A History of the Size Effect

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TITLE PAGE

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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:

\[
R_t = \frac{(P_tN_t - P_{t-1}N_{t-1})}{P_{t-1}N_{t-1}} + \frac{D_tN_t}{P_{t-1}N_{t-1}}
\]

(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:

\[
ME_t = (P_t)(N_t)
\]

(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:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BA</td>
<td>book total assets</td>
</tr>
<tr>
<td>BD</td>
<td>book total debt</td>
</tr>
<tr>
<td>BE</td>
<td>book equity</td>
</tr>
<tr>
<td>E</td>
<td>earnings per share</td>
</tr>
<tr>
<td>MD</td>
<td>market value of debt securities</td>
</tr>
<tr>
<td>MP</td>
<td>market value of preferred stock equity</td>
</tr>
<tr>
<td>RC</td>
<td>replacement cost of reproducible assets at market prices</td>
</tr>
<tr>
<td>V</td>
<td>trading volume number of shares</td>
</tr>
</tbody>
</table>

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:

\[
R_{it} = g_0 + g_1(P_{it}) + g_2(D_{it}) + g_3(N_{it}) \\
+ g_4(1/P_{it}) + g_5(1/D_{it}) + g_6(1/N_{it}) + e_{it},
\]

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.

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Variable(s)</th>
<th>Direct</th>
<th>Inverse</th>
<th>Compound</th>
<th>Year</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>1973</td>
<td>Blume</td>
</tr>
<tr>
<td>P/E</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>1977</td>
<td>Basu</td>
</tr>
<tr>
<td>BE/P</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>1985</td>
<td>Rosenberg</td>
</tr>
<tr>
<td>E/P,D/P</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>1978</td>
<td>Ball</td>
</tr>
<tr>
<td>D/P</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>1985</td>
<td>Keim</td>
</tr>
<tr>
<td>D/TA</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>1968</td>
<td>Nerlove</td>
</tr>
<tr>
<td>ME</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>1981</td>
<td>Banz</td>
</tr>
<tr>
<td>ME *</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>1985</td>
<td>Chan</td>
</tr>
<tr>
<td>ME,E/P</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>1981</td>
<td>Reinganum</td>
</tr>
<tr>
<td>MC/RC or q</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>1991</td>
<td>Servaes</td>
</tr>
<tr>
<td>BD/ME,D</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>1991</td>
<td>Chan</td>
</tr>
<tr>
<td>ME,MD/ME</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1982</td>
<td>Christi</td>
</tr>
<tr>
<td>ME,BD/ME</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1988</td>
<td>Bandari</td>
</tr>
<tr>
<td>ME,BE/ME</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1993</td>
<td>Fama</td>
</tr>
<tr>
<td>ME,BE/ME</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1995</td>
<td>Berk</td>
</tr>
<tr>
<td>ME,BE/ME,D</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1994</td>
<td>He</td>
</tr>
<tr>
<td>BE/TA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1994</td>
<td>Opler</td>
</tr>
</tbody>
</table>

* 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**


**Stage Two: Total Return as the Explained Variable**


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

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


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


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


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**.


**Stage Three**: Size as an *Explanatory* Variable


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


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


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**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Journal Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>AER</td>
<td>American Economic Review</td>
</tr>
<tr>
<td>EL</td>
<td>Economic Letters</td>
</tr>
<tr>
<td>FAJ</td>
<td>Financial Analysts Journal</td>
</tr>
<tr>
<td>FM</td>
<td>Financial Management</td>
</tr>
<tr>
<td>JB</td>
<td>Journal of Business</td>
</tr>
<tr>
<td>JBF</td>
<td>Journal of Banking and Finance</td>
</tr>
<tr>
<td>JEB</td>
<td>Journal of Economics and Business</td>
</tr>
<tr>
<td>JF</td>
<td>Journal of Finance</td>
</tr>
<tr>
<td>JFE</td>
<td>Journal of Financial Economics</td>
</tr>
<tr>
<td>JFQA</td>
<td>Journal of Financial and Quantitative Analysis</td>
</tr>
<tr>
<td>JIE</td>
<td>Journal of Industrial Economics</td>
</tr>
<tr>
<td>JPE</td>
<td>Journal of Public Economics</td>
</tr>
<tr>
<td>JPM</td>
<td>Journal of Portfolio Management</td>
</tr>
<tr>
<td>RES</td>
<td>Review of Economics and Statistics</td>
</tr>
<tr>
<td>RFE</td>
<td>Review of Financial Economics (formerly RBER)</td>
</tr>
<tr>
<td>RFS</td>
<td>Review of Financial Studies</td>
</tr>
</tbody>
</table>
REFERENCES


