California Debt & Investment Advisory Commission

Webinar Transcript
Intermediate Bond Math Part 2: Economics and Structures
August 20, 2014

(Editor's Note: This transcript has been prepared by the California Debt and Investment Advisory Commission (CDIAC) and it believes it to be a fair and accurate reproduction of the comments of the speakers. Any errors are those of CDIAC and not the speakers.)

Although municipal bonds are a mainstay of public finance, understanding their economic value requires specialized knowledge and expertise. The vocabulary, financial concepts and calculations, and market incentives may be unfamiliar, if not entirely new, to public agency officials. This two-part intermediate level webinar focuses on the mathematical concepts and calculations underlying bond pricing and structure.

Economics and Structures will introduce alternative bond structures, such as different call features and bullets, and their impact on long-term borrowing costs and bond pricing. This webinar will include callable bonds and effect on bond pricing (premium, par, discount); the mechanics and math of refundings; a comparison of non-callable and callable bonds; the differences between current interest, capital appreciation, and convertible capital appreciation bonds; and an evaluation of call options for refunding savings

Title Slide – Economics and Structures, Intermediate Bond Math (Part 2), Upcoming CDIAC Events

Mark Campbell: Good afternoon. This is Mark Campbell with CDIAC. I want to welcome you to Part 2, Intermediate Bond Math. We are going to speak today about the economics and structures. Again, Louis Choi is our speaker. I want to welcome all those back who participated in Part 1. We are going to run through a couple house-keeping items for those who are new.

Slide 2 – Information regarding Technical Assistance, MCLE and CE (00:30)

Mark Campbell: Presentation slides are available on the CDIAC website. The URL is posted on the slide in front of you. Captioning is also provided during the program. Participants may click on the link in the chat section at the bottom of the control panel to access remote captioning. For the audience, if you want to submit questions throughout the webinar, type the text in the box marked question near the bottom of the GoToWebinar control panel. We will try and field those through the course of the presentation and direct those to Louis and hopefully he will be able to integrate them in the presentation. If you have got particular questions on slides, you will want to get those to us as quickly as possible so we can address them. Those requiring a certificate of attendance, you must be registered and logged into the webinar under your own name. Certificate will be emailed to all the participants within the week. For MCLE credit, please email CDIAC at cdiac_education@treasurer.ca.gov. We will get one out to you. We are going to switch the slide here to identify CDIAC's upcoming events.

Slide 3 – Economics and Structures, Intermediate Bond Math (Part 2) (01:45)

Mark Campbell: That was already listed. Thank you. Well, I will be brief about those. We have got a seminar on Special Assessments in Sacramento on September 18, at the UC Davis extension. We have got a pre-conference program at the California Public Finance Conference hosted by *Bond Buyer* in October, October 8th. We are going to focus on alternative financing in the municipal market. Lastly, we have a webinar on the principals and practices of debt management, particularly employing a debt management policy and the importance of debt management policies in managing your debt program. That is to be held Wednesday, October 22nd. Again, for further information on CDIAC's seminars and programs, please visit our website.

With that, I am going to turn this over quickly to Louis Choi. We have got a lot of content. And I will give a brief introduction, again for those who are attending this having done the first part, you know Louis: Senior manager and director with PRAG. Joined the firm in January 2005 and serves as the primary investment advisor for PRAG's Los Angeles office. Louis has quantitative analytic experience, including forward-starting swap pricing models, tracking historic performance of municipal variable rate securities versus various swap indices, and structuring refundings with derivative products. Prior to joining PRAG, Louis was an investment banker in the public finance departments of two national investment banking firms. Louis, again thanks for doing this. I'm going to turn it over to you and let you go.

Louis Choi: Thank you. And welcome to everybody who is joining us and welcome back to those who were participants in the first part of the Intermediate Bond Math webinar. Before I begin, I want to point out that a number of the things here are going to be building upon some of the mathematics and methods that were described in the first webinar. And especially for those who were not able to join us last time, I would strongly encourage you to go back and look at some of those to try to fully understand what is being presented here. And where we make extensive use of that material, I will try to point a bit of it out. And hopefully it will not be too much of a leap for most folks to understand some of the things that have sort of been accepted or assumed to be true.

Slide 4 – Topics (04:49)

Louis Choi: Without further ado – I do not seem to have control of the slides. Yes, I do. Okay, now I do. First thing I want to lay out the topics that we will cover for this part two of the Intermediate Bond Math webinar. One fundamental thing in comparing a lot of the economics related to municipal bonds is to really understand how refunding economics works. And so we are going to begin as the first topic is by talking about how refundings work and how to calculate some of the economics related to that. And then we are going to apply those principles as well as some of the things that were from the previous webinar to talk about the economics of callable bonds, and then subsequently comparing them to non-callable bonds. And finally to cover some of the implications of using capital appreciation bonds, or CABs, as well as convertible CABs. And as a bonus we wanted to talk a bit about how we will go about valuing call options briefly so that the audience can be familiar with some of the tools that people use to evaluate that very important decision. And as was stated before, we encourage you to ask any questions in between

the webinar, during the webinar. And the amount of content for the second webinar is a bit shorter than the first one, and if anybody does have any questions related to the content of the first one, I will be happy to address them at the end of this one and probably right before we get to the bonus material. Okay? Starting with refundings, are you sure I have control over the slides?

Mark Campbell: Louis, click on the presentation itself. I think that renders control back to you.

Louis Choi: I did do that, but it's not. Something is missing here. Yeah, the mouse is not following my mouse.

Mark Campbell: Give it a try now.

Louis Choi: Okay. Got it. It's working now.

Mark Campbell: Okay. Great.

Louis Choi: Okay. So the first topic I want to cover is how refundings work. And here we have an example of cash flows related to a refunding. And similar to how we had gone about doing a lot of our analysis for the first webinar, we are going to start with talking about how refinancing for savings work with respect to a loan. And the format should be a bit familiar to those who had joined us last time in terms of how some of this looks.

Slide 5 skipped

Slide 6 – Refinancing for Savings **(07:48)**

Louis Choi: And we are going to start, like I said, with a loan and look at the economics from there and then build from there to illustrate how the example applies to municipal bonds. We begin with this particular example to have a $50 million outstanding balance for the loan. That could be repaid in five years and had an original interest rate of 5.0%. And we would refinance it with a new interest rate of 3.0% – that's a typo – as opposed to 4.0%. Really supposed to be 3.0%. And then having refinancing fees of $500,000. You will see in the boxed area there, where my arrow is pointing, the cash flows for what the original loan looks like amortizing the principal for the $50 million, as well as the interest related to that. The interest goes down as the principal is repaid. You sum those up to get the debt service. That is what you will have to pay for the original loan. And after the refinancing, we would pay a refinancing fee of $500,000, we would end up with a larger starting principal amount. So as opposed to $50 million, $50,500,000, but then there is a different amount of interest that is calculated on that because the rate is different. And the sum of that principal and interest is the debt service. And when you compare the two debt service schedules, you see the savings there. And that is what we are talking about. That is traditionally what you would expect to see in terms of refinancing with a loan, be that a house, a car or what have you, credit card fees, for instance. And it is entirely conceivable that the amount of principal upon refinancing will have to go up slightly but one is able to realize savings as long as the difference in interest is sufficient to cover that increase in principal, and that is exactly what we see here in this example. So this is how a refinancing for a loan works

and how one generates savings by moving from a higher to a lower interest rate even as the principal amount goes up slightly. And bonds are very similar to this. And as we go through and make the adjustments to show how it works for bonds, you will see many of the same principles at work. So right off the top we are going to do a number of different conversions. And this was all laid out basically in slides 21 through 27 of the Intermediate Bond Math Part 1 webinar, where we take it from a loan to represent a series of bonds by reflecting the different conventions and other things that relate to bonds.

Slide 7 – …Converting to Bonds… (10:34)

Louis Choi: For instance, one of those things is that for municipal bonds, we are typically dealing with a denomination and multiples of $5,000. And we have gone about doing it here. So as opposed to $50 million in various dollar amounts and cents that were being repaid before now, they are just being done in steps of $5,000. That goes both for the original and the new loan, the new bonds, if you will. We also introduced the fact that they got multiple different interest rates for bonds because a lot of times you are refunding a whole series of bonds. That is different than a typical loan where it is typically only one interest rate, but here you will see that consistently we are replacing some higher interest rates with lower interest rates. And then on top of that we have made some additional calculations to reflect proceeds based on coupons and yields. And in this particular example for right now at least, we kept the coupons and yields identical, so all of the prices would be 100.0% of the various, the respective principal amounts and so the proceeds would be perfectly equal to the principal amount in each and every maturity. We also would make adjustments of cost of issuance, underwriter's discount and things of that sort to get things to balance. The proceeds here are tied directly to the sources of funds, the cost of issuance and underwriter's discounts are deducted from those available proceeds to try and generate a net proceed amount such that it is sufficient to pay off the previous loan or the previous principal amount. And that, you know, we have done a number of steps here very quickly but we really went through last time in Part 1 going very step by step to make that conversion from loans to bonds. And the refinancing, the same kinds of principles exist when one looks at bonds rather than a loan, but we sort of summed it up in one step here on this slide. And, again, we are able to see that, you know, as long as the interest amount has been reduced, we are able to generate savings even though the new principal amount of $50,350,000 is more than the old principal amount. That's okay because the interest savings is more – it is around $3.4 million. And even after accounting for that difference in costs, we are able to generate savings of roughly $3 million.

Slide 8 – …Adjusting Coupons… (13:23)

Louis Choi: Now, one of the things that we know is true for municipal bonds is that often they don't price at par. That was also one of the things that we discussed last time. And it is actually possible for one to be issuing – and frequently true – that one issues coupons that are in excessive to yield. So here we are adjusting the coupons of the scenario. So in the middle yellow area here, where as opposed to having only par bonds where the coupons matched the yields, we now have the coupons that are substantially higher than the yields. And as a result of that, the interest calculation goes up significantly, but also the proceeds, the prices of the bonds go up a lot such that where one would issue in this scenario after moving to these higher coupons only

$46.9 million in principal, one is able to net $50.3 million of proceeds in all by calculating each of the prices based on the coupons and yields and maturity dates and so forth, which is, again, something we had discussed back in the first webinar, and calculating those prices, applying those prices to each respective principal amount to get to the proceeds and summing those up. And here you will see the difference between the principal and the proceeds is what is known as the "net original issue premium." And as a result of that, we are able to reduce the principal amount we have issued, and because of those two things, even though the coupons for the new loan, for the new series of bonds, is higher than the old coupons, one is still able to generate savings by virtue of the fact that the additional proceeds generated as a result of issuing premium bonds allows one to issue a smaller amount of bonds. And what we learned from this example is that it is rather the yields of the replacement bonds that are the determining primary driver for how much savings is generated rather than the coupons themselves. The offset is the increase in coupons increases prices, you allow less principal to be issued, and that is how the debt service savings is generated. At this point I will pause for a second in case anyone has any questions about any of this. This would seemingly cover a lot of material, but a lot of it, like I said, really is, was part of the previous webinar.

Mark Campbell: Louis, we don't have anything for you at this time.

Louis Choi: Okay. That's fine. Thank you.

Slide 9 – …Calculating Net Present Value Savings… (16:23)

Louis Choi: One of the things that gets done with these results often is that we are asked to create a single number rather than a series of numbers to represent the savings. Whereas the cash flow savings, which is what was seen before – the savings on not the very, very far right but near the far right, the second to last column here – that is the difference in the debt service between the beginning, from the previous loan to the new loan is a very important metric, especially from a budgetary perspective. Oftentimes, we are asked to sort of represent the savings level in aggregate and to take into account everything. And so what one does is calculate what is known as the net present value savings, so NPV savings, which takes into account the time value of money of the savings pattern. That is, the savings at a later date even though it is the same nominal dollar amount when it is savings that doesn't get realized for a long time from now, until a long time from now. It's probably not quite as valuable as a near-term savings.

So this goes back to the time value of money discussion we had, once again, in the first webinar, and it tries to accumulate all of those numbers into a single form, as well as taking into account any contributions as well as resulting funds on hand that might be generated upon the refunding. And a lot of times these funds on hand and resulting funds on hand do appear both because of tax rules, arbitrage regulations, which require one to apply any funds they have from prior deals into the new transaction, into the refunding transaction, so you might have to – money that one has on deposit with a trustee, for instance, that is dedicated debt service might have to be contributed into the transaction, as well as new amounts of money might be generated for security features, such as having a debt service reserve fund on hand and things of that sort. And the net present value savings calculation is an attempt to capture all of those things all rolled up into one number.

So here we have an example of doing that. Once again, we have the same original loan, the new loan, those cash flows, what those look like, the savings being the difference between the debt service of the two columns. And then we are able to apply a discount rate and take the present value of each and every single one of those savings cash flow payments, and then to add them up to come up with one component of the net present value savings. So the present value savings from cash flow, which goes here, and then also to take into account any contributions that we made initially in this transaction. In this case we had some original funds on hand. We applied them and added them in as an additional source of funds, so we deduct that from the amount of savings because the savings that is associated with a reduction of $11.5 million of contribution, by contributing money, we are able to issue effectively $11.5 million less principal. So one would expect there to be a reduction in debt service as a result of that. But that's really just spending money you already have as opposed to fully counting the cash flow savings related only to that component. One is supposed to take into account you are putting money in, therefore that's not true savings. So we put it in.

Mark Campbell: Louis, I have got a question going back to the former slide, but it probably applies to this as well. Your amortization of the loan assumes a flat amortization schedule?

Louis Choi: Yes.

Mark Campbell: All right. Then I have got two more and they apply to this. The appropriate discount rate that you are using for the present value calculation is what? And then, secondly, what rate is used for the discount factor for the net present value?

Louis Choi: It's the same rate that's being used to do the discounting. And the convention for doing this discounting, doing this present value discounting, is to use the current cost of capital for the issuer, which is impeded by basically what your borrowing cost now is for the new loan. So generally, by convention, the default is to use the arbitrage yield related to the new bond deal, but there are variations on that. Some people use true interest cost. Some others use all-in true interest cost. But really, generally speaking, people use the arbitrage yield for the new transaction. And that's actually what was on here. I might have done the TIC for this one, the true interest cost, but that is generally what is used to do the discounting. Okay.

Because these funds on hand came into the transaction, so those don't get counted as part of savings, but at the same time anything you generate as a result of the transaction, so now because you have done the new bond transaction, there might have been required a new reserve fund, for instance. The reserve fund deposit would be available in the future at the very least to pay the very last debt service payment. And it can also earn money and all that kind of stuff in the interim, as well as any contingency amount that might be generated. Because, really, if the cost of issuance covers everything that you need to pay for, that really becomes free cash flow that's available. Not that that's much, but all those things that are accounted for by subtracting or adding them in against the present value of the cash flow savings to arrive at the net present value savings. And oftentimes this net present value savings is divided by the original principal amount to get a sense as to how successful the refunding was on a relevant basis where you can compare across time, across size of transaction, things of that sort, on a percentage basis, so NPV

savings percentage. And you hear that and see that oftentimes in cash flows all the time. Are there any other questions related to this slide and how net present value savings is calculated or anything related to some of the refunding cash flows that goes into all this?

Mark Campbell: This goes back to Part 1, but you might want to summarize the difference between true interest cost and all-in true interest cost.

Louis Choi: So what true interest cost and all-in true interest costs are are attempts to represent the entire borrowing cost of a transaction as a single percentage number, if you will. And the way to do that is to discount the debt service related to the entire issue at a rate, so either at the true interest cost or all-in true interest cost, such that the present value of the debt service at that rate equals a target number. The difference between true interest cost and all-in true interest cost then is really what that target number is. And typically that target number is based on the proceeds one receives. And in the case of a true interest cost, it is the net proceeds, so principal plus net original issue premium minus the underwriter's discount. That's what – to set the target amount, that's what it is for true interest cost. And in the case of all-in true interest cost, it is the principal plus the net original issue premium, or minus net original issue discount, if that's the case. But also minus not only cost of issuance, not only underwriter's discount, but also cost of issuance. And the net effect of that is that in general the all-in true interest cost is slightly higher because your target number is lower, and that means your discount rate has to be slightly higher to get to that. Both of them are representations of the borrowing cost of a transaction in percentage terms. That's what those are. Are there any other questions?

Mark Campbell: No.

Louis Choi: Okay. So this is how you go about calculating net present value of savings taking into account everything, and these few slides, these last two, three slides…two, three, four slides, are really encapsulating what the cash flow adjustments or additional schedules and statistics and other things one will see to encapsulate what a current refunding is. And the next topic we're going to talk about is really advance refunding, which introduces even a bit more complication and a bit more math. But before we talk about the specifics of that math, let's just all be clear about exactly what an advance refunding is. And it starts on the next slide.

Slide 10 – Advance Refunding **(26:53)**

Louis Choi: Advance refunding is really a term that comes from PAC law and arbitrage regulations and it is defined formally to be a refunding in which new bonds delivered more than 90 days in advance of the call date of the old refunded bonds. And as a result of that and how one would generate the most economic as well as the special IRS rules and things of that sort, it is necessary for one to establish an escrow to fund the principal and interest due on the old bonds in the period between the delivery of the new bonds as well as – and the call date of the old bonds. Because in reality, even though in an advance refunding from an issuer's perspective, for the most part, one obligation to pay the old bonds have extinguished, the old bonds actually continue to exist until they are redeemed, where an investor holding the old bonds would continue to receive interest that they accrue until the date that they were called. So what we see is in this diagram and in the three graphs before, is that before the refunding the issuer has to be paying

the debt service of the old bonds. And in the period between the delivery of the new bonds and the retirement of the old bonds, the debt service of the old bonds has to continue to be paid. But the issuer doesn't want to pay the debt service on both the new and old bonds, so what he does is he issues the new bonds and moves the proceeds of the new bonds into an escrow account and the escrow account is structured such that it will be sufficient to pay for the entire amount of debt service due on the old bonds so that the issuer's left only with the obligation paid debt service on the new bonds. And then after the call date when the old bonds disappear entirely, so this blank spot here, the issuer goes along his merry way, he just paid debt service on the new bonds, and that's it. That's what an advance refunding is in terms of mathematics. And it is certainly possible to do a similar thing for a current refunding, which is where the new bonds delivered less than or equal to 90 days before the call date of the old refunded bonds, but the economics there isn't as important because the period of overlap is generally smaller, the investment opportunity for investing only for 90 days is smaller. But for an advance refunding, the advance refunding could be far out into the future. A lot of times municipal bonds are traditionally structured with 10-year calls and it is possible five years in to do an advance refunding where you would have to establish an escrow that lasts for five years before the old bonds are retired, and so in that case there is a lot more opportunity for investment, there is a lot more opportunity for overlap of the two bonds being in existence at the same time. So math-wise, this introduces an additional level of complexity, and not that the previous slide wasn't busy enough, I've decided to add more things to this to represent that. And what this is is really that one has to account for that escrow step that's involved. And a lot of the mathematics related to the escrow step is very, very similar to how we do calculations for the bonds themselves, and it's not really that different. It's just a reappropriation of the same principles and methods and putting a slight twist on it to get you where you need to go.

Slide 11 – …and Calculating Escrow Requirements and Escrow Cost (31:06)

Louis Choi: That escrow part is shown in the middle yellow box there. And starting with the left-hand side, essentially one of the first things one needs to do is… in this particular example we will call the bonds. We delivered the refunding bonds on May 1st, 2014. We are not going to be able to call the original refunded bonds until May 1st, 2015, so one year later. So what one needs to do then is calculate the precise amount of principal they need to pay on 5/1/2015 as well as how much interest they have to pay in the interim from the delivery date of the new bonds to the call date of the old bonds, so from 5/1/14 to 5/1/15, and when you add up that principal and interest requirement, that's what we call the escrow requirements. And then what one has to do is find out how one would structure an escrow as to be able to have the escrow fully make, be sufficient to make all of the payments that are due on the old bonds so that the issuer will no longer have to be responsible for it. And to do that, that is very much similar to how one goes about calculating debt service on the – on any kind of bonds, on any series of bonds. Because here basically what we are doing is the issuer's going to go out and buy a portfolio of security, or rather a series of treasury bonds, if you will, that will pay out debt service such that the amount of debt service to be received on those treasury securities would be exactly equal to the escrow requirement, and therefore, allow them not to pay any of the debt service. That is what you will see here that the cash flow from the security is exactly equal to the escrow requirements. So 1,190,925, it appears on November 1st, 2014 in both places, and then $51,190,925 appears in on May 1st, 2015 in both places. And how do you go about doing that is you have to buy securities

that both bear interest and pays out in principal. And the sum of these two things equal what the cash flow needs to be, and you can calculate how much it costs to buy those securities if those securities will have different yields and coupons. In this particular example, they don't. And a lot of times it doesn't because a lot of people use the state and local government series of treasuries or what is known as SLGS ("slugs") to do this, and then that becomes what your – the summation of that costs becomes the amount of deposit you will need to put in in order to fund, to establish an escrow of sufficient size. And so that is what we have done here. That becomes the target proceeds number. Once again, there's the reserve fund, cost of issuance, underwriter's discount, and all of those things that we have to pay for, but one is able to show all of those cash flows and have everything sort of flow through it and adjust the savings. What one would observe here is that the savings level, overall savings level now, the net present value savings, is lower because the establishment of an escrow, which is that you need to – if you need to invest at some kind of interest rate, which oftentimes is less than your borrowing cost, that creates an inefficiency. And on top of that, in this particular example and in any example, whenever you have to include non-callable bonds, you also end up reducing savings. So whereas we had about 5.0% savings before, now in this example we have just over 3.0% savings. And that's what it is. And then it is possible actually for one to take the next step actually, similar to how we have done other cash flows to adjust the principal amounts here in order to make sure our contingency is within $5,000 but still greater than zero and all of those kinds of things so where it flows out and works perfectly and the savings stay roughly about the same place. And that in a nutshell is how much sort of the complication that an advance refunding introduces into this. Does anybody have any questions on this?

Mark Campbell: Yeah. We've got a question on this slide, Slide 11, your cost of issuance. What is a good benchmark for local governments to use as a cost of issuance? Is it a percentage of the bond proceeds or are those actual costs?

Louis Choi: That varies widely across issues, and there is no one single number that's accurate. If one were to try to come up with a good estimate, my suggestion would be to come and go look around on EMMA for OSs, for deals that are similar to your own in terms of both size and credit. And from that, if you grab a few of those examples, pick an average and that is probably the best proxy of what it would be because it varies widely. The rating agency fees, for example, which is one component of cost of issuance, is proportional to the size of the transaction in general, but they also change depending on the type of credit and frequency of issuance. Legal counsel is the same thing, different credits a lot of times because of the complexity of the transaction command different levels of cost. And the same for financial advisors, the same for title insurance for lease deals and things of that sort. So the best thing to do is to really look for similar deals to the type of credit that you are doing, similar sizes, and if you are in California, also look for California ones because I think some costs and requirements are certainly state-specific and to use that as a way to gauge what yours might be. And, of course, if you are a frequent issuer of deals, you can just look back at your own deals and see how much it costs, and then you will have a good benchmark as to what that is.

Mark Campbell: Louis, I think the point is though your model includes costs of issuance that are actual costs on this deal.

Louis Choi: Yes, that's correct.

Mark Campbell: Okay. So I've got a couple more.

Louis Choi: Okay.

Mark Campbell: When do you take into account negative arbitrage when funding an escrow?

Louis Choi: In this example here there already is negative arbitrage in that, not that it is explicitly shown here, but the aggregate arbitrage yield of this transaction is actually more than the investment rate of this particular escrow. And by doing that, you have already factored in – when you use market rates for each component, you will automatically factor in what the negative arbitrage would be. Does that answer the question? That's when you do it. I mean, doing the way this example is shown, that takes it into account already, the negative arbitrage. And it is certainly a number that can be computed. We actually will talk about that a little bit in the next couple of slides, how you compute some of those values.

Mark Campbell: Okay. Got a couple more.

Louis Choi: Okay.

Mark Campbell: Other than doing an advance refunding just once, are there other legal tax considerations that limit when you can do an advance refunding?

Louis Choi: Well, certainly you wouldn't do an advance refunding if it won't save you money. That's a limitation. And in terms of tax rules, the fact that you can only do it once, that's about it. That's the biggest limitation because that is going to be, you can only advance refund a single issue once. After that, you can only currently refund after that. In terms of whether or not one would do an advance refunding, that is all part of a – as opposed to a current refunding, that is all part of a more extensive discussion, a lot of which we will cover here in some of the later slides. But there are other situations that cause one to have it be that an advance refunding would be more or less sufficient, because what happens when you do an advance refunding is that for regularly structured series of bonds, that is probably level debt service in the past, if you are doing advance refunding, you are probably leaving some candidates behind, which are the ones that are non-callable. And that might have implications about how the economics and everything else works for you. It may be that, for instance, you are doing a lease transaction and only have one asset, now you can't release the old asset unless you take out the old bonds. Well, if you throw in the old bonds, which I just talked about are less efficient, you are building an inherent inefficiency on top of the negative arbitrage and everything else, and at that point you might decide that I would be better off not advance refunding something, even putting aside all the tax rule implications and things of that sort and just wait for a current refunding where things might be more efficient. So there's a number of situational things, but none of them are really related to tax, per se, that would limit advance refunding. Okay. Another question?

Mark Campbell: I will let you field one more here. This is probably one you are very familiar with: Is there a quantitative savings that are the target for a refunding that justifies, in terms of net present value savings that would warrant going forward with the refunding?

Louis Choi: That's a good question. You know, that is in fact why so many people use the net present value savings percentage calculation. And I think it used to be that – and it may still be for some folks – that three percent NPV savings is the goal. People do a variety of different metrics on that, especially when one is talking about advance refunding, because advance refunding is inherently building a certain amount of inefficiency related not only to negative arbitrage but also some other things. And in those situations one might increase the savings target, let's say from 3.0% to 5.0% or something else. At the end of the day, there is no firm rule on what it is, but usually people adopt a kind of policy, which I think is one of your future webinars, to serve as a guide for them to justify their actions. Because at the end of the day, one is not supposed to try to read the market, if you will, to try to catch the lowest point possible because one can never catch the lowest point. Somebody might get lucky and catch the lowest point, but the other 99 times he will probably not be catching the lowest point. And in terms of the savings target, it is really just that level which one feels is adequate to match the effort involved. As I was talking about, it is 3.0% savings, right? Well, if it is 3.0% savings and your bond deal – it is 3.0% counting everything. So you have to count underwriter's discount, cost of issuance and everything else for that matter. Everything. So total NPV. So if it is 3.0% savings but only on a million dollars a bonds, maybe $30,000 isn't worth the effort for that to be done. So 3.0% can't be a hard-and-fast rule. Some of it is also dependent on scale and things of that sort on what the specific situation is and the kinds of structures one is looking at. I would say the 3.0% is probably the minimum for a fixed-rate to fixed-rate bond transaction where the risks are minimal after the fact. Okay? And it goes up from there.

Mark Campbell: We have a couple more, but I will let you return to the slides. If we have time at the end of the program, we will come back to the questions. If not, we will find another way to address those through the website or follow up with the education program. Okay?

Louis Choi: Sure.

Mark Campbell: Thanks.

Slide 12 – Estimating Refunding Savings **(45:03)**

Louis Choi: Next thing we will talk about is how we go about estimating what savings are. There's a proof that's on this page, but that's just really done for those who are suffering from either insomnia or who are really into this stuff. And so really what the proof is really just going back to the very basic principle of what NPV savings is, which is the difference between the present value of the old debt service and the present value of the new debt service and appreciating how some of the functions and equations can be applied and substituted in as to create a form that one is able to just take just a couple of statistics, a couple of rates, and to be able then apply that on a maturity-by-maturity basis to calculate savings. And essentially appreciating all of those facts, one is able to do it by basically using two price functions, if you will, and one is able to do this, whether it is on the calculator or on Excel, and in Excel is the

example here. And here in this particular example we have the delivery day of 5/14/14 and maturity of the bonds is 5/1/20, the call date is 5/1/15, we have an old coupon 5%, a new interest rate of 2.65%, an escrow yield of .25%, a call price of 1% of a hundred, and a COI of 0.8%.

Slide 13 – Using Excel to Estimate Refunding Savings (46:38)

Louis Choi: And basically subbing in all the various variables in the correct places per the formula from the previous place, one notices that you are just using two price functions, doing a subtraction, doing a little division, and one is able to come up with a percentage savings calculation just based on those simple functions. To come up with an estimation of a NPV savings for a whole series of bonds, one would just repeat that calculation for every single maturity, add it together, and that is the new savings estimate number. One thing to recognize is that all of these are estimates. There tends to be synergies when you refund multiple bonds at the same time. Or sometimes there could be certain inefficiencies when you aggregate things together for whatever reason. And also this kind of calculation obviously doesn't take into account release of reserve funds and things of that sort. So this is really done basically to help somebody guide them whether or not they should start looking more seriously at the transaction to engage somebody to help them run all of those numbers or if they have the savvy to try to do that themselves, and this is how you do it. One other thing I will point out on these calculations is that the new rate – and I used rate here just to make it very clear – needs to be the yield-to-maturity on the new refunding bond. So to the extent you have a callable premium bond, you need to follow up with the pricing conventions and things of that sort to solve the yield to maturity, but if the replacement bonds are non-callable, we can just use the yield. It is not just the new coupon or the new yield; you need to really look hard in figuring out what is appropriate. Does anyone have any questions on this or any part of the refunding? Because this is really the last part to read.

Mark Campbell: I have a couple more if you want to handle them. I just want to make sure you were able to get to them.

Louis Choi: Make it through.

Mark Campbell: Of course, people could stay on. I will ask a question. Slide 11 – you have got on the uses of funds line for contingency. It is represented as negative number. Why is that?

Slide 11 – …and Calculating Escrow Requirements and Escrow Cost (48:58)

Louis Choi: I didn't want to just change too many things on this one slide. If you go back to the first webinar, I had gone through many, many, many different iterations, each one taking a single step. What I would have technically done for this is I would have had, you know – in interest of time I didn't have that additional slide prepared – but I would have done another slide where I would have resized the new principal amount – the part I'm running my arrow over right now – such that I would generate more proceeds at the limited contingency or bring it down to within $5,000 but still a positive number. So really this is – the problem here isn't quite finished. I will say that. Okay?

Mark Campbell: Okay. Got another one. Why is the net present value saving measured as a percent of the original principal and not the present value of original principal? Wouldn't that be a more accurate measure of savings?

Louis Choi: Um, that brings the question of what is the present value of the original principal of the original debt service? The reason you do it based on principal is that the principal face amount is already sort of a discounted value, if you will, because in order to count for some kind of present value you should also have to inflate these by interest. So the present value would really be the present value of the debt service of the old bonds. That just adds more complication and doesn't necessarily make it any more meaningful. The intent of these measurements is to give a scaling factor so one can come back and have a feeling whether they did a $50 million refunding versus a $25 million refunding versus a $100 million refunding, there's some level of comparability. That is really all that is for. And doing it against the old principal amount is convention that has been taken because it is not something that you can change. That is just a fact as opposed to if you do it against new principal amount, you can actually mess with how you come up with principal amount by having higher coupons and lower coupons and things of that sort. Using the old principal amount is not something you can change, and it creates a consistency across the board for people to make comparisons.

Mark Campbell: Okay. Even if there isn't a net savings, is it worthwhile to do an advance refunding for cash flow purposes?

Louis Choi: You really have to look hard at how you are getting the cash flow savings. I would say, generally, no. But it is really not possible to get cash flow savings unless you are either contributing a lot of cash into the transaction or you are liquidating an old reserve, in which case you really are in a way borrowing from the future because that old reserve would have been used to pay for the last debt service payments of the bonds. So basically, essentially you have just liquidated – you just incurred a future obligation to create near term cash flow savings. And in that case, if that were the case, there are probably more efficient ways for one to get cash flow savings anyways, such as getting some kind of credit enhancement, be it a surety bond, a letter of credit if your indenture allows for it to get that cash flow savings and then still fulfill your reserve fund requirement.

Slide 12 – Estimating Refunding Savings **(52:50)**

Mark Campbell: If you want to take one more, I have got one more.

Louis Choi: Okay, I will take one more.

Mark Campbell: Alright, is there a benchmark of savings relative to negative arbitrage that should be targeted in a refunding? For example, should the savings be twice the amount of the negative arbitrage?

Louis Choi: There are a lot of people that do use that rule. There is no hard-and-fast rule on that really. At the end of the day, there are other metrics. If that metric isn't convincing, there are actually other different ways of evaluating a problem, some of which may provide more intuition

or be more intuitive to interpret in terms of, if it makes sense for you. But I have seen that metric be used and at the end of the day, should it be half? Should it be sixty percent? Seventy percent? Eighty percent? It's impossible to really know. Certainly, if there is no negative arbitrage, you should do it if it meets your savings level, but short of that there is always going to be a bit of a judgment call. And it may be worthwhile to look at other ways of looking at the problem to come up with some of the decisions of when or not to do the refunding.

Slide 14 – Economics of Callable Bonds: Economics and Structures (54:06)

Louis Choi: And, actually, if you stick around, there will be some of that talked about here in terms of looking at call option evaluation if we manage to get to the bonus material. Okay?

Mark Campbell: One last thing on Slide 13 in your formula for net present value savings. You use B9 cell. You call out B9. I'm wondering.

Louis Choi: Oh, that's supposed to be B8. Typo.

Mark Campbell: Great. Thank you. I will let you go.

Slide 15 – What Do Yields Really Mean? (54:37)

Louis Choi: Okay. The next thing I we are going to talk about is the economics of callable bonds. And it was important to introduce the topic of refunding first because at the end of the day the only value for having a callable bond for the most part is really for municipalities that you can use the call to refund it to generate savings in the future. So it was important to have an appreciation of how refundings worked before we talked about it. And last time during Part 1 of the webinar, we talked about pricing and how prices can deviate from par, that is deviate from 100 percent, so if you have a purchase principal amount, the price delivered is not equal to just the principal amount you are buying. And really we also talked about people use yields to express those prices because it provides more comparability. And a lot of it, some portion of the last webinar was dedicated to how to convert that yield to prices. One of the things that we didn't do is look at whether or not some of the message we used and how some of the calculations we had done really faithfully does that translation of yields to prices. And here we are going to talk a little about that because it does relate to how callable bonds that are not priced at par are affected by having yields that do not equal the coupon.

Here, I have put out a formula here that is supposed to represent what one's total net return is. And for anybody who has ever bought an income-generating or a cost-incurring asset like a home or a stock, a rental home, or a stock or something of that sort, you come to the realization that the total earnings one gets is not only the income or the cost one has along the way, but also the original acquisition price as well as the price at which you dispose of the asset. And this formula sort of captures all that, in that it's looking at the difference of price at one point in time and the price at a previous point in time plus the coupon that is related to that particular bond – in this case, a municipal bond. And when we have these premium and discount bonds, generally what happens over time is the original prices, which may be well away from par, drift towards par at a later date in time such that an investor's total return is equal to the coupon plus the

movement of the price over time. And looking at this example here, this person has $100,000 of a bond and a coupon of 4.0%. He bought it at a yield of 3.5%. And between date one, 5/1/14, and 5/1/15, let's look at it as overall economics, using the price conventions and formulas and things of that sort. Here are the two prices that were calculated, this is the price for 2015 and this is the price for 2014. You will notice that there is a drifting towards par – that is, towards 100%. And his total rate of return is the change in that price plus the 4.0% coupon he receives and all of that multiplied by the $100,000 ends up being $3,748.01 which is actually 3.5% of $107,149. It's 3.5% of this amount because this was the original price he paid. When you multiply price against the 100,000, that is how you get that number. That is what the yield means. It is the representation of the amortization of the price as well as the coupon. It is the rate of return he gets for the asset he owned over that period.

Slide 16 – What Do Yields Really Mean? (58:50)

Louis Choi: And when one looks at this over time, here the numbers of the prices appear right on top. These are the same as the ones on the prior page, over time it gradually goes towards 100.0% as I was talking about. So I took the difference of each of those steps of the change of value. As well as the coupon he receives, you add it all together that is the total interest, total earnings value, if you will, on a percentage basis, but when you to adjust it by the value of the original asset at that point in time, so here as in the example of the 3,748 would be divided by the 107, but at the end you would divide it by a much smaller amount. But when you do that division, you notice that the effective yield is consistently 3.5%. So the yield is the constant rate to get an equal rate of return after accounting for amortization of premiums and discounts, and that is what it is. And that is how it works. And what throws a wrench into all of these things is when we have callable bonds and we have those municipal bond pricing conventions. And the first of the examples we will look more closely at is how callable premium bonds work. From the first part of the webinar you will recall that for callable premium bonds, pricing is done to call date generally as opposed to maturity. And what that means is that the full amortization of the premium would have happened when you price something to the call date, the full amortization of the premium would occur by the call date. At the call date, the price from then on out would be 100% or the call price, if you have call premium. But at that level and stay steady at that level.

Slide 17 –Yields and Callable Premium Bonds (1:00:53)

Louis Choi: And when you look at that, what that means when you apply it to the same formula, when you look at that period crossing over and past the call date, because the prices are not changing. The only rate of return he is getting is the 4.0%, this coupon. And when you divide it by the value that he has on hand, what ends up being the calculation is his rate of return after the call date is equal to the coupon, and that is all it is equal to. It has nothing to do with the yield.

Slide 18 –Yields and Callable Premium Bonds (1:01:28)

Louis Choi: And looking at a stream of cash flow similar to the way we had just looked at it before, so for the entire period before the call date there is an amortization of total value where he is consistently at the stated yield he bought it at. But over time after that date, after the call date, which is in this example as 2024, his total return value for each period is the coupon. And

when you average these previous periods of 3.5%-ish return against the 4.0%, the more 4.0% periods there are, the higher your cumulative rate of return will be. As long as he is not getting called out, his effective rate of return on average for the whole holding period will be progressively higher. And if the bond were to stay outstanding to maturity and would never be called, his return is substantially higher than the nominal yield of the 3.5%. In this case it actually is 3.702%, which is 20 basis points higher. And that number that represents those callable premium bonds outstanding to maturity, is what's known as the yield to maturity. That is just what it is called. And this becomes another metric that people use to really measure the cost of borrowing for these callable premium bond structures. Anybody have any questions on this?

Mark Campbell: No. We are good.

Slide 19 –Yields and Callable Premium Bonds (1:03:07)

Louis Choi: Okay. A similar phenomenon actually exists for discount bonds. Once again, for all these bonds that are priced at premium or discount, there is a gradual drift from the original price you price it at towards par. So for discount bonds, the original expectation would have been it would have taken until the maturity date of the bond, which is much later, to fully amortize all of the discounts. But if one were to redeem the bonds early, one actually disrupts that amortization. Here, we have this example where a person had a 3.5% coupon bond with a yield of 3.75%, so a yield higher than the coupon. He had a maturity date originally was supposed to be 2034, but he also had an optional redemption date of 2024, in this case the bonds get called. He was going to amortize the original price which solved to 96.504% over time following the same mathematics as before to have a consistent rate of return to 3.75%. And if the bond had not been called, it would gradually go up to a hundred somewhere down here, such that the rate of return would be consistently 3.75%. But here because he's disrupted it, when you call it, you are going to pay him par at the face value. When you do that, he is actually getting more than just the amortization of the price plus the coupon. Instead, he is getting the coupon plus whatever his current accreted value or the remaining unamortized amount of the discount. And when you add those things together, you end up with a rate of return that is substantially higher. And so for discount bonds, this becomes sort of a hidden call premium, if you will, if you were to redeem the bonds early. And this hidden call premium doesn't just apply to optional redemptions but actually also applies to regular sinking funds of firm bonds. So that is why a lot of times you see discount term bonds, because investors are interested in that. Because while it is an additional cost to the issuer, the flip side of that is, of course, it is an additional benefit to the investor. And that is why they like it. Okay. So this sort of cuts both ways.

Slide 20 –Summary on Callable Bond Economics (1:05:30)

Louis Choi: So really when you look at callable bonds and how the economics work, this is the table that quickly summarizes what all of those terms mean. The stated yield on a par bond represents the actual yield of the par bond. For the premium bond it represents the yield to the call date. For discount bonds it represents the yield to maturity. So it is not really necessarily all the same thing. And the same is true for the yield to maturity. For the par bond it does represent the actual yield. For the premium bonds it represents the worst-case scenario – that is, one doesn't actually ever redeem it. And for the discount bond, it actually represents the best-case

scenario because if one were to redeem to the call date, one would actually incur additional costs there. And the yield to maturity actually represents the best-case scenario and taking the longest and the full period to amortize the discount back. For refunding callable bonds, a par is sort of neutral; it is what it is. For a premium bond, it is more likely to happen because it is easier to generate, say to make the 3.0% NPV savings threshold because the calculation of the economics for refundings is based on the old coupons and the new replacement yields, and by having higher old coupons it is easier to make that metric. Conversely, for discount bonds it is the other part, where now you have a discount, a low coupon, which is what a discount bond generally has, and becomes unlikely to be refunded. But also, if you do a refunding, it incurs the hidden cost of instantly fully amortizing any remaining unamortized, fully realizing any unamortized discounts.

So the one thing really for all of this is that one should think about whether or not it is appropriate to their particular scenario to use a particular structure. For par, because much of the market is pricing premium bonds in this low interest rate environment, the comparison should really be that if you are going to do it at par, that the overall economics makes sense relative to the market standard of having premiums. But for premiums, whether or not to do those really should be about whether or not you think it is likely that you will do a refunding in the future. Because if you don't think you are going to do a refunding, for whatever reason – for instance, one reason is the remaining outstanding maturity is too few, too small. So let's say that you had a bond that you were issuing and it was only a 12-year bond, 10-year par call, there are only two maturities where you can refund for savings. If you look at those two maturities and the size of those maturities, you are convinced that you are not going to do it, unlikely to do it because of the fixed cost of issuance or the hassle, then probably it is not a great idea to have callable premium bonds there. And on the flip side for discounts, different costs, you can cause an increase in the cost of refundings in the future and it creates hidden cost for term bonds. That is not immediately obvious at first glance. And then this table just summarizes what callable bond economics looks like for different coupon structures as expressed in price, whether it is par, premium, or discount. Are there any questions at this time?

Mark Campbell: We've got one. Why is – I think he may have touched on this. Why is the net present value savings measured as a percent on the original principal? You got to that. Nothing. Sorry. Nothing other than that.

Louis Choi: Okay. Hopefully some of this callable bond economics makes sense for folks and why you do certain things and what some of the nomenclature means.

Slide 21 – Non-Callable Bonds **(1:09:44)**

Lois Choi: Given all the complications of the pricing effect, the refunding impact of all these things being a premium discount bonds, and this-and-that for callable bonds, you think maybe would just think we should go with non-callable bonds. Makes life easier, right? Well, that's about the only thing it does, to be honest.

Slide 22 – Non-Callable Bonds Simplify the Math, But not the Analysis **(1:10:00)**

Louis Choi: So the standard bond for bonds longer than ten years right now is really to have, unless you are a lower-rated credit, for the most part it is generally a 5.0% coupon, which in this market given how low interest rates are is the premium, and callable in ten years. And the thing that you would be looking at for non-callable bond for the market to really accept it would still be a premium bond and be non-callable. And the one advantage of it really is that it does simplify the math in the sense that the nominal yield against maturity is the yield you will be paying and all that kind of stuff, but the disadvantage of having a non-callable structure is that you won't be able to do any future refundings for potential savings in the future. And also that there are certain tax laws and arbitrage implications related to giving up your 10-year par call or having even a par call more than ten years away, which you will also be giving up. So the analysis of figuring out whether or not this thing, this future refunding is worthwhile is actually as – if not more – complicated than the math of calculating something on a yield-to-maturity basis.

Slide 23 – Economic Analysis vs. "Standard" Bonds (1:11:16)

Louis Choi: Here I have set forth some of the economic analysis that one would look at when looking at non-callable bonds versus a standard bond. Many of the terms here are the same. We have the same delivery date, same maturity date, the same coupon because once again, non-callable bonds, investors want to retain that "above market" coupon, if you want to think of it that way, with greater certainty, and that is why almost all non-callable bonds are premiums. The yields will be different in the current market, it is such that non-callable bonds are actually higher than the nominal yields for callable bonds. That is just the way it is right now. That wasn't always true, but it is true in the current market in general. For the callable bond, we have a 10-year call, of course that is not applicable at par, and for non-callables, of course it is not applicable. And when you use these terms and follow the rules, you come up with a price of 111 and change for the callable bond and 115 for the non-callable bond. And the price is actually higher even though the yield is higher because, remember once again, price and yield are supposed to work inversely, where the higher yields tend to be lower prices and lower yields tend to be higher prices. But that does not follow here because for the non-callable bonds, you are pricing to maturity, whereas for callable premium bonds you price to call date. So that is why the price here is higher. The yield-to-maturity and the nominal yield in both cases for the non-callable bond – not that you have a choice to redeem it ten years early – is going to be consistently equal to the nominal yield.

But for the callable bond, it is different. And this is where you start to see the difference. Here, the yield on the standard structure is lower, as we talked about, than the non-callable bonds in the current market. But the yield-to-maturity is actually higher. So really whether or not the standard bond going to be better or worse than the non-callable bond, assuming you are not getting gobs of savings in any way or form in the future and just looking at the first transaction, is really going to be determined by when you end up redeeming the callable bond. And when one looks at whether or not the 3.88 is better than the 3.66 or the 4.173, there is a variety of tools people use to going about doing that. Call option calculation, the sum of the calculation really is the break-even calculation to figure out what future interest rates would have to be that this would get refunded to cause this to be equivalent and how that relates to where current interest rates are, what kind of NPV savings is that. People then decide whether or not it makes sense based on the

break-even metrics for this call option. And if we get to it, this is the part in the bonus that we will talk about a little bit more on whether or not those make sense and how that metric is done.

Slide 24 – Historical Data on Performance of Callable vs. Non-callable Bonds (1:14:20)

Louis Choi: But historically what has happened, and I don't know, it is a little difficult to see here and historical data is not complete, but what recent history shows is that non-callable bonds have under-performed versus callable bonds. In these two graphs, the left hand side is the 20-year bonds, the right hand side is the 30-year bonds. What I did is that I graphed the yield as represented by AAA GO MMD. For 20-year bonds at each moment in time and then also the very thin blue line – I know it is really hard to see, which is basically on top of the red line – is what it would be for the callable structure. So from a nominal yield perspective, the callable and non-callable are very similar. But when you factor in the refunding that would take place ten years later, which is why the line stops here because this represents the yield back in 2004 plus a refunding taking place in 2014 in aggregate, you will see that all-in for the callable structure plus the refunding results in a lower total rate than the non-callable structure. This is not that surprising given that interest rates have been low and we are in a declining environment. But the other thing really to recognize is that in a normal yield curve, in a normal environment, even if interest rates are frozen in time and never moved again, when you start with a 20-year bond in the first place, when you refund it, you will be able to boost down the yield curve with the replacement refunding such that after ten years you will be paying a 10-year rate. So really you are only paying the 20-year level, if you will, for the first ten years and for the rest of the time you are paying at the 10-year level, which is why, generally speaking, absent interest rate movement, it is still advantageous to have the call. And on top of that, in the current market actually, the non-callable yield is higher than the callable yield. Only time will tell whether or not for this remaining period if it would have been beneficial, you know, whether at the very bottom here, it would have been beneficial or not. But for now at least for the historical data that we have in recent periods, it has been advantageous to have the call. Any questions on any of this?

Mark Campbell: No. Go ahead.

Slide 25 skipped

Slide 26 – Uses of CABs/Convertible CABs (1:16:57)

Louis Choi: Next thing we're going to talk about is CABs and convertible CABs, CABs being capital appreciation bonds or zero coupon bonds, and convertible CABs being a hybrid version of capital appreciation bonds and current interest bonds. And just to lay a couple things out, capital appreciation bonds generally are non-callable. They generally are long. They generally have higher yields, and the reason people end up using these higher yield instruments on a non-callable and are not very flexible is really because you don't have to pay any interest. It's a zero-interest loan for now. And two applications of that are shown here. One is that sometimes you can reduce near-term debt service by deferring principal, for instance, which is what the top graph shows, but sometimes that's not enough. So in order to really get to this gray part, one would have to either capitalize interest, that is set up an escrow fund to pay for interest, or you

could issue CABs to do that because CABs have no interest, and therefore, there would be no interest payments, or at least that portion of it would be reduced proportionately. The other reason people do it is that there is some kind of structure where they are trying to bond to a projected pattern of revenue growth. And it is such that the revenue growth pattern is sufficiently steep as to disable somebody from fully leveraging the expected future revenues. And the way to really do this, by the fact that the current interest is already eating up the entire amount of revenue, and that the only way to incur more debt and still fit within this revenue pattern is to issue some kind of debt that doesn't require the payment of interest and, hence, CABs. And this frequently happens for something like a toll road for instance where you have inflation and increase in traffic and things of that sort that causes revenue growth to be steep, and justifiably steep.

Slide 27 – The Price of CABs/Convertible CABs (1:19:07)

Louis Choi: With that said, even though there are uses for it – there is certainly a price for using CABs. Here I have got some current interest bonds – that is what CIB stands for – and this is CAB yields as of a certain date, about a month ago at this point. And you will notice that the current interest yields are substantially lower than the CABs. And that is shown by the actual numbers in the bottom table here. And not only are the yields essentially different, this difference is probably a bit understated I would say because these are AAA GOs, and CABs spreads tend to bind even more as one moves to lower rated credits. Not only is the yield different, but one of the things that is strikingly different, a lot of times, is the interest-to-principal ratio, which is to say how much total debt service will be for every dollar you borrow, how much more debt service would be for every dollar you borrow. Whereas for a 30-year bond at 3.24%, that is about half. Once you think about everything for CABs, for that, it is about double. For CABs you are going to be making a 2.67 times higher, so almost three and two-thirds times larger for the total debt service for a 30-year CAB. Now, I think one of the things that people will come to realize – well, but CABs give a structuring flexibility, right? It gives you the ability to not to have to pay any interest. Isn't that worth something? Yes, it certainly is worth something, but it is actually not nearly worth as much as what the market is charging for it.

And it is actually possible to do some math to go figure out where CAB pricing should be. And how one goes about doing that is one builds a structure that includes CABs and without CABs. You set it to be so the two structures end up with the same debt service and the same proceeds level, and if those two things are equal, you get the same proceeds and have to pay the same debt service, those two structures must have the same cost, right? Well, if we were to structure it such that we only introduce one CAB at a time, it is possible for one going through these steps – I won't spend the time going through the steps – to impute what the fair mathematical value for a CAB would be relative to a current interest bond.

Slide 28 – Imputing Zero-Coupon Bond Yields (1:21:40)

Louis Choi: And in the lower right hand graph, I have graphed that out. And what one sees is that the imputed zero-coupon rate is a lot lower than what the market actually charges. And that is just the way it is in the current market, and it has been that way for a very long time. I don't know when it has deviated from that, but every time I have looked at it, which is too many times

at this point, that has been true. And the difference is substantial. It is not as if the imputed value is very close. It tends to be very wide. And that's really some of the additional cost of the CABs. Going back to that whole principal-to-interest ratio thing we are talking about, one of the things that critics of CABs will have oftentimes is really talking about how many times debt service becomes. And the fact that you compound the rate of return on CABs is what magnifies the effect. Not only that, CABs also have higher rates as we just saw. All that lends itself to that. And on top of that, the CABs structure itself creates that, whereas issuers – at the end of the day, bonds are two sides of a coin in that when something is economically disadvantageous for the issuer, it is something that is economically advantageous for investors.

Slide 29 – Compounded Rate of Interest **(1:23:06)**

Louis Choi: So it is not a surprise that investors have a preference for structures with CABs that are beneficial to them, which then end up being a fact that do not benefit issuers. And CAB investors generally prefer very long-dated maturities and the interest rate penalties also tend to increase with those longer-dated maturities. And CABs also tend to be non-callable for the most part, which then just compounds the issue because once an issuer is down that path, there is no real ability for them to take out the bond in a refunding or restructuring or something of that sort to correct the problem. They are stuck with it forever. And on the right-hand side of the page, I have graphed how much the compounded interest tends to expand over time for different interest rates, from four to eight percent and from five to 40 years. And here you will see at the end of 40 years at an 8.0% rate, it is not 25 times the amount you borrowed, but certainly more than 20 times the amount you borrowed. And even shorter maturities it can be quite a lot. And when you go out far, that just gets compounded very, very quickly. Any questions about any of that?

Mark Campbell: No. Louis, you might want to highlight last year's legislative restrictions regarding CABs, both with regard to debt service ratio and the call factor.

Louis Choi: I don't recall right off the top what those ratios were, but yes as this was pointed out, there were legislation attempted to cap because of these issues of how many folds some of these numbers are. Optically, it is very poor to issue CABs in terms of tying future generations' hands in terms of how one finances future needs. And what was the ratio? I forget.

Mark Campbell: It was four to one. And there is a law now. Just wanted to note those.

Louis Choi: And it doesn't take much to go past four to one here, as you see. Much of the graph does. Do we have any questions at this point? After this, this is just the bonus material.

Mark Campbell: No. You have covered all that have come in up until now.

Louis Choi: Okay. Fantastic. The last thing I wanted to talk quickly about is how people go about valuing call options. We are not going to go through in detail each and every single method and what it is and how to go about doing it because some of it just takes way too much math to do, and it is well beyond the scope of what this is. But it is important, I think, just to have a quick understanding of some of the underlying things about each of the methods that are commonly used. Because some of those – sometimes it gets to be that people, in my opinion, put

too much faith in some of these methodologies without recognizing some of the shortcomings to doing it. And also sometimes, as one of the questions that was asked before, a single method proves inadequate or unconvincing in terms of whether or not it helps in the decision-making process. And hopefully by showing you what some of the other options are, it may be that one is able to either request somebody to provide analysis in a different fashion or maybe they could look something up that they kept at a comfort firm.

Mark Campbell: Louis, if I could just mention, we are at the end of our allotted time, but we are going to let you go ahead with the bonus material. Recognize that people may drop off through the course of it, but we will let you go forward with what you prepared here.

Slide 30 skipped

Slide 31 – Three Basic Approaches…and Some Hybrid Approaches (1:27:19)

Louis Choi: Sure. This is only going to be three slides, so it should be fairly quick – or four slides. The first thing that I am going to talk about, basically there are three approaches people go about looking at call option value depending on a question. The first of those is something that people, as a person brought up earlier, which is savings relative to negative arbitrage. That is sometimes referred to as refunding efficiency. And what that is, there is a number of different things that are called refunding efficiencies, but one of them is this. Mathematically, it is that the NPV savings you can get now divided by the sum of the NPV savings plus negative arbitrage. And as the person had asked, is half a good number? That's a good question. Some people look at that and say half is good enough and that's what we would use. And this really has limited application. It is really just used to determine whether or not you should advance refund or current refund in the future. And the primary advantage of this method is all the inputs are something that you can know with the current market. Some of the other methods are going to be based on things that are really not knowable or are based on theoretical math that may or may not prove to be true over time – that requires more prediction. This particular method doesn't have any of that. And so in that way that is why it is liked.

The second of those methods is what is called the option valuation model. And what that is, there is a bunch of people who are very smart at math and who have been doing finance – quants – who have come up with different models for how to project interest rates in the future and at different points in time. And what one is able to do then is take those interest rates at different points in the future, use calculations similar to some of the estimated savings that I described above, to calculate what savings would be, and then somehow to collapse all of those different possibilities into a single number and to represent all of those things into a single number. People tend to like this method because it is very useful. It is somewhat magical in the sense that there is this one number that can capture what a call option is worth. But it is also worthwhile that it is the one method that is able to analyze multiple different options at the same time and different comparabilities. And it represents a market perspective on what future interest rates will be. A lot of this math that they use to come up with these future rate scenarios is based on hedging strategies, hedging instruments and things of that sort. So this is where one of the shortfalls of this method is that at the end of the day, yes, all this math is correct and accurate because it represents what you can hedge at today at those future interest rates, but guess what, none of the

issuers actually hedge those positions so whether or not that math is correct doesn't mean anything in the sense that the future might not actually be whatever these mathematical models sort of predict. If you were able or willing to do the hedging, it would perfectly predict it, but you are not and issuers generally don't. And that is where the shortfall happens. The predictive ability of some of these math models hasn't really worked out. For the most part, most of the predictions are interest rates are going to be higher than what they are now, and over time that hasn't proven itself out.

Another method to do is what is known as the break-even analysis. And in that case what you do is really you look at two different scenarios and you find what future interest rates would have to be such that the two scenarios would be at the same place. That is known as the break-even interest rate. And you use this to consider two different alternatives, such as different refundings, whether or not you advance refund or current refund, in the future you can come up with what the break-even change in rate in the future would have to be to wait for the current refunding, what interest rates would have to be for the current refunding in the future such that it gives you the same economics as advance refundings today, for instance, or difference coupon scenarios even. And this method is liked in that the results are easy to understand, and it doesn't rely on a whole lot on assumptions. One of the things apparent in the option valuation model is that there are assumptions about volatility and things of that sort, which may be hedgeable, market-provided data points, but they are still assumptions in the sense that the issuers don't lock in those market-provided data points, and therefore, the market-provided data points are no better than just merely assumptions. And the break-even analysis approach doesn't do any of that.

There are also some hybrid approaches that make use of more than one method. For instance, there is an alternate refunding efficiency calculation where the refunding efficiency is just NPV savings divided by the option value, and the option value is the one that comes out of the option valuation model. That is sometimes referred to as "refunding efficiency." And then sometimes people do the break-even analysis, and then depending on with the break-even interest rate in hand, they do some kind of statistical probability analysis similar to an option valuation model to come with confident level of whether or not that interest rate is likely or not. So you come up with: you run the Monte Carlo simulation or something of that sort and there is a 75% chance that the rates will be better than that or not, or something of that sort. And that is an alternative way of really combining the option valuation approaches, strategies with the break-even analysis. And these five things basically encompass the universe of different things that are used to evaluate options values in municipal finance. Any questions on this for right now? Next, I am going to go through and talk briefly about the top three methods and pull back a little bit of the curtain on how some of these things worked and things to think about respective of that.

Mark Campbell: Nothing yet.

Slide 32 – Refunding Efficiency Calculation (1:34:00)

Louis Choi: Okay. So refunding efficiency, which is the only one we will talk about how to do the math on because we already basically did all of the math before. On the slide – I forget exactly which slide it is – but it talks about calculating, estimating refunding savings in Excel. It is basically using the exact same method because you have all the pieces there. Oh there, Slides

10 and 11. And basically just adding the negative arbitrage component, and the formula here shows exactly how all of that is done. It is a repeat of sort of the same terms again and again to do that division and addition. And two parts of it are identical and the other parts are identical. The one new piece, if you will, is the very last term here – the price – which is just taking the price at perfect escrow, which is the escrow cost, assuming that one is – as opposed to be able to invest with the escrow yield – is able to invest at the new replacement rate. And that is it. That is all the math there is to it. And as the escrow yield approaches the new rate, what you will see is that the efficiency percentage goes up. But really probably conversely what is true is that what one notices is that as the new rate is closer and closer to the escrow yield, then the efficiency percentage goes up also. And how does that happen? That really happens if you are borrowing at a very low rate by refunding, for instance, a very short maturity. So bonds that are let's say callable in five years from now but you are only refunding a seven-year maturity, for example, because seven-year rates are so low, even though five-year rates in treasuries or SLGS or whatever isn't very high, you can get to a very high efficiency percentage. So this efficiency metric has the tendency of favoring refunding very short bonds, at least in the current market in the way it stands. So one has to sort of appreciate that to know whether or not – to recognize some of the limitations in how this analysis tends to bend results. Okay? Any questions on this?

Mark Campbell: No, Louis. Nothing yet.

Slide 33 – How Option Valuation Models Work (1:36:35)

Louis Choi: Okay. Next thing I will talk about is how option valuation models work. I talked about the fact that basically what these are is some very smart guys come up with math methods to come up with projections of future interest rates at different points in time. And then what happens then is where current interest rates are but then they have all different cases of different scenarios as you go through time, the variance in interest rates widens. And what ends up happening is you then take – using the same method estimating NPV savings that we talked about, you are able to calculate the NPV savings for each rate and at each point in time at these nodes, if you will, and then to clasp the nodes back, pull all of these nodes back into a single number. And how that gets done is basically a lot of times it is done on a binomial basis, where an interest rate scenario after rates have gone up, the prediction is it will either go up higher or come back down slightly. If this is the case, we have a certain savings number that is associated with this node 3.1, if you will.

Let's say we calculate that number, and I am going to say NPV savings of 6.0%. The 4.1 scenario node, because it is a higher rate later in the future, may be at a savings of 5.0%. And maybe it is that the 4.2 scenario is 8.0% or 9.0%. But what it ends up doing to collapse all of that is to say that the likely scenario that would have led to 4.2 and 4.1 is really starting at node 3.1. So you take the average of those two scenarios, compare it against this, and whichever is the higher one, you take that one. And you keep repeating that process again and again and again so these two collapse into here, these two collapse into here. So 4.1 and 4.2 collapse into 3.1; 4.2 and 4.3 collapse into 3.2; and 4.3 and 4.4 collapse into 3.3. And you continue the cycle – so 3.1 and 3.2 collapse to 2.1; 3.2 and 3.3 collapse to 2.2; and 2.1 and 2.2 collapse to 1.1. And if you keep doing that you eventually end up with a value for only one node. And that becomes your option value. That is how it is done. What ends up happening is these results are very much dependent

on how the interest rates themselves are modeled. I think it is pretty standard to have to do the time periods. And whether one does it more frequently or not – typically one does it on a semiannual basis because we have semiannual coupons and it makes some of the math easier – that really has very little impact on rates but depending on how one models how different the rates are, how wide they spread or how narrow it is or where the base point is. Here, I have drawn something that is very symmetrical, but it is equally possible to have a triangle where rates never go too low but always go too high and things of that sort. That can very, very much distort the results. And it is important to recognize that that is true. And what has happened for the most part when you look back at the 10-, 20-year history of these models right now, they tend to predict that interest rates would be higher than where they are now. And as a result of that, their option value tends to be undervalued for the most part. So is that always going to be continuing in the future? Who knows. Nobody knows until it is well after the model has been employed, but it certainly has not had a great track record. I will say it that way. And there is a lot of math here, and sometimes it is hard to tell what is going on. Okay. Any questions on this?

Mark Campbell: No. We are good to continue.

Louis Choi: Okay. And the last one of these three types is really the break-even analysis. And the break-even analysis is really a two-step process. I call it Step 1 and Steps 2 because the second step really requires a lot more work than the first step. The first step is pretty straightforward, which is to take one scenario and the two different scenarios and typically what ends up happening is one scenario appears better than the other at face value, assuming nothing else happens. But then you introduce the possibility that under the worst – the less-good of the two scenarios it is possible to refinancing. And when taking into account the refinancing, it may be that that scenario didn't outshine the first scenario. And there is some point where the refinancing is at a rate such that the refinancing plus the original part of the worst scenario is the same as the better scenario on a stand-alone basis. And that interest rate at which that happens is called the break-even rate. And that method is fairly straightforward to do. A little creative use of some of the estimate savings, NPV savings in Excel that we talked about in Slides 10 and 11 can get you there.

But really the challenge then becomes what to do with that information, what to do with that break-even analysis. And there's really a couple of different ways of doing that. That's why – and often times one looked at more than one to get a good feel for what they are looking at, and that's why it is steps in plural. First thing we do is really look at that break-even rate and just compare it against current rates. So let's say you have a scenario of a premium coupon or a discount coupon for the same bond. You would look and say, okay, it is a 20-year bond right now. Ten years from now we can refund it with the 10-year bond again. The break-even rate for the higher coupon scenario is – I don't know – 3.5%, let's say. You would then look at that 3.5% and compare it to what 10-year rates are now because for a 20-year bond, ten years from now it will be a 10-year bond. And then you will take that difference and say, okay, that change is 300 basis points, maybe. I don't know. Maybe I exaggerate. Maybe it is 200 basis points. Is that likely or not?

Slide 34 – Two Steps in a Breakeven Analysis **(143:20)**

Louis Choi: That's the first way to look at it. It is a really good way of looking at it when you are really assessing a very near term alternative because at that point if you only have to wait let's say six months and the movement is 200 basis points, you are pretty convinced it is not going to move 200 basis points in six months. It could, but that is a really outside chance of doing that. And in that case the accuracy of your outlook is very accurate or you have a good feeling that is pretty reliable, that is a good way of looking at it. But sometimes you are looking at rates that are out ten years from now or whatever, and you are looking at break-even of plus-150 basis points. At that point it is more difficult to tell if it is appropriate. So you can choose one of the other methods then.

One way to do that is to compare the results against history. Let's say we come up with the same analysis. We have 3.5% or whatever it is for 10-year rates. Well, let's look at where 10-year rates have been over time for the last 20 years, maybe, even. And say how often has it be 3.5%? How often above and how often below? That is appropriate for a long-term perspective; it's a bit less biased. Of course, there is all that disclaimer about how history is no predictor of future events, but certainly it can be helpful to be a service guide. So if you end up with the situation that your particular rate, break-even rate is 80th percentile and that would seem – and having lower rates is better – then that would seem to suggest it is pretty likely that you are going to be better off. But sometimes that result is ambiguous. And what if it is only 50th percentile? Then it's like, well, it is a coin toss whether or not history tells you if you are better or not.

So really there is another method, and maybe the previous method works, but there is another method of looking at all of this, which is then to take a look at your refunding transaction that was part of the break-even analysis and really assess whether or not that savings level is realistic. This is important because sometimes that's a very intuitive result. If it were that the break-even NPV savings of a scenario like the one I just described with a 20-year bond, you can refund it in ten years from now, that NPV savings percentage is only required it to be 2.7%. Then, it is actually pretty likely that you are going to be able to refund it for more than 2.7% savings, in which case it should be convincing to you that, gosh, I'm pretty sure that the refunding will happen and I'm pretty sure that the refunding will save me even more money, and that seems like a good scenario. That is another way of looking at what the break-even analysis is that actually moves away from what the rate is, per se, and it gives people a feel as to what the results mean and what they have personally experienced. One of the things that help make it helpful for that assessed savings level is to recognize that if the bond options you are considering are advance refundable, it's worth thinking about that. Because what ends up happening is, you have Scenario 1 and Scenario 2, and if you do nothing, Scenario 1 is better. Scenario 2 could be better if you managed to refund it, but you would have to refund it and generate let's say 15% savings. All of the bonds are advance refundable. Now, if you use the other two metrics, it may be that 15% savings doesn't seem unreasonable. The problem then there is that chances are if you actually went through Scenario 2, you will probably actually end up advance refunding the bonds issued under Scenario 2 well before you get your 15% savings. You probably – when you come along in the market six years later, you see somebody shows you a refunding that generates 8%, 9% savings, let's take it, in which you'll never be able to realize the 15% you would have needed to break even, in which case, that really does mean you probably should have picked Scenario 1 in the first place because you never could actually – it is highly unlikely one could wait and get the high-level savings you need. And that is another thing to sort of look at and have an

appreciation for in terms of whether or not to do any of this. And with that, that is the end of the webinar, unless some folks have questions, which I am happy to take.

Slide 35 – Questions? (1:48:34)

Mark Campbell: Well, we can hang on for just a few more minutes. Obviously, we extended beyond the time we proposed, but we are grateful, Louis, that you took the time to go through the rest of the material. If we get a couple questions, we will pass them on to you. At this point I want to make sure that people do know that are still online – and we have a good number still hanging on – we will provide transcripts and the webinar on our website to access in the future. The webinar number one, or Part 1, of this series is already available on the website, I believe. No, it's not? Do we expect to have that soon? Getting nods from the room. But we will have both the transcripts and the webinar available in the very near future. If we do get questions subsequent to this, we will try and pass them along to Louis and get answers. Anything come in yet? No, that's it. Louis, I want to thank you very much, both for preparing two lengthy programs, but for hanging on an additional 20-some minutes to present the bonus materials. There is a certificate of attendance that will be emailed. And again, for those needing MCLE credits, please email us at the CDIAC email address given on the screen now. Louis, thank you, and thank you to all of those who hung on through the extended period.

Louis Choi: Okay. Great. Thank you.

Mark Campbell: Take care, Louis.

Louis Choi: All right. Bye-bye.