CHAPTER TEN

FOUNDATIONS OF NEW VENTURE VALUATION

HOW DO VCS and other investors select the projects in which they invest? And how do they settle on the ownership stakes, terms, and conditions they require in exchange for investing? There are no simple answers to these questions. Certainly, the perceived value of the entrepreneur's concept and capabilities are critical factors. No venture will be funded unless an investor sees the merits of the concept and regards the entrepreneur as capable of implementing it or of working with the investor to build a capable team. In addition, there are issues of fit and timing: Can the investor contribute value to the project? Does the investor have the financial and organizational capacity to take on another project? The answers to these questions depend on the particular expertise of the investor and on whether, at the time, the investor is looking for new projects.

In this chapter, we introduce the foundations of valuation and present the most widely used valuation methodologies, identifying the pros and cons of each. Chapter 11 concerns implementation and provides guidance on how to ensure that the valuation approach is internally consistent and how to find the information necessary to perform the valuation. In Chapter 11, we use a single example to illustrate the use of the various valuation methods that we present in this chapter. An important lesson is that if the assumptions are all consistent, then, in a perfect world, every valuation method will produce the same estimate of value. Of course, in reality they do not. The data and assumptions in each valuation effort are estimates of the "true" underlying values. Differences in estimated value across methods therefore reflect the effects of estimation errors. The art of valuation is in deciding how to weight the information from each approach and use it to reach a conclusion about value.

10.1 PERSPECTIVES ON THE VALUATION OF NEW VENTURES

The value of any investment depends on its ability to generate future cash flows, as well as on investor assessments of and tolerance for the riskiness of those cash flows. Two aspects of valuation make new venture investment decisions particularly difficult. First, the future cash flows are volatile and difficult to forecast. Second, discount rates appropriate for new venture investments can be challenging to estimate.

In spite of the near impossibility of precision, earnings or cash flow forecasts appear in most business plans, and forecasts are made and studied by VCs and other investors who are shopping for deals. In addition, VCs and other investors address the problem of determining the appropriate discount rate routinely. We show in this chapter that financial economic theory provides considerable guidance for estimating appropriate discount rates.

In an area as competitive and complex as investing in new ventures, the importance of good decision making about the terms for investing cannot be overemphasized. One indicator of the potential for good decision making to add value is the variation in investment performance of VC funds. Several sources compile information on the returns to investors in VC funds. In Figure 10.1, we use information reported in the Preqin Private Equity database to produce a histogram of annualized internal rates of return (IRRs) for 1,715 funds that were launched between 1969 and 2013.[1] The returns range from almost a total loss (–79.2% per year) to one fund with annual returns of more than 500%. To put this in perspective, a fund that returns 500% per year for a five-year period would return more than $1,200 for each $1 invested. Based on its net multiple of 19.82 (i.e., each $1 invested returned $19.82), this particular fund, however, had a weighted average life of only about 1.5 years so the actual return is much lower that implied by the 19.82 net multiple.

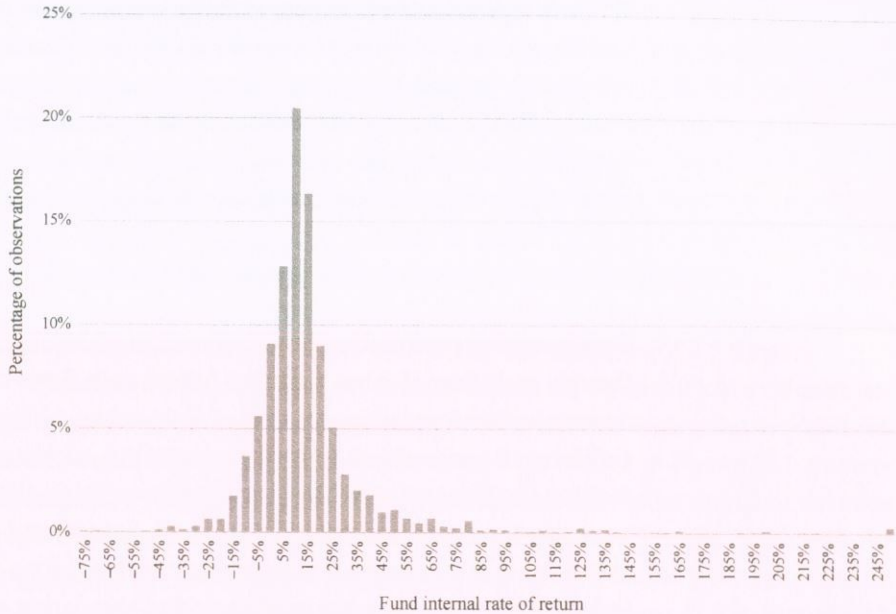
Such high returns are a rare occurrence; only 0.4% of the funds in the sample had IRRs over 200%. The average IRR in the sample is 13.2% per year, and the median is 8.7%. Weighting by fund size reduces the average IRR to 9.95%. The compound average annual return on the S&P 500 over approximately the same period (though not strictly comparable) was 8.6%, which is higher than almost half of the VC funds. Based on this evidence, historically VC investing has generally done better than investing in the market but the return differential has been small. Apparently, the small return premium is sufficient to compensate for the risk and illiquidity as VC has continued to attract funding.

Low rates of return for some VC funds can result from numerous factors: unfortunate timing, bad luck, lack of skill or access to deal flow, and unforeseeable negative events. However, two important reasons for low rates of return

FIGURE 10.1
Distribution of VC fund average annual IRRs (vintage years 1969–2013)

SOURCE: Preqin Private Equity Database.

Average fund IRRs are computed for 1715 funds as of returns reported though 2016.



are valuation mistakes and deal-structuring mistakes. Both of these can be avoided, or at least minimized, by using decision-making methods that give the investor a competitive advantage over its rivals in both project selection and deal structuring.

The arrival of professional investment managers to VC investing has changed the market in fundamental ways. Most important for our purpose is the changing way in which investment opportunities are valued by investors. In time, the changes will affect the ways in which entrepreneurs evaluate projects. Because the market is changing, some of the approaches and rule-of-thumb heuristics that have been used historically for investing in new ventures no longer can be relied on to identify projects that are likely to yield acceptable rates of return.

10.2 MYTHS ABOUT NEW VENTURE VALUATION

Past practices have generated four myths about new venture investing.

Myth 1: Beauty Is in the Eye of the Beholder

Three decades ago, Gordon Baty (1990) wrote, "Pricing a new company's stock is much like pricing any other glamour item (such as perfume, paintings, rare coins) where appeal is based on emotional, as well as analytical considerations."[2]

While it is reasonable to expect that the entrepreneur may care about qualitative factors, it would not be a good idea for a VC fund manager to propose to prospective investors that financial return be traded off against other factors. Professional investors understand that the fundamental trade-off between cash flow and risk must drive valuation. Here, we present theoretically sound valuation tools while at the same time recognizing the implementation challenges.

Myth 2: The Future Is Anybody's Guess

This is a more reasonable-sounding version of Myth 1. The claim is that even though cash flow is what matters, future cash flows of new ventures are so uncertain that forecasting them is of little value. Although new venture financial forecasts are subject to great uncertainty, such uncertainty—rather than making the forecast worthless—makes forecasting critical. In particular, it is important to try to understand the extent, nature, and implications of the uncertainty. It is true that a single-scenario forecast for a new venture is unlikely to be of much value. Scenario analysis and simulation are, however, of considerable practical value for understanding and dealing with the risks, establishing strategy, assessing cash needs, and valuing the venture.

Myth 3: Investors Demand Very High Rates of Return to Compensate for Risk

New ventures are high-risk investments that tie up the investor's capital for several years with no easy means of exit. This has led to a broadly held perception that required rates of return for VC investing must be very high. On this subject Michael Roberts and Howard Stevenson write, "In order to compensate for the high risk of their investments, give their own investors a handsome return, and make a profit for themselves, venture firms seek a high rate of return. Target returns of 50% or 60% are not uncommon."[3] As summarized in the following table, Jeffrey Timmons and Stephen Spinelli (2007, p. 449) provide a more comprehensive summary that echoes the same point:

Stage	Annual ROR (%)	Total expected holding period (years)
Seed and start-up	50–100% or more	More than 10
First stage	40–60%	5–10
Second stage	30–40%	4–7
Expansion	20–30%	3–5
Bridge and mezzanine	20–30%	1–3
LBO	30–50%	3–5
Turnaround	50%+	3–5

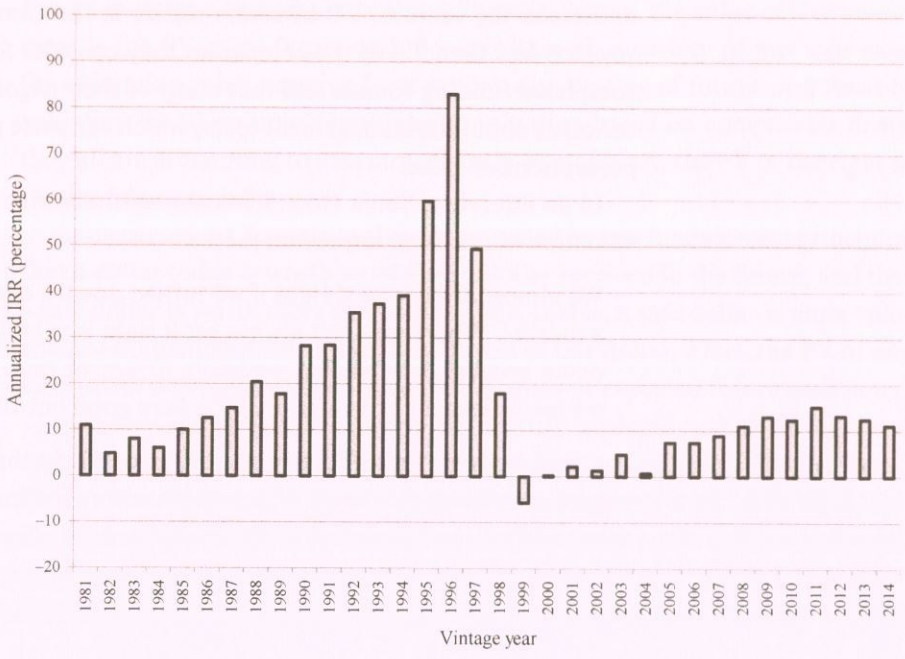
Scholars and others who remark on the high rates of return base their statements on historical practice or statements of "sought for" returns cited in PPMs, which generally are indicating the rates of return VC investors apply when discounting the entrepreneur's projected cash flows. Approaching the question in this way, they find that the rates are typically quite high. For example, Gompers, Gornall, Kaplan, and Strebulaev (2016) report, based on a survey of a large sample of VCs, that the median "required" IRR for investment selection was 30% and the "required" net multiple (cash-on-cash return) was 5.5 times. They also report that in marketing to potential investors VCs indicate seeking investments that can offer IRRs of 24% and net multiples of 3.5 times.

These high returns, however, are not supported by historical evidence; an examination of the actual average realized returns for investing in new ventures tells a very different story. In addition to the information in Figure 10.1, numerous studies by academics and industry participants over more than four decades report average annual rates of return to investors in VC funds in the mid- to high teens.[4] For the recent 20-year period, ending with the 2013 vintage year, the average annual return from a sample of U.S. VC funds was 17.3%. Figure 10.2 shows estimates of VC IRRs since 1981 by vintage year: the series exhibits very high volatility, including vintage years with very high returns and others with negative or near-zero returns.[5]

FIGURE 10.2
VC returns to limited partners by vintage year

SOURCES: Thomson Reuters, Venture Economics, VentureXpert database, extracted August 2009; PitchBook data are from the PitchBook 2017 PE VC Fund Performance Report and Preqin

Data through 2006 are pooled average VC returns by vintage year compiled by Thomson Reuters and measured through 2009. Data from 2007 on are VC fund medians reported by PitchBook/NVCA and measured through 2017.



How can the common practice of using very high discount rates to value projects be reconciled with the evidence that over many years the average realized return has been much lower? Do investors suffer from chronic unfounded optimism, so that actual returns have been disappointingly low? Or is there another interpretation of the evidence, one that does not rely on biased decision making? Surely, if rates of return in the neighborhood of 30% could reasonably be expected, capital would flood the new venture market, driving the returns to levels that are more consistent with those for other forms of investment. True required rates of return are much closer to the range documented in the empirical studies than to the very high rates that are sometimes sought by investors when they evaluate individual projects. Later in this chapter, we offer a reconciliation of the preceding statements and evidence that places the statements in a more useful context and demonstrates that actual required rates are much lower. The point for now is that the contradiction is more apparent than real.

Myth 4: The Investor Determines the Value of the Venture

A common contention is that it is pointless for the entrepreneur to undertake a valuation. The argument is that investors do not accept the entrepreneur's valuation anyway, so the entrepreneur's efforts are better spent in other ways. The problem with this view is that it fails to recognize the pivotal role that valuation plays in reaching agreement between the entrepreneur and the investor, as well as the role it can play in helping the entrepreneur decide whether to undertake the venture. VC investors report in the Gompers et al. (2016) survey that less than 2% of the companies they consider for investment result in completed funding rounds and that many of their negotiations fail because of concerns about the management team, which can arise partly from unrealistic perceptions of value.

In an interview, Sonja Hoel, a managing director at Menlo Ventures, cited valuation issues as an important factor.

> We almost always get it right if we turned down a deal because there wasn't a market. Where we don't always get it right is valuation. If we turned it down because of valuation, we had a 10% error rate. Of all the decisions we made because of valuation, 90% were good but 10% were bad.[6]

Good working knowledge of valuation can help the entrepreneur avoid a breakdown of negotiations. It is true that investors commonly prepare valuations based on their own research and assumptions. However, there is more to new venture financing negotiations than a simple exchange of cash for a percentage of the equity. In the context of a financing negotiation, valuation is important to the entrepreneur for at least three reasons. First, the entrepreneur can better understand how the venture is likely to be valued by prospective investors. Second, the entrepreneur can better understand what the venture should be worth to him and how that differs from its value to the investor. Third, the entrepreneur needs to understand how alternative deal structures affect overall value and the values of the financial claims of investors and the entrepreneur. Even for very early-stage ventures, where "unpriced" rounds are common, it would be difficult to reach agreement on deal terms without a sense of the value of the opportunity.

The entrepreneur might expect that competition among prospective investors can eliminate the need to value complex financial claims. This expectation is incorrect. Even if several investors are vying to participate in a venture, they may have varying views of the venture's strategy and will probably seek different structures of ownership claims and financing commitments. Without studying the valuation consequences of different proposals, choosing the best alternative can be problematic for the entrepreneur. A solid understanding of basic valuation techniques can ensure that entrepreneurs better understand how investors perceive the opportunity and help to reach a mutually beneficial agreement.

10.3 AN OVERVIEW OF VALUATION METHODS

For an investor who cares only about financial return, the value of any investment is the PV of its future cash flows. Although a variety of methods exist for estimating value, ranging from explicit discounting of future cash flows to valuation based on simple multiples to valuation based on comparable firms, they all are attempting to measure, directly or indirectly, the PV of the right to receive future cash flows.

As discussed in Chapter 1, valuation is guided by two fundamental principles: that a dollar today is worth more than a dollar received in the future, and that a safe dollar is worth more than a risky one, that is, a safe dollar is more valuable than a gamble with an expected payoff of one dollar. Thus, the PV of any investment depends on the timing and riskiness of expected future cash flows.

In theory, if a person could correctly identify expected cash flows, risk, and cost of capital, the result of a discounted cash flow analysis would be the "true" PV. In practice, however, there is considerable judgment involved in valuation. Because we must rely on estimates, we can be sure our calculations yield only approximations of true PV. Rather than despair, we should recognize that imperfect PV estimates provide opportunity. There are potentially large rewards for doing a better job of estimating PV than do your rivals. Other things being equal, the entrepreneur or investor who consistently does a good job of estimating value will outperform one who is right on average but makes large over- and underestimation errors. There are many theoretically sound and empirically validated valuation tools for analyzing new ventures. In this chapter, we introduce the following methods and highlight their strengths and weaknesses:

1. Discounted cash flow (DCF) methods
   a. The risk-adjusted discount rate (RADR) approach
   b. The certainty equivalent (CEQ) approach
2. Relative value (RV) method
3. The Venture Capital (VC) Method
4. The First Chicago Method

These methods vary in their complexity and the directness of their connection to underlying economic theory, but all are used in practice and therefore are important to entrepreneurs and investors.

The Discounted Cash Flow (DCF) Methods

We consider two approaches for estimating PV by DCF. The first is the RADR approach and the second the CEQ approach. The difference between them lies in how the adjustment for risk is incorporated into the calculation. If the approaches are applied in a consistent manner and the underlying assumptions are consistent, they will yield identical estimates of value. However, the information needed to implement the two approaches differs. Consequently, availability and quality of information are important determinants of which to use.

The RADR approach is the more widely known and used DCF approach. In RADR, an expected future cash flow is converted to PV by applying a discount rate that reflects both the time value of money and the riskiness of the future cash flow. This rate is known as the "risk-adjusted discount rate" because the effect of risk on value is built into the discount rate. The RADR approach is used most commonly in corporate finance because it is convenient and because the information requirements are easily satisfied by using data on comparable public firms.

With the CEQ approach, instead of adjusting the discount rate, the risk adjustment is made directly to cash flow. This adjustment yields a risk-adjusted (or certainty equivalent) cash flow that is converted to PV by discounting at the risk-free rate. It turns out that for new ventures, it can be easier to estimate the

CEQ cash flow than the RADR. In subsequent discussion, we examine both approaches.

The Relative Value (RV) Method

Relative valuation uses market data on other companies or other transactions as bases for inferring the value of the subject venture. This method is sometimes referred to as "comparables" or "multiples valuation." It is widely used in practice, especially for established private companies, and can provide a quick and easy ballpark estimate of value. The underlying logic is arbitrage. If two different companies are expected to produce identical future cash flows and are subject to identical risks, they should have the same value. If they did not, then investors should want to sell the higher-valued one and buy the lower-valued one. By inference, if firms have similar characteristics, the arbitrage reasoning should provide a good approximation.

Relative valuation is thus an effort to finesse questions of discount rates and explicit cash flow projections. If RV and DCF could be correctly and perfectly applied to a given venture, then they should yield identical values. Suppose, for example, that we find a perfect comparable for a venture we want to value and that the comparable has been the subject of a recent transaction that implied a specific value. Under RV, we could simply say that the values are the same; under DCF, in contrast, we could use the expected future cash flows and implied value of the comparable to infer the discount rate that we should use to value the cash flows of the subject venture. We would get the same answer either way. In practice, when RV and DCF yield different estimates of value, there is something inconsistent about the assumptions. Either the assumptions need to be revised or judgment must be used to assess the significance to place on each estimate.

In RV, market prices or prices from public or private transactions are collected along with information on observable characteristics of the comparable firms. This information may include accounting ratios and operating data that can be used to estimate the value of a private firm or new venture. While the logic behind RV is straightforward, there are many challenges to valid implementation. Appropriate comparables for a new venture (with transactions at the same stage of development) can be difficult or impossible to find or to verify, and common metrics such as P/E ratios are not useful for a start-up that has not reached profitability. Because some multiples are based on accounting data, the usual caveats about quality of earnings and adjustments to ensure comparability apply. More generally, while the idea of valuation based on comparisons to other firms sounds simple, it is not. There are many dimensions of comparability, including industry, business model, stage, size, and accounting ratios. Ideally, a comparable firm has expected cash flows and risk that are similar to those of the new venture.

Certainly, no public company can be a direct comparable for an early-stage venture. Moreover, there are no readily accessible databases of transactions related to early-stage private companies that have sufficient data to be useful in a valuation. Use of an RV approach is more common and more defensible for a company that is being valued at the time of an assumed harvesting event, such as an IPO or acquisition. At that stage, information on comparable firms and transactions is likely to be more plentiful and the necessary analogies are easier to make and defend. In fact, RV is often the approach that is used in DCF methods to estimate the harvest-date cash flow. That said, even for a mature private company there are likely to be no truly comparable public companies. Companies that are similar in some key respects but not identical to the subject company are likely to yield a wide range of value estimates. Deciding how to select the companies and how to weight the evidence are part of the art of valuation.

The Venture Capital (VC) Method

The VC Method combines elements of DCF and RV and has been popular in the private equity arena. It is computationally straightforward and parallels the way some VCs have traditionally approached their investments.[7] The method starts with an estimate of future value conditional on success—possibly the projections in the entrepreneur's business plan, which typically seek to demonstrate the potential success of the venture. Success scenario projections incorporate an assumed timetable for exit, typically three to five years, and a conjecture as to the form of exit and resulting future value. The estimate of exit value conditional on success is sometimes developed using RV multiples to a projected performance measure such as net income or EBIT. The success-scenario exit value is then discounted to PV, typically using a very high annual discount rate such as the "sought for" rates we presented earlier. This hurdle rate is intended to take account of (1) time value, (2) risk, (3) the bias associated with discounting only the success-scenario cash flows, and (4) the dilutive effect of subsequent financing rounds.[8] The result is an estimate of the venture's PV.

In spite of its widespread use and intuitive appeal, the VC Method has theoretical and practical shortcomings. Most important, the hurdle rate selection implicitly combines so many conditions that are difficult to specify so that there is no reliable way to determine the rate that should be used. Because only a success scenario is used, the assumed timing of the harvest cash flow can impart systematic bias to value estimates. We discuss these shortcomings in greater depth below. Because of these, we regard the VC Method as more of a device for negotiating with the entrepreneur than a reliable valuation method.

The First Chicago Method

The First Chicago Method is also used widely by VC and PE practitioners and represents an improvement on the VC Method.[9] The goals of the First Chicago Method are to provide a simple way of performing DCF valuation and to mitigate the valuation biases of the VC Method. Rather than limiting the analysis to a success scenario, the First Chicago Method uses probability-weighted scenarios to come up with a more reliable estimate of expected (in the statistical sense) cash flows, rather than just the optimistic cash flows used in the VC Method. These expected cash flows are then discounted using a more realistic cost of capital, rather than the high hurdle rates used in the VC Method. If the scenario probabilities are correctly weighted, the appropriate discount rate is identical to the one that would be used in DCF valuation by the RADR approach. A benefit of the First Chicago Method is that it requires the analyst to think about the range of possible outcomes for the venture and their probabilities.

The question of which valuation tool is best for a particular situation does not have a clear answer. Like any quantitative methodology, the results of each approach depend on the availability and quality of the information it requires. There is a benefit to using as many of the techniques as the data will allow. Doing so will inevitably produce a range of value estimates. The final step is to compare the results, seeking to understand the reasons for material differences. On reflection, you may conclude that in a given instance, one approach is more reliable than are the others. More likely, each provides some useful information, and your task is to decide how best to weight the different estimates.

10.4 DISCOUNTED CASH FLOW VALUATION

As noted earlier, we consider two approaches to DCF valuation, the RADR approach and the CEQ approach. The main difference between them is in the way we adjust for risk. Most introductory finance texts cover only RADR or only briefly describe CEQ. Because of its different information requirements, however, the CEQ method can be better suited than RADR for new venture valuation.

The Risk-Adjusted Discount Rate Approach

Under RADR, expected future cash flows are discounted to PV using a discount factor that reflects the time value of money and the riskiness of the future cash flows. The present value, PV_j, of an investment that offers a series of expected future cash flows, C_{jt}, is given as:

$$PV_j = \Sigma_t \frac{C_{jt}}{\left(1+r_t\right)^t} \tag{10.1}$$

In Eq. (10.1), r_t is the risk-adjusted discount rate that is appropriate for computing the PV of an expected time t cash flow. The expression is general in that it allows for cash flows to be received at any time and for the cost of capital to be specific to the period in which the flow is expected.

Note that PV_j is the value today of all of the cash flows that are generated by the venture's operations, whether they are positive or negative. It is not the same as net present value (NPV), which is net of the investment required to receive the venture's future cash flows. To illustrate, consider a delivery business such as Postmates. The PV would include positive cash flows (e.g., revenue) and negative cash flows (e.g., compensation to independent contractors, lease payments on vehicles, salaries, and fuel). Let's assume that discounting all of the positive and negative cash flows using Eq. (10.1) produces a PV of \$150,000. If the owner agrees to sell you the venture for \$130,000, the resultant NPV is \$20,000. That is, NPV is equal to PV minus the investment required to acquire the venture. Applying Eq. (10.1) requires that we (1) identify the cash flows that are appropriate to include in the valuation model and (2) determine the appropriate discount rate for valuing each cash flow.

Identifying relevant cash flows. Conceptually, determining the cash flows to include in an RADR valuation is straightforward. They are the cash flows the investor can expect (statistically) to receive in exchange for investing. To identify the relevant cash flows, we need to understand exactly what asset is being valued. The asset may be the entire venture or a particular financial claim on the venture, such as a portion of the common stock, preferred stock, or debt.

A share of stock, for example, yields a stream of cash flows in the form of dividends. An investor who owns the share for a finite period, of course, does not receive the entire dividend stream but receives dividends paid by the firm during the holding period and a lump-sum payment when the share is sold. The payment when the share is sold depends on the stream of dividends that are expected to be received from that point forward. Implicitly, then, the stock price at any point reflects the value of all subsequent dividend cash flows.[10] The expected proceeds from selling the stock at a future date can be thought of as the "continuing value" of the stock at that point, based on cash flows (dividend payments) expected after the sale. Because we normally project dividends in simple ways, such as by assuming that they are expected to grow at a constant rate, the continuing value approach (of an actual or hypothetical sale in the future) is a shortcut approach to discounting a long stream of future cash flows.

Debt is expected to yield a stream of interest payments and the eventual repayment of principal. If the debt is risky, the interest payments and principal repayment to be valued are not those specified in the debt contract. Rather, they are the cash flows that are expected to be received, recognizing that the borrower may prepay or default on the obligation.

If the asset to be valued is a venture, the relevant cash flows are the (positive and negative) periodic free cash flows generated by the venture and available to all capital providers. Depending on your purpose, it may be advantageous to measure these cash flows net of any retention for the purpose of capital replacement or growth and (for consistency) to measure investment as only the cash infusions that investors make in the venture.

Like a share of stock, a venture can, in principle, last forever. Conceptually, we would like to know the value of all future cash flows. However, at some point after the first few years it is more convenient (and possibly no less accurate) to assume a hypothetical sale where the selling price is based on the value (at the time of sale) of all free cash flows from that point forward. We refer to this value as the continuing value of the venture. The "explicit value period" is the span over which periodic cash flows are estimated explicitly and each is discounted to its PV. Total PV thus consists of two parts: (1) the PV of the expected cash flows from the explicit value period and (2) the PV of the expected continuing value.

Determining the discount rate (cost of capital). The next step in valuation by RADR is determining the discount rate for valuing each cash flow. Because in the RADR approach the discount rate takes account of both time value and cash flow risk, we can think of the discount rate used in Eq. (10.1) as having two components. The first is the return for investing in a risk-free asset that would pay off at the same time as the project cash flow. The second is a risk premium that depends on the riskiness of the expected future cash flow. For a particular project j that yields a single uncertain cash flow at time t, the appropriate discount rate can be stated as follows:

$$r_{jt}=r_{Ft}+RP_{jt} \tag{10.2}$$

where r_{Ft} is the required rate of return for investing in a risk-free asset that would pay off at time t, and RP_{jt} is a risk premium or risk adjustment. The risk adjustment depends, in some fashion, on the riskiness of the time t cash flow.

Because the cash flows being valued are expected cash flows, the appropriate discount rate is the opportunity cost (or rate of return) the investor could expect to realize by investing in an alternative financial claim with the same holding period and risk. In contrast to the *ad hoc* determination of the hurdle rate in the VC Method, the financial economic theory underlying determination of the discount rate for RADR valuation is well established.

In summary, the steps for using the RADR approach are as follows: (1) forecast expected future cash flows, (2) estimate the risky discount rate, r_{jt}, for each cash flow, (3) discount each future cash flow to its PV, and sum the PVs. Equation (10.2) is useful because it is sometimes easier to estimate r_{Ft} and RP_{jt} than to estimate r_{jt} directly. A simple way of estimating r_{Ft} is to examine currently available returns on zero-coupon government bonds of similar duration to the cash flow that is being valued. Estimating the risk premium is more difficult: first, we need a measure of risk; second, we need a metric to determine the associated risk premium.

The measure of risk. The measure of risk that has become the norm for investment valuation is the standard deviation of holding-period returns.[11] A holding-period return is a rate of return that is measured from the point of investment to the point when the return is realized. That is, the holding-period return is expressed as a percentage based on the amount invested. Take, for example, a common stock. Its holding-period return consists of two parts, a dividend yield and a capital gain (or loss). Uncertainty about the size of the dividend and the price at which the shares can be sold in the future are the risks faced by investors. Assume that a share of stock that has a market value of $20 today has the following equally likely payoffs and returns in one year and pays an annual dividend (in one year from the time of investment):

State of the economy	*Dividend* (D_1)	*Price* (P_1)	*Dividend yield*	*Percent appreciation*	*Total return*
Good	$2.00	$24.00	10%	20%	30%
Moderate	$1.00	$22.00	5%	10%	15%
Bad	$0.00	$18.00	0%	(10%)	(10%)
Expected	$1.00	$21.33	5%	6.67%	11.67%

With equally likely outcomes, the expected return over the holding period is the average of the three possible returns, which is 11.67%, and the standard deviation of the holding-period return is 16.5%.[12] Note that we calculated the holding-period returns and standard deviation based on today's market price of $20. We can use this calculation to infer cost of capital because the stock is traded in a market such that buying the stock today and holding it for one year is expected to be a zero-NPV transaction.

Here, we find an important distinction between new ventures and publicly traded stock. Because new ventures are not like shares of stock that trade in a market, we cannot assume that investing is a zero-NPV choice. We will see later that this feature makes RADR difficult to apply unless we can find some way to infer the appropriate discount rate.

The price for bearing risk. How do we go from measuring risk to inferring a price for bearing risk? To answer, we must first distinguish between the entrepreneur and prospective investors in a new venture. For investors, we follow the standard corporate finance approach to estimating a risk premium, which relies on the following assumptions:

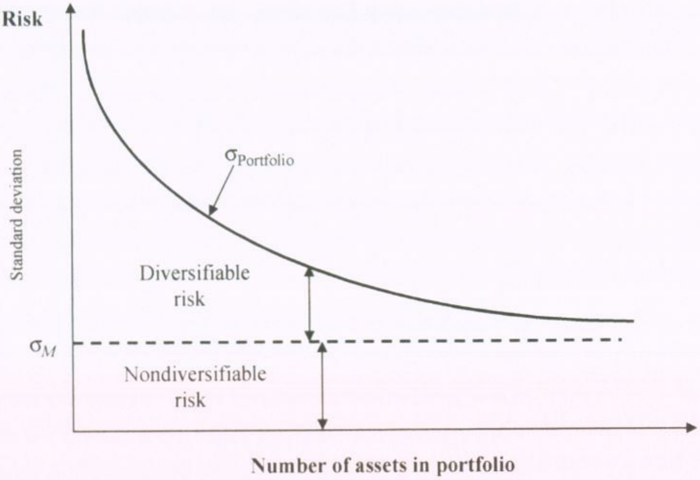
- There is active competition to invest in new ventures.
- Investors view new venture investing as an alternative to other investment opportunities.
- Investors assess project risk based on its contribution to the risk of a diversified portfolio.
- Illiquidity does not affect the investors' valuation of new venture investment.

These assumptions allow us to distinguish between market and nonmarket risk. The total risk, measured as the standard deviation of holding-period returns, is the sum of two categories of risk. The first—called market, systematic, or nondiversifiable risk—consists of marketwide risk factors that affect all ventures. Economic recession and boom, changes in inflation, and changes in the flow of funds into the capital markets are among the factors that tend to affect asset values marketwide. Because market risk affects all assets, it cannot be eliminated by diversifying the investor's portfolio. The second category—called firm-specific, idiosyncratic, nonmarket, or diversifiable risk—includes all risk other than market risk. Examples of diversifiable risk include success or failure in achieving a technology milestone and idiosyncratic product demand that is higher or lower than expected.

Because of diversification, the unexpected positive and negative nonmarket components of returns to different investments are random so that, in diversified portfolios, they tend to cancel each other out. In a portfolio with even a

FIGURE 10.3
How portfolio risk depends on the number of assets in the portfolio

The figure shows how diversification reduces total risk as the number of assets in the portfolio increases. Risk is measured by the standard deviation of holding-period returns. The risk that remains is shown as σ_M and is the market, or nondiversifiable, risk.



modest number of assets, the idiosyncratic component of risk can be substantially reduced. Diversification cannot be used, however, to reduce exposure to the component of risk that is due to the overall market.

Figure 10.3 demonstrates the diversification principle that the total risk of a portfolio, $\sigma_{Portfolio}$, varies as a function of the number of randomly selected securities. As shown, the total risk of the portfolio is composed of diversifiable (nonsystematic) and nondiversifiable (systematic) risk. By holding more securities, diversifiable risk approaches zero and total risk approaches the risk of the market, σ_M.

Any investor can diversify by investing in an equity mutual fund that is designed to match the performance of a standard market index, such as the S&P 500. Because diversification is easy, investors cannot expect to be compensated if they choose not to take advantage of the simple opportunity to diversify. Thus, the expected return on a risky asset depends only on risk that is not diversifiable.

The nondiversifiable component of risk is known as beta (β) risk, or market risk. By convention, the beta risk of the market portfolio is defined as one unit of risk. The risk-free asset, by definition, has no risk and therefore has a beta of zero. An asset with nondiversifiable risk that is half as great as the market has a beta of 0.5, and so on.

The notion that investors care only about time value and nondiversifiable risk is reflected in the Capital Asset Pricing Model (CAPM).[13] Figure 10.4 shows the relationship between beta risk and expected return that is implied by the CAPM. The CAPM tells us that different investments with different amounts of total risk but equal amounts of beta risk will have the same expected return. Accordingly, all assets and portfolios with the same beta risk plot at the same

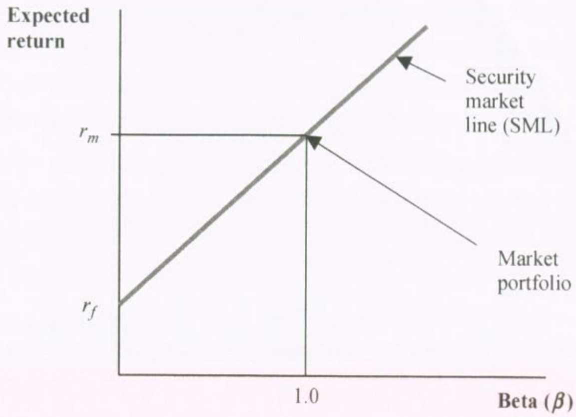


FIGURE 10.4

The capital asset pricing model (CAPM)

The CAPM describes the required return on an asset as a function of its nondiversifiable (market) risk as measured by beta. The market portfolio by definition has a beta of 1.0 and is expected to earn r_M. The riskless asset has a beta of zero and earns r_F, the risk-free rate. The difference between r_M and r_F is called the *market risk premium*. If the CAPM correctly describes investor behavior, then all market assets offer risk and expected return combinations that plot on the security market line (SML).

point in the figure. The sloping line in Figure 10.4 is known as the security market line (SML) because all risky assets must plot on the line. The result is a single price, or expected return, for bearing a unit of nondiversifiable, or beta, risk. The difference between the expected return on the market portfolio and the return on a risk-free asset is called the market risk premium.

In algebraic form, the CAPM is:

$$r_j = r_F + \beta_j(r_M - r_F) \tag{10.3}$$

Comparing Eq. (10.2) and Eq. (10.3), we can see that the CAPM defines the risk premium for an asset as $\beta_j(r_M - r_F)$, which has two components. The term in parentheses, $(r_M - r_F)$, is the market risk premium and is computed as the difference between the expected return on the market portfolio and the return on a risk-free asset. This market risk premium is then scaled by β_j, the beta or systematic risk of asset *j* relative to the risk of the market portfolio. The product of the two is the risk premium for asset *j*. The beta of asset *j* is the measure of its nondiversifiable risk. Specifically, β_j is computed as follows:

$$\beta_j = \frac{Cov_{r_j,r_M}}{\sigma_M^2} = \frac{\rho_{r_j,r_M}\sigma_j}{\sigma_M} \tag{10.4}$$

In Eq. (10.4), Cov_{r_j,r_M} is the covariance of holding-period returns of asset *j* with the holding-period returns of the market, ρ_{r_j,r_M} is the correlation coefficient of holding-period returns between the asset and the market, σ_M^2 is the variance of market returns, and σ_M and σ_j are the standard deviations of returns of the market and of asset *j*.

Equation (10.3) identifies the information necessary to use the CAPM to estimate the required rate of return on an investment. Estimating the risk premium for use in the RADR model requires estimating both the beta of the asset and the market risk premium. Equation (10.4) shows two different ways to estimate beta. As an alternative to estimating beta directly, we can calculate it from estimates of the standard deviations of holding-period returns for both the asset and the market and an estimate of the correlation between asset returns and market returns. In Chapter 11, we examine methods of estimating the information needed to use the CAPM in RADR valuation.

Given its focus on nondiversifiable risk, the CAPM is appropriate when investors are able to diversify at low cost. The typical investors in new ventures and in VC funds (pension plans, endowments, and insurance companies) are able to do so. The CAPM suggests that these investors should not require an increase in expected return for bearing venture-specific risk that is diversifiable. Other kinds of investors in new ventures may find diversification more difficult to achieve. In particular, private corporations and high-net-worth individuals, if they want to invest in venture capital, may be compelled to hold portfolios that are not well diversified. If such investors hope to be compensated for sacrificing diversification, they must either find opportunities that well-diversified investors do not recognize or be able to contribute unique value to the venture in other ways that well-diversified investors cannot.

The Certainty Equivalent Approach

It sometimes is difficult to use the RADR form of the CAPM to value real investment opportunities with risky cash flows. The model requires that risk be measured as the standard deviation of holding-period returns for an asset that is correctly valued—an equilibrium holding period return. However, even if we can estimate the expected cash flows of a project and their riskiness (i.e., standard deviation), we cannot correctly determine the expected holding-period return or the standard deviation of holding-period returns without knowing the PV of the project. When it is possible to rely on market assets to infer cost of capital, this is not a problem because market assets are zero NPV by definition (cost and present value are the same). However, this does not work so simply for new ventures, where we cannot easily refer to market assets.

We can demonstrate the difficulty of using RADR by making a couple of substitutions to Eq. (10.3). Equation (10.5) makes the appropriate substitutions for r_j and β_j in Eq. (10.3), where C_j is the expected cash flow of project j, σ_{C_j} is the standard deviation (risk) of this cash flow, and ρ_{C_j,r_M} is the correlation between the project j cash flow and the market return. For convenience, we will define rates of return in the preceding expressions over the holding period for C_j (one year, two years, etc.).

$$\frac{C_j}{PV_j}-1=r_F+\frac{\rho_{C_j,r_M}\left(\frac{\sigma_{C_j}}{PV_j}\right)}{\sigma_M}\left(r_M-r_F\right) \tag{10.5}$$

In this modified CAPM, the left-hand side of the equation is the expected return and the right-hand side is the expression for the required rate of return. In other words, we must find the required returns at the point where the expected return equals the required return. Note, however, that PV_j appears on both sides of the equation. The two sides will be equal only at the point where PV_j is the PV of C_j. That is, Eq. (10.5) can be used to search for the PV of a future cash flow by using trial and error to find the value of PV_j that equates the two sides of Eq. (10.5). Although this obviates the need to assume a standard deviation of holding-period returns (using, instead, the standard deviation of cash flows), it does not resolve the fundamental problem that the correct risky discount rate depends on the (unknown) value of the cash flows.

An illustration of the difficulties of using the RADR approach. To see the nature of the problem, consider a wager that will pay either \$1.00 or \$2.00, with equal probability. We can easily determine that the risk of the bet (in terms of the standard deviation of payoff cash flows) is \$0.50.[14] But what about the standard deviation of holding-period returns? Suppose the wager can be acquired for \$1.25. If so, the \$2.00 payoff is a return of 60% and the \$1.00 payoff is a return of −20%. This makes the expected return 20% and the standard deviation of holding-period returns 40%.[15]

But what if the wager costs \$1.50? In this case, the \$2.00 payoff yields a return of 33.3% and the \$1.00 payoff yields −33.3%. At this price, the expected return is zero, and the standard deviation of holding-period returns is 33.3%. Thus, the standard deviation of holding-period returns depends on the cost of the wager.

To find the PV of the wager, we need to know the standard deviation of holding-period returns that corresponds to investing exactly the PV of the expected payout. If the required investment is different from the PV of the expected payout, we can then correctly measure NPV as the difference between the actual investment and the investment that would yield a zero NPV. You can see that applying the conventional RADR form of the CAPM is challenging when it is being used to value real assets. The problem is the inherent simultaneity and the lack of a zero-NPV market asset to use as a basis for inferring the correct discount rate. Valuing the expected cash flows requires knowing the discount rate, but the discount rate calculation requires a beta, which depends on the standard deviation of holding-period returns, which, in turn, depends on the PV of the project.

In corporate settings, these problems are finessed by analogizing the investment decision to an existing market asset that is publicly traded (and, by inference, fairly priced). If that is possible, a two-step approach can be used: first, estimate the beta of the market asset; second, discount project cash flows using that beta. Unfortunately, convincing analogies are hard to find if the project is a new venture or a financial claim on a new venture. In Chapter 11, we seek to overcome this problem by providing some empirical estimates of betas for publicly traded corporations that are similar to entrepreneurial ventures. If those estimates are reliable, then using the RADR approach is straightforward, just as it is for public corporations. If not, the CEQ approach can be easier to use.

Advantage of the CEQ method. The certainty equivalent of a risky cash flow is the certain cash flow that, if received at the same time as the risky cash flow, would be equally valuable to the investor. For risk-averse investors, the certainty equivalent is less than the expected risky cash flow. Thus an investor might regard a risky cash flow with an expected value of \$200 and a standard deviation of \$50 as being equal in value to a certain \$125 cash flow.

In the CEQ approach of DCF valuation, instead of adjusting the discount rate, the risk adjustment is made to the cash flow:

$$CE(C_{jt}) = C_{jt} - RD_{jt} \tag{10.6}$$

where $CE(C_{jt})$ is the certainty equivalent of the period t expected cash flow, C_{jt}, and RD_{jt} represents the dollar-valued discount to C_{jt} that is required to convert the risky expected cash flow to its certainty equivalent. Once we have this stream of certainty equivalent cash flows, we can convert them to PV using a risk-free discount rate as follows:

$$PV_j = \Sigma_t \frac{CE(C_{jt})}{(1+r_{Ft})^t} \tag{10.7}$$

where r_{Ft} is the risk-free rate for period t cash flows.

To apply Eq. (10.7), we need a way to compute the CEQ cash flow. Because the CEQ form of the CAPM uses the standard deviation of cash flows instead of the standard deviation of holding-period returns, it avoids the simultaneity problem of the RADR form.

The CEQ approach is general in that it does not impose any particular tradeoff between risk and return. If we assume that the CAPM is the correct asset pricing model, then Eq. (10.5), the expanded version of the RADR form of the CAPM, can be solved for PV_j to yield the CEQ form of the CAPM.

$$PV_j = \frac{C_{jt} \frac{\rho_{C_j, r_M} \sigma C_j}{\sigma_M}(r_M - r_F)}{1 + r_F} \tag{10.8}$$

The numerator in Eq. (10.8) is the CAPM-based certainty equivalent of the risky cash flow, C_j, which corresponds to Eq. (10.5). The denominator is a discount factor that is used to determine the PV of a riskless cash flow.[16] When the CEQ form of the CAPM is used, the risky cash flow is adjusted by a factor that makes the PV of the CEQ cash flow, when discounted with a risk-free rate, exactly equal to the value derived by discounting the uncertain expected cash flow at the appropriate risky rate.

To see how the CEQ approach simplifies finding PV, let's revisit the wager that will pay either \$1.00 or \$2.00 with equal probability. We assume that the risk-free rate is 4%; the market risk premium is 6%; the standard deviation of holding-period returns of the market portfolio is 20%; and the correlation between the payoff of the bet and the return you could earn by investing in the market portfolio is 0.6. Given this information, it is easy to use Eq. (10.8) to determine the PV of the wager.

$$PV_j = \frac{c_j \frac{pc_j, r_M \sigma C_j}{\sigma_M}(r_M - r_F)}{1 + r_F} = \frac{\$1.50 - \frac{0.60\$0.50}{0.20}(0.06)}{1 + 0.04} = \frac{\$1.41}{1.04} = \$1.356$$

The CEQ cash flow of the expected (risky) \$1.50 is \$1.41, which when discounted at the riskless rate yields a PV of \$1.356 for the wager. You can verify that if this value is used in Eq. (10.5), then the two sides are equal (i.e., required return equals expected return at a PV of \$1.356).

Given the PV of the wager, the NPV of the opportunity to acquire it for \$1.25 is \$0.106 (i.e., \$1.356 − \$1.25 = \$0.106). We also can determine that the correct risk-adjusted discount rate (the cost of capital), given the PV of \$1.356, is $(C_j/PV_j) - 1$, or 10.62%.

Because Eq. (10.8) adjusts for risk by using the correlation between project cash flows and market returns, it circumvents the need to determine the riskiness of the holding-period returns. However, it does raise another question: How can we estimate the correlation between project cash flows and market returns? We address this problem later in the chapter. A similar information requirement exists if the RADR form is used, but in that case, the need is to estimate the correlation between project returns and market returns. The problem for the RADR form is sometimes finessed by analogizing the project to a publicly held corporation and using estimates of beta from published information.

10.5 THE RELATIVE VALUE METHOD

Relative valuation (RV) uses data from public companies and public and private market transactions to estimate value. It is widely used in the real estate industry, especially for residential real estate, for which it is particularly well suited. Owner-occupied housing does not produce observable cash flow streams that can be valued by DCF. Moreover, there are many trades of highly similar properties, where differences that affect value tend to be associated with observable factors such as square footage and number of bedrooms. For ventures, the RV method is commonly used to value companies at the time of IPO or acquisition.

Relative Valuation and New Ventures

We can apply RV to new ventures by gathering information on the value drivers of comparable firms. A firm's value is driven by its profitability, expected growth, and risk. In RV analysis, we can classify multiples into two categories: (1) multiples based on the capitalized value of equity and (2) multiples based on enterprise value, where enterprise value is defined as the market value of equity, plus the market value of interest-bearing debt, minus excess cash.

For consistency of comparison, before computing the multiples, excess cash (cash that is not needed for operation of the enterprise) should be subtracted from both the subject asset and the comparables. After the multiples are applied to estimate the enterprise value of the subject, any excess cash that is expected to be accumulated by the subject can be separately discounted to PV at the risk-free rate, analogous to distributing the cash as a dividend. For a firm such as Apple, which in 2017 had over $74 billion of cash and short-term investments (24% of total assets), this is not a trivial adjustment. We can also classify multiples as either (1) accounting based or (2) non-accounting-based.

Accounting-based approaches. Accounting-based multiples relate the value of venture equity or total capital to reported accounting information. The most familiar of these, the P/E ratio, is a way to estimate the value of equity on the basis of reported net income. Other accounting-based approaches to valuing equity include the following:

- Price to cash income, which is measured as net income plus noncash expenses
- Price to levered free cash flow, which differs from the previous measure by subtracting increases in net working capital and fixed assets

- Price to book value of equity (more commonly referred to as market value to book value of equity)

Accounting-based approaches can also be used to estimate the combined value of equity and debt, or enterprise value. The commonly used measures are similar to those for valuing equity, except that they are usually based on cash flow measures including interest expense. Such approaches include the following:

- Enterprise value to EBITDA (earnings before interest, taxes, and depreciation and amortization)
- Enterprise value to unlevered free cash flow, which is EBIT minus theoretical taxes as if the company were entirely equity financed
- Enterprise value to book value of debt and equity
- Enterprise value to sales

While accounting data are readily available for public firms, accounting-based valuation multiples have two major problems. First, they are subject to accounting choices that can make comparison across firms inaccurate. Second, the data in public financial statements are based on historical results, whereas value today depends on expected future performance. While accounting-based comparisons can work well for valuing established private businesses with simple business formats, such as dry cleaners or donut shops, they are not easily applied to early-stage ventures.

Because new ventures are often unprofitable at the valuation date, may not have initiated sales, and may also have negative net worth, many of the commonly used accounting measures may not be meaningful. The VC Method, discussed next, is designed to get around this problem while retaining the simplicity of RV.

Problems related to differences in accounting practices can be overcome with careful analysis. We can also overcome the backward-looking nature of accounting data by performing the RV analysis using forward projections for the comparable firms. For example, instead of calculating a P/E ratio based on the prior year's earnings, we can base the value estimate on multiples tied to earnings forecasts.

Of course, simple ratio-based comparisons are only helpful if the subject venture and the comparables have similar expected growth rates. There are other, more formal, approaches, as well, for incorporating growth expectations into multiples analysis. The following are two of the most common:

- The PEG ratio (or P/E/growth), where growth is the expected growth rate of earnings
- Enterprise value to EBITDA/growth, where growth is the expected future growth rate of EBITDA

The growth-adjusted approaches are ways of dealing with differences in growth expectations between the subject venture and the comparables.

Non-accounting-based approaches. The other category of multiple we consider is industry-specific nonfinancial metrics. An online subscription-based venture could be valued on the basis of the projected number of subscribers or estimated web pages of advertising. A proxy for the value of a biotechnology venture might be the number of patents, while a pharmaceutical venture's value might be estimated using the number of products in various stages of FDA approval. Internet ventures have been valued based on the number of website visits and time spent on the site.[17]

Depending on the venture's stage of development, the focus of non-accounting-based valuation might be on the drivers of revenue. Revenue-related metrics include, for example, the number of visitors per month, the fraction of visitors who become customers, the percentage of visitors who linger on the website instead of leaving quickly, average order size, monthly active users, revenue per active user, recurring (subscription) revenues, and annualized monthly revenue. For a more seasoned venture, useful metrics might include contribution margin per order or customer, the average cost of acquiring a customer, the customer churn rate (lost customers/total customers), the cash burn rate per month, and the average lifetime value of a customer. A number of websites provide benchmarking data that can be used to estimate value relative to other companies with established values. See, for example, SimilarWeb.com, JumpShot.com, and SemRush.com.

There is some evidence that industry-specific non-accounting-based measures can be better value predictors than accounting-based multiples.[18] For example, for early-stage Internet companies, commonly used valuation metrics include monthly unique visitors, conversion rates (visitors into customers), bounce rates, and average order value. Industry-specific multiples may be used to estimate either equity or enterprise value. The important consideration is consistency. If the comparables used in the valuation are materially debt financed but the venture is entirely financed with equity, then the comparables ratios need to be based on enterprise value.

An illustration: initial public offering. Here is a simple example to illustrate the concepts. Suppose your social media company is considering an IPO. The company's most recent annual EBIT is \$2.2 million on revenue of \$35 million, coming primarily from the sale of advertising. The company currently has 15 million users per day and the growth rate of users per day in the most recent year was 10%. You have also collected the following accounting-based and non-accounting-based data on recent IPO transactions:

Comparable transaction	Value at IPO (million)	Revenue (million)	EBIT (million)	Users per day (million)	Growth rate of daily users	Value/ Revenue at IPO	Value/ EBIT at IPO	Value/ Daily user at IPO
Company A	80	\$36.360	\$2.96	33.10	6.0%	2.20	27.03	2.42
Company B	120	\$38.710	\$1.88	11.00	12.0%	3.10	63.83	10.91
Company C	135	\$79.410	\$3.75	16.80	9.0%	1.70	36.00	8.04
Company D	55	\$13.750	\$0.71	9.20	21.0%	4.00	77.46	5.98
Average	100	\$42.058	\$2.325	17.53	12.0%	2.75	51.08	6.83

There are different ways to use the information from the comparables to estimate the enterprise value of the subject company. One simple approach, the one we illustrate here, is to consider each factor one at a time and compare the averages to the subject. If the comparables include large outliers, it can also be better to focus on medians instead of averages. A better approach, if sufficient data are available, is to fit a statistical model to the data, for example, by using multiple regression. The model can be used to assess the marginal effect on value of each factor in conjunction with the effects of the others.

The last row of the preceding table shows the averages of the key variables and enterprise value (EV) multiples. Averaging the results across the four comparable companies yields the following estimates of enterprise value:

$$\text{EV Est}_{\text{subject}} = Avg\left(\frac{Mkt\ Value}{Revenue}\right) \times Revenue_{Subject} = 2.75 \times \$35.0 = \$96.25 \text{ million}$$

$$\text{EV Est}_{\text{subject}} = Avg\left(\frac{Mkt\ Value}{Earnings}\right) \times Earnings_{Subject} = 51.08 \times \$2.2 = \$112.38 \text{ million}$$

$$\text{EV Est}_{\text{subject}} = Avg\left(\frac{Mkt\ Value}{Users}\right) \times Users_{Subject} = 6.83 \times 15.0 = \$102.52 \text{ million}$$

All three approaches yield similar estimates. Averaging the three produces an estimated enterprise value of \$103.72 million.

How reliable is this value? One positive indication is that the 10% growth rate in average users per day is similar to the 10.5% average over the comparable companies. Another indication is that the valuation based on the averages of comparable companies is almost the same as the median (not shown) for the comparables. The implied value based on the medians of each factor would be $105.10.

We can also look separately at each comparable. Company A yields the lowest implied value, $57.57 million based on the average of the three measures. But Company A has the lowest user growth rate of any of the comparables. Company B yields the highest implied value, $137.52 million, but has a higher growth rate of users and a high value per existing user. Overall, it appears that our valuation is reasonable.

Private value versus market value. It is important to be cognizant of the assumptions implicit in the choice of comparables. If, for example, a private venture is valued on the basis of public company multiples, then the result is an estimate of the value as if the venture were public. If the comparables are from private transactions, such as acquisitions, then the estimate is as if the venture were to be acquired.

In principle, if everything is properly controlled, there may be no difference between the values implied by the two different kinds of comparables data. However, the choice to go public or exit via acquisition is not arbitrary. Some companies are better suited for IPO and others are better suited for acquisition. The valuation is likely to be more credible if the comparables represent the exit choice that is most appropriate for the subject venture. The main drawback of relative value multiples is that current financial measures are linked primarily to assets in place, which may bear little relation to likely future performance.[19] Furthermore, comparable firm and comparable transaction data can be difficult to collect.[20] That said, practitioners frequently use multiples, so we include them here in our discussion and offer suggestions to help overcome their shortcomings.

10.6 VALUATION BY THE VENTURE CAPITAL METHOD

The VC Method is the traditional approach for VC investment valuation. It is also the simplest approach for valuing early-stage ventures.[21] In the VC Method, value is estimated on the basis of projected harvest-date cash flows under the assumption that the venture meets its performance objectives. The scenario in which the venture meets its objectives is referred to as a "success scenario."

The procedure is as follows:

1. Select a terminal year for the valuation by determining a point where, if the venture is successful, harvesting by acquisition or IPO would be feasible. Estimate net income or other cash flows in that year based on the success scenario.
2. Use the appropriate P/E or other multiple and the harvest-date earnings or cash flow projection to compute continuing value. The multiple should reflect the expected capitalization of earnings or cash flow for a company that has achieved the level of success reflected in the scenario.
3. Convert the continuing value estimate to PV by discounting at a hurdle rate that is high enough to compensate for time value, risk, the probability that the success scenario will not be achieved, and dilution from anticipated future funding rounds.
4. Based on estimated PV, compute the minimum fraction of ownership an investor would require in exchange for contributing a given amount of capital.

The VC Method is problematic for several reasons. Most fundamentally, it is based on an optimistic forecast of the future.[22] While the hurdle rate is intended to compensate for the optimistic cash flow estimate, there is no indication of the likelihood that the success scenario will be achieved. To compensate for the optimistic forecast of continuing value, the hurdle rate must be well above cost of capital. The approach can easily be based on hurdle rates in excess of 50%.

In addition, the VC Method does not consider cash flows in the explicit value period. This could make sense if the expected cash flows during the explicit value period are very small compared to continuing value. If they are not, the problem can be addressed by adding the PV of the cash flows from the explicit value period to the PV of continuing value. Because these cash flows are from a success scenario, the model implies that they again would be discounted at a high rate.

To illustrate, recall the stock price example from Section 10.4. If we were to value the stock using the VC Method, we would consider only the good state (i.e., the success scenario) as shown here.

State of the economy	*Dividend (D_1)*	*Price (P_1)*	*Dividend yield*	*Percent appreciation*	*Total return*
Good	$2.00	$24.00	10%	20%	30%

We know that the actual PV is equal to today's market price of $20, and in Section 10.4, we established that the cost of capital (i.e., the expected return) taking account of all three possible outcomes is 11.67%. To get the same

$20 market value by the VC Method, we would need to discount the Time 1 success-scenario price of $24, plus the $2 dividend by a 30% hurdle rate, well above the actual 11.67% cost of capital.

The Achilles heel of the VC Method is that intuition and experience form the basis of the hurdle rate to use. So while the method might work reasonably well for an investor who has years of experience of experimenting with different hurdle rates in different circumstances, there is no real guidance for an entrepreneur, a first-time investor, or a student who aspires to become a VC or entrepreneur. In spite of these problems and challenges, the VC Method continues to have some appeal because of its simplicity, intuitiveness, and potential usefulness in negotiating with an entrepreneur.

10.7 VALUATION BY THE FIRST CHICAGO METHOD

Under the First Chicago Method, a user identifies a small number of discrete scenarios and values them using a discount rate that is reflective of cost of capital. The First Chicago Method is designed to be simple to use but also to address the biases of the VC Method. Usually the First Chicago Method is based on three scenarios: "success," "sideways," and "failure." The success scenario might be the same as in the VC Method, possibly the entrepreneur's projection. The failure scenario is one in which investors realize essentially no return on their investment and lose the principal. The sideways scenario is one of moderate performance in which the venture languishes with no prospect of a high-valued outcome. In this scenario, investors might earn a preferred dividend return and recoup the initial investment but nothing more.

If the First Chicago Method is intended to correct the biases of the VC Method, the scenarios and their probability weights will be chosen so that opportunity cost of capital is the correct discount rate to use to value the scenario cash flows. Because the stock price example in Section 10.4 simplifies the stock price outcomes to three equally likely scenarios, we can think of it as an example of the First Chicago Method.

Implementation of the method involves the following steps:

1. Select a terminal year for the valuation based on the likely harvest date in the event of success.
2. Estimate the cash flows during the explicit value period based on a small number of discrete scenarios.

3. Compute the continuing value by applying a multiplier to the financial projection. The multiplier for the success scenario should reflect the expected capitalization for a company that has achieved the level of success reflected in the scenario. The multiplier for the sideways scenario may be different, depending on differences in expected growth rates used in the capitalization. In the failure scenario, the venture probably is not sold, but the liquidation value, if any, of the assets should be incorporated in the cash flows.
4. Compute the expected cash flow in each period by appropriately weighting the scenarios.
5. Compute PV by discounting the expected cash flows, including expected continuing value at opportunity cost of capital.
6. Based on PV, determine the minimum fraction of ownership the investor should require in exchange for contributing a given amount of capital.

The First Chicago Method makes fundamental sense because the goal is to value expected cash flows at opportunity cost of capital. Traditional application of the First Chicago Method, however, does not offer much guidance on how to determine the cost of capital. It might seem that the dispersion information reflected in the cash flow scenarios should be useful. Later, we will see that it is, but in the context of the CEQ model. In fact, if the CEQ model is applied to similar, discrete scenarios, it is the same as the First Chicago Method with the CAPM being used to value the cash flows.

Ultimately, it is not possible to value future cash flows by either the VC Method or the First Chicago Method without relying on some asset pricing model to determine the appropriate discount rates. The asset pricing model might be based on experience and rules of thumb. It might be based on simple comparisons to other assets in the market. Or it might be derived from a formal asset pricing model, such as the CAPM.

10.8 RECONCILIATION WITH THE PRICING OF OPTIONS

Option pricing theory implies that the values of some kinds of claims increase with risk.[23] Because new ventures are, in effect, portfolios of options, you might ask whether the Option Pricing Model (OPM) would be a better valuation model for our purposes. To answer, we need to examine the principles underlying the OPM.

Risk contributes positively to the value of options because options partition risk into the risk of an increase in the price of an underlying asset and the risk of a price decrease. An investor who is optimistic about the future performance of a share of stock can buy a call option on the stock instead of the underlying share. If the stock value increases, the call option will increase as well. However, unlike an investor in the stock, the call option investor is protected against price declines. If, on the date the option expires, the stock value has fallen to below the exercise price of the option, then the option is worthless. Conversely, if, on the day the call option expires, the stock price is above the exercise price, the value of the option will equal the difference between the stock price and the option exercise price.

Because the exposure to risk is not symmetric (only the upside matters), the value of a call increases with anything that increases the riskiness of the underlying shares. There is no inconsistency between using the OPM to value puts and calls and using the CAPM to value the underlying asset. The key to reconciliation is that an option is a derivative asset: its value is "derived" from the value of the underlying asset and from the risk characteristics of the underlying asset. Because the underlying asset does not partition risks into good and bad, an investor in the asset must bear the risk of loss to acquire the potential for gain. In that setting, risk aversion leads to the conclusion that investors will require compensation for bearing risk that is not diversifiable.

Although the CAPM and OPM are consistent, certain aspects of the OPM make its application to valuation of new ventures difficult. One problem is that the OPM is derived under an assumption of market completeness and continuous trading of assets. In general terms, a complete market is one with negligible transaction costs and where there is a price for every asset in every possible state of the world. A complete market, in our narrower context, means that the underlying asset, matched pairs of puts and calls (with the same exercise price and expiration date), and riskless debt must all be continuously available, and it must be possible, at low cost, to take long or short positions in each. In standard pricing of options on freely tradable assets, by either the Black-Scholes Option Pricing Model or the Binomial Option Pricing Model, the current price of a freely traded underlying asset is established in a market so that, implicitly, there is agreement on value. Riskless debt with the same maturity as an option on the underlying asset is also freely traded.

The logic of option pricing is arbitrage. Suppose, for example, that there are only two future states of the world and that a share of stock that sells for \$10 will, in one year, pay \$15 if the good state occurs or \$9 if the bad state occurs. Riskless debt with the same maturity will return 10%. You would like to price a one-year call option with an exercise price of \$10. The option will pay either

$4 or $0. In this case, we can replicate the payoffs of the call option by investing in two thirds of a share of the underlying stock on margin. The stock investment will cost $6.67. To construct the call option payoff profile, you will pay $1.22 of this price yourself and will borrow the remaining $5.45. At the time of option expiration, the stock investment will pay either $10 or $6, but you will need to pay off the margin loan and accrued interest, at a total cost of $6, leaving you with either $4 or $0, the same as if you had invested in the call option directly. Hence, by this replication argument, the current price of the call option must be $1.22.

In this example, we know the current stock price, the conditional payoffs of the stock in one year, and the interest rate on riskless debt, and we can use this information to find the conditional payoffs of the call option. We do not know the probabilities of the good and bad states in one year. Nor do we know how the market determined that those conditional payoffs had a current value of $10 per share. We can, however, narrow the feasible range of state probabilities. If investors are risk-averse to any extent, since $11 is the one-year payoff on a $10 investment in riskless debt, the true probabilities from investing in the one share of stock must result in an expected payoff greater than $11. Mathematically, we can determine that a 16.7% probability of the good outcome (a payoff of $15) would make the expected payoff $11, exactly the same as the risk-free payoff. So the implied probability of the bad state must be 83.3%. These state probabilities that would make the expected payoff the same as the risk-free payoff are what are referred to in standard option valuation as "risk-neutral probabilities." If investors are risk-averse, the true probability of the good state must then be more than 16.7%. Since standard option pricing relies on riskless arbitrage and a known set of current and contingent future prices, we can price the option even though we do not know the true probabilities.

These conditions or conditions like them that hold reasonably well for publicly traded options on publicly traded stock are the core of the Black-Scholes and binomial option pricing models. They also may provide reasonable approximations for options on assets such as gold mines, the values of which are closely linked to the value of gold, a freely traded asset. Clearly, however, they do not hold for many high-risk, high-potential new ventures. Investors and entrepreneurs are likely to disagree about the current value and about future state-contingent payoffs. The underlying asset, one that can service the full potential product-market demand and does not provide for abandonment, is virtually never observed or priced. As a consequence, riskless arbitrage between options and underlying assets is not possible. The upshot is that a replicating portfolio is unlikely to exist and the standard OPM logic is likely to misvalue the real options that comprise most new ventures. Moreover, as a new venture is an amalgam of many interrelated options, some with complex exercise provisions that are controlled by different parties, use of the OPM can quickly become impractical. The alternative we use is pricing by simulating the uncertainties in a decision tree that incorporates the important real options.

In summary, the choice of real option valuation methods depends on what you are believe you know, and what you don't. If you believe you know the state-contingent payoffs and that you can replicate the payoffs with a freely traded asset that has the same risk profile, but you do not know the state probabilities, you can use market data and the standard OPM replication approach to value the venture and price the real options. Alternatively, if the option structure is complex and there is no market asset that can replicate the venture, but you think you know the probabilities of option exercise and associated future values, you can use the decision tree simulation approach similarly to what was illustrated in Chapter 6 to value the venture. In a later chapter, we present a simulation approach to valuing new ventures and financial claims based on the CEQ form of the CAPM. The approach provides a convenient way to estimate the effects of embedded real options on the value of a new venture.[24]

10.9 REQUIRED RATES OF RETURN FOR INVESTING IN NEW VENTURES

Early in the chapter we promised a resolution of the paradoxical difference between the rates of return sought by VC investors and those realized by the investors. The CAPM helps with the explanation and offers some supporting evidence.

Assuming that the CAPM is a reasonable way to estimate the rates of return investors in new ventures require, how high would those rates be? Clearly, a new venture is a risky proposition, which might suggest that the expected returns should be very high. On the other hand, the point of the CAPM is that only nondiversifiable risk matters.

It seems likely that much of the risk associated with new ventures is diversifiable or firm specific. Consider, for example, a biotechnology venture. How much of the risk is likely to be nondiversifiable? In many respects, a biotechnology venture is like a lottery: by investing, you place a bet today, and at some future date, you learn whether you have a winning ticket. The future payoff from such an investment is highly unpredictable and depends on factors such as how significant the innovation proves to be. The payoff is not likely to depend very much on economic fluctuations or similar factors that would have much greater effects on such sectors as discretionary consumer durables.

Because beta risk depends on how the venture's payoff varies with marketwide fluctuations, a biotech venture is likely to have a low beta despite its high total risk. At the same time, the cash flows from investing in a portfolio of 100 different biotech ventures might not be very risky at all. Most of the risk is specific to the individual venture and would be substantially reduced by diversifying, even within the same industry. In fact, for a large sample of public biotechnology ventures, we estimated an average beta of 0.75 but an average total risk almost five times as high.[25]

We will see in Chapter 11 that estimating the beta of an individual new venture requires judgment. However, we can gain information about the betas of new ventures as a group by studying the price performance of publicly traded firms that were funded by VCs. Such firms typically have betas in the range of 1.0 to 2.0.

What do betas in this range imply for the required rates of return on new venture investments? We can answer by looking back at Eq. (10.3) and filling in the other pieces of the equation with reasonable values. Suppose we use 4.0% as an estimate of the riskless rate of return, r_F, and 8.0% as the historical average market risk premium, $r_M - r_F$.[26] Beta values in the 1.0 to 2.0 range would imply required rates of return in the 12–20% range. Such low required rates of return seem inconsistent with the earlier-mentioned claims that, for investing in new projects, VCs sometimes seek rates of return in excess of 50%. On the other hand, they are fully consistent with the historical evidence on VC returns cited earlier in this chapter.

To look more specifically at the rates of return required by VC firms, the discount rate for VC investing can be disaggregated into four components as follows:

$$r_{proj}^{VC} = r_F + \beta_{proj}(r_M - r_F) + Effort + Liquidity \tag{10.9}$$

where r_{proj}^{VC} is the discount rate used to value the VC's claim on the value of a project, is the beta risk of the project, *Effort* is a measure of the cost of effort committed to the project by the VC and expressed in returns form, and the last term is a measure of the required return differential due to illiquidity of the investment. Note that $r_F + \beta_{proj}(r_M - r_F)$ is just the CAPM applied to the project.

With the model from Eq. (10.9) in mind, an average gross realized return as high as 25% or 30% on VC investing could be understandable. The gross return is different from the net return because, as discussed in Chapter 3, it includes the fees charged by the GP and the portion of capital appreciation (the carried interest) that is retained by the GP.

We previously calculated, based on historical data, that a beta of 2.0 yields a cost of capital for an entrepreneurial venture of about 20%. This corresponds to the returns realized by LPs. VC limited partnerships segregate returns to the GP (the active investor) from returns to LPs (passive investors). The GP's return is typically 20% of fund returns after initial investment capital has been returned to the LPs, and after the annual management fee, which is equal to about 2.5% of committed and invested capital.[27] A reasonable estimate, then, is that one fifth of a 25% gross return is actually compensation to the GP.

This return leaves nothing to compensate for the illiquidity of the investment. However, an adjustment for illiquidity of near zero comports with recent empirical evidence on the cost of illiquidity.[28] Low compensation for bearing illiquidity risk also makes sense given the fact that most investors in VC limited partnerships are institutions with long-term investment horizons, at least for some fraction of their portfolios. It is reasonable to expect that competition would drive them to demand a negligible return premium to compensate for illiquidity.

Why does the CAPM accurately predict average returns of VC investors? In large part, the answer appears to be that assumptions underlying the CAPM are reasonably well satisfied. Most importantly, any venture is likely to represent only a small fraction of the asset portfolio of a large pension plan or life insurance company. For such investors, a substantial component of the total risk is diversifiable.

How, then, do we account for the high sought-for rates of return? Our answer is that those returns represent hurdle rates that investors sometimes use to value cash flow projections that are developed on the presumption that the venture will be successful. VCs know that a large fraction of their deals will fail completely and others will limp along offering breakeven returns at best. These will be offset by a few home runs that will offer spectacular returns, sometimes returning 5 or 10 times the initial investment. All of the prospective ventures have rosy forecasts at the time of investment, and there is no reliable way for the VC to know *ex ante* which will be home runs and which will fail. To compensate for the optimism built into the cash flow projections, the investor applies a hurdle rate that is substantially above the required return for investing in the project.[29]

10.10 THE ENTREPRENEUR'S OPPORTUNITY COST OF CAPITAL

A unique challenge to new venture contracting is that the entrepreneur necessarily invests a large fraction of his financial wealth and human capital in the venture. The resulting underdiversification implies that the entrepreneur faces a different risk-return tradeoff than does a well-diversified investor such as an LP in a VC fund.

The entrepreneur's decision to pursue a new venture is among the most difficult to make correctly. Yet research and books on entrepreneurial finance take the entrepreneur's investment decision as a forgone conclusion. A common perception is that the entrepreneur's investment problem is less a quantitative decision than a qualitative one, having to do with wanting to be one's own boss, one's lifestyle preferences, and one's tolerance for risk. This focus is too narrow.

The entrepreneur's investment decision problem is fundamentally different from the investor's. Even though the underlying financial economic theory is the same, because of necessary underdiversification, the opportunity cost of capital that is appropriate for the entrepreneur is different from that of the investor. This is true even if the parties hold identical financial claims.

The entrepreneur should take a separate look at value for three compelling reasons:

1. *Underdiversification causes differences in required rates of return.* Because an entrepreneur is necessarily sacrificing some ability to diversify, the entrepreneur's opportunity cost of capital is higher than that of investors.
2. *Ownership claims of investors and entrepreneurs usually are not identical.* As we have seen, investors often receive "sweeteners" such as options and preferences that make the deal more attractive. Sweeteners raise the value of an investor's ownership claims and therefore reduce the value of the entrepreneur's claim.
3. *The parties may have different beliefs about expected performance and risk.* The entrepreneur and the investor are unlikely to agree about the risk and expected return of the venture. Differences in expectations about such things as development timing, achievable sales, and profitability make contracting more difficult.

Building on financial economic theory from this chapter, we provide a valuation framework that addresses the entrepreneur's underdiversified risk. The framework can be applied in the context of differences in expectations and financial claims that differ in priority.

Opportunity Cost and Choosing Entrepreneurship

What drives the decision to become an entrepreneur? Opportunity cost is key to answering this question, along with related questions such as: Why, compared to in the U.S., do greater percentages of the populations in Brazil, Lebanon, and South Africa, for example, engage in entrepreneurial activities, and why do lower percentages in countries like France and Sweden? Why do students drop out of college to start businesses? And why is the probability of starting a new business in the U.S. positively related to wealth whereas in some other countries there is a negative relationship between per capita wealth and engagement in entrepreneurship?

Research indicates that, in general, the decision to become an entrepreneur rests on rational assessments that individuals make based on two components of opportunity cost—the opportunity cost of their committed effort (their human capital) and the opportunity cost of their invested wealth (financial capital). At least intuitively, individuals try to compare the expected value of starting their own businesses with the value of the next best alternative, which for many is staying on the employment track.

The patterns of entrepreneurial activity described here are explained by two factors, both reflective of opportunity cost. First, in countries with fewer good employment opportunities, individuals are more likely to turn to self-employment out of necessity. In countries such as the U.S., where attractive career opportunities are usually available, there are fewer entrepreneurs as a percentage of the population than in countries with chronically limited employment opportunities. However, the opportunity cost of pursuing an entrepreneurial opportunity is not very high for a student, who can easily return to student status if the venture fails, or for an employee, who can quickly return to similar employment. Second, the ability to diversify financial assets can significantly reduce the entrepreneur's opportunity cost of capital and make entrepreneurship more attractive. Wealthy individuals are able to commit smaller fractions of total wealth to an entrepreneurial venture and thus can be better diversified. Other things being equal, greater wealth lowers the opportunity cost of becoming an entrepreneur.

Of course, factors other than opportunity cost also affect the decision to become an entrepreneur, such as a desire to be one's own boss or to pursue a particular lifestyle, as well as differences in risk tolerance. In this section, we set these other considerations aside to focus on opportunity cost. We analyze, at a conceptual level, how risk and the opportunity cost affect the decision. To ensure clear understanding, we provide formal analysis of the underlying foundations and derivations. To make application more practical, Chapter 11 includes discussion of shortcut approaches that make the entrepreneur's valuation problem more tractable.

The Entrepreneur as an Underdiversified Investor

Often, an entrepreneur must commit most of his time, at least for a few years, as well as a substantial fraction of his financial capital to the venture. As a result, the entrepreneur necessarily bears not only the nondiversifiable risk of the venture but also the total risk. The focus on total risk as a determinant of the entrepreneur's required rate of return is appropriate in part because entrepreneurial ventures are not market assets.

To illustrate the differences between a well-diversified investor and the entrepreneur, consider an individual who has total wealth of \$300,000, which includes both financial and human capital. The entrepreneur is considering whether to invest one third of his total wealth (\$100,000) in a venture that will pay off in one year. Excluding the entrepreneur's salary, there are three equally likely payoffs on his investment, as shown:

Scenario	Probability	Year 1 payoff	Return
Success	1/3	\$200,000	100%
Likely	1/3	\$125,000	25%
Failure	1/3	\$53,000	(47%)

Using the required investment of \$100,000, the expected return and standard deviation of returns on the investment are 26% and 60%, respectively. The 60% standard deviation represents the total risk of the new venture. Assuming a 4% risk-free rate, an expected return on the market of 12%, a standard deviation of market returns of 15%, and a correlation coefficient of the venture's returns with the market of 0.2, our estimate the venture's beta is

$$B_j = \frac{\rho_{r_j,r_M}\sigma_j}{\sigma_M} = \frac{0.2 \times 0.60}{0.15} = 0.80$$

With this beta, the CAPM return that a well-diversified investor would require in exchange for investing in the new venture is 10.4%:

$$r_j = r_F + \beta_j(r_M - r_F) = 4\% + 0.8(12\% - 4\%) = 10.4\%$$

The anticipated 26% return indicates a positive NPV for a well-diversified investor. However, based on the opportunity cost of bearing risk, considering his inability to fully diversify, the entrepreneur possibly should not settle for a 26% return. Suppose the entrepreneur were to use leverage to achieve the same level of risk by investing only in the market portfolio. His expected return would be higher than 10.4%. But how much higher?

We can use this opportunity cost reasoning to compute the entrepreneur's required rate of return for investing in the new venture. We start by considering the standard deviation of the entrepreneur's portfolio, which (we assume) is divided between the new venture and the market. The standard deviation of a portfolio of two risky assets is calculated as follows:

$$\sigma_{port} = \sqrt{x_M^2\sigma_M^2 + x_P^2\sigma_P^2 + 2x_M x_P \rho_{M,P}\sigma_M\sigma_P} \quad (10.10)$$

The variables x_M and x_P are the value weights of total risky investments in the market and the project, respectively, where the weights sum to 100%. The variable $\rho_{M,P}$ is the correlation coefficient between the market and the project. In our example, the weights in the market and the venture are 2/3 and 1/3, respectively, which yields a portfolio standard deviation of 24.1%:

$$\sigma_{port} = \sqrt{(2/3)^2(0.15)^2 + (1/3)^2(0.60)^2 + 2(2/3)(1/3)(0.2)(0.15)(0.60)}$$

$$\sigma_{port} = 0.241 \text{ or } 24.1\%$$

The following formula allows us to calculate a portfolio's required return, using the total risk of the portfolio as compared to the market:

$$r_{port} = r_F + (\sigma_{port}/\sigma_M)RP_M \quad (10.11)$$

Using the CAPM-based approach, the entrepreneur's required return on his risky portfolio is

$$r_{port} = r_F + (\sigma_{port}/\sigma_M)(r_M - r_F) = 4\% + (24.1\%/15\%)(12\% - 4\%) = 16.85\%$$

Now that we have the required return on the portfolio, we can use the fact that the required return on the portfolio is equal to the weighted average of the required return on the project and the required return on the market. That is,

$$r_{port} = x_p r_p + x_M r_M \quad (10.12)$$

Because we know everything except the required return on the project, we can rearrange to solve for r_p, the project required return:

$$r_{port} = \frac{r_{port} - x_M r_M}{x_P} = \frac{16.8\% - (2/3)12\%}{1/3} = 26.55\% \quad (10.13)$$

Therefore, the opportunity cost of investing one third of total wealth in the new venture is a 26.55% return—slightly higher than the 26% expected return on the project. From a purely financial perspective, this is the return the entrepreneur would need in order to forgo an investment in the market portfolio that was leveraged to achieve the same total risk as the entrepreneur's portfolio. We can conclude that if the entrepreneur would have to invest one third of total wealth in the venture, the NPV of the investment would be negative. Note, however, that if the entrepreneur could find a way to invest a smaller fraction of wealth in the venture, his required return would be lower, and possibly the project NPV would be positive.

This example makes clear that the entrepreneur's required return, even with less than a full commitment of wealth to the new venture, is substantially higher than the return required by a diversified investor.

Factors That Offset the Entrepreneur's Cost-of-Capital Disadvantage

Based on the preceding discussion, the entrepreneur's cost-of-capital disadvantage may seem daunting. In a competitive market for launching new ventures, we should find that, because of their lower cost of capital, public corporations can spend more resources searching for viable ventures than can entrepreneurs and that corporations can legitimately undertake ventures before they reach the threshold of economic profitability for underdiversified entrepreneurs.

Offsetting their cost-of-capital advantage, however, corporations face challenges when they seek to engage in entrepreneurship. For example, because of internal equity concerns, the maximum reward a corporation can offer to an employee for perceiving and pursuing entrepreneurial opportunities can be less than what an individual can realize by acting alone. Consequently, corporate employees with good new venture opportunities frequently jump ship to pursue them on their own. As a result, the venture cash flows that are available to entrepreneurs may not be equally available to large corporations. Hence, a trade-off exists between some of the organizational efficiencies and expediencies of stand-alone entrepreneurial ventures and the cost-of-capital advantage of a public corporation.

This trade-off gives insight into the kinds of ventures that are likely to be pursued by corporations rather than individuals.

- The larger the scale of the venture and the more complex the organization that is required to undertake it, the more likely the venture is to be pursued by a corporation.
- The higher the level of total risk, as compared to beta risk, the greater the cost-of-capital advantage of the diversified investor, and hence the more likely the venture is to be pursued by a public corporation.
- With a longer expected holding period between investment and harvesting, the diversified investor's cost-of-capital advantage compounds, making corporate entrepreneurship more likely.

There are additional reasons why, in the market for new venture investing, large public corporations and diversified investors do not entirely displace entrepreneurs. As one example, for any given venture, investors may not perceive the opportunity or may be less optimistic than is the entrepreneur. In such cases, the entrepreneur may need to invest more resources that are personal because money from diversified investors is not available, or the entrepreneur may need to make a larger initial investment to help convince prospective investors of the merits of the venture.

10.11 MATCHING CASH FLOWS AND DISCOUNT RATES

Cash Flow Definitions

Many valuation errors, even by employees of well-known investment banks, arise from incorrect matching of cash flows and discount rates. The cash flow definitions used in a valuation need to be tied to the specific financial claim being valued and must be matched correctly with the appropriate discount rates. As an aid to identification, Table 10.1 includes specific definitions of the most important measures of expected cash flow that are appropriate for valuing debt and equity claims and for valuing the enterprise:

- *Cash flow to all investors* represents the amount of cash available to all capital providers, after funding net working capital and capital expenditures. Because this measure is after actual taxes in light of the venture's leveraging decision, the tax benefit of debt financing (i.e., tax deductibility of interest payments) is reflected in the cash flow measure.
- *Cash flow to creditors* is the net of what the firm's creditors expect to receive in the form of interest and principal payments less any new borrowing. If there is a risk of default or prepayment, then the expected cash flows to creditors are not the same as the contractual cash flows.
- *Cash flow to stockholders* represents the residual cash flow available to the equity investors in the venture. This is a measure of residual free cash flow after expected debt service (principal and interest payments to creditors less new borrowing), taxes, and investments in working capital and fixed assets.
- *Unlevered free cash flow* is the cash flow the venture would generate if it were unlevered, that is, financed entirely with equity (as is typical for high-risk, early-stage ventures). By calculating tax on EBIT, we ignore the beneficial tax effect of the actual financing choice. To offset, we need to incorporate the tax benefits of debt financing into the discount rate.

TABLE 10.1 Measures of expected cash flow

Cash flow to all investors (both stockholders and creditors)

Cash Flow to All Investors = $EBIT$ − Actual Taxes + $D\&A - \Delta NWC - \Delta Fixed\ Assets$

Cash flow to creditors

Cash Flow to Creditors = Expected INT - Expected $\Delta Debt$

Cash flow to stockholders (residual, in light of expected cash flows to creditors)

Cash Flow to Stockholders = $EBIT$ − Actual Taxes + $D\&A - \Delta NWC - \Delta\ Fixed\ Assets$ − Expected INT + Expected $\Delta Debt$

Unlevered free cash flow (as if financed with no debt)

Unlevered Free Cash Flow = $EBIT$ − Theoretical Taxes without Debt + $D\&A - \Delta NWC - \Delta Fixed\ Assets$

$EBIT$ = earnings before interest and taxes, or operating profit
$D\&A$ = depreciation and amortization
$\Delta Fixed\ Assets$ = change in fixed assets = net capital expenditures
ΔNWC = change in net working capital = NWC investment
INT = net interest payments
$\Delta Debt$ = net change in debt financing = proceeds from new debt – principal payments on outstanding debt

Consistent Discount Rates

In Table 10.2, we match these cash flow measures with the appropriate discount rates. Under the RADR method, expected cash flows are discounted to PV using a discount rate that is based on the market risk of the cash flow. The tax deductibility of interest payments is a complicating factor. In a correct valuation, the tax benefit can be recognized in either the cash flow measure or the discount rate, but not in both. Therefore, it is important to make sure the cash flow definition and discount rate assumption are consistent.

- *Unlevered cost of equity.* One way to achieve consistency is to estimate expected after-tax cash flows given the target capital structure and to discount those flows at a rate that is not adjusted for the tax deductibility of interest expense. The appropriate rate is called the "unlevered cost of equity." Under this approach, the tax benefit (if any) is incorporated as an adjustment to cash flows and not to the discount factor.
- *Weighted average cost of capital (WACC).* The other way to achieve consistency is to estimate theoretical cash flows as if the venture were financed entirely with equity and then discount those cash flows using a discount rate that is adjusted for the benefit of the debt tax shelter at the target capital structure. Under this approach, the tax benefit (if any) of debt financing is incorporated in the discount factor and not in the cash flow.

In principle, either approach can yield a correct estimate, but the net tax advantage is difficult to determine directly. The tax advantage of debt financing depends on the aggregate supply and demand for debt and equity, the statutory corporate tax rate, the structure of personal tax rates, and the company's profitability and nondebt tax shelters. Empirical evidence suggests that the tax advantage of debt financing is usually small as a result of low effective corporate tax rates and partially offsetting personal tax rates. Thus, in the calculation of WACC, the appropriate tax rate is probably well below the statutory rate. The preferred approach depends on ease of estimation and availability of information.

There are other ways to calculate cash flows beyond these definitions. Some informal valuation approaches are based on a narrower concept of operating cash flow: EBIT or EBITDA. While EBITDA is convenient to compute, it does not provide for capital replacement or expected growth. Consequently, EBITDA may not be a good measure of the cash flows investors can expect to receive. The important point is to match the cash flow of the claim being valued with a consistent discount rate.

TABLE 10.2 Matching cash flows to discount rates for various financial claims

Financial claim	Discount rate	Discount rate formula (CAPM)	Comment
Cash flows to all investors	Unlevered cost of equity	$r_A = r_F + \beta_A(r_M - r_F)$	The required rate of return on assets, or the unlevered cost of equity, is used to value cash flows that are expected to be received by all claimants given the target capital structure. The effect of tax deductibility of interest payments is reflected in the cash flows.
Cash flow to creditors	Cost of debt	$r_D = r_F + \beta_D(r_M - r_F)$	The cost of capital for debt depends on the extent to which debt service payments are subject to market risk.
Cash flow to stockholders	Cost of equity	$r_E = r_F + \beta_E(r_M - r_F)$	The cost of capital for equity depends not on the total risk of equity but on the market component of the risk.
Unlevered free cash flow	Weighted average cost of capital	$WACC = (D/V)(1 - t_c)r_D + (E/V)r_E$	The weighted average cost of capital (*WACC*) is used to value hypothetical cash flows as if the venture were financed entirely with equity. *D* and *E* are market values of debt and equity, $V = D + E$. The tax benefit of debt financing is an adjustment to the cost of debt capital.*

r_A = return on assets r_D = return on debt r_E = return on equity
WACC = weighted average cost of capital
β_A = asset beta β_D = debt beta β_E = equity beta
r_F = risk-free rate r_M = expected return on the market $(r_M - r_F)$ = market risk premium
t_c = corporate tax rate
D/V = market value debt/total firm value (debt + equity)
E/V = market value equity/total firm value (debt + equity)
*The correct tax adjustment should be the net advantage of debt financing, giving consideration to the offsetting effects of personal taxes. However, this number is unobservable and difficult to estimate, so in practice, t_c, the marginal corporate tax rate, is typically used. See Miller (1977) and DeAngelo and Masulis (1980).

Consistency in the Use of Continuing Value

The same issues of consistency can arise when we use continuing value in a PV calculation. Continuing value is a shortcut way of projecting future cash flows. Instead of explicitly projecting each period's cash flow, discounting it back to PV, and then summing, with continuing value a single cash flow number is capitalized using a capitalization rate that takes account of both the riskiness of the cash flow and its expected growth rate.

Consider a simple example in which, after several years of rapid growth, the cash flow available to all investors is expected to grow at a constant rate of 4%. Based on Table 10.2, if we are valuing cash flow to all investors, then the appropriate discount rate is the unlevered cost of equity. Suppose we have determined that the unlevered cost of equity is 10%. We can determine the appropriate continuing value multiple in this example as

$$\text{Multiple} = \frac{(1+g)}{(r_A - g)} = \frac{1.04}{(0.10 - 0.04)} = 17.33$$

Thus, we would estimate continuing value by multiplying cash flow to all investors in the last year of the explicit value period by 17.33. To determine the PV of the continuing value, we would discount the continuing value back to Time 0 at r_A. If we assume that the D/E ratio stays constant, we can use the same approach to find the PV of debt but would use r_D to determine the multiple and to discount the continuing value.

This example demonstrates the importance of consistency. If we were to use a different cash flow measure and not adjust the cost of capital to be consistent, the result would be a different (and biased) estimate of continuing value.

Many of the cash flow measures in the earlier discussion of relative value do not have obvious discount rates and multiples that are theoretically consistent. Instead, the normal approach is to estimate the multiple based on data for comparable companies. The consistency point, however, is the same. If we are using comparables to value cash flow to all investors, then the same cash flow should be used for the comparable companies, and either the comparables should be selected to have similar leverage ratios or the cash flows should be adjusted to be based on similar leverage ratios. Our overarching point is that consistency is important to the valuation. This is true whether you are using explicit DCF or RV and whether you are using an approach based on cost of capital or a simplified approach such as the VC Method.

10.12 SUMMARY

Valuation is central for entrepreneurs and investors when they are making decisions about business planning, capital raising, and deal structuring. In the last three decades, private equity investing has become more competitive, increasing the role and importance of theoretically sound and empirically supported valuation tools. The valuation is a key contributor to a successful negotiation between the entrepreneur and investors.

We describe several valuation methodologies that fall into two basic categories: discounted cash flow and relative value. Discounted cash flow approaches start with the premise that the value is simply the PV of all future cash flows. This is a theoretically sound approach, but DCF can also be challenging to implement. To use DCF, we need estimates of future cash flows and the corresponding discount rates.

We stress the importance of matching the financial claim with the appropriate cash flow measure and discount rate and also introduce the concept of continuing value. To estimate discount rates, the notion of nondiversifiable or market risk is highlighted. Because the investors who participate in VC investing will be those best able to diversify and hold illiquid investments, we are able to rely on CAPM-based measures for calculating the appropriate discount rates.

Continuing value represents a shortcut to estimating the value of the venture's long-term cash flows while avoiding the need for extensive, explicit cash flow forecasts. We review the RADR approach of DCF valuation and introduce the CEQ approach as a way to overcome the inherent challenges of using RADR to value new ventures.

The relative valuation method uses the values of comparable firms, relative to operating or financial multiples, to provide a basis for estimating value. The challenge in using RV is in finding comparables that are truly representative of the new venture at the point when the venture is being valued.

The Venture Capital Method is simple and intuitively appealing but has theoretical shortcomings that raise challenges to validity and call for caution in its implementation critical. Because the VC Method assumes a successful outcome, the corresponding annual discount rate is typically very high (30–80%) to compensate for the cash flow bias.

The First Chicago Method was developed to address some of the shortcomings of the VC Method. It is a scenario-based valuation methodology, which means it incorporates a range of possible outcomes and therefore uses a more reasonable, lower discount rate. The First Chicago and RADR approaches yield similar value estimates when the scenarios in the First Chicago approach are weighted to yield expected cash flows.

A key point in this chapter is to reconcile the high hurdle rates associated with use of the Venture Capital Method with reasonable estimates of cost of capital. We demonstrate that high hurdle rates are simply a heuristic device that investors can use to compensate for optimistic cash flow projections.

Another key point is that because entrepreneurs cannot be fully diversified, they bear the unsystematic risk of their investment of financial and human capital in the venture. As a result, the entrepreneur's cost of capital is higher than that of well-diversified investors. The extent of the disadvantage depends on the fraction of wealth the entrepreneur must commit to the venture.

The chapter concludes with a structured discussion of the importance of matching cash flow measures to discount rates and emphasizes that the tax advantage of debt financing can only be incorporated into the cash flow estimate or in the discount rate, but not in both.

REVIEW QUESTIONS

1. How might you respond to an entrepreneur who says, "There is so much risk and uncertainty associated with new ventures that forecasting future revenue and cash flows is a waste of time"?
2. Describe the recent performance of VC funds. Do the empirical results fit with your prior expectations? If not, how can you explain the discrepancy?
3. Explain the theoretical basis for discounted cash flow valuation. What are the key inputs required for DCF analysis?
4. Explain the intuition behind the Capital Asset Pricing Model. Is the CAPM a reasonable tool for estimating the required return for an investor? For an entrepreneur? Why or why not?
5. Why is it important to match the cash flows and discount rate when using DCF valuation?
6. What are the main differences between the RADR and CEQ approaches to DCF valuation? Why is the CEQ approach often preferable when valuing new ventures?
7. Explain the intuition behind each of the following valuation techniques: (a) relative valuation (b) the VC Method (c) the First Chicago Method. Describe the strengths and weaknesses of each approach and the caveats regarding its implementation.
8. How would you reconcile the following? (a) VCs often use very high hurdle rates when valuing potential new investments. (b) The historical average return for a large sample of VC funds is around 14%.
9. Why should an entrepreneur's cost of capital for valuing an opportunity depend on the fraction of the entrepreneur's wealth that must be invested in the venture?
10. How is the benefit of diversifying related to the correlation of returns or cash flows between different assets in the portfolio?

NOTES

1. Funds with vintage years later than 2013 do not have enough history to produce reliable IRRs.

2. Baty (1990, p. 63).

3. See Roberts and Stevenson (1992).

4. For more detail on historical VC returns in the early years of the industry, see Poindexter (1976), Ibbotson and Brinson (1987, pp. 99–100), Martin and Petty (1983), and Cochrane (2005).

5. All of these estimates are likely to be positively biased. Information on fund IRRs is not reported formally to any official source; rather, both Thomson Reuters and PitchBook obtain the information from voluntary disclosures, from third parties such as limited partners of the fund, and through Freedom of Information Act (FOIA) disclosures. Funds that have not performed well are less likely to disclose performance voluntarily.

6. See Roberts and Barley (2004, p. 8).

7. The term "Venture Capital Method" was first coined by HBS Professor William Sahlman in a 1987 publication.

8. We use the term "hurdle rate" to distinguish it from cost of capital, which is the rate used to discount expected cash flows as opposed to an optimistic projection.

9. The First Chicago Method was developed by the VC group of First Chicago Corporation. Sahlman and Scherlis (2009) describe it as a method developed to address valuation biases inherent in the VC Method.

10. See Brealey, Myers, and Allen (2017, chap. 4) for elaboration of the relation between share value and expected dividends.

11. A pioneer of modern portfolio theory, Harry Markowitz, first proposed use of the standard deviation of holding-period returns as the measure of risk; see Markowitz (1952). Markowitz was awarded the Nobel Prize in economics in 1990 for his contributions to the theory of decision making.

12. The expected return is computed as $[(30\% \times 1/3) + (15\% \times 1/3) + (-10\% \times 1/3)] = 11.67\%$. The standard deviation is computed as $[(30\% - 11.67\%)^2 \times 1/3 + (15\% - 11.67\%)^2 \times 1/3 + (-10\% - 11.67\%)^2 \times 1/3]^{0.5} = 16.5\%$.

13. Development of the CAPM from its roots in modern portfolio theory was the contribution of several individuals, working independently. See Sharpe (1964), Lintner (1965), and Mossin (1966). The model is based on a number of assumptions, including homogeneity of beliefs about risk and return, a one-period time horizon, availability of a risk-free asset, and quadratic utility functions for investors or normally distributed risk. Empirical evidence from testing of the CAPM is roughly consistent with the CAPM's theoretical predictions. This suggests that, in most uses, violations of the assumptions are not very important and do not impede its application as a venture valuation tool.

14. The expected return is computed as $[(\$1 \times 0.5) + (\$2 \times 0.5)] = \$1.50$. The standard deviation is computed as $[(\$1 - \$1.50)^2 \times 0.5 + (\$2 - \$1.50)^2 \times 0.5]^{0.5} = \$0.50$.

15. The expected holding-period return is computed as $[(60\% \times 0.5) + (-20\% \times 0.5)] = 20\%$. The standard deviation is computed as $[(60\% - 20\%)^2 \times 0.5 + (-20\% - 20\%)^2 \times 0.5]^{0.5} = 40\%$.

16. For additional discussion of the CEQ valuation approach, see Brealey, Myers, and Allen (2017).

17. See Demers and Lev (2001), Kozberg (2001), and Rajgopal, Venkatachalam, and Kotha (2003) for evidence of nonfinancial value drivers for Internet companies.

18. See Amir and Lev (1996), who explore the valuation impact of nonfinancial metrics such as population growth and market penetration in the wireless industry. See also the survey results summarized by Prinz (2013).

19. Black (2003) finds no value relevance of earnings in a sample of start-up and growth-phase firms. The author reports that cash flow measures are more value relevant than earnings in early stages of a firm's existence.

20. Wright and Robbie (1996) survey VC firms in the U.K. regarding their valuation approaches. They find that capitalization of historical or prospective earnings is the most widely relied-upon approach.

21. For discussion and examples using the VC Method, see Lerner and Willinge (2002) and Sahlman and Scherlis (2009). Sahlman and Scherlis describe the VC Method and illustrate its application. See also Timmons and Spinelli (2007).

22. The relation between net income and cash flow is not explicit. In our discussion, we assume that net income is used as an approximation of steady-state cash flow.

23. Fischer Black, Myron Scholes, and Robert Merton are the original developers of the OPM. See Black and Scholes (1973) and Merton (1973). Scholes and Merton were awarded the Nobel Prize in economics in 1998 for their contributions. Black died in 1996, and the prize is not awarded posthumously.

24. Most proposals for valuing options that are not traded or where the market is incomplete involve some means of backing into completeness. For example, Mason and Merton (1985) and Kasanen and Trigeorgis (1994) propose that real options that are not traded can be valued by appealing to the existence of a "twin security" that is traded and has risk characteristics that are perfectly correlated with the real option. Short of that possibility, several researchers suggest that untraded options can be valued in the presence of nondiversifiable risk by replacing expected cash flows with their certainty equivalents and valuing the certainty equivalent cash flows at the risk-free

rate of interest. They generally do not address how to determine the certainty equivalent. See Constantinides (1978); Cox, Ingersoll, and Ross (1985); and Harrison and Kreps (1979). For an overview and summary of the literature, see Trigeorgis (1996) and Borison (2005).

25. See Kerins, Smith, and Smith (2004).

26. These are roughly the long-run historical averages over the 1928–2016 period, as estimated by Damodaran. See http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/histretSP.html.

27. See Sahlman (1990) and Gompers and Lerner (1999).

28. For evidence that illiquidity premia tend to be small, see Blackwell and Kidwell (1988), Hertzel and Smith (1993), and Smith and Armstrong (1993).

29. See Bhagat (2014), who makes a similar argument.

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