WILLIAM A. SAHLMAN

The Basic Venture Capital Formula

Valuation Assuming No Dilution

Consider the situation of a venture capitalist who is contemplating a $3.5 million investment in a company that expects to require no further capital through year five. The company is expected to earn $2.5 million in year five and should be comparable to companies commanding price/earnings ratios (PERs) of about 15. The venture capitalist expects to harvest his investment at that point through sale of his stock to an acquiring company. Assume further that the VC requires a 50% projected internal rate of return (IRR) on a project of this risk. What price should he pay now for the stock?

Fact Summary:	
Required IRR:	50%
Investment:	$3.5 million
Term:	5 Years
Year 5 Net Income:	$2.5 million
Year 5 PER:	15

The venture capitalist must own enough of the company in year five to realize a 50% annual return on the investment. Thus, at that time his shares must be worth:

$$\text{required future value (investment)} = (1 + \text{IRR})^{\text{years}} \times (\text{investment})$$

$$= (1+.50)^{5} \times (\$3.5 \text{ million})$$

$$= \$26.6 \text{ million}$$

Now, at that point the company as a whole will be worth:

$$\text{total terminal value} = \text{PER} \times \text{terminal net income}$$

$$= 15 \times \$2.5 \text{ million}$$

$$= \$37.5 \text{ million}$$

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For the VC to receive the required $26.6 million in year 5 out of the $37.5 million terminal value, he will have to own a corresponding portion of the company's stock. The required percent ownership at that time must be $26.6/$37.5, or 70.9%.

The above steps can be collapsed into one, the *basic venture capital formula:*

$$\text{final ownership required} = \frac{\text{required future value (investment)}}{\text{total terminal value}}$$

$$\frac{(1 + \text{IRR})^{\text{years}} \times \text{investment}}{\text{PER} \times (\text{terminal net income})}$$

Alternatively, you may wish to think about the above formula as:

$$\text{final ownership required} = \frac{\text{investment}}{\text{terminal value} \,/\, (1 + \text{IRR})^{\text{years}}}$$

Computing Shares to Issue and Share Price

When a venture capitalist invests in a company, additional shares are issued, diluting the ownership of the previous investors. Note that "percent ownership" refers to the portion of the total stock that is owned after the new shares are issued:

$$\text{\% ownership acquired} = \frac{\text{new shares}}{\text{old shares} + \text{new shares}}$$

The formula above may be solved to determine new shares, the number of shares to be issued:

$$\text{new shares} = \frac{\text{\% ownership}}{1 - (\text{\% ownership})} \times \text{old shares}$$

Equivalently, if total shares = new shares + old shares, then:

$$\text{total shares} = \frac{1}{1 - (\text{\% ownership})} \times \text{old shares}$$

Thus, if the VC must own 70.9% of the company, and there are 1 million shares outstanding before the investment, then an additional 2,433,476 shares must be issued.

The share price is, by definition, the price paid divided by the number of shares purchased:

$$\text{share price} = \frac{\text{investment}}{\text{new shares}}$$

Thus, if $3.5 million is invested for 2,433,476 shares, the share price is $1.44.

Computing Implied Valuation

It is possible to infer a value for the company as a whole given the percent ownership the VC will obtain for his investment. In general:

$$\text{post-money valuation} = \frac{\text{investment}}{\text{\% ownership acquired}}$$

This quantity is referred to as the *post-money valuation* because it is the valuation applicable after the financing. For the example above, the post-money valuation is \$3.5 million / 70.9% = \$4.9 million.

The post-money valuation is the most frequently used "valuation" figure. Note that this \$4.9 million valuation figure includes \$3.5 million of value that has just entered the company in the form of cash.

It is sometimes important to consider the value attributable to only that portion of the company *not* purchased in this financing round. That figure is the *pre-money valuation*:

$$\text{pre-money valuation} = (\text{post-money valuation}) - (\text{new investment})$$

For the example above, the pre-money valuation is \$4.9 million – \$3.5 million = \$1.4 million. The pre-money valuation is that portion of the post-money valuation attributable to stock held by founders, employees, and previous investors.

The *carried interest* of a given shareholder (or group) is the valuation of that portion of the company owned by that party, after the financing. Thus, the post-money valuation may be broken down into the carried interests of the various parties. For any given shareholder:

$$\text{carried interest} = (\text{post-money valuation}) \times (\text{\% ownership post-money})$$

The carried interest of the new investors is equal to the value of their investment. In the case of a start-up, the founders' carried interest constitutes the entire pre-money valuation; it is the value assigned to their technology and to their hard work, thus explaining its other name: *sweat equity*. Using the above formula, the founders' carried interest is \$4.9 million x (1 – 70.9%) = \$1.4 million, which is of course equal to the pre-money valuation.[1]

The above items can also be expressed in terms of shares:

$$\begin{aligned} \text{post-money valuation} &= (\text{new price}) \times (\text{total shares}) \\ \text{pre-money valuation} &= (\text{new price}) \times (\text{old shares}) \\ \text{carried interest} &= (\text{new price}) \times (\text{shares owned}) \end{aligned}$$

Valuation Assuming Future Dilution

As new stock is issued to later-round investors or to new key employees, the early-round investors can expect to suffer *dilution*, a loss of ownership due to the issuing of additional shares. In

[1] Another definition of *carried interest* subtracts a shareholder's previous investments from his portion of the post-money valuation. For example, if the founders had contributed \$100,000 for their initial equity, then their carried interest would be (\$1.4 million – \$0.1 million) = \$1.3 million. This represents the amount by which the valuation of a shareholder's portion increases due to an increase in company valuation. Note that, under this definition, if an investor had bought in at a price higher than the current round's price, then his carried interest would be negative.

the single-stage financing above, the first round of financing was assumed to be sufficient to provide funds until the final year. A more realistic case will be the example where several rounds are required. In addition to estimating the appropriate discount rate for the current round, the first-round VC must now estimate the discount rates that are most likely to be applied in the following rounds, which we will project for years two and four. Although a 50% rate is still appropriate for year zero, it is estimated that investors in this company will demand a 40% return in year two and a 25% return in year four. The final ownership that each investor must be left with, given a terminal PER of 15, can be calculated using the basic valuation formula:

Round 1: $$\text{final \%} = \frac{\text{future value (investment)}}{\text{terminal value (company)}} = \frac{1.50^5 \text{ x\$1.5 million}}{15\text{x\$2.5 million}} = 30.4\%$$

Round 2: $$(1.40^3 \text{ x \$1.0 million}) \;/\; (15 \text{ x \$2.5 million}) = 7.3\%$$

Round 3: $$(1.25^1 \text{ x \$1.0 million}) \;/\; (15 \text{ x \$2.5 million}) = 3.3\%$$

Note that these are the final, or terminal, ownership shares that each investor requires. Because they are calculated from terminal value, current investment amount, and discount rate, they are not affected by the amount or pricing of future investments. That is, each investor's required final ownership stake is not influenced by the other investors' final ownership percentages. However, because the early-round investor must purchase enough shares now to make up for the dilution that will be caused by the future financings, it is in the conversion from future to current ownership shares that the effect of future financings will be felt.

Conversion to Current Ownership and Prices

The ratio of the percent ownership a given investor will hold as of the terminal year of a project—the final ownership share—to the percent ownership he holds as of his investment—the current ownership share—is that investor's *retention percent*:

$$\text{retention \%} = \frac{\text{final \% ownership}}{\text{current \% ownership}}$$

The reduction in ownership over time is caused by the sale of new shares to new investors or the award of additional options to management. To illustrate, an investor's retention ratio will be 75% if a later investor purchases 25% of the company. In general:

$$\text{retention \%} = 1 - (\text{total of future final \% ownerships})$$

The retention percent can also be thought of as that portion of the final ownership available to the current investor.

Thus, because the second- and third-round investors will hold 7.3% and 3.3% of the final ownership, the first-round investor will only retain 1 – (7.3% + 3.3%) = 89.3% of his original holding. The second-round investor will retain 1 – 3.3% = 96.7% of his investment, and the third-round investor will retain 100%, since there will be no subsequent investors through year five, the terminal year.

So what percent ownership should each investor purchase at the time of the financing? The formula below is equivalent to the ratio above:

$$\text{current \% ownership} = \frac{\text{final \% ownership}}{\text{retention \%}}$$

So, for **Round 1:** current % ownership = 30.4% / 89.3% = 34.0%

Round 2: current % ownership = 7.3% / 96.7% = 7.6%

Round 3: current % ownership = 3.3% / 100% = 3.3%

Using the formulas presented earlier, we can calculate the number of shares that each investor must purchase to obtain the above ownerships, assuming that there were 1 million shares outstanding before the first round. Recall that:

$$\text{new shares} = \frac{\text{\% ownership}}{1 - (\text{\% ownership})} \times \text{old shares}$$

So, for **Round 1:** $\text{new shares} = \frac{34\%}{1 - 34.0\%} \times 1{,}000{,}000 = 515{,}055$

Round 2: $\text{new shares} = \frac{7.6\%}{1 - 7.6\%} \times 1{,}515{,}055 = 124{,}077$

Round 3: $\text{new shares} = \frac{3.3\%}{1 - 3.3\%} \times 1{,}639{,}131 = 56{,}522$

The price per share can also be calculated; recall that:

$$\text{share price} = \frac{\text{investment}}{\text{new shares}}$$

So, for **Round 1:** share price = $1.5 million / 515,055 = $2.91

Round 2: share price = $1.0 million / 124,077 = $8.06

Round 3: share price = $1.0 million / 56,522 = $17.69

The terminal (or final-year) share price can also be calculated. There will be 1,639,131 + 56,522 = 1,695,653 shares outstanding after the third round. Thus, if the market value is 15 times the year-five earnings of $2.5 million, the price per share will be: (15 x $2.5 million) / 1,695,653 = $22.12.

To check that this pricing is consistent with the assumed discount rates, multiply each round's share price by the expected IRR:

Round 1:	\$2.91	x $(1+50\%)^5$	= \$22.12
Round 2:	\$8.06	x $(1+40\%)^3$	= \$22.12
Round 3:	\$17.69	x $(1+25\%)^1$	= \$22.12

Thus, this pricing schedule will yield the returns that are expected.

Options

Stock options are a critical element in attracting and retaining new employees. As with founders' interest, an options pool will suffer dilution through successive rounds of financing. In order to maintain an options pool that will remain large enough to attract future employees, it is critical that at the time of the initial VC financing, management establish the percentage of the company's equity that should be reserved for an options pool, then project the total number of shares that will be issued in all VC investment rounds, and then work backward to determine the number of options that should be set aside in the options pool.

projected total shares x options pool % of projected total shares = options pool shares

For example, if management has decided that 5% of the equity should be reserved for an options pool and it is estimated there will be 2 million shares outstanding after a final round of VC financing, management will need to set aside 2 million x 5% = 100,000 shares. Note that at earlier rounds, these 100,000 shares will represent a significantly larger share of the company than the final 5%.