Fundamentals of ENTREPRENEURIAL FINANCE

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4

Ownership and Returns

Learning Goals

In this chapter students will learn:

1. What is the relationship between investment amount, ownership shares, valuation, dilution, and returns.
2. To derive the allocation and prices of shares, as well as a company's pre- and post-money valuations.
3. How to analyze investor returns using alternative return measures.
4. Principles for how founders allocate ownership shares within a team.

This chapter examines what determines the split of ownership between investors and entrepreneurs. It explains the mechanical relationships between investment amounts, ownership shares, and the pre-money and post-money valuation of a company. The chapter also establishes how to compute the returns to investors. It discusses the relative merits of three alternative measures of investor returns: net present value, cash-on-cash, and internal rate of return. The chapter further analyzes the economic determinants of valuations. The final part examines how founder teams allocate founder shares internally and provides a practical tool for how to negotiate founder agreements.

4.1 The Mechanics of Ownership and Valuation

4.1.1 Pre-Money and Post-Money Valuation

In this chapter we explain the basic mechanical relationships between investment, ownership shares, and valuation. We first show how a venture's ownership structure is determined for a given valuation. We then turn to explaining how ownership evolves over time and how it generates returns for investors.

We start with the simple case of a company that receives a single round of financing from a single investor. Later in the chapter we extend the analysis by including the role of stock options and multiple rounds of financing. Throughout the chapter we assume that investors get common equity. This

means they own a fraction of the company that is given by the percentage of shares they own. With common equity, all shareholders hold shares that have the same rights. We delay the discussion of more complex types of equity until Chapter 6.

An investment is an economic exchange in which the investor contributes an amount of money to the company and receives in return shares that represent an ownership stake. The corresponding valuation reflects the investor's willingness to accept a certain ownership stake of the company in return for his investment. The value of this stake is purely hypothetical ("paper money"), as the company has no market for its shares (yet). We can describe the fundamental relationship between investment, ownership, and valuation as follows:

$$\text{Investment} = \text{Ownership}^{*}\text{Valuation} \tag{4.1}$$

The left-hand side of this equation describes what the investor contributes, namely, the investment amount. The right-hand side describes what the investor receives in return, namely, some ownership fraction in the company that is given a certain valuation. This equation implies that we only need to know two out of the three quantities, and the third falls out mechanically. Therefore, if we know how much money the investor contributes and what ownership he gets in return, then the valuation is mechanically given by:

$$\text{Valuation} = \text{Investment}/\text{Ownership} \tag{4.2}$$

To get a practical sense of how to make use of this formula, Box 4.1 takes a brief look at the world of TV reality shows.

Box 4.1 Tales from the Venture Archives: Of Snappy Dragons

TV buffs with an interest in entrepreneurship have a special affinity to dragons, tigers, or sharks, depending on where they live. It all started in 2001 with a Japanese TV show called "The Tigers of Money" which featured entrepreneurs pitching business ideas to fierce-looking investors in front of TV cameras. The format rapidly spread under a variety of names. The UK adopted the show's format in 2005, under the name of "Dragon's Den." Canada followed in 2006 with its Dragon's Den. In the U.S. the format was launched in 2009 under the name of "Shark Tank."[1]

In these TV shows entrepreneurs pitch their ideas to a fearsome set of investors, the "dragons" (or sharks or tigers). The investors are typically

experienced businesspeople who also have a flair for show business. They grill the entrepreneurs about various aspects of their venture. Whenever some dragons get interested in a company, they offer a deal. At this point, the entrepreneurs are trained to respond that they are looking for a given investment, in return for a given ownership stake in the company. The dragons then come back with a different offer, typically a lower investment and/or a higher ownership stake. Some drama ensues before they agree on the terms of a deal (or not). Truth be told, after the TV cameras are switched off, the entrepreneurs and investors can always back out of a deal—apparently this happens a lot.[2]

So, if you ever wondered how budding entrepreneurs value their companies, all you need to do is watch lots of those episodes. When the dragons make an offer, you can infer the valuation by dividing the investment amount (X) by the ownership percentage (Y). For example, Corla Rokochy from Saskatchewan, Canada, a mother of five children, presented the idea of "Snappy Socks."[3] She had a brilliant solution to the ubiquitous problem of the single sock that disappears in the laundry. Her invention was a pair of socks with a snap to hold them together. This way no single sock could ever disappear on its own (and apparently socks never disappear in pairs). Two intrigued dragons, Arlene Dickinson and Brent Wilson, seized opportunity and offered $50K for 25% of the company. This implied a valuation of $200K (since $50K / 0.25 = $200K). This was not as much as Snap Inc.'s IPO (see Box 3.2), but certainly enough to secure a lifetime supply of socks for a family of seven! Snappy Socks turned into a successful business, selling online, and through retail outlets such as Toys 'R' Us and Shoppers Drug Mart.

There are two measures of valuation: pre-money valuation refers to company valuation just *prior* to the investment, while post-money valuation refers to how much the company is valued *after* receiving the investment. Equations (4.1) and (4.2) were based on the post-money valuation. The pre-money valuation is obtained by subtracting the investment from post-money valuation:[4]

$$\text{Pre-money valuation} = \text{Post-money valuation} - \text{Investment} \quad (4.3)$$

This equation can also be switched around to obtain:

$$\text{Post-money valuation} = \text{Pre-money valuation} + \text{Investment} \quad (4.4)$$

We now introduce some notation to express these equations more concisely. The amount of investment is denoted by I. We denote the ownership fraction of the pre-investment shareholders by F_{PRE}. For the first financing round, these include the founders. For later rounds, these also include those who invested in the company in previous rounds. We denote the ownership fraction of new investors by F_{INV}, the pre-money valuation by V_{PRE}, and the post-money valuation by V_{POST}. P is the price per share at the time of the investment. Finally, we denote with S the number of shares and distinguish the following amounts: S_{PRE} is the number of shares existing before the investment; S_{INV} is the number of shares issued to the new investors; and S_{POST} is the number of shares after the investments, which is the sum of S_{PRE} and S_{INV}. We summarize the notation in Table 4.1.

Table 4.1 Notation for ownership and investor returns.

Symbol	Meaning
CCR	Cash-on-cash return
d	Discount rate
F_{INV}	Ownership fraction of new investors
F_{PRE}	Ownership fraction of pre-investment shareholders
F_{SOP}	Ownership fraction of the stock options pool
I	Investment amount
IRR	Internal rate of return
NVP	Net present value
S_{INV}	Number of shares of new investors
S_{POST}	Number of shares outstanding after the investment round
S_{PRE}	Number of shares of pre-investment shareholders
S_{SOP}	Number of shares allocated to the stock options pool
t	Time
T	Investment duration
V_{POST}	Post-money valuation
V_{PRE}	Pre-money valuation
X	Exit value

We now restate the four equations we have derived so far using this notation. We keep the same equation numbers as before, to indicate that they are exactly the same equations:

$$I = F_{INV} * V_{POST} \tag{4.1}$$

$$V_{POST} = I/F_{INV} \tag{4.2}$$

$$V_{PRE} = V_{POST} - I \tag{4.3}$$

$$V_{POST} = V_{PRE} + I \tag{4.4}$$

WorkHorse Box 4.1 illustrates these relationships.

WorkHorse Box 4.1 The Ownership and Valuation of WorkHorse

WorkHorse's four founders had presented their business to Michael Archie, a local angel investor. He was favorably impressed and indicated a potential interest in investing. WorkHorse needed .5M. Michael casually mentioned that he would ask for 20%, at a post-money valuation of $2.5M. As far as Astrid was concerned, Michael might well have spoken Chinese, since she had no idea what that meant. After Annie confirmed that indeed Michael had not spoken Chinese, the four founders consulted their favorite entrepreneurial finance book—the one that you are reading right now. They were delighted to find a clear explanation.

Using equations (4.1) to (4.4), they found out what Michael's offer meant. Using equation (4.1), they realized that Michael was proposing to invest the requested .5M in exchange for a 20% share in the company, which he consequently valued as $2.5M:

$$I = \$0.5M = 0.2 * \$2.5M = F_{INV} * V_{POST}$$

The post-money valuation could be computed as:

$$V_{POST} = \$2.5M = \$0.5M/0.2 = I/F_{INV}$$

The pre-money valuation was:

$$V_{PRE} = \$2M = \$2.5M - \$0.5M = V_{POST} - I$$

4.1.2 Price and Number of Shares

So far we have described the investment deal without any reference to shares. This is because the relationship between investment, ownership, and valuation does not depend on the number and price of shares. However, in order to practically implement the deal, it is necessary to define the number and price of shares that the investor gets in return for making the investment.

The first step is to define the number of shares outstanding before the investment, denoted by S_{PRE}. In the first round of financing, the choice of this number turns out to be irrelevant. This is because this number is a so-called numéraire, that is, a scaling factor that changes the number and prices of shares without affecting the ownership fractions.

When the investor makes an investment I, he receives S_{INV} shares, each at a price P. The total number of shares after the round (S_{POST}) consists of the new shares (S_{PRE}) plus those already outstanding before the investment (S_{PRE}):

$$S_{POST} = S_{PRE} + S_{INV} \tag{4.5}$$

The number of new shares is related to the amount invested. Specifically, the amount invested equals the share price times the number of shares received by the investor:

$$I = P * S_{INV} \tag{4.6}$$

The valuation after the investment then equals the share price times the total number of shares:

$$V_{POST} = P * S_{POST} \tag{4.7}$$

Combining equations (4.3), (4.5), (4.6), and (4.7), we obtain the expression for the pre-money valuation as:

$$V_{PRE} = P * S_{PRE} \tag{4.8}$$

This says that, just before the investment, the company's valuation equals the share price times the total number of preexisting shares.

Finally, the relationships between ownership fractions and shares are given by:

$$F_{PRE} = S_{PRE}/S_{POST} \text{ and } F_{INV} = S_{INV}/S_{POST} \tag{4.9}$$

WorkHorse Box 4.2 illustrates this.

WorkHorse Box 4.2 Share Numbers and Prices of WorkHorse

The four founders were curious as to how much their shares would be worth under the deal outlined by Michael Archie. To set a numéraire, Astrid decided that the founders would jointly get 1M shares.

$$S_{PRE} = 1M$$

To calculate the price per share, she solved equation (4.8) for P and obtained:

$$P = V_{PRE}/S_{PRE} = \$2M/1M = \$2$$

With this share price, she transformed equation (4.6) to work out the number of shares the company had to issue to its investors and obtained:

$$S_{INV} = I/P = \$0.5M/\$2 = 0.25M$$

Using this, she computed the company's total number of shares after the investment:

$$S_{POST} = S_{PRE} + S_{INV} = 1M + 0.25M = 1.25M$$

To confirm that the ownership fractions stated by Michael were correct, she noted that he would hold 0.25M out of 1.25M shares, so that:

$$F_{INV} = 0.25M/1.25M = 0.2$$

Since the founders had 1M out of 1.25M shares, their ownership fraction was:

$$F_{PRE} = 1M/1.25M = 0.8$$

Annie was a little unhappy with Astrid's calculations, as she thought that S_{PRE} = 1M shares was a bit stingy. She thought that maybe the four founders should start with S_{PRE} = 4M shares. Bharat quietly took her aside and walked her through the calculations using her alternative number of shares:

$$S_{PRE} = \$4M$$

$$P = V_{PRE}/S_{PRE} = \$2M/4M = \$0.5$$

$$S_{INV} = I/P = \$0.5M/\$0.5 = 1M$$

$$S_{POST} = S_{PRE} + S_{INV} = 4M + 1M = 5M$$

$$F_{INV} = 1M/5M = 0.2$$

$$F_{PRE} = 4M/5M = 0.8$$

Bharat explained that by quadrupling the number of preexisting shares from 1M to 4M, all that would happen is that investors also quadruple their number of shares from 0.25M to 1M. Since investment was still \$0.5M, the share price would mechanically drop to a quarter its previous price, from \$2 to \$0.5. Annie agreed, noting that Bharat was "just too smart a cookie," to which he replied: "It has nothing to do with cookies, it's just understanding what a numéraire is."

4.1.3 Stock Options

The previous section looks at the simple case where there are only two parties, founders and investors. We now augment the base model by noting that companies often use grants of stock-based compensation to defer cash payments to third parties. There are two main methods to grant ownership to third parties. One is to directly give out company shares, and the other is to grant stock options. These two methods are typically directed at different parties, and the details depend on company-specific circumstances. Moreover, personal and corporate taxation rules affect the appeal of stock options.[5]

Granting stock directly is largely done with parties external to the company, such as consultants, suppliers, or licensors (such as a university technology transfer office). They receive common stock in exchange for the goods or services they provide. In general, such stock allocations are used either to reward past contributions or to provide performance incentives, as well as to create loyalty to the company.[6] The average percentage ownership allocated to the recipients of these stocks and stock options is estimated to be around 15% for U.S. VC-backed companies and slightly lower for European companies.[7]

Granting stock options is more common with board members, managers, and employees.[8] Employee Stock Options Plans (commonly known as ESOPs) are an important tool for managing human resources in entrepreneurial companies. A stock option is the right (without obligation) to purchase a given number of common shares from the company at a set price, called the "strike" price, at or after a specified date. Depending on tax and regulatory circumstances, the strike price for employee stock options are either some extremely low nominal value (such as 0.01 cent), or the price of shares from the company's most recent funding round. The idea is that the price of shares will rise and thus allow employees to make a profit by converting their options into shares. Employee stock options are assigned to a specific person and cannot be traded. Once converted, the employees own shares, but typically they cannot sell these either because there is no liquidity until the company has some exit (Box 11.7).

How does the existence of a stock options pool affect the valuation and ownership of a venture? When the investor offers to provide I for an ownership stake F_{INV}, he does not want to pay for any stock options with his investment. This effectively means that the company has to issue shares to provide the stock options. The formulas we derive are based on this case.

We denote by S_{SOP} the number of shares in the "fully diluted" stock options pool. This means that all shares in the option pool are assumed to be converted into common stock. We examine dilution in more detail in Section 4.1.5. The subscript SOP stands for stock options pool. The total number of shares after the investment is now given by equation (4.5-SOP), where the additional term S_{SOP} denotes the presence of a stock options pool:

$$S_{POST} = S_{PRE} + S_{INV} + S_{SOP} \quad (4.5\text{-SOP})$$

Equation (4.8) then becomes:

$$V_{PRE} = P^{*}\left(S_{PRE} + S_{SOP}\right) \quad (4.8\text{-SOP})$$

The presence of a stock options pool changes the interpretation of the pre-money valuation V_{PRE}. In a first round, it no longer represents the value to the founders; instead it represents including the entire stock options pool. In later rounds, V_{PRE} represents the value to all existing shareholders, again including the stock options pool. Naïve founders may erroneously think that the entire pre-money valuation is theirs. With a stock options pool, however, they share the pre-money valuation with the stock options pool. In practice, we advise entrepreneur to always ask whether or not a pre-money valuation offered by an investor includes the stock options pool.

To see how the creation of a stock options pool affects ownership, we reformulate equation (4.9) to identify the ownership fraction of the stock options pool:

$$F_{PRE} = S_{PRE}/S_{POST} \quad (4.9\text{-SOP})$$

$$F_{INV} = S_{INV}/S_{POST}$$

$$F_{SOP} = S_{SOP}/S_{POST}$$

WorkHorse Box 4.3 illustrates stock options.

WorkHorse Box 4.3 The Stock Options Pool

The WorkHorse founders understood from Michael the need to create a stock options pool. When they inquired about how big a stock options pool should be, they were told that start-ups typically allocated 10–20% of founder equity to a stock options pool. The four founders always envisioned building a larger organization, so they embraced the idea of providing equity to attract the talented managers and employees they planned to hire.

They took the equity for the stock options out of their own 1M shares, so that 100K shares would be allocated to the stock options pool. The ownership fraction corresponding to the stock options pool would therefore

be 10% before the seed round and 8% after it. At a price of $2 per share, this implied that $200K of the pre-money valuation of $2M accrued to the stock options pool.

4.1.4 The Capitalization Table

Entrepreneurs and investors need to keep track of who receives and disposes of company shares and when. A capitalization table is a simple representation of the ownership structure of a company. It consists of a table that keeps track of the number of outstanding shares, who owns them, how much they paid for them, when, and how much capital has been put into the company. The capitalization table is sometimes also referred to as the ownership table.

The capitalization table lists three groups of owners of the company: founders, investors, and other parties. For each round, or Series (see Box 1.6), the columns identify for each shareholder: (1) the total number of shares owned, (2) the amount invested in a financing round, (3) the total amount invested so far, and (4) the current ownership fraction. The prices at which the shares were sold in each Series is also indicated.

One of the complications with ownership tables is that some allocations of shares are contingent on certain events. Section 4.1.3, for example, mentioned that stock options typically vest over time. To keep things transparent, capitalization tables represent ownership on a "fully diluted" basis. This assumes that all stock options are converted into common stock. The capitalization table thus represents a complete account of share ownership.

WorkHorse Box 4.4 illustrates the use of capitalization tables, at the time of its first (seed) round of financing.

WorkHorse Box 4.4 WorkHorse's Capitalization Table

The capitalization table for WorkHorse is based on Michael Archie's informal offer in WorkHorse Box 4.1. Michael indicated that for the seed investment in the first round, he would provide half of the money, that is, $250K. For the other half, he indicated that he planned to bring in the Ang brothers who were local angel investors whom he knew well. Michael also indicated that the four founders needed to come clean about who would own the founder shares. There were four issues to be sorted out. First, the four founders needed to write down how they planned to split the founder shares among themselves. Not having discussed the matter yet, they put down an equal number of shares for the time being (see WorkHorse Box 4.8). Second, Brandon's uncle JP Potro had originally provided $80K through a convertible note, whose structure we explain in Section 6.6. This was to convert into 50,000 shares and to be noted under the "Other parties." Third,

the company required an agreement from the University's technology transfer office. Thankfully, the University had an enlightened approach toward student-driven ventures and quickly agreed to transfer all of the relevant intellectual property to the company for a 5% stake, which would also come from founders' shares. Fourth, as shown in WorkHorse Box 4.3, they allocated 10% of founder stock to a stock options pool that could be used for recruiting and retention.

The capitalization table summarizes this distribution of shares and ownership fractions.

First Round (Seed)		**Number of shares purchased**	**Number of shares owned**	**Amount invested in round ($)**	**Total amount invested ($)**	**Ownership fraction**
Price per share ($)	2.00					
Founders:						
	Astrid Dala		200,000	0	0	16.0%
	Annie Ma		200,000	0	0	16.0%
	Bharat Marwari		200,000	0	0	16.0%
	Brandon Potro		200,000	0	0	16.0%
Investors:						
	Michael Archie	125,000	125,000	250,000	250,000	10.0%
	Ang brothers	125,000	125,000	250,000	250,000	10.0%
Other parties:						
	JP Potro		50,000	0	0	4.0%
	U. of Michigan		50,000	0	0	4.0%
	Stock Options Pool		100,000	0	0	8.0%
Total		250,000	1,250,000	500,000	500,000	100%

4.1.5 Dilution with Multiple Rounds

This section is technically more challenging and can be skipped for the first reading of this chapter.

In this section, we examine how a company can raise money across multiple rounds of financing. We encounter the concept of dilution where existing shareholders find their ownership reduced over time as the company issues shares to new investors.

A new round occurs when the company receives a new equity investment. The company issues new shares to the investors. A new share price is set, implying a new valuation. As a result, the ownership fractions of all existing shareholders are mechanically reduced; this is commonly referred to as dilution. To get an understanding of how ownership evolves across multiple rounds, we introduce some notation. We index rounds in which the investors made their investments by the subscript i = 1, 2, . . . R, and associate i = 0 with founder shares that are issued prior to the first round. For simplicity we ignore stock options in this section.

We index the current round for which we denote the ownership stake by r = 1, 2, . . . R, placed within brackets after the variable. Consequently, we denote the ownership stake after round r of investors who invested in round i by $F_i(r)$. For example, $F_1(3)$ denotes the ownership of the first-round investors after the third financing round. Note also that $F_r(r)$ denotes the ownership fraction of the new investors in round r. This is what we call F_{INV} in Section 4.1.1.

We use a similar notation for the number of shares. We denote the number of shares held after round r by investors from round i by the $S_i(r)$. Correspondingly, we denote the number of new shares in round r by $S_r(r)$, which we call S_{INV} in Section 4.1.2. We then denote the total number of shares after round r by $S_{POST}(r)$. Notice also that $F_{POST}(r) = \Sigma_i F_i(r) + F_r(r)$ and $S_{POST}(r) = \Sigma_i S_i(r) + S_r(r)$. Moreover, I(r) denotes the investment amount in round r, and $V_{PRE}(r)$ and $V_{POST}(r)$ denote the pre-money and post-money valuation.

We denote the case of multiple rounds by MR and restate equation (4.1) as follows:

$$I(r) = F_r(r) * V_{POST}(r) \qquad (4.1\text{-MR})$$

We write the relationships between pre- and post-money valuation from equation (4.3) as:

$$V_{PRE}(r) = V_{POST}(r) - I(r) \qquad (4.3\text{-MR})$$

Equations (4.5) and (4.6) become:

$$S_{POST}(r) = S_{POST}(r-1) + S_r(r) \quad (4.5\text{-MR})$$

$$I(r) = P(r) * S_r(r) \quad (4.6\text{-MR})$$

The valuation equations (4.7) and (4.8) become:

$$V_{POST}(r) = P(r) * S_{POST}(r) \quad (4.7\text{-MR})$$

$$V_{PRE}(r) = P(r) * S_{POST}(r-1) \quad (4.8\text{-MR})$$

Finally, the ownership fraction of investor i in round r is now given by:

$$F_i(r) = S_i(r)/S_{POST}(r) \quad (4.9\text{-MR})$$

We then rearrange (4.5-MR) and (4.9-MR) in the following way: $F_i(r) = S_i(r)/S_{POST}(r) = (S_i(r)/S_{POST}(r-1)) * (S_{POST}(r-1)/ S_{POST}(r)) = F_i(r-1)* (S_{POST}(r) - S_{INV}(r))/ S_{POST}(r) = F_i(r-1) * (1 - F_r(r))$. This gives us the following simple formula for computing the dilution of ownership across rounds:

$$F_i(r) = F_i(r-1) * (1 - F_r(r)) \quad (4.10\text{-MR})$$

This equation takes the ownership fraction of investors who originally invested in round i as it stood at the previous round (r–1), $F_i(r–1)$ and transforms it into their ownership at round r by multiplying it by $(1– F_r(r))$ which is one minus the ownership fraction obtained by the new investors in round r. This generates their ownership stake after round r, $F_i(r)$. An important implication of equation (4.10-MR) is that at every investment round all existing shareholders get diluted by the common factor $(1– F_r(r))$. We call this the ownership retention rate. This is an important measure for investors and entrepreneurs, since it gives an idea of how much ownership they will forgo to attract the capital needed to build the company. We discuss the role of the retention rate further in Section 9.2.4.

We conclude that dilution matters to all entrepreneurs and investors because it affects how their ownership stake evolves over time. Dilution reduced the entrepreneur's and previous investors' ownership shares. Investors can avoid dilution by continuing to invest in each round, something we discuss in detail in Section 9.2.1. Importantly, dilution is not bad in itself. The company receives financial resources in exchange for issuing new shares. If these resources sufficiently increase the value of the venture, they are worth obtaining.

As the company receives subsequent financing rounds and shareholders experience dilution, the capitalization table allows the entrepreneur to keep track of how ownership evolves over financing rounds (see WorkHorse Box 4.5).

WorkHorse Box 4.5 WorkHorse's Ownership Dilution Across Investment Rounds

As he was arranging the seed round of financing, Michael Archie thought ahead to a possible second round, in which professional investors' funding would come through in a Series A round. The financial projections suggested that one year later the company would need to raise $2M. For this second round, Michael planned to invest $200K. The Ang brothers were unlikely to participate further. For the remaining $1.8M he planned to ask some of his contacts in the venture capital industry. He hoped that Eagle-I Ventures would lead the A round, contributing $1M. Coyo-T Capital would likely contribute the remaining $800K.

Astrid knew that further funding would entail further dilution. She had been advised that she should expect to give up a quarter of the company at the next round. She wanted to explore what kind of valuation and ownership this would imply. The capitalization table summarizes all her calculations.

Using the equations for multi-round funding, Astrid calculated the founder shares after two rounds, denoted by $F_0(2)$, as follows:

$$F_0(2) = F_0(1) * (1 - F_2(2)) = 0.64 * (1 - 0.25) = 0.48$$

The stock options pool and the other third-party stakes would obtain the following ownership stake:

$$F_{SOP}(2) = F_{SOP}(1) * (1 - F_2(2)) = 0.16 * (1 - 0.25) = 0.12$$

For the first-round investors she obtained:

$$F_1(2) = F_1(1) * (1 - F_2(2)) = 0.20 * (1 - 0.25) = 0.15$$

She also noticed that Michael Archie would purchase 10% of the new shares. This would give him an additional 2.5% ownership stake, so that he could maintain a 10% ownership stake, as noted in the last column of the capitalization table.

Astrid observed that the post-money and pre-money valuations would be:

$$V_{POST}(2) = I(2)/F_2(2) = \$2M/0.25 = \$8M$$

$$V_{PRE}(2) = V_{POST}(2) - I(2) = \$8M - \$2M = \$6M$$

Since the number of existing shares prior to the round was 1.25M, she computed the price of new shares as:

$$P(2) = V_{PRE}(2)/S_{POST}(1) = \$6M/1.25M = \$4.80$$

Astrid noted that while the ownership fraction of the founders was already less than half, the value of their equity had increased considerably. At a price of $4.80, the 0.8M founder shares would already be valued at $3.84M. She wondered why the valuation and price per share had gone up so easily: "Isn't it a struggle for companies to survive and achieve higher valuations over time?" Brandon explained that successful companies are able to raise their next round of financing at a higher valuation, whereas unsuccessful companies typically don't even manage to raise another round. This explains why we see valuation rising over time. The calculations reflect this by using a higher price per share in the second round.

Astrid also computed the number of new shares issued to the new investors as follows:

$$S_2(2) = I(2)/P(2) = \$2M/\$4.80 = 0.417M$$

The number of total shares after two rounds was thus:

$$S_{POST}(2) = S_{POST}(1) + S_2(2) = 1.25M + 0.417M = 1.667M$$

The following capitalization table summarizes WorkHorse's projected ownership structure after the second round.

	Second Round (Venture Series A)	Number of shares purchased	Number of shares owned	Amount invested in round ($)	Total amount invested ($)	Ownership fraction
Price per share ($)	4.80					
Founders:						
	Astrid Dala		200,000	0	0	12.0%
	Annie Ma		200,000	0	0	12.0%
	Bharat Marwari		200,000	0	0	12.0%
	Brandon Potro		200,000	0	0	12.0%
Investors:						
	Michael Archie	41,667	166,667	200,000	450,000	10.0%
	Ang brothers	0	125,000	0	250,000	7.5%
	Eagle-I Ventures	208,333	208,333	1,000,000	1,000,000	12.5%
	Coyo-T Capital	166,667	166,667	800,000	800,000	10.0%
Other parties:						
	JP Potro	0	50,000	0	0	3.0%
	U. of Michigan	0	50,000	0	0	3.0%
	Stock Options Pool	0	100,000	0	0	6.0%
Total		416,667	1,666,667	2,000,000	2,500,000	100%

4.2 Investor Returns

4.2.1 Risk and Return

Investors provide money with the goal of earning a profit, so they base their investment decisions on the returns they expect to earn from the investment.

In this section, we review common measures of returns and discuss their advantages and limitations in the context of entrepreneurial finance.

A basic result of finance is that higher returns can only be achieved by taking on more risk: if two projects have the same risk, the one with a higher return would be in higher demand, it would become more expensive, and its return would become lower. This basic trade-off between risk and return allows us to approach entrepreneurial investments from the right angle.

To understand the relationship between risk and return let us first look at how risk is often misunderstood. Consider a risky investment that yields $100 (net of the invested amount) with 60% probability and nothing with 40% probability. This investment therefore has an expected (net) outcome of $60. If we compare it against an alternative safe investment that yields a guaranteed $100 (net), the risky investment is clearly worse: it never returns more than the safe one, and it may well return less. Here risk is the possibility that something can go wrong. Therefore, this is not a sensible comparison. Compare instead the above risky investment to a safe investment that returns $50 with certainty. Some people prefer the risky investment, considering that its expected return of $60 is above the safe return of $50. Others, however, may prefer the safe investment because the risk of the bad outcome that returns zero is too painful for them to contemplate. Risk is not simply that things can go wrong; instead, risk describes uncertainty around an expected return.

Next, consider an investor who has funded a project that has an expected return of 10% and a certain level of risk. A 10% return means the investor expects to obtain back the invested sum increased by 10%. If there was another project also with an expected return of 10% but with lower risk, the investor would prefer this latter one. This is because investors are typically "risk averse"; that is, they prefer safer projects to riskier ones, for a given expected return. Our investor will then prefer to pay more for the project with a lower risk. This will reduce that project's expected return: the investor pays more, but the project yields the same expected outcome. Projects with higher risk, therefore, can attract investors only if they offer a higher return.

The trade-off between risk and return is central to finance, and textbooks devote much attention to this topic and its implications for investment decisions.[9] For example, finance scholars have developed elaborate measures for comparing different distributions of risk, and there is an important distinction between diversifiable and non-diversifiable risks. Here we focus on addressing two important questions about the risk of financing entrepreneurial ventures.

The first question is whether one has to be a "risk-lover" to invest in entrepreneurial ventures. Here the answer is no. Risk-loving means preferring higher risk over lower risk, which resembles gambling. Most venture investors are not risk-lovers; they prefer lower over higher risk. However,

venture investors are clearly willing to take on substantial risk. The right way to describe them is as those having a high-risk tolerance. In addition, venture investors tend to believe that they possess the skills, resources, and willingness to reduce the risk by guiding the company through the challenges of the entrepreneurial process. Therefore, we should think of venture investors not as risk-lovers, but as risk-tolerant investors who work toward reducing risks.[10]

The second question asks what is different about the returns to venture investing, compared to other risky investments, such as investing in the stock market. There are many differences, but two of them stand out. First, the risk of investing in entrepreneurial ventures can be extreme. It is possible to generate extremely high returns—think of investing in Amazon or Alibaba—but it is also possible to lose everything. Statisticians call this property skewness, where the distribution of returns is asymmetric. Specifically, returns to venture investing exhibit "right skew" with what is called a "long right tail." While there is a chance of achieving extremely high returns, the probability of it is very low. The much more frequent outcomes are low returns where investors lose all or most of the investment. With a right skew distribution, average returns are higher than median returns.[11] Figure 4.1 illustrates this graphically.

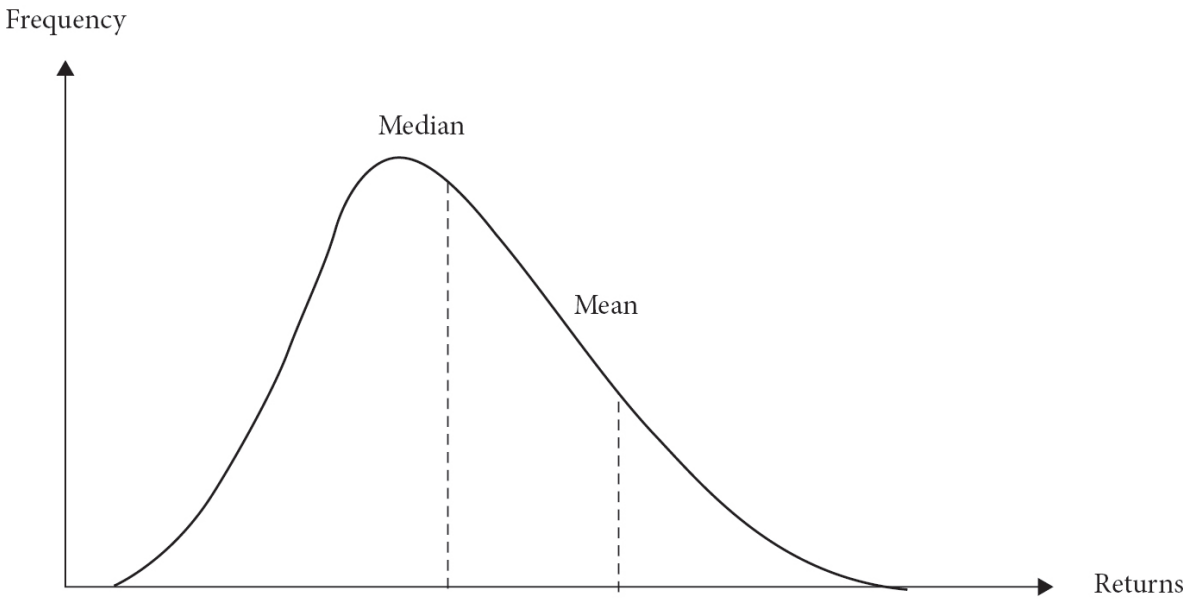

Figure 4.1. Skewed returns.

Second, there is liquidity risk in financing entrepreneurial ventures. In the stock market, one can buy and sell shares in seconds; this is called a liquid market. Selling shares in private company is considerably slower, with investors often having to wait years before they can sell their shares (see Chapter 11).

Here we make a distinction between realized and expected returns. The cash flows of an investor consist of making one or several investments over time and then waiting for an exit to realize a return. Realized returns are based on a backward-looking perspective of measuring what happened since the time of investment. Expected returns, by contrast, are forward-looking and measure what investors expect to happen in the future. Expected returns are often used to express what investors require before agreeing to make an investment. Our focus in this section is mostly on realized returns, although in Section 4.3.1 we also discuss expected returns.

4.2.2 Three Measures of Return

A lively debate has arisen among finance scholars and practitioners as to what measures of returns should be used in entrepreneurial finance. In this section, we describe the three most common measures used in practice. To motivate them, consider the responses from a survey by Gompers, Kaplan, and Mukharlyamov, which asked venture capitalists what financial metrics they used for analyzing investments.[12] 63% of the respondents reported use of cash-on-cash multiples, 42% internal rates of return, 22% net present value, 8% other measures, and 9% none. On average, respondents make use of two measures. This evidence suggests that investors use a variety of measures and that no single measure addresses everything.

We illustrate the three return measures in the simple case with only one investment round. In Section 4.2.4, we then consider returns with multiple rounds of investments. In start-ups, returns are entirely driven by the value of the company at exit, which we denote by X. In case of an acquisition, X is the acquisition price, net of any payments to existing debt holders. In case of an IPO, X is the company's market capitalization at the end of the so-called lock-up period, when investors are typically allowed to start selling their shares (Section 11.2.3). At the time of exit, investors receive an amount of money equal to their ownership share of the company times the exit value. We denote this amount by:

$$X_{INV} = F_{INV} * X \tag{4.11}$$

Notice that, correspondingly, the entrepreneur's share of the exit value is given by $X_{ENT} = F_{ENT} * X$. We denote the discount rate by d. The time between the investment and exit (investment duration) is denoted by T.

The standard criterion for financial investment decision is the net present value (NPV).[13] It is based on discounting back to the present all future cash flows. Box 4.2 provides an brief introduction.

Box 4.2 The Time Value of Money

To understand discounting, suppose first we invest one dollar today in a safe asset and earn back the same dollar plus some interest next year. One dollar today is worth more than one dollar in one year because we can earn some interest over this period. This gives rise to what financial economists call the time value of money. We can put this reasoning in a formula. Suppose that investing a sum I over one year earns interest d. The *future value* of I, which we denote by FV(I), is given by:

$$FV(I) = I + dI = I(1+d)$$

This equation expresses the value of I today as what it will be worth in one year. Having I today or I(1 + d) in one year are equivalent, since we can always obtain FV(I) by investing I today.

We use this equation to derive the *present value* of what we can earn in one year. We can rewrite the above equation as I = FV(I)/(1 + d). At this point, it is useful to define X as the forward value of I, that is, X = FV(I) = I(1 + d). Next we denote the present value of a future return X by PV(X). In our example, PV(X) = I, or:

$$PV(X) = X/(1+d)$$

This formula expresses the basic idea of discounting, which means moving the value of a sum X back from next year to today. In this formulation, d is called the discount rate.

If an investment lasts more than one year, we simply consider that each year the value of the investment is reinvested at the same interest rate. In T years, the investment I becomes:

$$FV(I) = I(1+d)^{T}$$

Correspondingly, discounting a return X back across T years gives:

$$PV(X) = X/(1+d)^{T}$$

The NPV of an investment is derived by the present value by subtracting the cost of the investment. In the simple case where investors provide an initial investment and then wait to exit the company after T years, the NPV is given by the present value of the investor's share of the exit value defined in (4.11), minus the investment I:

$$NPV = X_{INV} / (1+d)^{T} - I \tag{4.12}$$

The NPV is used to make investment decisions. If the NPV is negative, the investor should refrain from making the investment because the present value of future cash flows exceeds the cost of making the investment. If the NPV is positive, then the investor has a net gain from it and can use it to compare alternative investment projects. The NPV is scale-dependent, which sometimes makes it difficult to compare alternative investments.

What makes use of the NPV criterion difficult in an entrepreneurial finance context is the estimation of an appropriate discount rate. An appropriate discount rate should reflect the cash flow patterns and systematic risk of comparable companies, but these are difficult to pin down. Moreover, different investors might have different costs of capital. For example, business angels, who invest their own funds, have a lower cost of capital than venture capital firms, which raise funds from institutional investors (see Chapter 12). Without a proper value for the discount rate to properly move cash flows back in time, the NPV may become a poor measure to compute and compare returns (Section 5.2.3).

A popular return measure is the cash-on-cash multiple, which we abbreviate as CCM. It measures how many times the amount originally invested is returned to the investor at exit:

$$CCM = X_{INV} / I \tag{4.13}$$

The appeal of this return measure is its simplicity. Its major weakness is that it fails to account for the timing of cash flows, so that receiving the same exit value in one year or in one decade yields the same return. This is particularly relevant in venture investing, where the time to exit is often several years long. Beyond disregarding the time value of money, the CCM also disregards the amount of risk that one bears to receive a certain exit value, so that doubling the amount invested in a risky new venture is considered equivalent to doubling it on a safe government bond.

The third measure of returns that we consider is the internal rate of return, or IRR. This measure is also widely used in practice. However, it has some

important shortcomings, such as favoring returns over short horizons and not accounting for risk.

The IRR is defined as the discount rate corresponding to an investment's zero NPV. Setting NPV = 0 in (4.12), we obtain the following equation:

$$I * (1+IRR)^{T} = X_{INV} \tag{4.14}$$

The IRR is therefore defined by an implicit equation. In the case of a single period, one easily obtains IRR = (F_{INV}*X/I) – 1, but in the case of multiple investment rounds the equation can only be solved numerically. Spreadsheet tools can perform the required calculations.

4.2.3 Comparing Return Measures

We now compare the three return measures. Both IRR and CCM fail to take risk into account. The CCM also does not account for the timing of cash flows. The NPV, on the other hand, requires choosing a suitable discount rate. To compare the CCM with the IRR, we combine equations (4.13) and (4.14) and obtain the following simple relationship:

$$CCM = (1+IRR)^{T} \tag{4.15}$$

Based on this, Table 4.2 shows how different CCM and different time horizons result in different IRRs.

Table 4.2 IRR Values Corresponding to Different CCM Values and Time Horizons.

		Cash-on-Cash Multiples (CCM)						
		0.5	**1**	**2**	**3**	**4**	**5**	**10**
Time horizon (years)	0.5	–75%	0%	300%	800%	1,500%	2,400%	9,900%
	1	–50%	0%	100%	200%	300%	400%	900%
	2	–29%	0%	41%	73%	100%	124%	216%
	3	–21%	0%	26%	44%	59%	71%	115%
	4	–16%	0%	19%	32%	41%	50%	78%
	5	–13%	0%	15%	25%	32%	38%	58%
	6	–11%	0%	12%	20%	26%	31%	47%
	8	–8%	0%	9%	15%	19%	22%	33%
	10	–7%	0%	7%	12%	15%	17%	26%
	15	–5%	0%	5%	8%	10%	11%	17%
	20	–3%	0%	4%	6%	7%	8%	12%

Table 4.2 shows that CCMs do not vary with the time horizon, as every column has the same CCM. The IRR instead does: within every column, the IRR decreases with the time horizon. This means that investments with different time horizons cannot be compared on the basis of CCM. However, even the IRR can be misleading when comparing investments with different time horizons. For example, consider two investments, one that doubles in two years and one that quadruples in four years. Even though both generate an IRR of 41%, investors are likely to prefer the project with CCM of four over four years than the one with CCM of two over two years. This is because the high returns to the former investment last far longer. Comparing two investments at different time horizons requires some adjustments to compare them on the same time period. A common approach is to extend the shorter project to match the longer one. This means assuming that one would reinvest the money from the first investment at an IRR of 41% for two more years, which is difficult. Hence, most investors would prefer the former over the latter. More generally, we note that deciding based on the IRR favors projects with short time horizons when the IRR is high and favors projects with long horizons when the IRR is low.

The solution to this problem is to use the NPV. For example, at a 15% discount rate, an investment of $100 with a CCM of four over four years yields an NPV of $112, compared to an NPV of $45 for a CCM of two over two years. The advantage of the NPV is that different investments with different time horizons can be compared with each other. The main disadvantage of the NPV is that it requires choosing a suitable discount rate, which is precisely what enables the comparison across different time horizons. The NPV therefore provides a sound basis for comparisons and decision making, although it is a less convincing choice for reporting purposes. By contrast, CCM and IRR have serious limitations for decision making but are routinely used for reporting purposes, precisely because they do not require any further assumptions about discount rates.

We close this section with two comments. First, we have focused so far on computing investor returns. One can also look at returns from the entire company's perspective. Company returns include the returns to all shareholders: investors, founders, and stock option recipients. The latter two typically do not invest any financial capital but do receive some cash at exit. Since they include these additional gains, company returns are therefore mechanically higher than investor returns. We can think of the additional returns as compensation for the contributions provided by founders and stock option recipients. Founders provide the initial idea, the ability to execute it, and labor; stock option recipients mainly contribute labor. Measuring company returns is a straightforward extension of measuring investor returns. All that is needed is to replace X_{INV} with X.

Second, if we can calculate investor returns and company returns, shouldn't we also calculate the entrepreneurs' returns? Unfortunately, the standard return measures often do not work for founders or employees. This is because they receive financial gains but typically do not invest much cash. That is, their financial investments are insignificant relative to the ideas and labor they provide. Computing financial returns for entrepreneurs therefore has little meaning. Instead of looking at return measures, we recommend looking at entrepreneurs' financial gains, as given by X_{ENT} in (4.11).

WorkHorse Box 4.6 looks at all these return measures.

WorkHorse Box 4.6 The Ang Brothers' Return Calculations

Michael Archie was excited about WorkHorse and mentioned it as a co-investment opportunity to the Ang brothers. They were two wealthy brothers who were active angel investors. They had an investment philosophy of co-investing with others for a single round of investment. Their hope was that the company would achieve an exit without any additional financing rounds.

The brothers had different opinions about the timing of the exit. Quentin Ang, known as Quick Quentin, hoped WorkHorse would sell after two years. He thought that the company could achieve an exit value of $10M. His brother Simon Ang, known as Slow Simon, thought instead that exiting WorkHorse would take four years and that the company could then be sold for $12.5M. They planned to invest (jointly) $250K in return for 10% of the common equity (see the capitalization table in WorkHorse Box 4.1). Quentin and Simon therefore debated what would be the outcome of the investment. They denoted their respective opinions about exit as Quick and Slow. They expected to receive the following values at exit:

$$X_{Ang}^{Quick} = F_{Quick} * X_{Quick} = 0.1 * \$10M = \$1M$$

$$X_{Ang}^{Slow} = F_{Slow} * X_{Slow} = 0.1 * \$12.5M = \$1.25M$$

The two brothers were curious to compare their return calculations. They began by looking at the NPV, using a 10% discount rate, and calculated their respective NPVs as follows:

$$NPV_{Ang}^{Quick} = \$1M/(1+0.1)^2 - \$250K = \$576K$$

$$NPV_{Ang}^{Slow} = \$1.25M/(1+0.1)^4 - \$250K = \$604K$$

Under the NPV measure, Slow Simon expected to make higher returns. Next they calculated their cash-on-cash multiple as follows:

$$CCM_{Ang}^{Quick} = X_{Ang}^{Quick}/I_{Quick} = \$1M/\$250K = 4$$

$$CCM_{Ang}^{Slow} = X_{Ang}^{Slow}/I_{Slow} = \$1.25M/\$250K = 5$$

Quick Quentin expected to make his money back four times, Slow Simon five times. Again, Simon expected to make higher returns.

Next, they used Table 4.2 to convert these CCMs into IRRs. Quick Quentin's fourfold return over two years corresponded to an IRR of 100%. Slow Simon's fivefold returns over four years corresponded to an IRR of 50%. This time Quick Quentin expected to make the higher returns. This exemplifies the bias toward short-term investment inherent in IRRs.

For curiosity's sake they also calculated company returns using the full .5M seed round investment. Quentin used an exit value of $10M, and Simon used $12.5M. The table below shows both investor and company returns.

	Investor returns		**Company returns**	
Return measure	Quentin	Simon	Quentin	Simon
NPV	$0.58M	$0.60M	$7.76M	$8.04M
CCM	4	5	20	25
IRR	100%	50%	347%	124%

The company returns were dramatically larger than the investor returns. This is because they combined the returns of all parties, including the entrepreneurial gains of the founders and the stock options pool. At the same time, they only counted the capital investments of investors, not the investments of labor (and possibly IP) by the entrepreneurs, employees, and third parties. This shows that company return calculations should be interpreted with caution.

Finally, the two brothers wanted to figure out what the financial gains to entrepreneurs (and other parties) would be. From WorkHorse Box 4.4 they knew that the four founders owned 64% and the other parties (stock options holders, JP Potro, and the University of Michigan) owned 16%. Accordingly, the founders' financial gains at exit would be:

$$X_{ENT}^{Quick} = 0.64 * \$10M = \$6.4M$$

$$X_{ENT}^{Slow} = 0.64 * \$12.5M = \$8M$$

The financial gains to stock option holders would be:

$$X_{SOP}^{Quick} = 0.16 * \$10M = \$1.6M$$

$$X_{SOP}^{Slow} = 0.16 * \$12.5M = \$2M$$

All in all, the Ang brothers were impressed by the potential of the deal and agreed to be part of the deal.

4.2.4 Returns with Multiple Rounds

This section is technically more challenging and can be skipped for the first reading of this chapter.

In this section, we show how to generalize the return measures to the case of investments with multiple rounds. We focus on round-level returns, which measure the returns of all investors who participated in a specific round. As in Section 4.1.5, we index the current round by r = 1,2, . . . ,R. We include exit as the round after the Rth round, writing r = EXIT. Since the exit round doesn't involve any investment, ownership stakes do not change between round R and exit, and we can use the ownership fractions after round R for the exit, too. Recall that an investor's ownership stake from round i, after round r, is denoted by $F_i(r)$. We thus write:

$$F_i(EXIT) = F_i(R) \tag{4.16}$$

The value of the investor's ownership stake at the time of exit is thus given by:

$$X_i = F_i(R) * X \tag{4.17}$$

We denote investment dates by t(r) and the period of time between the investment at t(i) and the current round at t(r), by $\tau_i(r)$ = t(r)—t(i). For example, $T_1(4)$ stands for the period of time between the first and the fourth rounds, and $T_i(EXIT)$ stands for the period of time between the ith round and exit.

We use MR to identify formulas with multiple rounds, and we write:

$$NPV_i = \frac{X_i}{(1+d)^{T_i(EXIT)}} - I(i) \quad (4.12\text{-MR})$$

$$CCM_i = \frac{X_i}{I(i)} \quad (4.13\text{-MR})$$

$$I(i) * (1+IRR_i)^{T_i(EXIT)} = X_i \quad (4.14\text{-MR})$$

WorkHorse Box 4.7 illustrates how this works.

WorkHorse Box 4.7 WorkHorse's Returns with Multiple Rounds of Investments

Michael Archie thought that the Ang brothers were unrealistic in their belief that WorkHorse would exit after a single investment round. He agreed with the company's financial projections which foresaw a second round of $2M after one year. Furthermore, he thought that if everything went well, an exit at $12.5M after four years was a realistic goal. Based on that he calculated the various return measures for the first round and second round investors.

Michael Archie used the deal structure outlined in WorkHorse Box 4.5, which involves two rounds, so that R = 2. Using the information from WorkHorse Box 4.5, he calculated:

	Round 1	**Round 2**
Ownership	$F_1(2)$=0.15	$F_2(2)$=0.25
Value at exit	X_1=$1.875M	X_2=$3.125M
Investment	I(1)=$0.5M	I(2)=$2M

With this information, he calculated the CCMs as follows

$$CCM_1 = \frac{\$1.875M}{\$0.5M} = 3.75, \quad CCM_2 = \frac{\$3.125M}{\$2M} = 1.56$$

For the round IRRs he solved:

$$0 = \frac{\$1.875M}{(1+IRR_1)^4} - \$0.5M \quad \text{and} \quad 0 = \frac{\$3.125M}{(1+IRR_2)^4} - \frac{\$2M}{(1+IRR_2)^1}$$

This yielded $IRR_1 = 39.16\%$ and $IRR_2 = 16.04\%$.

Note that the formula for IRR_2 calculates everything back to the time of the first round. It is also possible to calculate everything back to the time of the second round. This makes no difference; exactly the same result obtains.

For the NPV he calculated:

$$NPV_1 = \frac{\$1.875M}{(1+0.1)^4} - \$0.5M = \$0.71M$$

$$NPV_2 = \frac{\$3.125M}{(1+0.1)^4} - \frac{\$2M}{(1+0.1)^1} = \$0.29M$$

Clearly, Michael Archie's returns were lower than those of the Ang brothers. Still they suggested that WorkHorse could be an attractive investment.

Finally, we note that equations (4.12-MR) to (4.14-MR) calculate the returns for an investor in round i. One can also write down formulas to describe the returns for investors who invest across multiple rounds and, similarly, the returns of all investors across all rounds. Since these formulas are rather complex, we report them in the book's website (www.entrepreneurialfinance.net).

4.3 The Determinants of Valuation and Returns

4.3.1 The Relationship Between Valuation and Returns

In this section we establish some important insights about the relationship between valuation, investor returns, and exit values. For simplicity, we focus on the simplest case where there is only a single investment round, and we consider only the CCM return measure. However, all the insights in this section apply to all return measures, as well as to returns over multiple investment rounds.

We first combine equations (4.2) and (4.13) to obtain:

$$CCM = X/V_{POST} \tag{4.18}$$

This says that the cash-on-cash realized return equals the exit value (X) divided by the company's post-money valuation (V_{POST}). With this relationship we establish two useful insights:

Insight 1: For a given post-money valuation (V_{POST}), a higher exit value (X) leads to a higher realized investor return (CCM).

Insight 2: For a given exit value (X), a higher post-money valuation (V_{POST}) leads to a lower realized investor return (CCM).

The simple message of these insights is that investors make higher returns when exit values are higher, but they make lower returns when the company's post-money valuation at the time of the investment is higher. This is basically just restating the well-known investor maxim "buy low (low V_{POST}) and sell high (high X)."

It is worth contrasting the investors' perspective with the entrepreneur's perspective. We have already noted that financial return measures may not be appropriate for the entrepreneur, who is investing mainly labor and not capital. Instead, we focus on the entrepreneur's gains at the time of exit X_{ENT}. Combining equations (4.1) and (4.16), and noting that $F_{ENT} = (1 - F_{INV})$, we can rewrite X_{ENT} as follows:

$$X_{ENT} = \left(1 - \frac{I}{V_{POST}}\right)X \tag{4.19}$$

This equation allows us to establish two additional insights:

Insight 3: For a given post-money valuation (V_{POST}), a higher exit value (X) leads to a higher entrepreneurial gain (X_{ENT}).

Insight 4: For a given exit value (X), a higher post-money valuation (V_{POST}) leads to a higher entrepreneurial gain (X_{ENT}).

Insight 3 mirrors Insight 1 and says that entrepreneurs, too, benefit from higher exit values. Insight 4, however, contrasts with Insight 2. Entrepreneurs make larger gains when the company's valuation at the time of the investment is higher. This is the exact opposite of investors, exposing a fundamental tension between entrepreneurs and investors. While both want the company to succeed in terms of achieving a higher exit value (X), they have opposing economic incentives concerning valuation at the time of the investment. For a given exit value, the entrepreneur wants a higher valuation and the investor a lower one. Note, however, that this is not necessarily true if we compare valuations offered by different investors, as we show in Section 4.3.2.

These four insights are based on realized returns and explain how they are affected by valuation. We can also use equation (4.18) to derive a formula for what the post-money valuation "should" be, by using a forward-looking perspective. For this purpose, we consider expected returns, not realized returns. By "expected" we mean the investor's required return, that is, the return the investor expects to achieve in order to commit his or her money. We add a superscript "e" to indicate expectations.

$$V_{POST} = X^e / CCM^e \tag{4.20}$$

This equation will be the starting point for Chapter 5 where we examine how to practically estimate a valuation with the available data. In preparation for that, we set some foundations here by providing two additional insights about the relationship between the valuation, the expected exit values, and the investor's expected returns.

Insight 5: For a given expected return (CCM^e), a higher expected exit value (X^e) leads to a higher post-money valuation (V_{POST}).

Insight 6: For a given expected exit value (X^e), a higher expected return (CCM^e) leads to a lower post-money valuation (V_{POST}).

Insight 5 reveals that investors are willing to pay a higher post-money valuation if they expect a better exit outcome. Insight 6 reveals that investors who expect to achieve a higher return only pay a lower post-money valuation. The difference between Insight 5 and 6 is that the former concerns beliefs about the company's performance—a more positive belief leads to a higher

valuation—whereas the latter concerns the investor's return requirements—a higher expected return leads to a lower valuation.

4.3.2 The Economic Determinants of Valuation

What determines venture valuation? In this section, we consider the important role of some economic forces. Clearly, the quality of the underlying opportunity matters (see Chapter 2), but there are other economic forces at work too. Box 4.3 summarizes some research insights.

Box 4.3 Economic Determinants of Valuation.

What economic forces affect start-up valuations? One study by Gompers and Lerner looks at a sample of deals from across the U.S. over an eight-year period.[14] One important finding is that venture capital valuations go up when the stock market goes up, and vice versa. A separate finding is that valuations increase with the amount of money raised by local VC funds. The effect is most pronounced in the largest, most competitive markets, such as California. The authors explain this effect as "money-chasing deals," where a larger number of investors are chasing a limited number of attractive deals. The first effect suggests that stock markets drive valuations, and the second that deal competition matters.

Another seminal paper, by David Hsu, uses valuation data from start-ups who received multiple offers from different investors at the same time.[15] The uniqueness of this data is that one can compare how different investors bid for the same company. The key result is that higher quality and better networked investors offer lower valuations. Importantly, entrepreneurs frequently accept those lower offers, effectively giving up more ownership. The study argues that entrepreneurs are willing to do so because they believe that the venture benefits from having higher quality investors on board.

We identify four important economic determinants of company valuation: the opportunity itself, the market context, deal competition, and investor quality. We can immediately see the effect for the first two determinants by using Insight 5 in Section 4.3.1. Better opportunities promise a higher expected exit value, which justifies a higher valuation. A rising stock market has a similar effect. Higher stock markets values suggest that start-ups can expect higher exit values, either when they go public themselves or when they get acquired by a listed company. Hot markets can be driven by technological breakthroughs, demographic trends, regulatory reforms, and possibly irrational exuberance and asset price bubbles (see also Box 12.1). Acquisitions are driven also by macroeconomic cycles (Section 11.3). In

terms of equation (4.21), we note that the higher valuation (V_{POST}) is justified with higher expected exit values (X^e).

To understand the deal competition, we note that valuations for start-ups are determined through a bargaining process. The valuation is affected by the context of the negotiation and in particular by how much the bargaining power lies with the entrepreneur or with the investor.[16] In Section 7.5 we take a comprehensive look at the negotiation process; here we focus on the role of competition. When competition is absent or weak, the investor is more powerful and can dictate the terms of the deal. The investor takes a larger ownership stake for a given investment, which implies a lower company valuation. This implies in part that the valuation no longer reflects just the value of the opportunity, but now also incorporates the stronger bargaining power of the investor. A company in a very competitive environment may fetch a higher valuation than another company in a less competitive environment, even if the latter has better business fundamentals. Competition can be elicited by entrepreneurs by actively seeking out potentially interested investors or by locating their company in vibrant clusters (Section 14.2). As noted in Box 4.2, competition also reflects the amount of funds available for investment in a given place and time. In terms of equation (4.21), we note that a higher valuation (V_{POST}), due to more competition, can be justified in terms of lower required returns to investors (CCM^e).

To see the effect of investor quality, suppose a high-quality investor is competing against a lower quality investor to invest in a company. The entrepreneur knows that the high-quality investor will add more value to the venture. If the high-quality investor offered the same valuation as the lower quality investor, the entrepreneur would always take the high-quality investor in a heartbeat. Knowing this, the high-quality investor can offer a lower valuation and still get the entrepreneur to take the offer. Thus, if one company gets an offer from a low-quality investor and another from a high-quality investor, then the latter may get a lower valuation. Yet its business opportunity may be stronger, in particular because it benefits from the help of the high-quality investor. This is precisely what Hsu's empirical study, discussed in Box 4.2, documents. In terms of equation (4.21) a higher valuation (V_{POST}) is again justified on the basis of higher expected exit values (X^e), in this case due to the greater value added by more experienced investors (Section 8.3).

Box 4.4 concludes this example by illustrating how valuations can be affected by deal competition and investor quality with a fictional example.

Box 4.4 The Long Road to Getting the Right Valuation

Adi and Sesi Mohoebi, a brother and sister from Maseru, were proud of the mobile phone health app they had developed. It would allow millions of their countrymen to obtain relevant medical information and support. They also believed their company would become a commercial success and be worth $2M at exit. All they needed was an investment of $100K, at the right valuation.

One challenge was that Maseru, the capital of Lesotho in southern Africa, was hardly a hotbed of entrepreneurial finance. The only angel investor in town was Lwazi Lengeloi. He liked the venture and offered the required $100K for an ownership stake of 40%, implying a post-money valuation of $250K. Adi and Sesi appreciated his support but knew that this was not his best offer. They decided to search for other investors. Since Lesotho was a small country, they took the long road to Bloemfontein, the nearest large city in neighboring South Africa. They were fortunate to be introduced to a friend of their uncle's wife, a local angel investor called Elspeth Engelvrou. She liked the business idea and asked for only 25% ownership in return for the investment, thus raising the valuation to $400K. When they reported back to Lwazi about this new offer, he made a final best offer, to invest $100K for 20%, thus further raising the valuation to $500K. Elspeth was not willing to match Lwazi's valuation but offered to introduce them to Pret-A-Investir, a Pretoria-based venture capital firm with a Pan-African investment portfolio. They therefore took the long road to Pretoria, the capital of South Africa. They were delighted to find out that Pret-A-Investir was willing to invest $100K. However, they wanted a third (i.e., 33.33%) of the company, implying a valuation of $300K. To get some clarity, Adi and Sesi put all the information into a table.

	Lwazi	**Elspeth**	**Lwazi**	**Pret-A-Invest**	
	First offer	**Only offer**	**Final offer**	**Adi's view**	**Sesi's view**
Investment ($)	100,000	100,000	100,000	100,000	100,000
Investor stake	40%	25%	20%	33.33%	33.33%
Valuation ($)	250,000	400,000	500,000	300,000	300,000
Exit value ($)	2,000,000	2,000,000	2,000,000	2,000,000	3,000,000
Investor exit value ($)	800,000	500,000	400,000	666,667	1,000,000
Investor CCM	8	5	4	6.67	10
Founder exit value ($)	1,200,000	1,500,000	1,600,000	1,333,333	2,000,000

The two entrepreneurs understood that it came down to a choice between Lwazi's final offers versus Pret-A-Investir's offer. Sesi remarked how powerful competition proved: "We showed Lwazi the exact same venture, but he valued it at $250K before we met Elspeth, and $500K afterwards."

Adi agreed and added: "The quality of a venture is not a reliable indicator of its valuation: deal competition matters, too."

Adi wanted to dismiss Pret-A-Investir's offer because the valuation of $300K was far below Lwazi's final offer. Sesi, however, argued that Pret-A-Investir was a smart investor with considerable experience in mobile services. With their investment, the company could grow far beyond Lesotho and South Africa, and ultimately reach an exit value of $3M. Sesi argued that their share of the expected exit value would thus amount to $2M, not $1.33M. This was now well above the $1.6M from Lwazi's offer. She didn't care about the fact that Pret-A-Investir's valuation was lower. She argued: "Our goal is not to get the highest valuation, but to get the best outcome. Normally, a higher valuation is better for the entrepreneur, but in our case a lower valuation from a higher quality investor is actually better." Adi agreed and added: "Valuations alone are not a reliable indicator of how attractive a deal is: investor quality matters too."

Box 4.4 highlights why valuations need to be interpreted with caution. The same company can attract a higher valuation if there is more competition for the deal. Therefore, one should not necessarily interpret a lower valuation as a sign of a weaker company. Investor quality effects further reinforce this message. More prestigious investors, who can add more value to a company, usually offer lower valuations. From the entrepreneur's perspective, this can still be a good deal, provided the prestigious investor actually adds significant value to the venture.

Let us add one more word of caution about the interpretation of valuations. So far we have focused on why some companies end up with low valuations, such as when there is limited deal competition, or high investor quality. It is also possible that some companies receive inflated valuations when markets are ebullient, as witnessed in the dotcom era. A different reason for getting inflated valuations is the use of complex preferred shares, which we discuss in Box 6.8.

4.4 The Determinants of Founder Ownership

4.4.1 Founder Agreements

Our discussion so far examines the determinants of valuation, and therefore the allocation of share ownership between entrepreneurs and investors. In this section, we address the question of what determines the allocation of share ownership within the founders' team. This question doesn't apply if there is a single founder, but it clearly matters with a team of founders. Furthermore, investors often have questions about the internal division of shares and the

logic behind it. This logic is different from the valuation logic discussed so far in this chapter. In fact, the internal allocation of shares is part of a broader negotiation among founders, which we will now examine.

The first deal in a start-up is often the internal founder agreement. Prior to approaching investors, entrepreneurs first need to bring their own house in order. As soon as there are two or more founders, some founder agreement is needed to define the legal rights and commitments of the various founding parties. Some founder teams address these issues early on in the development of the venture, whereas others wait until they are further along the journey. The latest time for the founder agreement to come together is at the time of structuring an investor term sheet (see Chapter 6). This is because investors want clarity on what these arrangements look like. The optimal timing of founder negotiations is neither too early nor too late. At the very beginning, it is difficult for founders to specify things because of the uncertainties lying ahead. There is also a discovery process of getting to know each other and assessing fit. However, there is a danger of procrastination. Having a founder agreement provides certainty and clarity within the team. Moreover, in the absence of an agreement, there is always a danger that some founders will start the venture on their own, cutting out the others. A key role of the founder agreement is to lay down who is in and thus also who is out.[17]

Founder agreements address five main issues. First, they determine who the members of the team are, typically also what their current and future expected roles are, and how they are expected to change in the future. This creates a shared understanding of who is responsible for what. Second, founder agreements can specify the salaries different founders are to receive. Start-ups typically pay low salaries, though there are exceptions. Third, founder agreements can detail any financial obligations of the company toward individual founders. For example, a founder may need to get repaid for a prior loan or for transferring IP to the company. Fourth, founder agreements determine ownership allocation. This means allocating common shares among the founders, which shapes voting rights, as well as the distribution of the eventual financial gains. Finally, founder agreements can specify contingencies. This means that certain awards (such as the receipt of shares or bonuses) depend on certain milestones. A common arrangement is the vesting of founder shares. This means that the company withholds a portion of founder shares and releases them over time, contingent on the founder still remaining with the company. Similar vesting arrangements are commonly used with employee stock options plans (Section 4.1.3). Other contingencies involve awarding shares that depend on individual founders achieving personal milestones, such as finishing a prototype or signing on a first customer.

How long and hard do founders negotiate their agreements? There is a human inclination to sweep difficult issues under the carpet, yet these

problems are bound to come back later on. A team that undergoes a forthright negotiation process is likely to write a better agreement and forge a stronger bond. Founder agreements may also need to be renegotiated over time. The original agreements may no longer work because individual circumstances change and the roles of individuals in the firms change. Moreover, there are ample opportunities for founders to fall out with each other. Stories of founder conflicts abound. We encounter two examples with the founders of Snap (see Box 3.2) and Stitch Fix (see Box 5.3).[18]

Does someone who considers him- or herself a founder have a claim on the company even if there is no founder agreement? This became a multimillion-dollar question in the case of Facebook, as dramatized in the *Social Network* movie. Facebook founder Mark Zuckerberg was sued by the Winklevoss twins, for allegedly stealing their idea and breaking off on his own. The case was eventually settled for an estimated $65M.[19] Even though there was no legal founder agreement in place, the law can infer that people have formed an implicit partnership. Having a proper founder agreement in place can save serious headaches down the road.

4.4.2 Principles for Internal Allocation

On what basis should teams allocate founder shares? This turns out to be a complex and highly subjective question. The allocation of founder shares not only has financial consequences for individual founders, but may also impact the morale and motivation of the entire team. Unfortunately, there is no objective formula that founders can resort to. Instead, the issue must be resolved through internal negotiation.

The simplest approach to splitting ownership shares is the equal split. This approach says that in a team of n founders, each founder gets the same number of shares, or 1/n of founder shares. This principle has a foundation in an egalitarian approach where each founder is inherently treated the same. This might be because founders fundamentally consider themselves equally worthy or because they find it too difficult to compare one another. Empirical studies of ownership splits within start-up teams suggest that approximately half of all founder's teams opt for the equal split solution.[20]

Although some teams may consider an equal split fair, others might consider an equal split unfair. For example, why would it be fair to give the same equity to two founders if one is working twice as much as another? Or if one has 20 years more experience than the other? Moreover, what may be considered fair by one team may be considered unfair by another. The evidence cited above suggests that the other half of founder teams opt for the unequal split solution.

One academic study by Hellmann and Wasserman examines survey data about the allocation of founder shares within high-tech start-ups.[21] Choosing

an equal split is associated with younger teams (e.g., teams where founders have few years of experience), and more homogenous teams (e.g., teams where founders have similar years of prior work experience). It is also more common in teams that spent less than a day negotiating—the authors call this the "quick handshake." The study finds that teams with equal splits are less likely to subsequently raise external financing. This calls into question the benefit of equal splitting and invites deeper reflections about what principles founder's teams want to adopt for themselves.

So, what principles should be used to allocate founder shares? It is useful to distinguish between backward-looking and forward-looking arguments. Some founder shares are given on the basis of what founders have already contributed, others on the basis of what they plan to do. While forward-looking arguments are clearly important, founders often spend considerable time focusing on past accomplishments. This may be because the past is more objective than the future. Some founders also view share ownership as a backward-looking entitlement rather than a forward-looking reward mechanism. An excessive focus on the past, however, can detract from the vast amount of work that lies ahead and what it will take to make the company a success.

A common backward-looking argument is that certain founders deserve more shares because they had the "original idea." In some cases, such a claim is uncontestable; other times the "original idea" may emerge through interactions among the founders themselves. Moreover, it is often unclear how important the original idea really was, given that the entrepreneurial process involves experimentation and may require numerous pivots (see Box 1.1). The claim to have come up with the original idea is clearer when intellectual property (IP) is involved. If a founder owns some IP, like a patent, and decides to transfer it to the company, then there is a case for rewarding this contribution with additional founder shares. Note, however, that the technology idea is often less important than the ability to further develop and implement the business idea. These contributions are forward-looking and should contribute to the allocation of shares.

Another clear case for backward allocating shares happens when founders contributed financially to the venture. Teams also tend to backward allocate more shares to those founders that have already worked longer on the venture. This might be because they took more risk early on and because they spent more time working on the venture.

Forward-looking arguments for allocating shares are largely based on providing the right incentives for success. To properly appreciate the incentive argument, Box 4.5 explains some of the fundamental insights from the economics of team incentives.

Box 4.5 Nobel Insights on Team Incentives

The 2016 Nobel Prize in Economics went to Bengt Holmström and Oliver Hart "for their contributions to contract theory." We discuss Hart's contributions in Box 6.2; here we focus on Holmström's work.[22]

Holmström is one of the fathers of incentive theory. His seminal 1982 paper formulated a theory of incentives within teams. This theory can be readily applied to the problem of allocating shares among founders. Holmström first shows that in an ideal world each founder would own 100% of the equity and would thus have fully loaded incentives for success. The obvious problem is that this is never possible in a team. Every time one team member gets more equity, her incentives go up, but the incentives of all other team members go down. This is what complicates the allocation of founder equity.

Holmström shows how the relative productivity of different founders should guide the optimal allocation of founder shares. The most productive team members should have the strongest incentives and thus the largest stakes. Prior experience, educational achievements and qualifications, as well as raw talent, are all likely to be correlated with productivity and are therefore likely to be rewarded accordingly. Moreover, different roles can have different performance impacts. A common argument is that the CEO should get a larger stake. This is because the leadership role involves greater responsibilities, has a stronger impact on performance, and therefore needs stronger incentives.

Holmström's analysis also highlights the importance of providing balanced incentives, in particular ensuring that everyone in the team has sufficient incentives to contribute their part. This is particularly important if each team member depends on all others who are also contributing their part. Ignoring the weakest link can bring down the entire team.

Holmström's analysis has broader implications than for founders' equity split. In our context, we can also think of the venture as a team of entrepreneurs and investors and apply Holmström's results to the division of ownership and the valuation problem we discuss in Section 4.1. The balance argument suggests that it is important to avoid extreme valuations. At a very high valuation, the entrepreneur retains a large stake, which is good for her incentives. However, the investor only retains a small stake and therefore has relatively little incentive to add value to the venture (see Chapter 8). Similarly, a very low valuation gives the investor a large stake and thus strong incentives. However, the entrepreneur is left with a low stake. This can be demotivating and can create poor entrepreneurial incentives. Once the entrepreneur is no longer motivated to maximize the financial returns of

the venture, many things can go wrong for the investors—hence the need to provide balance incentives for the venture's success.

Holmström's key insight is that, instead of thinking of the division of shares as a "zero sum game," we can view it as a team incentive problem. The objective is to find a share allocation that balances relative incentives, which will efficiently encourage all relevant parties to work toward the success of the venture.

To put the insights from Box 4.5 into practice, we need to consider the time dimension. Of particular importance is the time commitment of the individual founders. If some founders are committed full-time and others part-time, there is a clear rationale for giving more shares to the full-time founders. Sometimes a founder also has to go from full-time to part-time, either because of unexpected personal circumstances or by choice. Founder agreements can anticipate such eventualities by specifying vesting clauses that are based on the amount of time spent on the venture.

In addition to the incentive issues, the division of founder equity also has to be sensitive to bargaining power. Different founders have different outside opportunities; that is, they face different alternatives of earning money elsewhere. For example, an experienced engineer may have attractive offers from other employers, or an experienced entrepreneur may choose to work on a different venture. Founders with stronger outside options will then obtain additional shares. At the minimum, the final allocation of shares must be such that a founder actually prefers to work for the venture over all other options.

4.4.3 The FAST Tool

In this section, we introduce the Founder Allocation of Shares Tool (or FAST). This is a spreadsheet tool that we developed to help founder teams structure their founder agreements. It combines insights from our own academic research with observations from practice.[23] The book's website (www.entrepreneurialfinance.net) contains an accompanying spreadsheet, using the WorkHorse example, and a technical note that explains in greater detail how to use the tool. Here we provide a shorter outline.

The main output of the FAST spreadsheet is a recommendation on how to split the founder equity, along with suggestions about vesting and milestone contingencies. The inputs to the spreadsheet model are evaluations of the past and future contributions of each founder. This requires assigning relative weights to inherently heterogeneous contributions, thus forcing the team to take a stance on what they value most. The FAST point system is very flexible and easily adapts to users' circumstances and preferences.

Recall from Section 4.4.1 that a founder agreement contains five key elements: (1) team members and roles, (2) salaries, (3) financial obligations,

(4) allocation of share ownership, and (5) contingencies. FAST uses assumptions about (1), (2), and (3) to make a recommendation about points (4) and (5).

FAST is based on the following six-step procedure:

1. Define team members and roles.
2. Define time periods and weights.
3. Allocate points to individual founder contributions.
4. Identify net transfers.
5. Make recommendations for ownership stakes.
6. Make recommendations for contingencies.

WorkHorse Box 4.8 illustrates how FAST works.

WorkHorse Box 4.8 The Founder Agreement

During their initial honeymoon period, the four founders ignored the details of who would own what. This all changed with Michael Archie's e-mail: "I noted U all have same # of shares: are you sure? CU MA" His e-mail unleashed a big discussion among the four founders. Tempers flared for the first time. To turn it into a more constructive discussion, Astrid convened the team to define some general principles for dividing the equity.

Bharat started the meeting by declaring: "The only valid principle is an equal split. We are all equal, and we all started together, so we all get the same number of shares. Let's all shake hands and get back to work." There was an awkward silence, until Annie replied: "I am all for getting back to work quickly, I have to make an urgent call to China, but why should equal shares be fair? What if we all contribute different things or work different amounts?" A wild philosophical debate ensued about the meaning of fairness, until Brandon declared in a loud voice: "Enough of this, let's use FAST!" They looked confused, just as he had hoped, and continued: "Have you never heard of FAST, the Founder Allocation of Shares Tool? It's in my favorite entrepreneurial finance book. Let me show it to you." Intrigued, they gathered around Brandon's FAST spreadsheet and jointly developed the following table.

FAST	Astrid	Brandon	Bharat	Annie	Total	Contingency
Productivity						
Experience, qualifications & talent	0	0	0	0	0	
Roles and responsibilities	0.1	0	0	0	0.1	
Productivity points	1.1	1	1	1	4.1	
Productivity factor	0.268	0.244	0.244	0.244	1	
The past					20%	
Work days	80	40	60	40	220	
Productive work	21.463	9.756	14.634	9.756	55.610	Upfront
Achievements	10	5	10	5	30	Upfront
Outside options	0	0	0	0	0	Upfront
Total	31.463	14.756	24.634	14.756	85.610	
Normalized points	7.350	3.447	5.755	3.447	20.000	
The next year					20%	
Work days	365	365	182.5	365	1277.5	
Productive work	97.927	89.024	44.512	89.024	320.488	Vesting
Achievements	0	0	30	15	45	Conditional
Outside options	10	30	0	20	60	Upfront
Total	107.927	119.024	74.512	124.024	425.488	
Normalized points	10.146	11.189	7.005	11.660	40.000	
After next year					40%	
Work days	365	365	182.5	365	1277.5	
Productive work	97.927	89.024	44.512	89.024	320.488	Vesting
Achievements	0	0	30	0	30	Conditional
Outside options	10	30	0	20	60	Upfront
Total	107.927	119.024	74.512	109.024	410.488	
Normalized points	10.517	11.598	7.261	10.624	40.000	
Across all periods						
Total normalized points	28.014	26.235	20.021	25.731	100	
Transfer adjustments						
Net transfers	0	$98,913	-$12,500	$10,000	$96,413	
Valuation before transfers					$1,503,587	
Valuation after transfers					$1,600,000	
Transfers points	0	6.58	-0.83	0.67	6.41	
Normalized & transfers points	28.014	32.814	19.189	26.396	106.41	
Recommendations						
Ownership share	26.3%	30.8%	18.0%	24.8%	100.0%	

FAST	Astrid	Brandon	Bharat	Annie	Total	Contingency
Share allocation	210,604	246,690	144,264	198,442	800,000	

Step 1 was easy: they already knew their team members and roles. For step 2, they divided time into three periods. The work performed to date was given a weight of 20%. They divided the future into two periods, allocating 40% for the next year, which they felt would be critical, and 40% for everything thereafter.

For step 3 they began by allocating the points for past events. Astrid and Bharat had contributed the most to the original idea, so they received 10 points. Brandon and Annie both received 5 points. None of them had given up any outside opportunities so far, so no points were awarded for that. Next they estimated the number of days they each had spent on the venture so far. Astrid estimated 80 days. Bharat estimated his contribution at 60 days but found it difficult to separate his academic work from time spent on WorkHorse. Brandon and Annie both thought that 40 days was approximately right.

In order to calculate the points for productive work, they had to evaluate relative productivity. They didn't want to fall into the trap of trying to convince each other that their contribution was more important than the others'. Instead they decided to stick to specific criteria. Looking at their experiences, qualifications, and talent, they quickly agreed that there were no clear differences that would justify giving anyone extra points. The debate about roles and responsibilities, however, took an unexpected turn. Astrid thought that they should all get the same points again because each founder had clear and important responsibilities. To her surprise, the others argued that as a CEO, she bore greater responsibility and should therefore get extra points. In the end, Astrid reluctantly agreed but only after negotiating down her points to a very small premium. The resulting productivity factor, whose numbers mechanically add up to 1, gave Astrid a factor of 0.268, compared to 0.244 for the other three. Because she also had worked more days, Astrid ended up with considerably more productive work points than the others. Of the 20 normalized points allocated to the past, Astrid received 7.35, compared to 3.45 for Brandon and Annie and 5.75 for Bharat. Though arbitrary at one level, they liked to frame things in terms of points. It gave them a metric that was easy to use. At the same time, it was one step removed from the actual allocation of shares, making it easier not to get bogged down.

Turning to the all-important next year, Astrid, Brandon, and Annie declared that they would be working full time for the venture. Bharat turned bright red and with a clump in his throat declared that he was unwilling to give up his PhD. To his surprise the others nodded. Astrid responded: "We always knew that, and it makes sense for you to stay at the university. This

way you can help us to stay on top of technology. My question is: How much time will you spend on things related to the company?" Slightly stunned, Bharat responded "Not sure, maybe half." The others nodded, and Brandon entered 182.5 days for him.

The conversation about future achievements focused on personal milestones. Bharat had two clear milestones: deliver a prototype for the WonderFoal and then for the NokotaStar. To give him strong incentives, they allocated 15 points for each milestone. Annie argued that her role of signing up manufacturers in China was equally challenging and convinced them to allocate 15 points for that. Astrid and Brandon didn't think their work involved similarly tangible milestones and refrained from asking for achievement points. All achievement points were to be made contingent on actually meeting the specific milestones.

The discussion about outside options involved some one-upmanship. Brandon argued that, as a freshly minted MBA with finance experience, he was giving up huge salaries, and therefore he asked for 30 points. Annie argued that if she went back to China, she would make a killing working for budding start-ups over there. She also wanted 30 points but settled for 20, mainly to stop Brandon from arguing why finance people always make more money than salespeople. Astrid found it difficult to make an argument about her outside options. In her heart, she only wanted to work on WorkHorse, and never considered anything else. Still, the others insisted on giving her 10 points. Bharat wasn't giving up his PhD, so he received no points for outside options.

The discussion about the remaining 40 points went surprisingly fast, partly because they all found it difficult to imagine what they would be doing one year from now. They agreed that Bharat should get another 30 milestone points, contingent on developing further innovations. The other three couldn't identify obvious milestones and therefore refrained from asking for achievement points. Because Brandon insisted that his outside options would remain better than the others', they simply used the same points as the year before.

They completed step 3 by calculating their total normalized points, Astrid came close to 28, Brandon and Annie close to 26, but Bharat only to 20. He reluctantly conceded that this was fairer than the equal split he originally proposed. He received fewer points, but he was allowed to stay in the PhD program, which was more important to him.

"Are we done?" Annie asked, looking eagerly at her phone. "Not yet," Brandon declared; "step 4 is next. We need to talk about salaries and outstanding financial obligations." In their financial projections (see WorkHorse Box 3.6), they originally assumed a base salary of $25K for the first year, but $85K the second year onward. The immediate question was whether this still applied to Bharat, given his decision to go part-time. After

some debate, the team agreed that his salary had to be cut by half. Bharat looked distinctly unhappy.

Next, Brandon surprised the others by declaring that he would like to forego his salary, in return for more equity. To calculate the NPV of his salary sacrifice, he used a 15% discount rate. To be conservative, he only counted the first two years, calculating an NPV close to $99K.[24] The question was how much equity to give in return for his salary sacrifice. Astrid also noted that Annie had spent $10K of her own money to travel all over China to establish relationships with manufacturers. Still looking unhappy, Bharat suddenly had a new proposal. He didn't like getting only $12.5K in salary the first year. Instead he wanted $25K like everyone else. He was willing to pay for his extra salary by giving up equity. "Fine with us," Astrid replied "but how do we convert all this into shares? How many more shares should Brandon and Annie get, and how many less for Bharat?"

"This bring us to step 5." Brandon declared. "We need to determine a fair price for trading ownership points against compensation claims. This requires estimating the total value of all our founder shares." Astrid proposed: "How about $2M, this is the pre-money valuation Michael Archie gave us." Bharat noted that the value of the founder shares was only $1.6M, as the rest belonged to the stock options pool and other third parties. Even though the deal with Michael Archie was still under negotiation, they all liked the $1.6M figure; for them it represented a reasonable value of their stakes (after transfers). With this, FAST converted their net transfers into transfer points, added them to their normalized points, and finally generated a recommendation for their relative ownership stakes, as shown in the table. Further using the 800,000 founder shares from the capitalization table (see WorkHorse Box 4.4.), FAST calculated the recommended number of shares.

When the normalized points were compared to the final recommendations, Brandon's share went up to 30.84% and Bharat's share decreased to 18.30%, Annie's share was at 24.81%, and Astrid's share ended up at 26.33%: "So much for the CEO getting the biggest share," she thought to herself but quickly remembered that Brandon was given up all his salary. They all felt that the recommendation was reasonable and decided to go with it.

"Are we done now?" asked Annie, once more looking impatiently at her mobile phone. Brandon smiled: "That depends on whether you also want to know how many of your shares you actually get upfront?" Annie looked up again; actually, this was something she did want to know. Brandon shared the following table, which corresponds to step 6 of FAST.

Contingencies	Astrid	Brandon	Bharat	Annie
Contingent shares				
Recommended share allocation	210,604	246,690	144,264	198,442
Number of vesting shares	140,950	160,267	61,408	131,449
Number of milestone shares	0	0	41,387	10,875
Number of upfront shares	69,653	86,423	41,469	56,117
Vesting				
Vesting points - next year	9.206	8.369	4.185	8.369
Vesting points - year after	9.542	8.675	4.337	8.675
Fraction of vesting points	66.9%	65.0%	42.6%	66.2%
Milestones				
Milestone points - next year	0.00	0.00	2.82	1.41
Milestone points - year after	0.00	0.00	2.92	0.00
Fraction of milestones points	0.0%	0.0%	28.7%	5.5%

The table calculates how many shares are unconditionally given upfront, how many are subject to vesting, and how many depend on milestones. This requires calculating the fraction of normalized points that are subject to vesting and milestones. The fractions are then applied to the respective number of shares.

Approximately two-thirds of Astrid's, Brandon's, and Annie's shares were subject to vesting. This was a substantial amount, so the founders were eager to also determine the timing structure of vesting. Brandon reminded them that employee share options often vested over four years, on a quarterly basis, with a one-year cliff (Section 6.3.2). However, no one liked this approach; they wanted something faster and more fine-grained. After some debate, they decided that shares would vest over two years, on a monthly basis, without any cliff. Bharat only had 42.57% vesting shares, but 28.69% of his shares depended on milestones. They had already specified the first milestones but decided to leave the details of the remaining two milestones unspecified for the time being.

Amazed at how quickly and smoothly they had forged a complex founder agreement, Brandon proposed they shake hands—they always did that in the movies he liked to watch. Instead, Astrid gave him a big hug. "Are we done now?" asked Annie again. Brandon laughed: "It all depends how you look at it. Personally I don't think we are done, I think we are at the beginning of a great adventure." Annie rolled her eyes and rushed off to finally call China. Leaving the room more slowly, Astrid asked Brendan: "FAST worked out really well; is that the only way of calculating founder ownership stakes?" Brendan smiled: "Oh no, there are a thousand ways to skin the cat. What I like about FAST is that it imposes some logic and transparency, but it's still the team that decides." [25]

Summary

This chapter looks at how ownership is divided between entrepreneurs and investors and how this affects investor returns. An investment consists of an exchange of money for shares that represent an ownership stake in the venture. The chapter establishes a key equation where the investment equals the venture's (post-money) valuation times the investor's ownership stake. This equation is used to explain how valuations, share prices, and share allocations can be calculated. We also introduce the concept of dilution—that is, the reduction in the ownership stakes of founders and early investors that occurs when new investors arrive at later round investments. We address the strengths and weaknesses of the three most common return measures, namely, the net present value, the cash-on-cash multiple, and internal rate of return. We then develop six insights concerning the relationship between returns and valuations. The chapter also includes a discussion of what determines the valuation of a deal, focusing on four main factors: the underlying opportunity, the market context, deal competition, and investor quality. We conclude the chapter by looking at the allocation of founder ownership within teams and at the process of reaching an agreement. We discuss the Founder Allocation of Shares Tool (FAST), a practical spreadsheet-based tool that makes recommendations about ownership shares within start-up teams.

In terms of the FIRE framework (Chapter 1), this chapter launches our discussion of the INVEST step. The concepts of investment, ownership, valuation, dilution, and returns are at the core of the investment deal. Our goal in this chapter is to lay the foundation by explaining the basic relationships between these concepts. Our discussion of the internal allocation of shares within the founders' team starts to look at the practical challenges of calculating ownership shares. Chapter 5 takes this further by examining how to calculate valuations, and thus the division of shares between entrepreneurs and investors.

Review Questions

1. What is the relationship between investment, valuation, and ownership? What fundamental economic exchange is at play?
2. What is the difference between pre-money and post-money valuation? How do stock options affect this difference?
3. What is the role of the original number of founder shares? What happens if you double this number?
4. Why do founder stakes get diluted over time? What factors predict dilution?
5. What are the strengths and limitations of the following three return measures: net present value (NPV), cash-on-cash multiple (CCM), and internal rate of return (IRR)?
6. Both the entrepreneur and investor prefer higher exit values. The entrepreneur also prefers higher valuations, but the investor prefers lower valuations. Why?
7. What economic forces affect valuations?
8. Why would an entrepreneur accept a lower valuation from a higher quality investor?
9. What are the pros and cons for splitting equity equally among all founders?
10. What factors determine the allocation of shares within a founder team?

Notes

1. Information on *Shark Tank* can be found on the websites of Australia's ABC and the UK's BBC. For an overview of international shows, see Nisen (2013).
2. https://www.telegraph.co.uk/business/2016/02/11/half-of-dragons-den-investments- fall-through-after-the-show.
3. http://www.cbc.ca/dragonsden/pitches/snappy-socks, accessed April 15, 2019.
4. The equations in this chapter assume that the investor purchases shares newly issued by the company in what is called a primary share purchase. In Chapters 9 and 11 we will also encounter secondary share purchases where new investors buy already issued shares from the founders or from existing investors.
5. The details vary across jurisdictions and are beyond the scope of this book. Information on taxation of employee stock options across countries can be found on DLA Piper's Global Intelligence website: https://www.dlapiperintelligence.com/goingglobal/global-equity.
6. Kotha and George (2012).
7. Atomico (2018).
8. Hand (2008) provides an overview based on U.S. practice, and Henrekson and Sanandaji (2018) discuss the implications of the tax treatment of stock options in European countries. Index Ventures, a large VC firm headquartered in London and San Francisco, has published a comprehensive report on the use of stock option plans by U.S. and European start-ups, https://www.indexventures.com/rewardingtalent.
9. See Brealey, Myers, and Allen (2016) and Berk and DeMarzo (2016), among others.
10. Tian and Wang (2014).

11. Cochrane (2005), Hall and Woodward (2010), and Korteweg and Sørensen (2010) report and discuss evidence of the skewness of venture capital investments.
12. Gompers, Kaplan, and Mukharlyamov (2016).
13. Berk and DeMarzo (2016) examine investment decision rules at an accessible level.
14. Gompers and Lerner (2000).
15. Hsu (2004).
16. The work of Inderst and Müller (2004) provides a rigorous theoretical framework that shows how valuations are affected by the relative scarcity of entrepreneurs and investors.
17. Hellmann and Thiele (2015).
18. Wasserman (2012) discusses founder conflicts. For some examples, see Edwards (2017) for Snap, and Taylor (2017) for Stitch Fix.
19. Stempel (2011).
20. Estimates of the fraction of teams with equal splits range from approximately one-third to two-thirds. See Ruef, Aldrich, and Carter (2003), Hellmann and Wasserman (2016), and Vereshchagina (2018).
21. Hellmann and Wasserman (2016).
22. https://www.nobelprize.org/prizes/economic-sciences/2016/press-release and Holmström (1982).
23. Hellmann and Thiele (2015) and Hellmann and Wasserman (2016).
24. Specifically, we have \$25K + \$85K/1.15 = \$99K.
25. Other useful tools for determining ownership shares can be found at http://foundrs.com/ or https://gust.com/startups.