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VALUATION DEVELOPMENTS

NEW ISSUES IN TECHNOLOGY VALUATION

About This Article

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Valuing Early-Stage Technologies

Generating an appropriate value for an early-stage company is important because it provides the basis to allocate ownership interests to investors.

Early-stage companies are young companies, perhaps based on novel concepts, technologically focused, that generate sometimes significant negative early cash flows followed by large exit events. Early stage valuation is both important and difficult. In many cases, a company will not have the desire or ability to provide all of the financial resources it needs to commercialize an early stage concept. To fill the gap, the company looks to the capital markets for funding, usually through some form of equity financing. Companies generally get this funding from angel investors (angels) or venture capital investors (VCs) depending on the current state of the subject company. It is crucial for an early stage company to know its value in order to raise capital from these funding sources.

Problems in the Dot-Com Era

Before exploring valuation methods, it is important to look at problems with recent early-stage valuations. There are many important lessons for valuing early-stage companies one can find in the technology boom between 1996 and 2000, also known as the dot-com era. It is important to understand what went wrong during that era in the context of early stage valuations because it can change the value development approach one uses for a given assignment.

One of the first problems is that angels and VCs followed the advice of analysts who concocted new valuation measures that were fundamentally flawed. These analysts stated that the then current metrics and valuation methods, such as fundamental valuation analysis, no longer worked in the new economy.[1] Unfortunately, academics and independent analysts did not validate the new valuation methods. The studies conducted occurred after the fact, when there was general availability of data. Instead of academic studies, investment bankers, analysts and others with stakes in the outcomes (such as contingent fees paid on successful deal financing) proffered these new valuation methods. They offered new relative valuation metrics such as eyeballs or clicks on a web page as a means to generating massive valuations. The reasoning almost seems logical. Consider the following example.

Company X generates 2 million visits per month on its website and 10% of those visitors make an average $10 purchase. Company X generates $2 million per

[1]See Clark and Neill, *netValue: Valuing Dot-Com Companies—Uncovering the Reality behind the Hype*, (Amacom, 2001), p. 23, 33

month in sales and has a market value of $240 million. Company X thus has a value of $10 per eyeball.

$240M market value / (2M eyeballs per month x 12 months)

Company Y figures that, with the proper advertising and viral marketing, it will generate 5 million visits per month. Using Company X as a proxy for its own expected performance, and at $10 per eyeball for 60 million eyeballs per year, Company Y would have a valuation of $600 million. Suppose that Company Y figures that it will close those visitors with revenue per eyeball of $20, expecting higher sales performance to the Company X because of Company Y's superior website format. Company Y would then have a market valuation of $1.2 billion. At the height of the dot com boom, this type of analysis may have represented the bulk of the due diligence performed from a value perspective. Coupled with the documented conflicts of interest among analysts, public accountants, and investment bankers, it becomes easy to see how such methods persisted for as long as they did.

Early-stage analysts employed such methods regularly even though there were many problems with these approaches. First, there was little published analysis to correlate the buyers and sellers for various goods and services with retailers. Just because Amazon.com was successful selling books on the internet, it did not mean that Webvan.com would be successful selling groceries (it was not). Product timing needs were different; the distribution infrastructure was grossly different (books would not spoil, but produce would); and the margins were different (much higher for books versus retail grocery sales). Valuation analysts did not consider such correlations and the impact of these correlations on value. At one point, the market valued Webvan at $1.2 billion. That is phenomenal except for the fact that Webvan shuttered its operations in July 2001 after being in business an entirety of 18 months.[2] While the loss of Webvan as an entity erased some $1.2 billion in so-called value, that value was dubious to begin with. Without significant confirming research, it cannot be assumed that what works for Amazon.com also correlates to another concept.

Just because Amazon.com was successful selling books on the internet, it did not mean that Webvan.com would be successful selling groceries (it was not).

Second, the types of buyers who enter the market vary with where the early-stage concept is in the product life cycle. Buyers after a product launch are different from the early adopters, and there are different motivations for a buy. Early adopters will buy at higher prices and cause a given technology's revenues to grow faster in the early-stage. This allows the technology owner to price skim, which is common for products early in the product development life cycle.[3] However, later-stage buyers are cost conscious. They will shop for the best deal, which depresses per-unit revenues. In these cases, it is unreasonable to expect that the prices would stay the same or go higher, especially when competitive forces enter into the pricing equation. It is common for prices to lower as competitive market forces

[2] See German, "Top 10 dot-com flops," CNET.com, available at http://www.cnet.com/4520-11136_1-6278387-1.html

[3] See Kotler, *Marketing Management, Eleventh Edition*, (Prentice Hall, 2003), p. 474

impact the technology in the market. Empirically, this behavior is consistent in the markets for everything from medical devices to cellular telephone services.

These new valuation methods were not revolutionary, nor did they turn the valuation world on its ear. What this did in fact create was a massive disconnect between potential and reality. In fact, one study indicated that earnings from dot-com-era companies accounted for only 3% of the company's market value.[4] Another reference noted that the market viewed companies with larger losses as more valuable.[5] The market reasoned that companies losing less were not investing enough in R&D for the future. Statements of Financial Accounting Standards (SFAS) 2 and SFAS 86 perpetuated the appeal of larger losses with the over expensing of routine product development costs that companies should have otherwise capitalized. The market corrected in a tremendous way. As seen by one group of authors, analysts retreated from these valuation methods: "Although scenario-based DCF many sound suspiciously retro, it works where other methods fail, since the elements of economics and finance apply even in unchartered territory."[6]

These new valuation methods were not revolutionary, nor did they turn the valuation world on its ear. What this did in fact create was a massive disconnect between potential and reality.

Values generated via fundamental analysis, given that it works where other methods fail, are likely closer to the intrinsic value of the technology in the long run. It appears that the market realizes this since it corrects to fundamental analysis in the long run.

Early-Stage Valuation Purpose

A primary reason to value early-stage technologies is for a company to know how much ownership to provide to an investor for a given funding commitment. Is it 1% of the company or 100%? The percentage is very important to the company and investor alike. The company wants to provide an equitable amount of ownership for the risk and size of the investment and no more. The investor wants to receive an equitable amount of ownership for the risk it bears in making the investment and no less.

The ownership percentage question is a function of the investment amount in relation to the post-money valuation. The post-money valuation is the pre-money valuation of the company plus the investment amount considered. The pre-money valuation is the value of the investment before the investor's capital is considered. It is the value that accrues to pre-money owners for their investment of time and dollars. It can represent knowledge and time investment, more commonly known as sweat equity, or it can include contributions such as equipment, property, or cash. Algebraically, the post-money valuation is as follows:

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[4] See Trueman et al, "The Eyeballs Have It: Searching for the Value in Internet Stocks," (University of California, Berkeley, 2000), p. 3

[5] See Koller, Goedhart, and Wessels, *Valuation: Measuring and Managing the Value of Companies*, (Wiley, 2005), p. 655

[6] *Id.*

Post-money valuation = Pre-money valuation + Investment amount

For example, suppose that a company wants to raise $1 million to commercialize an early-stage concept. If the pre-money valuation is $3 million, then the post-money valuation is $4 million.

If an investor provides $1 million in the example above, then the investor would theoretically require 25% ownership in the company ($1 million investment / $4 million post-money valuation). Consider the same example, but the pre-money valuation is $1 million. In this case, the investor would theoretically require 50% ownership in the company ($1 million investment / $2 million post-money valuation). The pre-money valuation thus becomes a very important in the financing of an early-stage company. Exhibit 1 demonstrates the impact of pre-money valuation on post-money ownership percentage that accrues to the investors.

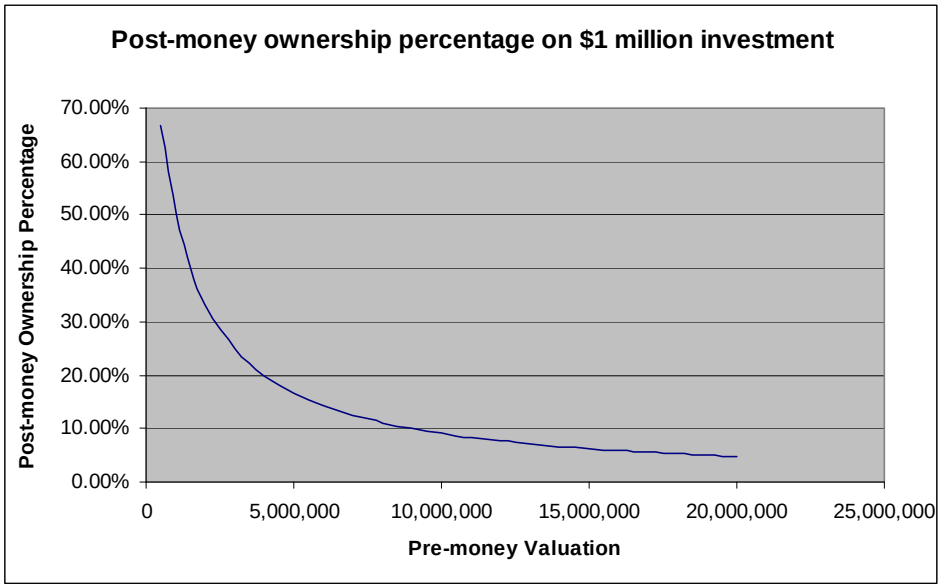

Exhibit 1 Pre-Money Valuation Impact on Post-Money Ownership Percentage

One of the main problems that companies face in the capital markets is presenting a credible pre-money valuation to angels and VCs. In the dot-com crash, angels and VCs lost billions investing in early-stage technology companies that marketed everything from online grocery shopping to pet supplies. In fact, more than 70% of the technology companies of the dot-com era that went through an initial public offering (IPO) between 1996 and first quarter 2000 went bankrupt.[7] Much of this had to do with the overvaluation of companies that had no business making an IPO in the first place on business models that lacked fundamental economic viability.

…more than 70% of the technology companies of the dot-com era that went through an initial public offering (IPO) …went bankrupt. Much of this had to do with the overvaluation of companies

[7] See Clark and Neill, *netValue: Valuing Dot-Com Companies—Uncovering the Reality behind the Hype*, (Amacom, 2001)

Valuation Methods

There are several common approaches to valuing early-stage technologies. These include the market approach, the cost approach, the income approach, the venture capital method, and the real options method. This article addresses all but the use of real options.

Market Approach

Using the market approach, an analyst looks for comparable transactions in the same industry and of the same relative size and form that recently occurred in the open market. The analyst determines value indirectly using the comparable transaction as a value proxy for target technology. The reasoning is logical: if the market paid $1 for a similar or like technology once, then one would expect that the market would reasonably pay a similar amount again, all things being equal.

In practice, valuation using the market approach is easy to calculate. For example, the property may generate $1 million of free cash flow, and the analyst uses a cash flow multiplier of eight, which makes the property worth $8 million. Valuation analysts use other multiplier factors commonly as well, and these factors are usually ratio-based. Once the analyst arrives at a value, he or she adjusts the property's value to account for identifiable differences, such as the market power of the comparable property to the property under valuation.

The problem is that the market approach does not work well for early-stage companies…the market is not rational.

The problem is that the market approach does not work well for early-stage companies. First, there is a presumption of existing revenues or sales, which early-stage companies do not have in most cases. Next, comparable circumstances do not exist. The comparable had a proven management team, existing customers, positive cash flow (usually), available working capital, and a host of other factors that dictated why the company sold for the price it did. Early-stage technologies do not have this.

Third, the market is not rational. While there is a general premise that investors behave in a rational manner, practically, this premise falls apart. Empirically, evidence supports the irrational behavior of markets, from tulip bulbs to technology companies. Investors are an emotional group who routinely enter the market with imperfect information and drive prices sky-high. That is why a company like Sonic Wall could have a P/E ratio of 8,675 in the dot-com bubble and a market valuation of $1.2 billion on earnings of $147,000. That is beyond irrational—it is insane and it grossly overstates the true value of a company. These same irrational investors panic and leave the market abruptly, thus abnormally depressing values, particularly for companies that are otherwise healthy.

Fourth, much of the comparable companies an analyst uses are publicly traded entities. However, comparisons to public companies are not appropriate since comparable circumstances do not exist. First, the price action of public companies, which is one factor that drives a firm's value, does not apply for private companies. Certain guideline companies may not have enough trading activity to generate meaningful results. In addition, interest in the entity may be different for

a small private company versus Microsoft, which has a large volume of daily trading. Again, the new company lacks cash flow, a proven product, the effects of market timing, etc. To use public companies as a comparable is a gross simplification of a complex market interaction.

Fifth, the market multiples ignore the portfolio income that a comparable company may generate. If the comparable company sells a comparable product to the early-stage company, but 50% of its revenues are from other sources such as services, then these multipliers do not account properly for the income mix. Further, many reporting entities do not segregate revenue and cost for specific technologies; thus, there is no meaningful way to make a comparison to a public entity. There simply is not enough detail in the financial numbers. All of these factors compound into errors that can misrepresent the value an early-stage technology in a material way.

Finally, the value standard for the market approach is generally not appropriate to the early-stage assignment. When using the market approach (or a hybrid market approach), one generally uses fair market value as the standard of value. Fair market value is the value at which the early-stage company could trade hands between a willing buyer and willing seller, both having access to relevant facts, neither being under compulsion to act. The problem is that there is no generalized market for early-stage companies and undeveloped ideas. There are no exchanges, markets, or clearinghouses where interested parties can buy and sell early-stage companies. Further, venture capital funds do not publish deal terms to establish some generalized market value.

… the value standard for the market approach is generally not appropriate to the early-stage assignment…there is no generalized market for early-stage companies…

Therefore, it is not appropriate to use the same value standard for a going concern implicit in a market multiple for an early-stage company. The appropriate value standard for an early-stage company is its intrinsic value. A rational investor should have no reason to invest in an early-stage concept at a value greater than its intrinsic value. To do so would abnormally depress returns for the investor and unjustly enrich existing ownership.

Despite the issues with market valuation techniques, analysts continue to look to these market techniques, usually with public companies, to value early-stage companies. It is easy to understand why—the calculation is simple. However, one should not expect a credible result from this approach.

Cost Approach

An analyst who values an early-stage concept using the cost approach looks at what it would cost to produce the concept, or what it would cost to reproduce the concept on a given effective date. The cost would include things like labor, materials, applied overhead, and capital charges. Depending on the effective date of the valuation, the analyst may trend costs from a historical reference point to the effective date. For example, if the concept owner has cost data from five years ago and wants a value using the cost approach in today's dollars, the analyst may grow the cost at the rate of inflation over those five years to arrive at the cost in today's

dollars. Once the analyst accumulates all factors of the cost, he or she adjusts the final tally for obsolescence to arrive at a final value opinion.

There are several methods to establish value using the cost approach. The first method is to use the reproduction cost new method. Under this method, the analyst looks to recreate the concept using the same or similar development methods and materials as the original effort. The reproduction cost new method does not account for changes in technology, higher utility from other materials, and other factors.

The second method is to use the replacement cost new method of the cost approach. Using this method, the analyst considers what it would take to recreate the concept, but the takes info account the impact of new technology and development methods on the concept recreation effort.

Once the analyst establishes value using the reproduction or replacement cost methods, he or she adjusts the value for obsolescence. Analysts consider four types of obsolescence factors. These factors include physical deterioration and functional, technological, and economic obsolescence.

The problem is that the cost approach rarely provides a credible valuation for an early-stage company, because the company's value is in what future income it will generate.

The problem is that the cost approach rarely provides a credible valuation for an early-stage company, because the company's value is in what future income it will generate. The company's value is not in what it invested to develop the company. For example, Nike paid Carolyn Davidson $35 in the 1971 to purchase the rights to the "swoosh" emblem that it puts on all its products.[8] That swoosh is worth substantially more than what it cost Nike to purchase it. Empirically, it is easy to see the value. Put a Nike swoosh on a golf club and the price of the golf club rises more than the $35 that Nike originally spent. Given that future income is what is important to potential investors, one generally will not use the cost approach for early-stage valuations.

Next, value using the cost approach can reward the wrong behavior. For example, the cost approach can reward inefficiency and penalize efficiency and creativity. A company expends $10 million in resources to generate a given technology has a value of $10 million. However, another company that generates the same exact technology for $1 million receives a lower value of $1 million, even though the result is the same. The cost approach thus emphasizes expenditures and investment instead of efficiency. Empirically, this was evident during the dot-com boom. Companies that lost larger sums were valued higher than companies that lost smaller sums.[9] Never mind the fact that the dot-com that lost more money and had a higher value is now bankrupt after wasting money on a Superbowl ad that generated no revenue, as opposed to the more fiscally prudent company still in existence today.

[8] See http://en.wikipedia.org/wiki/Carolyn_Davidson

[9] See Koller, Goedhart, and Wessels, *Valuation: Measuring and Managing the Value of Companies*, (Wiley, 2005), p. 655

Income Approach

An analyst using the income approach develops a value opinion based on the fundamental economics and factors included in business plans, marketing and operational inputs, and other external references. Using this method, the analyst projects the economic income generated solely from the early-stage technology over a discrete period, known as the remaining useful life (RUL), as well as any residual or perpetual value after the RUL. The income approach is the most principled, and it requires the most discipline and insight into value-creating features of the early-stage technology to complete.

An analyst performs an analysis of the business model for the technology and then builds a matching valuation model to determine the economic income for the technology. The analyst integrates revenues, expenses, and the capital requirements to develop the technology, accounting for the timing of each. Valuation analysts need to consider the following factors in this analysis:

- Current available market data and historical compound annual growth rates, and expected future unit sales.
- Direct costs associated with production activities.
- Expected revenues and production targets on a per-unit basis.
- Expected profit margins on a per-unit basis.
- Required operating expenses.
- Required working capital needs.
- Capital charges or economic rents.

The income approach is the most principled, and it requires the most discipline and insight into value-creating features of the early-stage technology to complete.

Using an appropriate discount rate, the analyst then discounts this economic income to the present value to arrive at a final value determination.

Alternatively, an analyst could arrive at a value by capitalizing some perpetual income stream using an appropriate capitalization rate. To do so requires the analyst to make simplifying assumptions that earnings are constant over the life of the early-stage concept. For example, the profit potential for an early-stage concept changes over time as it gains market acceptance. It generates early losses, followed by larger profits, before settling into steady lower profits and possible eventual losses. To assume a steady income state so early in the development stage is inappropriate as the simplifying assumption of constant earnings may materially affect the resulting value. Thus, analysts have to be careful about when to capitalize a perpetual income stream when valuing early-stage companies.

Venture Capital Approach

Dr. William Sahlman, a professor of business administration and senior associate dean for External Relations at Harvard University first published the venture capital method in 1987.[10] Sahlman based his approach on the premise that value to the

[10] See Sahlman, "A Method for Valuing High-Risk, Long-Term Investments," (Harvard Business Press, 1987)

investor is the present value of the early-stage company calculated at a successful exit event at some planned point in the future. It blends portions of the market approach with the income approach. The method borrows from the income approach in that it requires an analyst to build a set of projections centered on the business model for the early-stage company. The method borrows from the market approach in that it uses relative multiples of some factor such as sales or earnings against some projected future value. The product of the projected value and market multiple becomes the terminal value, which the analyst then discounts to the present value using an appropriate discount rate.

To determine value using the venture capital method, an analyst projects what the future revenues, expenses, and capital requirements for the early-stage company will be. From there, the analyst determines economic income at some given exit point, perhaps in the fifth or seventh year of the investment. The analyst takes some projected value such as sales or earnings in the exit year and multiples that value by an appropriate market multiple to determine what a terminal value could be for a success scenario for the subject technology.[11] If the technology were in an industry where there is little data in terms of historical financial performance or record of accomplishment, analysts may use price/sales multiples or price/gross profit multiples instead of a price/earnings multiple. In certain industries, analysts use other unique valuation metrics specific to that industry. For example, in the internet industry, analysts have used metrics such as market value per eyeball or acquisition cost per user.[12] Of course, in doing so, the analyst inherits many of the problems with using these relative valuation multipliers that were discussed in the introduction to the market approach. Once the analyst determines the terminal value, he or she discounts the terminal value to the present value using an appropriate discount rate. This present value thus becomes the value of the technology with liquidity and control.

To determine value using the venture capital method, an analyst projects what the future revenues, expenses, and capital requirements for the early-stage company will be.

To see the venture capital method in action, consider the example in Exhibit 2. An early-stage software company seeking investor capital needs a pre-money valuation. Using proforma after-tax earnings, a desired successful exit in year 5, a 19.188 median price/earnings multiple, the company generates a value in year 5 of $121,329,175. Discounting that amount to the present value using a 55.12%, risk-adjusted discount rate indicates a value of $13,509,249.

Valuing the same company using a price/sales multiple to calculate the terminal value yields a quite different value of $5,059,929 as seen in Exhibit 3. Value using price/earnings multiples in this case was 266% higher than the price/sales multiples.

Analysts would adjust the value to account for minority interest and illiquidity discounts as appropriate for the interest under consideration. In addition, analysts would also apply any other discounts as appropriate such as contractual discounts or premiums, or key person discounts.

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[11] *Id.,* p. 1.
[12] Note 4, *supra.*

Sample Software Company

Risk-Adjusted Discount Rate	55.12%
Median Price/earnings Multiple	19.188
Exit Event	Year 5

	Year 1	Year 2	Year 3	Year 4	Year 5
Projected After Tax Earnings	(178,065)	143,036	915,744	2,914,007	6,323,180
x Median P/E Multiple					x 19.188
Value in Terminal Year					121,329,175
Present value of terminal value	13,509,249				

Exhibit 2 Valuation Using Venture Capital Method and Earnings Multiples

Sample Software Company

Risk-Adjusted Discount Rate	55.12%
Median Price/sales Multiple	2.337
Exit Event	Year 5

	Year 1	Year 2	Year 3	Year 4	Year 5
Projected Sales	220,169	1,584,646	4,726,773	10,758,140	19,445,528
x Median P/S Multiple					x 2.337
Value in Terminal Year					45,444,199
Present value of terminal value	5,059,929				

Exhibit 3 Valuation Using Venture Capital Method and Sales Multiples

Critical Analysis

The venture capital method has its roots in fundamental analysis, because it requires an analyst to construct proforma financial projections. That is the good news. However, because the venture capital method also uses market approach methods to arrive at a terminal value, it inherits the same types of errors inherent in the market approach. This is the case regardless of whether the analyst uses equity price/sales, equity price/EBITDA, equity price/earnings, or other market multiple methods. Further, the venture capital method ignores interim economic benefits since it focuses entirely on the exit event. Thus, using the venture capital method, any dividends or other financial benefits that accrue before the exit have no explicit value impact.

Using market multiple valuation methods, there are several assumptions that an analyst makes that may not hold true, especially over time. First, an analyst should match market multiples to the purpose. If an analyst is valuing an early-stage concept in current terms, then the use of current market multiples may be appropriate. However, if an analyst is valuing an early-stage concept in the future,

then it is appropriate to use a forward market multiple. The problem is that sources for reliable forward market multiples is scarce. That leaves an analyst to use current multiples for future markets. Doing so is a simplifying assumption that can cause problems.

Next, analysts rarely have enough market multiples available in a given sample space for there to be any meaningful statistical confidence that the market multiples the analyst uses are appropriate. Ideally, the analyst would want 30 or more comparables in the sample space to use as a basis for determining a median market multiple, so that he or she can express some statistical confidence for the market multiples used. Empirically, it is common that analysts use market multiples derived from a sample size that contains fewer than 30 comparables. This affects the credibility of the value determination.

Consider an example of an early-stage orthopedic company that will manufacture an implantable knee. The company falls within the standard industry classification (SIC) code 3842 (Orthopedic, Prosthetic, and Surgical Appliances and Supplies). A quick search of comparable transactions using *Pratt's Stats* yields six transactions between 1/1/04 and 12/31/06. Factoring out transactions that are not knee-focused, or even implant-focused, there are two transactions available in the sample space. Obviously, there are few transactions in the sample space and certainly not enough to generate statistically significant results for valuation multiples. Broadening the transaction set to all transactions in the database yielded a maximum of 20 comparables; however, most of those comparables did not apply to the knee or were not implant-focused. The fact that there are so few comparables is common across many industries, not just orthopedics. However, how can an analyst possibly rely on the availability so few comparables to generate a value with any form of statistical significance? The bottom line is that it is not possible.

In the end, empirical analysis of this method yields that the venture capital and market-based methods consistently value similar early-stage companies higher, by a significant margin

This issue of statistical significance also applies to other discount and premium calculations as well, such as pre-IPO and control premium studies. In many cases, there are simply not enough transactions in the sample space (i.e., orthopedics) to generate statistically significant results without looking to the broader market (i.e., all companies). A detailed critical discussion of the statistical significance of these studies on an industry basis is outside the scope of this article.

Further, usage of market multiples assumes that market conditions remain constant; that profits grow at a constant rate; that the useful lives of the technologies are the same; that companies have the same operating and capital characteristics; that earnings are not manipulated; that synergistic value is identical at the time of the acquisition and the exit event; and other facts. These simplifying assumptions introduce a large amount of uncertainty in the final value. In the end, empirical analysis of this method yields that the venture capital and market-based methods consistently value similar early-stage companies higher, by a significant

Year	1999	2004	% difference
Number of Transactions	169	99	
Median Equity Price/Sales	3.457	1.308	-62.16%
Median Equity Price/Gross Cash Flow	23.552	16.761	-28.83%
Median Equity Price/EBT	17.722	14.617	-17.52%
Median Equity Price/Net Income	29.592	19.966	-32.53%
Median Equity Price/Book Value of Equity	16.222	5.825	-64.09%
		Mean change	-41.03%
		Median change	-32.53%

Exhibit 4 Analysis of Software Market Multiples in 1999 vs. 2004

margin, when compared with the net present value method of the income approach based on free cash flows.

Market Timing Matters

Market timing assumptions have a dramatic impact on value using the venture capital method. Market dynamics drive this value impact since they will change by time the company reaches an exit strategy. The easiest example is to consider the case of a dot-com company in 1999 with an exit event planned in year 5 (2004). In 1999, the sky was the limit for valuation market multiples. SonicWall (NASDAQ: SNWL) had a price/earnings ratio of 8,675 and a market valuation of $1.2 billion on $147,000 in earnings.[13] However, the economic climate was extraordinarily different in 2004. The market went through a serious correction in 2000, shedding 35% of its value in just six weeks; the country went through a recession; the country experienced a series of terrorist attacks that had a material impact on the economy; and the country was engaged in wars on two fronts. To make the assumption that the market would pay a similar rate is at best a gross assumption. In practice, it tends to value an early-stage company consistently higher relative to the discounted free cash flow method.

It is easy to underscore the differences and volatility in using market multiples for early-stage valuations used in the venture capital method by reviewing the market multiples from transactions in the software industry in 1999 and 2004. A search using the SIC codes 7371, 7372, 7373, 7375, 7376, 7377, 7378, and 7379 between 1/1/99 and 12/31/99 yielded 169 total transactions in *Pratts Stats*. The same search between 1/1/04 and 12/31/04 yielded 99 transactions.

The difference in the median value of common market valuation multiples is shown in Exhibit 4. The data in Exhibit 4 is compelling. In every case, the multiples that analysts use commonly with the venture capital methods are higher in 1999 than in 2004. On average, the multiples in 2004 were 41.03% lower than in 1999, with a median lower value of 32.53%.

[13] Note 7, *supra,* p. 45.

Year	1999	2004	% difference
Number of Transactions	997	1008	
Median Equity Price/Sales	0.725	0.575	-20.69%
Median Equity Price/Gross Cash Flow	8.149	6.233	-23.51%
Median Equity Price/EBT	7.929	5.08	-35.93%
Median Equity Price/Net Income	9.062	5.74	-36.66%
Median Equity Price/Book Value of Equity	4.714	3.367	-28.57%
		Mean change	-29.07%
		Median change	-28.57%

Exhibit 5 Analysis of Overall Market Multiples in 1999 vs. 2004

To demonstrate the impact of these changes, consider the following example. It is 1999 and an early-stage company projects to generate after tax net income of $1,000,000 in year 5. Using the median equity price/net income multiple in Exhibit 5, the analyst would assign a value of $29,592,000.

1,000,000 x 29.592

In 2004, the early-stage company has an exit event and it actually generated the $1,000,000 in after tax net income it predicted in 1999, what Dr. Sahlman calls a "success scenario."[14] In 2004, the current market multiple for price/equity is 19.966. The analyst would thus assign a value for the equity of $19,966,000. That means that analysts overvalued early-stage company's terminal values in the software industry in 1999 with the presumption of an exit in year five by 48.21% using the venture capital method.

(29,592,000 – 19,966,000) / 19,966,000

This tendency to overvalue is not limited to the software industry with the SIC codes listed above. An analysis of all transactions for 1999 and 2004 across all industries in *Pratts Stats* yielded a mean lower valuation in 2004 of 29.07% and a median lower valuation of 28.57% as seen in Exhibit 5.

Equally likely in this approach is the possibility to understate value relative to the first prediction. For example, if the empirical data from 1999 and 2004 were swapped, the analyst would have valued the equity in 1999 at $19,966,000 compared with an equity valuation in 2004 of $29,592,000. In this case, the analyst understated the value using the venture capital method by 32.52%. Neither the understatement nor overstatement is desirable, yet each is probable. Fundamental analysis using discounted cash flow analysis for early-stage technologies does not inherit the volatile swings in market multiples. In fact, fundamental analysis based on discounted cash flows will generate consistent values independent of external market forces.

[14] Note 10, *supra,* p. 1.

Useful Life Considerations

Another issue with the venture capital method is the simplifying assumption that guideline companies and the subject company have a similar useful life. For example, the venture capital method presumes the exit occurs using a given multiple of earnings or sales rate. However, none of the multiples describes the expected useful life of the company in the transaction. Thus, when an analyst uses a market multiple, the analyst has an implicit assumption that the useful lives for the guideline transactions and the subject company are identical.

A key driver for profitability for early-stage companies is the useful life over which the company will be able to exploit the technology it owns. Technologies with longer useful lives have a higher value than technology with a shorter useful life, all things being equal, as seen in Exhibit 6 using a 35% discount rate and an end-of-period discounting convention.

Useful life (years)	1	2	3	4	5
Annual cash flows	$100,000	$100,000	$100,000	$100,000	$100,000
Present value	$74,074	$128,944	$169,588	$199,695	$221,996

Exhibit 6 Value Impact of Useful Life on Technology

The venture capital method ignores the impact of matching the useful life for an early-stage company to the guideline companies used as a basis for multiples used to calculate the terminal value. A given transaction represents a defined useful life the acquirer expects to achieve once the transaction completes. Thus, by using market-derived multiples, one makes the implicit assumption that the useful lives are the same. The market price of an investment represented by a transaction should reflect the present value of the future anticipated economic benefits associated with the investment over time. The time factor has a material impact on the final purchase price. As show in Exhibit 6, technology that has a useful life of five years is worth $147,922 more than the same technology with a useful life of one year. If the useful lives are different and there is no knowledge of the difference in the useful lives of the subject property and the guideline transactions, then the value conclusion is essentially meaningless, amounting to nothing more than a random guess. A value of $1,000,000,000, $0, or -$1,000,000,000 may be equally probable.

The venture capital method ignores the impact of matching the useful life for an early-stage company to the guideline companies used as a basis for multiples used to calculate the terminal value.

The following example valuation model demonstrates that matching useful lives of the technology can have a larger value impact than choosing the appropriate valuation multiples from guideline transactions. The valuation example makes the following assumptions:

1) Revenues of $10,000,000 in the corresponding exit year.
2) Earnings of $1,000,000 in the corresponding exit year.
3) It is equally probable that the exit event can occur in year 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10.
4) Price/Sales multiples that range from 0.5 to 3 using a triangular distribution and a most likely value of 1.5.

5) Price/Earnings multiples that range from 10 to 50 using a triangular distribution and a most likely value of 20.
6) Discount rate of 35%.

Simulating this 10,000 times and analyzing the data with a regression analysis, it becomes obvious that the useful life is the most important value driver, even more important than the market multiples used to calculate the terminal value.

A regression analysis of the useful life and sales market multiple yielded the following coefficients:

Exit year	-0.842
Sales market multiple	0.344

The exit year has an expected inverse relationship to value. A shorter useful life equates to a lower value. The sales market multiple has an expected positive relationship to value. Higher the price/sales multiples equate to higher values. What is interesting is that the magnitude of the impact of the exit year is more than twice as large as the impact of the price/sales multiple. This makes sense. If the useful life is zero, then the total revenue is $0. One can multiply $0 in revenues that by a 1,000 market multiple and still get a value of $0. However, an early-stage concept with a long useful life can have a fractional market multiple and retain a value in the millions or more.

…the simplifying assumption that the useful lives for guideline companies and the early-stage technology has larger impact than any error inherent in the selection of the market multiples.

A similar regression analysis of the useful life and earnings market multiple yielded similar results:

Exit year	-0.834
Sales market multiple	0.350

The exit year exhibits an expected inverse relationship to value and the market multiple has an expected positive relationship to value. Like the price/sales market multiple analysis, the magnitude of the impact of the exit year is more than twice as large as the impact of the price/earnings multiple.

In short, the simplifying assumption that the useful lives for guideline companies and the early-stage technology has a large impact on value. In fact, matching useful lives has a larger impact than any error inherent in the selection of the market multiples. It is generally impossible to know the anticipated useful life a buyer presumes in a transaction, because buyers do not generally publish their views on this in any public forum. This magnitude of this uncertainty attacks at the basic premise of the venture capital method and its effectiveness at valuing early-stage technologies.

Fundamental analysis does not remove the risks of knowing the useful life of the early state technology; however, fundamental analysis at least makes the useful life consideration explicit because analysts can account for the useful life in valuation models. For example, if the useful life is five years, the analyst may ignore any economic impacts after year five. Thus, there is no need to make any simplifying assumption regarding useful life when using guideline companies.

Oversimplification of Price/Sales Multiples

Valuation analysts generally consider price/sales as a valuation approach using the venture capital method to be one of the least preferred of the relative valuation multiples when using the venture capital method.[15] This is because it ignores all aspects of profitability and cash flow generation. Recall that the value of an early-stage technology company is the present value of anticipated future economic income. It is common for early-stage companies to generate revenues and yet have negative earnings and negative cash flows. For example, consider a software company with revenues of $1,000,000 and negative cash flows and earnings. In 1999, one would, using the price/sales multiple of 3.457, value the early-stage company at $3,457,000. Thus, something which has never generated economic profit is worth more than $3 million using the price/sales multiple.

If this sounds irrational, consider that in 1999 alone, the median earnings before interest and taxes (EBIT) was -$232,451 with a mean of -$1,344,488 for software companies as listed in *Pratt's Stats*. Of the 169 transactions that occurred during that period, 112 companies, or 66.27% of the total population for that year, had negative earnings. Priceline.com is a great example. In 1999, Priceline.com issued stock in a public offering, which the market valued at some $10 billion. Priceline.com, with little more than a website, database, and some supplier agreements, was worth more than most of the airline industry carriers combined, even though the carriers owned gates, planes, contracts, and other assets. In 1998, Priceline.com had revenues of just over $35 million. Thus, Priceline.com had a price/sales multiple of just over 285. This may sound reasonable at the time until one considers that Priceline.com lost $114 million in 1998 or about $3 for every $1 in revenue it generated. Further, it was selling its tickets for less than it cost to buy them.[16] Price/sales multiples for early-stage technologies perpetuate an illusion of value that has no ties to economic reality. Today, Priceline.com trades at one tenth of its opening price today, though it does today have positive gross profit and earnings.

Priceline.com, with little more than a website, database, and some supplier agreements, was worth more than most of the airline industry carriers combined

Next, the price/sales multiple ignores the stage for the early-stage company relative to the comparable company in the product life cycle. The early-stage technology has a higher loss potential in the near term because it is in a growth phase. The comparable is later in the product life cycle, generating robust profits. Therefore, to presume that the value of the two companies based on sales alone is an oversimplification of what amounts to a nontrivial analysis. There are many simplifying assumptions that one makes using price/sales multiples including debt utilization, financing structure, outstanding options or warrants, and others.

Market multiples from prior transactions also generally ignore why the market transaction occurred in the first place. Was it part of a divesture? Was it part of a success sale or a distressed sale? Each of these will have a different value

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[15] Note 9, *supra,* p. 385.

[16] See Cassidy, John, *dot.con: How America Lost Its Mind in the Internet Era*, (Perennial, 2002), p. 3.

standard, and impact on the resulting transaction value is quite different from an early-stage transaction's valuation focus and purpose. Granted, the analyst is supposed to account for such transactions in the selection of appropriate comparables; however, such data is not always readily apparent in the comparable description. Even if appropriate comparables were available, any adjustments that the analyst applies would be arbitrary, as there are no published correlations or multipliers among value standards (e.g., forced liquidation is always 35% of fair market value).

Oversimplification of Price/Earnings Multiples

The use of price/earnings ratios is preferable to other relative valuation ratios. Earnings are generally closer to positive cash flows than revenues since earnings represent some net after consideration of expenses. As already discussed, using price/sales ratios causes problems. Companies may never have profitability or positive cash flow, yet still be valued at billions of dollars. However, if earnings are available, an analyst should use a price/earnings multiple instead of a price/sales multiple.

Price/earnings ratios are subject to the same types of market euphoria and bias that price/sales ratios introduce…in the most perverse situation, the market underweighs earnings value.

Price/earnings ratios are subject to the same types of market euphoria and bias that price/sales ratios introduce. In the most perverse situation, the market underweighs earnings value. As mentioned previously, one author found that earnings accounted for only 3% of the value of a company. Inherent in price/earnings ratios are the same problems, related to market timing considerations and matched useful lives, as those found in the price/sales ratios. Empirically, price/earnings ratios may in fact generate higher values on average relative to price/sales ratios.

An early-stage concept may not have a representative earnings proxy in the market, particularly if it is a novel concept. For example, companies that designed and manufactured the first portable MP3 music players had no earnings proxy in the market to use as a basis for a price/earnings valuation. Valuation analysts would then have likely used some other industry market multiples, such as for portable CD players or general consumer electronics. In this case, the problem is that one is not comparing like products. When portable MP3 players entered the market, portable CD players were already around for more than a decade and that was a mature market. The profit potential and growth prospects were at different stages in each products respective product life cycle, despite the fact that they are both consumer electronics. To use an earnings market multiple from a CD player company may distort the MP3 player company's value. In addition, if an analyst is using current market multiples for lack of forward multiples, then there is a mismatch between expected earnings and current earnings. This can compound valuation error.

Industry	DCF Method	Price/Sales VC Method	Price/Sales vs. DCF	Price/Earnings VC Method	Price/Earnings vs. DCF
Orthopedics	2,077,667	1,317,302	63.40%	7,726,237	371.87%
Orthopedics	5,613,862	1,424,884	25.38%	15,457,262	275.34%
Orthopedics	4,830,696	1,234,708	25.56%	13,389,824	277.18%
Orthopedics	73,856	191,762	259.64%	2,643,058	3578.64%
Pharmaceuticals	7,202,743	8,475,558	117.67%	6,072,685	84.31%
Energy	20,586,880	2,438,849,231	11846.62%	20,354,818	98.87%
Software	3,621,304	5,798,995	160.14%	19,862,220	548.48%
Software	3,681,422	14,710,600	399.59%	18,170,229	493.57%
Medical Devices	1,193,621	3,188,565	267.13%	5,225,987	437.83%
Trucking	1,611,185	1,618,081	100.43%	809,932	50.27%
Consumer Electronics	4,062,302	18,165,570	129.18%	46,575,438	331.21%
Software	5,439,960	2,593,638	47.68%	10,775,853	198.09%
Software	2,755,025	2,822,334	102.44%	7,895,050	286.57%
Telecommunications	17,006,248	51,237,984	301.29%	96,642,944	568.28%
Energy	2,512,762	807,438,950	32133.53%	2,483,832	98.85%
Energy	4,614,998	831,662,118	18020.85%	2,860,484	61.98%
Software	1,243,573	2,272,320	182.73%	6,066,752	487.85%

Exhibit 7 Empirical Analysis of Recent Early-Stage Valuations

For this article, a subset of existing technologies valued over the course of the last year was analyzed. This subset covered a broad set of industries and included orthopedics, medical devices, software, physical sciences, pharmaceuticals, and energy. The value using the venture capital method using both price/sales and price/earnings market multiples and the result was compared against the value indication using the discounted cash flow method. Exhibit 7 contains the results of these comparisons.

The venture capital method calculated using the price/sales market multiple yielded a value higher than the DCF method 76.47% of the time, with a mean percentage higher value of 3775.49% and a median percentage higher value of 160.14%. The venture capital method determined using the price/earnings market multiple yielded a value higher than the DCF method 70.59% of the time, with a mean percentage higher value of 485.25% and a median percentage higher value of 29.41%.

The standard deviations of the discounted cash flow method, the price/sales VC method, and the price/earnings VC method are $5,876,029, $625,536,163, and $23,339,778 respectively. If one uses the standard deviation as a measure of the relative precision of the valuation method, it is clear that the discounted cash flow method has the smallest standard deviation among the three methods. This indicates that the discounted cash flow method has less of a tendency to generate outlier values that one may consider unreliable. For example, an energy concept in Exhibit 7 has a price/sales value of $2.4 billion, yet the DCF method and the price/earnings value are both at about $20 million. The consumer electronics concept in Exhibit 7 has a price/earnings value of $46 million, but neither the discounted cash flow value nor the price/sales value is greater than $18 million.

The price/earnings venture capital method would be preferable to the price/sales venture captial method, as it has a smaller standard deviation. This is consistent with what other authors have published. It is interesting to note that even though the price/earnings venture capital method may be more reliable relative to the price/sales venture capital method, it generates a consistently higher value relative to the price/sales venture capital method.

More data needs to be collected to verify the statistical measurements with a greater confidence level. This additional data should only reinforce the findings to date. The fact is that the venture capital method valued the subject early-stage concepts higher than the discounted cash flows in most cases and generated higher standard deviations in all cases. Additional research will demonstrate that the venture capital method will consistently return a higher valuation on average for early-stage technologies.

What About Standards

...in the consideration of early-stage technology valuations for venture capital and IPOs is that no governmental or regulatory agency manages or promulgates rules...companies use whatever means it desires

An interesting aside in the consideration of early-stage technology valuations for venture capital and IPOs is that no governmental or regulatory agency manages or promulgates rules for the valuation of early-stage technologies. Moreover, professional societies do not address the issue adequately, either, investing more in generic business valuation programs. Thus, companies use whatever means it desires appropriate to arrive at a value to determine ownership percentages. There are no standards. There is no consistency. Moreover, the valuation methods may not even be reliable. Compare that with a valuation for a litigation or tax matter. In those cases, it is imperative that the value opinion be developed and reported in accordance with appraisal standards such as the Uniform Standards of Professional Appraisal Practice (USPAP), which define what constitutes a credible value development and reporting effort.

CONCLUSION

Early-stage company valuation is an important and vital step in the financing of early-stage companies. Early-stage valuations have historically had many problems, including the use of untested methods, documented conflicts of interest, and simplifying assumptions that created a large disconnect between perceived value and true value. Generating an appropriate value for the early-stage company is important to determining an appropriate pre-money valuation, which provides the basis to allocate ownership in a company to investors.

There are four general ways to value early-stage technologies. These include the market approach, the cost approach, the income approach, and the hybrid venture capital method. There are many issues with the use of the market approach, the cost approach, and the venture capital method for valuing early-stage companies. Use of these methods requires the analyst to make simplifying assumptions that simply to not reflect economic reality, and to apply incorrect value standards. These simplifying assumptions include consistent useful lives between comparable companies and the subject early-stage company, a constant market environment over time, and enough comparable companies to generate statistically significant

results.

The assumptions increase the probability that final value determinations are not as precise as an income-based approach using fundamental discounted cash flow analysis. Empirical evidence suggests that the venture capital method, using both price/sales and price/earnings market multiples, overvalues a given early-stage company most of the time compared with a fundamental discounted cash flow analysis.