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ANDREW LO: So what I want to do in this lecture is to provide a quick overview of the equity business, and then talk about a couple of simple but rather powerful models to price equities-- we're using the exact same tools that we've developed-- and then talk a bit about growth opportunities and growth stocks. OK, so industry overview. What is equity? As I said, it's an ownership in a corporation. And typically, when you own a piece of a corporation, you're owning that sequence of cash flows.

There are two components of possible cash flows for a piece of equity security. One is dividends. But, of course, we know that there are companies that don't pay dividends. Typically, companies that are early stage growth companies, they want to conserve their cash, because they've got lots and lots of investment ideas that they want to implement. And so any cash that's generated internally, they're going to be plowing back into current operations.

So growth companies typically don't pay dividends. But you still get value from the security, because as the firm grows, as the corporation becomes more valuable, that piece of paper that you hold becomes more valuable. So in other words, you get capital gains or price appreciation of that piece of paper. And if you want to get value out of that price appreciation, you could always sell it, right?

So those are the two ways of getting value. It's dividends-- and by the way, there are two different forms of dividends. Cash dividends or stock dividends, both of which provide additional value. But also the fact is that you could sell it, and so you can get money from capital gains.

Now there are a couple of key characteristics of common stock that are distinct from bonds. The cash flows we will be able to analyze using the same tools, but those tools will ultimately give us different answers, because the legal structure for equities is different than for bonds. And I have to say, that whoever invented equities-- this is many, many centuries ago-- really was a brilliant financial innovator, because equities have just an enormously powerful ability to provide proper motivation and incentives for innovation, all sorts of innovation. And let me explain what that means.

First of all, one aspect of equities that I think you all probably know is that they are the residual

claimant to a corporation's assets after the bondholders. In other words, bondholders have first dibs on the assets of the company, but their claim on those assets is only equal to the face value or promised payments of that debt, right? They don't have access to any more than what the face value of that bond is, as well as the coupons along the way.

And to say that equity holders are the residual claimant means that they get everything else. Now you might say, gee, that's not really all that interesting, because you're second in line. Well, it's very interesting if being second in line means that you get access to all of the upside of a company's growth and success.

I'm sure that you've all heard of stories of entrepreneurs that have made many hundreds of times what they put into a company, whereas the bondholders may have gotten a handsome return of 10, 15, 20%, but that's the upper bound as to what they can get. As a bondholder, your upside is capped, it's limited, OK? Whereas, as the residual claimant, as the equity holder, you have no limit on your upside, right? Because once the bondholders get paid, you get everything else.

Now the other aspect of equity that's really important is something called limited liability-- the fact that, as an equity holder, the most you can lose is everything. Now that might not seem like a good deal, but trust me, it's an amazing deal. By everything, we mean everything that you put in, so it's not literally everything.

For example, you don't lose your life. You don't lose your freedom. You don't lose your pinkie. You don't lose any other body parts, or loved ones. All you are at risk of losing is what you put in to the venture. So that's what limited liability means.

And the reason that it's an innovation is, prior to the modern-day corporation and limited liability, it used to be the case that entrepreneurs faced unlimited liability, or you could be put in prison if you were to default on your obligations. The fact that there is a downside limit to what you could possibly lose is a tremendous boon to innovation, because now it means that each and every one of you can go out and start your own company and risk whatever money you want to put into the company, but no more. And if it doesn't work out, well, you can walk away and do it again. And I suspect many of you know of so-called serial entrepreneurs that just go from one company to another to another.

Many years ago, when I was at the Wharton School, I heard a talk by the person who started up Domino's Pizza. I unfortunately don't remember his name, but he was giving a talk in one of

these CEO series and he's a billionaire, because of the incredible growth of Domino's Pizza in the country. And somebody asked this fellow, how did you know that having a national pizza chain was going to succeed as well as it did?

And he's very honest. He said, you know, I didn't know. You know, this was my ninth company. The first eight went bankrupt. And if this one had gone bankrupt, I probably would've started a tenth.

And I think that's just a wonderful expression of the power of modern capitalism and limited liability, because here's an individual that just really wanted to do something on his own and wanted to make a success of it, and was willing to work his heart out time after time after time until he hit upon something that was really valuable. And that's the power of limited liability.

Think what innovation would be if we decided that if your first company fails, from that point on, you would never be allowed to start a company ever again. Think how many people would take the risk or take the plunge to do something like starting up your own company. So the fact that we have a security that limits your downside, and that limits the downside of other investors that want to join you in your venture, really allows for capital formation to occur at a rate and at a scale that would be impossible without it.

Now there's also voting rights and the ability to access public markets. What that means is that you can actually get other people, large numbers of people, to co-invest with you. So that's particularly important when you're thinking about taking on very, very ambitious projects.

For example, if you want to start up a biotech company. Biotech companies require more than a few hundred thousand dollars to get started. I think a few hundred thousand dollars would maybe buy you a quarter of a centrifuge these days. Doesn't really help for starting up a biotech company.

And so if we didn't have the ability to access public markets, if we didn't have the ability to bring the power of the public to bear on a particular investment opportunity, it wouldn't get done. So that combination of limited liability and ability to access public markets, and then voting rights that give investors some say in how the company is run, is really the secret to unlocking the power of the masses for development of innovation and capital formation.

Now there's another point that I wanted to make here, which is short sales. I think that by now you should have an appreciation for the importance of short sales. Short sales allow

information to get into the market price that may not be positive news, but is nevertheless important for people to have. And so the ability to short sell a security is a method for allowing investors to get information into the market price as quickly and as easily as possible.

Those of you who participated in the trading game that we did a couple of weeks ago on that Friday-- you know, when we go over the results towards the end of this course, when we talk about efficient markets, I'm going to show you that the prices that occurred in that marketplace was not very efficient. Part of the reason that it wasn't very efficient is because we didn't allow you to short sell.

And so those of you who had the information that at one point the stock was worthless, the most you could have done was to divest yourself of shares that you already owned. But once you did that, that was the end, and you're out of the market. You couldn't do anything more. If, on the other hand, we allowed you to short sell, you would have driven that price down to 0, where it belonged at that point. And so the ability to short sell is a very, very important aspect of capital market efficiency and for making prices as informative as you can.

Now there are two markets for equities-- primary market and secondary market. Primary market means the market where securities are issued for the very first time. Primary, that's what primary means. Secondary you could think of as the market for used securities. We have a market for used cars. You have a market for used homes. And there's a market for used securities. I know you don't really think of the New York Stock Exchange as such, but, in fact, it is. It just turns out that used securities are just as good as new securities, and in many ways, better.

And so the steps for getting a primary security issued is very different than the steps for dealing with secondary markets. For the most part, what we're going to be talking about in this course is secondary market transactions and dynamics. However, there is obviously a lot more to be said about primary markets. I'm going to leave that to other courses in the Finance group, including M&A and capital budgeting and venture capital. Those are courses that deal with the dynamics of the primary market.

These are the markets that you would care about if you're doing an IPO, launching a new company, and issuing securities for the very first time. So I won't spend too much time on that. If you're interested, you're welcome to read the relevant chapters in the textbook. But what we're going to do is to focus on the behavior of secondary markets, in particular, in the price

formation mechanism for secondary market securities.

Here's a little bit of a summary about how these markets have developed. You can see that for primary markets, the IPO market goes through cycles. There are periods where the market's very, very active, and there are periods where the market is pretty quiet and not a lot is going on.

That has to do a lot with the business cycle and with the credit cycle-- how much money there is out there. And it's obviously very important for those of you who are thinking about doing startups, because when you do a startup and you get funding from a venture capitalist, the way the venture capitalist ultimately gets paid is not by the satisfaction of being part of your wonderful company, but rather by having your company go public and having securities be issued so that the venture capitalist can cash out at those public market prices. So the venture capital and technology industries are very much caught up in the business cycle and credit cycle as well, and so this gives you a little bit of a picture of how that's changed over time.

On the other hand, the secondary market has a somewhat different set of dynamics. It's related, but not nearly as highly correlated as you might expect. This is an example of the dynamics of public secondary markets, the NYSE and NASDAQ over the last few years. What this displays is the trading volume, both measured in terms of shares as well as in composite fraction on the NYSE volume.

And you can see that over time that the share volume, the amount of shares traded, has just gone up year on year, and this year will be no different. 2008 will be a tremendously significant year for the amount of shares traded on the exchange. Lots more participation in public markets, and the volume, while there may be little bits of a dip that are functions of business cycles, not nearly as sensitive as the primary market is. Yeah.

AUDIENCE: Is the internet also, you know, more volume?

ANDREW LO: Oh, absolutely. Well, there are a number of technological innovations that have made this market increase so quickly. So the internet is one. Now all of us can trade on the internet.

In fact, when I was teaching Finance back in, let's see, was it 2000 or 2001? I remember during the middle of the day one of the undergraduates in the class looked at some kind of cell phone device and then ran out. And he came back in shortly before the end of class, and at the end of class I asked him if everything was all right, because he seemed really distressed.

And then he said that he just had to respond to a margin call on his equity position that he'd put on the day before.

This is an undergraduate. He's trading on his little cell phone. That's a technological innovation that has actually increased the volume in these exchanges. But there are other technological innovations as well. For example, something called ECNs, electronic communications networks. These are-- essentially, they started out as bulletin boards, where large buyers and sellers of equities could come together anonymously and transact with each other at relatively inexpensive prices.

They can cut out the middleman and reduce the bid offer spread by hitting a transaction price that was right in the middle. ECNs have grown tremendously since the early, the mid 90s, when they started, and now account for a pretty significant fraction of the volume. Electronic order routing, electronic trading, all of these technologies have caused this kind of increase in the equity market trading over the last several years.

So today, as an individual investor, you can trade much more quickly. You can trade much more cheaply. And you can trade much more easily than ever before. So consumers have benefited a great deal. Along the way, a number of hedge funds and other investors have ended up going out of business because they have not been able to compete effectively with these kind of technological innovations.

And this is what I mentioned last time, that technology plays a very important role in financial markets now, much more so than ever before. It used to be that it mattered who you knew, rather than what you knew. That it was the old boys network that mattered, instead of the computer network. And that the graduates of Harvard and Yale had an advantage over the graduates of MIT and Caltech. That's been flipped on its head now over the last several years. It's what I call the revenge of the nerds, which bodes well for all of you.

[LAUGHTER]

OK, so let me now turn to the very first valuation model that was ever developed for equities. It couldn't be simpler. It's a model that I think all of you are going to immediately understand, and yet the implications are going to be really far-reaching and profound.

This is called the Dividend Discount Model, and it starts with the recognition that, when you invest in a company, what you're getting for that piece of paper, this common equity, you're

getting the rights to the flow of cash forever. And what kind of cash are we talking about? Well, we're talking about dividends. So it's true that not all stocks pay dividends, but eventually you would figure the stock will pay dividend at some point, right?

For years, Microsoft never paid a dividend. But about, was it five years ago or six years ago? They announced that they're starting to pay dividends. Why? Because they had accumulated so much cash that they didn't have enough things to invest that cash in, so they figured, let's give some of it back to the investors.

In their early days, they kept every penny of their earnings to reinvest, because they had so many different opportunities to take advantage of. But because they became so mature and they had already a number of investment projects that were quite valuable, and yet were still generating so much cash, they decided to return some of it to investors. So at some point, you're going to get dividends. And if a company never, ever pays dividends, well, then, it should be worth 0, right? If it pays you no cash forever, then that seems like a very bad asset. Yeah.

AUDIENCE: What stops the board of directors [INAUDIBLE] really depends on [INAUDIBLE] issuing dividends [INAUDIBLE].

ANDREW LO: Well, first of all, if they issued dividends to pay themselves, that's fine, as long as they pay all the other shareholders at the same time. So the answer is, in principle, nothing stops them, but what makes them decide against that is if they have uses for the cash other than paying themselves. If, as a company, you have no idea what to do with the money you are generating, well, first of all, that suggests that maybe you're not doing your job, because as a company, you're supposed to be coming up with valuable ways of earning money for your investors.

However, it may be that your company is very mature, stable, there's no growth, there's nothing going on, and all the cash that you're generating you don't know what to do with. In that case, you may very well return all of that money to investors. That's nothing wrong with that.

The idea behind having a vote though, is that you want to make sure that the board of directors, who typically do own or are responsible to shareholders that own large blocks of shares, will be deciding in the best interests of the shareholders. And it could be that the best interest of the shareholders is to give them back their money, because we, the mature

company that we are, don't have any other uses for the money. Yeah.

AUDIENCE: [INAUDIBLE] that, if the company never pays dividends, [INAUDIBLE]. What about the [INAUDIBLE]? Is there no value [INAUDIBLE]?

ANDREW LO: Well, but think about it. If a company keeps on appreciating in value, but never pays out a dividend, what's happening to the cash? You know, when I say never, I mean never. So I don't just mean like in 10 years or in 20 years. I mean never. So can you think of a company that appreciates in value all the time, but never, ever, ever pays a dividend? There's no cash, so you'll never get any cash. That's--

AUDIENCE: Well, then, wouldn't you make a profit by selling [INAUDIBLE]?

ANDREW LO: Oh, yes, you could make a profit by selling, but if you sell a security to somebody else and they know for a fact that it never, ever, ever, ever pays any money, well, then, that's called a Ponzi scheme, right? In other words, you're selling a piece of paper that's worthless to somebody and hoping that they are a bigger fool than you are for having bought it.

So when I say it never pays any cash, I really mean it. If it never-- if you know for sure that it never, ever pays any cash, then it can't be worth anything, right? If you don't believe that, then I have a piece of paper that I would like you to take a look at, and I would like to sell you, OK? Yeah.

AUDIENCE: Could it be like coupons and, like, the company dissolves?

ANDREW LO: What's that?

AUDIENCE: Even if it never pays dividends, you could still get something back if the company dissolves [INAUDIBLE].

ANDREW LO: Well, then it does pay something. That's a liquidating dividend. Then that violates my condition that it never, ever, ever pays anything, right? And that's the point. If the company is growing and it has value, then you know for a fact that either A, it will pay you a dividend at some point, or B, if it doesn't and it gets liquidated, then when it gets liquidated, you'll get a pro rata share of whatever's in the company, in which case, that's a payment.

So to say that a company never, ever pays a dividend, I literally mean it will never, ever pay anything, OK? And in that case, it can't be worth anything if you know that. But if you can find

somebody who will buy it anyway, then that's an example of an arbitrage. That's a free lunch. And so you can do that a lot if you can find people like that.

OK, so we're going to apply the very basic principles of present value analysis to a security that pays dividends. So let's let the price of a stock, P_t , today, be given by that. Let D_t be the cash dividend that gets paid at time t .

And by the way, D_t could be 0 for many, many years and at some point become positive, all right? D_t can never be negative, right? We're not talking about taking money from investors. It pays either a positive amount or 0.

And I'm going to let E_t be the expectation operator at time t . So now I'm going to explicitly recognize that these dividends are not known in advance. Unlike bonds, where you know the coupons in advance, I don't know the dividends in advance. So I'm going to have to guess. I'm going to have to make a forecast as to what they are.

And let me let r_t be the so-called risk-adjusted return that is commensurate with the risks of the dividends that are there. I'm going to wave my hands at this point as to how we get the dividend discount return, the appropriate risk-adjusted return, but I'll come back to that in a few lectures, when we go over methods for determining the appropriate risk adjustment, OK? But for now, let's assume that we have it, and we get it from the marketplace, right? Just like we got the yield from the marketplace, it's a sum total of everybody's fears, expectations, hopes, and so on.

So with these components defined, I'm now going to simply write the price of my instrument as this value function of the future cash flows, right? That's the most general expression we started with on day one. And given what we now know about present value and valuing cash flows that come in the future, it's not a big leap of faith to put some structure on this valuation operator, OK? The value of this sequence of future cash flows is simply equal to the expectation today, time t , of future dividends out into the infinite future, discounted back by the appropriate risk-adjusted rate of return.

Now you'll notice that the rate of return, this r , I put a subscript, t , plus 1, and t plus 2, and so on. I'm explicitly recognizing the fact that the appropriate risk-adjustment changes over time as market conditions change and as the business changes, OK? So it could be that the risk-adjusted return for a one-year cash flow is this, but the risk-adjusted return for a two-year cash flow is different.

Just like we have a yield curve for riskless bonds, we may have a yield curve for risky cash flows, OK? And if I really wanted to be a masochist when it comes to notation, what I could do is to have a double subscript that says that this is the appropriate risk-adjusted return between years t and $t + 1$, and then this is between years t and $t + 2$, and so on, because these discount rates may be completely different tomorrow.

In other words, tomorrow's discount rate for a one-year cash flow may be different than today's discount rate for a one-year cash flow, right? So I can have a whole string of discount rates for today, and a completely different string of discount rates for tomorrow and for every day in the future. These things change all the time.

I think you'll see now why I told you earlier equities is a lot more complicated than fixed income instruments. It's because there are two sources of uncertainty. One is the discount rate, and the other is the cash flows.

And moreover, the discount rate that we're talking about, it's not the risk-free discount rate, but it's the risk-adjusted discount rate. And if risks change over time, as certainly they have over the past even few days, then the discount rate should change. So in addition to the term structure effect of different yields, we also have the risk effect of looking out into the future, given current market conditions.

So while this expression is tidy, and it looks nice and clean, in order to turn this into an actual number that you can look at and decide, gee, do I want to invest in this stock? Is it undervalued or overvalued? It's going to take a lot of work. So before we get to that work, I want to spend some time thinking about simpler things, and try to come up with relatively simple implications of this relatively robust model. Question?

AUDIENCE: Yes, sir. Does it take into account the riskiness of the company itself, or is it of the marketplace?

ANDREW LO: The answer is yes. It's both. It's the riskiness of the company, as well as the riskiness of the aggregate set of market conditions. It's both. And so we have to figure out how that factors into this equation. That's going to take us a few lectures to get there. But the answer is both. Yeah.

AUDIENCE: Would you say it's related to the riskiness of the expectation of the dividend being whatever it

is at time t ?

ANDREW LO: Well--

AUDIENCE: If I were to know that the first dividend is absolute certain, but after that, not so much, then could I replace r_t with a risk-free rate, but r_t plus 2 with something else, and so forth?

ANDREW LO: Yes, assuming that that dividend really was risk-free. Yes, that's right. So the idea behind the discount rate-- and, by the way, I'm going to ask you to explain this to me. So I'm going to make a statement, and then I'm going to ask you to justify it, OK? The statement is this-- the discount rate that's used in the denominator of each of these fractions, that discount rate has to be risk-adjusted in a way to reflect the risks of the numerator, as well as general market conditions. It has to be commensurate with the risks of that particular numerator.

So if this numerator is much less risky than this numerator, I would argue that you would have to use a different discount rate, one that's higher for the more risky numerator than for the less risky. Now justify that for me. Why is that a reasonable thing to want to do? Yeah.

AUDIENCE: Because you're getting more return on [INAUDIBLE].

ANDREW LO: That's right.

AUDIENCE: Your discount rate would be [INAUDIBLE].

ANDREW LO: That's right. You get more return on your capital for something of greater risk on average, because you've got to be rewarded for bearing that risk. And if you're not rewarded, you're not going to take on that risk. How do you know that? How do you know that you're going to get rewarded for taking on that risk? Where did you get that from, besides me?

AUDIENCE: That's just the law of the jungle, I don't know.

[LAUGHTER]

ANDREW LO: You're right. It's a law of the jungle. But in this case, what is the jungle?

AUDIENCE: [INAUDIBLE]

ANDREW LO: Exactly, thank you. The market. Excellent. The market. The market is the jungle from which you compete for scarce resources. And in order to get your pet project funded, you've got to provide the right incentives for people to buy into your project. So that's the logic of the

justification.

Now let me go one step farther and say, suppose that you want to replicate these cash flows. Suppose that you want to create a portfolio that gives you these kind of cash flows. Well, then, you've got to go to the marketplace and figure out what the appropriate opportunity cost is for each of those cash flows and then discount them, because that's what the market is charging for those cash flows.

So that's why you have to get the appropriate discount rate matched to the appropriate cash flow, all right? It comes straight out of what we learned about bond pricing, but now we're adding an extra dimension-- risk. And I'm not going to be able to talk about it in any more detail than this until we put more quantitative structure on what we even mean by risk.

I mean, you all take for granted, when I say risk, you say, yes, you understand what risk is. But in order for us to justify a particular expression for how to make that kind of adjustment, we have to be very specific about how to measure risk. So in about three or four lectures, I'm going to actually propose a method for measuring risk.

And once we have that method in hand, we can then make that risk adjustment extremely explicitly. I'm going to give you a formula that you can actually compute in an Excel spreadsheet that will tell you exactly whether the number should be 6.5% or 7.3% or 8.9%. You're going to actually see how to do that yourself. Yeah.

AUDIENCE: The score wasn't implying that those time structured to when dividends paid out. Like, the time between $t + 1$ and $t + 2$ doesn't have to be the same as $t + 2$ and $t + 3$.

ANDREW LO: Correct, correct. It doesn't have to be the same. And if it's not the same, then the difference in horizon should be reflected by the implicit size of that discount rate. Yeah.

AUDIENCE: [INAUDIBLE] the company's bond yield [INAUDIBLE]?

ANDREW LO: Well, you tell me. Can we use the company's bond yield to use as a discount rate for the equity? Well, that depends. It depends on whether or not the equity and the bond are of comparable risk, right?

Remember, it's not the company that determines the discount rate. It's not the company-- or rather, it's not determined by fiat, or by announcement of a company's particular policies. What determines the yield is the riskiness of that yield and the marketplace. The market

determines that particular price, not the individual, or not the sources of those funds.

AUDIENCE: Whenever [INAUDIBLE] of the company's bonds do not reflect on the company's equity?

ANDREW LO: Oh, of course, they do, but they reflect in a very specific way, and we're going to talk about that when we get into capital structure. Companies that have very high leverage are going to have more risky equity than companies with very low leverage. So the leverage does have an impact on the equity. We're going to come to that in a little while. There is a relationship, all right?

But for now, let's look at these securities in isolation and not worry about it. And I'm going to keep coming back to the idea that it's not the company that gets to determine the discount rate, but rather it's the company's riskiness-- or rather the riskiness of the cash flows and the market's assessment of the cost of that riskiness-- that determines the interest rate.

A few years ago, there was a faculty member at Carnegie Mellon who won a Nobel Prize, and it ended up that he was one of the highest paid professors at the time. And so he was being interviewed by the school newspaper, and they said, Professor So and So, do you think it's appropriate that even though you won a Nobel Prize, that you should get paid twice as much as some of the other faculty who are Nobel Prize-winning physicists and fields medalists in the Mathematics department, and so on? I mean, do you think it's fair that your salary is twice as high as other people in the school?

And the faculty member, who is an economist, said, listen son. The university does not determine my equilibrium salary. They only determine what city I work in. In other words, the salary of an individual is not determined by that particular institution. It's determined by the marketplace. The marketplace bids on that faculty member, and the highest bidder, presumably, will be able to get that faculty member.

The same thing with these cash flows. It's not the company's debt, or the company's weighted average cost of capital, which we don't know what it is yet, but I'll define a little later on. It's not the company that gets to choose what the discount rate is. The question is, given the riskiness of that cash flow, what does the market tell me is the fair rate of return for that cash flow? That's the number I want to plug into that denominator. Yeah, question.

AUDIENCE: The market may determine the discount rate, but the company determines the growth rate on the dividend, right? They get to decide what the dividend is.

ANDREW LO: Well, they get to decide what the dividend is subject to their ability to pay that dividend. But if it turns out that they make a bad decision, and they pay out all the dividends, and they have no more money, and they can't grow the company anymore, then who determines what's worth what? Ultimately, the market.

The market is the final arbiter in all of these calculations. At least that's the theory of finance. That's the basic, plain vanilla, frictionless model, OK? It's the market that determines these interest rates.

Later on, after we go through the basics and you understand the frictionless model, I'm going to introduce frictions, and then you'll see what impact corporate policies have on these implications. In some cases, corporate directors can actually do a lot of harm by making suboptimal decisions that go against the market. In other cases, you could argue that corporate decision-makers know more than the market and are able to make bets that the market is not capable of doing. That's certainly possible, because who knows the company better than you do?

Although a market expert would say it's not knowing the company that will determine the value of the company. It's knowing how that company compares to all the other companies that are out there that determines the value of the company. And you, as the corporate insider, may know your business very well, but you don't know how you stack up against the 25 other businesses in your industry, and we, the market, know better than you, the individual. That's the argument that would be made against that.

AUDIENCE: In the case of refinanced stocks, can I use the same formula?

ANDREW LO: We're going to get to that. We're going to talk about preferred stocks. That's a separate issue. Preferred stocks have a different priority of claim, and that's going to require some slightly different modifications to this formula. Yeah.

AUDIENCE: So I had a question about the expected value. So yesterday in the example, you discounted the 1,000 to 900 [INAUDIBLE] Et. So what else do you need to discount in the r to account for the risk?

ANDREW LO: Well, I mean, you have to take into account the fact that there are other competing opportunities for this particular project in the marketplace. And so it's not just the risk of this project, but rather how the risk of this project stacks up against the risks of all other possible

projects that you would be competing for in the open market.

Let me put it to you this way. Let's do a simple thought experiment. Suppose that instead of these as being dividend streams for a given company, let's do the following thought experiment. Let's imagine doing a strip, OK? You all know what strips are now, right? So let's think about stripping out dividends, OK? It's a very weird thought experiment, granted, but just bear with me.

Let's suppose that instead of one company, I generate an infinity of companies. Each company lives only for one dividend payment, after which it gets liquidated. So each of these cash flows, D_t plus 1, D_t plus 2, each one of these things is a separate and independent company that gets liquidated right after it pays the dividend, OK? Now how would you value a portfolio of all of these companies?

Well, you would do this, right? For each company, you would figure out what the appropriate discount rate is, and the appropriate discount rate reflects not just the time value of money, but the appropriate riskiness of that cash flow. For example, if I took that company-- let's actually do a thought experiment of how we do that. Let's go through the motions, OK.

I've got a piece of paper that is something that funds nanotechnology in a very specific application. And this company is going to require a certain amount of investment, and then it'll pay off all of its earnings in 2013, December, and then it'll liquidate and be done with, OK? That's the company. How do I figure out the price of the company today? Anybody? How do I figure out the price?

I have this piece of paper that says in 2013, the company will liquidate, and I want to know what the price is. What's the first thing you would do with that proposal if you got it in the mail? What would you want to know? Yeah.

AUDIENCE: I would want to know, like, if there's a security I can buy in the market, is the company going to pay for it? Because it's the same risk return profile. And I look at the marketplace for that.

ANDREW LO: Why would you do that?

AUDIENCE: Because there's no reason I would go through the hassle, or friction, as you call it, of pricing a new company if I could just go online and buy it.

ANDREW LO: Right, that's one logic, but another logic is that you have money looking for a home. You can

put it in this new venture, or you can put it in this existing company. And if they're comparable, then at least you have some sense of what it's worth. Exactly.

In order to figure out whether or not you can get a comparable security, you need to know what the cash flow is for that nanotechnology startup, right? So you might think first about estimating the expected cash flow in the liquidating dividend in 2013. OK, so you calculate the numerator, all right? And you find a company out there that has that same kind of cash flow. You have to find one that has the same profile, so it does it in 2013, at which point it gets liquidated.

But let's even forget about-- suppose we didn't have such a company. Suppose we didn't have an existing security. So this is literally a fresh start. You've got a piece of paper that gives you the claim to a company that liquidates in 2013 with one cash flow only. And now you've estimated that cash flow to be approximately \$27 million, OK?

So now you've got the numerator. A piece of paper that pays \$27 million. How do you figure out its price? What would you do? Yeah.

AUDIENCE: Calculate the risk that it's going to [INAUDIBLE], also you have the time [INAUDIBLE].

ANDREW LO: OK, and you've done that, and that's the \$27 million.

AUDIENCE: That's included in the valuation.

ANDREW LO: Right, the \$27 million includes the probability that it actually is 0, so the expected value is 27 million. How would you go about-- yeah.

AUDIENCE: Wouldn't it actually be two [INAUDIBLE], so when the 27 million liquidates, you get the value of the assets?

ANDREW LO: The liquidation value is the 27 million on average.

AUDIENCE: [INAUDIBLE] two payments for that.

ANDREW LO: No, no, no, it's just one payment-- 27 million on expectation. Oh, it may be two possibilities. Maybe you either get 54 million with 50% probability, or nothing with 50% probability, so the expectation is 27 million. What would you do? Yeah.

AUDIENCE: I think if you're already weighted in the probability [INAUDIBLE] 0 [INAUDIBLE]

ANDREW LO: Suppose you don't know what to use. Suppose you want to figure out what the price is.

AUDIENCE: [INAUDIBLE] discount.

ANDREW LO: Yeah, I know what you mean. But suppose that you didn't have that. What would you do?

AUDIENCE: [INAUDIBLE] at the yield curve just to get an idea of what in 2010, at least either a risk-free security or a security with that same credit risk. You know, what discount rate that would go in there, discounting by that [INAUDIBLE].

ANDREW LO: You could do that, but now we're getting more and more complicated. Isn't there an easier way to figure out what the price is? Exactly. You know, let's let the market decide. Auction it off. Now when you auction it off, you take the highest bidder, right? And you get a number. I don't know what that number is, but let's just say the number is, I don't know, 15 million.

You've got somebody who's willing to pay 15 million today for a cash flow that gives them expected 27 million in 2013. With those two numbers, that gives you r , doesn't it? That's how r is established. It's established the exact same way that we establish r for riskless bonds.

The way that US treasuries ended up being three basis points on September 18th was, basically, tons of people wanted to buy these securities, bidding down the yield and bidding up the price. So if we had this piece of paper that paid only one dividend in 2013 and we auctioned it off, we would get a yield. The yield would be a risk-adjusted yield.

I don't know how the risk adjustment got made. So you could be quite right that you take the risk-free yield, and you add on top of that a credit spread and who knows what. The point is, the market did it for us, OK? So what I'm getting after with this formula is I want to use those discount rates that are determined by the marketplace.

Because if ever I have to sell my company, if ever I have to take this company and break it apart and get rid of it, and the market is going to pay me for it, the way that the market is going to evaluate the different pieces is just the way that I described. It'll look at each cash flow, look at how risky it is, look at the opportunity cost of other investments that they can get the same risk return profile for, and they'll pay that amount, which will implicitly give me the appropriate yield. Yeah.

AUDIENCE: So let's say that me purchasing a stock with this calculation, do I have to assume that this calculation is wrong? Because why would I pay out money for something that's going to be

exactly the same, kind of discounted, cash flow back to right now?

ANDREW LO:

So that's a good point. Let me repeat the question. The question's why-- in order for you to buy the stock, would you have to assume that this is wrong, or rather, that the market price is not equal to this? Well, the answer is no, you don't have to. Although if you did, that would provide a motivation for you to want to do that. But it could be that you simply want the risk and reward of this particular cash flow. What's wrong with that?

Suppose that the security is fairly priced. So this equation at the very bottom says that the price of the security is equal to the present value of all the future expected cash flows discounted at the fair rate of return. That's a perfectly reasonable thing for somebody to want to invest in, if they like that kind of risk/reward combination.

So some people want to put their money in Google, and some people want to put their money in IBM, and some people want to put their money in US Steel. Those are different companies that have different rates of return based upon their different risks and cash flows, and even if those things are fairly priced, it's not like you're going to make no money. You're going to make money based upon the fair market rate of return for that security.

Now if you think you've got a better mousetrap, and you can identify mispriced securities, that gives you a whole another reason for investing. But even without any mistakes being made, even with if market prices are perfectly fair, people want to invest, because they want the return that those kind of investments give them, right?

OK, so let's consider some simple cases. In order for us to really make use of this formula, which at this level of generality really is useless, let's try to simplify and see what we get. And we're going to simplify in the ways that we've done before. Let's assume that dividends are fixed throughout time, and given by a number D , OK? And let's assume that the risks don't change over time and are given by a discount rate r .

Well, if you fix D and you fix r , magically, what you get is that the price of the security is equal to our old friend, the perpetuity formula, D over r , OK? Not that surprising. If you have a constant stream of dividends, with a constant discount rate, then the price is equal to D over r .

Now, again, this may seem totally trivial to you, but it does provide a very interesting observation. Number one, the price of common stock is an increasing function of the expected cash flows in the form of future dividends. So if you expect there to be higher dividends going

forward, the price should go up, and if you expect lower dividends going forward, the price should go down. So that's a nice insight.

Another insight, though, is that the price of a stock is inversely proportional to its discount rate. If interest rates go up in general, if interest rates go up, what should happen to the stock price?

AUDIENCE: [INAUDIBLE]

ANDREW LO: Exactly, it should go down. There are two ways of thinking about it. One is that future cash flows are going to have to be discounted at a higher price. Or two, the demand for stocks will not be as great, because now the opportunity for earning higher return exists in other securities like bonds, and so that will reduce the demand for stocks and the price will come down, right?

So that's a very nice model, but we can make it a little bit nicer by allowing the dividends to grow. So now suppose you have a growth company, a company where the dividends are expected to grow at a rate of g every period. Well, then, once again, we have our old friend, the perpetuity, with growing coupons, right? D over r minus g .

And now, as I think I alluded to early on when we went through this formula, we have in this very, very simple expression one explanation for the technology bubble, both how it got so big, and secondly, how it burst. If r is close to g , if the growth rate is very large, you're going to get a very big price. And if there are rapid changes in what people expect g to be, or what people estimate g to be, you can get very rapid shocks in the level of prices, including price one-ups and then crashes, right? Yeah.

AUDIENCE: What kind of confuses me is that, I mean, yeah, so is r greater than g ? And r greater than g is necessary in order to get that [INAUDIBLE] efficient. But is there any more meaning to that, or is this just a mathematical thing?

ANDREW LO: There is meaning to that. The meaning is actually quite simple, and we alluded to it when we first went through this formula. Suppose that r were not greater than g . Suppose r were less than g . What that's telling you is that the rate of growth of this security, or this cash flow, or this dividend, the rate of growth is much faster than the interest rate, all right?

So you've got wealth that's growing over time faster than the interest rate, which means that if

it really is true that it'll last out into perpetuity, then in very short order you should become bigger than the entire planet's GDP, right? Because you're going to be bigger than the interest rate. So the rate at which assets in the future are being deflated to the present is actually less than the rate of what you're growing your wealth. Pretty soon, you're going to become richer than God himself, and we know that that can't happen.

AUDIENCE: But isn't it that-- I mean, so right now, the inflation rate is greater than the interest rate, for example, right?

ANDREW LO: That's right now. That's right now, but this is out of the perpetuity. Do you believe that that's sustainable out of the perpetuity?

AUDIENCE: No.

ANDREW LO: Well, then, this formula doesn't work. This formula is a formula that's predicated on infinity, not 10 years, not 20 years. As we mentioned, when we went over the formula, China has been growing at a rate of 10% for the last 15 years. Do you think 10% growth rate is sustainable?

If China continues to grow at 10%, pretty soon we're all going to be speaking Mandarin. I mean, it's just not possible for a country to both be reasonably-sized and not totally dominant, and to have a rate of growth so much larger than what can be sustained over a long period of time. And so that's the key. This is a formula that's about infinity. It's not about five years or 10 years.

OK, another question. No. OK, so in this case, the Gordon growth model allows us to get an expression that tells us if there are very, very significant growth opportunities that can actually push up the price of a stock dramatically. If somehow all of us decide that those growth opportunities no longer exist because we have new information, then boom, it disappears, OK?

A good example of this is cold fusion. I don't know how many of you remember, 15 or 20 years ago, there was a big controversy about the Pons and Fleischmann experiment, where they did an experiment where it seemed like they generated heat, but heat not from a chemical reaction, but from a nuclear reaction in a standard laboratory setting. And typically, you need very, very unusual conditions to generate thermonuclear reactions that can create that kind of heat.

Now in the end, they were discredited and, apparently, although there's still controversy out

there, it doesn't seem like it was a nuclear reaction. But if it were, if it was possible to generate a nuclear reaction at room temperature, what that could have meant is that it would eliminate all of the energy problems of the world, because you'd be able to run your car on tap water. And the amount of energy in an ounce of tap water is enough to fuel your car for about a year.

So think about it. If that technology really worked to have worked out, what do you think the value of that would be? What's the g in that case? And you can understand why people would have invested hundreds of billions of dollars into that kind of an opportunity, if it were, in fact, a real opportunity.

There was a short time where we didn't know, and during that time, r minus g looked pretty small. g looked big relative to r , all right. And so that created very, very large swings in prices of both traditional energy companies like oil companies. You can imagine what oil companies would be worth if we figured out how to run cars on water, right?

That would maybe be justifiable in light of how much they've made over the years. But the point is that it creates enormous opportunity and potential dislocation so that the expectations of the market matter a great deal, and this is why. This is how it actually gets incorporated.

Now I'm going to take that equation and turn it around, turn it on its head, and it'll give us another insight into how to think about the discount rate and the value of corporations. If the price of a stock today is given by D over r minus g , then I can flip things around and say that r minus g is equal to D over P , right? The dividend price ratio is equal to r minus g , or r -- the discount rate that I'm using for the cash flows-- is given by the dividend yield plus the rate of growth implicit in that company's investment opportunity set.

Now why is this interesting? Well, in order for you to understand the importance of this expression, you have to realize that, for many years, stock analysts would look at a company's discount rate or cost of capital by simply using the dividend yield. So in the exact same way that if you have a bond, and you see what the coupons are, and you take the coupon and divide it by the price, that gives you a sense of what your rate of return is over a given period.

When you look at a stock, and you want to ask the question, how much am I earning on that stock? What is the rate of return on that stock for me, the investor? You take the dividends that you get paid every quarter, and you take that dividend and you divide it by the stock price, and that gives you a sort of rate of return, right? Because if you think about buying the stock

for a price, P , and then getting cash flows of D every quarter, or every period, then your yield, your rate of return, is D over P . That's called the dividend price ratio, or dividend yield.

What this expression says is something that every MIT graduate knows in his or her heart, which is that technology adds value above and beyond what you observe in current cash flows. It's not just the dividend that gives a company value, it's the ability for companies to grow over time. It's not just the company's current plant and equipment and operations that give it value, it is all of the interesting, wonderful, innovative, creative ideas that are locked up in that company that may one day be implemented and allow it to grow far beyond the founders' wildest dreams. That also has to be factored into the rate of return of the company.

And this simple little dividend yield model tells us this. It says that the required rate of return, the risk-adjusted discount rate, the cost of capital, the user cost, whatever you want to call it, this r , has two pieces to it. One is the cash that you get on a regular basis, the dividends that the current operations generate, plus the growth opportunities of those dividends out into the infinite future, OK?

Now remember, the way that we structured this dividend payment, the way that we had our formula set up, the dividends are the dividends that get paid next period, right? If you go back and look at the formula, this is the price today, and it's given by the dividends paid at time t plus 1. So this price that I'm using in my notation is the current ex-dividend price, meaning this period's dividend has been paid already, and now the value to this piece of paper is the future dividend, starting next period, t plus 1.

So when I say D is fixed, it's fixed, but it's getting paid next period, OK? So in this expression, this D is actually next period's dividend. But remember that when I'm trying to value the company today, I don't observe next period's dividend, which is random, but I know how much was just paid in the most recent period.

So if I want to use D , and there's growth, I actually have to take the most recent dividend, the one that just got paid, and multiply that by $1 + g$ to get the value of next period's dividend. So that's why this expression I've corrected-- not corrected, it's not that it's wrong-- it's just I've changed the expression so that it is D_{t-1} , which is the most recent dividend that was just paid multiplied by $1 + g$ divided by P .

So I just do that-- if you want to use this formula, and by the way, you can actually go out and use this now. I would actually encourage you to use it. Go out and take a look at your favorite

stock, and take a look at its dividend yield. You can find it on yahoofinance.com as well as other web sites. And then you make a guess as to what the appropriate growth rate is, and try to figure out whether it fits this equation, OK?

You can observe dividends. You can observe today's price. And you have to make an assumption about what you think the growth rate is. And when you plug that in, that will give you an estimate of what the cost of capital is for that particular company. Yeah.

AUDIENCE: So like this exercise without the [INAUDIBLE], with just the perpetuity formula, D over r , incurs-- I mean, every stock that I look at seems to be more than the dividends divided by--

ANDREW LO: That's right. Exactly. That's because why? Why is it, if you just use D over P , every single stock looks like it's overvalued. What are you missing?

AUDIENCE: g .

ANDREW LO: Yeah, exactly. Right, you're missing g .

AUDIENCE: But then g turns out to be higher than r , right?

ANDREW LO: Well, no, no, no, no. How did you get r ?

AUDIENCE: OK, OK. We don't know r

ANDREW LO: We don't know r . That's what we're trying to figure out, right? So you just said you're looking at D over P , and you're trying to figure out implicitly what that implies for the growth rate of stocks. Take a look at this expression in light of future growth opportunities and you'll see that dividend yield is not the only story. You've got to use other expressions. Yeah.

AUDIENCE: So looking at that [INAUDIBLE] about it on an annualized basis or between dividend payment?

ANDREW LO: Well it should be on an annualized-- well, it should be on whatever cycle the dividends get paid. So if dividends get paid quarterly, then it's a quarterly growth rate. If it's an annual payment, then it's an annual growth rate. So the benefit of this expression is that there is no timing that's been assumed. It's just whatever the periods are. So if it's quarterly dividends, use quarterly growth rate. Yeah, question.

AUDIENCE: We can't just go out and use this model on just about any company, right? Doesn't the company have to, I guess, pay dividends and use dividends as, perhaps, a way to represent

the [INAUDIBLE] of the company?

ANDREW LO: Well, yes. So if it doesn't have dividends, then this formula is not going to be all that interesting, right? D's going to be 0. But remember, this is not the current D. This is the steady state D. And if companies are in the early part of their growth phase, it's going to be hard to estimate what that steady state D is.

So there'll be other expressions that we're going to derive in a few minutes, where we use accounting identities to relate dividends to earnings or to cash flows. It used to be the case that instead of using dividends, you would use earnings, because even though companies that don't pay out dividends, they still have earnings. Well, that is until the internet came about, right? Then you had companies that actually had no earnings.

So how do you value a company that has no dividends and has no earnings, and has negative cash flows? In fact, if you use those models, the more negative the cash flow, the higher the value. So something weird is going on. It has to do with the fact that these are meant to be steady state formulas, and not formulas for individual time periods.

If there are individual time periods where you have zero cash flows or negative cash flows because of growth, you'll have to make adjustments in the formulas, and I'll show you how to do that in a few minutes. Yeah.

AUDIENCE: Do you have to change the formula if, let's say, the board decides to change dividend [INAUDIBLE]?

ANDREW LO: Well, again, this formula is really meant to be steady state dividends, right. So if they change the dividends, what you should not use is this. What you should go back and use, which is going to be a bit more complicated, is this, the bottom equation, right? So this equation is always correct, because this is completely general.

Dividends at time t plus k out into the future. And so if you know the future path of dividends, or if you have an expectation of what that future path is, you can use this formula. But look how difficult this is.

I mean, think about how an equity analyst has to make his living. They've got to figure out, not only what the appropriate discount rate is, which is hard enough, but they've going to figure out what the appropriate path of dividends are, not just what the dividends will be in steady state, because they may not be able to do that. They may want to figure out what the

dividends are going to be next year, the year after, the year after that.

So there's a lot of work to be done. It's hard. It's hard work. But more importantly, it's not just hard work, it's actually very inaccurate work. In other words, it's really hard to estimate this thing with any degree of accuracy, so what do you know? You know you're going to be wrong most of the time.

Imagine a job where you go into the job knowing that if you do really well, you're a genius. You're at the top of your class. You're the best that's ever done this thing. And in that case, you're going to be right 52% of the time. 52% of the time. That means you're wrong 48% of the time. That's pretty discouraging.

But that's really the nature of this task. It's really hard. You know, it's like trying to do weather forecasting, but weather forecasting over the next 30 years, and then taking the sum total of all of those decisions, putting it into a portfolio, and then investing your life savings in that. That's kind of tough, right? But it's also exciting. Yeah, question? OK, oh yes.

AUDIENCE: [INAUDIBLE] If dividend is going to change in the future, wouldn't this formula be likened to the annuity equation? So that point in time when it changes, for which--

[INTERPOSING VOICES]

ANDREW LO: You would use the annuity discount formula in pieces. So for example, if the cash flows for the first 10 years look like one thing, and then the next 20 years look like another thing, and then the next 30 years look like something else, what you could do is apply the annuity discount formula to the first 10 years, and then apply the annuity discount formula with a different discount rate and a different cash flow to the next 20, and then discount that back and then discount that back 10 more years, and then do that to the next 30, and then discount it back to the very beginning. So exactly. That's the way to do it, which is effectively doing it like this, but it's hard.

I mean, it's hard enough to estimate cash flows next year. And I can tell you there are a lot of firms that have forecasted this year's cash flows last year are scratching their heads, wondering how they can be so far off. Now imagine doing it 30 years hence.

I mean, it's an impossible task. But at the end of the day, it has to be done. In other words, whether you want to make those forecasts or not, people are going to trade your stock. And so

if you're not making those forecasts, well, somebody else is going to, because they've got to trade the stock.

So what we want to do is to figure out a slightly better mousetrap of understanding what those forecasts are telling us. And if we can literally get 52% correct rates, we're going to be rich beyond our wildest expectations. That's really hard to do. And it's just the nature of this particular endeavor. It's very difficult to estimate cash flows, discount rates, and risk conditions so far out into the future. Question, yes.

AUDIENCE: You said we could use this formula to calculate the firm's cost of capital. I'm wondering why would we do that? Why do I care about the firm's cost? I think it's much more interesting to calculate the growth rate [INAUDIBLE].

ANDREW LO: Well, in order to calculate the cost of capital, you need the growth rate.

AUDIENCE: OK but, I mean, I think it's easier to get the cost of capital and guess the growth rate. I just don't understand why I would be interested in getting to know this firm's cost--

ANDREW LO: In the cost of capital, OK. Well, you would have to wait about another seven lectures for that, because there is a reason why you care about the cost of capital, and that is that if you're trying to decide how to spend your firm's money, if you're a CFO and you're allocating cash across different activities, you need to know what your firm's cost of capital is so that you get a sense of what the opportunity cost versus taking that money and investing it in other opportunities outside the firm. So in order to make decisions, you need that number.

AUDIENCE: If I'm in [INAUDIBLE], as an investor outside, like, looking at the stock market, [INAUDIBLE]?

ANDREW LO: Well, you do, in the sense that you want to know whether you're going to get your money's worth. I mean, if you're investing in one company versus another, in order to make that decision, you need to know what the rate of return is, right? So it's actually quite important. It's very important for decision-making what that number is.

AUDIENCE: Right after return. It's not cost of capital. If I look it that way.

ANDREW LO: So let's call it the rate of return. That's right, yeah. Well, and by the way, the reason that I always use four or five names for the same quantity is to sensitize you to the fact that people look at these numbers from different perspectives. So when I use the term cost of capital, I'm thinking about it as a corporate manager who has internal funds that are going to be deployed

in different activities. And the cost of that capital as a CFO is given by r .

Now as an investor external to the company, I'm thinking about how to invest my money. I want to know what my rate of return is. And as a regulator that wants to understand what the appropriate capital charge is for different kinds of activities that are going to be appropriate for borrowing and lending, I also need to know what the appropriate risk adjustments are to that particular number. Yeah.

AUDIENCE: I was wondering how frequently the companies actually change their dividend policy. Is it every year, every few years? And also are there exceptions? Like is there a reason sometimes where a company who is, like, growing to issue dividends, or for a company that's got a lot of cash to not do so?

ANDREW LO: So that's a great question. The question is how companies set their dividend policy. The short answer is that companies don't like to pay dividends unless they know for a fact that they can maintain the level for a good long period of time. And the reason is simple. When a company cuts dividends, that's considered bad news.

No matter how you slice it, when a company decides to reduce its dividends, the typical response is uh oh, it's cash-strapped, or it's in trouble, there's a problem. So once you know that, then as a corporate financial-- chief financial officer-- you will not recommend to the board to cut dividends unless there's a really significant issue with the firm.

And therefore, as a result, you're not going to either pay or raise dividends unless you think you can support that level for a good long time. So because of that reason, you're right, dividends don't get changed very often. And actually, it's quite costly in some senses to change that dividend policy, not just from the corporate perspective, but from shareholder perception.

AUDIENCE: What about exceptions? Like why would a company currently do something that is different from--

ANDREW LO: There are exceptions because of certain circumstances that are unique to the company. For example, a company could be in a cash crunch, like, right now, because of some kind of capital charge due to a certain underperforming securities, in which case they may declare a temporary suspension of dividends. The other side of the equation is that a company may have gotten a big windfall.

They just decided to sell a division, and they've got a large amount of cash. They don't know what to do with all the cash, so what they'll do is that they'll pay out an extraordinary dividend. Extra ordinary dividend, which means that it's a one-time thing, and then from that point on, they'll go back to a regular dividend policy. Yeah.

AUDIENCE: What does a [INAUDIBLE]. How you want to invest in billions of dollars. Do you borrow money to invest versus [INAUDIBLE] dividend [INAUDIBLE]?

ANDREW LO: Well, it depends on how much money you have. It depends upon what your shareholders want to have done. I mean, that's certainly a decision that a corporate financial manager would have to make in concert with the shareholders, as well as the CEO. And that's a strategic decision. But in order to make that decision, you've got to have a few things at your fingertips. You've got to have the opportunity cost of capital. You've got to figure out what your borrowing cost is. And in order to figure out your borrowing cost, what do you need to know about your debt?

AUDIENCE: [INAUDIBLE]

ANDREW LO: How risky. And how do we measure risk with corporate debt? We just talked about it last class. Hint, hint.

AUDIENCE: You got to rate it.

ANDREW LO: Yeah, you need a rate, right. So you have to figure out whether or not the cost of funds from internally-generated sources is cheaper or more expensive than going to the external capital markets. Right now, I would say that it's extremely expensive to go out into capital markets, if you could do it at all.

If you're going to raise money, you're going to be paying up through the nose. General Electric credit default swap today was priced at 700 basis points. This is AAA-rated security, at 700 basis points credit. It's crazy! But people don't want to lend right now. So if you want to borrow in capital markets today, good luck.