A History of the Size Effect

R. D. Coleman

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Author   R. D. Coleman
for   3715 Bryn Mawr Drive
Correspondence: Dallas, Texas 75225
         (214) 363-7424

         numeraire @ earthlink.net

Requests   R. D. Coleman
for   3715 Bryn Mawr Drive
Reprints: Dallas, Texas 75225

         numeraire @ earthlink.net

ABSTRACT

Size, as measured by the market value of equity capitalization of a company, is a fallacious explanation of expected return. Specification of size reduces the asset pricing model to either a logical identity which is tautologous or a data-instigated autoregression of market-generated variables which is a form of market timing. The so-called technical analysis of the capital market pricing process is not considered to be sound scientific methodology, being devoid of theoretical motivation. The popular small-cap investment strategy is a financial fad based on this fallacy.

The "size effect" is the anomalous pricing of the size factor as indicated by a significant risk premium in the conventional capital asset pricing model. The history of the size effect as it appears in published academic journal papers provides an etiology of the small-cap contagion, a manifestation of motivated irrationality.

INTRODUCTION

The publishing history of the "size" effect as it appears in academic journals can be seen as the etiology of a contagion, a financial fad, if one applies an epidemiological model. Instead of evincing concern for protecting the investing public and their own retirement accounts, academicians are primarily responsible for the origination and maintenance of this epidemic.

The "size" of a firm as measured by the market value of its common stock equity has been observed to have a significant inverse relationship with stock returns in capital asset pricing models that are specified to explain total return. Total return is measured before tax, information costs, and transactions costs. Total return is defined as stock price appreciation (capital gains) plus dividend yield (dividend income), both adjusted for number of shares outstanding, where t indexes time and there is no index for firms:

$$R_t = (P_t N_t - P_{t-1} N_{t-1})/P_{t-1} N_{t-1} + D_t N_t/P_{t-1} N_{t-1} \tag{1}$$

The market value of equity, sometimes referred to as firm "size", is defined as share price multiplied by the number of common stock shares outstanding:

$$ME_t = (P_t)(N_t) \tag{2}$$

Whenever a contemporaneous or lagged variable appears simultaneously on both sides of an equation, either directly or entailed, spurious inferences can be made as a result of logical circularity. It may appear in either a positive or an inverse relationship.

Variables that are circular with total return include:

D	dividends per share
MC	market value of equity and debt claims, (ME+MP+MD)
ME	market value of common stock equity, (P)(N)
N	number of shares outstanding
P	share price
R	total return

Variables that are not circular with total return include:

BA   book total assets
BD   book total debt
BE   book equity
E   earnings per share
MD   market value of debt securities
MP   market value of preferred stock equity
RC   replacement cost of reproducible assets at market prices
V   trading volume number of shares

Table 1 lists the possible types of circular asset pricing models and examples of each type where known. One omission from the Table 1 list of known types of variables explaining stock returns in actual studies is an empirical asset pricing model cross-sectional estimating equation that specifies share price, dividends per share, and number of shares outstanding, all in both positive and inverse relation to return:

$$R_{it} = g0 + g1(P_{it}) + g2(D_{it}) + g3(N_{it})$$

$$+ g4(1/P_{it}) + g5(1/D_{it}) + g6(1/N_{it}) + e_{it}, \qquad (3)$$

where i indexes individual stocks and t indexes both time periods for flows and end of time periods for stock-levels. To avoid collinearity among the types, plausible variables that entail these circular variables could be specified as explanatory variables. For example, P/D could be added to the model to provide an inverse relationship with dividends. Also, ME in itself and 1/ME entailed in, say BD/ME, could be added as explanatory variables.

Regardless of their findings, there is no justification for asset pricing models with explanatory variables that are identities rather than autoregressive lagged variables, i.e., that include variables that are entailed in the explained variable or entail such variables. Each price signal for each security issue is a fixed-point realization of a random variable. A single fixed-point realization cannot meaningfully be used to explain itself, either directly or indirectly. Even autoregressions are fallacious without theoretical rationale.

There is no shortage of published papers about circular models whose authors appear to want to be considered serious scholars and members of a serious scientific research community. Except where a rejection of a circular variable is noted, each of the empirical studies in the chronological list in Table 2 either concluded that one or more circular variables explained stock returns or implicitly assumed that one or more circular variables explained stock returns.

The historical record in Table 2 is a convenience sample of 58 papers. The chronological list is divided into three stages to emphasize important transitions in the common thread of development of what came to be known as the "size effect." In stage one, covering four listed papers with publication dates from 1936 to 1958, the explained variable is capital appreciation or price change. In stage two, covering 18 listed papers published in the period 1960 to 1980, the explained variable has changed from capital gain return to total return including capital gain and dividends. In stage three, covering 36 listed papers published from 1981 to 1995, the explained variable is still total return, but size as measured by market value of equity has become an explicitly specified explanatory variable along with transforms of the size variable such as book-to-market equity.

It is undoubtedly a manifestation of irrational phenomena to observe self-avowed truth seekers in academia willingly and knowingly subvert the search for truth as a result of succumbing to peer pressures and career pressures. An epidemiological model (McNeil, 1976) could offer some explanation of this behavior by viewing the "size effect" as one strain of an infectious virus that continues to spread. The conflicts of interest in both academia and Wall Street as a result of institutional dynamics now are more often resolved in favor of advancing careers and making money rather than the traditional contribution to knowledge and service to customers, respectively. This is not a new disease, but rather a new variety of "idols of the mind"

or *idola mentis* that were first elucidated by Francis Bacon in his *Novum Organum*.

The size effect supplies another chapter in the history of "extraordinary popular delusions and the madness of crowds" (Mackay, 1970). It is instructive to extract from these published works the names of authors, commentators, advisors, supporters, contributors, reviewers, editors, journals, schools, conferences, et cetera, all with a view to discovering the pattern of relationships that emerges.

Table 1. Models of R regressed on P, D and N. Full citations appear in the references.

No.	Model Variable(s)	Basic Forms of Explanatory Variables								Year	Author
		Simple						Compound			
		Direct			Inverse			Dir.	Inv.		
		P	D	N	1/P	1/D	1/N	ME	1/ME		
		Models with Simple Variables Only									
1	P	X								1973	Blume
2	P/E	X								1977	Basu
3	BE/P				X					1985	Rosenberg
4	E/P,D/P		X		X					1978	Ball
5	D/P		X		X					1985	Keim
6	D/TA		X							1968	Nerlove
7	V/N						X			1968	Nerlove
		Models with Compound Variables									
8	ME	X		X				X		1981	Banz
9	ME *	X		X				X		1985	Chan
10	ME,E/P	X		X	X			X		1981	Reinganum
11	MC/RC or q			X		X			X	1991	Servaes
12	BD/ME,D		X	X		X			X	1991	Chan
13	ME,MD/ME	X		X	X	X	X		X	1982	Christi
14	ME,BD/ME	X		X	X	X	X		X	1988	Bandari
15	ME,BE/ME	X		X	X	X	X		X	1993	Fama
16	ME,BE/ME	X		X	X	X	X		X	1995	Berk
17	ME,BE/ME,D	X	X	X	X	X	X		X	1994	He
18	BE/TA									1994	Opler

* portfolio formation variable

Legend to Table 1

BD	book debt
BE	book equity
D	dividends per share
E	earnings per share
MC	market value of debt and equity claims
MD	market value of debt
ME	market value of common stock equity
MP	market value of preferred stock equity
N	number of shares outstanding
P	share price
R	total returns
RC	replacement cost of reproducible assets
TA	total assets
V	trading volume number of shares

Table 2. Chronological List of Published Papers.

The following information is included for each citation: year of publication, journal name or book publisher, author(s), explanatory variable(s), and an optional comment. A legend to Table 2 gives the full title of the journal acronyms. These brief citations without paper titles do not appear in the references unless they also appear in Table 1.

Stage One: Capital Gain as the *Explained* Variable

1936, *JB*, Fritzemeier, L. H.; **P,** relation with price index changes.

1951, *JF*, Clendenin, J. C.; reject **P**, relation with price variability.

1954, *JF*, Latané, H. A.; **P,** relation of price changes with price, earnings, and dividend history.

1958, *FAJ*, Renshaw, E. F.; **P,** relation with price-average changes.

Stage Two: Total Return as the *Explained* Variable

1960, *FAJ*, Nicholson, S. F.; **P/E**.

1962, McGraw-Hill, Graham, B., Dodd, D. L., Cottle, S., and Tatham, C.; **P**, *Security Analysis*, pp. 649-53.

1966, *JB*, Heins, A. J. and Allison, S. L.; reject **P**, equivocate on **P/E** relation with price variability.

1966, *FAJ*, McWilliams, J. D.; **P/E.**

1967, *FAJ*, Miller, P. F., Jr. and Beach, T. E.; **P/E**, price performance is explained variable.

1967, *FAJ*; Molodovsky, N.; reject **P/E**, price performance is explained variable.

1968, *FAJ*, Breen, W.; **P/E** market and industry relatives.

1968, *JF*, Breen, W. and Savage, J.; **D/P**.

1968, *RES*, Nerlove, M.; **D/BA, N**.

1968, *FAJ*, Nicholson, S. F.; **P/E**.

1973, *JF*, Blume, M. E. and Husic, F.; **P**.

1974, *JFE*, Black, F. and Scholes, M.; **D/P**.

1977, *JF*, Basu, S.; **P/E**.

1978, *JFE*, Ball, R.; **E/P, D/P**, survey, addressed reverse causality.

1978, *JFE*, Long, J. B., Jr.; **D/P**.

1979, *JFE*, Litzenberger, R. H. and Ramaswamy, K.; **D/P**.

1980, *RES*, Blume, M. E.; **D/P**.

1980, *JPE*, Gordon, R. H. and Bradford, D. F.; **D/P**.

Stage Three: Size as an *Explanatory* Variable

1981, *JFE*, Banz, R. W.; **ME**, coined the term "size effect."

1981, *JFE*, Reinganum, M. R.; **E/P, ME**.

1981, *JF*, Roll, R.; **ME**.

1982, *JFE*, Christie, A. A.; **ME, MD/ME**.

1982, *JF*, Reinganum, M. R.; **ME**.

1983, *JFE*, Basu, S.; **ME, E/P**.

1983, *JFE*, Blume, M. E. and Stambaugh, R. F.; **ME**.

1983, *JFE*, Brown, P. , Kleidon, A. W., and Marsh, T. A.; **ME**.

1983, *JBF*, Elton, E., Gruber, M., and Rentzler, J.; **D/P, ME**.

1983, *FAJ*, Goodman, D. A. and Peavy, J. W.; **P/E** industry relative.

1983, *JFE*, Keim, D. B.; **ME**, survey.

1983, *JFE*, Reinganum, M. R.; **ME**.

1983, *JPM*, Reinganum, M. R.; **ME**.

1983, *JFE*, Roll, R.; **ME**.

1983, *JPM*, Roll, R.; **ME**.

1983, *JFE*, Schultz, P.; **ME**.

1983, *JFE*, Schwert, G. W.; **ME**, survey.

1983, *JFE*, Stoll, H. R. and Whaley, R. E.; **ME, P**.

1984, *JF*, Berges, A., McConnell, J. J., and Schlarbaum, G. G.; **ME**.

1984, *JFQA*, Cook, T. and Rozeff, M.; **ME, E/P**.

1985, *JFE*, Chan, K. C., Chen, N., and Hsieh, D. A.; **ME**.

1985, *JFE*, Keim, D. B.; **D/P**.

1985, *JPM*, Rosenberg, B., Reid, K. and Lanstein, R.; **BE/P**.

1986, *JF*, Banz, R. W. and Breen, W.; **P/E, ME**.

1986, *JBF*, Lakonishok, J. and Shapiro, A. C.; **ME**.

1988, *JF*, Bhandari, L. C.; **BD/ME**, **ME**.

1988, Cambridge University Press, Keim, D. B.; synthesis of regularities.

1989, *JF*, Jaffe, J., Keim, D. B., and Westerfield, R.; **E/P, ME**.

1990, *RFS*, Lo, A. W. and MacKinlay, A. C.; **ME**, addressed "data-snooping" bias but silent on logically prior circularity.

1991, *JF*, Chan, K. C. and Chen, N.; **ME**.

1991, *JF*, Servaes, H.; **RC/MC**, **RC/(ME+MP+MD)**, i.e., Tobin's *q*.

1992, *JF*, Fama, E. F. and French, K. R.; **ME, BE/ME**.

1993, *JFE*, Fama, E. F. and French, K. R.; **ME, BE/ME**.

1994, *JB*, He, J. and Ng, L. K.; **ME, BE/ME, D.**

1994, *JF*, Opler, T. C. and Titman, S.; **BD/BA**, avoided reverse causality but silent on logically prior circularity.

1995, *RFE,* Berk, J. B.; **ME, BE/ME**, explicitly acknowledges the logical circularity of size and book-to-market equity, but then remarkably asserts that these two variables should be specified in every capital asset pricing model.

Legend to Table 2

AER   American Economic Review

EL   Economic Letters

FAJ   Financial Analysts Journal

FM   Financial Management

JB   Journal of Business

JBF   Journal of Banking and Finance

JEB   Journal of Economics and Business

JF   Journal of Finance

JFE   Journal of Financial Economics

JFQA   Journal of Financial and Quantitative Analysis

JIE   Journal of Industrial Economics

JPE   Journal of Public Economics

JPM   Journal of Portfolio Management

RES   Review of Economics and Statistics

RFE   Review of Financial Economics (formerly *RBER*)

RFS   Review of Financial Studies

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