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# Valuation of Venture Capital Securities: An Options Based Approach

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# Valuation of Venture Capital Securities: An Options Based Approach

## **Disciplines**

Business | Finance and Financial Management

# Valuation of Venture Capital Securities

## An Options Based Approach

Wharton Research Scholars

2005-2006

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## Introduction

This paper and the accompanying spreadsheets are intended as an aid to those negotiating financing terms with venture capitalists (VCs). It is hoped that through using this methodology those in this position (hence forth referred to as entrepreneurs) will be able to construct an argument to help justify their requests for higher valuations, lower venture capital ownership or the use of less aggressive securities.

### ***Venture Capital Financing Negotiations***

Venture capital is an important source of capital for small growing companies. In 2003 over \$22bn was invested in such companies<sup>1</sup>. In exchange for this funding, venture capitalists receive equity ownership in the company. The value of the firm, the amount of ownership that the entrepreneur must give to the venture capitalist, and the form of equity given up, are all interrelated and disputed during fund raising negotiations.

The “Venture Capital Method” is used as a framework for this analysis. Given the expected sale/IPO (Initial Public Offering) year, the expected sale/IPO value, the required rate of return (to compensate the venture capitalist for systematic risk, liquidity, value added and a cash flow adjustment), and the amount of investment currently needed, the Venture Capital Method will value the entrepreneur’s business and the amount of equity that must surrendered to the Venture Capitalist. The final sale/IPO value is discounted back at the venture capitalist’s required rate of return (usually 30% for late stage and 50% for early stage) to the date of investment. The percentage of the

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<sup>1</sup> PricewaterhouseCoopers/National Venture Capital Association MoneyTree(TM) Report, Data: Thomson Financial

company's equity that the venture capitalist will require will be the venture capitalist's investment divided by this discounted terminal value. The post money valuation is investment divided by the percentage of ownership acquired.

It is important to note that date and value of sale/IPO are facts that will be revealed ex-post, whose expectations will be the subject of discussion rather than negotiation. The venture capitalist's required rate of return could be a topic of negotiation but in practice tends to be the accepted by the entrepreneur and becomes treated as almost a fact, around which other negotiations and discussions take place.

In the post-dotcom era, it has become more and more common for venture capitalists to demand equity not in the form of common stock, but rather more exotic versions of preferred equity. The increased bargaining power of venture capitalists during this period stems from the scarcity of capital; however, venture capitalists often justify their demands as risk mitigants (which normally affect the payouts in the case of liquidation or sale, rather than IPO). The negotiation of these securities, in theory, takes place after, or at least as separately as possible from, the negotiation over valuation using the Venture Capital Method, although in practice negotiations become interdependent. The valuation was justified on the basis that the venture capitalist must meet his/her required rate of return to compensate for the risk inherent in the business activity. However, this paper will show that the addition of these securities will cause the venture capitalist to receive a return in excess of the stated goal.

There is often a misunderstanding on the part of entrepreneurs, who, while they realize that these securities are detrimental, fail to quantify or accurately comprehend the value they are giving up. This paper will explain a methodology of quantifying the value

of these securities, not just for the entrepreneur's edification, but also as a tool to aid the entrepreneur in negotiation. If the entrepreneur can demonstrate to the venture capitalist that he/she is receiving a larger return than the one used to justify the valuation, this puts pressure on the venture capitalist to agree to a more attractive valuation or some other compensation for the entrepreneur. It is important to note, however, that this is pressure, not a magic pill, and ultimately supply and demand are much stronger forces on price of venture capital equity.

## ***Venture Capital Securities***

Some of the securities demanded by venture capitalists are listed and their most relevant characteristics are summarized below:

### **Common Stock**

This is the most basic type of security, and is, in fact, rarely taken by venture capitalists. It is normally the form of stock held by entrepreneurs and employees. All dividends and returns on liquidation that are available to common stock holders are split pro rata.

### **Liquidation Preferences**

Venture capitalists sometimes demand preferred stock that has liquidation preferences. This means that upon liquidation or sale of the company, the venture capitalist will receive a multiple (referred to in the model as  $\lambda$ ) of his/her investment (referred to in the model as  $I$ ) before common stock holders divide the remaining value. The multiple is negotiated upon issuance of the security, and is referred to with the suffix “x”, as in 3x being that the venture capitalist receives three times his/her investment before the remaining value is divided up by common stock holders. If the proceeds from the sale or liquidation are not sufficient to cover the liquidation preference, all of the proceeds will be paid to the venture capitalist and the common stock holders will receive nothing.



## Participation

On top of liquidation preferences, the venture capitalist can demand preferred stock with participation rights. Upon liquidation or sale of the company, not only with the venture capitalist receive the liquidation preference, but the remaining value will be distributed not only among common stock holders but also to the venture capitalist as well. Normally this sort of preferred stock is converted on a 1:1 basis to common stock (although this can differ, this model is based on this assumption), after the liquidation preference payment is made, and thus the venture capitalist participates in the remaining distribution as if he/she held common stock, and gains the same percentage of the remaining value to be distributed as the percentage of common stock he/she would own if converted (referred to in the model as  $\epsilon$ ).

## Participation Caps

Participating preferred, as it is called, can often lead to excessive returns for the venture capitalist. Sometimes entrepreneurs can succeed in negotiating a “cap” on participation. In this case the proceeds from the sale/liquidation are capped usually at a multiple of investment (referred to in the model as  $\kappa$  – kappa). Thus if there is a 3x cap on participation, this means that the venture capitalist participates until three times the investment has been recovered in total (i.e. proceeds from liquidation preference + proceeds from participation = 3 x investment). This is probably the most likely positive result from using the analysis in this paper: the entrepreneur may succeed in negotiating a small cap on participation after the extent of the venture capitals profit is made plain to both parties.

**Redeemable Participating Preferred**

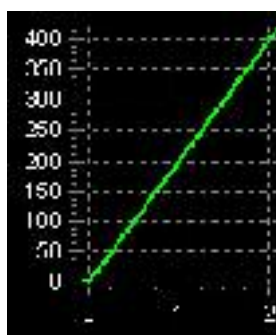
This is a security that has become somewhat more common over the past few years. It is essentially the same as participating preferred, except that the liquidation preference is computed after the venture receives the full principle of the investment back, thus effectively lifting the liquidation preference by one, (e.g. from 2x to 3x).

## Option Pricing

The model to be explained relies on reader's ability to view these securities as a series of options. These options will be all be translated into European call options to be valued using the Black-Scholes methodology. It is therefore useful if the reader has some basic comprehension of Black-Scholes formula (for information see references in the bibliography), although it can just as easily be viewed as a valuation "black box" into which the call option parameters are fed. The translation of these options relies on the principles of Put/Call Parity, which is summarized below.

## Put/Call Parity<sup>2</sup>

Option translation is easiest to understand if their payoff schedules are compared



graphically. On the left is an example of the payoff schedule of common equity.

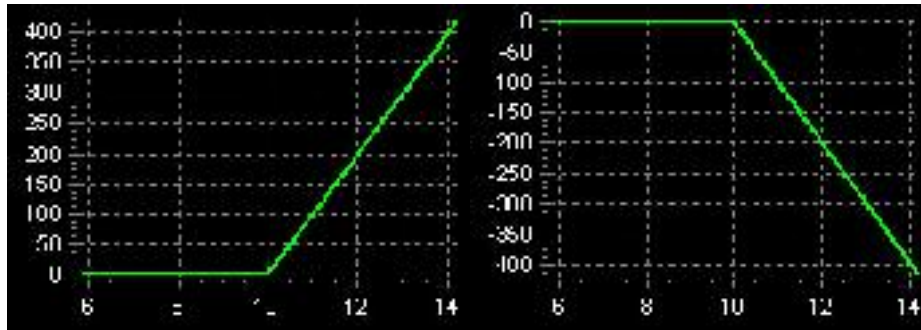
The value of the security (y axis) increases in a linear fashion as the value of the firm (x axis) increases. The diagram on the



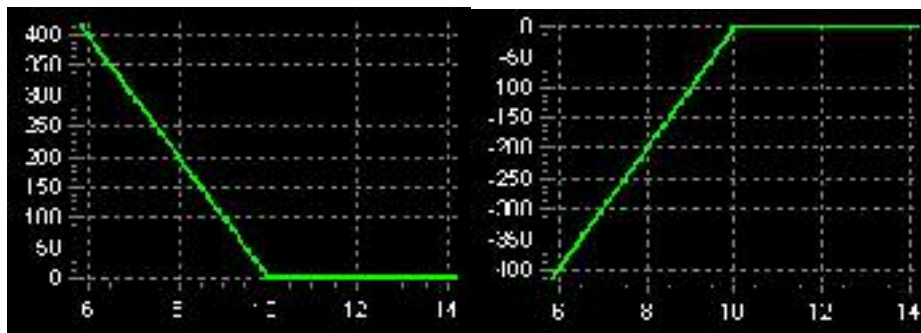
right is an illustration of the payoff schedule of an investor who is short common equity: it is exactly the same except the negative function.

Call options only pay out once the strike price has been reached. It then pays off positively in a linear fashion. On the left below, the call option payouts are shown, and the corresponding payouts of being short this security are shown below on the right.

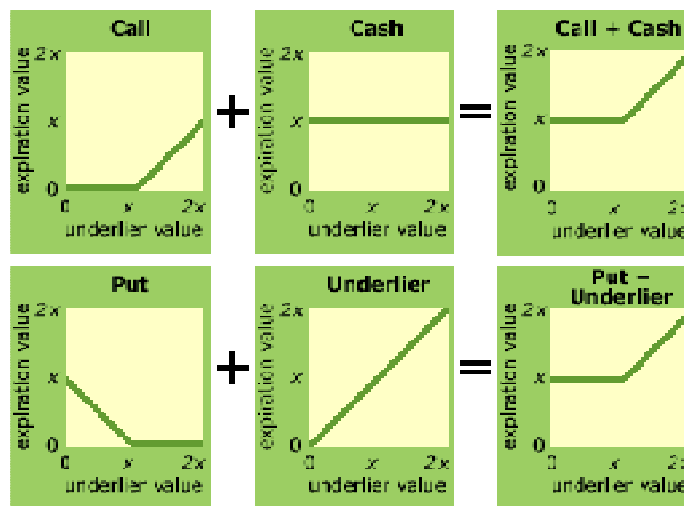
<sup>2</sup> Diagrams in this section are not copyrighted, but are taken from <http://www.optionpricer.free.fr/strats.html> and [http://www.riskglossary.com/link/put\\_call\\_parity.htm](http://www.riskglossary.com/link/put_call_parity.htm)



Put options, the right to sell, pay off in a negative linear fashion until the strike is reached. The payoff schedule for this security is shown below on the left. The corresponding short position is shown below on the right.



These options are **additive**, and thus they can be combined with each other or even flat payments to produce other payoff schedules as illustrated below:



The diagram above, Put/Call Parity, shows how these options can be added together to make synthetic versions of each other. These principles can be extended to hugely broaden the number of options that can be converted into European call options. The technique of adding two sloping sections with perfectly negatively correlated gradients to create flat payoffs (as shown in the bottom row of the diagram above) will be used extensively in the model to follow.

These payoff schedules are also **multiplicative**. That is to say that the gradient of the payoffs can be increased by owning multiple securities. For example, a doubling of the gradient can be achieved by owning two of the securities.

### ***Pre-valuation Negotiations/Discussions/Assumptions***

As noted before, several of the inputs of the model are assumed to be fixed, but are in fact unknowable (but somewhat predictable) ex ante. It is useful therefore that before these securities are analyzed, these parameters values are estimated. In order to effectively negotiate on the inclusion of these securities, it is important that the venture capitalist and entrepreneur make each other aware of their assumptions with regards to these values. Thus there will be no confusion during the discussions over whether the subject of negotiation is these assumed values (e.g. sale price, sale date) or on inclusion and parameters of these securities (e.g. liquidation preference, participation cap).

These assumptions are:

- The expected year of sale/IPO/liquidation
- The expected value of sale/IPO/liquidation
- The probability of IPO vs. sale/liquidation
- The venture capitalist's required rate of return (after valuation this will be shown to be false)
- The risk free rate
- The volatility of the firm's equity

## ***A Note on Notation***

The model in the next section will use the following notation (in alphabetical order).

### **Common Notation**

- $\epsilon$**  The fraction of the equity that the venture capitalist would own if all preferred stock was converted to common stock, often given as a percentage. =  $v/n$  (see below)
- $\kappa$**  The cap on participation as multiple of investment, (e.g. 1, 2, or 2.5 etc). Referred to in prose or speech as  **$\kappa x$**  (e.g. 1x, 2x, 2.5x etc.)
- $\lambda$**  Liquidation preference as a multiple of investment (e.g. 1, 2, or 2.5 etc). Referred to in prose or speech as  **$\lambda x$**  (e.g. 1x, 2x, 2.5x etc.)
- $n$**  total number of common shares of the firm if all venture capital securities were converted to common, referred to sometimes using quotations as “common shares”, to distinguish it from actually common equity that does not have a linear profile, but is in fact, a call option (see below)
- $v$**  the total number of common shares that would be held by the venture capitalist if all venture capital securities were converted to common

**BS[ $S_0$ ,  $X$ ,  $T$ ,  $rf$ , volatility]** is the output of Black-Scholes European Call Option Calculator with inputs:

- $S_0$**  Current price of underlying
- $X$**  European call option exercise price

<b>t</b>	Expected sale/liquidation year
<b>rf</b>	Risk free rate
<b><math>\sigma</math></b>	Volatility of underlying

### ***Firm Value Method Notation***

<b>I</b>	Total venture capitalist investment
<b><math>\Pi</math></b>	Post-money valuation
<b>S</b>	Estimated volatility of the value of the total equity of the firm

### ***Per Security Method Notation***

<b>i</b>	Total venture capitalist investment per share or security
<b><math>\pi</math></b>	Post money valuation per share (or $\Pi / n$ )
<b>s</b>	Estimated volatility of the value of the common stock if all venture capital securities were converted.



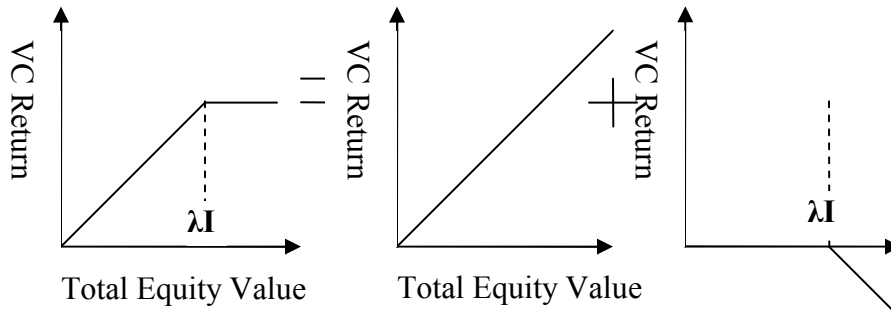
## The Model

The model for valuing these venture capital securities is explained step by step below. Valuing the venture capitalist's returns on the entire investment, by comparing it to changes in value of the total equity of the firm (the Firm Value Method), is much more intuitive and is thus discussed first. The task of valuing an individual unit of a security (the Security Value Method) held by venture capitalist is slightly more complex and is explained subsequently. The model will show that these securities are can be seen to be common stock plus a package of long and short call options.

### *The Firm Value Method (FVM)*

#### Liquidation Preference

This security allows the venture capitalist to claim all value from the enterprise that has been invested in, up to a limit, usually a multiple of his/her investment, liquidation preference  $\times$  investment (or  $\lambda I$ ). This can be seen as a call option on firm value with a strike at the value that fully satisfies the preference (the return rights of the venture capitalist  $\lambda I$ ), which is subtracted (and therefore is a short call) from the right to all returns from the sale no matter what the value (the value of which is the post-money valuation, by definition, the value of the total equity,  $\Pi$ ). The return profile is displayed below - the dotted line represents the fully satisfied liquidation preference,  $\lambda I$  (and strike price):

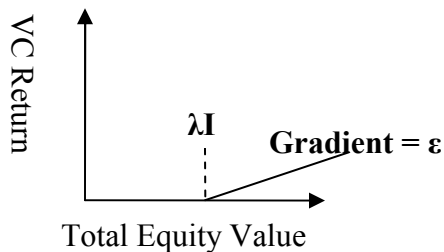


Thus the value of this security is:

$$\Pi - BS[\Pi, \lambda I, t, rf, S]$$

### Participation

This security allows the venture capitalist to receive returns above his/her liquidation preference in proportion to his/her ownership of common shares if his/her preferred shares were converted ( $\epsilon$ ). This is similar to a call option, with the strike at the fully satisfied liquidation preference, except that the venture capitalist does not receive the full amount of the increase in value, only a fraction of it, thus it is the fraction of converted common shares ( $\epsilon$ ) x a call option on the firm, with a strike of where the liquidation preference is satisfied ( $\lambda I$ ). The return profile is displayed below:



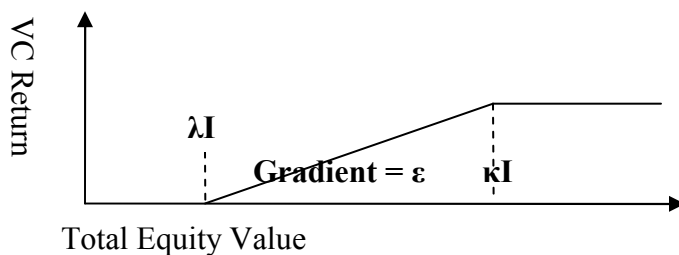
The value of this security is therefore:

$$\epsilon * BS[\Pi, \lambda I, t, rf, S]$$

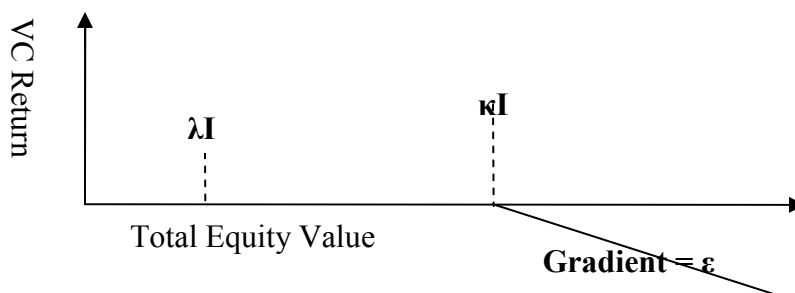
## Participation Caps

If a cap on participation has been negotiated, the venture capitalist only participates above the liquidation preference until the cap is satisfied. That is to say as the value of the firm rises above this value, ( $\kappa I$ ), the venture capitalist's return is flat.

Thus participation will look like this:



This flattening of the gradient can be done using the method alluded to in the options section above, by adding the corresponding short position. Adding a function that grows negatively to a function that grows positively of the same magnitude will cancel each other out, leading to a function that neither grows nor decays. This corresponding function is therefore  $\varepsilon$  short call options with a strike price  $\kappa I$ . This is displayed below:

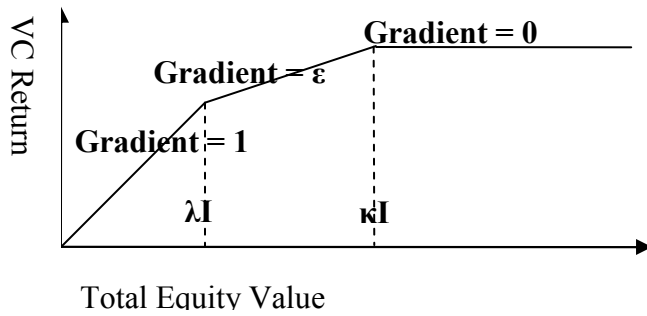


The value reduction that results from the addition of a cap on participation is therefore:

$$\varepsilon * BS[\Pi, (\kappa I), t, rf, S]$$

### Capped Participating Preferred

Capped participation securities are usually held in conjunction with the liquidation preferences as Capped Participating Preferred Stock. The venture capitalist's total return function is thus displayed below:



The value of this position can therefore be computed in the following way:

Liquidation Preference	+ Participation	- Cap (if present) adjustment
=		
$\Pi - BS[\Pi, \lambda I, t, rf, S]$	+ $\epsilon * BS[\Pi, \lambda I, t, rf, S]$	- $\epsilon * BS[\Pi, (\kappa I), t, rf, S]$

### ***The Security Value Method (SVM)***

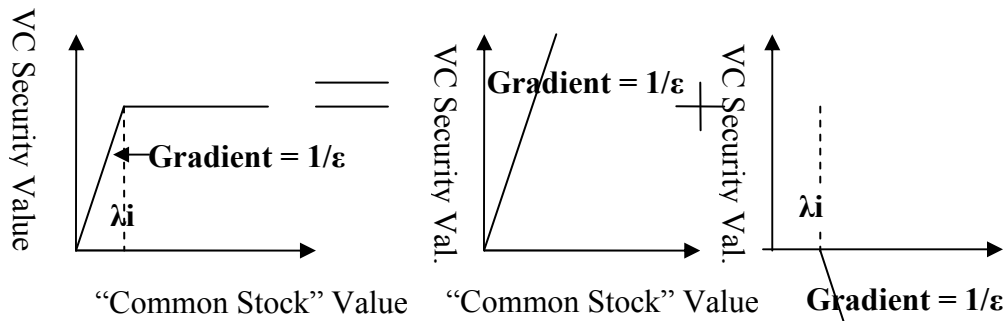
We can also measure these securities on a per share or per security basis. That is to say we can create a security which is a package of sub-securities which would be analogous to a share (if these securities did not exist). For example, if instead of the venture capitalist receiving one million shares of common stock, it was negotiated that he/she would receive equity in the form of participating preferred, he/she would receive one million securities of participating preferred (assuming a 1:1 conversion), that were made up of one sub-security that behaves way that common stock would if the venture capitalist owned only common stock, and a set of sub-securities that will behave similarly to the liquidation preference described in the introduction, plus a set of sub-securities that behaves similarly to the capped or uncapped participation described introduction. Thus, in order to compute the total value of the venture capitalist's position, the value of the participating preferred security must be multiplied by the number of these securities that were issued to the venture capitalist.

### **Liquidation Preference**

This liquidation preference is similar to the one described in the FVM, however, it is important to note, that as this valuation is on a per security basis, the strike price is not the liquidation preference multiplied by the investment, it is the liquidation preference multiplied by the venture capitalist's investment on a per security basis,  $i$  (or  $I/n$ ). Furthermore, the venture capitalist claims all shareholders returns until the preference is satisfied and thus he/she does not just hold an option on each share he/she owns, but on all the "common stock" of the firm (if the venture capitalist's position were converted),

therefore the security must be multiplied by  $1/(\text{fraction owned})$ , or  $1/\epsilon$ . Thus if the venture capitalist owned 33% of the shares (if converted to common), he/she would be entitled to have 3 of these sub-securities included in his/her security.

As in the FVM this security is made by subtracting call options from equity to make the marginal return zero after the liquidation preference has been satisfied. On a per share basis, therefore, these returns are analogous to subtracting  $1/\epsilon$  call options (the strike is the value of the fully satisfied liquidation preference on a per share basis) from the returns of  $1/\epsilon$  shares of common stock (which are valued today at the post money valuation per share,  $\pi$ ). The return profile is displayed below:



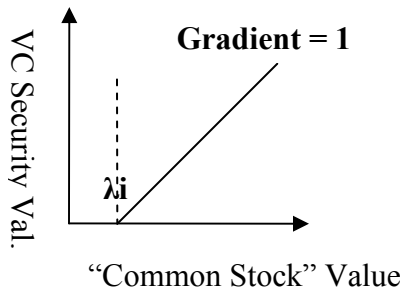
Thus the value of this sub security is:

$$(1/\epsilon * \pi) - (1/\epsilon * BS[\pi, \lambda i, t, rf, s])$$

### Participation

As in the FVM case above, this is a call option. It is intuitive that the strike would be the value of the fully satisfied liquidation preference per share/security ( $\lambda i$ ). However, it is actually a call option on one share of common stock if all venture capital securities were converted, as the venture capitalist and entrepreneur participate in proportion to the

number of shares they would own assuming this conversion. Thus the gradient is not  $\epsilon$ , but 1. The return profile is displayed below:

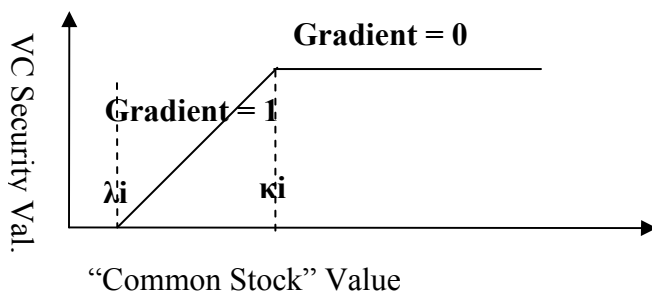


The value of this security is therefore:

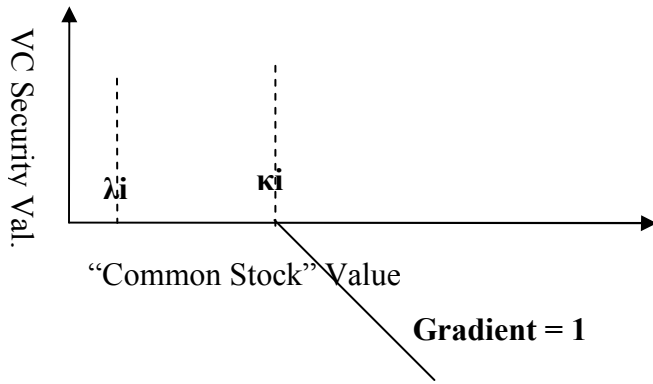
$$BS[\pi, \lambda i, t, rf, s]$$

### Participation Caps

A cap can also be added in the SVM. The value per common share where the venture capitalist no longer participates will now be  $(\kappa i)$ . Thus participation will look like this:



This flattening of the gradient can once again be done by adding the corresponding short position. This corresponding function is therefore 1 short call option with a strike price  $\kappa i$ . This is displayed below:

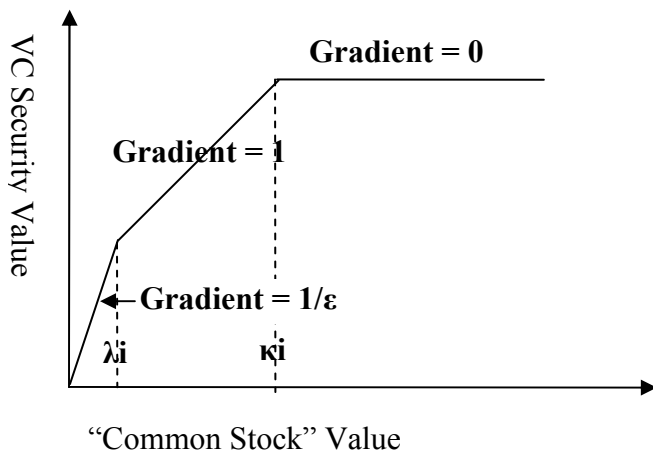


The value reduction that results from the addition of a cap on participation on a per security basis is therefore:

$$BS[\pi, (\kappa i), t, rf, s]$$

### Capped Participating Preferred

Once again this is the addition of these securities. The return profile is displayed below:



The value of this position can therefore be computed in the following way:

$$\begin{aligned} & \text{Liquidation Preference} && + \text{Participation} && + \text{Cap (if present)} \\ = & && && \\ & (1/\epsilon * \pi) - (1/\epsilon * BS[\pi, \lambda i, t, rf, s]) & + & BS[\pi, \lambda i, t, rf, s] & - & BS[\pi, (\kappa i), t, rf, s] \end{aligned}$$



It may be desirable to analyze the excess value that the venture capitalist is receiving by viewing the security as a common share and additional sub-securities. This can be done by subtracting one common share from the formula above such that now the security's value can be expressed as

Common share + Package of sub-securities

=

Common share + Modified Liq. Preference + Participation + Cap (if present)

=

$\pi + \{(1/\varepsilon - 1) * \pi\} - (1/\varepsilon * BS[\pi, \lambda_i, t, rf, s]) + BS[\pi, \lambda_i, t, rf, s] - BS[\pi, (\kappa_i), t, rf, s]$

## **Limitations**

### ***Garbage in / Garbage Out***

As stated previously, certain parameters have to be negotiated before valuation, or at least both parties have to be aware of each other's assumptions. Most of these assumptions (such as the likely sale price and year of sale) are difficult to predict and thus this model is only as good as these predictions.

### ***Simplifications***

#### **Deterministic/Stochastic Model**

Although this model is based on Black-Scholes, and could thus be said to be stochastic, many of the model's assumptions listed above are in random or semi-random, and thus the assumption of these values means that the output of this model is predicated on the fact that these values are known ex ante, which is not the case.

#### **Seniority**

The model has tacitly assumed that there is no debt in the firm, which is often the case for these companies. This assumption, however, is not binding, and the analysis will be similar when traditional debt is present.

However, this model assumes that the venture capitalist's securities are the most senior equity in the firm. This is a fair assumption in the case that this is the last round of

financing. It is, however, probable that the firm may undergo another round of financing. In this case, it is likely that the new equity will be senior to the equity being valued in the model and thus this will have a large effect on the payout. Although the Venture Capital Method of valuation takes such scenarios into account (poorly), this model does not.

## **Conversion**

This model assumes 1:1 conversion of these securities to common stock; however, it would not be very difficult to use a different conversion ratio.

## **IPO**

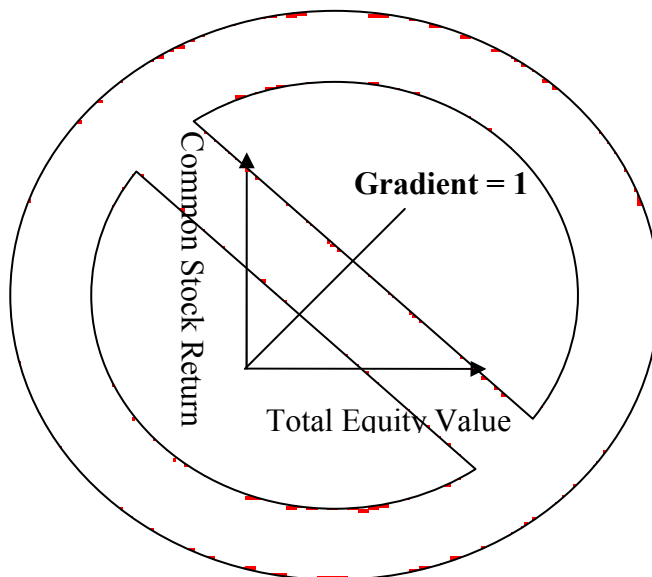
The valuation model above assumes that the firm will be sold or liquidated for an assumed price in an assumed year. It therefore does not include the possibility of an IPO of the firm. This is a huge problem, as many Venture Capitalists see IPO as their goal for exit. In most cases, upon IPO, the venture capitalist's equity is converted to common and thus these securities and their payoffs no longer exist.

There are, however, some methods that can be used to attempt to factor in the IPO condition, however, none of them are theoretically perfect. As with the other assumptions, the value and timing of IPO are not predictable ex ante, but can be estimated inaccurately. One approach would be to value the securities according to the method above, use the Venture Capital method in the case of IPO and then weight these values according to the probability of IPO vs Sale/Liquidation. However, the actual causation of an IPO is somewhat internal, that is to say that both the venture capitalist

and entrepreneur have some control over its occurrence, and thus they may attempt to initiate or block an IPO depending on how it affects their returns. This makes it a real option and thus can not be valued by weighting expectations.

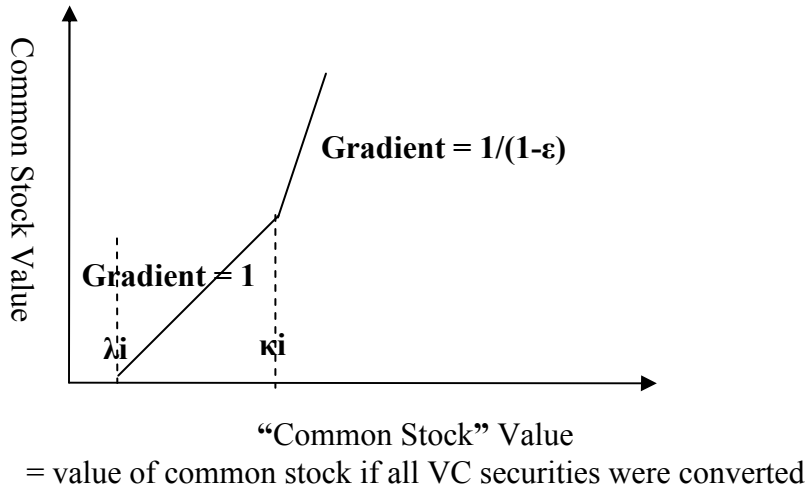
### ***The Nature of Common Stock***

Throughout this paper the venture capitalist's returns are compared to that of common stock. There is an implicit assumption that these are independent, which is absolutely not the case. The common stock return profile is not linear with the value of the firm as most equity is (above 0), as has been described above:



It is the existence of these venture capital securities that causes this not to be the case. It is because of this that returns have been compared to returns to common stock **as if all venture capital securities were converted**, which has been referred to using quotations marks, “common stock”, rather than common stock. The reason for this discrepancy is that the liquidation preference means that common stock receives no proceeds until total equity value has increased beyond to value of the fully satisfied

liquidation preference. Furthermore, if there is a cap, the common stock returns are boosted by the fact that venture capitalist is no longer participating. An example of this return on a per share basis is shown below



As an aside, it is interesting to note that this is also a series of call options. The section before the venture capitalist cap has been reached ( $\lambda_i$ ) is a call option with strike  $\lambda_i$ , (as the entrepreneur has no returns before this value), with a similar call option with strike  $\kappa_i$  subtracted from it, to make the return of that sub-security flat after the end of venture capital participation ( $\kappa_i$ ), such that the next section can be added to a blank slate. Consequently the section after the venture capitalist’s participation is capped is also just a call option, except that the common stock holder receives returns that would have gone to the venture capitalist if there was no cap, thus the gradient will be greater. Using the same logic as above, this will be  $1/\text{the percentage equity ownership of the common stock holder}$ , or in this example,  $1/(1-\epsilon)$ . These call options can thus be valued using Black-Scholes.

## **Black-Scholes**

One of the most obvious weaknesses of this model is the limited applicability of the Black-Scholes option pricing models. This model should only be used in certain conditions. The table below sets out the conditions, and why some of these conditions are not met:

<b>Condition</b>	<b>Condition met (yes, no, sort of)? If no, why?</b>
Short selling possible	Sort of: A security like this could written, imperfectly
No arbitrage opportunities	<b>No</b> : The post money valuation using the venture capital method is not priced by a market, although it is difficult to see how to take advantage of this.
Trading is continuous	<b>NO</b> . This is the largest violation. Venture capital securities are rarely traded, and tend to be revalued upon subsequent rounds of financing.
No transaction costs or taxes	<b>No</b> . Transaction costs are large due to the magnitude of the investment and its opaque nature which requires due diligence. Taxes do indeed exist
Securities are perfectly divisible	Sort of. Very small denominations can be made when the share classes are created
Risk free rate exists, is constant	Sort of. This is a fair assumption to make
Maturity dates constant	<b>NO</b> . This is another huge flaw, discussed in above.
Volatility is known	<b>NO</b> . This is another large flaw. The volatility of the investment is not known, but can be approximated (poorly) from publicly traded comparables

## The Template, a Practical Example, and a Conclusion

A template for entrepreneurs is attached. The template is currently set to the parameters of a fictional example of how the valuation works.

The particular circumstances for this example are:

Assumptions	Firm Value Basis	Per Share Basis	VC Target Return	30%
Pre-money valuation	\$ 11,000,000	\$ 2.20	Number of shares outstanding	5,000,000
Initial investment	\$ 5,000,000	1.00	VC Liquidation Preference	2x
Post-money valuation	\$ 16,000,000	3.20	Cap	4x
Number of shares issued	1,562,500	1.00	Maximum (cumulative) convertible	9%
Number of shares owned by VC	1,562,500	1.00	Number of shares convertible	5,000,000
Number of shares owned by entrepreneur	3,437,500	1.00	Year end of sale of co	30%
			Salary paid	0
			Preferred share dividend rate	8%

The model computes the value of the venture capital securities using both the FVM and the SVM assuming the venture capitalist receives common stock, non-participating preferred (in this case the liquidation preference is 2 x), capped participating preferred (in this case the cap is 4 x), uncapped participating preferred and redeemable participating preferred. It also computes the venture capitalist's actual rate of return for each security and the valuation necessary to maintain the target using the formula:

$$\frac{I * (\text{expected sale price} - \text{actual preference payment})}{(I * (\text{VC target return})^{\text{sale year}} - \text{actual preference payment})} - I$$

Intermediate Calculations	Firm Value Method					Security Value Method				
	Redeemable	Participating	Capped Participating	Uncapped Participating	Common	Redeemable	Participating	Capped Participating	Uncapped Participating	Common
VC Investment	\$ 5,000,000	\$ 5,000,000	\$ 5,000,000	\$ 5,000,000	\$ 5,000,000	\$ 5,000,000	\$ 5,000,000	\$ 5,000,000	\$ 5,000,000	\$ 5,000,000
Pre-Money Valuation	\$ 11,000,000	\$ 11,000,000	\$ 11,000,000	\$ 11,000,000	\$ 11,000,000	\$ 11,000,000	\$ 11,000,000	\$ 11,000,000	\$ 11,000,000	\$ 11,000,000
Post-Money Valuation	\$ 16,000,000	\$ 16,000,000	\$ 16,000,000	\$ 16,000,000	\$ 16,000,000	\$ 16,000,000	\$ 16,000,000	\$ 16,000,000	\$ 16,000,000	\$ 16,000,000
Total Security Value	\$ 14,750,000	\$ 14,750,000	\$ 14,750,000	\$ 14,750,000	\$ 14,750,000	\$ 14,750,000	\$ 14,750,000	\$ 14,750,000	\$ 14,750,000	\$ 14,750,000
VC Return	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%
Valuation to maintain target	\$24,418,750	\$24,418,750	\$24,418,750	\$24,418,750	\$24,418,750	\$24,418,750	\$24,418,750	\$24,418,750	\$24,418,750	\$24,418,750

As one can see from the results above, these securities have a much greater value than the initial investment (\$5m) or FVM or converted common stock value (\$3.20) for SVM. In most cases (except non-participating securities), the venture capitalist's return is actually in excess of the 30% demanded.

The fact that there is a discrepancy between the implication of the IRR and security valuations demonstrates how the venture capital method is an imperfect method of valuation, and shows the model's vulnerability to the incorrect no-arbitrage assumption.

This "valuation to maintain target" feature should be very useful in negotiations as this is the fair value that the venture capitalist should accept if he/she was serious about only wanting a 30% return.



## The Future

The most logical areas to extend this research would be to tackle the limitations of the model:

- This model could be complemented by another model for the assumptions:
  - The expected year of sale/IPO/liquidation
  - The expected value of sale/IPO/liquidation
  - The probability of IPO vs. sale/liquidation
  - The volatility of the firm's equity
- Including a feature where by the effects of predicted subsequent financing rounds can be included
- Including a feature to account for preferred:common conversion ratios that are not 1:1
- Including a feature to account for the possibility or probability of an IPO, and the returns that would be generated
  - An extension of this would be to use real options framework to account for shareholder control over timing and likelihood of IPO, although Dr. Fluck has made a good start on this subject
- Modeling venture capital returns in comparison with actual common stock returns, not "common stock" (as if all venture capital securities were converted)
- Researching some way to overcome the limitations of Black-Scholes, perhaps using binomial lattices

## Acknowledgements - A Note of Gratitude

Although this is a paper on valuing venture capital securities, I started this year with the intention of investigating valuation methods for privately held firms, a subject which gradually morphed into investigations on: discounts for liquidity, premiums for control, entrepreneurial corporate governance and valuing the venture capitalist's right to fire the entrepreneur. Thus, over the past year, I have had the good fortune of receiving help and advice from a variety of sources on a variety of subjects relating to the many different stages of this paper. I would like to take this opportunity to thank:

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