

OTHER MULTIPLES

While earnings multiples are intuitively appealing and widely used, analysts in recent years have increasingly turned to alternative multiples to value companies. For new technology firms that have negative earnings, multiples of revenues have replaced multiples of earnings in many valuations. In addition, these firms are being valued on multiples of sector-specific measures such as the number of customers, subscribers or even web-site visitors. In this chapter, the reasons for the increased use of revenue multiples are examined first, followed by an analysis of the determinants of these multiples and how best to use them in valuation. This is followed by a short discussion of the dangers of sector-specific multiples and the adjustments that might be needed to make them work.

Revenue Multiples

A revenue multiple measures the value of the equity or a business relative to the revenues that it generates. As with other multiples, other things remaining equal, firms that trade at low multiples of revenues are viewed as cheap relative to firms that trade at high multiples of revenues.

Revenue multiples have proved attractive to analysts for a number of reasons. First, unlike earnings and book value ratios, which can become negative for many firms and not meaningful, the revenue multiples are available even for the most troubled firms and for very young firms. Thus, the potential for bias created by eliminating firms in the sample is far lower. Second, unlike earnings and book value, which are heavily influenced by accounting decisions on depreciation, inventory, R&D, acquisition accounting and extraordinary charges, revenue is relatively difficult to manipulate. Third, revenue multiples are not as volatile as earnings multiples, and hence may be more reliable for use in valuation. For instance, the price-earnings ratio of a cyclical firm

changes much more than its price-sales ratios, because earnings are much more sensitive to economic changes than revenues.

The biggest disadvantage of focusing on revenues is that it can lull you into assigning high values to firms that are generating high revenue growth while losing significant amounts of money. Ultimately, a firm has to generate earnings and cash flows for it to have value. While it is tempting to use price-sales multiples to value firms with negative earnings and book value, the failure to control for differences across firms in costs and profit margins can lead to misleading valuations.

Definition of Revenue Multiple

As noted in the introduction to this section, there are two basic revenue multiples in use. The first, and more popular one, is the multiple of the market value of equity to the revenues of a firm- this is termed the price to sales ratio. The second, and more robust ratio, is the multiple of the value of the firm (including both debt and equity) to revenues – this is the value to sales ratio.

$$\text{Price to Sales Ratio} = \frac{\text{Market Value of Equity}}{\text{Revenues}}$$

$$\text{Enterprise Value to Sales Ratio} = \frac{(\text{Market Value of Equity} + \text{Market Value of Debt} - \text{Cash})}{\text{Revenues}}$$

Why is the value to sales ratio a more robust multiple than the price to sales ratio? Because it is internally consistent. It divides the total value of the firm by the revenues generated by that firm. The price to sales ratio divides an equity value by revenues that are generated for the firm. Consequently, it will yield lower values for more highly levered firms, and may lead to misleading conclusions when price to sales ratios are compared across firms in a sector with different degrees of leverage.

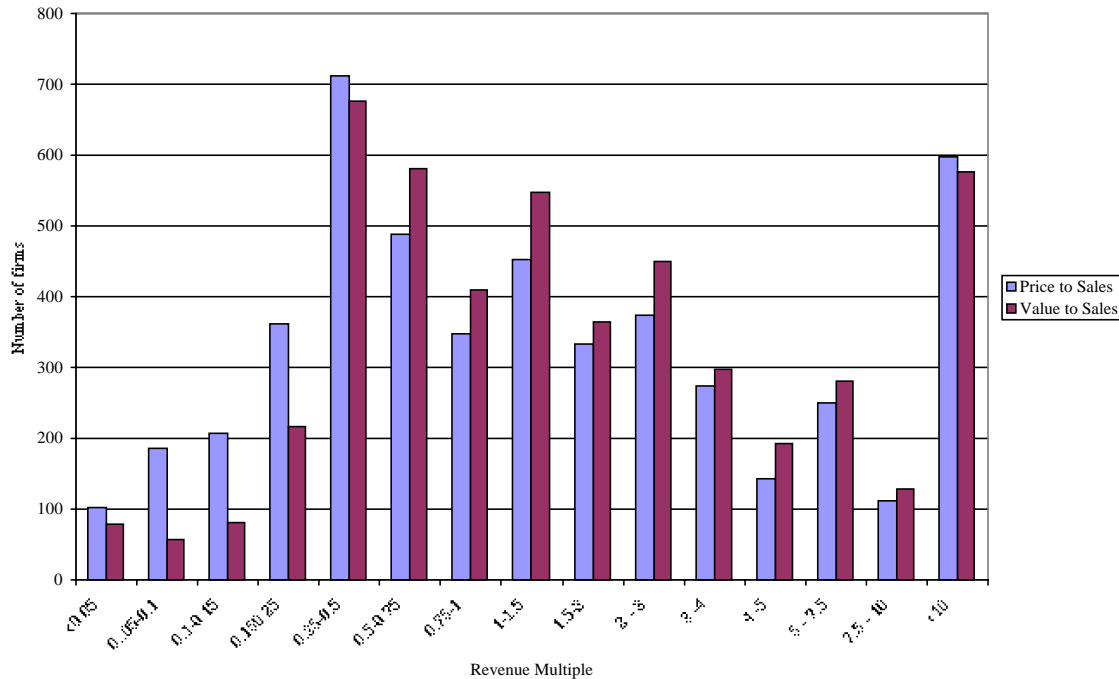
One of the advantages of revenue multiples is that there are fewer problems associated with ensuring uniformity across firms. Accounting standards across different sectors and markets are fairly similar when it comes to how revenues are recorded. There

have been firms, in recent years though, that have used questionable accounting practices in recording installment sales and intra-company transactions to make their revenues higher. Notwithstanding these problems, revenue multiples suffer far less than other multiples from differences across firms.

Cross Sectional Distribution

As with the price earning ratio, the place to begin the examination of revenue multiples is with the cross sectional distribution of price to sales and value to sales ratios across firms in the United States. Figure 10.1 summarizes this distribution:

Figure 10.1: Revenue Multiples



There are two things worth noting in this distribution. The first is that revenue multiples are even more skewed towards positive values than earnings multiples. The second is that the price to sales ratio is generally lower than the value to sales ratio, which should not be surprising since the former includes only equity while the latter considers firm value.

Table 10.1 provides summary statistics on both the price to sales and the value to sales ratios:

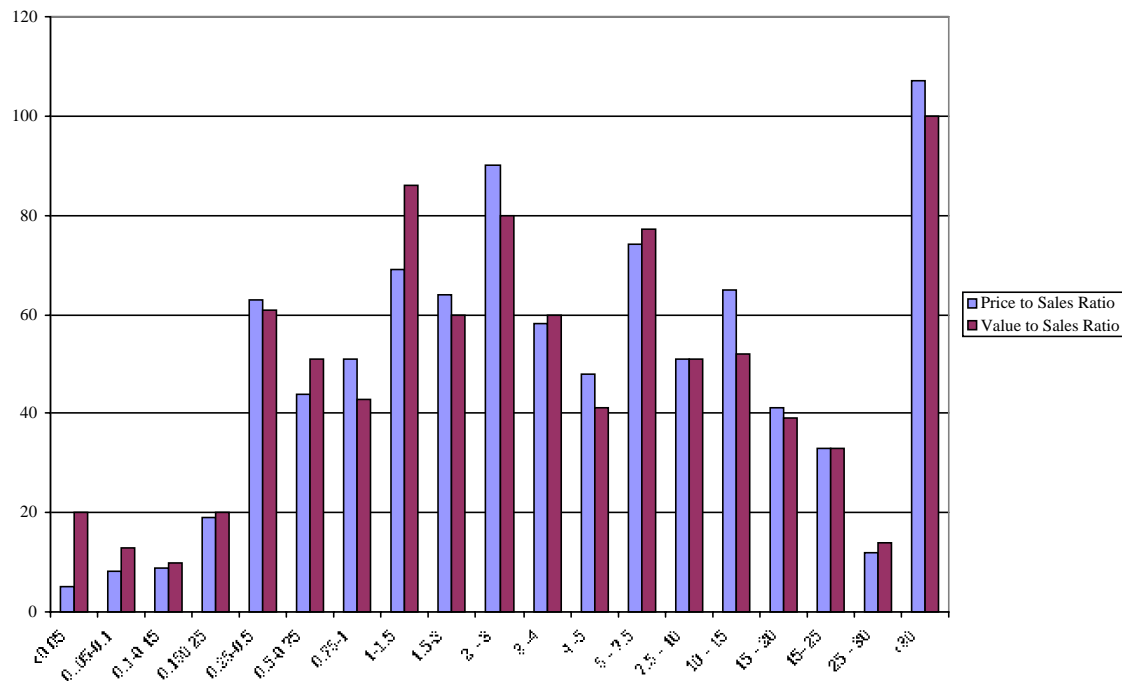
Table 10.1: Summary Statistics on Revenue Multiples: July 2000

	<i>Price to Sales Ratio</i>	<i>Value to Sales Ratio</i>
Number of firms	4940	4940
Average	14.22	13.89
Median	1.06	1.32
Standard Deviation	131.32	127.26
10 th percentile	0.15	0.27
90 th percentile	13.25	12.89

The price to sales ratio is slightly lower than the value to sales ratio, but the median values are much lower than the average values for both multiples.

The revenue multiples are presented only for technology firms in figure 10.2.

Figure 10.2: Revenue Multiples for Technology Firms: July 2000



In general, the values for both multiples are higher for technology firms than they are for the market.

Table 10.2 contrasts the price to sales at technology firms with revenue multiples at non-technology firms.

Table 10.2: Price to sales Ratios: Technology versus Non-technology Firms

	<i>Technology Firms</i>	<i>Non-technology firms</i>
Number of firms	944	4029
Average	25.65	11.63
Median	3.57	0.82
Standard Deviation	181.51	116.90
10 th percentile	0.44	0.13
90 th percentile	34.98	7.45

Technology firms trade at revenue multiples that are significantly higher than those of non-technology firms. It is worth noting in closing that revenue multiples can be estimated for far more firms than earnings multiples are, and the potential for sampling bias is, therefore, much smaller.



[psdata.xls: There is a dataset on the web that summarizes price to sales and value to sales ratios and fundamentals by industry group in the United States for the most recent year](#)

Analysis of Revenue Multiples

The variables that determine the revenue multiples can be extracted by going back to the appropriate discounted cash flow models – dividend discount model (or other equity valuation model) for price to sales and a firm valuation model for value to sales ratios.

Price to Sales Ratios

The price to sales ratio for a stable firm can be extracted from a stable growth dividend discount model:

$$P_0 = \frac{DPS_1}{r - g_n}$$

where,

P_0 = Value of equity

DPS_1 = Expected dividends per share next year

r = Required rate of return on equity

g_n = Growth rate in dividends (forever)

Substituting in for $DPS_1 = EPS_0 (1+g_n)$ (Payout ratio), the value of the equity can be written as:

$$P_0 = \frac{EPS_0 * \text{Payout Ratio} * (1 + g_n)}{r - g_n}$$

Defining the Profit Margin = $EPS_0 / \text{Sales per share}$, the value of equity can be written as:

$$P_0 = \frac{\text{Sales}_0 * \text{Margin} * \text{Payout Ratio} * (1 + g_n)}{r - g_n}$$

Rewriting in terms of the Price/Sales ratio,

$$\frac{P_0}{\text{Sales}_0} = PS = \frac{\text{Profit Margin} * \text{Payout Ratio} * (1 + g_n)}{r - g_n}$$

If the profit margin is based upon expected earnings in the next time period, this can be simplified to,

$$\frac{P_0}{\text{Sales}_0} = PS = \frac{\text{Profit Margin} * \text{Payout Ratio}}{r - g_n}$$

The PS ratio is an increasing function of the profit margin, the payout ratio and the growth rate, and a decreasing function of the riskiness of the firm.

The price-sales ratio for a high growth firm can also be related to fundamentals. In the special case of the two-stage dividend discount model, this relationship can be made

explicit fairly simply. The value of equity of a high growth firm in the two-stage dividend discount model can be written as:

P_0 = Present value of expected dividend in high growth period + Present value of terminal price

With two stages of growth, a high growth stage and a stable growth phase, the dividend discount model can be written as follows:

$$P_0 = \frac{EPS_0 * \text{Payout Ratio} * (1 + g) * \left(1 - \frac{(1 + g)^n}{(1 + k_{e,hg})^n}\right)}{k_{e,hg} - g} + \frac{EPS_0 * \text{Payout Ratio}_n * (1 + g)^n * (1 + g_n)}{(k_{e,st} - g_n)(1 + k_{e,hg})^n}$$

where,

g = Growth rate in the first n years

$k_{e,hg}$ = Cost of equity in high growth

Payout = Payout ratio in the first n years

g_n = Growth rate after n years forever (Stable growth rate)

$k_{e,hg}$ = Cost of equity in stable growth

Payout $_n$ = Payout ratio after n years for the stable firm

Rewriting EPS_0 in terms of the profit margin, $EPS_0 = Sales_0 * \text{Profit Margin}$, and bringing $Sales_0$ to the left hand side of the equation, you get:

$$\frac{\text{Price}}{\text{Sales}} = \text{Net Margin} \left[\frac{\text{Payout Ratio} * (1 + g) * \left(1 - \frac{(1 + g)^n}{(1 + k_{e,hg})^n}\right)}{k_{e,hg} - g} \right] + \text{Net Margin}_n \left[\frac{\text{Payout Ratio}_n * (1 + g)^n * (1 + g_n)}{(k_{e,st} - g_n)(1 + k_{e,hg})^n} \right]$$

The left hand side of the equation is the price-sales ratio. It is determined by--

(a) *Net Profit Margin during the high growth period and the stable period:* Net Income / Revenues. The price-sales ratio is an increasing function of the net profit margin

(b) *Payout ratio during the high growth period and in the stable period:* The PS ratio increases as the payout ratio increases.

(c) *Riskiness (through the discount rate $k_{e,hg}$ in the high growth period and $k_{e,st}$ in the stable period):* The PS ratio becomes lower as riskiness increases.

(d) *Expected growth rate in Earnings, in both the high growth and stable phases:* The PS increases as the growth rate increases, in either period.

This formula is general enough to be applied to any firm, even one that is not paying dividends right now.

Illustration 10.1: Estimating the PS ratio for a high growth firm in the two-stage model

Assume that you have been asked to estimate the PS ratio for a firm that has the following characteristics:

Growth rate in first five years = 25%

Payout ratio in first five years = 20%

Growth rate after five years = 8%

Payout ratio after five years = 50%

Beta = 1.0

Riskfree rate = T.Bond Rate = 6%

Net Profit Margin = 10%

Required rate of return = 6% + 1(5.5%)= 11.5%

This firm's price to sales ratio can be estimated as follows:

$$PS = 0.10 * \left[\frac{0.2 * (1.20) * \left(1 - \frac{(1.25)^5}{(1.115)^5} \right)}{(.115 - .25)} + \frac{0.50 * (1.25)^5 * (1.08)}{(.115 - .08) (1.115)^5} \right] = 2.35$$

Based upon this firm's fundamentals, you would expect this firm to trade at 2.35 times revenues.

Illustration 10.2: Estimating the price to sales ratio for Cisco

The price to sales ratio for Cisco can be estimated using the fundamentals that were used to value it on a discounted cash flow basis. The fundamentals are summarized in the table below:

	<i>High Growth Period</i>	<i>Stable Growth Period</i>
Length	12 years	Forever after year 12
Growth Rate	36.39%	5%
Net Profit Margin	17.25%	15%
Beta	1.43	1.00
Cost of Equity	11.72%	10%
Payout Ratio	0%	80%

The riskfree rate used in the analysis is 6% and the risk premium is 4%.

$$PS = \left[0.1725 * \frac{0 * (1.3639) * \left(1 - \frac{(1.3639)^{12}}{(1.1172)^{12}} \right)}{(.1172 - .3639)} + 0.15 * \frac{0.80 * (1.3639)^{12} * (1.05)}{(.10 - .05) (1.1172)^{12}} \right] = 27.72$$

Based upon its fundamentals, you would expect Cisco to trade at 27.72 times revenues, which was approximately what it was trading at in July 2000.

Price to Sales Ratio and Net Profit Margins

The key determinant of price-sales ratios is the net profit margin. Firms involved in businesses that have high margins can expect to sell for high multiples of sales. A decline in profit margins has a two-fold effect. First, the reduction in profit margins reduces the price-sales ratio directly. Second, the lower profit margin can lead to lower growth and hence lower price-sales ratios.

The profit margin can be linked to expected growth fairly easily if an additional term is defined - the ratio of sales to book value of equity, which is also called a turnover ratio. Using a relationship developed between growth rates and fundamentals, the expected growth rate can be written as:

$$\begin{aligned} \text{Expected growth rate} &= \text{Retention ratio} * \text{Return on Equity} \\ &= \text{Retention Ratio} * (\text{Net Profit} / \text{Sales}) * (\text{Sales} / \text{BV of Equity}) \end{aligned}$$

$$= \text{Retention Ratio} * \text{Profit Margin} * \text{Sales/BV of Equity}$$

As the profit margin is reduced, the expected growth rate will decrease, if the sales do not increase proportionately.

In fact, this relationship between profit margins, turnover ratios and expected growth can be used to examine how different pricing strategies will affect value.

Illustration 10.3: Estimating the effect of lower margins of price-sales ratios

Consider again the firm analyzed in illustration 10.1. If the firm's profit margin declines and total revenue remains unchanged, the price/sales ratio for the firm will decline with it. For instance if the firm's profit margin declines from 10% to 5%, and the sales/BV remains unchanged:

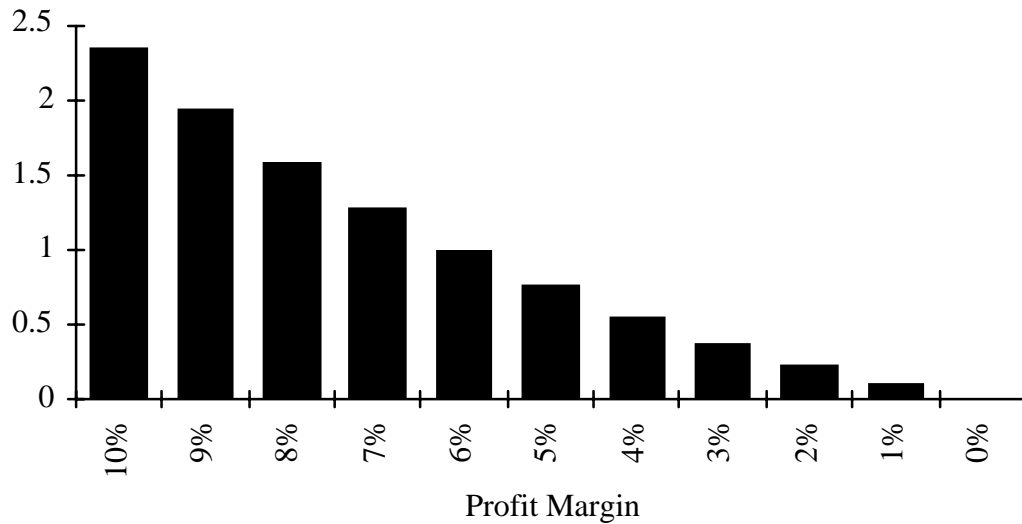
$$\begin{aligned} \text{New Growth rate in first five years} &= \text{Retention Ratio} * \text{Profit Margin} * \text{Sales/BV} \\ &= .8 * .05 * 2.50 = 10\% \end{aligned}$$

The new price sales ratio can then be calculated as follows:

$$PS = 0.05 * \left[\frac{0.2 * (1.10) * \left(1 - \frac{(1.10)^5}{(1.115)^5}\right)}{(.115 - .10)} + \frac{0.50 * (1.10)^5 * (1.08)}{(.115 - .08) (1.115)^5} \right] = 0.77$$

The relationship between profit margins and the price-sales ratio is illustrated more comprehensively in the following graph. The price-sales ratio is estimated as a function of the profit margin, keeping the sales/book value of equity ratio fixed.

Price-Sales Ratios and Profit Margins



This linkage of price-sales ratios and profit margins can be utilized to analyze the value effects of changes in corporate strategy as well as the value of a 'brand name'.

Value to Sales Ratio

To analyze the relationship between value and sales, consider the value of a stable growth firm:

$$\text{Firm Value}_0 = \frac{\text{EBIT}_1(1-t)(1-\text{Reinvestment Rate})}{\text{Cost of Capital} - g_n}$$

Dividing both sides by the revenue, you get

$$\frac{\text{Firm Value}_0}{\text{Sales}} = \frac{(\text{EBIT}_1(1-t)/\text{Sales})(1-\text{Reinvestment Rate})}{\text{Cost of Capital} - g_n}$$

$$\frac{\text{Firm Value}_0}{\text{Sales}} = \frac{\text{After-tax Operating Margin}(1-\text{Reinvestment Rate})}{\text{Cost of Capital} - g_n}$$

Just as the price to sales ratio is determined by net profit margins, payout ratios and costs of equity, the value to sales ratio is determined by after-tax operating margins, reinvestment rates and the cost of capital. Firms with higher operating margins, lower

reinvestment rates (for any given growth rate) and lower costs of capital will trade at higher value to sales multiples.

This equation can be expanded to cover a firm in high growth by using a two-stage firm valuation model:

$$P_0 = \text{AT Oper Margin} \left[\frac{(1 - \text{RIR}) * (1 + g) * \left(1 - \frac{(1 + g)^n}{(1 + k_{c, \text{hg}})^n} \right)}{k_{c, \text{hg}} - g} \right] + \text{AT Oper Margin}_n \left[\frac{(1 - \text{RIR}_n) * (1 + g)^n * (1 + g_n)}{(k_{c, \text{st}} - g_n)(1 + k_{c, \text{hg}})^n} \right]$$

where


AT Oper Margin = After-tax operating margin (AT Oper Margin_n is stable period margin)

RIR = Reinvestment Rate (RIR_n is for stable growth period)

k_c = Cost of capital (in high growth and stable growth periods)

g = Growth rate in operating income in high growth and stable growth periods

Note that the determinants of the value to sales ratio remain the same as they were in the stable growth model – the growth rate, the reinvestment rate, the operating margin and the cost of capital – but the number of estimates increases to reflect the existence of a high growth period.

 [firmmult.xls: This spreadsheet allows you to estimate the value to sales ratio for a stable growth or high growth firm, given its fundamentals.](#)

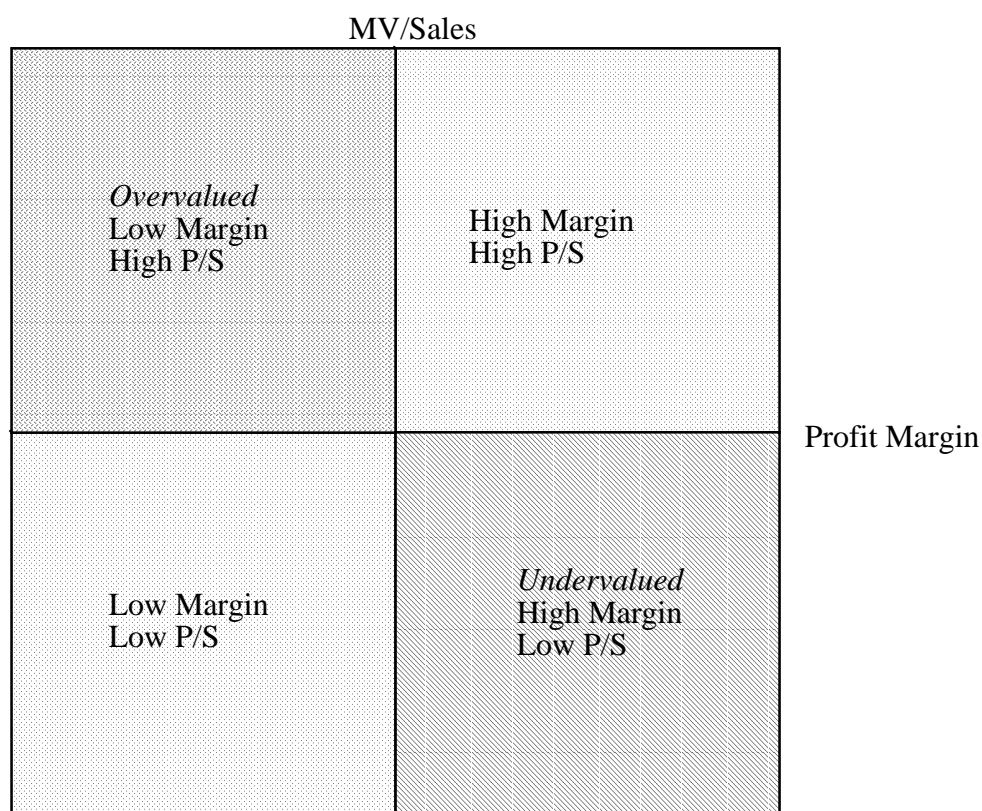
Using Revenue Multiples in Analysis

The key determinants of the revenue multiples of a firm are its expected margins (net and operating), risk, cashflow and growth characteristics. To use revenue multiples in analysis and to make comparisons across firms, you would need to control for differences on these characteristics. In this section, you examine different ways of comparing revenue multiples across firms.

Looking for Mismatches

While growth, risk and cash flow characteristics affect revenue multiples, the key determinants of revenue multiples are profit margins – net profit margin for equity multiples and operating margins for firm value multiples. Thus, it is not surprising to find firms with low profit margins and low revenue multiples, and firms with high profit margins and high revenue ratios. However, firms with high revenue ratios and low profit margins as well as firms with low revenue multiples and high profit margins should attract investors' attention as potentially overvalued and undervalued securities respectively. In figure 10.3, this is presented in a matrix:

Figure 10.3: Value/Sales and Margins



You can identify under or over valued firms in a sector or industry by plotting them on this matrix, and looking for potential mismatches between margins and revenue multiples.

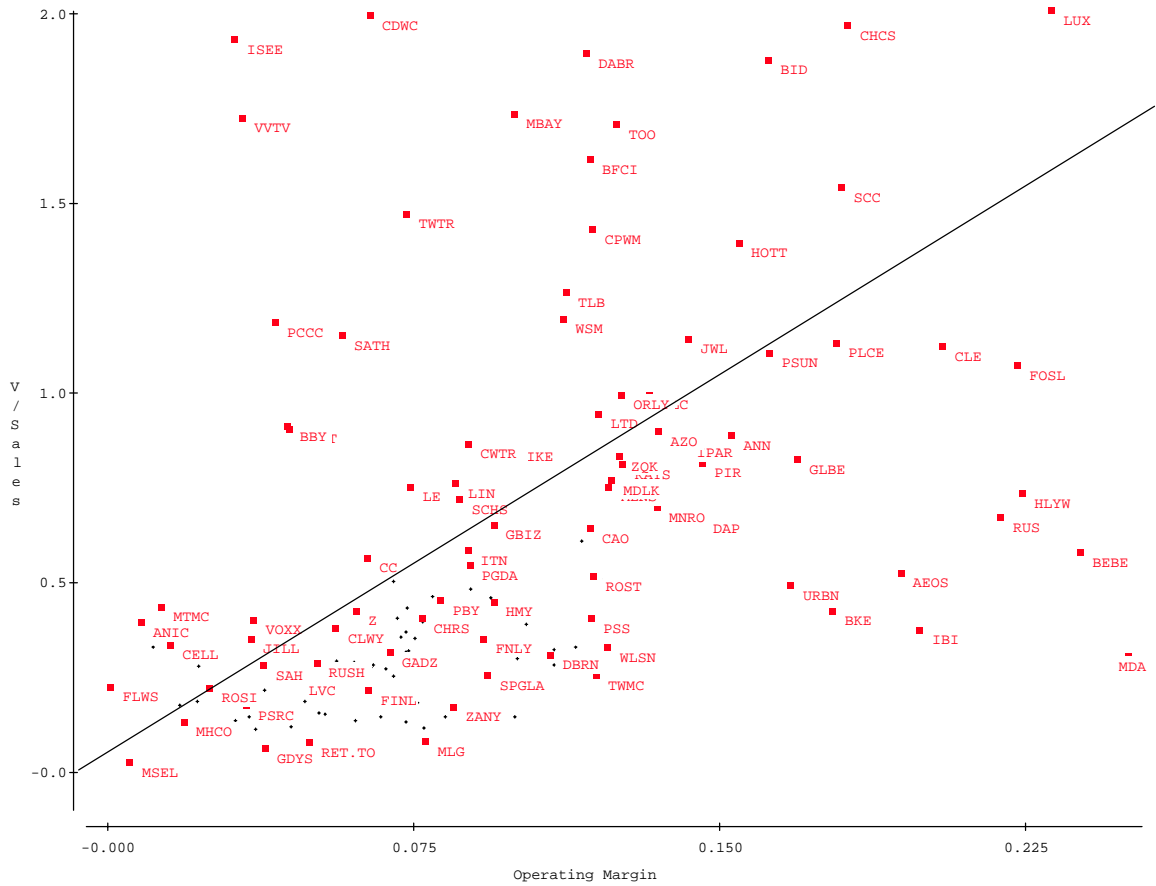
While intuitively appealing, there are at least three practical problems associated with this approach. The first is that data is more easily available on historical (current)

profit margins than on expected profit margins. If a firm's current margins are highly correlated with future margins – a firm that has earned high margins historically will continue to do so, and one that have earned low margins historically will also continue to do so – using current margins and current revenue multiples to identify under or over valued securities is reasonable. If the current margins of firms are not highly correlated with expected future margins, it is no longer appropriate to argue that firms are over valued just because they have low current margins and trade at high price to sales ratios. The second problem with this approach is that it assumes that revenue multiples are linearly related to margins. In other words, as margins double, you would expect revenue multiples to double as well. The third problem is that it ignores differences on other fundamentals, especially risk. Thus, a firm that looks under valued because it has a high current margin and is trading at a low multiple of revenues may in fact be a fairly valued firm with very high risk.

Illustration 10.4: Revenue Multiples and Margins: Specialty Retailers

In the first comparison, you look at specialty retailers with positive earnings in the most recent financial year. In figure 10.4 below, the value to sales ratios of these firms are plotted against the operating margins of these firms (with the stock symbols for each firm next to each observation):

Figure 10.4: Value to Sales Ratios and Operating Margins

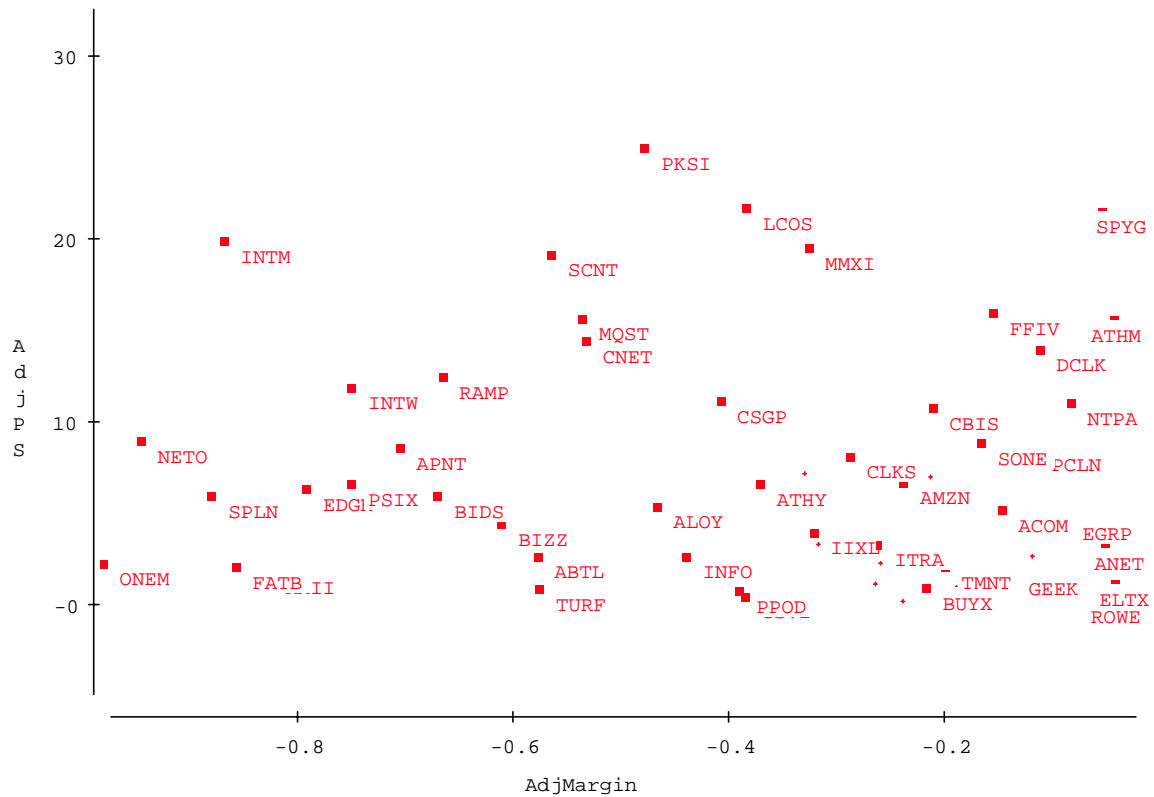


Firms with higher operating margins tend to have higher value to sales ratios, while firms with lower margin have lower value to sales ratios. Note, though, that there is a considerable amount of noise even in this sub-set of firms in the relationship between value to sales ratios and operating margins.

Illustration 10.5: Revenue Multiples and Margins: Internet Retailers

In the second comparison, the price to sales ratios of internet retailers are plotted against the net margins earned by these firms in the most recent year in figure 10.5:

Figure 10.5: Price to Sales Ratios versus Net Margins: Internet Stocks



Here, there seems to be almost no relationship between price to sales ratios and net margins. This should not be surprising. Most internet firms have negative net income and net margins. The market values of these firms are based not upon what they earn now but what they are expected to earn in the future, and there is little correlation between current and expected future margins.

Statistical Approaches

When analyzing price earnings ratios, you used regressions to control for differences in risk, growth and payout ratios across firms. You could also use regressions to control for differences across firms to analyze revenue multiples. In this section, you begin by applying this approach to comparables defined narrowly as firms in the same business, and then expanded to cover the entire sector and the market.

A. Comparable Firms in the Same Business

In the last section, you examined firms in the same business looking for mismatches – firms with high margins and low revenue multiples were viewed as under valued. In a simple extension of this approach, you could regress revenue multiples against profit margins across firms in a sector:

$$\text{Price to Sales Ratio} = a + b (\text{Net Profit Margin})$$

$$\text{Value to Sales Ratio} = a + b (\text{After-tax Operating Margin})$$

These regressions can be used to estimate predicted values for firms in the sample, helping to identify under and over valued firms.

If the number of firms in the sample is large enough to allow for it, this regression can be extended to add other independent variables. For instance, the standard deviation in stock prices or the beta can be used as an independent variable to capture differences in risk, and analyst estimates of expected growth can control for differences in growth. The regression can also be modified to account for non-linear relationships between revenue multiples and any or all of these variables.

Can this approach be used for sectors such as the internet where there seems to be little or no relationship between revenue multiples and fundamentals? It can, but only if you adapt it to consider the determinants of value in these sectors.

Illustration 10.6: Regression Approach – Specialty Retailers

Consider again the scatter plot of value to sales ratios and operating margins for retailers in illustration 10.4. There is clearly a positive relationship and a regression of value to sales ratios against operating margins for specialty retailers yields the following:

$$\text{Value to Sales Ratio} = 0.0563 + 6.6287 \text{ After-tax Operating Margin} \quad R^2 = 39.9\%$$

- (10.39)

This regression has 162 observations and the t statistics are reported in brackets. To estimate the predicted value to sales ratio for Talbots, one of the specialty retailers in the group, which has a 11.22% after-tax operating margin:

$$\text{Predicted Value to Sales Ratio} = 0.0563 + 6.6287(.1122) = 0.80$$

With an actual value to sales ratio of 1.27, Talbot's can be considered over valued.

This regression can be modified in two ways. One is to regress the value to sales ratio against the $\ln(\text{operating margins})$ to allow for the non-linear relationship between the two variables:

$$\text{Value to Sales Ratio} = 1.8313 + 0.4339 \ln(\text{After-tax Operating Margin}) \quad R^2 = 22.40\% \\ (10.76) \quad (6.89)$$

The other is to expand the regression to include proxies for risk and growth:

$$\text{Value to Sales} = -0.6209 + 7.21 (\text{At Op Mgn}) - 0.0209 \sigma_{\text{OpInc}} + 3.1460 \text{Growth}$$

Where

AT Op Mgn = After-tax operating margin

σ_{OpInc} = Standard deviation in operating income over previous 5 years

Growth = Expected Growth Rate in earnings over next 5 years

This regression has fewer observations (124) than the previous two but a higher R squared of 50.09%. The predicted value to sales ratio for Talbot's using this regression is:

$$\text{Predicted Value to Sales} = -0.6209 + 7.21 (.1122) - 0.0209 (.7391) + 3.1460 (.225) \\ = 0.88$$

Talbot's remains over valued even after adjusting for differences in growth and risk.

Illustration 10.7: Regression Approach – Internet Retailers

In the case of the internet stocks graphed in illustration 10.5, the regression of price to sales ratios against net margins yields the following:

$$\text{Price to Sales Ratio} = 44.4495 - 0.7331 (\text{Net Margin}) \quad R^2 = 0.22\%$$

Not only is the R-squared close to zero, the relationship between current net margins and price to sales ratios is negative. There is little relationship between the pricing of these stocks and their current profitability.

What variables might do a better job of explaining the differences in price to sales ratios across internet stocks? Consider the following propositions.

- Since this sample contains some firms with very little in revenues and other firms with much higher revenues, you would expect the firms with less in revenues to trade at a much higher multiple of revenues than firms with higher revenues. Thus, Amazon with revenues of almost \$ 2 billion can be expected to trade at a lower multiple of this value than iVillage with revenues of less than \$ 60 million.
- There is a high probability that some or many of these internet firms will not survive because they will run out of cash. A widely used measure of this potential for cash problems is the cash burn ratio, which is the ratio of the cash balance to the EBITDA (usually a negative number). Firms with a low cash burn ratio are at higher risk of running into a cash crunch and should trade at lower multiples of revenues.
- Revenue growth is a key determinant of value at these firms. Firms that are growing revenues more quickly are likely to reach profitability sooner, other things remaining equal.

The following regression relates price to sales ratios to the level of revenues ($\ln(\text{Revenues})$), the cash burn ratio (Absolute value of Cash/EBITDA) and revenue growth over the last year for internet firms:

$$\text{Price to Sales Ratio} = 37.18 - 4.34 \ln(\text{Revenue}) + 0.75 (\text{Cash/EBITDA}) + 8.37 \text{Growth}_{\text{Rev}}$$

$$(1.85) \quad (0.95) \qquad (4.18) \qquad (1.06)$$

The regression has 117 observations and an R-squared of 13.83%. The coefficients all have the right signs, but are of marginal statistical significance. You could obtain a predicted price to sales ratio for Amazon in this regression of:

$$\text{PS}_{\text{Amazon}} = 37.18 - 4.34 \ln(1,920) + 0.75 (2.12) + 8.37 (1.4810) = 18.34$$

At its actual price to sales ratio of 6.69, Amazon looks significantly under valued relative to other internet firms.

For Ariba, a similar analysis would yield

$$PS_{\text{Ariba}} = 37.18 - 4.34 \ln(92.5) + 0.75 (6.36) + 8.37 (1.2694) = 32.91$$

At its actual price to sales ratio of 247.91, Ariba looks significantly over valued relative to other internet firms.

In either case, the regressions are much too noisy to attach much weight to the predictions. In fact, the low explanatory power with fundamentals and the huge differences in measures of relative value should sound a note of caution on the use of multiples in sectors such as this one, where firms are in transition and changing dramatically from period to period.

B. Market Regressions

If you can control for differences across firms using a regression, you can extend this approach to look at much broader cross sections of firms. Here, the cross-sectional data is used to estimate the price to sales ratio as a function of fundamental variables - profit margin, dividend payout, beta and growth rate in earnings.

Consider first the technology sector. Regressing the price to sales ratio against net margins, growth rate in earnings, payout ratios and betas in July 2000 yields the following result:

$$PS = -8.48 + 30.37 (\text{Net Margin}) + 20.98(\text{Growth Rate}) + 4.68 \text{Beta} + 3.79 \text{Payout}$$

(7.19) (10.2) (10.0) (4.64) (0.85)

There are 273 observations in this regression and the R-squared is 53.8%.

This approach can be extended to cover the entire market. In Damodaran (1994), regressions of price-sales ratios on fundamentals - dividend payout ratio, growth rate in earnings, profit margin and beta - were run for each year from 1987 to 1991.

<i>Year</i>	<i>Regression</i>	<i>R squared</i>
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1987	PS = 0.7894 + .0008 PAYOUT - 0.2734 BETA + 0.5022 EGR + 6.46 MARGIN	0.4434
1988	PS = 0.1660 + .0006 PAYOUT - 0.0692 BETA + 0.5504 EGR + 10.31 MARGIN	0.7856
1989	PS = 0.4911 + .0393 PAYOUT - 0.0282 BETA + 0.2836 EGR + 10.25 MARGIN	0.4601
1990	PS = 0.0826 + .0105 PAYOUT - 0.1073 BETA + 0.5449 EGR + 10.36 MARGIN	0.8885
1991	PS = 0.5189 + 0.2749 PAYOUT - 0.2485 BETA + 0.4948 EGR + 8.17 MARGIN	0.4853

where,

PS = Price /Sales Ratio at the end of the year

MARGIN = Profit Margin for the year = Net Income / Sales for the year (in %)

PAYOUT = Payout Ratio = Dividends / Earnings ... at the end of the year

BETA = Beta of the stock

EGR = Earnings Growth rate over the previous five years

This regression is updated for the entire market in July 2000 and presented below:

$$PS = -2.36 + 17.43 (\text{Net Margin}) + 8.72(\text{Growth Rate}) + 1.45 \text{Beta} + 0.37 \text{Payout}$$

(16.5) (35.5) (23.9) (10.1) (3.01)

There are 2235 observations in this regression and the R-squared is 52.5%.

The regression can also be run in terms of the value to sales ratio, with the operating margin, standard deviation in operating income and reinvestment rate used as independent variables:

$$VS = -1.67 + 8.82 (\text{Operating Margin}) + 7.66(\text{Growth Rate}) + 1.50 \sigma_{oi} + 0.08 \text{RIR}$$

(14.4) (30.7) (19.2) (8.35) (1.44)

This regression also has 2235 observations but the R-squared is slightly lower at 42%.

Illustration 10.8: Valuing Cisco and Motorola using Sector and Market Regressions

These sector and market regressions can be used to estimate predicted price to sales ratios for Cisco and Motorola. In the following table, the values of the independent variables are reported for both firms:

	<i>Cisco</i>	<i>Motorola</i>
Net Margin	17.25%	2.64%
Expected Growth Rate (Analyst projection over 5 years)	36.39%	21.26%
Beta	1.43	1.21
Payout Ratio	0	35.62%

Using these values, you can estimate predicted price to sales ratios for the two firms from the sector regression:

$$PS_{\text{Cisco}} = -8.48 + 30.37 (.1725) + 20.98(.3639) + 4.68 (1.43) + 3.79 (0) = 11.09$$

$$PS_{\text{Motorola}} = -8.48 + 30.37 (.0264) + 20.98(.2126) + 4.68 (1.21) + 3.79 (0.3562) = 3.79$$

You can also estimate predicted price to sales ratios from the market regression:

$$PS_{\text{Cisco}} = -2.36 + 17.43 (.1725) + 8.72(.3639) + 1.45 (1.43) + 0.37 (0) = 5.89$$

$$PS_{\text{Motorola}} = -2.36 + 17.43 (.0264) + 8.72(.2126) + 1.45 (1.21) + 0.37 (0.3562) = 1.84$$

Cisco at its existing price to sales ratio of 27.77 looks significantly over valued relative to both the market and the technology sector. In contrast, Motorola with a price to sales ratio of 2.27 is slightly over valued relative to the rest of the market, but is significantly under valued relative to other technology stocks.

Sector-specific Multiples

The value of a firm can be standardized using a number of sector specific multiples. For new technology firms, these can range from value per subscriber for internet service providers to value per web site visitor for internet portals to value per customer for internet retailers. While these sector specific multiples allow analysts to compare firms for which other multiples cannot even be estimated, they can result in

tunnel vision where analysts focus on comparing the values of these multiples narrowly across a few firms in a sector and lose perspective on true value.

Definitions of Sector-specific Multiples

For internet service providers (such as AOL) or information providers (such as TheStreet.com) that rely on subscribers for their revenues, the value of a firm can be stated in terms of the number of subscribers:

$$\text{Value per Subscriber} = \frac{(\text{Market Value of Equity} + \text{Market Value of Debt})}{\text{Number of Subscribers}}$$

For retailers such as Amazon that generate revenue from customers who shop at their site, the value of the firm can be stated in terms of the number of regular customers:

$$\text{Value per Customer} = \frac{(\text{Market Value of Equity} + \text{Market Value of Debt})}{\text{Number of Customers}}$$

For internet portals that generate revenue from advertising revenues that are based upon traffic to the site, the revenues can be stated in terms of the number of visitors to the site:

$$\text{Value per Site Visitor} = \frac{(\text{Market Value of Equity} + \text{Market Value of Debt})}{\text{Number of Visitors/Site}}$$

These are all multiples that can be estimated only for the sub-set of firms for which such statistics are maintained, and are thus sector-specific.

Determinants of Value

What are the determinants of value for these sector-specific multiples? Not surprisingly, they are the same as the determinants of value for other multiples – cash flows, growth and risk – though the relationship can be complex. The fundamentals that drive these multiples can be derived by going back to a discounted cash flow model stated in terms of these sector-specific variables.

Consider an internet service provider that has NX existing subscribers, and assume that each subscriber is expected to remain with the provider for the next n years. In addition, assume that the firm will generate net cash flows per customer (Revenues

from each customer – Cost of serving the customer) of CFX per year for these n years¹.

The value of each existing customer to the firm can then be written as:

$$\text{Value per customer} = VX = \sum_{t=1}^{t=n} \frac{CFX}{(1+r)^t}$$

The discount rate used to compute the value per customer can range from close to the riskless rate, if the customer has signed a contract to remain a subscriber for the next n years, to the cost of capital, if the estimate is just an expectation based upon past experience.

Assume that the firm expects to continue to add new subscribers in future years and that the firm will face a cost (advertising and promotion) of C_t for each new subscriber added in period t. If the new subscribers (ΔNX_t) added in period t will generate the a value VX_t per subscriber, the value of this firm can be written as:

$$\text{Value of Firm} = NX * VX + \sum_{t=1}^{t=\infty} \frac{\Delta NX_t (VX_t - C_t)}{(1+k_c)^t}$$

Note that the first term in this valuation equation represents the value generated by existing subscriber, and that the second is the value of expected growth. The subscribers added generate value only if the cost of adding a new subscriber (C_t) is less than the present value of the net cash flows generated by that subscriber for the firm.

Dividing both sides of this equation by the number of existing subscribers (NX) yields the following:

$$\text{Value per existing subscriber} = \frac{\text{Value of Firm}}{NX} = VX + \frac{\sum_{t=1}^{t=\infty} \frac{\Delta NX_t (VX_t - C_t)}{(1+k_c)^t}}{NX}$$

In the most general case, then, the value of a firm per subscriber will be a function not only of the expected value that will be generated by existing subscribers, but by the

¹ For purposes of simplicity, it has been assumed that the cash flow is the same in each year. This can be generalized to allow cash flows to grow over time.

potential for value creation from future growth in the subscriber base. If you assume a competitive market, where the cost of adding new subscribers (C_t) converges on the value that is generated by that customer, the second term in the equation drops out and the value per subscriber becomes just the present value of cash flows that will be generated by each existing subscriber.

Value per existing subscriber $C=VX = VX$

A similar analysis can be done to relate the value of an internet retailer to the number of customers it has, though it is generally much more difficult to estimate the value that will be created by a customer. Unlike subscribers who pay a fixed fee, retail customers buying habits are more difficult to predict.

In either case, you can see the problems associated with comparing these multiples across firms. Implicitly, you either have to assume competitive markets, and conclude that the firms with the lowest market value per subscriber are the most under valued. Alternatively, you have to assume that the value of growth is the same proportion of the value generated by existing customers for all of the firms in your analysis, leading to the same conclusion.

Value can also be related to the number of site visitors, but only if the link between revenues and the number of site visitors is made explicit. For instance, if an internet portal's advertising revenues are directly tied to the number of visitors at its site, the value of the internet portal can be stated in terms of the number of visitors to the site. Since sites have to spend money (on advertising) to attract visitors, it is the net value generated by each visitor that ultimately determines value.

Illustration 10.9: Estimating the Value per Subscriber: Internet Portal

Assume that you are valuing GOL, an internet service provider with 1 million existing subscribers. Each subscriber is expected to remain for 3 years, and GOL is expected to generate \$ 100 in net after-tax cash flow (Subscription revenues – Costs of

providing subscription service) per subscriber each year. GOL has a cost of capital of 15%. The value added to the firm by each existing subscriber can be estimated as follows:

$$\text{Value per subscriber} = \sum_{t=1}^{t=3} \frac{100}{(1.15)^t} = \$ 228.32$$

Value of existing subscriber base = \$ 228.32 million

Furthermore, assume that GOL expects to add 100,000 subscribers each year for the next 10 years, and that the value added by each subscriber will grow from the current level (\$228.32) at the inflation rate of 3% every year. The cost of adding a new subscriber is \$ 100 currently, assumed to be growing at the inflation rate.

Table 10.3: Value Added by New Subscribers

<i>Year</i>	<i>Value added/Subscriber</i>	<i>Cost of acquiring subscriber</i>	<i>Number of subscribers added</i>	<i>Present Value at 15%</i>
1	\$ 235.17	\$ 103.00	100,000	\$ 11,493,234
2	\$ 242.23	\$ 106.09	100,000	\$ 10,293,940
3	\$ 249.49	\$ 109.27	100,000	\$ 9,219,789
4	\$ 256.98	\$ 112.55	100,000	\$ 8,257,724
5	\$ 264.69	\$ 115.93	100,000	\$ 7,396,049
6	\$ 272.63	\$ 119.41	100,000	\$ 6,624,287
7	\$ 280.81	\$ 122.99	100,000	\$ 5,933,057
8	\$ 289.23	\$ 126.68	100,000	\$ 5,313,956
9	\$ 297.91	\$ 130.48	100,000	\$ 4,759,456
10	\$ 306.85	\$ 134.39	100,000	\$ 4,262,817
				\$ 73,554,309

The cumulative value added by new subscribers is \$73.55 million. The total value of the firm is the sum of the value generated by existing customers and the value added by new customers:

Value of Firm = Value of existing subscriber base + Value added by new customers

$$= \$ 228.32 \text{ million} + \$ 73.55 \text{ million} = \$ 301.87 \text{ million}$$

Value per existing subscriber = Value of Firm/ Number of subscribers

$$= \$ 301.87 \text{ million} / 1 \text{ million} = \$ 301.87 \text{ per subscriber}$$

Note, though, that a portion of this value per subscriber is attributable to future growth. As the cost of acquiring a subscriber converges on the value added by each subscriber, the value per subscriber will converge on \$228.32.

Analysis using Sector-Specific Multiples

To analyze firms using sector-specific multiples, you have to control for the differences across firms on any or all of the fundamentals that you identified as affecting these multiples in the last part.

With value-per –subscriber, you have to control for differences in the value generated by each subscriber. In particular -

- Firms that are more efficient in delivering a service for a given subscription price (resulting in lower costs) should trade at a higher value per subscriber than comparable firms. This would also apply if a firm has significant economies of scale. In illustration 10.9 above, the value per subscriber would be higher if each existing subscriber generated \$ 120 in net cash flows for the firm each year instead of \$ 100.
- Firms that can add new subscribers at a lower cost (advertising and promotion) should trade at a higher value per subscriber than comparable firms.
- Firms with higher expected growth in the subscriber base (in percentage terms) should trade at a higher value per subscriber than comparable firms

You could make similar statements about value-per-customer.

With value per site visitor, you have to control for the additional advertising revenue that is generated by each visitor – the greater the advertising revenue, the higher the value per site visitor – and the cost of attracting each visitor – the higher the costs, the lower the value per site visitor.

Illustration 10.10: Comparing Value per Site Visitor

In table 10.4, the market value per site visitor is presented for internet firms that generate the bulk of their revenues from advertising. The number of visitors per site was from July 1, 2000 to July 31, 2000 and the market value is as of July 31, 2000:

Table 10.4: Value per Visitor

<i>Company Name</i>	<i>Firm Value</i>	<i>Visitors</i>	<i>Value per visitor</i>
Lycos, Inc.	\$ 5,396.00	5,858	\$ 0.92
MapQuest.com Inc	\$ 604.80	6,621	\$ 0.09
iVillage Inc	\$ 250.40	7,346	\$ 0.03
CNET Networks	\$ 1,984.30	10,850	\$ 0.18
Ask Jeeves Inc	\$ 643.50	11,765	\$ 0.05
Go2Net Inc	\$ 1,468.60	12,527	\$ 0.12
LookSmart, Ltd.	\$ 1,795.30	13,374	\$ 0.13
About.com Inc	\$ 541.90	18,282	\$ 0.03
Excite@Home	\$ 7,008.20	27,115	\$ 0.26
Yahoo! Inc.	\$ 65,633.40	49,045	\$ 1.34

Source: Media Metrix

Note the differences in value per site visitor across Yahoo, Excite and Lycos. Excite looks much cheaper than either of the other two firms, but the differences could also be attributable to differences across the firms on fundamentals. It could be that Yahoo earns more in advertising revenues than

Conclusion

The price to sales multiple and value to sales are widely used to value technology firms and to compare value across these firms. An analysis of the fundamentals highlights the importance of profit margins in determining these multiples, in addition to the standard variables - the dividend payout ratio, the required rate of return and the expected growth rates for price to sales, and the reinvestment rate and risk for value to sales.

Comparisons of revenue multiples across firms have to take into account differences in profit margins. One approach is to look for mismatches – low margins and high revenue multiples suggesting over valued firms and high margins and low revenue multiples suggesting under valued firms. Another approach that controls for differences in fundamentals is the cross-sectional regression approach, where revenue multiples are regressed against fundamentals across firms in a business, an entire sector or the market

Sector-specific multiples relate value to sector specific variables but they have to be used with caution. It is often difficult to compare these multiples across firms without making stringent assumptions about their operations and growth potential.