering book value is equal to the sum of pre-offering book value and investment. The coefficients on these two components are significantly different in Table 3, supporting the disaggregated approach adopted.

the agency analysis assumes that the true relation, as well as the equilibrium perceived relation, relates α and μ. Thus, while the signaling analysis takes μ as exogenous and focuses on overcoming an assumed information asymmetry, the pure agency analysis views μ as endogenous and assumes that there is no informational asymmetry between the manager and investors beyond that arising from the inability to observe the manager's actions. A model of firm value and insider holdings in which an agency relation is present has been presented by Jensen and Meckling. The idea underlying the agency hypothesis is that managerial compensation schedules do not induce managers to produce as much as would be the case with 100 percent owner-management. The implication is that the lower the fraction of insider holding, α, the lower will be the firm value because the cash flows will be reduced due to managerial shirking. Because outside investors know that the manager will do more shirking the lower is α, the market value of the firm will be positively related to α, ceteris paribus.

This does not mean, however, that the agency model implies a positive sample correlation between α and firm market value. In deriving equation (1) nothing was said about the cross-sectional distribution of investment opportunities among firms. α, after all, is determined endogenously, and is affected by factors including the initial wealth of owners, the amount of debt financing, and the ratio of gross present value to investment. Furthermore, if the size of any given project is variable, as is the case in Jensen and Meckling's formulation, then the size of each project is a choice variable of the manager, and marginal agency costs must be balanced against marginal rates of return on investment. However, there is no presumption that these effects are strongly negatively

correlated with α, so that rather than reversing the positive relation between α and firm market value, they may merely add "noise" to the relation in cross-sectional data.

The agency-signaling dichotomy can be analyzed in terms of production functions. In the agency model, firms have production functions, the potential output of which is easily observable. What is not easily observable, however, is where on the production function a manager will be. Insider holdings, which are observable, indicate how effectively the manager will choose to utilize the inputs, and investors are thus able to discern where on a known production function the firm will operate.

The signaling model, on the other hand, assumes that the manager has no discretionary power regarding how effectively to utilize the inputs. The potential output of the firm, however, is not directly observable, and insider holdings convey information about the production function.

Both the Leland-Pyle signaling model and the Jensen-Meckling agency model predict that there will be a monotonic relation between insider holdings and firm value. While the Leland-Pyle model also predicts that the equilibrium relation should be convex, specific assumptions on the form of a single owner-manager's utility function are required. Since almost without exception there is more than a sole initial owner of the firm that is going public, it is not at all clear that one should expect convexity of the relation when looking at the evidence from initial public offerings.

IV. The Wealth Effect Analysis

While the signaling and agency hypotheses provide plausible rationales for a positive relation between insider holdings and observed firm value, there is another possible explanation for the observed correlation. This third possibility is that the observed statistical relation may be due merely to the confounding of signaling or agency effects with wealth effects, just as income effects are sometimes confounded with substitution effects in estimating demand elasticities. The wealth effect argument differs slightly, depending upon whether we are dealing with a primary or a secondary offering. In both cases, however, the basic reasoning is the same: to raise a given amount of money, the initial owners must sell a smaller proportion of the stock in a firm, the greater is the market value of the firm. Thus, the owners of firms with high market values may retain large percentage holdings even if there is no signaling or agency effect. Of course, a wealth effect of exactly the opposite kind might arise if the owners of successful firms have strong diversification motives and/or the firms with the greatest growth opportunities, and hence high market values, seek to raise the largest sums of money for investment.

Casual evidence indicating that a wealth effect should be expected comes from a recent article on the effect of insider holdings on the price of initial public offerings in Venture magazine: "The decision to offer insiders' shares must be made by the underwriter, say most investment bankers, who frequently agree to selling insiders' stock only when the primary offering would be too small to satisfy demand or net the underwriter a satisfactory commission."

There is some reason to expect a positive wealth effect for secondaries; the argument rests upon a capital gains "locked in" effect. With highly successful firms, the market value of the equity will greatly exceed the book value. In the sample used in this paper, for instance, the average MV/Book ratio is 5.10. Since the original investment of the initial owners is approximately the book value of the stock, large capital gains have been incurred, and taxes might be substantial enough to outweigh portfolio rebalancing motivations. Furthermore, since the "spread," i.e., the sales commission, averages over 8 percent for these initial public offerings, and since the offering price averages another 5 percent below the after-market price, the opportunity costs of selling stock in an initial public offering are very substantial. Thus, it seems plausible that only strong reasons to sell, such as to pay taxes on estates or for immediate consumption, are sufficient to overcome the high costs involved. Because of this, it seems plausible that the elasticity of secondary sales with respect to firm value, both measured in dollars, is likely to be less than one, which is sufficient to generate a positive relation between MV/Book and α due to the pure wealth effect.

For primary offerings, the capital gain tax argument is not relevant, although the underpricing argument still is. Since firms with the best investment opportunities also, in general, have the highest MV/Book ratios, the necessary condition for a positive relation between MV/Book and α due to the pure wealth effect is that the market value of equity increases at a faster rate than dollar external equity does as investment grows.[8] There does not appear to be a strong theoretical

[8] I.e., the elasticity of funds raised for investment with respect to firm value is less than one.

reason for this to be the case. A look at the empirical relation seems justified. To examine the possible causal effect of wealth on α, the appropriate dependent variable in a regression is α. Using this, Table 4 examines whether or not the wealth effect is different for primary and secondary offerings.

The hypothesis that the coefficients on Log MV/Book for both the Pure Primaries and Pure Secondaries regressions are identical can be formally tested by viewing the estimated coefficients as observations from

TABLE 4

OLS REGRESSIONS WITH ALPHA AS DEPENDENT VARIABLE

	Constant	Log MV/Book	Log Sales	R^2	Sample Size
Pure Primaries	-0.045 (0.105)	0.062 (0.009)	0.043 (0.006)	0.36	135
Mixed Offerings	0.075 (0.087)	0.061 (0.008)	0.033 (0.005)	0.18	336
Pure Secondaries	0.146 (0.197)	0.035 (0.016)	0.031 (0.011)	0.10	88
Entire Sample	0.125 (0.063)	0.055 (0.006)	0.031 (0.004)	0.18	559

Standard errors in parentheses. Pure primaries are defined as firm commitment initial public offerings where all of the shares being sold are newly issued by the firm. Pure secondaries are those where all shares being sold come from existing shareholders. Mixed offerings have both primary and secondary shares.

a common distribution, so that a simple comparison-of-means test can be performed. For the parameter values of 0.062 on the Pure Primaries coefficient and 0.035 on the Pure Secondaries coefficient, the resultant t-statistic for the hypothesis that the coefficients are observations from a common distribution is 1.57, which has a p-value of 0.11. In other

words, parameter values as far or further apart as 0.062 and 0.035 would be drawn by chance 11 percent of the time if in fact they were from a common distribution with a variance that is consistent with the standard errors of 0.009 and 0.016 reported in Table 5 above.[9] Consequently, the sample will not be disaggregated by type of offering in the coming tests.

The wealth effect hypothesis does have a strong prediction. If high firm value causes high α values, then a regression with Log MV/Book as the dependent variable will be subject to simultaneous equation bias. Furthermore, the agency hypothesis predicts unidirectional causality in exactly the opposite direction. Thus, if there is an agency relation, regressions using α as the dependent variable, as in Table 4, will be subject to simultaneous equation bias.

With these two hypotheses making strong predictions regarding the existence of simultaneous equation bias, tests should be straightforward. However, with α and Log MV/Book as endogenous variables, the two equation system has an identification problem. In particular, while the equation for α is overidentified, the equation for Log MV/Book is not identified, and thus only one test for the existence of simultaneous equation bias can be made. Using a t-statistic in excess of 2.0 as the criteria for inclusion of a variable in a regression, we find that Log MV/Book is a

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[9] Formally, the test statistic is $\frac{\hat{\beta}_{1p} - \hat{\beta}_{1s}}{s.e.(\beta_1)} = 1.57$ where

$$s.e.(\beta_1) = \left(\frac{1}{n_p n_s} \cdot \left(\frac{n_p + n_s}{n_p + n_s - 2}\right)\left[n_p(n_p-1)\left(s.e.(\hat{\beta}_{1p})\right)^2 + n_s(n_s-1)\left(s.e.(\hat{\beta}_{1s})\right)^2\right]\right)^{\frac{1}{2}}$$

where $\hat{\beta}_{1p}$ and $\hat{\beta}_{1s}$ are the parameter estimates for primary and secondary offerings, respectively.

function of α, Log Age, Log Sales, AMEXPE, and Log Sales Growth, as well as a constant term. Of these variables, all but α are exogenous. For α as a dependent variable, only Log MV/Book and Log Sales provide significant explanatory power, along with a constant. Using these explanatory variables, the structural equation parameter estimates are as follows:

TABLE 5

ORDINARY LEAST SQUARES ESTIMATES OF STRUCTURAL EQUATIONS

	Constant	Log $\frac{MV}{Book}$	Alpha	Log Age	Log Sales	AMEXPE	Log Sales Growth	R^2
Log $\frac{MV}{Book}$	1.91 (0.40)	---	2.07 (0.24)	-0.12 (0.03)	-0.14 (0.02)	0.03 (0.01)	1.39 (0.15)	0.43
Alpha	0.125 (0.063)	0.055 (0.006)	---	---	0.031 (0.004)	---	---	0.18

TWO-STAGE LEAST SQUARES ESTIMATES FOR IDENTIFIED EQUATION

	Constant	Log $\frac{MV}{Book}$	Log Sales	R^2
Alpha	0.187 (0.082)	0.042 (0.012)	0.028 (0.004)	0.08

Standard errors in parentheses. The coefficient of determination of the reduced form equation, not presented here, with Log MV/Book as the dependent variable, is 0.35.

The pure wealth effect hypothesis states that a higher Log MV/Book ratio causes a higher α, while the agency hypothesis states that a higher α causes a higher Log MV/Book ratio. If the agency hypothesis is correct, then the OLS estimate of the coefficient on Log MV/Book will be biased upwards, and the 2SLS estimate will be closer to zero than the OLS estimate.

While the explanatory power of the second-stage regression is quite low, with an R^2 of only 0.08, there seems to be no strong evidence of simultaneous equation bias of the type suggested by the agency hypothesis. In particular, the estimated coefficient on Log MV/Book in the OLS regression is 0.055, while the coefficient estimate in the 2SLS regression decreases slightly to 0.042. The standard errors are sufficiently high so that the small difference in coefficient estimates could easily be accounted for by chance, although the change is in the direction that is predicted by the agency hypothesis.

While the Table 6 regressions could not find strong evidence in support of the agency hypothesis, using the entire sample may not provide the most powerful test. Agency and signaling relations may be more important for small firms. Smaller firms are more difficult to evaluate

TABLE 6

OLS AND 2SLS ESTIMATES WITH ALPHA AS DEPENDENT VARIABLE, BY FIRM SIZE

	Constant	Log $\frac{MV}{Book}$	Log Sales	R^2	Sample Size
OLS, Small Firms	0.336 (0.114)	0.061 (0.009)	0.017 (0.007)	0.17	225
2SLS, Small Firms	0.311 (0.140)	0.067 (0.020)	0.018 (0.008)	0.05	225
OLS, Large Firms	0.030 (0.099)	0.051 (0.008)	0.037 (0.005)	0.17	334
2SLS, Large Firms	0.138 (0.120)	0.031 (0.014)	0.032 (0.006)	0.08	334

Standard errors in parentheses. For 2SLS regressions, Log MV/Book is predicted value from reduced form regressions, using Log Age, Log Sales, AMEXPE, and Log Sales Growth as explanatory variables. The reduced form regressions had coefficients of determination of 0.26 and 0.36 for small and large firms, respectively. Small firms are defined as those having fewer than 250 employees at the time of the initial public offering; large firms are those having 250 or more employees.

by conventional means, and therefore insider holdings may play a more important role for these firms. If there is more of an agency relation present with smaller firms than with bigger firms, then there should be more evidence of simultaneous equation bias for small firms when the sample is split, as is done in Table 6, where α is the dependent variable. The top two rows contain results for small firms; the bottom two rows contain results for large firms. While large standard errors hamper strong conclusions, there is no evidence of larger bias for small firms than for large firms, once again casting doubt on the importance of the agency hypothesis in explaining the observed relations. In summary, no evidence in support of the simultaneous equations bias predicted by the agency hypothesis has been found.

V. Analysis of the Efficiency of Investment Bankers' Pricing

While the regressions reported so far are appropriate for the investment bankers' pricing problem, when an investor is presented with the opportunity to invest in a new issue, one further piece of information is available—the underwriter's spread. This is the percentage difference between the offering price and the proceeds per share to the firm. Since the underwriters cannot charge more than the offering price if the offering is oversubscribed, one component of the spread is the implied value of a put option that the underwriter has sold to the issuer. This put option component of the spread was first noted by Ibbotson (footnote 20, page 263). The greater is the uncertainty regarding the after-market price, the larger is the value of the put, unless the offering price (the equivalent of the exercise price on an option) is lowered to offset this. The size of the spread is thus a proxy for uncertainty,

or "quality", and as Table 8 indicates, the spread conveys substantial information to potential investors, with a t-statistic in excess of 6.

TABLE 7

OLS REGRESSION RESULTS, WITH AND WITHOUT UNDERWRITER'S SPREAD

	Constant	Alpha	Log Age	Log Sales	AMEXPE	Log Sales Growth	Spread	R^2
Log $\frac{MV}{Book}$	3.87	2.00	-0.15	-0.21	0.02	1.25	-8.04	0.46
	(0.51)	(0.23)	(0.03)	(0.03)	(0.01)	(0.15)	(1.37)	
Log $\frac{MV}{Book}$	1.91	2.07	-0.12	-0.14	0.03	1.39	---	0.43
	(0.40)	(0.24)	(0.03)	(0.02)	(0.01)	(0.15)		

Standard errors in parentheses. All regressions use 559 observations from 1965-73. Spread ≡ Underwriter's spread divided by offering price per share. Mean value of Spread is 0.082 (8.2 percent of the offering price) with a standard deviation of 0.018. Regression results without underwriter's spread also reported in Table 2.

The negative coefficient on Spread can be given two interpretations. First, it may be that the spread is positively correlated with systematic risk, and the negative coefficient indicates a positive risk premium. Second, the higher the spread, the lower the net proceeds of the issue, and the negative coefficient reflects the difference between price paid and revenue received.

The spread negotiated by the underwriter and issuing firm is a potential source of information for investors. Unlike for underwriters, it is an exogenous variable from the viewpoint of an investor. Consequently, investors should use this information, along with any other information they possess, for predicting firm values.

Investment bankers have so far been assumed to use the information available to them appropriately when pricing initial public offerings. In particular, if insider holdings really did signal true firm value, but this signal was not reflected in the offering price, then the tests

performed in this paper would not have been very powerful. Ibbotson's empirical work on the price performance of initial public offerings indicates that investment bankers have trouble predicting market prices, for substantial price changes (both increases and decreases) immediately after the offering are the rule rather than the exception. The information available to investment bankers appears to be insufficient to completely ascertain market demand. This section will perform a "semi-strong form" test of whether or not investment bankers are using available information efficiently in pricing initial public offerings. In particular, a simple trading rule will be formulated based upon deviations between actual and predicted prices. Whether this simple trading rule produced profits will then be analyzed.

The procedure followed is to estimate a pricing equation using data from 1965-67 and then use the parameter estimates to predict Log MV/Book ratios for initial public offerings in 1969.[10] If the predicted value is higher than the actual number implied by the offering price, the security is purchased; if the pricing equation indicates that the security is overpriced, the security is sold short. For initial public offerings in 1970, the pricing equation is reestimated using data from 1965-69. For initial public offerings in 1971, the pricing equation is similarly reestimated using data from 1965-70, and for 1972, data from 1965-71 is used; for 1973, data from 1965-72 is used.[11]

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[10] No observations are available for 1968; otherwise they would have been used.

[11] In calculating the pricing equations, the Log MV/Book ratio was constructed using end-of-month after-market prices rather than offering prices.

Market prices were collected for the end of the month in which the firm went public for the 559 firms in the sample. (Or a bid price, if there were no actual transactions within a few days of month end.) These data were used to calculate the one-month rate-of-return that would have been received by an investor who purchased each security at the offering price. (The results including dividend payments in the rate-of-return calculations are identical to three decimal points. Very few of the firms went ex-dividend in the month of the offering, and of those that did, the dividend yields are usually well below one percent.) For the firms for which these returns were available, the pricing equations resulted in 270 "buy" recommendations and 172 "sell" recommendations. The mean returns that would have been realized following the strategy are reported in Table 8.

Table 8's results indicate that implementing the simple trading rule proposed here would have resulted in smaller returns than a naive strategy of purchasing all initial public issues. In particular, going short in the 172 securities that the pricing equations indicated might be overpriced was not wise, since these securities had initial performance insignificantly different from the securities in which a long position was indicated. No evidence indicating that investment bankers do not appropriately evaluate available information is contained in Table 8. Instead, the residuals from the pricing equations can be interpreted as security-specific residuals, and not deviations from the offering prices that "should" be set.

As in all tests of efficiency, what is actually being tested is a joint proposition. In this case, the appropriate model for efficient

pricing is not completely clear.[12] Furthermore, since only the differences in conditional means were examined, it may be that inefficiency was not detected because overpricing and underpricing exactly balance out within each category so that the overall mean pricing error is zero, even though the absolute value of the pricing error is large for every single initial public offering. Since the test has no power against this plausible alternative, it is a weak test.

TABLE 8

RESULTS OF IMPLEMENTING SIMPLE TRADING RULE IN 1969-73

	Mean Rate of Return	Standard Deviation of Mean	N
BUY	0.041	0.024	270
SELL	-0.052	0.018	172

Rate of Return computed as (End-of-month Price - Offering Price)/Offering Price. Adjustments for market returns do not noticeably affect results. Mean Rate of Return is an equally-weighted arithmetic average. Standard Deviation of Mean calculated assuming independence of returns. Total number of returns (270 + 172) is less than 559 because for the first 117 observations representing 1965-67 no prediction equations were available since the sample did not include pre-1965 observations with which to contruct prediction equations. After-market price quotations collected from Investment Dealers Digest, Bank and Quotation Record and Commercial and Financial Chronicle, and National Stock Summary. Results were also computed adjusting for market returns, with virtually identical results.

One further item to examine is whether or not a pricing equation estimated using after-market prices has more explanatory power than one estimated using offering prices.

[12] In "A Theory of Investment Banking Contract Choice" (1981), Ritter has presented a model of the determination of offering prices in which the expected initial returns on initial public offerings deviate in a systematic manner from what would be predicted by the Capital Asset Pricing Model.

For the 559 firms in the sample, a pricing equation was estimated using after-market prices rather than offering prices in constructing market-value to book-value ratios. Table 9 compares the coefficients for the two cases. The R^2's reported represent the ratio of regression sum of squares to the sum of squares of the after-market market-value to book-value ratios. Thus, the R^2 of 0.44 in the top equation is not the R^2 obtained using the offering price in the dependent variable. It should be noted that the variance of after-market price MV/Book ratios is larger than the variance of offer-price MV/Book ratios.

TABLE 9

PRICING EQUATIONS USING OFFERING PRICES AND AFTER-MARKET PRICES IN LOG MV/BOOK

	Constant	Alpha	Log Age	Log Sales	AMEXPE	Log Sales Growth	Spread	R^2
Offering	3.87	2.00	-0.15	-0.21	0.02	1.25	-8.04	0.44
	(0.51)	(0.23)	(0.03)	(0.03)	(0.01)	(0.15)	(1.37)	
After-Market	4.13	2.35	-0.17	-0.23	0.02	1.52	-8.61	0.45
	(0.61)	(0.27)	(0.04)	(0.03)	(0.01)	(0.18)	(1.61)	

Standard errors in parentheses. Both equations use 559 observations from 1965-73. The R^2's are computed as one minus the ratio of the sum of squared prediction errors to the sum of squares of the dependent variable defined using after-market prices. Thus, the bottom R^2 corresponds to the usual definition, while the top R^2 differs from normal in that the denominator is computed using market prices, rather than offering prices, in the sum of squares. R^2 of 0.44 computed as [Var(A) - Var(B)]/Var(A) where A ≡ Log (MV/Book) using market prices and B ≡ Log (MV/Book) minus predicted value from offering price regression. Note that the resulting R^2 in the top row cannot be larger than the R^2 in the bottom row. See Table 7 for a description of Spread. All other variables defined under Table 2.

VI. Summary and Conclusions

Three hypotheses were presented to explain the observed relation that, in a cross-sectional study of initial public offerings, market-value to book-value ratios are positively correlated with levels of insider

holdings. Several tests were done in an attempt to discriminate among the alternative, but not mutually exclusive, hypotheses.

A test of the Leland-Pyle signaling hypothesis using weighted least squares found that the estimated parameter had a value more than 8 standard errors above its theoretical value if insider holdings were a sufficient signal of firm value. Agency and wealth effect explanations were then entertained, but only very weak evidence of the simultaneous equation bias predicted by the agency hypothesis was found. The wealth effect hypothesis also implies that a simultaneous equation bias problem will exist, but an identification problem precluded testing this.

Studies of changes in insider holdings, such as Jaffe have found substantial impacts on share prices. While Jaffe interprets his results as favorable to the signaling hypothesis, an agency explanation could also account for his results. Since he dealt with changes in insider holdings, the wealth effect hypothesis advanced here to explain cross-sectional differences in levels of insider holdings would not be relevant. Jaffe's results create a strong presumption that signaling and/or agency effects are behind the relation documented in this paper. Tests for the simultaneous equation bias that an agency relation would induce failed to find any supporting evidence, however, leading to the conclusion that Jaffe's signaling interpretation of his results is plausible. The parameter estimate from the test of the Leland-Pyle model performed in this paper, however, leads to the conclusion that signaling cannot explain the entire relation between insider holdings and relative firm values. Consequently, although no direct test for a wealth effect has been performed, the strong relation between insider holdings and relative firm values can tentatively be attributed to the joint influence of signaling and wealth effects at work.

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