Another Look at Equity and Enterprise Valuation Based on Multiples

Mingcherng Deng
University of Minnesota

Peter Easton
University of Notre Dame

Julian Yeo
Columbia Business School

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Abstract

We examine errors in enterprise and equity valuation based on multiples of firm fundamentals. When compared with other studies of the usefulness of multiples, our sample is more representative of the population of firms (firms with losses, smaller start-up firms, etc). Our focus is on multiples of current financial variables. We show vast improvement in valuation errors when an average omitted variable (intercept) is incorporated in the calculation of harmonic means. We demonstrate how harmonic means can be calculated when different multiples are combined. This enables us to examine the change in valuation errors when a combination of multiples is used instead of just a single multiple. Our results show valuation errors are significantly improved when combining fundamentals from different financial statements; the largest improvement in valuation errors is observed when balance sheet fundamentals (net operating assets and book value of equity) are combined with fundamentals from the income statement (for example, EBITDA).

1. Introduction

We examine errors in enterprise and equity valuation based on multiples of firm fundamentals. When compared with other studies of the usefulness of multiples, our sample is more representative of the population of firms (firms with losses, smaller start-up firms, etc). Our focus is on multiples of current financial variables. Unlike most other studies, we do not consider forward earnings-based multiples because requiring the availability of forecasts restricts the sample and limits the generality of the conclusions. We do not exclude firms with negative fundamentals. Our conclusions, based on our sample which does not require forecasts of future pay-offs, differ considerably from those in the extant literature. These conclusions are particularly pertinent to the valuation of entities for which forecasts are unavailable or difficult to make.

We show vast improvement in valuation errors when an average omitted variable (intercept) is incorporated in the calculation of harmonic means. We extend the extant literature by demonstrating how harmonic means can be calculated when different multiples are combined, while incorporating intercepts in our analysis. This in turn enables us to examine the change in valuation errors when a combination of multiples is used instead of just a single multiple. Our results show valuation errors are significantly improved when combining fundamentals from different financial statements. The largest improvement in valuation errors is observed when balance sheet fundamentals (net operating assets and book value of equity) are combined with fundamentals from the income statement (for example, EBITDA).

Market price multiples (levered and/or unlevered) are commonly cited in the popular press as summary statistics for comparison of the market valuation of fundamental financial variables among a set of comparable firms. In practice, these multiples are widely used as a preliminary screening device to rank stocks; Asquith, Mickhail and Au (2005) observe that 99 percent of analysts' reports rely on multiple-based valuations. In cases where firm-specific detailed projections are difficult (for example, privately-held companies or when the proposed entity has yet to be created), these multiples serve as a substitute for comprehensive valuation. The widespread use of price-multiples stems, at least partially, from their ease of computation. However, these price-multiples often do not yield sensible estimates; in particular negative fundamental/financial measures are meaningless. Further, valuations of the same firm based on different price-multiples are often difficult to reconcile. Reliance on one measure to the exclusion of another likely ignores important value-relevant information.

Liu, Nissim and Thomas (2001) – hereafter LNT -- provide a comprehensive analysis of the absolute and relative performance of several multiples in explaining stock prices. Their focus is on a set of forward-looking multiples; hence they examine a sub-sample of stocks: (1) that have analyst following and are included in the I/B/E/S data base; (2) for which all (earnings-based, cash flow-based, book value-based, and sales-based) multiples are positive; (3) that are in an I/B/E/S industry sector which has at least four other firms; (4) with a market price greater than $2 per share; and (5) that have at least 30 monthly return observations (not necessarily continuous) over a 60 month period ending at the valuation date. They find that forward earnings multiples out-perform current earnings multiples which, in turn, out-perform multiples based on cash flow, book value, and sales. In addition, they find that the relative performance of these multiples is consistent across industries.[1]

Since LNT require analysts' earnings and growth forecasts and since they exclude firm-year observations with negative values for any value driver, their results are only representative of larger, profitable firms with analyst following. Although this set of firms are a very important subset of the population of firms, we show that the conclusions regarding trailing multiples based on this sample do not apply to a larger sample of firms. We do not mean to diminish the contribution of LNT at all. Rather the results and analyses in our paper should be seen as complimentary to the results and analyses in LNT and vice-versa.

We provide evidence that a number of the LNT conclusions do not apply to a broader cross-section of firms. We find that sales are not the worst valuation fundamental. In fact, we find that the mean absolute valuation errors for multiples based on sales are the lowest for both enterprise and market value multiples. When we compare book value and earnings as valuation fundamentals, we do not find that earnings-based multiples outperform book value-based multiples. Overall, we find that book values (net operating assets as the fundamental for enterprise valuation and book value of equity as the fundamental for market valuation) outperform all other fundamentals. We attribute the difference between our results and those reported in LNT to the fact that we do not restrict our samples to non-negative observations of the accounting fundamentals and to

[1] Lie and Lie (2002) conduct an analysis similar to that of LNT for a sample of firms in 1998. Like LNT, they find that sales revenue performs poorly as a valuation multiple. The main difference between their analysis and ours is that, for each variable they consider, they analyze all firms for which they have a positive value for that particular variable so that they have many more observations for, say, sales revenue, than for, say EBITDA, and they have many more observations for realizations of fundamentals than for forecasted fundamentals. They find that sales revenue performs poorly relative to the other variables. Our approach, like LNT, is to compare the valuation errors within a common sample of firms.

firms followed by I/B/E/S. Also, our focus is on current financial measures rather than forward looking measures.

Our findings are consistent with conventional wisdom that negative value drivers do not yield sensible valuation estimates. When compared to fundamentals that generally do not have negative realizations (sales, most book value measures), financial fundamentals with negative values, on average, do not outperform those with non-negative financial fundamentals.

Toward the end of the paper we conduct further analyses of firms with negative fundamentals. The main thrust of these analyses is the comparison of the difference in valuation relevance of fundamentals such as sales revenue, which is always positive, or book value, which is generally positive, across samples of firms where the values of other fundamentals (such as income and/or cash flow) are positive vs. firms where the values of these fundamentals are negative. Differences in valuation errors are not big and in some comparisons we observe that the valuation errors based on sales revenue are smaller for the sub-sample with negative income and free cash flow than for the sub-sample with positive net income and free cash flow. These results are important inasmuch as they run counter to the conventional wisdom that analysts use sales revenue as a (possibly inferior) last resort when the values of other fundamentals are negative. Indeed a multiple that is relatively unaffected by accounting (accruals) may generally be a valid multiple in general. We also show a decrease in valuation errors when observations of negative fundamentals (income and free cash flow) are combined with observations with positive values (sales revenue and book value).

2. Why consider firms with negative fundamentals?

It is common to find firms reporting negative earnings, negative cash flows, and in some cases negative book values. Nevertheless, multiples are also used in the valuation of these firms. We observe common reference to book values and sales multiples for firms with negative financial metrics (for example, internet stocks, start-ups, and growth firms). As Damodaran (2002) points out, sales and/or book value may do better when earnings are negative. In one sense, the sales multiple is obviously better inasmuch as it, at least, gives a positive valuation (though this does not necessarily mean a lower valuation error).

Limiting the entire analysis to firms with positive values of all of the fundamentals under consideration necessarily is: (1) silent on the importance of multiples in the valuation of these firms; and (2) limits the set of comparable firms. The exclusion of firms with negative financial metrics implicitly assumes that the subject firms whose values are being examined only have non-negative distributions of these key/fundamental financial attributes. In other words, when a profitable firm is only compared with other profitable firms, the analysis, at least implicitly, assumes that this firm has an earnings distribution that is not within the population of firms that will make losses at some point. We remove this limitation in our analyses.

3. Method

3.1 General Introduction

Since there is no empirical evidence documenting the usefulness of multiples for a sample of firms that are more representative of the general population of firms (firms with losses, smaller start up firms, etc.), we begin by examining the usefulness of multiples in enterprise valuation and in equity valuation for a large sample of firms. Our methodology for comparison of the various multiples follows LNT quite closely but our study differs in several important ways. First, we focus on multiples of current financial variables; we do not consider forward earnings-based multiples. Removing the restriction that the firm is followed by I/B/E/S allows us to analyze a broader cross-section of stocks. Second, we include firms with negative fundamentals, including negative EBITDA, negative earnings and negative book values. Third, we use a different industry classification: where possible we group on 4-digit SIC code and, where this is not possible, we group on 3-digit SIC code. This industry classification allows us to analyze the usefulness of multiples at a more micro industry level. Fourth, we focus our analyses on the absolute mean and median valuation error instead of the inter-quartile range of errors as in LNT; the use of the inter-quartile range is not appropriate for multiples with skewed distributions (sales multiples, for example, are always non-negative resulting in a distribution that is less dispersed, clustered around zero, and right-skewed).

Although price multiples are often cited as a basis for valuation, there is rarely a reconciliation of conflicting valuations based on multiples of various firm fundamentals. A common criticism of the use of price multiples is the inability to reconcile different multiples. In an attempt to combine different firm fundamentals, LNT also examine short-cut intrinsic value measures incorporating book value and forward earnings based on the residual income model. They find that their intrinsic value measures perform considerably worse than forward earnings. Even though these measures contain more information than forward earnings, they attribute the worse performance to potential measurement error associated with the terminal value estimates required for the intrinsic value calculation.

Beatty, Riffe, and Thompson (1999) provide an alternative means of combining multiples in valuation; they use the price-scaled regressions to compare different linear combinations of value drivers. LNT also combine two or more value drivers based on the method in Beatty, Riffe, and Thompson (1999) and calculate the mean and median pricing errors. Little or no improvements are observed. Given that the extant literature is silent on how harmonic means are calculated when different multiples are combined, we extend the method developed in LNT to combine multiples and consider the change in the valuation error when we consider a combination of multiples rather than a single multiple. This method is particularly useful when we consider a combination of a positive multiple (such as sales revenue) and a negative multiple (such as free cash flow).

3.2 *The Fundamentals*

Many valuation texts focus on enterprise value; that is, the value of the operations of the firm to its owners – debt and equity holders.[2] This permits a comparison of firm values that are not affected by capital structure. For litigation purposes, enterprise values are often computed in order to compare firms with different capital structures. On the other hand, from an investor's standpoint, the focus may be on the value of equity, consistent with the observation that analysts and the popular financial press often associate financial fundamentals with the market value of the equity. We consider the

[2] See, for example, Brealey, Myers, and Allen (2007), Damodoran (2002), Easton, Fairfield, McAnnally, Zhang, and Halsey (2010), and Penman (2009).

use of multiples to value both the operations of the firm (the enterprise value) and the value of stockholder's equity in the firm.

We examine a set of fundamentals (sometimes referred to as value drivers) that are commonly used in practice. The fundamentals we consider as the basis for enterprise valuation are: (1) net operating assets, NOA; (2) earnings before interest, taxes, depreciation and amortization, EBITDA;[3] (3) free cash flow to debt and equity holders; and the top-line of the income statement – sales revenue. The fundamentals we consider for equity valuation are: (1) book value of equity; (2) EBITDA; (3) earnings before extraordinary items; and (4) sales revenue. This limited set is chosen to represent the main categories of fundamentals we observe in analysts' reports: (1) a balance sheet variable; (2) an income statement variable; (3) a cash flow variable; and, (4) sales revenue.

3.3 Valuation using Price Multiples

LNT show that the performance of price multiples improves when these multiples are calculated using the harmonic mean rather than the simple mean or median. Like LNT, we consider multiples calculated as the harmonic mean. We calculate valuation errors for the subject firm (always calculated out-of-sample) as the difference between the actual price and the predicted price divided by the actual price.

LNT derive a method that relaxes the assumption that prices are directly proportional to the valuation fundamental. We begin with an outline of the LNT method and then we extend it to permit a valuation based on a combination of two fundamentals. This extension is important in the context of our study given that we are interested in the possibility that valuation errors may be reduced by combining fundamentals in the

[3] EBITDA is often used as a rough approximation for cash flow from operating activities.

valuation. The use of a combination of multiples in the Delaware Chancery Court, which is the most influential valuation court in the United States, is a practical reason why this extension matters.[4]

3.3.1 The LNT method

LNT begin with the assumption that the price of firm i in year t is proportional to a fundamental x_{it} and that there is a possibility of a non-zero average price when the fundamental is equal to zero:

$$p_{it} = \alpha_t + \beta_t x_{it} + \varepsilon_{it} \tag{1}$$

where β_t is the multiple on the fundamental. Following Beatty, Riffe, and Thompson (1999), Easton and Sommers (2002), and LNT we divide both sides of equation (1) by price:

$$1 = \alpha_t \frac{1}{p_{it}} + \beta_t \frac{x_{it}}{p_{it}} + \frac{\varepsilon_{it}}{p_{it}} \tag{2}$$

LNT derive the formula for α_t and β_t such that the variance of $\varepsilon_{it} / p_{it}$ is minimized and the expected value of $\varepsilon_{it} / p_{it}$ is zero. The derivation is as follows:

$$Min \quad var(1 - \alpha_t \frac{1}{p_{it}} - \beta_t \frac{x_{it}}{p_{it}})$$

subject to:

$$\sum (1 - \alpha_t \frac{1}{p_{it}} - \beta_t \frac{x_{it}}{p_{it}}) = 0$$

[4] Yee (2004) describes the Delaware Block Method in some detail. It is essentially a weighted sum of contemporaneous market price, book value of net assets, and five-year trailing earnings. The weights are determined by the Court. Yee's (2004) analysis provides suggestions as to how these weights may be estimated.

Note that:

$$var(1-\alpha_t \frac{1}{p_{it}} - \beta_t \frac{x_{it}}{p_{it}}) = \sum(1-\alpha \frac{1}{p_{it}} - \beta \frac{x_{it}}{p_{it}})^2$$

Because:

$$E(1-\alpha_t \frac{1}{p_{it}} - \beta_t \frac{x_{it}}{p_{it}}) = 0.$$

For ease of exposition, let $m = 1/p_{it}$ and $n = x_{it}/p_{it}$, so that the minimization problem is

$$Min \quad \sum(1-\alpha_t m - \beta_t n)^2$$

subject to:

$$\sum(1-\alpha_t m - \beta_t n) = 0.$$

This problem can be solved by forming the Lagrangian:

$$L = \sum(1-\alpha_t m - \beta_t n)^2 - \lambda \sum(1-\alpha_t m - \beta_t n).$$

Taking derivatives respect to $\alpha_t, \beta_t,$ and λ_t yields:

$$\begin{aligned} \frac{\partial L}{\partial \alpha_t} &= 2\sum(1-\alpha_t m - \beta_t n)\cdot m - \lambda_t \sum m \\ &= \sum m - \alpha_t \sum(m)^2 - \beta_t \sum mn - \frac{\lambda_t}{2}\sum m = 0, \end{aligned} \tag{3}$$

$$\begin{aligned} \frac{\partial L}{\partial \beta_t} &= 2\sum(1-\alpha_t m - \beta_t n)\cdot n - \lambda_t \sum n \\ &= \sum n - \alpha_t \sum mn - \beta_t \sum\left(n\right)^2 - \frac{\lambda_t}{2}\sum n = 0, \end{aligned} \tag{4}$$

$$\begin{aligned} \frac{\partial L}{\partial \lambda_t} &= \sum(1-\alpha_t m - \beta_t n) \\ &= \sum -\alpha_t \sum m - \beta_t \sum n = 0. \end{aligned} \tag{5}$$

Assuming that there are N samples in the population (that is, $\sum = N$) and solving for three equations simultaneously, we have:

$$\alpha_t = \frac{N\left(\sum m \sum n^2 - \sum n \sum mn\right)}{\left(\sum n\right)^2 \sum m^2 + \left(\sum m\right)^2 \sum n^2 - 2\sum m \sum n \sum mn} \tag{6}$$

$$\beta_t = \frac{N(\sum n \sum m^2 - \sum m \sum mn)}{\left(\sum n\right)^2 \sum m^2 + \left(\sum m\right)^2 \sum n^2 - 2\sum m \sum n \sum mn} \tag{7}$$

Given:

$$E[x] = \frac{\sum x}{N}$$

$$var[x] = E[x^2] - (E[x])^2$$

$$cov(x, y) = E[x \cdot y] - E[x] \cdot E[y],$$

we can rewrite (7) as:

$$\beta_t = \frac{E[n]var(m) - cov(m,n)E[m]}{E[m]^2 var(n) + E[n]^2 var(m) - 2E[m]E[n]cov(m,n)}.$$

Substituting $1 / p_{it} = m$ and $x_{it} / p_{it} = n$ leads to:

$$\beta_t = \frac{E[\frac{x_{it}}{p_{it}}]var(\frac{1}{p_{it}}) - cov(\frac{1}{p_{it}}, \frac{x_{it}}{p_{it}})E[\frac{1}{p_{it}}]}{E[\frac{1}{p_{it}}]^2 var(\frac{x_{it}}{p_{it}}) + E[\frac{x_{it}}{p_{it}}]^2 var(\frac{1}{p_{it}}) - 2E[\frac{1}{p_{it}}]E[\frac{x_{it}}{p_{it}}]cov(\frac{1}{p_{it}}, \frac{x_{it}}{p_{it}})}$$

3.3.2 Extending LNT to two multiples without an intercept

Let the price of firm i in year t be proportional to two fundamentals x_{it} and y_{it} and permit the possibility of a non-zero average price when the fundamental is equal to zero:

$$p_{it} = \alpha_t x_{it} + \beta_t y_{it} + \varepsilon_{it} \tag{8}$$

where α_t and β_t are the multiples on the fundamentals. Following LNT, we divide both sides of equation (8) by price:

$$1 = \alpha_t \frac{x_{it}}{p_{it}} + \beta_t \frac{y_{it}}{p_{it}} + \frac{\varepsilon_{it}}{p_{it}} \tag{9}$$

We minimize the variance of $\varepsilon_{it} / p_{it}$, subject to the restriction that the expected value of $\varepsilon_{it} / p_{it}$ is zero (subscript understood):

$$Min \sum (1 - \alpha \frac{x_{it}}{p_{it}} - \beta \frac{y_{it}}{p_{it}})^2$$

subject to:

$$\sum (1 - \alpha \frac{x_{it}}{p_{it}} - \beta \frac{y_{it}}{p_{it}}) = 0.$$

The solutions have the same form as (6) and (7), that is:

$$\beta_t = \frac{E[n]var(m) - cov(m,n)E[m]}{E[m]^2 var(n) + E[n]^2 var(m) - 2E[m]E[n]cov(m,n)}.$$

where $m = x_{it} / p_{it}$ and $n = y_{it} / p_{it}$. Substituting into (7), we have:

$$\beta_t = \frac{E[\frac{y_{it}}{p_{it}}]var(\frac{x_{it}}{p_{it}}) - cov(\frac{x_{it}}{p_{it}}, \frac{y_{it}}{p_{it}})E[\frac{x_{it}}{p_{it}}]}{E[\frac{x_{it}}{p_{it}}]^2 var(\frac{y_{it}}{p_{it}}) + E[\frac{y_{it}}{p_{it}}]^2 var(\frac{x_{it}}{p_{it}}) - 2E[\frac{x_{it}}{p_{it}}]E[\frac{y_{it}}{p_{it}}]cov(\frac{x_{it}}{p_{it}}, \frac{y_{it}}{p_{it}})}.$$

3.3.3 Extending LNT to two multiples with an intercept

Assume that the price of firm i in year t is proportional to two fundamentals x_{it} and y_{it} and that there is a possibility of a non-zero average price when the fundamentals are equal to zero:

$$p_{it} = \alpha_t + \beta_t x_{it} + \rho_t y_{it} + \varepsilon_{it} \tag{10}$$

Divide both sides of equation (10) by price:

$$1 = \alpha_t \frac{1}{p_{it}} + \beta_t \frac{x_{it}}{p_{it}} + \gamma_t \frac{y_{it}}{p_{it}} + \frac{\varepsilon_{it}}{p_{it}} \tag{11}$$

so that the minimization problem (with subscription understood) is:

$$Min \quad \sum (1 - \alpha_t m - \beta_t n - \gamma_t q)^2$$

subject to:

$$\sum (1 - \alpha_t m - \beta_t n - \gamma_t q) = 0.$$

where $m = 1/p_{it}$, $n = x_{it}/p_{it}$, and $q = y_{it}/p_{it}$. This problem can be solved by forming the Lagrangian:

$$L = \sum (1 - \alpha_t m - \beta_t n - \gamma_t q)^2 - \lambda \sum (1 - \alpha_t m - \beta_t n - \gamma_t q)$$

Taking derivatives respect to α, β_t, γ_t and λ_t yields:

$$\begin{aligned} \frac{\partial L}{\partial \alpha_t} &= 2\sum (1 - \alpha_t m - \beta_t n - \gamma_t q) \cdot m - \lambda_t \sum m \\ &= \sum m - \alpha_t \sum (m)^2 - \beta_t \sum mn - \gamma_t \sum mq - \frac{\lambda_t}{2} \sum m = 0, \end{aligned} \tag{12}$$

$$\begin{aligned} \frac{\partial L}{\partial \beta_t} &= 2\sum (1 - \alpha_t m - \beta_t n - \gamma_t q) \cdot n - \lambda_t \sum n \\ &= \sum n - \alpha_t \sum mn - \beta_t \sum (n)^2 - \gamma_t \sum nq - \frac{\lambda_t}{2} \sum n = 0, \end{aligned} \tag{13}$$

$$\begin{aligned} \frac{\partial L}{\partial \gamma_t} &= 2\sum (1 - \alpha_t m - \beta_t n - \gamma_t q) \cdot q - \lambda_t \sum \gamma_t \\ &= \sum q - \alpha_t \sum mq - \beta_t \sum nq - \gamma_t \sum q^2 - \frac{\lambda_t}{2} \sum \gamma_t = 0, \end{aligned} \tag{14}$$

$$\begin{aligned} \frac{\partial L}{\partial \lambda_t} &= \sum (1 - \alpha_t m - \beta_t n - \gamma_t q) \\ &= \sum - \alpha_t \sum m - \beta_t \sum n - \gamma_t \sum q = 0. \end{aligned} \tag{15}$$

Solving the four equations simultaneously, we have:

$$\beta_t = \frac{1}{\Delta}\left[\mu_n\sigma_{mq}^2 - \mu_m\sigma_{mq}\sigma_{nq} + \sigma_{mn}(-\mu_m\sigma_q + \mu_q\sigma_{mq}) + \sigma_m(\mu_q\sigma_{nq} - \mu_n\sigma_q)\right], \tag{16}$$

$$\gamma_t = \frac{1}{\Delta}\left[\mu_q\sigma_{mn}^2 - \sigma_{mn}(\mu_n\sigma_{mq} + \mu_m\sigma_{nq}) + \mu_n\sigma_m\sigma_{nq} + \sigma_n(\mu_m\sigma_{mq} - \mu_q\sigma_m)\right], \tag{17}$$

$$\alpha_t = \frac{1}{\mu_m}\left[1 - \beta\mu_n - \gamma\mu_q\right], \tag{18}$$

where :

$$\Delta \equiv \mu_q^2\sigma_{mn}^2 + \mu_n^2\sigma_{mq}^2 + \mu_m^2\sigma_{nq}^2 + 2\mu_n\mu_q\sigma_m\sigma_{nq} - \mu_q^2\sigma_m\sigma_n + 2\mu_m\sigma_{mq}(\mu_q\sigma_n - \mu_n\sigma_{nq})$$
$$-\sigma_q(\mu_n^2\sigma_m + \mu_m^2\sigma_n) - 2\sigma_{mn}(\mu_n\mu_q\sigma_{mq} + \mu_m\mu_q\sigma_{nq} - \mu_m\mu_n\sigma_q),$$

and $\mu_m = E[m]$, $\sigma_m = var(m)$, and $\sigma_{mq} = cov(m,q)$. We can apply equations (16) to (18) to estimate the case of two multiples with an intercept.

4. Sample and Data

We collect all Compustat firm-year observations from 1963 to 2006 and prices from CRSP for all firms traded on the NYSE, the AMEX and NASDAQ. We require firm-year observations to have complete data for the following items: sales revenue, EBITDA, earnings before extraordinary items, net operating assets, common stockholders' equity, free cash flow, market capitalization, and enterprise value (see the Appendix for detailed descriptions of these variables).[5] Lastly, we require share price three months after the fiscal year end to be greater than or equal to $1.*4.1 Selection of Comparable firms*

[5] For our multiples with enterprise value as the deflator, we restrict our analysis to observations with positive enterprise value (firms with net financial assets larger than common stockholders' equity have negative enterprise values).

When forming our groups of comparable firms, we first sort firms according to their four-digit Standard Industry Classification (SIC) code and size (market capitalization). We start by forming groups of 21 firms (including target/subject and comparable firms) for each four-digit year industry-size matched combination.[6] We are able to find 2,159 groups of firms (45,339 firm-year observations) using the four-digit SIC code. For the remaining firms for which we are unable to form groups of 21 firms with the same four-digit SIC code, we pool observations within the same three-digit SIC code and, again, we sort firms by size. We then repeat our procedure, again forming groups of 21 firms. We form an additional 1,159 groups of firms (24,339 firm-year observations) in this manner. The resulting sample includes 69,678 firm-year observations from 1963 to 2006.[7]

Within the groups of 21 firms, we select a target firm and the remaining 20 firms are treated as comparables. In practice, extreme price-multiples are excluded in computing valuation errors. In an attempt to emulate this idea, we remove the firms with the highest and lowest price multiple within the set of 20 comparable firms. Thus, for each target firm, our analyses are based on 18 comparable firms-year observations.[8]

[6] LNT cite Kim and Ritter (1999), claiming that SIC codes frequently misclassify firms; they use the industry classification by I/B/E/S (based loosely on SIC codes with adjustments). LNT and Kim and Ritter (1999) use the intermediate Industry classification (Sector, Industry, and Group) as Sector is too broad, and Group is too narrow to allow for the inclusion of sufficient comparable firms (at least 5). We cannot use I/B/E/S classifications like LNT as this would pose a restriction on our sample size and bias our sample. We also consider an alternative industry classification (as in Fama and French 1997) and find similar results to those reported using four- and three-digit SIC codes.

[7] LNT's sample before excluding any negative price multiples includes 26,613 firms.

[8] Although not tabulated, we repeat our analysis using groups of 11 firms. The empirical results using 11 firms provide stronger support for our conclusions.

5. Results

5.1 Descriptive Statistics

Table 1 outlines the descriptive statistics for the various price multiples. Our sample size (69,678) is much larger than LNT (26,613). This is mostly due to LNT's focus on firms with forward information, hence restricting their sample to firms with I/B/E/S analyst earnings per share forecasts. Since our focus is on multiples of current financial fundamentals, we have a broader cross-section of companies. In addition, we have a longer sample period covering firm-year observations from 1963 to 2006 (in contrast to LNT's sample period of 1982 to 1999).

LNT note that most distributions of their price multiples for firms with I/B/E/S following contain very few negative values (with the exception of multiples based on free cash flow). Further, they remove all negative observations from their analyses. In stark contrast, in our sample more than 28 percent of the firms in our sample report negative net income before extraordinary items and more than 18 percent have negative EBITDA. It is also interesting to note that 55 percent of observations of free cash flow are negative, which is clear evidence of the questionable relevance of free cash flow as a fundamental variable for valuation.

5.2 Pricing Errors based on Harmonic Means and Medians

The results of our first stage analysis are reported in Table 2. We report the distribution of absolute pricing errors for multiples based on the various fundamentals. These valuation errors are calculated without incorporating the intercept in the price-fundamental relation, which is traditionally how multiple analyses are done in practice. The valuation error for the subject firm (always calculated out-of-sample) is the difference between the actual price and the predicted price divided by the actual price. Valuation errors greater than 100 percent are assigned an error of 100 percent. We report two measures of central tendency (mean and median) and four non-parametric distribution measures (frequency of absolute percentage error less than five percent, frequency less than 10 percent, frequency less than 25 percent, and frequency less than 100 percent).

Since LNT eliminate all negative observations, their valuation errors are skewed to the left with a median that is greater than the mean. The skewness is particularly prominent for multiples based on sales revenue and cash flow and less noticeable for those based on forward earnings. Rather than inferring from the median or the mean absolute errors, LNT focus on the inter-quartile range in assessing the performance of different price multiples.

A comparison of the inter-quartile range of pricing errors among various fundamentals may be a reasonable indication of the relative accuracy when the shapes of the distributions are similar. However, in our analyses, the distributions differ considerably – for example, sales revenue clusters around zero, has a long right tail and no negative observations while earnings is much more smoothly distributed with both a long right tail and a long left tail. Use of the inter-quartile range in our analysis tends to suggest that sales revenue is the much superior fundamental – but this result reflects little more than the shape of the distribution of pricing errors based on sales as the fundamental. We examine the performance of our price multiples by focusing on the mean and median absolute valuation errors.

In Table 2, Panel A, we report the absolute valuation errors based on the harmonic mean multiple of the comparable firms. In Table 2, Panel B, we report the absolute valuation errors based on median multiples of the comparables. The mean absolute *enterprise* valuation errors for the analyses based on the median multiple are very similar to those based on the harmonic mean multiple. The mean absolute equity *market* valuation errors for the analyses based on the median multiple are higher than for multiples based on the harmonic mean multiple. This is consistent with LNT's finding that performance improves when multiples are computed using the harmonic mean rather than the median. The median absolute valuation errors for both equity value and for enterprise value) are slightly lower for multiples based on the median than for those based on the harmonic mean. Given the absolute performance of different price multiples is similar under both approaches, we proceed by tabulating only the valuation errors calculated using the harmonic means of the comparable firms.

Examination of the mean and median valuation errors indicates the following ranking. Mean absolute valuation errors for enterprise value are lowest when NOA is the valuation fundamental, closely followed by sales revenue. EBITDA ranks third while free cash flow ranks last with the highest valuation errors. Mean absolute valuation errors for market value are lowest when book value is the fundamental, higher when sales is the fundamental, and much higher when EBITDA or net income is the valuation fundamental. The ranking based on median absolute valuation errors is similar.

Our results are in sharp contrast to those reported in LNT in the following ways. First, valuation errors based on sales are not the largest when compared with errors based on other fundamentals. Second, when comparing book value and earnings, we do not find that earnings metrics outperform book value metrics. This is due to the fact that only a small proportion of the observations have negative net operating assets and/or book value, while a significant number of our sample firms report losses and negative EBITDA. This result may, in part, also be due to earnings being more volatile from one period to another. Third, we find that, for market value multiples, EBITDA has lower valuation errors than net income. Again, we attribute this to the fact that negative multiples do not yield sensible value estimates; twice as many firms report negative net income as compared with negative EBITDA.

To provide further insights into the relative performance of these multiples, for each of the 3,318 sets of industry-year observations, we rank the multiples by their median absolute out-of-sample valuation errors based on harmonic means (without intercept). Lower ranks imply lower valuation errors; that is, rank 1 is assigned to multiples with the lowest valuation errors; while rank 4 is assigned to multiples with the highest valuation errors.

For our enterprise value multiples, we find that multiples based on NOA have rank 1 for 46.65 percent of our industry-year observations; while multiples based on sales revenue rank first for 30.17 percent of our industry-year observations. Multiples based on free cash flow rank last in 99.7 percent of our industry-year observations. The mean or median rank score shows that multiples based on NOA rank best, followed multiples based on sales revenue, then multiples based on EBITDA, and lastly multiples based on free cash flow.

For our market value multiples, those based on book value rank highest for 56.40 percent of our sets of industry-year observations; while those based on sales revenue rank highest for 16.67 percent of our industry-year observations. The mean and median rank score indicates that, when comparing the relative ranking of these multiples, those based on book value rank best, followed by those based on sales revenue, then those based on EBITDA, and lastly by multiples based on net income. Visual depictions of the relative ranking of multiples across our industry-year observations are provided in Figure 1.

5.3 Inclusion of an Average Effect

In Table 4, we show the results of incorporating the average valuation effect beyond the application of the multiple to the fundamental by allowing for an intercept in the price-fundamental relation. When compared to the valuation errors reported in Table 3, the range of these valuation errors is narrower. Our results show improvement in the absolute performance of all the price-multiples. We find that the poor performing multiples in our previous analysis have the highest reduction in valuation errors (EBITDA, and free cash flow for enterprise value multiples; EBITDA and net income for market value multiples). Our results indirectly imply that some (on average) adjustments are required in applying price multiple analysis to yield sensible value estimates, especially for value drivers such as earnings and free cash flow.

The improvements in absolute performance of the price multiples are not uniform. The rank ordering of these value drivers also changes after incorporating the average effect of omitted variables. NOA and book value remain as the best fundamentals for both enterprise value and market value but the mean and median absolute error for EBITDA is lower than the mean and median absolute error based on sales multiples for either enterprise or equity valuation.

Our results are consistent with LNT inasmuch as allowing for an intercept improves performance mainly for poorly performing multiples. We observe vast improvement in valuation errors for our EBITDA, net income and free cash flow multiples. Nevertheless, free cash flow and net income before extraordinary items remain the poorest valuation fundamentals for enterprise value and market value multiples, respectively.

We repeat the same analysis for each of 3,318 industry-year observations. We assign the ranking of 1 to 4 for each price multiple at each industry-year level. Although the better ranked multiples retain their better ranking, they are ranked better less often. Book values (NOA and book value of equity) have the highest frequency of being ranked first (45 percent for enterprise value multiples and 40 percent for market value multiples). Free cash flow still has the highest frequency of being ranked last (68 percent) for enterprise value. In contrast to conventional wisdom about the central role of earnings in equity valuation, net income ranks last for 41 percent of our industry-year observations. The mean and median rank of these multiples are similar to those reported in Table 4, with the exception that EBITDA now outperforms sales after including average effects in the valuations.

5.4 Combining Multiples

Price multiples are often cited without much reconciliation being made between conflicting multiples. One common criticism of the use of price multiples is the inability to reconcile different multiples. In an attempt to incorporate information from different multiples, LNT also examine short-cut intrinsic value measures incorporating book value and forward earnings based on the residual income model. They find that their intrinsic value measures perform considerably worse than forward earnings, even though these measures contain more information than forward earnings. They attribute the poorer performance to potential measurement error associated with the terminal value estimates required for the intrinsic value calculation.

LNT also combine two or more value drivers using price-scaled regressions to compare different linear combinations of value drivers based on Beatty, Riffe, and Thompson (1999). Little or no improvement is observed. In addition, LNT combine price-to book and price-earnings ratios using the conditional price-earnings (price-book) that is appropriate given the forecast of earnings growth (forecasted book profitability) of the subject firm. They estimate the relation between the forward price-earnings ratio and forecast earnings growth (price-book with forecast return-on-equity) for each industry-year; then they obtain the price-earnings multiple (price-to-book) corresponding to the earnings growth (forecasted return-on-equity) for the firm being valued. Again, they find little or no improvement in performance over the unconditional price-earnings and price-book multiples.

Given that the extant literature is silent on how harmonic means can be calculated when different multiples can be combined, we extend the method developed in LNT to combine multiples and consider the change in the valuation error when we consider a combination of multiples rather than a single multiple. Table 6 shows the distribution of absolute pricing errors when combining two multiples from different financial statements. This, in turn, provides an insight into the incremental information when price multiples from different financial statements are combined.

The mean valuation errors for the highest-ranked value drivers, NOA and book value are 0.41 and the median valuation errors are 0.34. We observe improvement in the absolute performance of the NOA price multiples when they are combined with information on other statements. The biggest improvement in valuation errors is when NOA is combined with EBITDA for enterprise valuation and when book value is combined with EBITDA for equity valuation.

The remaining panels of Table 6 partition the sample according to the sign of the income statement and free cash flow variables. The aim of these analyses is to investigate the valuation relevance of negative fundamentals when combined with book value, which is positive for the vast majority of our observations. Without exception, the results show that combining the income statement or free cash flow variables with book value leads to a decrease in valuation error whether or not the income statement fundamental is negative; sometimes, however, the improvement is quite modest. For example, when NOA is combined with observations of positive EBITDA, the median absolute percentage error declines from 0.33 to 0.27, and when NOA is combined with observations of negative EBITDA, the median absolute percentage error declines from 0.39 to 0.36.

5.5 Combining Sales Revenue and Negative Fundamentals

An argument for the use of sales multiples is that they yield positive, and therefore possibly more meaningful, valuations when other fundamentals are negative. Combining multiples allows us to examine the extent to which negative fundamentals may, indeed, be incrementally useful (over sales alone) in valuation. Table 7 reports the results of combining sales revenue and income (net income before extraordinary items and EBITDA) multiples. Adding the income multiples reduces the valuation error for the entire sample. For enterprise value multiples the median valuation error drops from 0.41 when sales revenue alone is being used to 0.33 when EBITDA is combined with sales revenue. Similarly for market value multiples, the median valuation errors when sales revenue is the fundamental is 0.39. When sales revenue is combined with EBITDA, the median valuation error is lower at 0.33; also when sales revenue is combined with net income before extraordinary items, the valuation error is at 0.31.

More importantly, our results show that when sales revenue is combined with EBITDA and/or net income, improvements in valuation errors are observed regardless of whether the subject firms have positive or negative EBITDA. For example, the enterprise valuation errors are reduced from 0.40 for sales revenue multiples to 0.32 when sales revenue and EBITDA are combined for the set of subject firms with positive EBITDA. For the set of subject firms with negative EBITDA, we also observe improvements from 0.43 when sales revenue alone is being used to 0.32 when sales revenue is combined with EBITDA.

It is also interesting to note that for the market value multiples the valuation errors based on sales revenue as the single fundamental are much less for the sample of observations with negative EBITDA (0.30) than for the sample with positive EBITDA (0.42). Similarly, the valuation errors are lower for the sample of observations with negative net income (0.34) than for the sample with positive EBITDA (0.41). These results suggest that sales revenue is much more than a fundamental that can/should be used as a last resort when other fundamentals are negative.[9]

6. Conclusions

The extant literature on the usefulness of multiples in explaining stock prices focuses mostly on a set of observations that have non-negative analysts' earnings forecasts. We document the usefulness of multiples in enterprise valuation and in equity valuation for a sample of firms that are more representative of the general population of firms (firms with losses, smaller start-up firms, etc). Our focus is on multiples of current financial variables. We do not consider forward earnings-based multiples as removing this restriction allow us to analyze a broader cross-section of stocks. We do not exclude firms with negative fundamentals. We use an industry classification at a more micro industry level; where possible we group on 4-digit SIC code and where this is not possible, we group on 3-digit SIC code. We focus our analyses on the absolute mean and median valuation error instead of the inter-quartile range. The use of inter-quartile range is not appropriate as some multiples have skewed distributions (for example, sales multiples are always non-negative), these multiples will naturally have a distribution that is less dispersed.

Our results are in sharp contrast to those reported in LNT (2002) in the following ways. First, valuation errors based on sales are not the largest when compared with errors based on other fundamentals. Second, when comparing book value and earnings, we do not find that earnings metrics outperform book value metrics. We attribute our

[9] Firms with negative EBITDA, negative net income, or negative free cash flow tend to be smaller, younger, have less capital expenditure per unit of market capitalization, tend to be in the later years of the sample and are less followed by I/B/E/S.

results to the fact that only a small proportion of the observations have negative NOA and book value, while a significant number of our sample firms report losses and negative EBITDA. Our results may also in part driven by the fact that current earnings metrics (rather than forward earnings) are more volatile from one period to another. Third, we find that for market value multiples, EBITDA has lower valuation errors than net income. Again, we attribute this to the fact that negative multiples do not yield sensible value estimates. Twice as many firms report negative net income compared with negative EBITDA in our sample.

The widespread use of price-multiples stems, in part, from their ease of computation. There are two common criticisms for the use of multiples. First, these price-multiples often do not yield sensible estimates with negative multiples. We show vast improvement in valuation errors when an average omitted variable (intercept) is incorporated in the calculation of harmonic means. Our results, in turn, imply that the traditional method (without adjustment) of applying price multiples to obtain value estimates is inadequate.

Another common criticism of the use of multiples is that valuations of the same firm based on different price-multiples are difficult to reconcile. We extend the extant literature by demonstrating how harmonic means can be calculated when different multiples are combined, while incorporating intercepts in our analysis. This in turn enables us to examine the change in valuation errors when a combination of multiples is used instead of just a single multiple. Our results show valuation errors are significantly improved when combining fundamentals from different financial statements. Our results show the best improvement in valuation errors when balance sheet fundamentals (net operating assets and book value of equity) are combined with fundamentals from the income statement (EBITDA).

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Table 1: Distribution of Price Multiples

	mean	25%	50%	75%	Number of –ve Observations
Panel A: Our Sample with n=69,678					
NOA/EV	1.22	0.20	0.52	0.88	2946
EBITDA/EV	0.05	0.03	0.10	0.17	13004
FCF/EV	-0.42	-0.10	-0.01	0.05	38093
Sales/EV	2.02	0.30	0.72	1.54	0
BV/MV	1.18	0.25	0.48	0.82	1822
EBITDA/MV	0.37	0.03	0.11	0.23	13004
NIBE/MV	0.01	-0.02	0.04	0.08	19801
Sales/MV	3.04	0.31	0.81	1.90	0
Panel B: LNT's Sample with n=26,613*					
EBITDA/EV	0.11	0.08	0.11	0.15	
Sales/EV	0.94	0.40	0.71	1.23	
BV/MV	0.55	0.31	0.49	0.71	
NIBE/MV	0.05	0.03	0.06	0.08	
Sales/MV	1.42	0.55	0.99	1.77	

** LNT exclude negative price multiples in their analysis, their final sample n=19,879*

Table 2: Distribution of Absolute Pricing Errors for Multiples
Using 4-digit and 3 digit SIC, Sample Size: 69,678 - 1963-2006

	Mean	Median	Frequency <5%	Frequency <10%	Frequency <25%	Frequency <100%
Panel A: Multiples based on harmonic means of firms from the same industry grouping						
Multiples of EV						
NOA	0.51	0.47	7.39%	13.84%	29.88%	85.67%
EBITDA	0.61	0.65	5.17%	10.47%	24.65%	62.67%
FCF	0.94	1.00	0.53%	1.09%	2.81%	12.61%
Sales	0.53	0.52	5.06%	9.99%	24.77%	88.75%
Multiples of MV						
BV	0.51	0.48	5.74%	11.42%	27.58%	87.47%
EBITDA	0.64	0.71	4.45%	8.95%	21.18%	63.74%
NIBE	0.77	1.00	3.28%	6.33%	14.54%	39.39%
Sales	0.58	0.60	4.04%	8.21%	20.49%	87.60%
Panel B: Multiples based on medians of firms from the same industry grouping						
Multiples of EV						
NOA	0.50	0.45	11.92%	18.31%	33.61%	79.52%
EBITDA	0.57	0.55	10.04%	15.58%	30.18%	63.73%
FCF	0.93	1.00	2.51%	3.05%	4.78%	12.21%
Sales	0.52	0.48	10.16%	15.34%	30.07%	79.98%
Multiples of MV						
BV	0.48	0.43	10.81%	16.86%	33.30%	82.26%
EBITDA	0.60	0.63	9.17%	13.95%	27.07%	61.26%
NI	0.66	0.97	8.34%	12.68%	23.90%	50.61%
Sales	0.55	0.54	9.28%	13.74%	27.17%	77.14%

Table 3 Relative ranking of multiples across industry groupings.
For each 3,318 industry year observations, multiples are ranked by absolute out-of-sample pricing errors based on harmonic means without intercept. Lower ranks imply lower pricing errors (better performance). Chi-squares are reported in parentheses. * denotes significant at the 0.01 level.

Panel A: Multiples of EV

		Multiple of EV			
		NOA	EBITDA	FCF	Sales
Ranks	1	1548 (622.35*)	759 (5.99)	10 (809.62*)	1001 (35.46)
	2	1177 (147.61*)	795 (1.28)	20 (787.98*)	1318 (290.74*)
	3	531 (42.84*)	1187 (330.00*)	118 (488.51*)	983 (109.86*)
	4	62 (836.27*)	577 (150.41)	3170 (5124.90*)	16 (924.52*)
Mean Rank		1.73	2.48	3.94	2.00
Median Rank		2	3	4	2

Panel B: Multiples of MV

		Multiple of MV			
		BV	EBITDA	NIBE	Sales
Ranks	1	1872 (1310.19*)	499 (131.68*)	394 (228.64*)	553 (92.17*)
	2	826 (0.01)	888 (4.16)	287 (354.58*)	1316 (285.71*)
	3	469 (84.92*)	1326 (520.91*)	296 (245.95*)	771 (4.31)
	4	151 (665.91*)	605 (121.59)	2341 (2068.67*)	678 (74.83*)
Mean Rank		1.67	2.61	3.38	2.47
Median Rank		1	3	4	2

Figure 1: Relative Ranking of multiples across industries
Multiples are ranked based on absolute out-of-sample pricing errors based on harmonic means without intercept. Lower ranks imply lower pricing errors (better performance).

Figure 1b: Multiples of EV

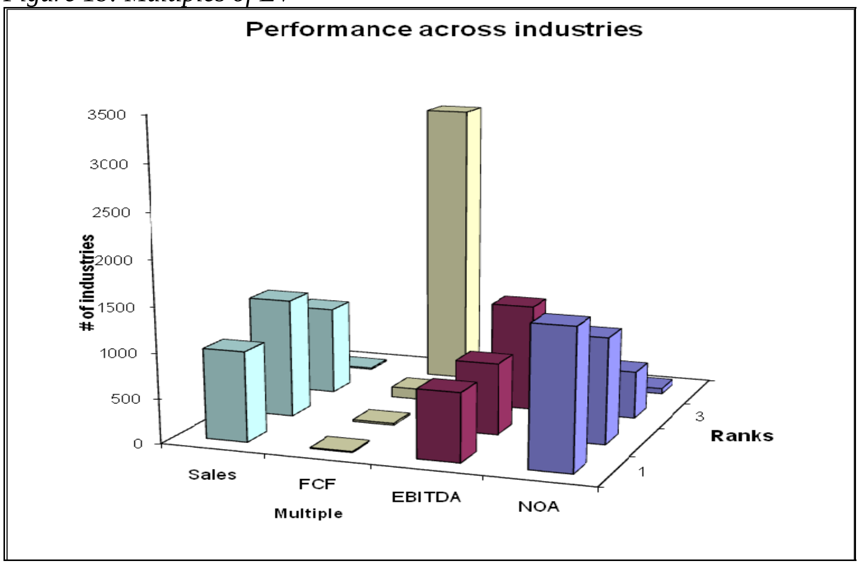

Figure 1b: Multiples of MV

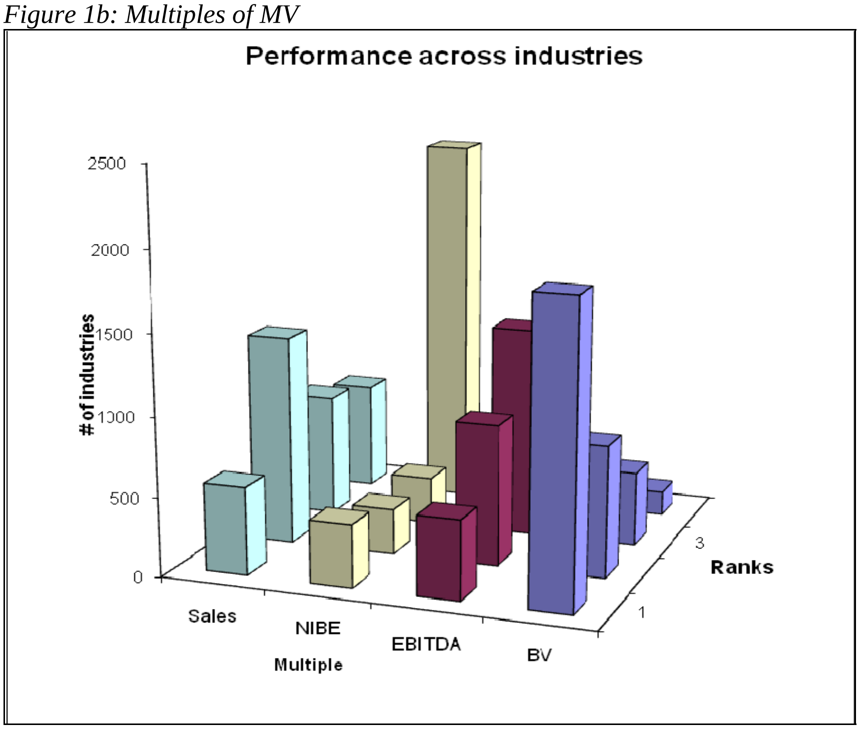

Table 4: Distribution of Absolute Pricing Errors for Multiples (with intercepts) Using 4-digit and 3 digit SIC, Sample Size: 69,678 - 1963-2006

	Mean	Median	Frequency <5%	Frequency <10%	Frequency <25%	Frequency <100%
Multiples based on harmonic means of firms from the same industry						
Panel A: Multiples of EV						
NOA	0.41	0.34	9.17%	17.62%	39.29%	91.47%
EBITDA	0.44	0.38	7.56%	14.87%	35.49%	88.96%
FCF	0.57	0.57	4.67%	9.31%	22.94%	81.20%
Sales	0.45	0.41	6.88%	13.34%	32.21%	89.76%
Panel B: Multiples of MV						
BV	0.41	0.34	8.33%	16.50%	38.69%	92.21%
EBITDA	0.43	0.36	7.66%	15.50%	36.69%	90.99%
NIBE	0.46	0.40	7.33%	14.71%	34.09%	88.19%
Sales	0.45	0.39	7.12%	14.05%	33.86%	91.10%

Table 5: Relative ranking of multiples across industry (with intercept)
For each 3,318 industry year, multiples are ranked by absolute out-of-sample pricing errors based on harmonic means with intercept. Lower ranks imply lower pricing errors (better performance). Chi-squares are reported in parentheses. * denotes significant at the 0.01 level.

Panel A: Multiples of EV

		Multiple of EV			
		NOA	EBITDA	FCF	Sales
Ranks	1	1511 (559.91*)	1005 (37.13)	261 (389.62*)	541 (100.34*)
	2	924 (11.01)	986 (29.94*)	365 (259.30*)	1039 (53.48*)
	3	624 (49.94*)	904 (7.12)	430 (190.76*)	1351 (331.60*)
	4	259 (395.30*)	423 (201.62*)	2262 (2453.02*)	387 (238.60*)
Mean Rank		1.89	2.22	3.41	2.48
Median Rank		2	2	4	3

Panel B: Multiples of MV

		Multiple of MV			
		BV	EBITDA	NIBE	Sales
Ranks	1	1323 (293.99*)	792 (1.67)	674 (29.07)	528 (109.44*)
	2	847 (0.39)	1083 (77.82*)	598 (64.37*)	788 (2.03)
	3	722 (14.11)	973 (24.54)	658 (35.74)	968 (22.85)
	4	426 (196.28*)	470 (155.81*)	1388 (376.04*)	1034 (50.42*)
Mean Rank		2.08	2.34	2.83	2.76
Median Rank		2	2	3	3

Figure 2: Relative Ranking of multiples across industries
Multiples are ranked based on absolute out-of-sample pricing errors based on harmonic means with intercept. Lower ranks imply lower pricing errors (better performance).

Figure 2a: Multiples of EV

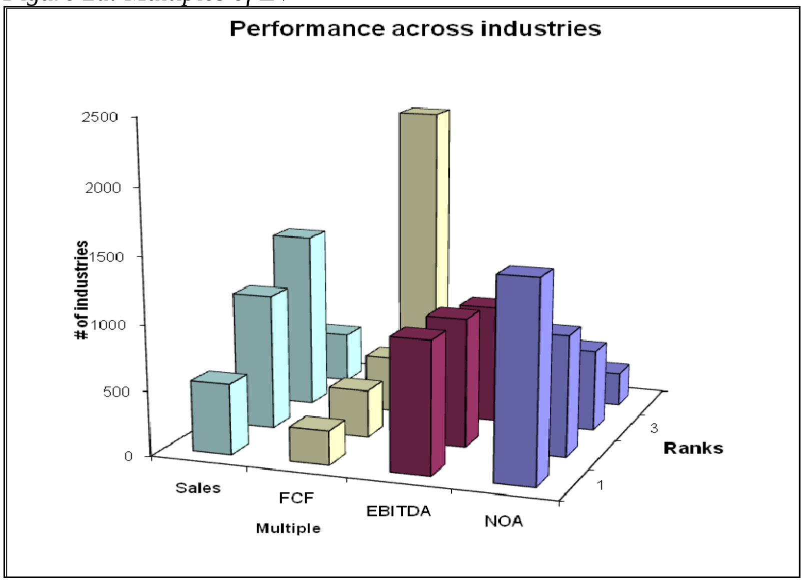

Figure 2b: Multiples of MV

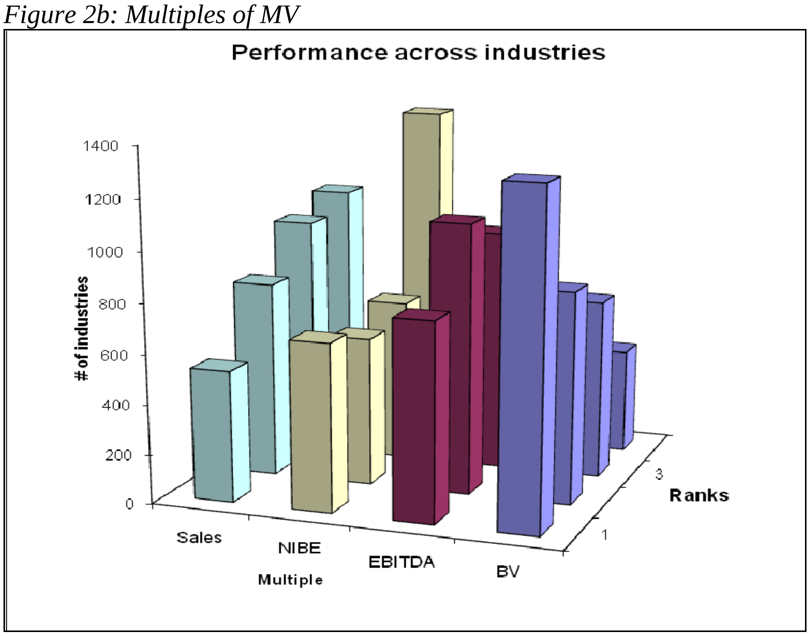

Table 6: Distribution of Absolute Pricing Errors combining NOA/BV multiples with other multiples; 1963-2006

Multiple A	Multiple B	Res. 1	Res. 2	n	Mean	Median	< 5%	< 10%	< 25%	<100%
Panel A: Absolute Pricing Errors										
Multiples of EV										
NOA				69678	0.41	0.34	9.17%	17.62%	39.29%	91.47%
NOA	EBITDA			69678	0.35	0.29	10.38%	19.58%	43.95%	95.53%
NOA	FCF			69678	0.37	0.31	9.25%	17.89%	41.06%	94.99%
NOA	Sales			69678	0.37	0.31	9.59%	18.28%	41.36%	95.13%
Multiples of MV										
BV				69678	0.41	0.34	8.33%	16.50%	38.69%	92.21%
BV	EBITDA			69678	0.36	0.30	8.71%	17.86%	42.69%	95.94%
BV	NIBE			69678	0.36	0.30	8.90%	17.96%	42.38%	95.80%
BV	Sales			69678	0.37	0.31	8.34%	16.97%	41.01%	95.67%
Panel B: Absolute Pricing Errors (with intercept) - combining NOA with EBITDA (Multiples of EV)										
NOA		EBITDA≥0		56674	0.40	0.33	9.79%	18.59%	40.85%	92.31%
NOA		EBITDA<0		13004	0.46	0.39	6.47%	13.38%	32.48%	87.83%
NOA	EBITDA	EBITDA≥0		56674	0.34	0.27	11.25%	21.13%	46.35%	96.07%
NOA	EBITDA	EBITDA<0		13004	0.42	0.36	6.60%	12.84%	33.48%	93.20%
NOA		NOA≥0	EBITDA≥0	55385	0.39	0.32	9.91%	18.84%	41.36%	92.81%
NOA	EBITDA	NOA>=0	EBITDA>=0	55385	0.33	0.27	11.41%	21.38%	46.83%	96.23%
Panel C: Absolute Pricing Errors (with intercept) combining NOA with FCF(Multiples of EV)										
NOA		FCF≥0		31585	0.42	0.35	9.25%	17.52%	38.51%	90.94%
NOA		FCF<0		38093	0.40	0.33	9.10%	17.70%	39.94%	91.91%
NOA	FCF	FCF≥0		31585	0.38	0.32	9.22%	17.90%	40.30%	95.17%
NOA	FCF	FCF<0		38093	0.37	0.31	9.27%	17.87%	41.70%	94.84%
NOA		FCF≥0	NOA≥0	30265	0.41	0.34	9.45%	17.91%	39.36%	91.81%
NOA	FCF	FCF≥0	NOA≥0	30265	0.37	0.32	9.47%	18.31%	41.07%	95.54%
Panel D: Absolute Pricing Errors (with intercept) combining BV with EBITDA(Multiples of MV)										
BV		EBITDA≥0		56674	0.42	0.36	8.03%	15.82%	37.21%	92.22%
BV		EBITDA<0		13004	0.37	0.29	9.61%	19.45%	45.12%	92.16%
BV	EBITDA	EBITDA≥0		56674	0.36	0.31	8.53%	17.40%	41.73%	95.93%
BV	EBITDA	EBITDA<0		13004	0.34	0.27	9.46%	19.84%	46.88%	95.95%
BV		BV≥0	EBITDA≥0	55810	0.41	0.35	8.10%	15.95%	37.51%	92.62%
BV	EBITDA	BV≥0	EBITDA≥0	55810	0.36	0.30	8.60%	17.51%	41.93%	96.03%
Panel E: Absolute Pricing Errors (with intercept) combining BV with NIBE (Multiples of MV)										
BV		NIBE≥0		49877	0.41	0.35	8.06%	15.92%	37.53%	93.12%
BV		NIBE<0		19801	0.40	0.32	8.99%	17.95%	41.59%	89.92%
BV	NIBE	NIBE≥0		49877	0.36	0.30	9.01%	17.89%	42.07%	96.32%
BV	NIBE	NIBE<0		19801	0.36	0.30	8.63%	18.13%	43.17%	94.50%
BV		NIBE≥0	BV≥0	49482	0.41	0.35	8.09%	15.97%	37.67%	93.33%
BV	NIBE	NIBE≥0	BV≥0	49482	0.36	0.30	9.04%	17.94%	42.18%	96.40%

Absolute pricing errors (out-of-sample) is the absolute value of difference between the actual price and the predicted price dividend by the actual price. Multiples are estimated using harmonic means with intercepts ($p_{it} = \alpha_t + \beta_t x_{it} + \varepsilon_{it}$) of firms from the same industry. When combing more than one multiples, multiples are estimated using harmonic means with intercepts ($p_{it} = \alpha_t + \beta_t x_{it} + \rho_t y_{it} + \varepsilon_{it}$). n is the number of observations. < X% are the proportion of observations that has absolute pricing errors less than X%. Descriptions of the variables are as follows: EV is Enterprise Value and MV is Market Value. EV is calculated as MV plus Net Financial Obligations. MV is calculated as closing prices for the fiscal year times the number of shares outstanding (compustat #25). Net Financial Obligations is Financial Liabilities minus Financial Assets; Financial Liabilities is calculated as the sum of debt in current liabilities (#34), long-term debt (#9), preferred stock (#130), preferred dividends in arrears (#242), minority interest (#38) minus preferred treasury stock (#227); Financial Assets are the sum of cash and short-term investments (#1) and investments and advances (#32). NOA is Net Operating Assets, calculated as common Stockholder's Equity (common equity (#60) + preferred treasury stock (#227)- preferred dividends in arrears (#242)) plus Net Financial Obligations. EBITDA is Earnings before Interest, Taxes, Depreciation and Amortization (#13). FCF is calculated as Cash Flows from Operations minus capital expenditures (#128) plus acquisitions (#129) plus increase in investment (#113) minus sale of PP&E (#107) minus sale of investment (#109); Cash Flows from operations is calculated as EBITDA minus interest expense (#15) minus tax expense (#16) – net change in working capital (calculated as change in current assets (#4) minus change in cash and cash equivalents (#1) minus change in current liabilities (#5) plus change in debt included in current liabilities (#34), with items 15, 16,1 or 34 set to zero if missing). Sales is Sales for the fiscal year (#12). BV is Common Stockholder's Equity. NIBE is Net Income before extraordinary items, calculated as net income (#172) minus extraordinary items and discontinued operations (#48).

Table 7: Distribution of Absolute Pricing Errors (with intercepts) combining sales multiples with other multiples using 4-digit and 3 digit SIC, 1963-2006

Multiple A	Multiple B	Res.	n	Mean	Median	< 5%	< 10%	< 25%	<100%
Panel A: Absolute Pricing Errors – all observations:									
Multiples of EV									
Sales			69678	0.45	0.41	6.88%	13.34%	32.21%	89.76%
Sales	NOA		69678	0.37	0.31	9.59%	18.28%	41.36%	95.13%
Sales	EBITDA		69678	0.39	0.33	7.78%	15.46%	38.08%	94.30%
Sales	FCF		69678	0.41	0.37	6.95%	13.65%	34.17%	93.72%
Multiples of MV									
Sales			69678	0.45	0.39	7.12%	14.05%	33.86%	91.10%
Sales	BV		69678	0.37	0.31	8.34%	16.97%	41.01%	95.67%
Sales	EBITDA		69678	0.38	0.33	7.88%	16.18%	39.33%	95.02%
Sales	NIBE		69678	0.38	0.33	8.05%	16.29%	39.47%	95.18%
Panel B: Absolute Pricing Errors - combining Sales with NOA (Multiples of EV)									
Sales		NOA≥0	66732	0.45	0.40	6.88%	13.35%	32.29%	90.08%
Sales		NOA<0	2946	0.51	0.45	6.96%	13.14%	30.45%	82.55%
Sales	NOA	NOA≥0	66732	0.36	0.31	9.74%	18.54%	41.85%	95.26%
Sales	NOA	NOA<0	2946	0.46	0.42	6.14%	12.53%	30.41%	92.09%
Panel C: Absolute Pricing Errors - combining Sales with EBITDA (Multiples of EV)									
Sales		EBITDA≥0	56674	0.45	0.40	6.96%	13.49%	32.51%	90.36%
Sales		EBITDA<0	13004	0.48	0.43	6.53%	12.67%	30.92%	87.14%
Sales	EBITDA	EBITDA≥0	56674	0.38	0.32	8.23%	16.32%	39.78%	94.85%
Sales	EBITDA	EBITDA<0	13004	0.44	0.39	5.85%	11.70%	30.66%	91.89%
Panel D: Absolute Pricing Errors - combining Sales with FCF (Multiples of EV)									
Sales		FCF≥0	31585	0.46	0.42	7.03%	13.30%	31.80%	88.28%
Sales		FCF<0	38093	0.45	0.40	6.76%	13.36%	32.55%	90.98%
Sales	FCF	FCF≥0	31585	0.42	0.39	6.59%	12.98%	32.46%	93.90%
Sales	FCF	FCF<0	38093	0.40	0.35	7.24%	14.20%	35.59%	93.57%
Panel E: Absolute Pricing Errors - combining Sales with BV (Multiples of MV)									
Sales		BV≥0	67856	0.45	0.39	7.10%	13.99%	33.84%	91.27%
Sales		BV<0	1822	0.46	0.38	7.63%	16.25%	34.74%	84.80%
Sales	BV	BV≥0	67856	0.37	0.31	8.39%	17.05%	41.15%	95.69%
Sales	BV	BV<0	1822	0.40	0.37	6.64%	13.83%	35.73%	94.90%
Panel F: Absolute Pricing Errors - combining Sales with EBITDA (Multiples of MV)									
Sales		EBITDA≥0	56674	0.46	0.42	6.70%	13.09%	31.70%	90.68%
Sales		EBITDA<0	13004	0.38	0.30	8.91%	18.23%	43.29%	92.95%
Sales	EBITDA	EBITDA≥0	56674	0.39	0.34	7.59%	15.57%	38.26%	94.95%
Sales	EBITDA	EBITDA<0	13004	0.36	0.29	9.17%	18.84%	44.03%	95.33%
Panel G: Absolute Pricing Errors - combining Sales with NIBE (Multiples of MV)									
Sales		NIBE≥0	49877	0.46	0.41	6.61%	12.99%	31.62%	91.84%
Sales		NIBE<0	19801	0.42	0.34	8.39%	16.71%	39.51%	89.25%
Sales	NIBE	NIBE≥0	49877	0.39	0.33	7.98%	16.07%	39.14%	95.64%
Sales	NIBE	NIBE<0	19801	0.38	0.32	8.21%	16.85%	40.31%	94.05%

Appendix A - Variable measurement

We follow Nissim and Penman (2001) in our variable measurement.

Price (P):	Share price from CRSP, as of 3 months after fiscal year end
Market Capitalization (MC)	P × shares outstanding (#25)
Enterprise Value (EV):	Market Capitalization + Net Financial Obligations
Net Financial Obligations (NFO):	Financial Liabilities - Financial Assets
Financial Liabilities (FL):	Debt in current liabilities (#34) + long-term debt (#9) + preferred stock (#130) - preferred treasury stock (#227) + preferred dividends in arrears (#242) + minority interest (#38).
Financial Assets (FA):	Cash and short-term investments (#1) plus investments and advances (#32)
Sales (SALES):	Sales (#12)
Core Operating Income (COI):	Comprehensive Net Income + Net Financial Expense – Unusual Operating Income
Comprehensive Net Income (CNI):	Net income (#172) - preferred dividends (#19) + the change in marketable securities adjustment (change in #238) + the change in cumulative translation adjustment (change in #230).
Net Financial Expense (NFE)	After tax interest expense (#15 × (1 – marginal tax rate)) + preferred dividends (#19) - after tax interest income (#62 × (1 - marginal tax rate)).
Unusual Operating Income (UOI):	After tax non-operating income (expense) excluding interest and equity in earnings ((#190 - #55) × (1 - marginal tax rate)) + after tax special items (#17 × (1 - marginal tax rate)) + extraordinary items & discontinued operations (#48) + cumulative translation adjustment (#230) and - lag cumulative translation adjustment (lag #230).
EBITDA:	Earnings before interest, taxes, depreciation and amortization = EBITDA (#13)
Net Operating Assets (NOA):	Common Stockholders' Equity + Net financial Obligations
Common Stockholders' Equity (CSE):	Common equity (#60) + preferred treasury stock (#227) - preferred dividends in arrears (#242).
Cash Flows from operations (CFO):	EBITDA – interest expense (#15) – tax expense (#16) – net change in working capital (calculated as change in current assets (#4) – change in cash and cash equivalents (#1) – change in current liabilities (#5) + change in debt included in current liabilities (#34). Data items 15, 16, 1 or 34 are set to zero if missing.
Free Cash Flow (FCF)	CFO – capital expenditures (#128) + acquisitions (#129) + increase in investment (#113) – sale of PP&E (#107) minus sale of investment (#109).

Marginal Tax Rate	The top statutory federal tax rate plus 2% average state tax rate. The top federal statutory corporate tax rates were 46% in 1979–1986, 40% in 1987, 34% in 1988–1992 and 35% after 1993.