

The Discounted Cash Flow (DCF) Method Applied to Valuation: Too Many Uncomfortable Truths

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The subprime crisis was an important wake up call for the financial discipline and the academic community. Several fundamental tenets of the field were called into question as the empirical evidence showed that they were less solid than previously believed. Currently, the list of issues under examination is long and challenging. It goes from basic ideas (are markets stable? are investors rational and homogeneous?) to more specialized topics (does the Value-at-Risk metric work? are credit ratings reliable?) The conventional Discounted Cash Flow (DCF) method--since it did not play any role in the crisis-- has gone so far unexamined. Yet, with or without subprime crisis, it remains one of the weakest and most difficult to defend elements of the financial canon.

Introduction

What is the value of an asset? That is, arguably, the ultimate financial question, the equivalent of Hamlet's *To be or not to be*. *Of course*, we all know the answer: the present value of the future cash flows. That much is clear. And if we push any expert for a clarification, the response is always the same: "...take the future cash flows and discount them with the appropriate rate."

Unfortunately, behind this seemingly innocuous statement there are two ill-defined concepts ("future cash flows" and "appropriate rate"), a faulty analogy, and a repudiation of statistics as a useful tool to analyze uncertainty. In what follows, we discuss these topics in more detail.

History of a Curious Analogy

Joel Dean introduced the DCF approach as the right tool for valuing financial assets, also referred to, as projects or investments opportunities (Dean, 1951). The thought was straightforward. If the Net Present Value (NPV) of a given project (or asset) cash flows, estimated with the DCF method, was positive, the investment was worth pursuing. The idea was motivated by an analogy with bond valuation. It had long been established that the price of a bond corresponded to its future cash flows discounted at a rate determined by the market, which was supposed to capture, primarily, the credit risk associated with the issuer (Parker, 1968). We are referring here to regular fixed-coupon bonds with no imbedded options. With that as background, it seemed natural to extend the bond-valuation approach to other financial assets.

Upon further inspection, however, one notices that the analogy between bonds cash flows and projects cash flows is not as clean as it appeared to be. In the case of a bond, the future cash flows are well-defined (say, 6% per year plus a bullet payment at maturity). There is no ambiguity. In essence—and this is critical—the uncertainty in the bond cash flows comes from the potential lack of ability of the issuer to pay (credit risk); but there is no uncertainty as to the amount to be paid. A purist might complain that we are disregarding liquidity and interest rate risk here, but for the purpose of this discussion, they are irrelevant. To put it differently, the bond (in the absence of interest rate variations) has no upside. The best outcome is to receive the coupon and principal we have been promised. Therefore, the probabilistic distribution of the cash flows is one-sided; it only includes downside scenarios.

In a project, however, the uncertainty comes from not knowing what the cash flows could be, not from the "ability" of the project to pay them. That is, we do not expect the project to fail in its commitment to pass on the cash flows; we just do not know exactly what the cash flows could be. Moreover, even if we make an optimistic estimate of the cash flows, there is always a possibility to exceed that estimate. That is, the project has a potential for doing "better than expected". In short, the probabilistic distribution of the cash flows is not bounded: we can get more, or we can get less than expected. The distribution is two-sided. There is upside and downside potential.

These differences are further exacerbated if we notice that the life of a project is not as clearly defined as the time-to-maturity in a bond. Projects cash flows have notoriously uncertain lives.

Therefore, extending a technique valid for analyzing bond cash flows to project cash flows is not as obvious as it might have appeared initially. The analogy breaks down simply because the nature of the cash flows is very different in both cases. Economics textbooks never address this issue.

A Simple Example

If the preceding explanation is not sufficiently clear, consider this example. A friend offers you \$1,000 in a month. Thus, the best you can do is to get \$1,000. You will never get more than that. However, if he experiences financial problems, you might receive less than \$1,000 or even zero. Under this arrangement, which mimics the *bond cash flows* case, it might make sense to value his offer by discounting the \$1,000 with a rate commensurate with the credit rating of your friend. In a way, we use a “safety factor” type of approach.

Suppose now that other friend, who has a variable salary (around \$10,000 per month) and a AAA-rating, offers you 10% of his monthly earnings. There is no credit risk here, you are sure he will make the payment: you just don’t know what the payment will be. Maybe \$1,000 under the “typical” scenario; but it could be more, or maybe less. *Project cash flows* are like this.

Are these two situations analogous? Can we use the same method of analysis in both instances? The answer is far from obvious.

The Inconsistency

Now the funny part: corporate finance books, having "established" a similarity between bond and project cash flows (despite the shortcoming discussed previously), suggest that the right discount rate to use when evaluating a project is the opportunity cost of capital. That is, a number derived from a characteristic of the potential investor (or decision maker). Not a number associated with any feature of the project cash flows.

Interesting enough (or strangely enough) in the case of bond valuation the discount rate is derived from a characteristic of the cash flows (credit risk). The opportunity cost of capital of the potential bond investor does not come into the picture.

Why bothering making an analogy between bond and project cash flows to end up with such a different strategy at the moment of estimating the correct discount rate defies logic.

From Uncertainty in the Numerator to Uncertainty in the Denominator

What do we mean by “future cash flows”? That is, the numerator in the DCF computation. Are we talking about *expected* cash flows (in the statistical sense of the term)? Or best-case scenario cash flows? Or baseline-scenario cash flows? Or typical-case cash flows? The vagueness in terms of what to put in the numerator is astounding. Most textbooks circumvent the issue by simply referring to the “project cash flows” or sometimes the “risky

cash flows” without much elaboration. In summary, the analyst is normally left in the dark as to what degree of precision or conservatism to employ in estimating what is one of the most relevant inputs in the valuation analysis.

Let us look now at the denominator (or more precisely, denominators) in the DCF computation. All issues here are centered on one concept: the “appropriate” discount rate. Before considering the merits of some common approaches to estimate the discount let us reflect of what we are doing.

Valuation problems are challenging because the cash flows are difficult to estimate: they are stochastic in nature. However, in the DCF method, we have chosen not to deal with the essence of the problem: the probabilistic nature of the cash flows (numerator). Instead, we have chosen to go directly to the denominator hoping that by performing a clever manipulation of it (“adjusting” the discount rate) we can get the correct result.

Hence, we are attempting to transform a problem, which is probabilistic in nature, into a deterministic one, by means of a “safety factor”, that we hope will remove the uncertainty imbedded in it. The crudeness of this tactic is conceptually indefensible.

Bring Statistics into the Picture

Back to the 50s and Harry Markowitz (Markowitz, 1952). Curiously enough, at the same time the DCF approach was being introduced as a legitimate valuation tool, Markowitz was introducing a more sound approach to deal with a problem, which, at least conceptually, is not that different: portfolio selection.

Recognizing that assets returns were stochastic in nature Markowitz did the only intellectually honest thing one could do: tried to model them probabilistically. Consequently, he assumed that returns could be characterized as random variables that followed a normal distribution with a given mean and standard deviation. Strictly speaking, we could argue that assets returns do not follow the normal distribution very well. But that is beside the point; the critical issue is that it is difficult to find anything wrong with an attempt to characterize a random variable probabilistically. That is a solid starting point. Never mind that there is a well-established discipline (statistics) that offers a wide variety of tools to deal with random variables. In summary, in portfolio theory, the problem of dealing with a group of N assets is tackled by characterizing their returns through their probabilistic distributions, in short, using standard statistical tools. The fact that asset returns are “uncertain” has not given birth to the idea of making pseudo-deterministic calculations using “safety factors.”

That begs a question: why did portfolio theory decide to embrace statistics while valuation techniques went with “safety factors” to account for uncertainty? To sum up, why did valuation techniques repudiate statistics and embrace the DCF approach?

A Few More Operational (and Conceptual) Difficulties

The following issues also add to the shaky foundation of the DCF approach. (Some of these issues have been pointed, in a slightly different manner, by previous authors.)

- Most financial textbooks present sanitized versions of real investment decisions. There is always only one negative cash flow (at time equals zero) followed by a sequence of positive cash inflows. However, many investment decisions involve long periods with multiple outlays (negative cash flows). This is typical, for example, of the big infrastructure projects (highways, airports, tunnels) which take years to execute before becoming operational. In such cases, the DCF approach is misleading, since, by virtue of discounting both positive and negative cash flows with the same rate introduces a systematic error. More to the point, it treats the positive cash flows in a “pessimistic” fashion and the negative cash flows in a “forgiving” way. Economics and financial texts never address this shortcoming, which, conveniently, does not arise when the only negative cash flow occurs at time zero.
- Estimating the correct discount rate is still a problematic issue. In summary: (i) the idea of using the weighted average cost of capital (WACC) of the firm is only feasible, at best, for firms that have publically traded debt and equity. And for projects that have a time-varying capital structure (like big civil engineering projects for they in general combine different forms of financing depending on the stage of completion) estimating the WACC is an operational nightmare; (ii) the well-known Capital Asset Pricing Model (CAPM), leaving aside the practical difficulties associated with identifying the right Beta as well as the “market portfolio”, which, in many cases it does not even exist, has suffered important conceptual blows as a result, most recently, of the subprime crisis. This, of course, in addition to substantial empirical evidence that has accumulated over the years and has undermined its validity; and (iii) when the investor is a natural person, the conventional recipe is to use the opportunity cost of a similar investment proposition as a proxy for the correct discount rate. This approach has an uneasy “circular reasoning” taste: how can we judge if two projects have the same risk profile if we don’t know the value of one of them?
- The DCF method assumes that the risk profile of the cash flows is fairly specific. In fact, it assumes that the uncertainty in the cash flows increases with time according to a rigid pattern, which depends on the ratio of the risk-free rate and the risk-adjusted discount rate. (This follows directly from some algebraic manipulation, which shows that the DCF method is essentially a very special version of the certainty equivalent method.) It is easy to think of many situations in which the uncertainty pattern of the cash flows might decrease with time, remain more or less the same, or simply vary according to a pattern different than the one imposed by the conventional DCF method. In all these cases, a direct application of the DCF would be tantamount to ignoring a key feature of the valuation problem. Again, this limitation of the DCF approach is never discussed in standard financial courses.
- Another problematic characteristic of the DCF technique becomes apparent if we need to decide between two investment propositions. If the risk profile of the two cash flows is different, or, alternatively, if the degree of precision we have in our

estimates of the cash flows is different, there is no way to incorporate the feature in the DCF analysis. If we accept that the discount rate is a function of the capital structure of the firm (and has nothing to do with the nature of the cash flows) we are in a bind: we have to use the same discount rate for the two cases and we are left without alternatives to account for the different risk profiles. If, on the other hand, we follow the advice of some “practitioners” and we use a higher rate when analyzing the riskier cash flows, then, we are in contradiction: this would imply that the discount rate is not determined by the capital structure alone. The impotence of the conventional DCF technique to deal with this problem in a clean manner is apparent.

- Finally, the fact that the relationship between a sequence of cash flows and the NPV of those cash flows (calculated with the DCF method) is not one-to-one is somewhat problematic. In essence, for a given NPV value there could be several (in fact, infinity) sequence of cash flows such that they have the same NPV. How do we know which asset (sequence of cash flows) is the best investment? Are all equally risky? Clearly, the DCF has nothing to say about this decision as it is unable to distinguish them. This suggests that perhaps the DCF method does not take into account all the relevant information. More specifically, it is unable to incorporate into the decision-making process the risk profile (utility function) of the decision maker.

The Voice of the Establishment

The University of Chicago can be hardly accused of being a center of iconoclastic thoughts when it comes to finance. That said, two observations, both from prominent members of what can be considered the establishment in academic finance and economics, are worth noting.

Let us hear from Eugene Fama (Fama, 1996):

“A fundamental open question nevertheless remains. Given the massive uncertainties inherent in all aspects of project valuation, does a discounting rule produce value estimates that have less measurement error than a less complicated approach, like payback? In advocating discounting rules, textbooks in corporate finance implicitly answer this question in the affirmative. But the conclusion is based more on faith than evidence.”

What can we possibly add to that?

Only what John Cochrane said when he gave his 2010 Presidential Address to the American Finance Association (Cochrane, 2011):

“Discount rates vary a lot more than we thought. Most of the puzzles and anomalies that we face amount to discount-rate variations we do not understand. Our theoretical controversies are about how discount rates are formed.”

Given the importance that both, discount rates and discount rules, play in the conventional DCF analysis, the previous two statements should make anyone nervous about this method.

Conclusion

Summarizing, much of the problems affecting the DCF method come from the fact that it tries to capture with one parameter-- the discount rate-- two completely different effects: (i) the time value of money, and (ii) the stochastic nature of the cash flows. Not only that, it attempts to transform a problem which is probabilistic in nature (cash flows are uncertain) into a deterministic problem by appealing to the "right" discount rate.

Finance is undergoing a major review of its fundamentals as a result of the subprime crises. Markets are more complex, more psychologically driven, more inter-connected, and more unstable than previously recognized. The limits of models based on questionable assumptions (normal distributions, stable volatilities, simplistic utility functions, efficiency of markets, rational decision makers, etc.) are being re-examined. There is no reason to exclude the DCF from this exercise.

In light of the arguments presented herein, we would like to finish by making a strong call to refocus valuation techniques research. We should abandon at once all efforts aimed at determining the "correct" discount rates. An honest assessment of these efforts inevitably leads to one conclusion: after years of investigating this topic, not much has been clarified as basic guidelines are as elusive as fifty years ago. Instead, we should shift gears and focus on developing good tools aimed at characterizing cash flows probabilistically. That is, at developing tools to estimate their means, standard deviations, and correlations. Moreover, the merits of the certainty equivalent approach, and the possibility of incorporating different utility functions to describe the risk-aversion profiles of the decision makers need to be explored.

Skeptics will undoubtedly complain about the difficulties associated with the above-mentioned tasks. In fairness, it will not be easy. But it has not been easy to estimate means and correlations in portfolio theory either. And, in any event, nobody can state that estimating discount rates, appropriate opportunity costs, comparable equity returns, or identifying the market portfolio or the correct Beta's in the CAPM model is easy.

Moreover, even if the proposed tasks turn out to be difficult (something which, incidentally, might be premature to assess since not much has been done to advance this cause) one fact remains: It is even more difficult (in fact, indefensible) to plead that the extreme complexity of this problem (cash flow valuation) calls for an exception and thus, the problem should be managed outside the realm of probability and statistics and only dealt with by resorting to special fudge factors, also known as discount factors.

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