California Debt and Investment Advisory Commission

Webinar Transcript
The Public Investment Portfolio: Investing in Treasuries
May 21, 2015

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"Treasuries" are securities that are issued and backed by the full faith and credit of the U.S. government. Pursuant to statute, California local agencies may include Treasury instruments in their investment portfolio. In this webinar, presenters will consider what U.S. Treasuries are; the different types of Treasuries, including bills, notes, bonds, etc.; how public investors should understand price and yield information; the market risks of investing in Treasuries; how Government Code section 53601(b) should be interpreted with respect to the purchase of Treasuries; and what role Treasuries can play in an investment portfolio.

Disclaimer: The information presented in this webinar series is intended to assist public investment professionals. The content presented is informational and does not constitute investment advice or the recommendation to invest in any or all of the investment instruments discussed. When choosing an investment instrument for a public portfolio, the whole portfolio, investment policy, suitability, financial needs of the public agency and any associated risks should be considered. In addition, the information in each webinar is set to reflect the period in time in which it is presented and any changes that may affect any of the instruments discussed, such as legislation, reform or market conditions, or that may alter the relevancy of any of these webinars, will not be reflective in the post archival recordings. In such instances, viewers should be advised to use the information only as a reference as no updates to the recordings will be made. Please consult the California Debt and Investment Advisory Commission's publication, *Local Agency Investment Guidelines* for any interpretive updates.

Title Slide – The Public Investment Portfolio: Investing in Treasuries

Robert Berry: Good morning, everyone, and welcome to the California Debt and Investment Advisory Commission's webinar, The Public Investment Portfolio: Investing in Treasuries. My name is Robert Berry. I am the deputy director here at CDIAC. Before proceeding further, if you are experiencing technical problems, please contact GoToMeetings at 1(800) 263-6317, the number on the screen. Or you can try the website at the address on the screen. The website includes information that might help you troubleshoot your problem.

Investing in Treasuries is the first of a nine webinar series on public investments that CDIAC has scheduled to run through this summer. Each webinar will focus on a category of statutorily authorized investments in a way that will help you to understand many of features and risks and how you might go about assessing whether or not a particular investment meets or fits into your agency's investment policy objectives. Each webinar in the series, including today's, is designed to be a standalone. Each will cover the fundamental analytical tools and then dive into some of the specific information needed for you to assess the suitability of the investments within the featured category. The point is that we have designed the series so that you should find value in

as many of the sessions that your schedule will allow. At the same time, if you can take in all of the sessions, gaining a fundamental understanding of the full spectrum of investment options available to you will inform your investment policy making and portfolio management decisions.

So in the case that you need to fill in for a missed webinar or just to broaden your knowledge of other important management topics, CDIAC has a number of different resources available to you on our website. First, specifically for today, the presentation slides are available on the website at the address on the slide. Next, a replay of the webinar and all the future webinars will be posted to CDIAC's website approximately two to three weeks following each of the broadcasts. Also, CDIAC's *Local Agency Investment Guidelines*, the 2015 edition, is currently linked on CDIAC's main page and the address for that link is on your screen as well. You can also find the latest edition of the local agency – you can always find, I should say, the *Local Agency Investment Guidelines* on CDIAC's website along with the *Public Fund Investment Primer* and numerous other investment publications from CDIAC and many of our allied organizations. I believe we have linked those in the recommended reading section under the information for the webinar series.

A few more notes before we jump into the program. If you would like captioning during the program, you may paste the address on your screen into your browser or click on the link in the chat section at the bottom of your control panel. Participants who need a certificate of attendance for CPE credit – you need to be registered and logged into the webinar under your own name and a certificate will be emailed to participants within about a week. You'll have the ability to submit questions using the box marked "Questions" near the bottom of your control panel. I will ask our speakers to address some of your questions during the presentation. Others we will hold until there will be a Q&A session at the end. And if we run out of time for all the questions, we will follow up with responses on the CDIAC website following the webinar.

Slide 2 – Disclaimer **(03:38)**

Robert Berry: So before I introduce our speakers, I ask that you take note of the important notice on the screen here. The presentation today is informational and does not constitute investment advice or recommendation. There are many risks, policy, portfolio and suitability factors that must be considered by an agency prior to making an investment decision. Also, the webinar material is presented as of May 21, 2015, and in a current context. Keep in mind a replay of the webinar will not reflect any changes in investment authority or market conditions that occur after today and that may affect the suitability of an investment. Having taken care of the formalities, I would like to introduce our speakers for today.

Slide 3 – The Public Investment Portfolio: Investing in Treasuries **(04:18)**

Robert Berry: First up is Kent Morris. Kent is the chief investment officer for the City of San Diego and has worked in the City's investments division for over 15 years. He oversees the division and is responsible for managing the City treasurer's investment pool, which as of 2014 year end was valued at approximately $2 billion. Kent has over 17 years of professional experience in the areas of investments and treasury management and is a Certified Treasury Professional. Next, to speak will be Kevin Webb. Kevin is a director with Cantor Fitzgerald in the firm's Houston office. Kevin joined the firm in 2009 and has been a guest lecturer and speaker at numerous fixed income workshops and conferences. He is a chartered financial

analyst and a member of the Houston Society of Financial Analysts, the CFA Institute, and Global Association of Risk Professionals. So with that, gentlemen, I will turn it over to you.

Slide 4 – A Brief History of U.S. Treasury Debt (05:12)

Kent Morris: This is Kent Morris. Good morning, everyone. Thank you for attending. The first slide here we wanted to just start with sort of a brief history of U.S. debt, and this is the federal debt as a percentage of GDP from 1790, which was when the Funding Act of 1790 was enacted by Congress to basically take on or assume the states' debt to allow them more flexibility in terms of their expenses. This really kind of shows the history of debt. And as the U.S. Treasury accumulates debt, it needs to finance it and it does that through the issuance of Treasury securities. This chart is interesting as a percentage of GDP because you can see the big spikes happen at the big times of expenditure, which is generally here times of war, or if you look at the end of 1980, you see the Cold War, the unofficial war, and then you see the financial crisis there at 2014. And looking forward, it looks like the projections look like we are going to continue to accumulate some more debt in terms of financing it.

Slide 5 – A Brief History of U.S. Treasury Debt (cont'd) (06:35)

Kent Morris: Just some major points in terms of the history again. In 2000, the U.S. debt level was actually $5.7 trillion and through the financial crisis, we have seen that balloon up to $17.8. And I highlight this only because, again, the way the U.S. government finances much of its debt is through Treasuries, so it just goes to show what a huge liquid market Treasuries are and need to be for the United States. In 1929, the U.S. actually shifted to auction for the T-bill. That made it a more competitive process. In 1959, regular issuance of 6-month and 1-year T-bills. And with many of these, the government will actually retire certain issues and then bring them back. You saw that with the 30-year bond, for instance. This is just sort of highlights of different points in time. In 1963, bonds were actually put out for competitive bids with dealers and the banks. In 1974, cash management bills were introduced, and this is really a funding mechanism for the Department of Treasury for when they have a mismatch of cash flow needs. They can issue Treasury management bills. Book entry in 1979 was required for Treasury bills that were issued, and they finally went to an electronic entry for new Treasury notes and bills in 1982.

Slide 6 – Bond Basics (Vocabulary) (08:08)

Kent Morris: I thought as a basic beginning, we would talk about some basic vocabulary because I want to make sure that everybody at least has the basics in terms of some of the terminology you see with Treasuries. So term to maturity is really just the number of years the issuer has promised to meet the conditions of obligation. So if it is a 5-year Treasury note, in five years they will go ahead and pay you your principal back. The par value is the amount that is agreed to be repaid by the bondholder by the maturity date. You also have heard this as the face value as well. So here is an example: you can have a bond that has a par value of $5,000 and if it is selling at $5,500 in the bond market, you'll hear people say that the price is 90 *[Price is 110; speaker corrected himself on page 7]*. And you get that from taking $5,000 and dividing that by $5,500, the market price. The coupon is the rate in which the issuer/borrower agrees to be paid each year. For most Treasury instruments, that is a semiannual coupon. And again, just to show people how that is calculated: if you take the face value, or the par value, of $1,000 and the

coupon is 7%, you take 7% and multiply it by $1,000 and then divide you it by two because they are semiannual payments, so that would be $35 every six months. Treasury securities generally have a fixed-rate coupon. That means that the coupon rate does not change over the life of the bond. You can get variable rate. The Treasury just in January of 2014 started to issue floating-rate, 2-year notes. So in that case what you generally will have is a reset period. In the case of the 2-year notes, it is every quarter. And the way variable-rate notes or coupon payments works is, there is a reference rate and then there is usually a quoted margin. The reference rate is what the basic structure of the note is. It could be 3-month LIBOR or the 3-month Treasury bill, and then the quoted margin is the amount that the issuer agrees to pay above or below that reference rate. So in the example here, I say 3-month LIBOR plus 15 basis points, right here.

Slide 7 – Bond Basics (Issue Types) (10:39)

Kent Morris: Just a few issue type basics. So many of you may hear the terms "on-the-run," "off-the-run," and "when issued," and I just wanted to explain each one and some of the characteristics. So an on-the-run issue would be the most recently auctioned issue or current issue. It is the most liquid issue on the Treasury curve. It will have a tighter bid/ask spread compared to off-the-run issues. And when I say bid/ask spread, the bid price would be the price the broker is willing to buy a security at, and an ask price is the price that a broker is willing to sell you a security at. So for on-the-run issues, the difference between what they will buy and sell a particular security for is much tighter than one that is off-the-run. And you see this because there is just more demand. You have index funds, you have central banks, you have pension funds that come in and will want to buy the most current issue of Treasuries. So they are much more in demand, which means there is a tighter market for it.

"Off-the-run" is a security that is replaced by an on-the-run. So, for instance, if you have an on-the-run, 2-year Treasury, and then the Treasury goes ahead and issues a new one the following month, the current one then becomes the off-the-run. And it will move down the curve as it starts to issue more and more of those securities. So what you see from those, because there is less demand, you see the spread start to increase. An on-the-run Treasury is about a quarter of a point and then when you get off-the-run, you'll see those widen out to half, maybe three quarters of a point. So very close, but still you see a small difference. And then "when issued" is a trade based on a security that has been announced but not issued yet, so you can start to purchase those as well.

Slide 8 – The Basics of U.S. Treasury Securities (Bills, Notes, and Bonds) (12:43)

Kent Morris: So just some of the basics of the Treasury securities. So I'm going to be talking about in this case bills, notes, and bonds. I will talk about TIPS and STRIPS in just a second, but these are the bulk of what most people buy, so I wanted to address these first. And all of these securities that I will be talking about are issued by the Department of Treasury. They have the full faith and credit of the U.S. government. So unlike a corporate security that is issued by the corporation, the federal government is standing behind it with its full spending power. All of the series are issued through an auction process that makes the issuance a competitive process. So for bills, you have 1-month, 3-month, 6-month, and 1-year. For notes you have 2, 3, 5, 7, and 10 [*year*]. As I mentioned before, in January 2014, you have the floating-rate, 2-year note, as well which the Treasury is now starting to issue. And then you have the 30-year bond.

So of these structures, they fall into two different types. You have a discount type, which is issued at a discount to par. There is no coupon and then it matures to value, so I used this as an example right here. An example of a bill that might be issued at 99, for instance, and then it matures to 100. So your income is the difference between the par value of 100 and what you bought it at, which is 99. And then U.S. Treasury bills are from one day to one year. The fixed-rate is approximately at par, usually, when it is issued. It has a coupon rate and it matures at a par value. And the coupon rate is done because it is done by a competitive process. It is determined by the bid. So based on what the price bids are, the coupon rate will change so that the issuance comes at par. The maturity range for these are 2, 3, 5, 7, 10, and 30 years. And as I said, the auction determines the coupon rate.

Slide 9 – The Basics of U.S. Treasury Securities (TIPS) (14:58)

Kent Morris: So TIPS, which are also – the wording of it is Treasury Inflation-Protected Securities. These are a little bit different. They are an effective way to eliminate the inflation risk of a security, and the reason is because the principal amount is adjusted by a CPX, or a consumer price index metric. So every period, the TIP is recalculated higher based on the CPI index, or lower if you are having deflation. You still have a semiannual coupon and the coupon is applied to the principal amount. So as in a normal situation where you have inflation going up over time, the principal of the TIP will keep increasing, and then the coupon that that TIP is based on will also increase over time. The amount at maturity will be based on the inflation-adjusted amount. As I said, the principal is adjusted over time, so as inflation continues to go higher and higher and higher over time, that principal amount will keep increasing. So instead of earning the par amount at maturity, you'll earn what the principal adjusted amount is when it matures. Now, in the case of deflation, if it were to happen, there is a downside risk and that is that TIPS can't go below par amount. These are issued again by auction. And I think here – and I will talk about this on the next slide – one thing you have to do if you go into TIPS is you have to the time or make the time to do a forecast of inflation because that is the decision of whether you want to buy a TIP or a nominal Treasury security. It is your opinion of how inflation is going to be moving over time. So you don't want to just buy a TIP because you want to diversify your portfolio. You want to understand what you feel inflation is going to do over time and then based on that opinion, either buy a nominal Treasury or buy a TIP. So just be careful – I'll mention this later on – California Government Code has a five-year final. So if you buy a five-year, for instance, TIP, you want to make sure that the actual maturity is five years or less. If it is five years and two days, even though it is a five-year security, it is not eligible by California code.

Slide 10 – When Do TIPS Make Sense (5 year breakeven rates) (17:33)

Kent Morris: So here is what is called a breakeven. And a breakeven really takes the nominal Treasury rate and subtracts out the TIPS yield, and it tells you what the inflation rate needs to be in order to basically make the decision equal between the two securities. So in this case what I did was I took the most recent 5-year, which had a breakeven of 1.67, and so I looked at what the 5-year Treasury was, which was 1.52. The TIPS yield was -0.15. So if I subtract the TIPS yield from the nominal yield, I come up with 1.67, which is the breakeven on this graph. What this graph is really telling you is that if you think inflation is going to be above 1.67, then you should buy a TIP. If you think inflation will be below that based on the current rates right now, then you should buy a nominal Treasury yield.

Slide 11 – The Basics of U.S. Treasury Securities (STRIPS) (18:37)

Kent Morris: And now STRIPS. So what are STRIPS? The actual wording of the acronym is Separate Trading of Registered Interest and Principal of Securities, aka STRIPS, which were introduced in 1985. They are a very basic sort of understanding. It is a very simple concept, so it is really where you take the interest and principal cash flows of a U.S. Treasury bond, and you separate them into separate securities. So you take the interest payments on a bond or a note, and you strip them off into just coupon payments, and then you create another security in which you use the principal as the only cash flow in that instrument.

Slide 12 – How Are STRIPS Created (19:25)

Kent Morris: So to give you an example, if we look here, I just used an example of a $1 million par for a 3-year Treasury note at a 5% coupon. So at time zero, you see that every six months, I'm going to be earning $25,000 in interest payments, and then at the end of that security, I am going to have my principal of $1 million back. So what you do with a STRIP is, they take the coupon payments and strip them out into a security, so that all you are getting is the coupon payment. And then for the principal STRIP, you are not getting any of the coupon payments. You are still getting the 3-year Treasury note, which is also called the zero coupon bond, and you just get the principal amount at the end of the three-year period.

Slide 13 – Characteristics of Treasury Securities (20:18)

Kent Morris: Just some characteristics of Treasuries now that we have gone through the basics. So really, the investment world sees Treasuries as a risk-free rate. There is no default risk like corporates, or even technically agencies, because they don't have the implied guarantee. What you see is in times of crisis, you see a flood to Treasuries. You saw this during the financial crisis. You saw corporate people move out of corporates and agencies and other riskier securities, equities, and buy Treasuries. There is no credit risk because, again, you have the full faith and credit of the U.S. government behind it, and they are very, very liquid. Like I mentioned in the very first slide, you look at how much debt we have accumulated and all the participants in it, it is a very liquid market. Doesn't mean that when there are anomalies in the market or stresses in the market that that bid/ask spread doesn't increase, but even if it does increase, it will increase less than other comparable securities like agencies and corporates. They are very liquid. Like I said, very small bid/ask spreads, so again you have a quarter of a 32nd might be typical on-the-run Treasury spread between the bid/ask, whereas the agencies can be anywhere between two and six. So it can be a lot wider for other securities. So if you are going to have just buy or sell a security, Treasuries are very liquid and you virtually don't lose that much money from buying or selling of them. The benchmark interest rate around the world – they are seen as the dominant security.

And then the last thing that I wanted to mention is interest rate risk. So while I sort of give this great appeal to Treasuries, which they are very safe, they are very liquid, but they still have interest rate risk, which means the longer purchase of a maturity you have, the more sensitivity they are going to have to moving interest rates in the market. So you just want to be mindful of what is called a bond's duration, which Kevin will talk about in just a second. But just be mindful to understand what the duration of an individual Treasury might be and then how sensitivity moves might affect its price.

Robert Berry: This is Robert. We have a question that came in relative to the pricing example that you had on slide five. And that is, the question is, isn't a bond with a par value of $5,000 selling at $5,500 selling at 110 and not 90? Maybe you might want to cover that just quickly.

Kent Morris: Oh, you know what, I'm sorry. You are absolutely correct. That was my mistake. It should be flipped around. I apologize for that.

Robert Berry: So, Kevin, go to you now.

Kevin Webb: Good morning, everyone. My name is Kevin Webb. I'll be responsible for the entertainment portion of our program this morning. And by that, I mean we're going to be talking about, or I'm going to be covering price, yield, and duration. Now, on this slide here that Kent has regarding characteristics of U.S. Treasuries, I want to focus on point number four. The Treasuries act as a benchmark for interest rates around the world. So when you tune into the evening news or you read the financial paper, and the reporters write or talk about how the equity market did, they almost invariably, at least here in the United States, give the change in the Dow Jones Industrial Average by the magnitude point change and the percent change and then offer a narrative on why that occurred. Now, almost universally when they refer to what happened in the bond market, what did the bond market do today – tying back into this fourth point with the characteristics of Treasury securities that Kent has on slide 13 here – they talk about the price and yield change, one or both, on either a 2-year, a 5-year, a 10- or a 30-year Treasury. And this happens to be the case whether you are in the U.S., for the most part, or not.

Slide 14 – Understanding Price & Yield (25.02)

Kevin Webb: And so I'm going to cover two parts. I'm going to have a first part that focuses on price and yield and their relationship. They are the flip side of the same coin. And before I get into that, and you can understand what that means, I want to talk about a few principles: time value of money – something I call the time value of money circle of life, that addresses what is price, what is yield, and then offer a brief set of links to those of you who don't have Bloomberg for you to find Treasury yield/price information on the Internet. And then I want to move to the price-yield-duration connection, and this goes to that last point that Kent had on the previous slide, for all practical purposes, Treasuries' primary risk is interest rate risk. So price, yield and duration are core fundamental concepts. And you can see the role the Treasuries play and the world being the benchmark for interest rates around the world, why CDIAC chose to start this webinar series with Treasuries. And we felt within this webinar series on Treasuries, it is the perfect place to introduce these three core concepts, this framework for understanding risk and return in fixed income of price, yield, and duration.

Slide 15 – Framework for Understanding… (26:26)

Kevin Webb: So John Maynard Keynes, besides being a brilliant economist and at times a wonderful writer, wrote about the role of economics, that it doesn't "furnish a body of settled conclusions immediately applicable to policy. It is a method rather than a doctrine, an apparatus of the mind, a technique of thinking, which helps its possessor to draw correct conclusions." And I use that quote because the price/yield duration framework for thinking about risk and return when it comes to fixed income doesn't give the right answer for you. It only shows what the current risk/reward tradeoffs are in the market right now. The answer for any individual or any

individual institution will depend on what they view as suitable, which will be a byproduct of their investment policy in their institution's own risk/reward profile.

Slide 16 – The Treasury Yield Curve Framework (27:30)

Kevin Webb: And this risk/reward framework – many of you are probably familiar with this graph or a version of it, and this is a Treasury yield curve. And so this is the typical presentation of a Treasury yield curve. Just briefly, what do we have here? On the vertical axis, on the Y axis, we have yield. And then on the horizontal axis, the X axis, we have tenor. Now, it says tenor there. Kent gave a definition of that in an earlier slide – it is the same thing as final maturity. And what this graph shows is the tradeoff between giving up the use of your money for two, three, five, seven, ten or 30 years, or even three months or six months, and the rate of return that you will be paid for giving up the use of your money. Now, that phrase that I used – giving up the use of your money – implies that there are some fundamental principles regarding the time value of money that explain why, on average, the curve yield has this shape, called a normal yield curve. It is normally upward sloping. The yield curve can be flat, it can be inverted, and indeed at times it has been, but the usual shape of the yield curve is upward sloping like this. The levels may differ, the steepness may differ, but it usually looks like this.

And it has to do with some of what I call "free fundamental axiomatic truths regarding the time value of money." And they are what? 1.) Everything else being equal, we prefer more money to less money; 2.) Everything being equal, we prefer our money sooner rather than later; and 3.) Everything being equal, we prefer our money more certain rather than less certain. So if you think about it, you have often heard the question, why is the value of a dollar today worth more than a dollar at some point in the future? Many of the answers you'll hear have to do with risk or a common answer is inflation. And those can be mitigating circumstances, but they are not a necessary and sufficient condition that really explains why the value of a dollar today is worth more than a dollar in the future. And that is, you can take something less than a dollar, put it to some productive use, and get this yield curve here. You can take it and give it to the U.S. government and loan them money, and in less than a year or some other amount of time, end up with a dollar. And so these three fundamental concepts, axiomatic truths regarding the time value of money, can be graphically represented in one of my favorite graphical representations, and that is the time value of money circle of life.

Slide 17 – Time Value of Money Circle of Life (30:31)

Kevin Webb: Many of you have had business classes or read business books. You have read or heard or were taught that the value of any financial asset is the present value of future cash flows. So what this diagram shows is that when we want to move money through time, if we want to take present value dollars and move them to the future, we call it compounding. If we want to take dollars from the future and bring them back to the present, we call it discounting. So think of it this way. If you were given three sums of money – ¥100,000, €100,000, and $100,000 – and you were asked, how much money do I have? You wouldn't answer, I have generically 300,000 generic monetary units. You would convert them using some exchange rate to all be the same currency, whether that was dollars, euros or yen or some other currency, and you convert them all to the same monetary base and add them together.

Slide 18 – Time Value of Money Math (31:45)

Kevin Webb: The equation that helps explain moving money through time this way – I promise you, this is the only equation in this entire presentation – is this one here: the future value – that is what FV equals – is equal to the present value times one plus the interest rate, raised to the "n." There is a wonderful quote regarding this equation from a book called *The Foundations and Applications of Time Value Money* by Fabozzi. And it sums up the point of this, and that is that this basic valuation equation is the foundation of all financial mathematics. If you understand this, you understand most everything involved in financial mathematics. So what I want to do is I want to take that equation and overlay it onto my time value of money circle of life and talk about that for one second.

Slide 19 – Time Value of Money Circle of Life (32:35)

Kevin Webb: So this is the equation. Future value, to get the future value of dollars, you take the present value and we compound it. To bring it back in time, we rearrange this equation – and this will become important when we start looking at what yields mean on the yield curve – and the thing that allows us to move the money through time is the "i." Now, you can see I have an underline there. If you download the presentation, you can click on this link, and if you want to convince yourself that that is how you rearrange the equation algebraically to solve for the interest rate, you can do that and take you to Wolfram Alpha, something that I will talk about in a few slides from now. But what "i" is is really something amazing. It shows that everything is connected, and when you think back to that yield curve, "i" is that temporal exchange rate that allows us to move money through time.

Slide 20 – Price vs Yield: Which Came First? (33:35)

Kevin Webb: So I want to take an example. I want to take the 5-year Treasury which was issued and it actually settled on April 30, 2005. The yield curve that I showed you back on slide 16 was the yield curve as of April 30, 2015. And for you Excel spreadsheet junkies that are out there, I have included the formulas so you can replicate the spreadsheet yourself and get the same answers. But when you think about this, if we bought $1 million of this 5-year Treasury, it came with a 1.375 percent coupon, it pays semiannually – and Kent covered this on the semiannual nature of the payments – and it came at a yield of 1.434. So think about what I said about moving money through time or adding up those different monetary units. So if I just take the cash flows of this bond – which I can get by taking the par amount and dividing the coupon rate by the frequency and multiplying it by the par amount – this bond would pay me every six months $6,875. Now, if I just add all those together and I get $1,068,750 for the total, I have really done something similar to adding my ¥100,000, my €100,000, and my $100,000, and saying I have generic monetary units. And why is that? Well, because all of these cash flows occur at future dates and since we know the value of a dollar today is worth more than a dollar in the future, they can't all be worth the same thing.

What are they worth? Well the 5-year Treasury, the interaction of all the buyers and sellers in the Treasury market, determined on the close of April 30th, 2015, that the yield on the 5-year Treasury would be a 1.434. So if I take this equation, this is just the present value is equal to the future value divided by one plus the interest rate. One quick note on that term there, yield. The interest rate, the yield curve, it goes by many different names. You will read it in articles or textbooks as the required rate of the return, the internal rate of return, so on and so forth. It all means the same thing. It is that temporal exchange rate that allows us to move money through

time. And when I do that, when I adjust each of these nominal cash flows and turn them into a value that is equivalent in today's dollars, right now, and I add them all together, I get $997,163.07. So the way that I get the price of a bond is you take the total present value of the bond and you divide it by the par amount. Now, it is customary to quote the price not as a percent. So if someone said, what is the price on this bond, they would say it is 99.716307. Price is expressed as a percentage of the face value. A bond quoted at 99.716307 has a dollar price of this amount, which is the sum of the present value of the future cash flows, which happens to be that percentage of the $1 million face. That is how you do it. Now, it just happens this bond didn't have any accrued interest. If it had accrued interest, that would not be included, and they differentiate between clean price and dirty price. Dirty price includes the accrued interest and clean price doesn't. It is a custom that when you are quote a price on a bond, it is the clean price. It does not include the accrued interest.

So what is the yield? Well, the yield is the discount rate, the interest rate, the "i" from that equation that we used to bring all of these nominal cash flows back in time and bring them to the present and allowed us to compute the present value of those future cash flows. So yield is simply the bond's internal rate of return. It is the yield to maturity, that is, the interest rate that will make the present value of the bond cash flow equal to its market price. You are probably thinking to yourself, this seems to have a little bit of a chicken and egg scenario to it. Which came first, the price or the yield? Well, one reason I put this quote here from a wonderful book on bond math, the theory behind the formulas – if you really want to delve into it, this book is worth checking out. And he knows that there is, so to speak, a which-comes-first aspect to bond prices and yields. Do prices drive yields or do yields drive prices? If we know an investor's required rate of return for a particular bond, we can calculate the bond price. If instead we insert the price, we can calculate the yield to maturity and thereby infer the required rate of return. A couple of notes here – notice how even in the sentence describing what yield is, he used several different terms to describe the same thing: yield, required rate of return, internal rate of return. But in practice even though price and yield are the flip side of the same coin – think back to the yield curve on slide 16 – the yield curve is plotted normally with yield – that's the name, yield curve – on the vertical axis and the final maturity on the horizontal axis. So it is more common to talk about the yield on these bonds than the price, but there is that aspect of which came first.

Slide 21 – Price & Yield Relationship **(39:19)**

Kevin Webb: So the price/yield relationship. It is not linear. It is curvilinear. So in this slide here, I have taken the 5-year Treasury bond and re-priced it for extraordinarily high prices, or I have re-priced it for extraordinarily high yields. And you can see that as the yield rises, the price falls, or vice versa, as the price rises, the yield falls. Price and yield are inversely related. So if the price of my bond is going to go down, then the yield on my bond goes up, or if the required rate of return on my bond goes down, then the price of my bond goes up.

Slide 22 – Question **(40:04)**

Kevin Webb: Now, I'm going to ask you a question. You are going to have this pop up on your screens to see how many of you are awake and paying attention.

Polling Question **(40:16)**

Kevin Webb: What will the price of our bond do if we take the discount rate, the yield, and we move it from 1.434 to 2.434? We'll give everybody a chance to answer, and even if you have no idea, please click on the screen. This is our test to see how many of you are still awake. Give everybody a chance to answer.

Polling Results **(40:59)**

Kevin Webb: So 11 percent of you said the price will go up, 84 percent of you said the price will go down, one percent said the price will stay the same, and three percent of you are awake but said you have no idea.

Return to Slide 22 – Question **(41:15)**

Kevin Webb: So if we raise the interest rate – think about this for a second, if we raise the interest rate and we take that discount rate where we are going to move those future cash flows back in time and we are going to divide each of them by a much higher interest rate here, then we are going to end up with a lower price on the bond.

Slide 23 – Answer **(41:47)**

Kevin Webb: And how does that work? So think about this right here. So we take the same nominal cash flows and we are dividing them by a much higher yield, just by virtue of that fact the present and bringing them all back in time. And why are we bringing them all back in time? Because the nominal cash flows are not the same. They occur at different future dates. I want to add them all together much like my monetary exchange rate example, and I want to bring them back to the present. And the way I do that is, I do that with yield. And when I increase the yield, I have lowered the present value of those future cash flows. And if you notice price – if I take the total present value of those cash flows and divide it by the $1 million par amount, I end up with a price of 95.042827.

Slide 24 – Treasury Yield Data Sources **(42:32)**

Kevin Webb: So a couple points here on finding information on Treasury yield data sources. Now, I have listed these five here. There are obviously many, many more web pages where you can get Treasury data. I would be remiss if I didn't have the first one be the actual Department of the Treasury. There are three different links there and they have lots of data. And each of those links provides a slightly different view of the yield curve and of the historical data. The next one, of course, is Yahoo Finance. Then there's the Wall Street Journal Market Data Center. And then there's the Bloomberg Treasury yields. Here, I am going to skip Wolfram Alpha for one second. The Bloomberg U.S. Treasury yields will not give you the yield curve you saw on slide 16. That is from a Bloomberg professional terminal which your money managers, investment advisors or brokers will have, or you may have yourself you can get off there, but you can get the current U.S. Treasury yield. Wolfram Alpha, briefly I mentioned back on slide 19, that the "i" I that I had in the middle of the Time Value Circle of Life, you can click on that link and it will take you to Wolfram Alpha and will show you how the equation was rearranged. Wolfram Alpha is what is known as a knowledge engine. It was created by Stephen Wolfram, a brilliant mathematician, writer of *Mathematica*. It is a knowledge engine. That differs from a search engine like Google, where a search engine returns links to information and a knowledge engine returns answers and

you can do all kinds of stuff. So you can click on that link right there and you will go to Wolfram Alpha's representation of the Treasury yield curves and you can do all kinds of things. Definitely worth checking out.

Slide 25 – Primary Risks Associated with Bonds (44:26)

Kevin Webb: Before I move to the price-yield-duration connection, I want to revisit the risks that Kent covered earlier with the primary risk in Treasury being interest rate risk – that is the risk that bond price will fall as interest rates rise. You saw that in the example where we raised the discount rate, the interest rate, the yield to maturity, the required rate of return, whatever term that you want to use, on our bond from the 1.434 to the 2.434, and the price of the bond went down. That is interest rate risk. Reinvestment risk – that is the risk that the proceeds from the bond will be reinvested at something less than yield to maturity. So the yield to maturity, internal rate of return has built into it the assumption that the cash flows themselves are reinvested at the yield to maturity. This of course is not entirely accurate and assumes the flat yield curve, which is not true, but it is something to keep in mind. The higher those coupons are, the higher the yield is. Call risk – while there have been callable Treasuries, they are not normal. They are not what is represented on the Treasury yield curve. Call risk in a bond – this will be covered more in the agency webinar to occur next month. It is the risk that a bond with a call provision will be called, that is, redeemed before the stated maturity date by the issuer. And then, of course, default risk – the risk that the issuer does not pay the promised principal and interest. Kent covered this for all practical purposes. The U.S. Treasury owns the printing presses. Even if the dollars aren't worth what you thought they would be, they can print the money to repay the principal and interest on the bond.

Slide 26 – Interest Rate Risk: Duration (46:11)

Kevin Webb: So duration. We just covered price and yield. Duration is a byproduct of price and yield, and it is connected to price and yield. And they are interrelated. One of them doesn't change without the other changing. So this screenshot here is of our 5-year Treasury as of April 30, 2015. It has a maturity date of April 30, 2020. And I have highlighted in red here. This is a common Bloomberg screen. It can be changed slightly, but this is what you normally would see. You can see that the modified duration is a 4.814 and then this little number, convexity, is a 0.26. If you go back in the presentation and you look at the calculations that I showed how you can do in Excel on slide 20, you will see that those modified duration and convexity numbers match what Bloomberg shows here.

Slide 27 – The Price-Yield-Duration Connection (47:07)

Kevin Webb: So what is duration? Well, duration is the risk in our risk/reward framework of price, yield and duration. When we go back to the price/yield relationship that I showed you on slide 21, and I'm going to add in a line. I have added in this blue line and what this blue line represents, it represents the slope of this price/yield relationship at a point. I tried to match it to the point of price on the bond close to the price of 99.716307 as I could. What it represents, it represents the slope at that line, which is the duration, the 4.814. And what that means is that a one percent rise in interest rates will lower the price of the bond by 4.814 percent, approximately, and conversely at one percent decline in interest rates will raise the price of the bond by 4.814 percent, reemphasizing the point that changes in interest rates and changes in the

price of a bond are inversely related. Now, if you go back to the slide number 26 where I had the Bloomberg screen or slide number 20 where I calculated it in Excel, both of them showed the convexity for this bond to be 0.26. And what convexity represents is that even though the slope of the line for this bond at this point is 4.814 percent, for very large changes in interest rates, this Treasury bond will actually have a price that differs by what would be predicted alone by modified duration, and convexity accounts for that difference.

Slide 28 – Duration & Final Maturity (49:04)

Kevin Webb: So a couple of major things to keep in mind. What affects duration? Well, duration is obviously affected by the final maturity. So what I have done here is, I have taken our 5-year Treasury and I have kept everything constant, but I have increased the maturity date, and you can see that here on the horizontal axis, and then recompute the modified duration. There is an MDUR function in Excel where you can do this. And you will notice that a hundred year bond does not have the interest rate risk of 100. It has something less than that. And that is the point of duration that the final maturity, especially the further out you move in maturity, does not have a 1:1 relationship with the actual interest rate risk in the bond. And so as you increase maturity, though, duration increases at a decreasing rate. Hence, this is not a 45 degree angle. It starts to decrease. That helps explain part of the reason, not all, of why the yield curve has a similar shape as you move out. So duration and final maturity – duration rises as maturity increases.

Slide 29 – Duration & Coupon Rate (50:26)

Kevin Webb: What about the coupon rate? So taking our 5-year Treasury, holding everything the same except the coupon, as I increase the coupon rate, the duration on the bond falls. Why might that be? Well, thinking back to our time value money circle of life with our formula rearranged on slide 19, as you increase the size of all those intermittent cash flows – think about slide 20 with our bond, as we raise the coupon, you recreate that spreadsheet yourself and increase the coupon of that bond holding everything else constant – the duration of the bond will fall because more of the cash flows, or the percentage of the total present value of the cash flows, will be closer to you in time than they were before. So the higher the coupon, duration falls.

Slide 30 –Duration & Yield (51:23)

Kevin Webb: What about yield? Taking again our 5-year Treasury bond and holding everything constant and just changing yield, as the yield rises, the duration falls. Now, why is that? Kind of a similar thing to the coupon. More of the present value of the bond as we discount each of those future cash flows back to the present and we increase the rate that we are discounting them at, there is a higher and higher percentage of them that are represented by the ones that are closer to us in time, and that, therefore, lowers the duration on the bond.

Slide 31 – Excel'ing @ Bonds! (52:01)

Kevin Webb: So summing up my section here – two points. One, this slide here, for all you Excel gurus, if you want to Excel at bonds, here is how to lay this out. You can recreate this and calculate all these things in Excel. You don't need a Bloomberg or anything else to do it.

Slide 32 – Wolfram Alpha Duration Calculator (52:27)

Kevin Webb: But if you are so inclined and you are interested about duration, I would reference you again, I have on the link if you download it, you can see this little link that pops up – it was not worth pasting it into the slide itself – but if you click on this link when you download the slide, it will take you to Wolfram Alpha with the particulars of the bond that I have used in this example. And there is much more than what I have on the slide. And Wolfram Alpha shows you the duration relationship, the equation, and you can change all the variables and calculate it. It is a good bookmark maybe to have in your browser where if you want to compute duration or yield on your own.

Slide 33 – California Government Code 53601 (U.S. Treasuries Securities) (53:11)

Kent Morris: So I'm going to take it back over. I'm just going to walk through government code now, 53601(b), which is for the U.S. Treasuries, which is basically what is eligible is United States Treasury notes, bonds, bills, or certificates of indebtedness or those for which the full faith and credit of the United States are pledged for the payment of principal and interest.

Slide 34 – CA Government Code 53601 Guidelines (53:42)

Kent Morris: So looking at CDIAC's guideline primer, this is just the section, and as other sections of this webinar go through, maybe they will highlight the different areas. But for U.S. Treasuries, basically the maximum maturity is five years. The maximum percent of the portfolio is unlimited, so there is no restriction. And the minimum quality amount because it is backed by the full faith and credit of the U.S. government is none. So there is no minimum of A or better, because even though one rating agency has the U.S. government at AA, the rest have them as AAA. There are subnotes on these. Now, on U.S. Treasuries, they are not all applicable. I do want to just note what they are really quickly. And for the maximum maturity, you can actually go farther than five years, but in order to do that you need legislative body approval. And if you are going to exceed five years, then you have to do it no less than three months prior to purchasing the security. Bond funds are an exception to this. They are ruled by the indenture itself. So if you buy Treasuries for a bond issue, either construction for a reserve fund, those are mandated by the indenture that has a permitted investment section. And then also in footnote D, where it says percent of portfolio is unlimited, but for instance medium term notes have a restriction of 30 percent. That is an example. In this case there is none but for other categories there are. One thing to note though, for bond issues, for instance, those are a little bit different than your normal investment pool. If you work on the construction funds, those are more cash flow based. So you want to think about not only your yield to try to get above your arbitrage limits, but you also want to think about if you have to sell that security early or quickly to meet a cash flow need, that's where a Treasury can be very helpful for you. Also, the reserve funds, I know some places will buy, for instance, if it is a 30-year issue they might buy a 10- or 15- or 28-year bond and just put it in the reserve fund and put it away. The only issue there, you might consider is, is there a possibility of refunding? Because if you refund that, you will have to sell that security and you could take a loss on that. Also, some reserve funds, you have to mark to market. And if you are marked to market and interest rates have risen fast enough and you start to take losses, unrealized losses on those, then you may have to attribute more funds to the

reserve funds. So just keep those two things in mind when you think about Treasuries for your debt issuances as well.

Slide 35 – Where Do Treasuries Fit in Your Portfolio (56:45)

Kent Morris: So where do Treasuries really fit in your portfolio? One, I think the first place you really need to assess is your risk profile. How risky do you feel in terms of how much time and expertise you might have to manage your portfolios? How important is the interest income? Because there is a yield difference, but especially in the case of corporates, you have to have the time and expertise to do the credit review as well. They provide good diversification, so they give you a different correlation compared to other investments. And they increase your liquidity because as I said a number of times, Treasury securities are highly liquid. They can also help manage your credit exposure. So while you do have interest rate exposure, the credit spread exposure that you have with Treasuries, you could, for instance, purchase longer-dated Treasuries and buy shorter-dated corporates. That way the corporate spread difference is on the shorter end of your portfolio and you'll have less exposure to credit spreads blowing out, for instance. So that could be a way that Treasuries could help you still invest, still have the percentages you want, but perhaps you use your longer-dated, more interest sensitive securities as Treasuries and your shorter-dated ones as corporates.

I know, for instance, what one of the things we do in terms of credit spreads is – and I will talk about this a little bit with market relative value – is that the yield between agencies and Treasuries sometimes gets so tight that we don't want to be in an agency anymore because they are virtually on top of Treasuries. So at that point, we will move from an agency to a Treasury and wait for a reasonable credit spread to reintroduce itself, and then we will move back into that credit product. So you kind of have to monitor sometimes the credit spreads between Treasuries and other securities. With a passive index, if you have a Treasury benchmark – for instance, if you are truly passive, you'll just buy treasuries basically mimicking that index. If you have a slightly enhanced one where you are trying to get it at a little extra yield, Treasuries again are very liquid and they are all across the curve. So if you benchmark against a 1:3 or a 1:5, they are very good securities that can meet all of your indexing needs.

The last two are more active strategies. So you have the time and the expertise in terms of Treasuries. Relative value is one opportunity you can have. So the example I gave with the agency – a typical spread to agencies might be 20 – this is just an example – basis points, but over time that same Treasury comparable might compress and you might only have five or six basis points to it. Well, the question that you really want to ask yourself is, are you happy with earning that difference in case the yields start to, the spreads blow out again? Because what you could do is go into – and I will show an example in just a second – you can move back into a Treasury and then wait for the spreads between the two securities [to] normalize. And then another example is market timing. And I will show you an example, or an anomaly in the market.

Slide 36 – Relative Value (1:04:28)

Kent Morris: So here is an example of relative value. What I did was I took the 2-year Fannie Mae and the 2-year Treasury note from May 2001 to December 2001. And the white line is the agency and the tan line is the Treasury. Down below is the spread between the two. So you can kind of see is that the spread between the two agencies more or less track around 35 basis points

but right around September, with the events of September 11th, you see the spreads spike out. So at that point, looking at it and understanding what is happening in the market, you might feel that at that point, agencies are very cheap and your Treasuries are more expensive. So you would sell your Treasuries and move into those agencies with the idea that over time as you move through September and October and then into November, the spread between those two securities starts to compress and then you realize that now the agencies are actually more expensive, and you want to move back into your Treasuries. And if you would have done that or something reasonable to that, you would see that you could have earned some extra income by Treasuries tightening and then agencies expanding out, and you could get back to what would be relative value for agencies.

Slide 37 – Market Anomalies **(1:01:40)**

Kent Morris: The other one, market timing anomalies is this example. And this is a good example of an anomaly in the market that happens. This happened back in 2013 when the government was going to shut down. This is a 1-month Treasury note – sorry, Treasury bill. And what you see here really is as we started looming towards the government shutdown, you see the yield on the 1-year Treasury bill spike up. And so one could assess that you have to interpret the results that are happening in the market, and for us we realized that if the government was going to be shut down, it would probably be for only a very limited amount of time. Nobody wants to go through that. So as we saw the spike in interest rates, we realized this was an opportunity to go ahead and buy more of the security with the idea that with one month we could get much, much higher yields than other securities that were around at the time. And what was interesting is if you look at the 6-month and the 3-month, 6-month, and 1-year Treasury in the same time period, the relative increases are nowhere near as dramatic. That is really the idea that the market was telling investors that we might expect a shutdown, but if we do, it is going to be for a very limited amount of time because it really affected the 1-month T-bill rate but not necessarily the 3-month, 6-month or 1-year as much. So with that I think we are open to any questions that anyone might have.

Slide 38 – Questions **(1:03:08)**

Robert Berry: I think – this is Robert. We are running a bit over time. I apologize to folks. There are a handful of questions that I think at this point we would be better off to just answer offline, and we will post an FAQ to our website with those answers, if that is okay, Kent and Kevin.

Kent Morris: Absolutely.

Slide 39 – Public Investment Webinar Series: The Public Investment Portfolio **(1:03:30)**

Robert Berry: Okay. So just before we close I want to draw your attention to our remaining slate of webinars in the investment series. And we hope that you will be able to join us for all of them or just a few, depending on your schedule. The agendas for each session and registration is open. The agendas are posted and registration is open so please go to our website and register for those. In closing, on behalf of CDIAC, I would like to thank Kent Morris and Kevin Webb for a great presentation and dedication of their time and expertise to making this webinar a success. And also a thank you to our education team here at CDIAC – Linda Louie, Susan Mills and

Sandra Kent – for their hard work in producing this webinar. We are a bit over time. We apologize for that, but we thank everyone for participating this morning, and we look forward to you joining us again in just a few weeks.