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Investment Behavior and the Small Firm Effect

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Our purpose in this review is to develop one explanation of market behavior which is consistent with the many empirical findings that appear to be inconsistent with the market efficiency hypothesis. To date, researchers have attempted to reconcile their empirical results with market efficiency based on either measurement error or structural inefficiencies. We propose a different approach to market efficiency. We posit that the empirical findings previous researchers report are by their nature *ex post*, and are a direct result of a market which is best described as efficient. We develop a model and provide a simulation to support this explanation.

I. INTRODUCTION

Research evidence has documented that many small firms have systematically shown inordinately high stock price appreciation. This price appreciation coupled with dividend payments is frequently referred to in the financial literature as "excess returns" or "abnormal returns." The existence of systematic excess returns implies the possibility of achieving abnormal stock market returns by selecting portfolios of common stocks with small market value capitalizations. Yet, such an opportunity contradicts the economic theory of the efficient market hypothesis. This theory holds that any systematically available information is immediately known and also instantly reflected in market price which provides the investor with a return that is strictly a function of investment risk (Roll, 1981b). There appears to be reluctance on the part of investigators to embrace a process whereby observed excess returns are congruent with efficient capital market theory. This current review resurrects the small firm effect debate by focusing on an approach

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that is consistent with efficient market theory and by demonstrating logically that normal firm capital investment behavior gives rise to excess returns and that these returns are at some point in time reflected in stock price.

Some financial theorists argue that a new theory is needed to explain this contradiction (Schwert, 1983). However, three possible explanatory frameworks can be applied to reconcile existing theory with the evidence of the market place:

1. associate measurement error with studies that report abnormal returns (Basu, 1983; Booth & Smith, 1987; Schultz, 1983);
2. identify structural inefficiencies in the operation of markets or incompleteness in market models that permit excess returns to be observed (Constantinides, 1984; Keim, 1983; Officer, 1975); or
3. demonstrate the consistency of anomalous returns with normal firm behavior and thereby with efficient capital market theory.

Our purpose is to provide an explanation of the small firm effect that is consistent with the context of efficient markets and thus follows the third approach identified above. Our approach is consistent with the recent work by Berk (1995), who shows that what has been considered as size-related anomalies are not anomalous but rather congruent with market efficiency. Furthermore, Westhead (1995) indicates that firm growth is related to its ability to move into new markets or niches. The breadth of new markets is not constant, the identification of their presence is not predictable, and a firm's ability to compete in different arenas is not universal. Therefore, even if the investors recognized a firm's performance in a given market, some surprises will still remain. The market's reaction to those new surprises should mimic those in our model. Specifically, we develop the argument that observed normal market returns are a consequence of the greater size of a small firm's capital budget, containing embedded positive net present values, relative to the market value of its equity. Excess returns result because of the delay in translating operating decisions into market valuation decisions. The model we develop is *not* to be considered a specific representation of today's business environment. Rather, we use this simple example to illustrate that even in a highly efficient market structure, an *ex post* assessment of returns will produce an empirical small firm effect.

We operate from the assumption that an inverse relationship exists between firm size and capital budget. Additional empirical research is needed to determine what relation, if any, exists between firm size and the corresponding capital budget. In addition, our model assumes that the net present value for any year is recognized immediately when the funds are raised to support the capital budget. The timing of the recognition of the net present value will affect the size and timing of the excess return; however, this in no way diminishes the importance of the excess

return. While it might be reasonable for investors to project positive net present values from multi-year budget plans, at some point investors will be "surprised" by subsequent budget plans as technology changes and unknowable opportunities are presented. To argue otherwise requires the market to be more than efficient, it requires market clairvoyance.

Four fundamental propositions underlie our explanation:

1. Since firms make new capital investments up to the point where marginal cost equals marginal expected return, firms should realize an excess return overall on their capital budgets;
2. The excess return the firm earns leads to an upward revision in the firm's stock price; this increase creates an *ex post* risk-adjusted excess return to the stockholder;
3. The extent of the upward price revision, and consequently the size of the abnormal returns to the stockholder, depend upon the size of the excess dollar return to the firm relative to the size of the firm's market valuation; and
4. Small firms as a group are likely to have larger capital budgets relative to their total market value than do larger firms as a group, and thus earn greater relative excess capital budget returns than do larger firms; this leads to greater abnormal returns for small firm shareholders (the small firm effect).

II. RESEARCH EVALUATING THE SMALL FIRM EFFECT

The identification of the small firm effect has been attributed to Banz (1981) and Reinganum (1981a). Since the initial work, a catalog of literature has developed with the principal focus on why such an anomaly would remain unexploited in an environment where arbitrage opportunities abound, or, alternatively, that the small firm effect is observed because of errors in measurement or methodology (Reinganum, 1981b; Roll, 1983a,b). Neither measurement errors nor structural inefficiencies have proven to be conclusive alternative explanations of the observed excess returns associated with small firms (Dyl, 1977; James & Edmister, 1983). Supporting evidence for either alternative explanation relies on the delicate choice of time period examined and/or the data set employed, as the following discussion indicates.

Measurement Error Explanation

Table 1 provides a summary of studies employing the measurement error hypothesis to explain the small firm effect. The table documents the research issue,

Table 1
Summary of Research on the Measurement Error Hypothesis

Author	*Research Issue/question*	*Data Source*	*Time Period*	*Results*
Basu, S. (1983)	Relationship between earnings yield, firm size and returns on common stock	NYSE	1962-1973	Small NYSE firms have earned higher rates of returns than large firms. Firms with higher e/p rations earned higher rates of return than their low e/p counterparts
Blume, M. Stambaugh, R. (1983)	Analyze size effect data	NYSE & AMEX	1963-1980	Average size effect over entire year is only 0.05% per day (half as much as reported by Reinganum & Keim): virtually all is attributable to January; the size effect is .60% per day in January and roughly zero for the rest of the year.
Booth, J. R. Smith, R. (1987)	Can small firm effect be explained on basis of investor preference for positive skewness?	Daily CRSP tapes	1963-1981	Result indicates that small firm effect cannot be fully attributed to tax effects, benchmark error, or incorrect assumptions of the CAPM about investor aversion
Carleton,W. Lakonishok, J. (1986)	If at least part of the small firm effect can be attributed to joint effects of inter- industry differences and seasonality	13 industries on NYSE	1961-1980	Small firms outperformed large firms, even after controlling for industry effects
Reinganum, M. R. (1981a)	Is the simple one period CAPM misspecified or are capital markets inefficient?	Sample 566 NYSE & AMEX firms	1976-1979	The evidence appears to indicate that the equilibrium pricing model is misspecified
Reinganum, M. R. (1981b)	Does the arbitrage pricing theory offer a parametric alternative to simple one period CAPM?	NYSE & AMEX	1963-1980	Tests do not definitely reveal which hypothesis or hypotheses cannot be supported
Reinganum, M. R. (1982)	See if Roll's (1980) suggestion that small firm effect may be attributable to improper estimation of security Betas	NYSE & AMEX	1963-1980	Precise estimates of Betas for small firms are difficult to obtain; Beta's highest point estimate of small firms did not explain its superior performance
Roll, R. (1981b)	Smaller firms with same risk yield on average higher returns than large firms do. How can this be explained?	S&P 500 & sample NYSE & AMEX	1962-1979	Auto correlation in portfolio returns has resulted in an improper measurement of small firm risk
Roll, R. (1983a)	Which method of computing mean returns is best?	NYSE	1963-1981	Investment experience is best depicted by buy and hold portfolio returns but often arithmetic or rebalanced portfolio returns are used because they are easy to compute
Schultz, P. (1983)	How do transaction costs affect small firms stock returns?	NYSE & AMEX common stock	1955-1979	Anomalous behavior of small firms returns cannot be explained solely on the difference of transaction cost between small and large firms
Stoll, H. R. Whaley, R. (1983)	Affect transaction costs have on small firm effect and CAPM	NYSE & AMEX	1955-1979	Transaction costs affect abnormal returns and CAPM but affect lessens the longer security is held

the data used, the time period employed, and a brief discussion of the empirical results of studies which focus on measurement error as an explanation for the small firm effect. The most common explanation centers on criticism of the risk adjustment and market return measures researchers have employed. Roll (1983b) and Blume and Stambaugh (1983) found that about half of the size effect can be attributed to the use of daily vs. annual holding periods in calculation of risk-adjusted returns. These investigators conclude that significant abnormal returns still exist. Roll (1981a) suggests that infrequent trading may give rise to underestimated betas for small firms, because of the greater autocorrelation of returns in such circumstances. Reinganum (1982), however, found the small firm effect persisted even after adjusting betas for the effects of non-synchronous trading. Risk and return measurement differentials alone, therefore, do not account for the small firm effect, even though infrequent trading, in Roll's (1981b) words, "seems to be a powerful cause of bias in risk assessments" (p. 887).

Basu (1983) found the small firm effect to be non-significant after controlling for differences in both risk and earnings-price ratios. Yet Reinganum (1981a) concluded from empirical study, that results demonstrate the size effect subsumes any earning-price effect. Stoll and Whaley (1983) found transaction costs partially accounted for the small firm effect, but Schultz (1983) included a broader sample of stocks and found the small firm effect significant, net of transaction costs. Finally, Carleton and Lakonishok (1986) hypothesized that the small firm effect might be an industry effect.

Another approach to the measurement error explanation has been to question whether the Capital Asset Pricing Model (CAPM) effectively captures the relevant valuation factors investors incorporate into their decisions. Reinganum (1981b) sought to answer this question using arbitrage pricing theory, while Booth and Smith (1987) made a similar effort using stochastic dominance. Both found significant other factors, but neither was able to effectively dilute the significance of the small firm effect.

Regardless of the time period employed (1955-1981), the exchange where the security was traded (NYSE or AMEX), or the issue addressed, the small firm effect persisted. The calculation of the return, the frequency of trading, and the risk-differential transaction cost are inadequate explanations for the small firm effect.

Structural Inefficiency Explanations

Table 2 documents the research relating to the structural inefficiency explanation. A review of the studies in Table 2 shows a failure to completely explain the small firm effect. We discuss this research below. One form of inefficiency that could affect investor required returns is lack of information. Barry and Brown

Table 2
Summary of Research on the Structural Inefficiencies Hypothesis

Author	*Research Issue/Question*	*Data*	*Time Period*	*Results*
Barry, C. Brown, S. (1984)	Possible explanation of the small firm effect (small firms' larger risk-adjusted return than large firms)	Monthly NYSE security returns	1931-1980	Period of listing is associated with the firm size anomaly; information argument does not fully explain the firm size anomaly
Berges, A. McConnell, J.J. Schlarbaum, G.G. (1984)	Sought to confirm or reject small firm effect in turn of year stock returns (stockholders sell declining stock to write-off capital losses against ordinary income in computing income taxes)	391 companies on Toronto and Montreal stock exchange	1950-1980	Results indicate a significant January effect in Canadian stock returns; effect is more pronounced in small firms; relationship also exists between potential tax-loss selling measure used and January returns
Branch, B. (1977)	Compared buy and hold strategy vs. Tax loss strategy	NYSE	1965-1974	Tax loss selling has little to no impact on general level of stock prices in an average year
Beedles, W.L. (1992)	Examines the link between firm size and liquidity	Australian stock market	1974-1987	Small firms exhibit less liquidity and higher required returns
Berk, J.B. (1995)	Theoretical relationship between firm size and market return	N/A	N/A	Found when an inverse relationship exists between firm size and market return, a small firm effect is a natural result
Brown, P. Keim, D. Kleidon, A. Marsh, T. (1983)	Examines tax loss selling hypothesis using the Australian stock market	Sample of Australian stock with par value > one million	1958-1981	The evidence is difficult to reconcile that tax loss hypothesis is cause of seasonality in Australia
Constantinides, G.M. (1984)	Does optimal stock trading have an effect on abnormal January returns?	NYSE & AMEX	1962-1977	Tax trading does not explain the small firm anomaly but does predict a seasonal pattern in trading volume
Dyl, E.A. (1977)	Do income tax reasons major factor in explaining the abnormal year end trading volume?	Random 100 common stock on CRSP	1948-1970	Capital gains taxes affect investors' year end portfolio decision and is reflected in the trading volumes in December
Givoly, D. Ovadia, A. (1983)	Cause of high return during January	NYSE securities recorded on CRSP	1945-1976	Due to tax induced sales, price of many stocks was depressed in December but recovered in January; this price recovery is major contributor to high returns in January
Gultekin, M. Gultekin, N. (1983)	Stock market seasonality in major industrialized countries is examined empirically	1,100 shares on NYSE & AMEX	1959-1979	Seasonality appears to be caused by the disproportionately large January returns in most countries and April returns in U.K.

James, C. Edmister, R. (1983)	Relationship between common stock, trading activity, and market value	Sample 500 firms on NYSE & AMEX	1963-1980	Firm size and trading activity are highly correlated; difference in trading activities are not the underlying reason for the firm size anomaly; systematic differences in risk adjusted returns across stocks of firms of different sizes
Jones, C. P. Pearce, D. K. Wilson, J. W. (1987)	Is January effect tax-motivated?	Stock price data	1871 - NOW	January effect existed before income taxes with no major change taking place after income taxes were imposed
Keim, D. B. (1983)	Month to month stability of size anomaly	CRSP files of NYSE & AMEX firms	1963-1979	Relations between abnormal returns and size is always negative and more pronounced in January; size effect unable to explain January effect
Leonard, D.C., Shull, D.M.(1996)	Monthly comovement of closed-end funds and small firm returns	CRSP files of NYSE & AMEX	1965-1994	The January effect was pronounced prior to 1980; disappearance of the effect is associated with institutional trading
Officer, R. R. (1975)	Does a seasonal effect exist in Australian markets?	851 companies on Melbourne Stock Exchange	1976-1970	A seasonal effect does exist in the stock market but not the bond market
Reinganum, M. R. (1982)	Does Roll's (1980) suggestion that small firm effect may be attributable to improper estimation of security Betas?	NYSE & AMEX	1963-1980	Precise estimates of Betas for small firms are difficult to obtain; Beta's highest point estimate of small firms did not explain its superior performance
Reinganum, M. R. (1983)	Are January size effects associated with tax loss selling?	NYSE & AMEX	1963-1980	High returns at very beginning of January are consistent with tax loss selling, but cannot explain entire January seasonal effect
Reinganum, M. R. Shapiro, A. (1987)	Find cause of January and April monthly effects	Sample of London stock exchange	1955-1980	While the April effect is consistent with the tax loss selling hypothesis, the January effect cannot be attributed solely to the introduction of a capital gains tax
Rozeff, M. S. Kinney, W. R., Jr. (1976)	Present evidence of seasonality	Aggregate rates of returns for NYSE	1904-1974	Seasonality undetectable with any clarity in auto correlation function of returns; rates of return are tested by month with January having highest average rate of return
Schultz, P. (1985)	Is course of large abnormal returns earned by small firms in first few days of January due to investors trying to minimize income taxes?	Small firm stocks	1900-1929	Crucial finding is that there is no evidence of January effect prior to the 1917 tax act
Tinic, S. M. Barone-Adesi, G. West, R. R. (1987)	Since the capital gains were taxed in Canada starting in 1972, is this the cause of abnormal January returns on common stock?	Canadian stock market	1950-1980	January effect shows up for the entire period so it is difficult to believe that tax related trading by Canadian investors can account for all of the observed seasonality in returns
Wachtel, S. B. (1942)	Document seasonal movements in stock prices and to show they exist	Dow Jones Industrial Average	1927-1942	Seasonal curve is worth watching when formulating investment policy

(1984) studied lesser-known firms to determine whether a risk premium related to information could be identified. They found an association between time since original exchange listing and security returns, but learned that a significant inverse relationship between returns and firm size nevertheless coexisted with their measure of maturity.

The level of trading activity has been tested as an explanation of the small firm effect. Following Reinganum's (1982) conclusion that adjustments to betas for infrequent trading bias were insufficient to account for the small firm effect, James and Edmister (1983) tested the hypothesis that the small firm effect can be associated with the liquidity premium for less-frequently traded stocks. They found no support for their hypothesis. Beedles (1992) examined companies trading in the Australian capital market. This explanation posits a relationship between the small firm effect and greater costs of equity capital for small firms. Empirically the research demonstrates a negative and monotonic relationship between size and illiquidity and a positive and monotonic relationship between illiquidity and risk-adjusted performance. A conclusion is drawn that "this provides the clearest evidence ... that the high cost of equity finance experienced by small firms results ... from their comparatively low liquidity" (Beedles, 1992, pp. 64-65).

Seasonality in markets had been researched over fifty years ago by Wachtel (1942) and more recently by Rozeff and Kinney (1976), who identified a predictable beginning of year seasonal effect (the January effect). Relating size and seasonality, Keim (1983) showed that half of the small firm effect occurs in January. Although Keim acknowledges this explanation is incomplete, Reinganum (1983) relates this effect to tax loss selling, reflecting the attempt to establish securities losses in the prior year.

The possibility of explaining the better part of the small firm effect, and most of the January effect, as a consequence of tax strategy has attracted numerous researchers. Some studied the domestic environment (e.g., Brown, Keim, Kleidon, & Marsh, 1983; Dyl, 1977; Schultz, 1985), while others focused on international comparisons (e.g., Givoly & Ovadia, 1983; Gultekin & Gultekin, 1983; Kato & Schallheim, 1985; Tinic, Barone-Adesi, & West, 1987). Several studies found seasonality where there were no taxes (Constantinides, 1984; Jones, Pearce, & Wilson, 1987); while some researchers identified significant tax effects either in response to security price movements or to tax law changes (Berges, McConnell, & Schlarbaum, 1984; Keim, 1983). Studies that relate seasonality to size generally conclude that, whether or not there is a significant tax effect, a significant small firm effect is still identifiable (Keim, 1983; Leonard & Shull, 1996; Rozeff & Kinney, 1976).

In a recent article Berk (1995) shows "... theoretically (1) that the size-related regularities should be observed in the economy and (2) why size will in general explain the part of the cross-section of expected returns left unexplained by an

incorrectly specified asset pricing model" (p. 275). Berk demonstrates that empirically observed anomalies obtained in an environment where the logarithm of market value is inversely related to expected return. Furthermore, he concludes that the finding of an inverse relationship between return and market value—the small firm effect—is not an indictment of any model of asset pricing.

III. SMALL FIRM EFFECT

The body of existing research fails persuasively to explain that observed excess returns are predicated on measurement errors or market inefficiencies. In fact, these two explanations are contradictory and inconclusive. Thus, we develop an explanation of the small firm effect that is consistent with the efficient market hypothesis. Firm behavior leads to higher stock price valuation through the normal course of the capital budgeting process. Since firms make new capital investments up to the point where marginal cost equals marginal expected return, firms should realize an excess return overall on their capital budgets. The excess return the firm earns leads to an upward revision in the firm's stock price; this increase creates an *ex post* risk-adjusted excess return to the stockholders. Excess returns result because of the imperfect, or lagged, translation of operating decisions (the asset side of the balance sheet) into market valuation decisions (the financing side of the balance sheet).

The extent of the upward price revision, and consequently the size of the abnormal returns to the stockholder, depend upon the size of the excess dollar returns to the firm relative to the size of the firm's market valuation. Moreover, small firms as a group are likely to have larger capital budgets relative to their total market value (capital investment intensity ratio) than do larger firms as a group. Thus, smaller firms generate greater relative excess capital budget returns (i.e., returns greater than their cost of capital) than do larger firms. This leads to greater abnormal returns for small firm shareholders. This phenomenon is called the small firm effect. We believe the small firm effect is due to a higher capital intensity ratio (i.e., the ratio of the capital budget to total market value). Again, the purpose of the example is to demonstrate that the empirical small firm effect is observable in a highly efficient market context. The effect is the market's reaction to new information concerning the investment behavior of firms that produces a revision in stock price. Since firms are expected to invest in positive net present value opportunities, we would anticipate that the preponderance of the price changes would be upward revisions.

The small firm effect is a natural consequence of the market adjustment to a firm's realization of an unanticipated positive net present value from capital investment. The following example illustrates how the market translates these

excess asset returns earned by the firm into abnormal stock returns for the shareholders.

Capital Budget Expenditure Leads to Equity Value Appreciation

For the purposes of this illustration, assume that a firm exists in frictionless markets and is in a steady state as of time period zero (T=0), in which initially:

1. the firm is financed entirely with equity and has 100 shares of stock outstanding;
2. the firm earns $100 per year in perpetuity;
3. the firm has a 100% dividend payout ratio, $1 per share;
4. the firm's average and marginal costs of capital are 10%; and
5. following the Gordon Model, the firm has a stock value of $10 per share ($1/10%) and a total market value of equity of $1000 (100 shares X $10).

Assume next that the firm is provided with the one time investment opportunity schedule (IOS) at T=1 as described in Table 3. All projects in this IOS are identical in risk to the risk of the firm in its initial steady state. Each of the assets A_T through L_T costs $100. The *ex ante* perpetual returns are given in column 3, the expected dollar return in column 4, the cumulative dollar investment in column 5, and the cumulative dollar return in column 6 (see Table 3). Given the available

Table 3
Investment Opportunity Schedule, Cumulative Investment, and Cumulative Dollar Return (time period = T)

(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Asset	*Cost*	*E[Return]*	*E[$ Return] Per Year*	*Cumulative Cost*	*Cumulative $ Return/year*
A_T	$100	19%	$19	$100	$19
B_T	100	18	18	200	37
C_T	100	17	17	300	54
D_T	100	16	16	400	70
E_T	100	15	15	500	85
F_T	100	14	14	600	99
G_T	100	13	13	700	112
H_T	100	12	12	800	124
I_T	100	11	11	900	135
J_T	100	10	10	1000	145
		⇒Required Rate of Return = 10 Percent⇐			
K_T	100	9	9	1100	154
L_T	100	8	8	1200	162

projects, a 10% cost of capital, and a decision rule based on the internal rate of return (IRR), this firm will accept projects A_T through J_T, investing a total of \$1000 at T=1. Consequently, the firm will generate an additional total dollar return of \$145 in perpetuity, beginning at T=2. Of this amount, \$45 represents excess risk-adjusted return because of positive net present values. The use of an IRR decision rule is appropriate in this case because all available projects are of identical scale, duration, and timing of cash flows as well as identical risk of the firm.

To finance these additional investments, the firm must sell new shares of stock. Assume that the company discloses to the market that it intends to invest \$1,000 at T=1 in new projects that are expected to be of identical risk to the firm as it existed up to today, that it expects to earn \$145 per year in perpetuity beginning at T=2 from those projects, and that it intends to raise capital today by selling sufficient shares at the equilibrium price to obtain the needed capital.

The value of the new shares depends on the information the company discloses and on the market's reaction to that information. Assume that the market reacts immediately to the news by raising the equilibrium value of the stock to \$14.50 per share (see Appendix A). At this value, 68.96552 shares are sold, providing the company with the \$1,000 it needs to undertake the investments. Existing share holders will realize a one time \$4.50 (45% excess return, as the value of their shares rises from \$10 to \$14.50, in addition to receiving their steady state dividend of \$1.00 (10%). Once the new steady state is reached, dividends of \$1.45 (\$245/168.96552) per share will be paid, the value of the company will rise to \$2,450 (\$245/.10), and both the new shareholders and the existing shareholders will earn a perpetual 10% return on their investment, assuming no other changes.

Table 4 shows in detail the one period returns stockholders would earn from T=0 to T=1 and from T=1 to T=2, where the firm both does not (Table 4A) and does (Table 4B) acquire the new set of assets. Without accepting the new assets, the firm's stock would continue to be valued at \$10 per share and the shareholders would receive a constant 10% return, composed entirely of dividend yield. Undertaking the new investments at T=1 would cause the stock value to rise to \$14.50 immediately, and the dividend to increase to \$1.45 starting at T=2, which together would generate a 10% return from T=1 to T=2. Between T=0 and T=1, the existing original shareholders would realize a 55% return, which is composed of the 10% required return from dividends (1.00/10.00) and a 45% unanticipated appreciation [(14.50-10.00)/10.00]. Once the market makes the appropriate adjustment to the new information, the return to the shareholders will resume at this required 10% as Table 4B illustrates.

Debate regarding when the timing of the market's recognition of the excess return to the firm and when the subsequent adjustment occurs could alter the timing of the adjustment but not the effect from the adjustment. Further, the value adjustment and excess returns will be obtained in an efficient market, but not in a

Table 4
Return for First and Second Periods Assuming the Firm Does and Does Not Make Investments A-J (Single Period Model)

A. Without Undertaking Investments A_1-J_1

T=0	T=1	T=2
P_0=10	D_1=1 P_1=10 I_1=10	D_2=1 P_2=10

$$R_{0,1} = \frac{1 + 10 - 10}{10} = 10\% \qquad \frac{1 + 10 - 10}{10} = 10\%$$

B. Undertaking Investments A_1-J_1

T=0	T=1	T=2
P_0=10	D_1=1.000 P_1=14.500 I_1=1,000	D_2=1.450 P_2=14.500

$$R_{0,1} = \frac{1.000 + 14.50 - 10}{10} = 55\% \qquad R_{1,2} = \frac{1.450 + 14.50 - 14.50}{14.50} = 10\%$$

Notes: P_T = Share Value;
D_T = Divident per share;
$R_{T-1,T}$ = Holding period return;
all at or as of year end T

$$I_T = \sum_{K=A}^{J} K_T \quad = \text{Capital investment}$$

clairvoyant market. That is, if the market had complete foreknowledge of the firm's entire set of future investment opportunity schedules, the value of the stock would adjust at the time of the initial public offering (T=0) to include the additional present value of the dividend stream associated with all of those investments; otherwise, the observed, *ex post*, excess returns is a natural result of the rational investor in an efficient market.

The excess shareholder returns illustrated in Table 4 are sensitive to the assumptions of an all-equity capital structure and constant risk. For some range, the substitution effect of debt for equity would be likely to result in an overall lower cost of capital, making more capital budget opportunities attractive. Thus, the actual availability of positive net present value (NPV) projects, some of them highly so, at constant risk is implausible. These assumptions greatly simplify the mathematics of the illustration at the expense of a more realistic calibration of return estimates. Yet the relationship between excess returns and market value identified here arises from the capital expenditure decision itself and does not depend on either of these simplifying assumptions.

Excess Returns Over Time

The preceding section addressed excess returns accruing to existing shareholders where a unique opportunity existed to capitalize on excess capital budget returns. It is possible to generalize this example to a firm continuously facing such unanticipated excess investment return possibilities. Such a firm invests each year in equal-risk projects which, up to the margin, are expected to yield positive NPVs.

It is not our purpose here to argue that investors would (or would not) forever remain oblivious to the possible value/information content in the incessant repetition of the surprise announcement, year after year, of an unanticipated set of positive NPV opportunities. The use of an annual adjustment of new information simply allows us to illustrate analytically the relationship of capital investment and growth to equity value. The validity of this illustration, in general, relies only upon

Table 5
Return for First and Second Periods Assuming the Firm Does and Does Not Make Investments A-J (Single Period Model)

A. Without Undertaking Investments A-J, Ever

T=0	T=1	T=2
P_0=10	D_1=1 P_1=10 I_1=0	D_2=1 P_2=10 I_2=0

$$R_{0,1} = \frac{1 + 10 - 10}{10} = 10\% \qquad R_{1,2} = \frac{1 + 10 - 10}{10} = 10\%$$

B. Undertaking Investments A-J at T=1 and T=2

T=0	T=1	T=2
P_0=10	D_1=1.000 P_1=14.500 I_1=1,000	D_2=1.450 P_2=19.169 I_2=1,000

$$R_{0,1} = \frac{1.000 + 14.50 - 10}{10} = 55.00\% \qquad R_{1,2} = \frac{1.45 + 19.169 - 14.50}{14.50} = 42.20\%$$

At the beginning of T=3, the firm will acquire assets A_3 through J_3. The additional shares issued will yield 10%. The previously existing shareholders will realize a total return of 33.3%, including 23.3% for unanticipated equity value appreciation because of excess expected returns from the firm's capital investment decisions.

Notes: P_t = Share Value;
D_t = Divident per share;
$R_{t-1,T}$ = Holding period return;
all at or as of year end T

$I_t = \sum_{K=A}^{J} K_T$ = Capital investment

the assumption that some future positive NPV capital investments were unanticipated at the time of the firm's initial public offering.

Table 5 illustrates the stream of returns and values that accrue to shareholders if the firm undertakes investments A_T through J_T at the beginning of at least two future time periods, and finances those investments at a stock value that impounds the NPVof the new assets. The first period of such an investment strategy yields results identical to the single opportunity investment case above. Thereafter, at the beginning of T=2, the firm invests an additional $1000 in new assets A_2 through J_2 , 34.48276 shares will be sold. The new share value will be $19.169, determined identically as was the value for T=1 (as calculated in Appendix A). The new shareholders at T=2 will expect to earn a perpetual 10% return, as in the single period case. However, the existing shareholders (those who bought stock at T=0 or T=1) will realize a return of 42.20%, a normal return of 10% plus an unanticipated excess return of 32.20%.

At the beginning of T=3, the firm will acquire assets A_3 through J_3. The additional shares issued will yield 10%. The previously existing shareholders will realize a total return of 33.3%, including 23.3% for unanticipated equity value appreciation because of excess expected returns from the firm's capital investment decisions.

Table 6 demonstrates the total return that accrues to existing shareholders in each of years T=1 through T=5, assuming assets A_T through J_T are acquired each year, and continuing to assume that investors respond immediately in adjusting stock values to new future return expectations.

Table 6 shows that existing shareholders will benefit from the firm's ability to generate positive NPV investments relative to the market value of equity. Specifically, while the NPV of each bundle of investments remains constant, the benefit must be shared across an ever increasing equity base. Consequently, over time for any single firm, the realized return will approach the firm's marginal cost of capital, as shown in Figure 1.

Table 6
Realized Return in Each of Years One Through Five Assuming Constant Capital Budget

(1) *Year Or Quintile*	*(2)* *Market Value Of Equity ($)*	*(3)* *Realized Return (%)*
1	2,450	55.00
2	3,900	42.20
3	5,350	33.25
4	6,800	28.11
5	8,250	22.15

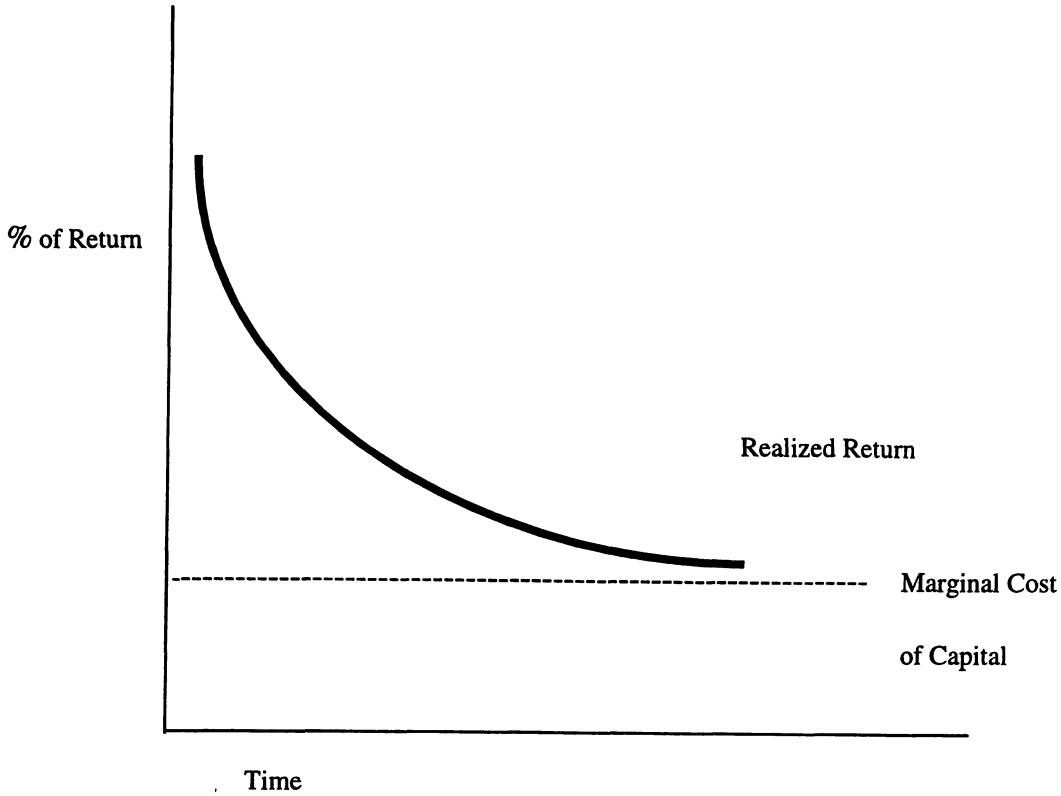


Figure 1
Realized Return Over Time Holding Scale of Investment Constant

IV. DISCUSSION

The small firm effect which is observed in security returns to companies of lower market value of equity, relative to those of large market value, is an effect consistent with sound capital budgeting and firm growth theory. That there is an observable small firm effect of some magnitude has been supported in the literature. Evidence of the effect's existence and attempts to explain the small firm effect have filled the literature for some time, to the point that small firm effect has become a term of art. Our conclusion is that this effect reflects rational behavior. The consistency of the theoretical explanation of the small firm effect we have developed is strong evidence that firms do follow wealth maximizing behavior. Small capitalization firms, as a group, are able consistently to take advantage of positive NPV investment opportunities that are large by comparison to their equity market capitalization.

Our conceptual and analytical development focuses on firm size relative to investment activity. However, "large" and "small" are not absolutes, but are rela-

tive terms driven more by market size, market growth, and competitive strength than by longevity and time. Thus, the strong association of capital investment intensity with excess returns that emerged in our illustration is entirely consistent with financial theory and with the small firm effect that has been observed in the literature. The small firm effect exists for that subset of small firms that are capturing unanticipated gains from investment activity that is relatively more aggressive than their larger counterparts. But, this capital investment intensity effect subsumes size. The effect must exist for firms able to capitalize on unanticipated investment opportunities that are significant, relative to their equity market value, *regardless* of the firms' absolute size.

Our explanation removes the small firm effect from the category of an anomaly and suggests that empirical research is required to validate this hypothesis. To the extent that the association of excess returns with capital investment intensity is a phenomenon associated with small firms, it is an outgrowth of rational investment decision making, not an example of a market imperfection that should (but has not) been resolved through arbitrage. More broadly, firms of any size can and do capture investment opportunities that are unanticipated but ultimately recognized in an efficient market. It is between the unanticipation and the recognition where an opportunity for excess returns arises. Future research which focuses on the key characteristic of having a high capital investment intensity ratio (i.e., a large capital budget relative to total market value) may be necessary. But in the broader sense, it is not size of firm, but rather capital investment opportunity in relation to firm size, that rationalizes the excess returns observed and unravels the quandary of the small firm effect. Even in a highly efficient market setting, an empirical small firm effect may be observed. Our model is posited to illustrate the relationship between firm investment behavior, stock price, and realized return. The model, although not an exact replica of the market, does serve to show that the empirical small firm effect is observable in an efficient market and its presence is not an indictment of market efficiency.

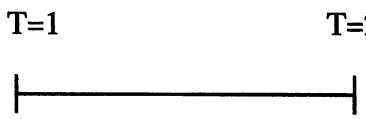
Furthermore, the persistence of the small firm effect should not be mistaken for evidence of market inefficiencies. In a rational market, investors purchase securities offering a return commensurate with the systematic risk of the security. On occasion, the realized return will exceed expectation; while during other time periods, the realized return will fail to measure up to expectation. With a population of risk-averse investors, one would expect any bias to be towards underestimating expectations, thereby systemically creating more positive excess returns relative to negative excess returns. Consequently, the hypothesized results reported above serve more to support market efficiency and rational investor behavior than they serve to refute market efficiency.

Management must recognize the time lag between firm performance and when that performance is reflected in stock prices. The need for timely, accurate, and

complete information by investors will improve the quality of stock prices and free management from the need to "operate by the numbers."

APPENDIX A

Number of New Shares Issued at any Point in Time To Finance Investments A-J



$100

$100 Earnings (Perpetuity)
145 Additional Earnings
(Investments A-J)

245

Value of Company ($245 / 0.10) $2450

Shares Outstanding	=	100 + New Shares Issued to Finance A - J
Dividend	=	$245 / (100 + New Shares)
New Stock Price	=	$2450 / (100 + New Shares)
	=	Dividend / 0.10
New Shares Issued	=	$1000 / New Stock Price

Solving the above set of equations yields:

New Stock Price	=	$14.50
Dividend	=	$1.45
New Shares Issued	=	68.96552

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