## Table of Contents – DCF Questions & Answers

# Overview and Key Rules of Thumb

It would be **shocking** if you went through an interview and you did *not* get questions on the DCF analysis and related concepts like discount rates and WACC.

**Valuation** is one of the core skill sets you use in investment banking, private equity, at hedge funds, in equity research, and anything else in finance, and the Discounted Cash Flow analysis is one of the key methods you use to value a company.

Yes, there are plenty of downsides… and in some industries and for some companies it is not taken seriously.

But it is still an extremely common topic in interviews, so you need to know it like the back of your hand – even if you're interviewing for a group like FIG where it's not as applicable.

Here are the 5 main topics you need to understand with a DCF:

1. **What it is**, how you use it, and how to walk through a DCF analysis.
2. How to calculate and project **Free Cash Flow (FCF)** and how Levered Free Cash Flow (Free Cash Flow to Equity) differs from Unlevered Free Cash Flow (Free Cash Flow to Firm).
3. How to calculate the **discount rate** in a DCF and how to apply concepts like WACC and the Cost of Equity.
4. How to calculate the **Terminal Value**, what it means, and how it contributes to a DCF.
5. How different factors **impact** the output of a DCF and what changes have the biggest effect.

We're going to tackle those 5 topics in each of the sections below, bringing in the Excel DCF model included with this guide as necessary.

Then, we'll go through a **comprehensive** set of Basic and Advanced interview questions on the DCF that covers all topics – including a few questions that most working bankers would not even be able to explain (e.g. how to derive the Gordon Growth formula for Terminal Value).

## *Key Rule #1: DCF Concept and Walking Through It*

The basic concept behind a Discounted Cash Flow analysis is that a company is worth the **present value of its future cash flows**.

What the "market" thinks the company is worth is irrelevant – all that matters is how much in real cash flow it generates in the future.

Money today is worth more than money tomorrow, because you could always invest money today, earn interest on it, and end up with more in the future.

So you have to **discount** all these future cash flows back to their present value to account for that "cost" – the **time value of money**.

**Example:** Let's say you estimate that a company's future cash flows are $100 in Year 1, $120 in Year 2, and $140 in Year 3. You're going to discount the cash flows at 10% per year because you believe you could earn 10% per year by investing your money elsewhere.

| | | | |
|---|---|---|---|
| Discount Rate: | | | 10% |
| | **Year 1** | **Year 2** | **Year 3** |
| **Cash Flows:** | $ 100 | $ 120 | $ 140 |
| **Discounted Value:** | 91 | 99 | 105 |
| | | | |
| **Net Present Value:** | $ 295 | | |

So the discounted value in Year is $100 / (1 + 10%), or about $91, in Year 2 it's $120 / ((1 + 10%)^2), or about $99, and in Year 3 it's $140 / ((1+ 10%)^3), or about $105. Adding these up, the net present value is $295.

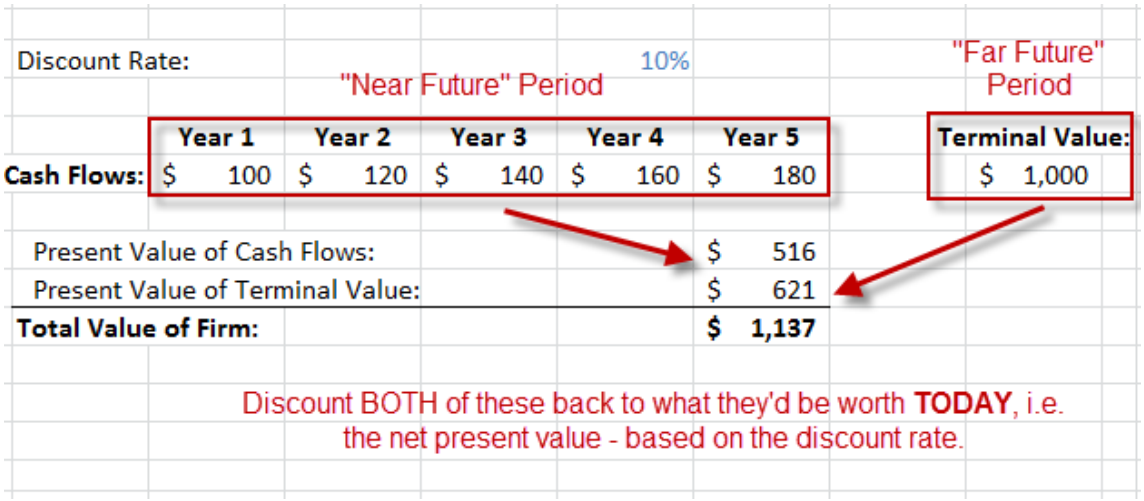
This is the basic concept, but it gets more complicated for a simple reason: **companies don't just "stop" operating after a few years**.

They continue to generate cash flow far into the future, perhaps for decades or hundreds of years – and we need a way to estimate all those cash flows and discount them appropriately.

You normally tackle this problem by dividing a DCF into 2 parts: the **projection period** (the near future) and the **Terminal Value** (the distant future).

We assume that we can project a company's cash flows more precisely over the next 5-10 years, so we project them, discount them, and add up everything for that period.

Beyond that we say, "We can't estimate cash flows as precisely, so let's not even bother… but we *can* come up with an approximation (the Terminal Value) of how much the company might be worth into the distant future."




So that is the basic concept: divide a company's cash flows into a "near future" period and then a "distant future" period, determine the values for each period, and then discount them back to their present values since **money today is worth more than money tomorrow**.

This concept is not rocket science, but the **execution** gets tricky:

1. How do you **project cash flows** for a company?

2. What's the appropriate **discount rate** to use?
3. How do you estimate the **Terminal Value**, AKA what the company might be worth in that "distant future" period?

We'll go into detail on each of these points below. When you walk through a DCF in interviews, you should divide it into steps and say something like this:

"In a DCF analysis, you value a company with the Present Value of its Free Cash Flows plus the Present Value of its Terminal Value. You can divide the process into 6 steps:

1. **Project** a company's Free Cash Flows over a 5-10 year period.
2. **Calculate** the company's Discount Rate, usually using WACC (Weighted Average Cost of Capital).
3. **Discount and sum up** the company's Free Cash Flows.
4. **Calculate** the company's Terminal Value.
5. **Discount** the Terminal Value to its Present Value.
6. **Add** the discounted Free Cash Flows to the discounted Terminal Value."

Now that we've been through the concept and the main steps in the analysis, we'll go through each step in more detail.

## *Key Rule #2: Calculating and Projecting Free Cash Flow (FCF)*

If you've been through the Accounting and Valuation sections of this guide, you already know what "Free Cash Flow" means: how much after-tax cash flow the company generates on a **recurring** basis, after you've taken into account non-cash charges, changes in Operating Assets and Liabilities, and required Capital Expenditures.

You calculate and use Free Cash Flow in a DCF because **that closely corresponds to the actual cash flow that you, as the investor, would receive each year if you bought the entire company**.

It is far more accurate than metrics like Net Income and EBITDA, because those leave out big uses of cash like CapEx, and because those don't take into account changes in cash due to items like Accounts Receivable, Accounts Payable, Inventory, and more.

How do you project Free Cash Flow? The first step is to decide **which kind of Free Cash Flow** you need: Unlevered FCF (Free Cash Flow to Firm), which *excludes* net interest expense and mandatory debt repayments, or Levered FCF (Free Cash Flow to Equity), which *includes* net interest expense and mandatory debt repayments.

99% of the time you care about Unlevered FCF, which is good news because it's much easier to calculate.

If you already have a 3-statement model for the company you're valuing, this entire process is easy: you can pull all the numbers directly from there.

But in interviews you won't have that and so you'll have to understand the Free Cash Flow calculation. If you're calculating Unlevered FCF (we'll go through Levered FCF after this), here's what you do:

1) First, you project the company's **revenue growth**, i.e. the percentage it grows revenue by each year over that 5-10 year "near future" period. From that, you can determine the company's projected annual revenue based on the most recent historical numbers.

| Ralcorp Holdings - Projections | Historical | Historical | Historical | Forward | Forward | Projected Forward | Forward | Forward |
|---|---|---|---|---|---|---|---|---|
| | Historical Year 1 | Historical Year 2 | Historical Year 3 | Forward Year 1 | Forward Year 2 | Forward Year 3 | Forward Year 4 | Forward Year 5 |
| **Revenue:** | $ 2,644 | $ 3,892 | $ 4,049 | $ 4,721 | $ 4,907 | $ 5,152 | $ 5,410 | $ 5,680 |
| *Revenue Growth Rate:* | | *47.2%* | *4.0%* | *16.6%* | *3.9%* | *5.0%* | *5.0%* | *5.0%* |

2) Next, you need to assume an **operating margin** for the company so that you can calculate its EBIT, or Operating Income, each year. Usually you base this on historical margins. So if they have $1 billion in revenue and a 30% EBIT Margin, that's $300 million in EBIT.

| Ralcorp Holdings - Projections | Historical | Historical | Historical | Forward | Forward | Forward | Forward | Forward |
|---|---|---|---|---|---|---|---|---|
| | Historical Year 1 | Historical Year 2 | Historical Year 3 | Forward Year 1 | Forward Year 2 | Forward Year 3 | Forward Year 4 | Forward Year 5 |
| **Revenue:** | $ 2,644 | $ 3,892 | $ 4,049 | $ 4,721 | $ 4,907 | $ 5,152 | $ 5,410 | $ 5,680 |
| *Revenue Growth Rate:* | | *47.2%* | *4.0%* | *16.6%* | *3.9%* | *5.0%* | *5.0%* | *5.0%* |
| Operating Income (EBIT): | 209 | 484 | 505 | 637 | 682 | 721 | 757 | 795 |
| *Operating (EBIT) Margin:* | *7.9%* | *12.4%* | *12.5%* | *13.5%* | *13.9%* | *14.0%* | *14.0%* | *14.0%* |

3) Now, you apply the company's effective tax rate to calculate its Net Operating Profit After Tax, or NOPAT. Continuing with this example, if the tax rate is 40% then the NOPAT is $300 million * (1 – 40%), or $180 million.

| Ralcorp Holdings - Projections | Historical | Historical | Historical | Forward | Forward | Forward | Forward | Forward |
|---|---|---|---|---|---|---|---|---|
| | Historical Year 1 | Historical Year 2 | Historical Year 3 | Forward Year 1 | Forward Year 2 | Forward Year 3 | Forward Year 4 | Forward Year 5 |
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| *Operating (EBIT) Margin:* | *7.9%* | *12.4%* | *12.5%* | *13.5%* | *13.9%* | *14.0%* | *14.0%* | *14.0%* |
| Less: Taxes: | (75) | (174) | (182) | (229) | (246) | (260) | (273) | (286) |
| **Net Operating Profit After Taxes (NOPAT):** | **134** | **310** | **323** | **408** | **437** | **462** | **485** | **509** |

4) Once you have this, you move to the **Cash Flow Statement** and project the 3 key items there that impact Free Cash Flow: Non-Cash Charges, Changes in Operating Assets and Liabilities, and Capital Expenditures.

5) The main Non-Cash Charges are Depreciation & Amortization; you may also project others, such as Stock-Based Compensation. You **add them back** here because you want to reflect how the company saves on taxes, but does not actually pay any cash for them. You can make these percentages of revenue. If we assumed they were equal to 5% of revenue here, we'd add back $50 million here.

| Ralcorp Holdings - Projections | Historical | Historical | Historical | Forward | Forward | Forward | Forward | Forward |
|---|---|---|---|---|---|---|---|---|
| | Historical Year 1 | Historical Year 2 | Historical Year 3 | Forward Year 1 | Forward Year 2 | Forward Year 3 | Forward Year 4 | Forward Year 5 |
| **Net Operating Profit After Taxes (NOPAT):** | **134** | **310** | **323** | **408** | **437** | **462** | **485** | **509** |
| Plus: Depreciation & Amortization: | 100 | 145 | 167 | 183 | 190 | 199 | 209 | 220 |
| *% Revenue:* | *3.8%* | *3.7%* | *4.1%* | *3.9%* | *3.9%* | *3.9%* | *3.9%* | *3.9%* |
| Plus: Stock-Based Compensation: | 12 | 13 | 18 | 19 | 20 | 21 | 22 | 23 |
| *% Revenue:* | *0.4%* | *0.3%* | *0.4%* | *0.4%* | *0.4%* | *0.4%* | *0.4%* | *0.4%* |

6) Next, you estimate the **change in Operating Assets and Liabilities**. What this really means is, "If the company's *Operating* Assets increase more than its *Operating* Liabilities, it needs extra cash to fund that… so it **reduces** cash flow. If its Liabilities increase more, that **adds** to cash flow." You can make this a percentage of revenue as well – so if it's 3% of revenue and Assets increase more than Liabilities, then we *subtract* $30 million here.

| Ralcorp Holdings - Projections | Historical | Historical | Historical | Forward | Forward | Forward | Forward | Forward |
|---|---|---|---|---|---|---|---|---|
| | Historical Year 1 | Historical Year 2 | Historical Year 3 | Forward Year 1 | Forward Year 2 | Forward Year 3 | Forward Year 4 | Forward Year 5 |
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| *% Revenue:* | *3.8%* | *3.7%* | *4.1%* | *3.9%* | *3.9%* | *3.9%* | *3.9%* | *3.9%* |
| Plus: Stock-Based Compensation: | 12 | 13 | 18 | 19 | 20 | 21 | 22 | 23 |
| *% Revenue:* | *0.4%* | *0.3%* | *0.4%* | *0.4%* | *0.4%* | *0.4%* | *0.4%* | *0.4%* |
| | | | | | | | | |
| Change in Operating Assets & Liabilities: | (23) | 77 | (99) | (21) | (22) | (23) | (24) | (25) |
| *% Revenue:* | *(0.9%)* | *2.0%* | *(2.4%)* | *(0.4%)* | *(0.4%)* | *(0.4%)* | *(0.4%)* | *(0.4%)* |

7) Finally, you estimate **Capital Expenditures** each year, which always reduces cash flow. You might average previous years' numbers, assume a constant change, or make it a percentage of revenue. In this case if CapEx is $50 million, that reduces cash flow by $50 million.

| Ralcorp Holdings - Projections | Historical | Historical | Historical | Forward | Forward | Forward | Forward | Forward |
|---|---|---|---|---|---|---|---|---|
| | Historical Year 1 | Historical Year 2 | Historical Year 3 | Forward Year 1 | Forward Year 2 | Forward Year 3 | Forward Year 4 | Forward Year 5 |
| | | | | | | | | |
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| | | | | | | | | |
| Less: Taxes: | (75) | (174) | (182) | (229) | (246) | (260) | (273) | (286) |
| **Net Operating Profit After Taxes (NOPAT):** | **134** | **310** | **323** | **408** | **437** | **462** | **485** | **509** |
| | | | | | | | | |
| Plus: Depreciation & Amortization: | 100 | 145 | 167 | 183 | 190 | 199 | 209 | 220 |
| *% Revenue:* | *3.8%* | *3.7%* | *4.1%* | *3.9%* | *3.9%* | *3.9%* | *3.9%* | *3.9%* |
| Plus: Stock-Based Compensation: | 12 | 13 | 18 | 19 | 20 | 21 | 22 | 23 |
| *% Revenue:* | *0.4%* | *0.3%* | *0.4%* | *0.4%* | *0.4%* | *0.4%* | *0.4%* | *0.4%* |
| | | | | | | | | |
| Change in Operating Assets & Liabilities: | (23) | 77 | (99) | (21) | (22) | (23) | (24) | (25) |
| *% Revenue:* | *(0.9%)* | *2.0%* | *(2.4%)* | *(0.4%)* | *(0.4%)* | *(0.4%)* | *(0.4%)* | *(0.4%)* |
| Less: Capital Expenditures: | (63) | (115) | (129) | (134) | (139) | (146) | (153) | (161) |
| *% Revenue:* | *(2.4%)* | *(3.0%)* | *(3.2%)* | *(2.8%)* | *(2.8%)* | *(2.8%)* | *(2.8%)* | *(2.8%)* |
| | | | | | | | | |
| Unlevered Free Cash Flow: | $ 160 | $ 430 | $ 280 | $ 455 | $ 486 | $ 513 | $ 539 | $ 566 |

So what's the Free Cash Flow in this case? You take NOPAT, $180 million, add back the $50 million of non-cash charges, subtract the $30 million change in Operating Assets and Liabilities, and subtract the $50 million of CapEx, so that FCF equals **$150 million**.

Most of this is straightforward because we're **replicating the Cash Flow Statement, but excluding interest, debt repayments, and everything in Cash Flow from Financing.**

We're also eliminating everything under Cash Flow from Investing *except* for CapEx because that's generally the only recurring item there from year to year.

We eliminate the entire Cash Flow from Financing section as well, because items there are either related to Debt (not applicable since this is Unlevered FCF) or to one-time events such as Equity Issuances and Share Repurchases.

**Operating Assets and Liabilities… Say What?**

You may be confused about the **Change in Operating Assets and Liabilities**, otherwise known as the **Change in Working Capital** or **Change in Operating Working Capital**.

This section comes **directly** from a company's Cash Flow from Operations section, and **all you are doing here is the following:**

- If an Asset goes *up*, cash flow goes *down*…
- If an Asset goes *down*, cash flow goes *up*…
- If a Liability goes *up*, cash flow goes *up*…
- If a Liability goes *down*, cash flow goes *down*.

These are the exact rules we went over in the Accounting section of the guide.

What makes this concept of "Changes in Operating Assets and Liabilities" confusing is that you're **combining many items into one single line**.

Let's look at a few examples to make this clearer:

**Example #1:** Let's say that Accounts Receivable goes up by $10 and Inventory goes up by $10 and on the other side, Deferred Revenue goes up by $10. How does cash change here?

| Changes in Operating Assets & Liabilities: | | |
|---|---|---|
| Accounts Receivable: | - | (10) |
| Prepaid Expenses: | - | - |
| Inventory: | - | (10) |
| Accounts Payable: | - | - |
| Accrued Expenses: | - | - |
| Deferred Revenue: | - | 10 |

The Operating Assets have increased by $20, which reduces cash flow, and Operating Liabilities have increased by $10, which increases cash flow. So overall cash flow is down by $10, and we would record this as a **negative $10** in the "Changes in Operating Assets and Liabilities" line.

**Example #2:** Now let's say that AR goes down by $10, Inventory goes up by $10, Prepaid Expenses goes down by $10, and on the other side Accounts Payable goes up by $10 and Deferred Revenue goes up by $10.

| Changes in Operating Assets & Liabilities: | | |
|---|---|---|
| Accounts Receivable: | - | 10 |
| Prepaid Expenses: | - | 10 |
| Inventory: | - | (10) |
| Accounts Payable: | - | 10 |
| Accrued Expenses: | - | - |
| Deferred Revenue: | - | 10 |

Here, cash flow is up by **$30** because the Operating Assets have *decreased* by a net amount of $10, which boosts cash flow by $10, and the Liabilities have *increased* by $20 total, which also boosts cash flow by $20.

All you're doing in this section of the DCF is estimating the **net cash flow impact from changes in these items**. If the Operating Assets *increase* more than the Operating Liabilities, it's a cash flow reduction, and vice versa. And if Operating Assets *decrease* more than the Operating Liabilities, it's an addition, and vice versa.

You exclude Cash because you're *calculating* the Change in Cash at the bottom of the Cash Flow Statement; you also exclude Short-Term and Marketable Securities

because those count as Investing Activities and are normally one-time purchases or sales. You exclude all changes in Debt here as well because issuing / repaying Debt is a Financing Activity.

Do **NOT** fall into the trap of stating that this section has "only" Current Assets and Current Liabilities because that is not true at all… "Operating Assets and Liabilities" is the best way to state it.

**Unlevered vs. Levered Free Cash Flow**

One final point: how does this calculation change if we're using Levered Free Cash Flow (Free Cash Flow to Equity) rather than Unlevered Free Cash Flow (Free Cash Flow to Firm)?

The main difference is that you need to **subtract interest expense and add interest income** right after you calculate EBIT. So effectively, you use something closer to Net Income rather than NOPAT.

And then you also need to subtract **mandatory debt repayments** after you subtract CapEx – so if the company must repay, at the minimum, $20 million in debt per year, that would be subtracted in the Levered FCF calculation.

Projecting Levered FCF can be considerably more time-consuming because you need to know how the company's Debt and Cash balances change from year to year – so you need to track those as well.

And then you need to hunt through its filings to find the required debt repayments each year.

To make things even more confusing, sometimes you'll see alternate definitions for Levered FCF: some people will **add** additional borrowings (debt issuances) and subtract even *optional* debt repayments, for example.

We don't view those definitions as correct because neither one is **required** for the company to continue operating and paying off its Debt and Interest each year.

In an interview, you are best off **avoiding this issue altogether** by sticking with Unlevered FCF unless they ask you about Levered FCF specifically – and if they do, stick to the definition we outlined here, where the differences lie in interest and mandatory debt principal repayments.

## *Key Rule #3: Discount Rates and WACC*

After the calculation of Free Cash Flow, the Discount Rate probably causes the greatest amount of confusion in DCF models.

You need to discount both the company's future Free Cash Flows and its Terminal Value because of the **time value of money**. Yes, it's great to earn $100 in cash flow each year from an asset… but if you invested that money in something else *today*, what could you earn on it?

There's also another way to interpret it: what return are investors **expecting** to earn, at the minimum, when they invest in this company?

The Discount Rate therefore reflects not just the time value of money, but also the return that investors **require** before they can invest. It also represents the "**risk**" of a company, because higher potential returns correspond to higher risk.

All else being equal, smaller companies tend to have higher Discount Rates than larger, more mature companies because investors **expect** that they will grow more and deliver higher growth, profits, and returns in the future. And they're also "riskier" than large companies.

Companies in **emerging markets** also have higher Discount Rates than companies in developed markets, because the potential growth, returns, and risk (the government could collapse, mercenaries could take over, etc.) are all higher.

You estimate a company's Discount Rate by separating its capital structure into components – normally Equity, Debt, and Preferred Stock – and calculating the "cost" of each one.

The "costs" of Debt and Preferred Stock are simple and intuitive: you use the Interest Rate on Debt or the Effective Yield on Preferred Stock (e.g. if it's a $100 million issuance and pays $7 million in Preferred Dividends each year, it's 7%).

Sometimes in real life you will see variations and adjustments, particularly when the **market value** of Debt drifts significantly from the **book value**. But for interview purposes, Interest Rate on Debt = Cost of Debt.

**Calculating the Cost of Equity**

"But wait," you say, "issuing Debt or Preferred Stock *costs* the company something in the future, but how does issuing Equity 'cost' it anything?"

Equity **costs** the company something in two ways:

1. If the company issues **Dividends** to common shareholders, that is an actual cash expense.
2. By issuing Equity to other parties, the company is **giving up future stock price appreciation to someone else** rather than keeping it for itself.

These "expenses" are tricky to estimate because **the company's share price changes over time**. So for #1, you can't just assume a simple Dividend Yield and base everything on that.

In practice, here's the method you normally use to estimate Cost of Equity:

Cost of Equity = Risk-Free Rate + Equity Risk Premium * Levered Beta

| Discount Rate Calculation - Assumptions | |
|---|---|
| Risk-Free Rate: | 4.20% |
| Equity Risk Premium: | 7.00% |
| Interest Rate on Debt: | 6.20% |

The "Risk-Free Rate" means, "What interest rate could we earn by investing in a 'risk-less' security, such as 30-Year US Treasury notes?" If you're in another country you would use the going rates on government bonds in that country.

The Equity Risk Premium is the **extra yield you could earn by investing in an index that tracks the stock market in your country of choosing**.

The theory behind this number: "Well, yes, we could get 2% or 3% or 4% interest by investing in boring government securities, but that's… *boring*. We could make more by putting our money into the stock market instead, since historically the stock market has generated higher returns than these government bonds!"

What number do you use for this Equity Risk Premium? **No one knows**.

You will see a wide range of values there, from 3% to 10% to everything in between, because finance professors, textbook authors, bankers, and analysts all have different views about what this "Equity Risk Premium" should really be.

Generally you use a number in the middle of this range; some banks also use a publication called Ibbotson's that provides estimates each year.

The last part of the equation, **Beta**, refers to the "riskiness" of this company relative to all other companies in the stock market. If Beta = 1, that means that the company is just as risky as the overall index. If the market goes up by 10%, this company's stock will go up by 10%.

If Beta = 2, the company is twice as risky as the market; if the market goes up by 10%, this company's stock will increase by 20%; and if the market goes down by 10%, this company's stock will go down by 20%.

You could just use the company's **historical Beta** (e.g. how its own stock has moved up or down in relation to the market as a whole) for this.

The more popular method, though, is to **make your own estimate for Beta** by using the Public Company Comparables for the company you're valuing and assuming that the company's "true" Beta is different from what the historical data suggests.

**Un-levering and Re-levering Beta**

The reason you go through this exercise is because of the assumption that the company's "true" riskiness is more in-line with how risky similar companies in the market are than to its own historical track record.

In a Valuation you might say, "Well, right now the company's **Enterprise Value** based on its current share price is $1 billion. But *based on the median multiples that similar companies are trading at*, it appears that it *should* be valued at $1.2 billion instead."

You're doing the same thing with Beta: it's about figuring out what a company's "riskiness" *should* be rather than what it *is* currently.

The first step: you look up Beta for each company in the set of Public Company Comparables you're using to value the company.

Then, you **un-lever** Beta for each company using the following formula:

**Unlevered Beta** = Levered Beta / (1 + (1 – Tax Rate) * (Debt / Equity Value))

| Comparable Companies - Unlevered Beta Calculation | | | | | |
|---|---|---|---|---|---|
| Name | Levered Beta | Debt | Equity Value | Tax Rate | Unlevered Beta |
| Campbell Soup Company | 0.29 | $ 3,080 | $ 11,397 | 35.0% | 0.25 |
| The J.M. Smucker Company | 0.63 | 1,300 | 8,553 | 35.0% | 0.57 |
| Seaboard Corporation | 0.71 | 156 | 2,694 | 35.0% | 0.68 |
| United Natural Foods, Inc. | 0.71 | 198 | 1,938 | 35.0% | 0.67 |
| TreeHouse Foods Inc. | 0.45 | 877 | 1,994 | 35.0% | 0.35 |
| | | | | | |
| Median | 0.63 | | | | 0.57 |

**What this formula means:** We've been saying that Beta represents "risk." If you think about it, there are two types of risk with a company: the inherent, *business* risk, and then the risk that comes from **Debt** – e.g. defaulting on the debt, not being able to pay interest, and so on.

We're **removing the additional risk from Debt** with this formula. The bottom part is saying, "Let's assume that this risk from Debt is **directly proportional** to the company's Debt / Equity ratio. But remember that interest paid on Debt is also tax-deductible, and as a result that helps *reduce* the risk from Debt slightly, since we save on taxes."

**Example:** The company's "Levered Beta" (i.e. the number you find when you look it up) is 1.0. Its tax rate is 40% and it has $200 million in Debt and an Equity Value (Market Cap) of $1.0 billion.

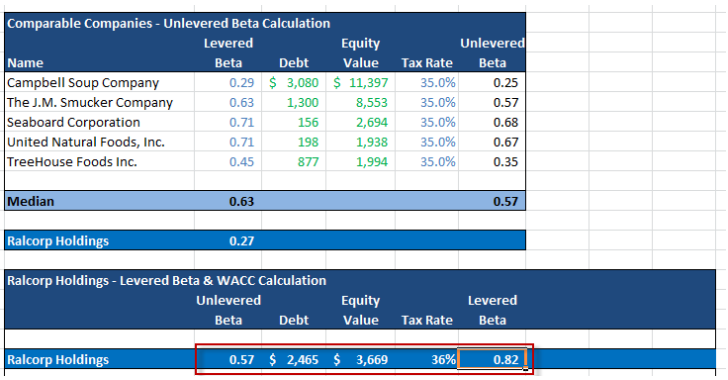
Here, Unlevered Beta = 1.0 / (1 + (1 – 40%) * ($200 / $1000)) = 1.0 / (1 + 60% * 20%) = 0.89.

If you **ignore** this company's Debt, it's *less* risky than the market as a whole.

The next step is to calculate this Unlevered Beta for all the Public Comps, take the median, and then **re-lever** it to calculate the approximate **Levered Beta** for the company we're valuing.

You do this because you want to determine the company's **true, inherent business risk**, based on the comps.

But if the company has Debt, it's not fair to ignore that altogether in the calculation. Debt **does create additional risk** and we need to account for it.



Comparable Companies - Unlevered Beta Calculation

| Name | Levered Beta | Debt | Equity Value | Tax Rate | Unlevered Beta |
|---|---|---|---|---|---|
| Campbell Soup Company | 0.29 | $ 3,080 | $ 11,397 | 35.0% | 0.25 |
| The J.M. Smucker Company | 0.63 | 1,300 | 8,553 | 35.0% | 0.57 |
| Seaboard Corporation | 0.71 | 156 | 2,694 | 35.0% | 0.68 |
| United Natural Foods, Inc. | 0.71 | 198 | 1,938 | 35.0% | 0.67 |
| TreeHouse Foods Inc. | 0.45 | 877 | 1,994 | 35.0% | 0.35 |
| Median | 0.63 | | | | 0.57 |
| Ralcorp Holdings | 0.27 | | | | |

Ralcorp Holdings - Levered Beta & WACC Calculation

| | Unlevered Beta | Debt | Equity Value | Tax Rate | Levered Beta |
|---|---|---|---|---|---|
| Ralcorp Holdings | 0.57 | $ 2,465 | $ 3,669 | 36% | 0.82 |

We can re-lever Beta for the company by **multiplying** by that term above instead:

Levered Beta = Unlevered Beta * (1 + (1 – Tax Rate) * (Debt / Equity Value))

Here we're saying, "Now

let's *increase* Unlevered Beta by however much additional risk the Debt adds, also taking into account that the tax-deductible interest reduces risk as well."

You can then use either the company's **Historical Beta** or its **Calculated Beta** (that you found by un-levering and re-levering Beta): Cost of Equity = Risk-Free Rate + Equity Risk Premium * Levered Beta.

| Ralcorp Holdings - Levered Beta & WACC Calculation | Unlevered Beta | Debt | Equity Value | Tax Rate | Levered Beta |
|---|---|---|---|---|---|
| Ralcorp Holdings | 0.57 | $ 2,465 | $ 3,669 | 36% | 0.82 |
| Cost of Equity Based on Comparables: | | | | | 9.94% |
| Cost of Equity Based on Historical Beta: | | | | | 6.09% |

**To recap:** We estimate Cost of Equity by approximating what a stock's **potential return** in the future might be via the formula above.

We un-lever Beta to **isolate** inherent business risk, and then we assume that the company we're analyzing has that same inherent business risk; then we re-lever it to capture the total risk, including inherent business risk + risk from Debt.

One final note: there is an alternate formula for Cost of Equity:

- Cost of Equity = (Dividends per Share / Share Price) + Growth Rate of Dividends

We generally don't use that because **not all companies issue Dividends**. But it can be useful for companies in industries such as Utilities that issue and grow Dividends at stable, predictable rates.

**Calculating the Weighted Average Cost of Capital (WACC)**

Now we get to the easy part: calculating the Weighted Average Cost of Capital (WACC).

WACC = Cost of Equity * % Equity + Cost of Debt * % Debt * (1 – Tax Rate) + Cost of Preferred Stock * % Preferred Stock.

| Discount Rate Calculation - Assumptions | |
|---|---|
| Risk-Free Rate: | 4.20% |
| Equity Risk Premium: | 7.00% |
| Interest Rate on Debt: | 6.20% |

| Ralcorp Holdings - Levered Beta & WACC Calculation | Unlevered Beta | Debt | Equity Value | Tax Rate | Levered Beta |
|---|---|---|---|---|---|
| Ralcorp Holdings | 0.57 | $ 2,465 | $ 3,669 | 36% | 0.82 |
| Cost of Equity Based on Comparables: | | | | | 9.94% |
| Cost of Equity Based on Historical Beta: | | | | | 6.09% |
| WACC = Cost of Equity * % Equity + Cost of Debt * % Debt * (1 - Tax Rate) + Cost of Preferred Stock * % Preferred Stock | | | | | |
| WACC | | | | | 7.54% |

You're determining the "cost" of each part of a company's capital structure, and then calculating a weighted average based on how much Equity, Debt, and Preferred Stock it has.

You multiply by (1 – Tax Rate) for Debt because interest payments are tax-deductible and so Debt will (almost) always cost a company less than Equity or Preferred Stock (Preferred Dividends are **not** tax-deductible).

If you're using Unlevered FCF (Free Cash Flow to Firm), you use **WACC** as the Discount Rate because you care about **all parts of the company's capital structure** – Debt, Equity and Preferred – because you're calculating Enterprise Value, which includes **all investors**.

If you're using Levered FCF (Free Cash Flow to Equity) instead, you use **Cost of Equity** as the Discount Rate instead because you **only** care about Equity investors there, and you're calculating Equity Value rather than Enterprise Value. Think: "Free Cash Flow to **Equity** → Cost of **Equity** → **Equity** Value."

We'll get into this in more detail in Key Rule #5 below, but you can already see some implications of this formula for WACC:

- **Debt** will almost always push down WACC because the Cost of Debt is almost always lower than the Cost of Equity – interest rates on Debt are lower and the interest is tax-deductible.
- **Preferred Stock** is generally cheaper than Equity, but not as cheap as Debt because Preferred Dividends are not tax-deductible.
- **Equity** tends to "cost" the most, which makes sense intuitively: would you expect to earn more investing in the stock market over the long-term, or by investing in bonds?

And for Cost of Equity:

- Higher **Risk-Free Rates** and **Equity Risk Premiums** always increase it.
- Yes, **Debt *increases* the Cost of Equity** – how is that possible?! Well, if a company has Debt, **investing in its Equity also becomes riskier** – because Debt increases the chances of it defaulting and leaving you, the common shareholder, with nothing.

One final note before we move on: **Unlevered vs. Levered Beta has nothing to do with Unlevered vs. Levered Free Cash Flow** (yes, it's confusing).

Regardless of which type of Free Cash Flow you use, you *always* use Levered Beta when calculating Cost of Equity. Remember that if a company has Debt, it makes **both** the Equity of the company *and* the entire company itself riskier.

**Targeted vs. Existing Capital Structures**

This one always seems to come up: **what if the company's capital structure changes in the future?**

In other words, what if it raises additional Debt or issues more Equity or Preferred Stock or does something else?

If you know for sure that the company's capital structure will change in the (near) future, sure, you can use the new Debt and Equity values in all these calculations.

**In real life this almost never comes up because no one "knows" how a company's capital structure will change far in advance**.

So if this comes up in interview, say, "Yes, ideally we would use the company's targeted or planned capital structure rather than the one they currently have… *if* we have access to that information."

## *Key Rule #4: Calculating Terminal Value*

Once you've calculated the Discount Rate following the steps in the last section, you discount the company's cash flows over the projection period and add them all up.

Then, in the next step you estimate the company's "far in the future" value, AKA its Terminal Value.

You can do that with one of two methods:

**Method #1: Assume That the Company Gets Sold for a Certain Multiple**

For example, maybe the company has EBITDA of $500 million in Year 5 and based on the Public Comps, you think it might be worth 10x EBITDA if they sell to an acquirer at that stage. That means their approximate "far future value" is $5 billion ($500 million * 10x).

| | |
|---|---|
| Terminal EBITDA Multiple: | 9.0 x |
| Terminal Growth Rate: | 1.0% |
| Terminal Value: | $ 9,134 |

This method (the Multiples Method) is simple and is commonly used in banking.

The downside is that the exact multiple is hard to estimate years in advance, so you **always use a range of multiples** in the analysis and show the results in a sensitivity table – see the diagram below for an example:

| Ralcorp Holdings - Net Present Value Sensitivity - Terminal EBITDA Multiples | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Discount Rate | | | | | | | | |
| | | 6.0% | 6.5% | 7.0% | **7.5%** | 8.0% | 8.5% | 9.0% | 9.5% | 10.0% |
| Terminal EBITDA Multiple | 6.0 x | $ 73.10 | $ 70.80 | $ 68.55 | **$ 66.37** | $ 64.24 | $ 62.16 | $ 60.14 | $ 58.17 | $ 56.26 |
| | 7.0 x | 85.99 | 83.39 | 80.85 | **78.38** | 75.98 | 73.63 | 71.35 | 69.13 | 66.97 |
| | 8.0 x | 98.88 | 95.98 | 93.15 | **90.39** | 87.71 | 85.10 | 82.56 | 80.09 | 77.68 |
| | **9.0 x** | **111.77** | **108.56** | **105.45** | **102.41** | **99.45** | **96.57** | **93.77** | **91.04** | **88.39** |
| | 10.0 x | 124.66 | 121.15 | 117.74 | **114.42** | 111.19 | 108.05 | 104.98 | 102.00 | 99.10 |
| | 11.0 x | 137.55 | 133.74 | 130.04 | **126.44** | 122.93 | 119.52 | 116.19 | 112.96 | 109.80 |

This table does *more* than just estimate the Terminal Value – it actually gives us the entire company's value – but you can understand the fundamental idea from looking at the table.

**Method #2: Assume That the Company Keeps Operating Indefinitely and Sum Its Future Cash Flows**

**Warning:** there will be some math here. With this method (the "Gordon Growth" or "Perpetual Growth" method), you assume that the company's Free Cash Flow keeps growing far into the future and that it keeps operating forever…

But the **present value** of the Free Cash Flow each year keeps shrinking because **the Discount Rate is higher than the growth rate** of these Free Cash Flows. Here's an example:

| Discount Rate: | | | | | | 10% | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Year 6** | **Year 7** | **Year 8** | **Year 9** | **Year 10** |
| **Free Cash Flow:** | $ 100 | $ 110 | $ 119 | $ 128 | $ 136 | $ 144 | $ 150 | $ 154 | $ 159 | $ 162 |
| Growth Rate: | N/A | 10% | 8% | 8% | 6% | 6% | 4% | 3% | 3% | 2% |
| **Present Value of FCF:** | $ 91 | $ 91 | $ 89 | $ 88 | $ 84 | $ 81 | $ 77 | $ 72 | $ 67 | $ 63 |
| **Cumulative Sum of PVs of FCF:** | $ 91 | $ 182 | $ 271 | $ 359 | $ 443 | $ 525 | $ 601 | $ 674 | $ 741 | $ 804 |

See how the Present Value of FCF decreases each year and how the Cumulative Sum keeps growing… but by a **smaller amount** each year? Those two together mean that **the sum of these future cash flows will eventually *converge* on a single number**.

You can estimate that single number with this formula:

- **Terminal Value** = Final Year Free Cash Flow * (1 + Terminal FCF Growth Rate) / (Discount Rate – Terminal FCF Growth Rate).

You must use the **correct** Terminal Growth Rate. It should always be very low – less than or equal to the country's GDP growth rate, the rate of inflation, or something else like that. Otherwise, eventually the company's FCF will exceed the GDP of the entire country, which wouldn't make sense.

**We're going to explain where this formula comes from below, but you can skip this section if you want – it is NOT necessary for interviews.**

The present value of all Free Cash Flows is a **geometric series** – as the series approaches infinity, each individual item approaches $0 due to the Discount Rate and the time-value of money.

The sum of a geometric series is defined as a / (1 – r) – click here to see the derivation.

We need to decide what to use for **a** and **r** in this equation before we can apply it to the Gordon Growth formula.

In this case, a = Present Value of Free Cash Flow one year *after* the final year in the model, because a always represents the **first term** of a geometric series.

r is the "common ratio" – basically, the number that you multiply each term by to get the next term in the series.

Now, what is the **common ratio** in this scenario?

Well, you multiply each year's Free Cash Flow Present Value by (1 + Growth Rate) / (1 + Discount Rate) to get the next term in the series each time… so that is the "common ratio" here.

Let's plug these terms into the equation of a / (1 – r) now:

- **a** = Final Year FCF * (1 + Growth Rate) / (1 + Discount Rate)
- **r** = (1 + Growth Rate) / (1 + Discount Rate)

So, a / (1 – r) = (Final Year FCF * (1 + Growth Rate) / (1 + Discount Rate)) / (1 – ((1 + Growth Rate) / (1 + Discount Rate)))

You can rewrite the "1" part of the second fraction there as: (1 + Discount Rate) / (1 + Discount Rate) so that you can get a common denominator.

Then:

1 – (1 + Growth Rate) / (1 + Discount Rate) = (1 + Discount Rate) / (1 + Discount Rate) – (1 + Growth Rate) / (1 + Discount Rate)

And then since both fractions have the same denominator now, you can combine them and apply some algebra:

(1 + Discount Rate) – (1 + Growth Rate) / (1 + Discount Rate)
= (Discount Rate – Growth Rate) / (1 + Discount Rate)

So now your entire fraction looks like this:

(Final Year FCF * (1 + Growth Rate) / (1 + Discount Rate)) * 1 / ((Discount Rate – Growth Rate) / (1 + Discount Rate))

In the main denominator of that fraction, the (1 + Discount Rate) cancels out the other (1 + Discount Rate) because one is in the numerator and one is in the denominator, so it becomes:

Final Year FCF * (1 + Growth Rate) / * 1 / ((Discount Rate – Growth Rate))

And we can write that more clearly as:

Final Year FCF * (1 + Growth Rate) / (Discount Rate – Growth Rate)

**YOU DO NOT NEED TO KNOW THIS FOR INTERVIEWS. We are just including it because we've received questions on it before, and because I am a math nerd and enjoy manipulating formulas.**

**Which Method to Use?**

There is no "best" method when calculating Terminal Value. You almost always use both in a DCF and **compare the results**:

| Ralcorp Holdings - DCF Assumptions & Output | |
|---|---|
| Use Multiples Method? | Yes |
| Discount Rate: | 7.5% |
| Revenue Growth, Years 3 - 5: | 5.0% |
| EBIT Margin, Years 3 - 5: | 14.0% |
| Terminal EBITDA Multiple: | 9.0 x |
| Terminal Growth Rate: | 1.0% |
| Terminal Value: | $ 9,134 |

| Ralcorp Holdings - DCF Assumptions & Output | |
|---|---|
| Use Multiples Method? | No |
| Discount Rate: | 7.5% |
| Revenue Growth, Years 3 - 5: | 5.0% |
| EBIT Margin, Years 3 - 5: | 14.0% |
| Terminal EBITDA Multiple: | 9.0 x |
| Terminal Growth Rate: | 1.0% |
| Terminal Value: | $ 8,737 |

The main disadvantage in both cases is that the key variables – the Terminal Multiple and the Terminal Growth Rate – are **difficult to determine precisely**.

Neither one will necessarily produce a higher or lower value because you can't directly compare them – it depends on the company's financial profile, the Discount Rate, and so on.

If the industry is **cyclical** or multiples are **hard to predict**, the Gordon Growth method may be better; if multiples are easier to estimate, the Multiples Method may be better.

| Ralcorp Holdings - DCF Assumptions & Output | |
|---|---|
| Use Multiples Method? | Yes |
| Discount Rate: | 7.5% |
| Revenue Growth, Years 3 - 5: | 5.0% |
| EBIT Margin, Years 3 - 5: | 14.0% |
| Terminal EBITDA Multiple: | 9.0 x |
| Terminal Growth Rate: | 1.0% |
| Terminal Value: | $ 9,134 |
| PV of Terminal Value: | 6,350 |
| Sum of PV of Cash Flows: | 2,052 |
| **Enterprise Value:** | **$ 8,402** |
| Terminal Value % EV: | 75.6% |
| Enterprise Value: | 8,402 |
| Balance Sheet Adjustment: | (2,564) |
| **Implied Equity Value:** | **$ 5,838** |
| Diluted Shares Outstanding: | 57.137 |
| **Implied Share Price:** | **$ 102.17** |

Once you have the Terminal Value, you discount it using the same Discount Rate, and then add it to the discounted value of the company's Free Cash Flows (see the diagram on the left).

That gets you Enterprise Value (with Unlevered FCF) or Equity Value (with Levered FCF). And then you can work out what the company's implied per share price is.

You can see a sample calculation for all this on the left.

Remember that **this is just the "baseline" calculation – we always show a range of values for the analysis using a sensitivity table**.

## *Key Rule #5: Factors That Impact a DCF and WACC*

Ah, now for the fun part. This section is **important because many interview questions involve these concepts**. They'll ask things like:

- Will Cost of Equity be higher for a $500 million or $5 billion company?
- Will a 1% change in revenue or 1% change in the Discount Rate have a greater impact on the DCF?

Luckily, you have a secret weapon at your disposal: **the DCF model we've included with this guide** (see the section below).

You should use that model as much as possible, play around with and tweak all the variables there, and see what *really* makes an impact.

We explain quite a few questions on this topic in the Q&A sections below, but here are some rules of thumb to keep in mind.

**Overall Impact:** The **Discount Rate** and **Terminal Value** tend to have the biggest impact here. Yes, if a company's revenue growth rate or margins change **dramatically**, those could change the DCF significantly.

But even a 1% increase or decrease in the Discount Rate makes **far more** of an impact than a 1% increase or decrease in revenue or revenue growth or EBIT margins because that Discount Rate affects **everything** in the analysis.

A Discount Rate difference of 1% will impact the analysis far more than a 1% increase or decrease in Terminal Value because Terminal Value is a large number and 1% is **tiny**.

It gets trickier with questions like, "Well, what about a 10% change in revenue vs. a 1% difference in the Discount Rate?"

You're better off "hedging" your answer here and saying that at a certain level, the revenue increase or decrease will make more of a difference than the new Discount Rate, but it varies greatly by company and by the specific assumptions you've made.

**Rules of Thumb for Cost of Equity:**

- **Smaller companies** generally have a higher Cost of Equity than larger companies because expected returns are higher.
- Companies in **emerging and fast-growing geographies and markets** also tend to have a higher Cost of Equity for the same reason.
- **Additional Debt** raises the Cost of Equity because it makes the company riskier for all investors.
- **Additional Equity** lowers the Cost of Equity because the percentage of Debt in a company's capital structure decreases.
- **Using Historical vs. Calculated Beta** doesn't have a predictable impact – it could go either way depending on the set of comps.

**Rules of Thumb for WACC:**

- Assuming that the companies all have identical capital structures, the first two points above about Cost of Equity also apply to WACC – it's **higher** for smaller companies and those in emerging markets.
- **Additional Debt** reduces WACC because Debt is less expensive than Equity. Yes, Levered Beta will go up, but the additional Debt in the WACC formula more than makes up for the increase.
- **Additional Preferred Stock** also generally reduces WACC because Preferred Stock tends to be less expensive than Equity (Common Stock).
- **Higher Debt Interest Rates** will increase WACC because they increase the Cost of Debt.

When in doubt, think about the **individual components** of these items and reason your way through how each one changes.

And if it's something truly ambiguous, they will care far more about your thought process than whether you got it "right or wrong."

## *For Further Learning*

The rules above are a great start, but sometimes you need more: if you're in this position, click here to check out our Financial Modeling Fundamentals course.

You receive a $50 discount as a *Breaking Into Wall Street* member, and you get 20 hours of video tutorials along with several **bonus case studies** on real M&A deals and leveraged buyouts – plus valuation case studies and DCF examples.

It has been one of our most popular courses year after year, and it's a great way to extend your knowledge of valuation, learn how it works in the context of real deals, and prepare more intensively for interviews.

# Discounted Cash Flow (DCF) Model

This is *combined* with the Valuation model from the previous section because it makes more sense to include all the required spreadsheets when valuing a company.

This one consists of a full valuation of **Ralcorp**, a US-based company in the consumer sector (food and beverages specifically). You'll see how to apply Public Comps, Precedent Transactions, and a DCF analysis in real life to value a publicly traded company.

And you'll get a full video tutorial that explains the entire model. You should play around with this model, tweak the numbers, and see how the valuation output changes as a result.

This model is **particularly helpful for DCF-related questions** because you can tweak all the values and see how the output is impacted.

Get the full model and video tutorial right here:

- Ralcorp Holdings – DCF Model and Video Tutorial

# DCF Interactive Quiz

We've also included an interactive quiz on the Discounted Cash Flow Analysis in this guide. This covers both the Basic and Advanced question categories below, and thoroughly tests your knowledge of all things DCF-related.

Ideally, you will go through this **after** you've been through all the Rules of Thumb above and the questions below so that you can test yourself one last time before your interviews.

This quiz isn't quite as long as the one on Accounting because there are fewer categories of questions – but it's just as important since there is a 99.9% chance you will get questions on Valuation and the DCF analysis in interviews.

- Basic DCF Quiz
- Advanced DCF Quiz

# DCF Questions & Answers – Basic

If you've been through the Overview, Key Rules of Thumb, and Interactive Quiz, these questions will be straightforward to answer.

The main categories correspond to the sections above: walking through and explaining the concept of a DCF, calculating and projecting FCF, explaining Discount Rates and WACC, Terminal Value, and then explaining how various changes impact a DCF.

## *Walking Through and Explaining a DCF*

**1. What's the basic concept behind a Discounted Cash Flow analysis?**

The concept is that you value a company based on the **present value** of its Free Cash Flows far into the future.

You divide the future into a "near future" period of 5-10 years and then calculate, project, discount, and add up those Free Cash Flows; and then there's also a "far future" period for everything beyond that, which you can't estimate as precisely, but which you can approximate using different approaches.

You need to discount everything back to its **present value** because money today is worth more than money tomorrow.

**2. Walk me through a DCF.**

"A DCF values a company based on the Present Value of its Cash Flows and the Present Value of its Terminal Value.

First, you project a company's financials using assumptions for revenue growth, margins, and the Change in Operating Assets and Liabilities; then you calculate Free Cash Flow for each year, which you discount and sum up to get to the Net Present Value. The Discount Rate is usually the Weighted Average Cost of Capital.

Once you have the present value of the Free Cash Flows, you determine the company's Terminal Value, using either the Multiples Method or the Gordon Growth Method, and then you discount that back to its Net Present Value using the Discount Rate.

Finally, you add the two together to determine the company's Enterprise Value."

**3. Walk me through how you get from Revenue to Free Cash Flow in the projections.**

First, **confirm** that they are asking for *Unlevered* Free Cash Flow (Free Cash Flow to Firm). If so:

Subtract COGS and Operating Expenses from Revenue to get to Operating Income (EBIT) – or just use the EBIT margin you've assumed.

Then, multiply by (1 – Tax Rate), add back Depreciation, Amortization, and other non-cash charges, and factor in the Change in Operating Assets and Liabilities. If Assets increase by more than Liabilities, this is a negative; otherwise it's positive.

Finally, subtract Capital Expenditures to calculate Unlevered Free Cash Flow.

Levered Free Cash Flow (FCFE) is similar, but you must also subtract the Net Interest Expense before multiplying by (1 – Tax Rate), and you must also subtract Mandatory Debt Repayments at the end.

**4. What's the point of Free Cash Flow, anyway? What are you trying to do?**

The idea is that you're replicating the Cash Flow Statement, but **only including recurring, predictable items**. And in the case of Unlevered Free Cash Flow, you also exclude the impact of Debt entirely.

That's why everything in Cash Flow from Investing except for CapEx is excluded, and why the entire Cash Flow from Financing section is excluded (the only exception being Mandatory Debt Repayments for Levered FCF).

**5. Why do you use 5 or 10 years for the "near future" DCF projections?**

That's about as far as you can reasonably predict for most companies. Less than 5 years would be too short to be useful, and more than 10 years is too difficult to project for most companies.

**6. Is there a valid reason why we might sometimes project 10 years or more anyway?**

You might sometimes do this if it's a **cyclical industry**, such as chemicals, because it may be important to show the entire cycle from low to high.

**7. What do you usually use for the Discount Rate?**

In a Unlevered DCF analysis, you use WACC (Weighted Average Cost of Capital), which reflects the "Cost" of Equity, Debt, and Preferred Stock. In a Levered DCF analysis, you use Cost of Equity instead.

**8. If I'm working with a public company in a DCF, how do I move from Enterprise Value to its Implied per Share Value?**

Once you get to Enterprise Value, ADD Cash and then SUBTRACT Debt, Preferred Stock, and Noncontrolling Interests (and any other debt-like items) to get to Equity Value.

Then you divide by the company's share count (factoring in all dilutive securities) to determine the implied per-share price.

**9. Let's say we do this and find that the Implied per Share Value is $10.00. The company's current share price is $5.00. What does this mean?**

By itself, this does not mean much – you have to look at a **range** of outputs from a DCF rather than just a single number. So you would see what the Implied per Share Value is under different assumptions for the Discount Rate, revenue growth, margins, and so on.

If you consistently find that it's greater than the company's current share price, then the analysis might tell you that the company is **undervalued**; it might be **overvalued** if it's consistently less than the current share price across all ranges.

**10. An alternative to the DCF is the Dividend Discount Model (DDM). How is it different in the *general* case (i.e. for a normal company, not a commercial bank or insurance firm?)**

The setup is similar: you still project revenue and expenses over a 5-10 year period, and you still calculate Terminal Value.

The difference is that you do **not** calculate Free Cash Flow – instead, you stop at Net Income and assume that Dividends Issued are a percentage of Net Income, and then you discount those Dividends back to their present value using the Cost of Equity.

Then, you add those up and add them to the present value of the Terminal Value, which you might base on a P / E multiple instead.

Finally, a Dividend Discount Model gets you the company's Equity Value rather than its Enterprise Value since you're using metrics that **include** interest income and expense.

## *Calculating Free Cash Flow (FCF)*

**1. Let's talk more about how you calculate Free Cash Flow. Is it always correct to leave out most of the Cash Flow from Investing section and all of the Cash Flow from Financing section?**

Most of the time, yes, because all items other than CapEx are generally non-recurring, or at least do not recur in a predictable way.

If you have **advance knowledge** that a company is going to sell or buy a certain amount of securities, issue a certain amount of stock, or repurchase a certain number of shares every year, then sure, you can factor those in. But it's extremely rare to do that.

**2. Why do you add back non-cash charges when calculating Free Cash Flow?**

For the same reason you add them back on the Cash Flow Statement: you want to reflect the fact that they save the company on **taxes**, but that the company does not actually pay the expense in cash.

**3. What's an alternate method for calculating Unlevered Free Cash Flow (Free Cash Flow to Firm)?**

There are many "alternate methods" – here are a few common ones:

- EBIT * (1 – Tax Rate) + Non-Cash Charges – Changes in Operating Assets and Liabilities – CapEx
- Cash Flow from Operations + Tax-Adjusted Net Interest Expense – CapEx
- Net Income + Tax-Adjusted Net Interest Expense + Non-Cash Charges – Changes in Operating Assets and Liabilities – CapEx

The difference with these is that the **tax numbers** will be slightly different as a result of when you exclude the interest.

**4. What about alternate ways to calculate Levered Free Cash Flow?**

- Net Income + Non-Cash Charges – Changes in Operating Assets and Liabilities – CapEx – Mandatory Debt Repayments
- (EBIT – Net Interest Expense) * (1 – Tax Rate) + Non-Cash Charges – Changes in Operating Assets and Liabilities – CapEx – Mandatory Debt Repayments

- Cash Flow from Operations – CapEx – Mandatory Debt Repayments

**5. As an approximation, do you think it's OK to use EBITDA – Changes in Operating Assets and Liabilities – CapEx to approximate Unlevered Free Cash Flow?**

This is inaccurate because it excludes **taxes** completely. It would be better to use EBITDA – Taxes – Changes in Operating Assets and Liabilities – CapEx.

If you need a very quick approximation, yes, this formula can work and it will get you closer than EBITDA by itself. But taxes are significant and should not be overlooked.

**6. What's the point of that "Changes in Operating Assets and Liabilities" section? What does it mean?**

All it means is that if Assets are increasing by *more* than Liabilities, the company is spending cash and therefore **reducing** its cash flow, whereas if Liabilities are increasing by *more* than Assets, the company is **increasing** its cash flow.

For example, if it places a huge order of Inventory, sells products, and records revenue, but hasn't receive the cash from customers yet, Inventory and Accounts Receivable both go up and represent **uses** of cash.

Maybe some of its Liabilities, such as Accounts Payable and Deferred Revenue, also increase… but think about what happens: if the Assets increase by, say, $100, and the Liabilities only increase by $50, it's a **net cash flow reduction of $50**.

So that is what this section is for – we need to take into account the cash changes from these operationally-linked Balance Sheet items.

**7. What happens in the DCF if Free Cash Flow is negative? What if EBIT is negative?**

Nothing "happens" because you can still run the analysis as-is. The company's value will certainly decrease if one or both of these turn negative, because the present value of Free Cash Flow will decrease as a result.

The analysis is **not** necessarily invalid even if cash flow is negative – if it turns positive after a point, it could still work.

If the company *never* turns cash flow-positive, then you may want to skip the DCF because it will always produce negative values.

**8. Let's say that you use Levered Free Cash Flow rather than Unlevered Free Cash Flow in your DCF – what changes?**

Levered Free Cash Flow gives you Equity Value rather than Enterprise Value, since the cash flow is only available to Equity Investors (Debt investors have already been "paid" with the interest payments and principal repayments).

**9. If you use Levered Free Cash Flow, what should you use as the Discount Rate?**

You would use Cost of Equity rather than WACC since we're ignoring Debt and Preferred Stock and only care about the Equity Value for Levered FCF.

**10. Let's say that you use Unlevered Free Cash Flow in a DCF to calculate Enterprise Value. Then, you work backwards and use the company's Cash, Debt, and so on to calculate its implied Equity Value.**

**Then you run the analysis using Levered Free Cash Flow instead and calculate Equity Value at the end. Will the implied Equity Value from both these analyses by the same?**

**No**, most likely it will not be the same. In theory, you could pick equivalent assumptions and set up the analysis such that you calculate the same Equity Value at the end.

In practice, it's difficult to pick "equivalent" assumptions, so these two methods will rarely, if ever, produce the same value.

Think about it like this: when you use Unlevered FCF and move from Enterprise Value to Equity Value, you're always using the same numbers for Cash, Debt, etc.

But in a Levered FCF analysis, **the terms of the Debt will impact Free Cash Flow** – so simply by assuming a different interest rate or repayment schedule, you'll alter the Equity Value. That's why it's so difficult to make "equivalent assumptions."

## *Discount Rates and WACC*

**1. How do you calculate WACC?**

- **WACC** = Cost of Equity * (% Equity) + Cost of Debt * (% Debt) * (1 – Tax Rate) + Cost of Preferred * (% Preferred)

In all cases, the percentages refer to how much each component comprises of the company's capital structure.

For Cost of Equity, you can use the Capital Asset Pricing Model (CAPM – see the next question) and for the others you usually look at comparable companies and comparable debt issuances and the interest rates and yields issued by similar companies to get estimates.

**2. How do you calculate Cost of Equity?**

- **Cost of Equity** = Risk-Free Rate + Equity Risk Premium * Levered Beta

The Risk-Free Rate represents how much a 10-year or 20-year US Treasury (or equivalent "safe" government bond in your own country) should yield; Beta is calculated based on the "riskiness" of Comparable Companies and the Equity Risk Premium is the percentage by which stocks are expected to out-perform "risk-less" assets like US Treasuries.

Normally you pull the Equity Risk Premium from a publication called *Ibbotson's*.

**Note:** Depending on your bank and group, you might also add in a "size premium" and "industry premium" to account for additional risk and expected returns from either of those.

Small-cap stocks are expected to out-perform large-cap stocks and certain industries are expected to out-perform others, and these premiums reflect these expectations.

**3. Cost of Equity tells us the return that an equity investor might expect for investing in a given company – but what about dividends? Shouldn't we factor dividend yield into the formula?**

Trick question. Dividend yields are already factored into Beta, because Beta describes returns in excess of the market as a whole – and those returns **include** Dividends.

**4. How can we calculate Cost of Equity WITHOUT using CAPM?**

There is an alternate formula:

- **Cost of Equity** = (Dividends per Share / Share Price) + Growth Rate of Dividends

This is less common than the "standard" formula but sometimes you use it when the company is guaranteed to issue Dividends (e.g. Utilities companies) and/or information on Beta is unreliable.

**5. How do you calculate Beta in the Cost of Equity calculation?**

First off, note that you don't *have* to calculate anything – you could just take the company's Historical Beta, based on its stock performance vs. the relevant index.

Normally, however, you come up with a *new* estimate for Beta based on the set of Public Comps you're using to value the company elsewhere in the Valuation, under the assumption that your estimate will be more accurate.

You look up the Beta for each Comparable Company (usually on Bloomberg), un-lever each one, take the median of the set and then lever that median based on the company's capital structure. Then you use this Levered Beta in the Cost of Equity calculation.

The formulas for un-levering and re-levering Beta are below (see the Rules section above for explanations).

- **Unlevered Beta** = Levered Beta / (1 + ((1 - Tax Rate) x (Total Debt/Equity)))
- **Levered Beta** = Unlevered Beta x (1 + ((1 - Tax Rate) x (Total Debt/Equity)))

**6. Why do you have to un-lever and re-lever Beta when you calculate it based on the comps?**

When you look up the Betas on Bloomberg (or whatever source you're using) they will already be **levered** because a company's previous stock price movements reflect the Debt they've taken on.

But each company's capital structure is different and we want to look at **how "risky" a company is regardless of what % debt or equity it has.**

To do that, we need to un-lever Beta each time. We want to find the **inherent business risk** that each company has, separate from the risk created by Debt.

But at the end of the calculation, we need to re-lever the median Unlevered Beta of that set because we want the Beta used in the Cost of Equity calculation to reflect the total risk of our company, **taking into account its capital structure this time as well.**

**7. Wait a second, would you still use Levered Beta with Unlevered Free Cash Flow? What's the deal with that?**

They are different concepts (yes, the names get **very** confusing here). You **always** use Levered Beta with Cost of Equity because Debt makes the company's **stock** riskier for everyone involved.

And you always use that same Cost of Equity number for both Levered Free Cash Flow, where Cost of Equity itself is the Discount Rate, and also for Unlevered Free Cash Flow, where Cost of Equity is a **component** of the Discount Rate (WACC).

**8. How do you treat Preferred Stock in the formulas above for Beta?**

It should be counted as Equity there because Preferred Dividends are **not** tax-deductible, unlike interest paid on Debt.

**9. Can Beta ever be negative? What would that mean?**

Theoretically, yes, Beta could be negative for certain assets. If Beta is -1, for example, that would mean that the asset moves in **the opposite direction from the market as a whole**. If the market goes **up** by 10%, this asset would go **down** by 10%.

In practice, you rarely, if ever, see negative Betas with real companies. Even something labeled as "counter-cyclical" still follows the market as a whole; a "counter-cyclical" company might have a Beta of 0.5 or 0.7, but not -1.

**10. Would you expect a manufacturing company or a technology company to have a higher Beta?**

A technology company, because technology is viewed as a "riskier" industry than manufacturing.

**11. Shouldn't you use a company's *targeted* capital structure rather than its current capital structure when calculating Beta and the Discount Rate?**

In theory, yes. If you know that a company's capital structure is definitely changing in a certain, predictable way in the future, sure, go ahead and use that.

In practice, you rarely know this information in advance, so it's not terribly practical to make this kind of assumption.

**12. The "cost" of Debt and Preferred Stock make intuitive sense because the company is paying for interest or for the Preferred Dividends. But what about the Cost of Equity? What is the company really paying?**

The company "pays" for Equity in two ways:

1. It may issue **Dividends** to its common shareholders, which is a cash expense.
2. It **gives up stock appreciation rights** to other investors, so in effect it's losing some of that upside – a non-cash but very real "cost."

It is tricky to estimate the impact of both of those, which is why we usually use the Risk-Free Rate + Equity Risk Premium * Beta formula to estimate the company's *expected return* instead.

**13. If a firm is losing money, do you still multiply the Cost of Debt by (1 – Tax Rate) in the WACC formula? How can a tax shield exist if they're not even paying taxes?**

This is a good point, but in practice you will still multiply by (1 – Tax Rate) anyway. What matters is not whether the Debt is *currently* reducing the company's taxes, but whether there's *potential* for that to happen in the future.

**14. How do you determine a firm's Optimal Capital Structure? What does it mean?**

The "optimal capital structure" is the combination of Debt, Equity, and Preferred Stock that **minimizes WACC**.

There is no real way to determine this formulaically because you'll always find that Debt should be 100% of a company's capital structure since it's **always** cheaper than Equity and Preferred Stock… but that can't happen because all companies need some amount of Equity as well.

Plus, taking on additional Debt will impact the Cost of Equity and the Cost of Preferred, so effectively it is a multivariable equation with no solution.

You may be able to **approximate** the optimal structure by looking at a few different scenarios and seeing how WACC changes – but there's no mathematical solution.

**15. Let's take a look at companies during the financial crisis (or really, just any type of crisis or economic downturn). Does WACC increase or decrease?**

Break it down and think of the individual components of WACC: Cost of Equity, Cost of Debt, Cost of Preferred, and the percentages for each one.

Then, think about the individual components of Cost of Equity: the Risk-Free Rate, the Equity Risk Premium, and Beta.

- The Risk-Free Rate would **decrease** because governments worldwide would drop interest rates to encourage spending.
- But then the Equity Risk Premium would also **increase** by a good amount as investors demand higher returns before investing in stocks.
- Beta would also **increase** due to all the volatility.
- So overall, we can guess that the Cost of Equity would **increase** because the latter two increases would likely more than make up for the decrease in the Risk-Free Rate.

Now, for WACC:

- The Cost of Debt and Cost of Preferred Stock would both **increase** as it would become more difficult for companies to borrow money.

- The Debt to Equity ratio would likely *increase* because companies' share prices would fall, meaning that Equity Value decreased for most companies while Debt stayed the same…
- So proportionally, yes, Debt and Preferred would likely make up a higher percentage of a company's capital structure.
- But remember: the Cost of Debt and Cost of Preferred both increase, so that shift doesn't matter too much.
- As a result, WACC almost certainly **increases** because almost all these variables push it up – the only one that pushes it down is the reduced Risk-Free Rate.

There's a simpler way to think about it as well: all else being equal, did companies become more valuable or less valuable during the financial crisis?

**Less valuable** – because the market discounted their future cash flows at higher rates. So WACC must have **increased**.

## *Terminal Value*

**1. How do you calculate the Terminal Value?**

You can either apply an exit multiple to the company's Year 5 EBITDA, EBIT or Free Cash Flow (Multiples Method) or you can use the Gordon Growth method to estimate the value based on the company's growth rate into perpetuity.

The formula for Terminal Value using the Gordon Growth method: Terminal Value = Final Year Free Cash Flow * (1 + Growth Rate) / (Discount Rate – Growth Rate).

Note that with either method, you're estimating the same thing: **the present value of the company's Free Cash Flows from the final year into infinity, *as of* the final year**.

**2. Why would you use the Gordon Growth Method rather than the Multiples Method to calculate the Terminal Value?**

In banking, you almost always use the Multiples Method to calculate Terminal Value in a DCF. It's easier to get appropriate data for exit multiples since they are based on Comparable Companies – picking a long-term growth rate involves more guesswork.

However, you might use Gordon Growth if you have no good Comparable Companies or if you believe that multiples will change significantly in the industry several years down the road. For example, if an industry is cyclical (e.g. chemicals or semiconductors) you might be better off using long-term growth rates rather than exit multiples.

**3. What's an appropriate growth rate to use when calculating the Terminal Value?**

Normally you use the country's long-term GDP growth rate, the rate of inflation, or something similarly conservative.

For companies in developed countries, a long-term growth rate over 5% would be quite aggressive since most developed economies are growing at less than 5% per year.

**4. How do you select the appropriate exit multiple when calculating Terminal Value?**

Normally you look at the Public Comps and pick the median of the set, or something close to it.

You always show a *range* of exit multiples and what the Terminal Value looks like over that range rather than picking one specific number.

So if the median EBITDA multiple of the set were 8x, you might show a *range* of values using multiples ranging from 6x to 10x.

**5. Which method of calculating Terminal Value will produce a higher valuation?**

It's impossible to say because it could go either way depending on the assumptions. There's no general rule here that always applies, or that even applies most of the time.

**6. Can you explain the Gordon Growth formula in more detail? I don't need a full derivation, but what's the intuition behind it?**

We actually *do* have a full derivation if you look in the Key Rules section above. Here's the formula:

Terminal Value = Final Year Free Cash Flow * (1 + Growth Rate) / (Discount Rate – Growth Rate).

And here's the intuition behind it:

Let's say that we know for certain that we'll receive $100 every year indefinitely, and we have a required return of 10%.

That means that we can "afford" to pay $1,000 now ($100 / 10%) to receive $100 in year 1 and $100 in every year after that forever.

But now let's say that that stream of $100 were actually **growing** each year – if that's the case, then we could afford to invest *more* than the initial $1,000.

Let's say that we expect the $100 to grow by 5% every year – how much can we afford to pay now to capture all those future payments, if our required return is 10%?

Well, that **growth increases our effective return**… so now we can pay *more* and still get that same 10% return.

We can estimate that by dividing the $100 by (10% – 5%). 10% is our required return and 5% is the growth rate. So in this case, $100 / (10% – 5%) = $2,000.

This corresponds to the formula above: $100 represents Final Year Free Cash Flow * (1 + Growth Rate), 10% is the Discount Rate, and 5% is the Growth Rate.

The higher the expected growth, the more we can afford to pay upfront. And if the expected growth is the same as the required return, theoretically we can pay an **infinite amount** (you get a divide by zero error in the equation) to achieve that return.

You can test this yourself by plugging the values into a spreadsheet: enter $100, make it grow by 5% each year, and then use NPV(10%, Area With All The Numbers) and you'll see how it approaches $2,000 as you add more to it:

| Discount Rate: | | | | | 10% | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Year 6** | **Year 7** | **Year 8** | **Year 9** | **Year 10** |
| **Free Cash Flow:** | $ 100 | $ 105 | $ 110 | $ 116 | $ 122 | $ 128 | $ 134 | $ 141 | $ 148 | $ 155 |
| Growth Rate: | N/A | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% |
| **Cumulative NPV of FCF:** | $ 91 | $ 178 | $ 261 | $ 340 | $ 415 | $ 487 | $ 556 | $ 622 | $ 684 | $ 744 |

| **Year 68** | **Year 69** | **Year 70** |
|---|---|---|
| $ 2,628 | $ 2,760 | $ 2,898 |
| 5% | 5% | 5% |
| $ 1,915 | $ 1,919 | $ 1,923 |

**7. What's the flaw with basing the Terminal Multiple on what the Public Comps are trading at?**

The median multiples may change greatly in the next 5-10 years, so they may no longer be accurate by the end of the period you're looking at. This is why you look at a wide range of multiples and run sensitivity analyses to see how these variables impact the valuation.

**8. Wait a second: why isn't the present value of the Terminal Value, by itself, just the company's Enterprise Value? Don't you get Enterprise Value if you apply a multiple to EBITDA?**

Yes, you do get Enterprise Value – but that only represents the company's **"far in the future" value**. Remember that in a DCF, a company's value is divided into "near future" and "far future."

If you leave out the present value of Free Cash Flows in the projection period, you're saying, "For the next 5 years, this company has no value. But then at the end of year 5, the company is miraculously worth something again!" And that doesn't make sense.

**9. How do you know if a DCF is too dependent on future assumptions?**

Some people claim that if over 50% of a company's value comes from the present value of the Terminal Value, the DCF is too dependent on future assumptions.

The problem, though, is that in practice this is true in almost all DCFs. If the present value of the Terminal Value accounts for something like 80-90%+ of the company's value, then maybe you need to re-think your assumptions.

**10. How can you check whether your assumptions for Terminal Value using the Multiples Method vs. the Gordon Growth Method make sense?**

The most common method here is to calculate Terminal Value using one method, and then to see what the **implied long-term growth rate** or **implied multiple** via the other method would be.

**Example:** You calculate Terminal Value with a long-term growth rate assumption of 4%. Terminal Value is $10,000. You divide that Terminal Value by the final year EBITDA and get an implied EBITDA multiple of 15x – but the Public Comps are only trading at a median of 8x EBITDA. In this case your assumption is almost certainly too aggressive and you should reduce that long-term growth rate.

## *Impact of Changes on a DCF and WACC*

**1. You're looking at two companies, both of which produce identical *total* Free Cash Flows over a 5-year period. Company A generates 90% of its Free Cash Flow in the first year and 10% over the remaining 4 years. Company B generates the same amount of Free Cash Flow in each year.**

**Which one has the higher net present value?**

Company A, because **money today is worth more than money tomorrow**. All else being equal, generating higher cash flow earlier on will always boost a company's value in a DCF.

**2. Should Cost of Equity be higher for a $5 billion or $500 million Market Cap company?**

It should be higher for the $500 million company, because all else being equal, smaller companies are expected to outperform large companies in the stock market (and are therefore "riskier").

**3. What about WACC – will it be higher for a $5 billion or $500 million company?**

This is a bit of a trick question because it depends on whether or not the capital structure is the same for both companies. If the capital structure *is* the same in terms of percentages and interest rates, then WACC should be higher for the $500 million company for the same reasons as mentioned above.

If the capital structure is *not* the same, then it could go either way depending on how much debt/preferred stock each one has and what the interest rates are.

**4. What's the relationship between Debt and Cost of Equity?**

More Debt means that the company is riskier, so the company's Levered Beta will be higher – so all else being equal, Cost of Equity would increase. Less Debt would decrease Cost of Equity.

**5. Two companies are exactly the same, but one has Debt and one does not – which one will have the higher WACC?**

The one without Debt will generally have a higher WACC because Debt is "less expensive" than Equity. Why?

- Interest on Debt is tax-**deductible** – hence the (1 – Tax Rate) multiplication in the WACC formula.
- Debt is **senior** to Equity in a company's capital structure – debt investors would be paid first in a liquidation or bankruptcy scenario.
- Intuitively, interest rates on Debt are usually **lower** than Cost of Equity numbers (usually over 10%). As a result, the Cost of Debt portion of WACC will contribute less to the total figure than the Cost of Equity portion.

**6. Wait a minute, so are you saying that a company that *does not* take on Debt is at a disadvantage to one that does? How does that make sense?**

The one without Debt is not "at a disadvantage" – but it won't be valued as highly because of the way the WACC formula works.

Keep in mind that companies do not make big decisions based financial formulas. If a company has no reason to take on Debt (e.g. it is very profitable and does not need funds to expand its business), then it won't take on Debt.

**7. Let's say that we assume 10% revenue growth and a 10% Discount Rate in a DCF analysis. Which change will have a bigger impact: reducing revenue growth to 9%, or reducing the Discount Rate to 9%?**

The Discount Rate change will almost certainly have a bigger impact because that affects *everything* from the present value of Free Cash Flows to the present value of Terminal Value – and even a 10% change makes a huge impact.

**8. What about if we change revenue growth to 1%? Would that have a bigger impact, or would changing the Discount Rate to 9% have a bigger impact?**

In this case the change in revenue growth is likely to have a bigger impact because you've changed it by **90%** but you've only *changed* the Discount Rate by **10%** – and that lower revenue growth will push down the present value of the Terminal Value (EBITDA and the FCF growth rate will both be lower) as well as the present value of the Free Cash Flows.

**9. The Free Cash Flows in the projection period of a DCF analysis increase by 10% each year. How much will the company's Enterprise Value increase by?**

A percentage that's less than 10%, for two reasons:

1. Remember that we **discount** all those Free Cash Flows – so even if they increase by 10%, the present value change is less than 10%.
2. There's still the **Terminal Value** and the present value of that. That has **not** increased by 10%, so neither has the company's total value.

You can't give an exact number for the increase without knowing the rest of the numbers (Discount Rate, Terminal Value, etc.) in the analysis.

**10. Let's say that we want to analyze all these factors in a DCF. What are the most common sensitivity analyses to use?**

Common sensitivities:

- Revenue Growth vs. Terminal Multiple
- EBITDA Margin vs. Terminal Multiple
- Terminal Multiple vs. Discount Rate
- Terminal Growth Rate vs. Discount Rate

**11. A company has a high Debt balance and is paying off a significant portion of its Debt principal each year. How does that impact a DCF?**

Trick question. You **don't account for this at all in an Unlevered DCF** because you ignore interest expense and debt principal repayments.

In a Levered DCF, you factor it in by reducing the interest expense each year as the Debt goes down and also by reducing Free Cash Flow by the mandatory repayments each year.

The exact impact – i.e. whether the implied Equity Value goes up or down – depends on the interest rate and the principal repayment percentage each year; however, in most cases the principal repayments far exceed the net interest expense, so the Equity Value will most likely **decrease** because Levered FCF will be lower each year.

**12. So if you're using Levered FCF to value a company, is the company better off paying off Debt quickly or repaying the bare minimum required?**

It's always better to pay the **bare minimum**. Think about the math for a second: interest rates on Debt rarely go above 10-15%... let's just assume that they're 10%, and that the company has $1,000 in Debt.

Initially, it pays $100 in interest expense, and after taxes that's only $60 ($100 * (1 – 40%)). So Levered Free Cash Flow is reduced by $60 each year assuming no principal repayment.

What happens if the company decides to repay $200 of that Debt each year? Levered Free Cash Flow is down by *at least* $200 each year, and the company still pays interest, albeit lower interest, until the end of the period.

So the company is always better off, valuation-wise, waiting as long as possible to repay Debt.

# DCF Questions & Answers – Advanced

These more advanced questions cover how you use a DCF "in real life" and the complexities that arise when you're valuing real companies.

These questions are more likely if you have **significant** full-time work experience and you're interviewing for more advanced positions (**not** internships or first-year analyst roles).

**Skip this section if you have not worked full-time in finance before. It is overkill for internship and entry-level interviews.**

There are not that many "advanced" questions on the DCF analysis because… it's not an advanced topic, and there are fewer complexities than what you see with merger models, LBO models, and even accounting.

So this section will be short and sweet.

## *Mid-Year Discounts and Stub Periods*

**1. Explain why we use the mid-year convention in a DCF.**

You use it to represent the fact that a company's cash flow does not arrive 100% at the end of each year – instead, it comes in evenly throughout each year.

In a DCF *without* the mid-year convention, we would use discount period numbers of 1 for the first year, 2 for the second year, 3 for the third year, and so on.

*With* the mid-year convention, we would instead use 0.5 for the first year, 1.5 for the second year, 2.5 for the third year, and so on.

The end result is that the mid-year convention produces **higher values** since the discount periods are all lower.

**2. What's the point of a "stub period" in a DCF? Can you give an example?**

You use a stub period when you're valuing a company before or after the end of its fiscal year and there are 1 or more quarters in between the current date and the end of the fiscal year.

For example, it's currently September 30th and the company's fiscal year ends on December 31st.

In this case it wouldn't be correct to assume that Free Cash Flow only **starts** on January 1st of the next year – there are still 3 months between now and the end of the year, the company still generates FCF in those 3 months, and you need to account for it somewhere in your model.

So you would calculate FCF in that 3-month period, use 0.25 for the discount period, and then use 1.25 for the discount period for the first *full* year of the model, 2.25 for the next year, and so on.

**3. What discount period numbers would you use for the mid-year convention if you had a stub period – e.g. Q4 of Year 1 – in a DCF?**

The rule is that you divide the stub discount period by 2, and then you simply subtract 0.5 from the "normal" discount periods for the future years. Example for a Q4 stub:

| | Q4 | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|---|
| **Normal Discount Periods with Stub:** | 0.25 | 1.25 | 2.25 | 3.25 | 4.25 | 5.25 |
| **Mid-Year Discount Periods with Stub:** | 0.125 | 0.75 | 1.75 | 2.75 | 3.75 | 4.75 |

Another example for a Q2 – Q4 stub (e.g. we're valuing the company on March 31st and its Fiscal Year ends on December 31st):

| | Q2 – Q4 | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|---|
| **Discount Periods with Stub:** | 0.75 | 1.75 | 2.75 | 3.75 | 4.75 | 5.75 |
| **Mid-Year Periods with Stub:** | 0.375 | 1.25 | 2.25 | 3.25 | 4.25 | 5.25 |

**What is the logic here?** Think about it like this: let's take the example of the normal discount period for Year 1 being 1.75, representing 3 quarters and then a full year.

**Now, ask yourself *when* you receive that cash flow *in* Year 1**. You're still receiving it midway through that first year… in other words, you still use 0.5 for the period.

However, you also need to take into account the 3 / 4 of this partial year because 3 quarters pass between **now** and the **start of Year 1**. So you still have 0.75 there, and the mid-year discount period with the stub period is 0.75 + 0.5, or 1.25.

That is why it's not 1.75 / 2, like you might expect: **it's about *when* you receive that cash flow *in* Year, *from* the perspective of the start of Year 1** – and then you add the total amount of time that passes between now and the start of Year 1. There's no mid-year discount applied there because we **don't** receive any Year 1 cash in this first partial year.

**4. How does the Terminal Value calculation change when we use the mid-year convention?**

When you're discounting the Terminal Value back to its present value, you use different numbers for the discount period depending on whether you're using the Multiples Method or Gordon Growth Method:

- **Multiples Method:** You **add** 0.5 to the final year discount number to reflect that you're assuming the company gets sold at the **end** of the year.
- **Gordon Growth Method:** You use the final year discount number as is, because you're assuming the free cash flows grow into perpetuity and that they are still received throughout the year rather than just at the end.

**5. What if you have a stub period *and* you're using the mid-year convention – how does Terminal Value change then?**

It's the same as what's described above – a stub period in the beginning does not make a difference.

## *DCF Special Cases*

**1. How does a DCF for a private company differ?**

The mechanics are the same, but calculating Cost of Equity and WACC is problematic because you can't find the market value of Equity or Beta for private companies.

So you might estimate WACC based on the median WACC of its Public Comps, and do the same for Cost of Equity if you're using that as the Discount Rate.

**2. How do you factor in one-time events such as raising Debt, completing acquisitions, and so on in a DCF?**

Normally you ignore these types of events because the whole point of calculating Free Cash Flow is to determine the company's cash flow on a **recurring, predictable basis**.

If you know for a fact that something is going to occur in the near future, then you could factor that in – issuing Debt or Equity would change Cost of Equity and WACC (and the company's Free Cash Flow in a Levered DCF); completing an acquisition or buying an asset would reduce cash flow initially but perhaps boost it later on.

**3. What should you do if you don't believe management's projections in a DCF model?**

You can take a few different approaches:

- You could create your own projections.
- You could "hair-cut" management's projections (reduce them by a certain percentage) to make them more conservative.
- You could show a sensitivity table based on different growth rates and margins, and show the values using both management's projections and a more conservative set of numbers.

**4. Why would you *not* use a DCF for a bank or other financial institution?**

Banks use Debt differently than other companies and do not use it to finance their operations – they use it to create their "products" – loans – instead.

Also, **interest** is a critical part of banks' business models and changes in "Operating Assets and Liabilities" can be much larger than a bank's Net Income. Finally, CapEx does *not* correspond to re-investment in business for a bank, and is often negligible.

For financial institutions (commercial banks and insurance firms), it's more common to use a **Dividend Discount Model** or **Residual Income Model** instead of a DCF. See the industry-specific sections of the guide for more.

**5. Walk me through a Dividend Discount Model (DDM) that you would use in place of a normal DCF for financial institutions.**

The mechanics are the same as a DCF, but we use Dividends rather than Free Cash Flows:

1. **Project** the company's earnings, down to Earnings per Share (EPS).
2. Assume a **Dividend Payout Ratio** – what percentage of the EPS gets paid out to shareholders in the form of Dividends – based on what the firm has done historically and how much regulatory capital it needs.
3. Use this to calculate Dividends over the next 5-10 years.
4. Do a check to make sure that **the firm still meets its required Tier 1 Capital Ratio and other capital ratios** – if not, reduce Dividends.

5. Discount the Dividends in each year to their present value based on **Cost of Equity – NOT WACC –** and then sum these up.
6. Calculate Terminal Value based on P / BV and Book Value in the final year, and then discount this to its present value based on the **Cost of Equity**.
7. Sum the present value of the Terminal Value and the present values of the Dividends to calculate the company's net present value per share.

The **key difference** compared to a DDM for normal companies is the presence of the capital ratios – you can't just blindly make Dividends per Share a percentage of EPS. See the industry-specific guides for more.

**6. Do you think a DCF would work well for an oil & gas company?**

If it's an **exploration & production (E&P)-focused company**, generally a DCF will not work well because:

- CapEx needs are **enormous** and will push FCF down to very low levels.
- Commodity prices are cyclical and both revenue and FCF are difficult to project.

For other types of energy companies – services-based companies or downstream companies that just refine and market oil and gas – a DCF might be more appropriate.

For more on this topic and the alternative to a DCF that you use for oil & gas companies (called a NAV, or Net Asset Value, analysis), see the industry-specific guides.

**7. How does a DCF change if you're valuing a company in an emerging market?**

The main difference is that you'll use a much higher Discount Rate, and you may not even necessarily link it to WACC or Cost of Equity… because there may not even be a good set of Public Comps in the country.

You might also add in a premium for political risk and uncertainty, and you might severely reduce management's growth or profit expectations, especially if they have a reputation for being overly optimistic.

## *Other Advanced DCF Additions*

**1. When you're calculating WACC, do you count Convertible Bonds as real Debt?**

Trick question. If the Convertible Bonds are **in-the-money** then you do not count them as Debt, but instead assume that they contribute to dilution, so the company's Equity Value is higher.

If they're **out-of-the-money** then you count them as Debt and use the interest rate on the Convertible Bonds for the Cost of Debt (and include them in Debt in the formula for Levered Beta).

**2. What about the treatment of other securities, like Mezzanine and other Debt variations?**

If interest is **tax-deductible**, you count them as **Debt** in the Levered Beta calculation; otherwise they count as Equity, just like Preferred Stock.

For WACC itself, you normally look at each type of Debt separately and assume that the "Cost" is the weighted average effective interest rate on that Debt.

**3. Should you ever factor in off-Balance Sheet Assets and Liabilities in a DCF?**

Potentially, yes, especially if they have a big impact on Enterprise Value and Equity Value (i.e. if they're something that the acquirer would have to repay).

But it's not terribly common to see them, partially because when off-Balance Sheet items *are* more important (for commercial banks with derivative books, for example), you don't even use a DCF.

**4. How do Pension Obligations and the Pension Expense factor into a DCF?**

If you're running an Unlevered DCF and you're counting *Unfunded* Pension Obligations as Debt, you should **exclude** pension-related expenses from *Unfunded* obligations on the Income Statement and Cash Flow Statement, for the same reason you exclude interest payments on Debt.

For a Levered FCF you would do the opposite and leave in these expenses because they're a form of "interest expense."

**5. Can you explain how to create a multi-stage DCF, and why it might be useful?**

You use a multi-stage DCF if the company grows at much different rates, has much different profit margins, or has a different capital structure in different periods.

For example, maybe the company grows revenue at 15% in the first two years, then 10% in years 2-4, and then 5% in year 5, with decreasing growth each year after that.

So you might separate that into 3 stages and then make different assumptions for Free Cash Flow and the Discount Rate in each one.

Note that a standard DCF, by itself, is actually a **two-stage DCF** because you divide it into the "near future" and "far future."

You can divide it into more periods if you want, and it would just be an extension of this concept.

**6. How does Net Income Attributable to Noncontrolling Interests factor into the Free Cash Flow calculation?**

It doesn't – or more specifically, it has no net impact because you subtract it at the bottom of the Income Statement but then add it back on the Cash Flow Statement.

Just be careful that you do **both** of those, or that you leave it out altogether – it would be **incorrect** to only subtract it or to only add it back, which might happen if you're not careful with the calculation.

**7. What about Net Income from Equity Interests?**

Again, this should have **no net impact** on Free Cash Flow because you add it at the bottom of the Income Statement and then subtract it out on the Cash Flow Statement.

**8. Which tax rate should you use when calculating Free Cash Flow – statutory or effective?**

Normally you use the **effective** tax rate because you want to capture what the company is *actually* paying out in taxes, not what it "should" be paying out according to standard federal and state rates.

Sometimes you may adjust the tax rate if it's an unusual situation (e.g. the company is a sole proprietorship LLC and therefore income is taxed at the owner's personal income tax rate, but a large corporation is considering acquiring the company).

**9. When calculating FCF, you always take into account taxes. But when you calculate Terminal Value, you don't do that – isn't this inconsistent? How should you treat it?**

Here's how to think about this one:

- First off, if you use the Gordon Growth method to calculate Terminal Value, you *are* taking into account taxes because you're valuing the company's Free Cash Flow into perpetuity.

- And if you're using the Terminal Multiple method, you're **implicitly taking into account taxes** because you're assuming that [Relevant Metric] * [Relevant Multiple] *is* the company's present value from that point onward, as of the final year. You're not assuming that the company **is** actually sold… just estimating what a buyer *might* pay for it, fully taking into account the value that the buyer would receive from its far-in-the-future, after-tax cash flows.

**10. We're creating a DCF for a company that is planning to buy a factory for $100 in Cash in Year 4. Currently the net present value of this company, according to the DCF, is $200. How would we change the DCF to account for the factory purchase, and what would the new Enterprise Value be?**

In this scenario, you would include additional CapEx spending of $100 in Year 4 of the DCF, which would reduce Free Cash Flow for that year by $100. The Enterprise Value, in turn, would decrease by the present value of $100 in Year 4.

The math gets messy, but you would calculate the difference by dividing $100 by ((1 + Discount Rate)^4). Then you would subtract this amount from the Enterprise Value.