

Callable Agency Analysis

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Callable GSE Deep Dive - 5 items

How to achieve sleep-adjusted returns

1

Philosophical Overview

2

What are they?

3

Why do they exist?

4

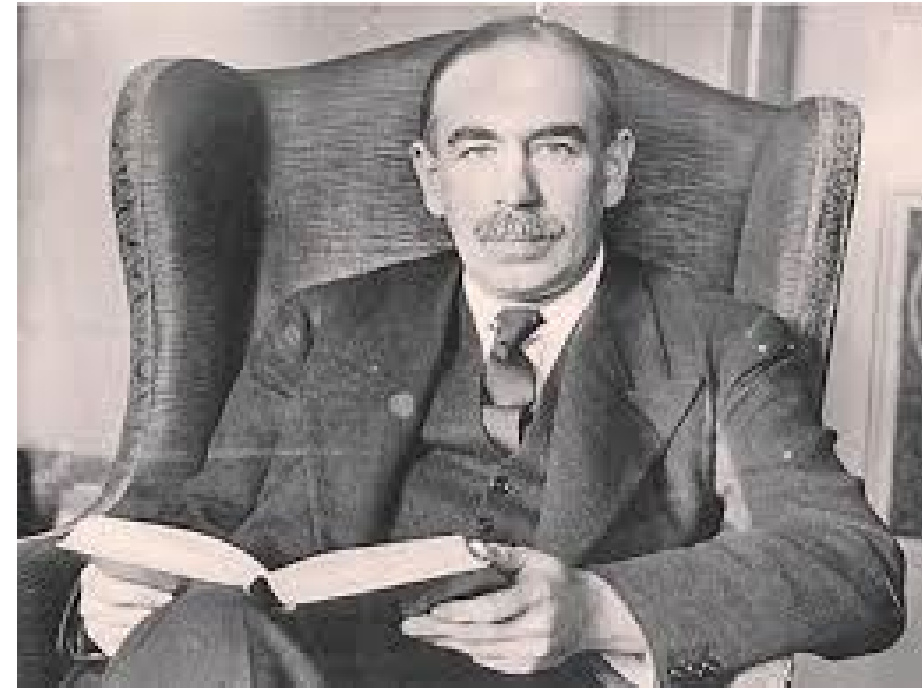
How should they be analyzed?

5

A Digression on OAS and Volatility

Economic Words of Wisdom 1

“The Theory of Economics does not 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.”



John Maynard Keynes writing in the introduction of
H.D. Henderson, *Supply and Demand* (New York: Harcourt, Brace and Company, 1922), v. Emphasis added.

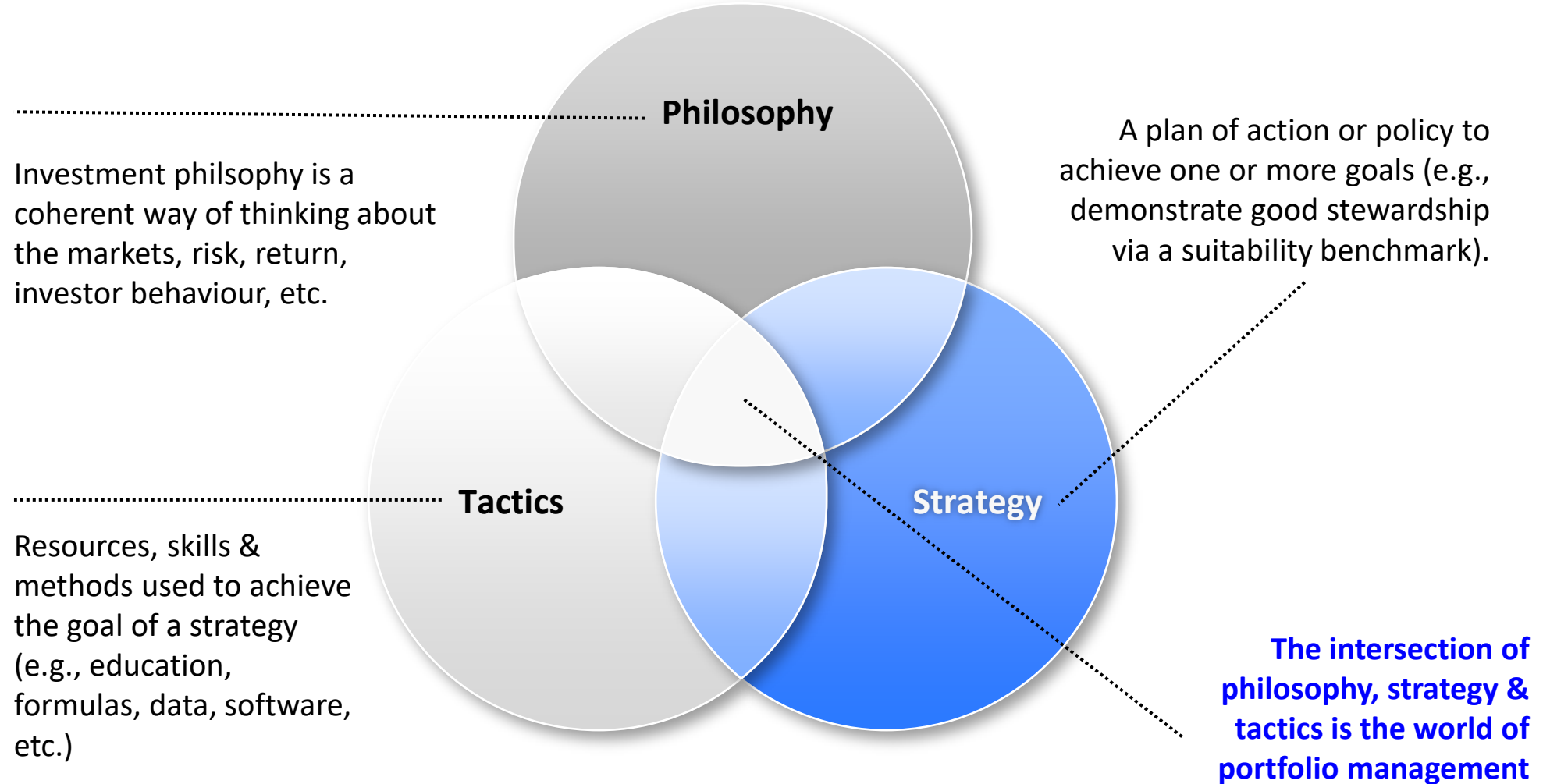
Economic Words of Wisdom 2

“Nobel laureate Kenneth Arrow has warned, “[O]ur knowledge of the way things work, in society or in nature, comes trailing clouds of vagueness. Vast ills have followed a belief in certainty.””



Philosophy, Strategy & Tactics

Sleep-Adjusted returns via Suitability Benchmark using evidence based methods.



The difference between strategy and tactics: Strategy is done above the shoulders, Tactics are done below the shoulders.

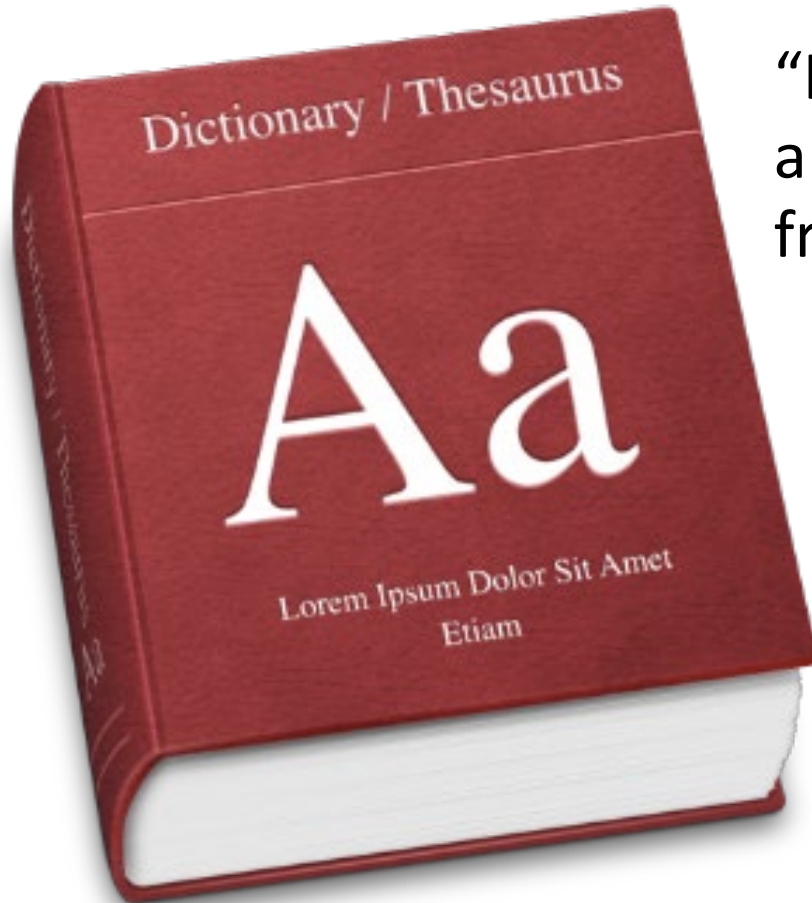




WARNING

**ASSUMPTIONS
AHEAD**

Definitions



“Knowledge is knowing a tomato is a fruit; Wisdom is not putting it in a fruit salad.”



Brandreth, Gyles. Oxford Dictionary of Humorous Quotations (Kindle Location 4265). OUP Oxford. Kindle Edition.
See this useful Microsoft Help page for Microsoft Word on the definition/history of “Lorem Ipsum Dolor Sit Amet Etiam”:

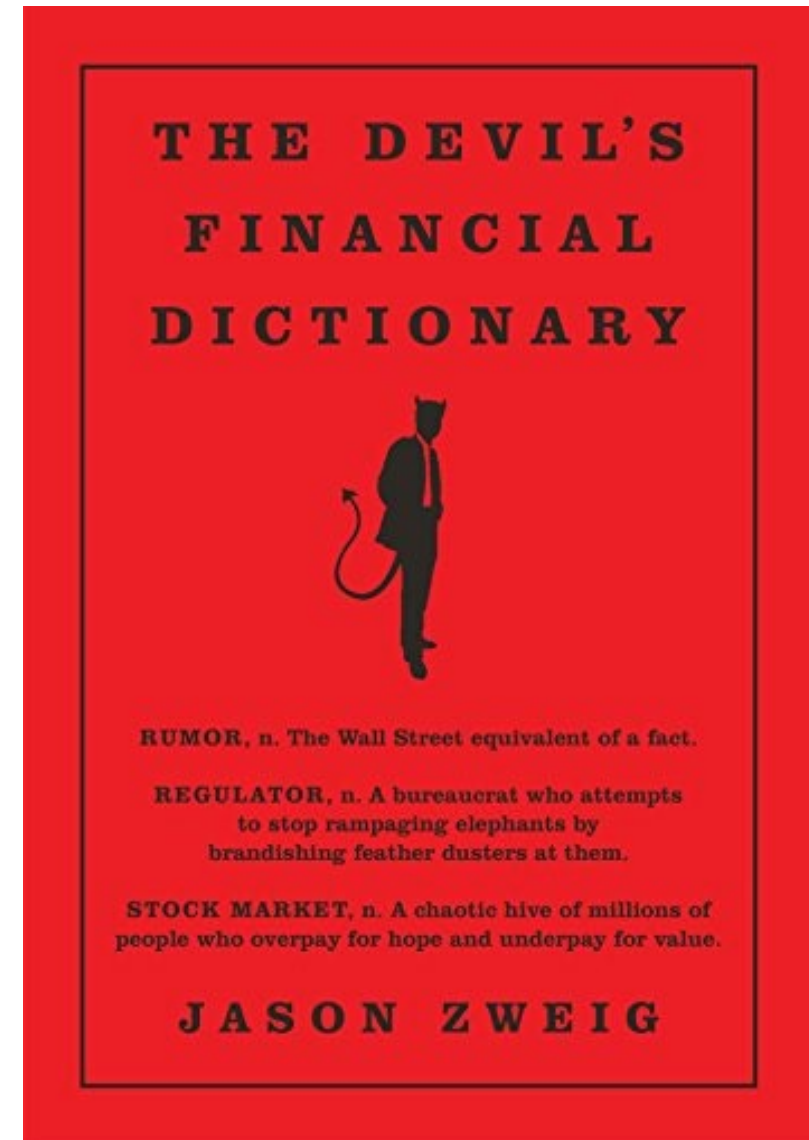
<https://support.microsoft.com/en-us/kb/114222>



Risk Defined

More things can happen than will happen.

... It has been philosophically defined by finance professor Elroy Dimson of London Business School this way: ***“Risk means more things can happen than will happen.”*** In the end, risk is the gap between what investors think they know and what they end up learning— about their investments, about the financial markets, and about themselves.

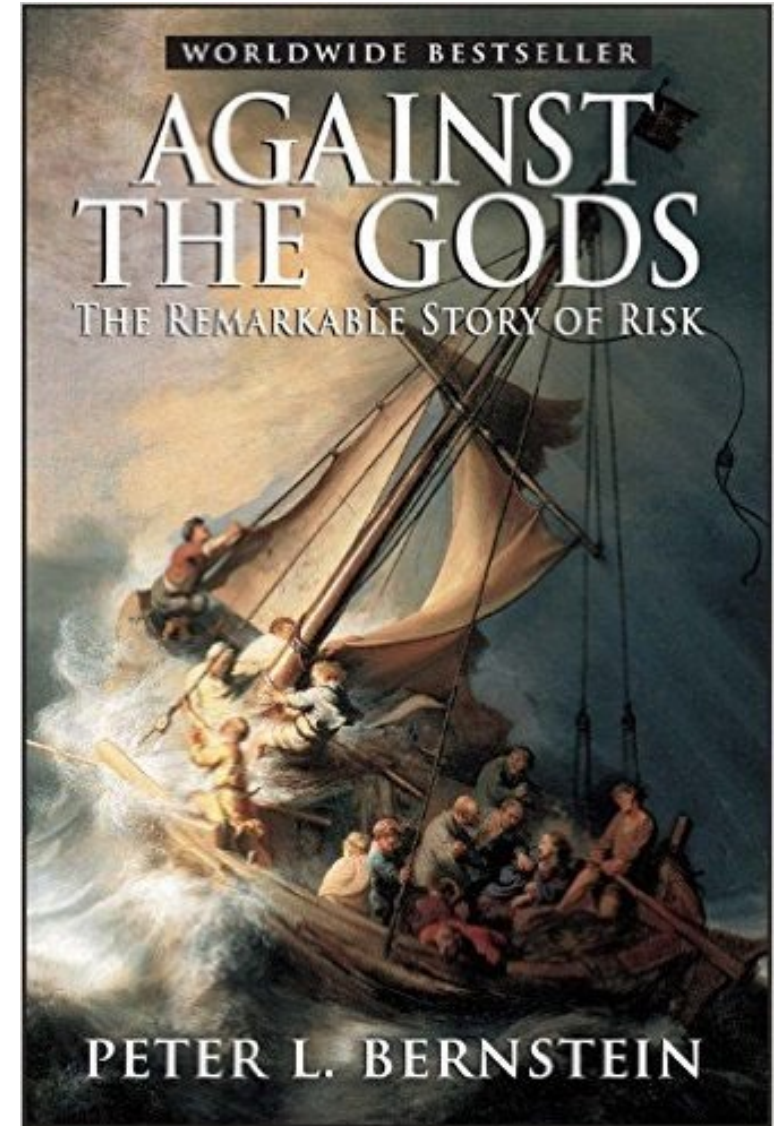


Risk & Return are Related

Finding the right trade-off is the key

*The scientist who developed the Saturn 5 rocket that launched the first Apollo mission to the moon put it this way: ***"You want a valve that doesn't leak and you try everything possible to develop one. But the real world provides you with a leaky valve. You have to determine how much leaking you can tolerate."***

(Obituary of Arthur Rudolph, in The New York Times, January 3, 1996.)



What Should I Benchmark?

Prudent Person

Investments shall be made with judgment and care, under circumstances then prevailing, which persons of prudence, discretion and intelligence exercise in the management of their own affairs, not for speculation, but for investment, considering the probable safety of their capital as well as the probable income to be derived.

Prudent Investor

A U.S. law that sets the standard of fiduciary duty for those entrusted with the responsibility of managing others' money, such as trustees and estate administrators. It requires that a trustee weigh risk versus reward when making investment decisions, taking into account the income that may be generated by the investment as well as the probable safety of the invested capital.

Prudent Investor vs Prudent Man/Person

1. Trust accounts are judged on their entire portfolio, rather than whether the investment was prudent at the time of purchase.
2. Diversification is explicitly required under the Prudent Investor Act
3. Suitability is deemed more important than individual investments
4. Fiduciaries are allowed to delegate investment management to qualified third parties

What Should I Benchmark?

General Objectives

“The primary objectives, in priority order...

1. Safety

Safety of principal is the foremost objective... ***The goal will be to mitigate credit risk and interest rate risk.***

2. Liquidity

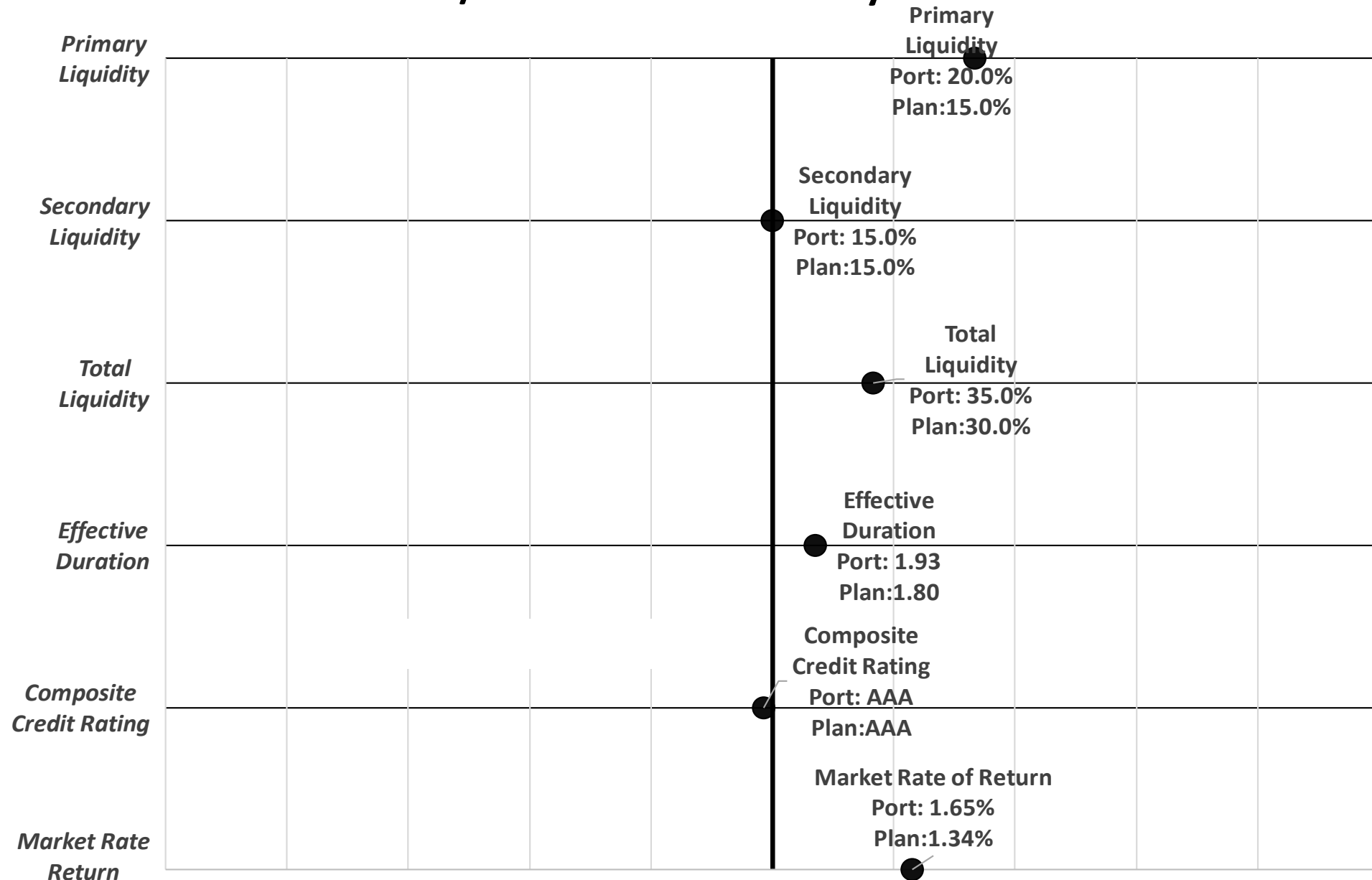
The investment portfolio shall ***remain sufficiently liquid*** to meet all operating requirements that may be reasonably anticipated.

3. Return

The investment portfolio shall be designed with the objective of attaining a ***market rate of return throughout budgetary and economic cycles***, taking into account the investment risk constraints of safety and liquidity needs.”

Benchmark Suitability

Gain/Loss is not listed! Why not?





What & why?

Callable bonds: What are they?

- ***A bond where the issuer has the option to call (buyback) the bond*** from an investor at a pre-determined price on a pre-specified date.
- The option to call the bond is usually one of the following kind:
 - **European:** One time only
 - **Bermudan:** Multiple times quarterly or semi-annually usually on coupon payment dates
 - **American:** Any time after a specified date
- In return for the option to call, the issuer pays a higher coupon than a non-callable bond of similar maturity.
- **The value of the call option depends on:**
 - *How often* and at what price the issuer can call the bond (exercise option)
 - *Time to the call date*
 - ***Volatility of interest rates***

American Options:

Continuously Callable
Callable Anytime

Bermuda Options:

Discretely Callable:
Callable On Specific Dates

European Options:

One Time Callable:
Then Converts To Bullet



Verde Options:

Bermuda Call To 1st Step
Callable On Step Dates

Canary Options:

Callable Until 1st Step
Then Converts To Bullet

4 <GO> to Set Current Selection as Default

95) Actions ▾ 96) Alerts ▾ 97) Summary 98) Set Homepage 99) Export ▾ New Issue Monitor

Selection U.S. Agencies (NIM 2) ▾ 1) Show Filters 2) Clear Filters Issues & News ▾

Real Time Issue History Date Range 04/03/22 - 05/03/22 6) Prelim Bonds | PREL

	Date ↓	Issuer/Headline	Coupon	Maturity	Spread	Curr	Outst	Book Mgr	Note
			All ▾	All ▾	All ▾	All ▾	All ▾		
101	14:00	FED HOME LN BANK	STEP	11/24/23		USD	15	TSI-sole	1.5-NC1 1X
102	13:21	FED HOME LN BANK	STEP	08/11/23		USD	15	PIPR-sole	1.25-NC3MBER
103	13:20	FED HOME LN BANK	2.200	05/25/23		USD	55	JOINT LEADS	1-NC6MO INC
104	12:57	FED HOME LN BANK	STEP	08/25/23		USD	20	JOINT LEADS	1.25-NC6MO1X
105	12:42	FED HOME LN BANK	4.000	05/26/27		USD	130	JOINT LEADS	5-NC3MO INC
106	11:56	FED FARM CREDIT	2.900	05/09/25		USD	300	JOINT LEADS	3-NC
107	11:51	FED HOME LN BANK	2.700	11/24/23		USD	25	JOINT LEADS	1.5-NC1 1INC
108	11:42	FED HOME LN BANK	3.625	06/12/37		USD	3	RBS-sole	15-NC
109	11:38	FED HOME LN BANK	2.125	05/05/23		USD	35	JOINT LEADS	1-NC
110	10:39	FED HOME LN BANK	4.120	05/10/32		USD	5	TSI-sole	10-NC1 CONT
111	10:26	FED HOME LN BANK	3.400	09/09/25		USD	10	LOOPCM-sole	3.25-NC3MBER
112	10:00	FED HOME LN BANK	STEP	05/26/27		USD	30	FHN-sole	5-NC3MO INC
113	9:40	FED HOME LN BANK	4.000	05/26/27		USD	35	RWB,STONEX	5-NC3MO INC
114	9:15	FED HOME LN BANK	STEP	05/25/27		USD	50	WFS-sole	5-NC1 BERM
115	9:03	FED HOME LN BANK	3.400	05/23/25		USD	15	MIZ-sole	3-NC1 BERM
116	8:59	FARMER MAC	3.080	05/11/26		USD	20	INSPRX,MSRV	4-NC
117	8:58	FED HOME LN BANK	3.400	05/23/25		USD	28	FHN-sole	3-NC1 BERM
118	8:58	FARMER MAC	3.100	05/13/27		USD	20	OPP,RAM	5-NC
119	8:49	FED HOME LN BANK	3.125	11/26/24		USD	15	JOINT LEADS	2.5-NC1 1X

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 Japan 81 3 4565 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000
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Callable bonds: Data/Information

- FHLMC (Freddie Mac) Bond Data:
<http://www.freddiemac.com/debt/html/sactivitymain.html>
- FNMA (Fannie Mae) Bond Data:
<http://www.fanniemae.com/portal/funding-the-market/debt/reports/>
- FHLB (Federal Home Loan Bank) Bond Data:
http://www.fhlb-of.com/ofweb_userWeb/pageBuilder/debt-securities-21
- FFCB (Federal Farm Credit Bank) Bond Data:
https://www.farmcreditfunding.com/ffcb_live/activitySummary.html
- FRB (Federal Reserve Bank) Call Notices:
<https://www.frbservices.org/app/callnotices/CallNotices.action>
- TRACE (FINRA Trade Reporting and Compliance Engine):
<http://finra-markets.morningstar.com/BondCenter/Default.jsp>

Callable bonds: Why are they?

- **Agencies buy mortgage loans** and assets backed by mortgage loans.
- **Home owners usually have the right to pre-pay** the mortgage loan at any time:
 - When rates drop home owners are likely to pre-pay loans and “re-finance” at lower rates.
 - When rates rise home owners are likely to keep the low rate loan rather “re-finance” with a higher rate loan.
- Therefore, Agencies are short options to homeowners
- **The issuance of callable bonds allows the Agencies to match the characteristics of the mortgage loan** (asset/liability management):
 - When interest rates drop, mortgage loans (assets) pre-pay, Agencies can redeem their callable bonds (liabilities).



How should they be analyzed @ the sector level?

Return: Total Return or Book Yield?

“Total rate of return measures the increase in the investor’s wealth due to both investment income (for example, dividends and interest) and capital gains (both realized and unrealized). ***The total rate of return implies that a dollar of wealth is equally meaningful to the investor whether that wealth is generated by the secure income from a 90-day Treasury bill or by the unrealized appreciation in the price of a share of common stock.***”

$$HPR = \frac{I_t + P_t - P_{t-1}}{P_{t-1}}$$

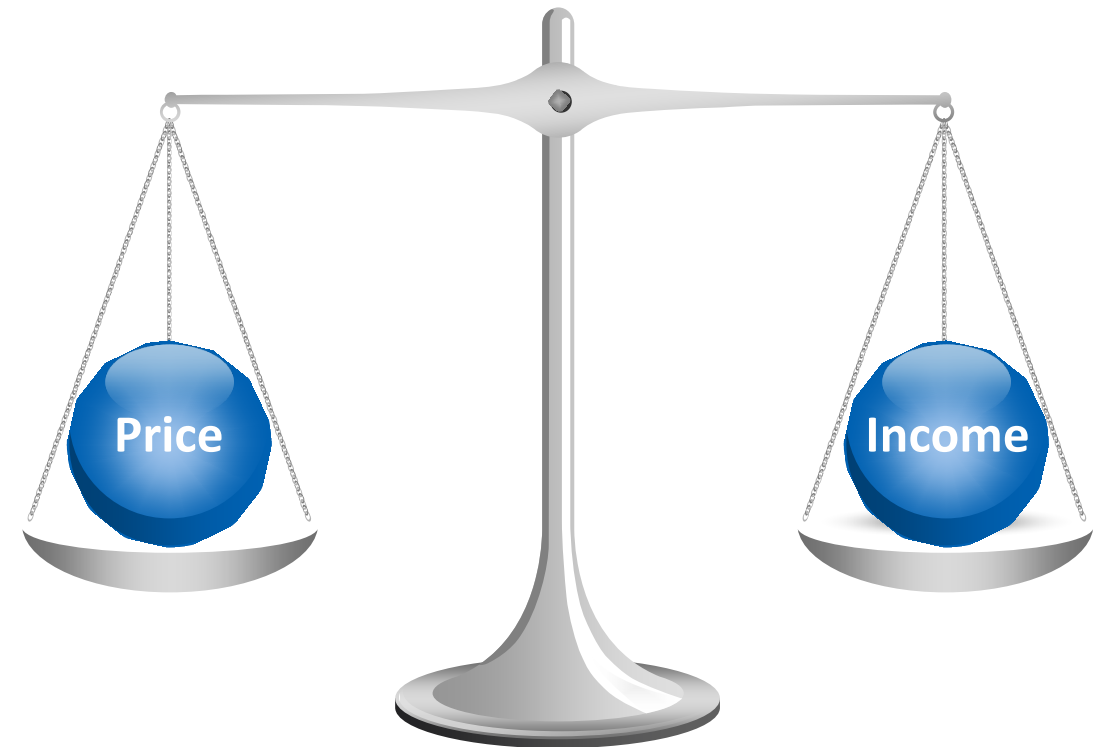
where HPR = holding period return

I_t = income

P_t = ending price

P_{t-1} = beginning price

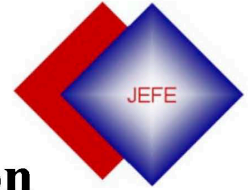
$$\text{Total Return} = \frac{(\text{EndingMarketValue} - \text{BegMarketValue}) + \text{CashFlow}}{\text{BegMarketValue}}$$



Yield To Maturity (Book Yield) is always received as promised

This note points out that the above-mentioned common treatment in many textbooks turns out to be a fallacy. The truth is that YTM on a (coupon) bond is always received regardless of how coupon payments are re-invested, provided that the bond is held until maturity without default. It addresses a basic question in bond theory: between YTM and realized compounding yield (RCY hereafter), which concept measures the true rate of return from holding a coupon bond until maturity? It is well accepted that YTM measures the rate of return from holding a bond until maturity for both coupon bond and zero-coupon bond as well. By definition, the YTM received from holding a bond is independent of how coupon payments are allocated, as long as they are paid on time as contracted. By comparing the initial investment and the final value accumulated over the investment horizon, on the other hand, RCY on a bond measures the rate of return from an account (or trust) that holds the bond and the interests paid. Of course, it depends on how coupon payments are reinvested. We demonstrate that the RCY actually measures the YTM from a combined investment - holding a coupon bond plus an additional periodic investment with each coupon payment received. Not surprisingly, YTM and RCY would be normally unequal; RCY equals YTM if and only if coupon payments are reinvested at the same rate as the initial YTM. However, this conclusion should not be interpreted as “the yield to maturity is actually received only if coupon payments are reinvested at the yield to maturity”.

Journal of Economics and Finance Education



Volume 7 Summer, 2008 Number 1

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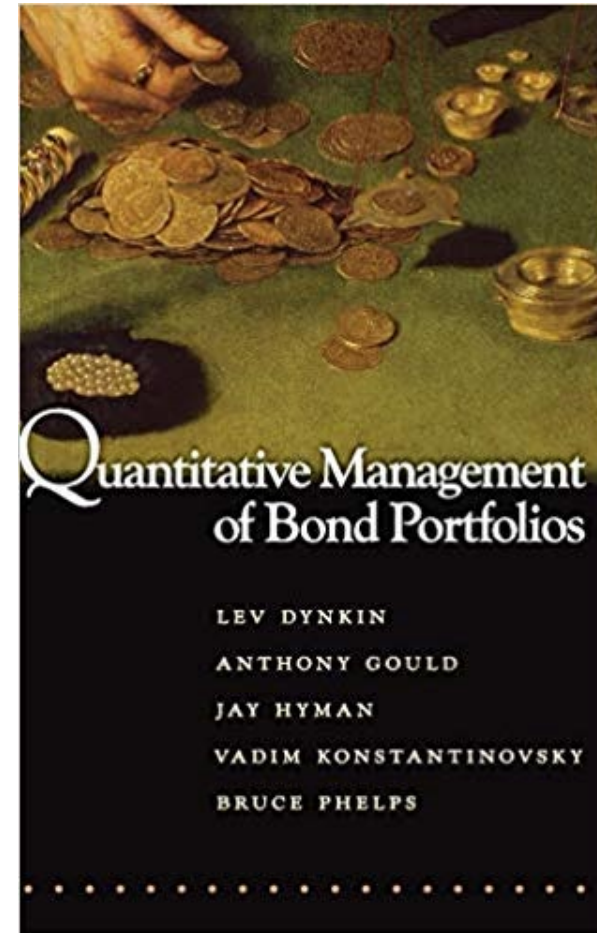
Don't let Tactics drive Philosophy

Don't let Wall Street make you over in their image and likeness...

...investors, who are predominantly concerned with book yield and risk adjusted book returns, can benefit from performance benchmarks that also use book accounting.

Because the book accounting performance of an index depends on the timing and amounts of cash inflows and outflows (and the particular rules for handling such cash flows) preceding the current performance month, no two investors will likely have the same book benchmark even if their underlying index is the same. By its very nature, a book benchmark must be customized for each investor to allow him or her to input their historical vector of cash inflows and outflows (including rules) so as to produce proper book accounting values in the current month. ...

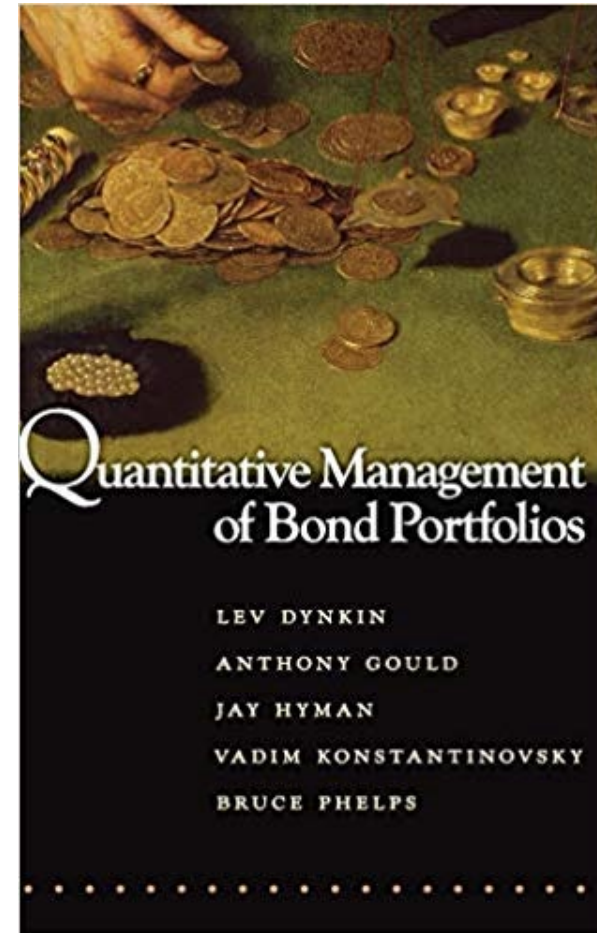
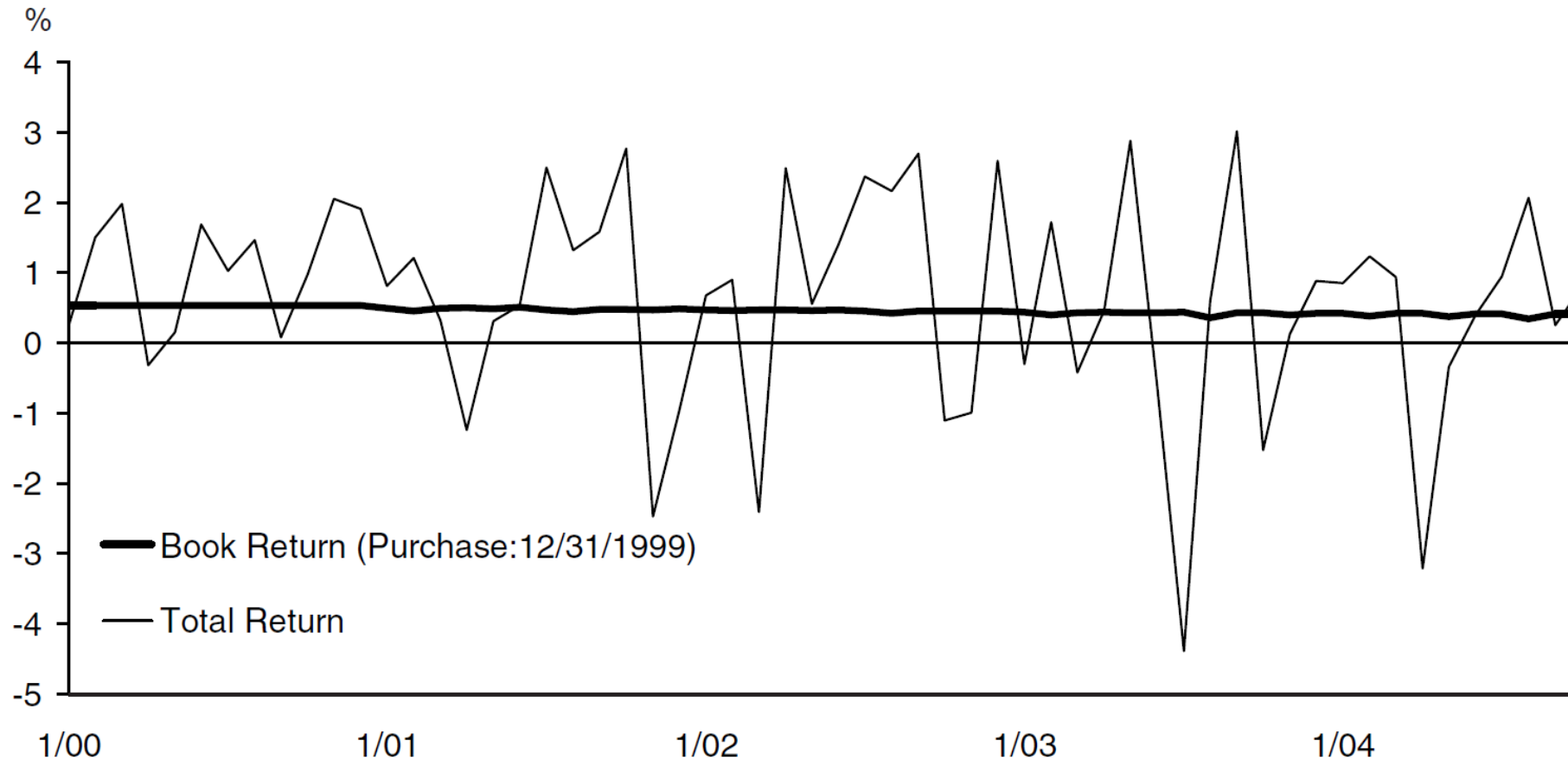
The benchmark book yield and book income are indications of what could be achieved if the manager followed a passive strategy. ...



Don't let Tactics drive Philosophy

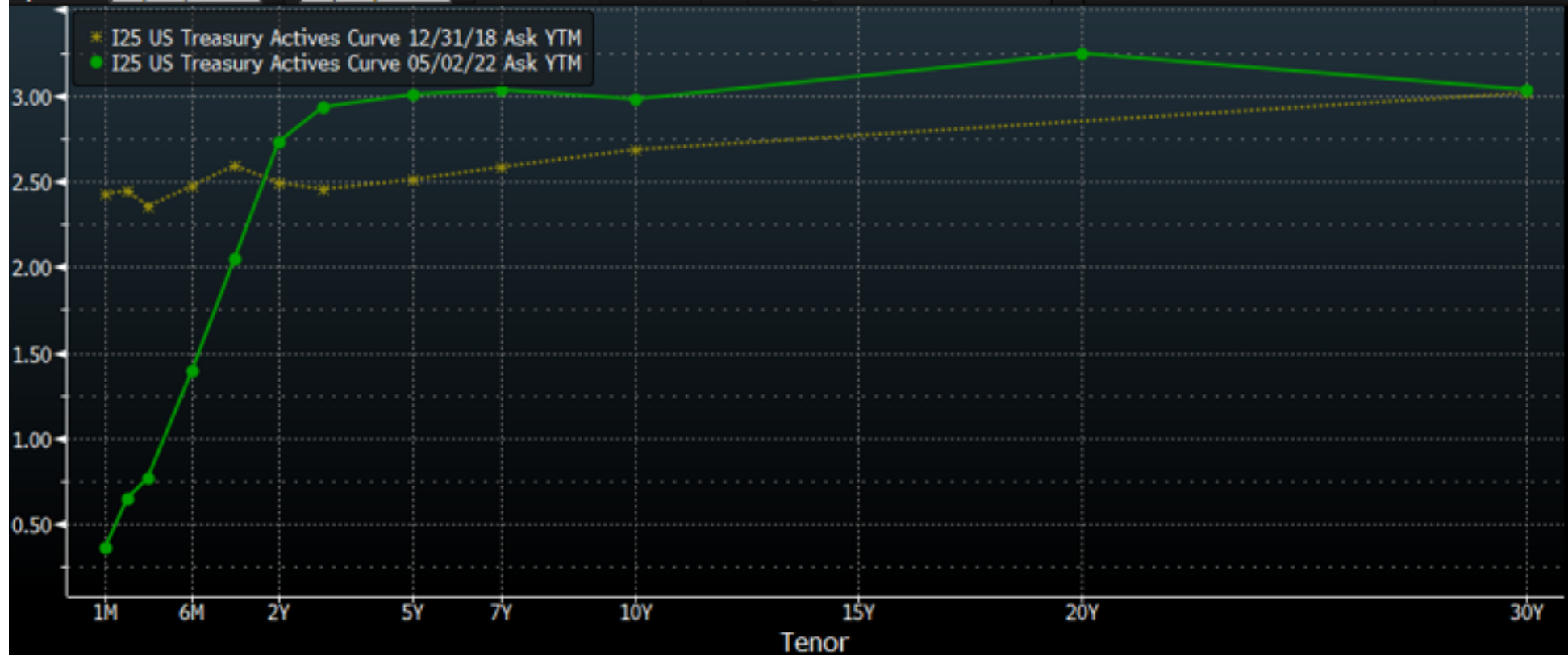
Don't let Wall Street make you over in their image and likeness...

Figure 1. **Book Return versus Market Return: A Portfolio of the Lehman Brothers U.S. Treasury Index, Purchased on December 31, 1999**



Running as C15. Run GC for more features.

US Treasury Actives Curve Actions 98 Table Export Settings Graph Curves
 X-Axis Tenor Y-Axis Ask YTM Currency None PCS BGN Lower Chart History Table
 Specific 12/31/18 05/02/22 Relative Last 1D 1W Modify Curves & Relative Value



Curve Id	1M	3M	2Y	5Y	10Y	20Y	30Y
1) I25 05/02/22	0.363	0.769	2.731	3.005	2.981	3.246	3.033
2) I25 12/31/18	2.425	2.355	2.488	2.511	2.684		3.015
13) I25 (05/02/22-12/31/18)	-206.2	-158.6	24.3	49.3	29.6		1.8

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US Generic Govt 2 Yr Index | D USGG2YR <Index> US Generic Government Yields 2 Yr

USGG2YR Index 94 Suggested Charts 96 Actions 97 Edit Line Chart
12/31/2018 - 05/02/2022 Last Px Local CCY Mov Avgs Key Events
1D 3D 1M 6M YTD 1Y 5Y Max Daily Table + Quick-Add Add Data Edit Chart



Source: Bloomberg on 5/3/22

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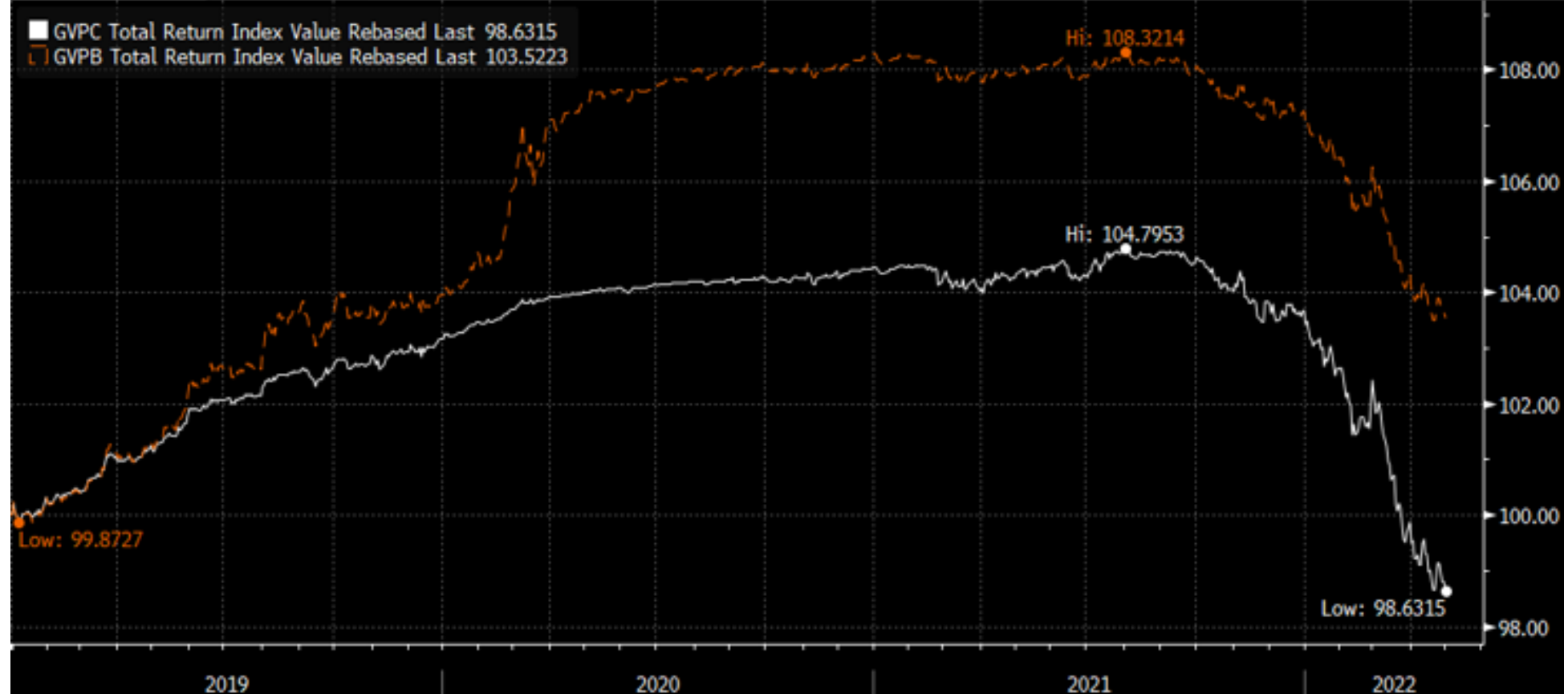
ICE Bond Indices: Index Charts/Tables

Date Range	12/31/2018	-	05/02/2022	Frequency	Daily			
Index	Currency	Start	End	High	Low	Avg	StDev	Annl StDev
GVPC	LOC	100.000	98.631	104.795	98.631	103.148	1.476	23.428
GVPB	LOC	100.000	103.522	108.321	99.873	105.721	2.630	41.749

Attribute: Total Return Index Value Rebase to 100 at Start Date

MTD 1M QTD 1Q YTD 1Y 3Y 5Y 10Y Max

51) Data Chart 52) Spread 53) Correlation 54) Data Table



2019 2020 2021 2022

Australia 61 2 9777 8600 Brazil 5511 2395 9000 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
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ICE Bond Indices: Index Charts/Tables

Date Range	12/31/2018	-	05/02/2022	Frequency	Daily				
Index	Currency	Start	End	High	Low	Avg	StDev	Annl StDev	
GVPC		2.69	2.91	2.91	0.31	1.23	0.82	13.01	
GVPB		2.56	2.70	2.70	0.21	1.07	0.83	13.21	
Attribute	Yield to Worst (Conventional)								
MTD	1M	QTD	1Q	YTD	1Y	3Y	5Y	10Y	Max
51) Data Chart	52) Spread	53) Correlation	54) Data Table						



Source: Bloomberg on 5/3/22. Data & calculations by ICE.

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ICE Bond Indices: Index Charts/Tables

Date Range	12/31/2018	-	05/02/2022	Frequency	Daily			
Index	Currency	Start	End	High	Low	Avg	StDev	Annl StDev
GVPC		2.69	2.91	2.91	0.31	1.23	0.82	13.01
GVPB		2.56	2.70	2.70	0.21	1.07	0.83	13.21

Attribute	Yield to Worst (Conventional)								
MTD	1M	QTD	1Q	YTD	1Y	3Y	5Y	10Y	Max
51) Data Chart	52) Spread	53) Correlation	54) Data Table						



Australia 61 2 9777 8600 Brazil 5511 2395 9000 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 4585 8900 Singapore 65 8212 1000 U.S. 1 212 518 2000
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ICE Bond Indices: Index Charts/Tables

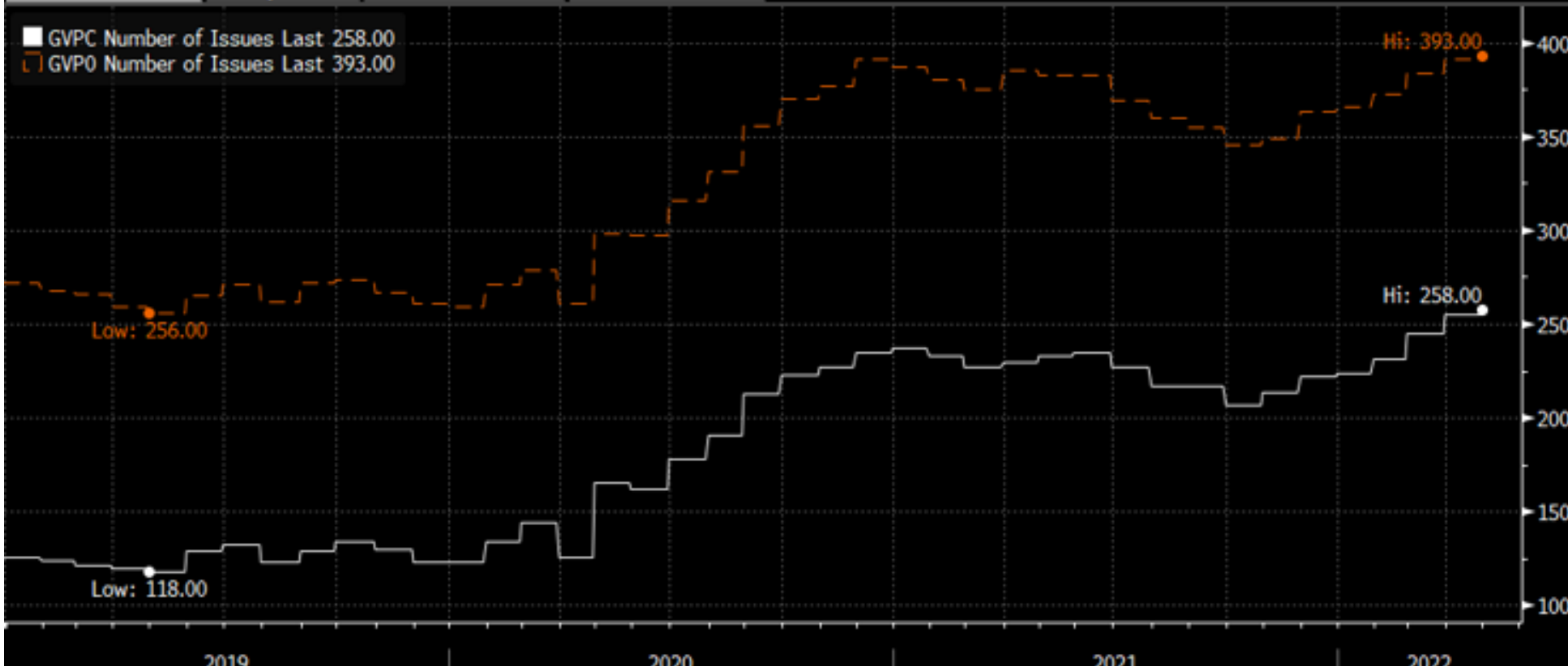
Date Range 12/31/2018 - 05/02/2022 Frequency Daily

Index	Currency	Start	End	High	Low	Avg	StDev	Annl StDev
GVPC		126	258	258	118	182	48	767
GVPO		272	393	393	256	324	51	813

Attribute Number of Issues

MTD 1M QTD 1Q YTD 1Y 3Y 5Y 10Y Max

51) Data Chart 52) Spread 53) Correlation 54) Data Table



2019 2020 2021 2022

Australia 61 2 9777 8600 Brazil 5511 2395 9000 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
 Japan 81 3 4585 8900 Singapore 65 8212 1000 U.S. 1 212 518 2000

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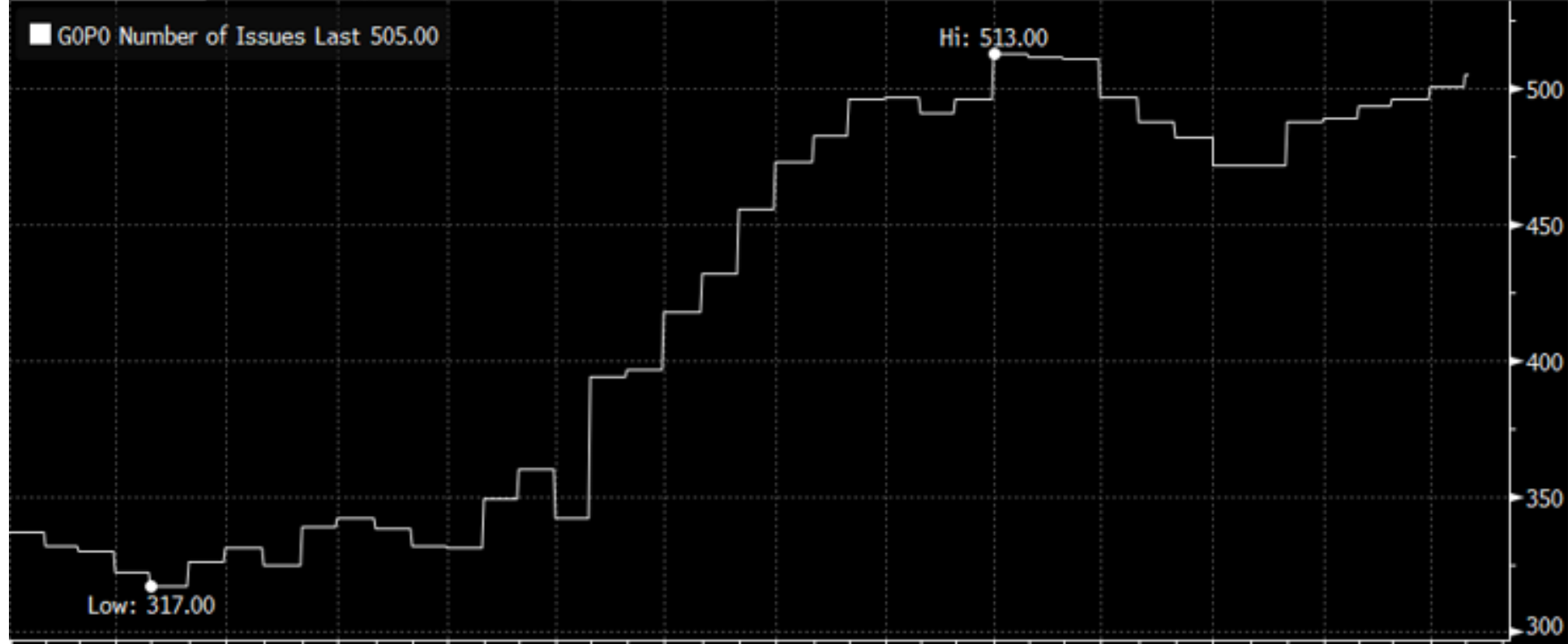
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ICE Bond Indices: Index Charts/Tables

Date Range	12/31/2018	-	05/03/2022	Frequency	Daily			
Index	Currency	Start	End	High	Low	Avg	StDev	Annl StDev
GOP0		337	505	513	317	420	75	1,184
<Enter Index>								

Attribute	Number of Issues								
MTD	1M	QTD	1Q	YTD	1Y	3Y	5Y	10Y	Max

51) Data Chart 52) Spread 53) Correlation 54) Data Table



2019	2020	2021	2022
Australia 61 2 9777 8600	Brazil 5511 2395 9000	Europe 44 20 7330 7500	Germany 49 69 9204 1210
Japan 81 3 4565 8900	Singapore 65 6212 1000	U.S. 1 212 318 2000	Hong Kong 852 2977 6000
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 Comparison Compliance Analysis Scenario Analysis L/H AMBEST Life/Health
 Reporting & Analysis Insurance & ALM

Portfolio List #2 - USAGY on 05/03/2022

Name	Type	Title	Manager	Class					
USAGY	Func	US Agency	kpw	00					
Add/Modify Lookup Sec ID Screen Sort Refresh Calculate Save Close									
Total Market Value	YTE	EDUR	ED2	ED3	SDUR	YTM	DTM	Convexity	Espread
537,537,377	2.91	2.96	1.43	2.33	2.96	2.74	3.40	-0.10	0.11
Group/Sec ID	Holdings	Description	Coupon	Maturity					
2796	31359MFJ	2,834	FEDERAL NATL MTG AS BNCHMK 7	7.125000 01/15/:					
2797	3134A1Z6	47	FEDERAL HOME LN MTG CORP STEP	6.930000 06/01/:					
2798	31359MEU	2,350	FEDERAL NATL MTG AS BNCHMK BD	6.250000 05/15/:					
2799	31331RN6	64	FEDL FARM CR BKS CO FR 5.75	5.750000 12/07/:					
2800	31364F6P	46	FEDERAL NATL MTG AS FR 5.96	5.960000 09/11/:					
2801	31364F6C	8	FEDERAL NATL MTG AS FR 6.08	6.080000 09/01/:					
2802	31359MEA	264	FEDERAL NATL MTG AS GLBL DB	6.160000 08/07/:					
2803	31359MEB	359	FEDERAL NATL MTG AS CONS BD	6.210000 08/06/:					
2804	31364FYC	50	FEDERAL NATL MTG AS FR 5.625	5.625000 04/17/:					
2805	31364FHW	12	FEDERAL NATL MTG AS FR 5.83	5.830000 11/26/:					
2806	31364FVZ	258	FEDERAL NATL MTG AS FR 6.12	6.120000 03/23/:					
2807	31364FSY	6	FEDERAL NATL MTG AS FR 5.65	5.650000 02/22/:					
2808	31364FQN	7	FEDERAL NATL MTG AS FR 6.15	6.150000 01/28/:					
2809	31364FPD	11	FEDERAL NATL MTG AS FR 6	6.000000 01/21/:					
2810	31364FKW	72	FEDERAL NATL MTG AS FR 6.32	6.320000 12/20/:					
2811	31364FGK	6	FEDERAL NATL MTG AS FR 5.98	5.980000 11/12/:					
2812	31364FDC	311	FEDERAL NATL MTG AS FR 6.03	6.030000 10/08/:					
2813	31364FCB	129	FEDERAL NATL MTG AS FR 6.09	6.090000 09/27/:					
2814	31364CDR	26	FED NATL MTG ASSN M FR 7.19	7.190000 05/29/:					
2815	31364CCC	28	FED NATL MTG ASSN M FR 7.125	7.125000 04/30/:					
2816	31364A6J	48	FEDERAL NATL MTG AS FR 8.28	8.280000 01/10/:					
2817	31364A7K	30	FEDERAL NATL MTG AS FR 7.93	7.930000 02/14/:					

USAGY on 05/03/2022

Portfolio List #1 - USAGY on 12/31/2018

Name	Type	Title	Manager	Class					
USAGY	Func	US Agency	kpw	00					
Add/Modify Lookup Sec ID Screen Sort Refresh Calculate Save Close									
Total Market Value	YTE	EDUR	ED2	ED3	SDUR	YTM	DTM	Convexity	Espread
503,928,582	2.72	2.22	1.04	1.61	2.22	2.70	2.50	-0.05	0.10
Group/Sec ID	Holdings	Description	Coupon	Maturity					
1545	3134A1Z6	47	FEDERAL HOME LN MTG CORP STEP	6.930000 06/01/:					
1546	31359MEU	2,350	FEDERAL NATL MTG AS BNCHMK BD	6.250000 05/15/:					
1547	31331RN6	64	FEDL FARM CR BKS CO FR 5.75	5.750000 12/07/:					
1548	31364F6P	46	FEDERAL NATL MTG AS FR 5.96	5.960000 09/11/:					
1549	31364F6C	8	FEDERAL NATL MTG AS FR 6.08	6.080000 09/01/:					
1550	31359MEA	264	FEDERAL NATL MTG AS GLBL DB	6.160000 08/07/:					
1551	31359MEB	359	FEDERAL NATL MTG AS CONS BD	6.210000 08/06/:					
1552	31364FYC	50	FEDERAL NATL MTG AS FR 5.625	5.625000 04/17/:					
1553	31364FHW	12	FEDERAL NATL MTG AS FR 5.83	5.830000 11/26/:					
1554	31364FVZ	258	FEDERAL NATL MTG AS FR 6.12	6.120000 03/23/:					
1555	31364FSY	6	FEDERAL NATL MTG AS FR 5.65	5.650000 02/22/:					
1556	31364FQN	7	FEDERAL NATL MTG AS FR 6.15	6.150000 01/28/:					
1557	31364FPD	11	FEDERAL NATL MTG AS FR 6	6.000000 01/21/:					
1558	31364FKW	72	FEDERAL NATL MTG AS FR 6.32	6.320000 12/20/:					
1559	31364FGK	6	FEDERAL NATL MTG AS FR 5.98	5.980000 11/12/:					
1560	31364FDC	311	FEDERAL NATL MTG AS FR 6.03	6.030000 10/08/:					
1561	31364FCB	129	FEDERAL NATL MTG AS FR 6.09	6.090000 09/27/:					
1562	31364CDR	26	FED NATL MTG ASSN M FR 7.19	7.190000 05/29/:					
1563	31364CCC	28	FED NATL MTG ASSN M FR 7.125	7.125000 04/30/:					
1564	31364A6J	48	FEDERAL NATL MTG AS FR 8.28	8.280000 01/10/:					
1565	31364A7K	30	FEDERAL NATL MTG AS FR 7.93	7.930000 02/14/:					
1566	313586H3	63	FEDERAL NATL MTG AS DSM 19-A	8.100000 08/12/:					

USAGY on 12/31/2018



How should they be analyzed @ the bond level?

More Analysis & Information Here...

CDIAC No. 20-07



CALIFORNIA DEBT AND INVESTMENT ADVISORY COMMISSION

Investing in Callable Securities - September 2020 Update

In recent years, “callable” securities, which contain options that allow issuers to retire them prior to their final maturity dates, have gained usage among public fund investors. Their greater usage as a tool for state and local investment officials largely can be seen in the wide variety of bonds containing call features that are available for public fund investment. For example, corporations and U.S. Agencies both issue a variety of different types of callable bonds. The increased use of callable securities is due, in part, to the growing sophistication of financial markets. Over the past twenty years, methods for comparing intricately structured investments have been developed and refined, thus allowing public fund investors to be able to more easily compare and better understand the risks and value of these potential investment alternatives. Moreover, during times of lower returns on investment, callable bonds provide relatively higher returns than noncallable bonds because investors are compensated for the potential call risk they face without incurring additional credit risk.

However, while the higher yields available on callable securities can be attractive for investors who can accept call risk in their fixed-income portfolios, these instruments can introduce other types of risk that public investors should consider. Most notably, investment in callable securities can increase a portfolio’s “reinvestment risk” (that is, the risk of having to reinvest money in a lower interest-rate environment if the original investment is called); consequently, investors

need to weigh the potential benefits and drawbacks of such an investment.

This *Issue Brief* seeks to provide public investment officials with information to assist them in evaluating callable securities relative to noncallable securities. It provides information on the key characteristics of callable securities, the potential advantages and disadvantages of incorporating them into an investment portfolio, and how to assess their value compared to noncallable securities. It concludes with recommendations to consider when deciding whether to invest in callable securities.

I. AN OVERVIEW OF CALLABLE SECURITY FEATURES

Callable securities are term bonds within which the issuer has the option to redeem the bonds prior to the final maturity of the issue. In such cases, the issuer is enabled, during specific time periods, to “call”, or repurchase, a bond away from the investor at a specified price. The action is entirely at the election of the issuer, with no recourse by the investors in the bonds. The call feature has a noticeable impact on the issuer’s cost of borrowing, and hence the returns achieved by public fund investors. To compensate for the maturity uncertainty that an investor is assuming, the yields on callable securities are at a premium over those obtainable from fixed maturity debt with the same final maturity.

Diversity of Call Types

Corporations and U.S. Agencies issue callable debt in a variety of forms. Final maturities typically range from one to thirty years. In addition, all callable bonds have a period of time during which the issuer cannot call the bond – the “lockout period”.

The lockout period can be any time after issuance to any time before maturity and at any frequency. The securities can be issued with either single or multiple call provisions. Popular call provisions include the following three types:

- **EUROPEAN CALL.** The bonds may be called one time only on a pre-specified date after the initial lockout period.
- **BERMUDAN CALL.** The bonds may be called according to a pre-specified schedule (e.g. monthly, quarterly, or semi-annually) after the initial lockout period. A bond with a Bermudan call option is also known as a discretely-callable bond.
- **AMERICAN CALL.** The bonds are continuously callable after the initial lockout period. That is, they are callable at any time on or after the first call date.

As is the case with investment products generally, the variations on the basic call structures continue to grow. For example, one variation includes the “step-up” call structure. A step-up call will have a call date at which point the issuer may retire it or the security will “step up” to a higher coupon rate.

Regulations Regarding Disclosure of Call Features

Municipal Securities Rulemaking Board (MSRB) Rule 12 and Rule 15a require broker/dealers to inform investors that an investment has a call option and to provide information about whether/how that option may impact the investment’s value. Specifically, in the case of callable securities, the broker/dealer must provide the yield/price of the lower of the following two scenarios:

1. The bond’s yield/price to call, which assumes the bond is called, typically at the next/first call date.



CALIFORNIA DEBT AND INVESTMENT ADVISORY COMMISSION

CDIAC No. 20-10

Issue Brief: Benefits and Limitations of Option-Adjusted Spread Analysis

INTRODUCTION

Public fund managers want to ensure that their investment practices are consistent with their investment policy, and accomplish the main objectives of optimizing safety, liquidity, and return on agency assets. These goals charge public agencies with thoughtfully choosing investments that mitigate risk, ensure sufficient liquidity to meet ongoing obligations, and also generate income for the portfolio over budgetary and economic cycles. These different objectives often come into contention with one another, as assets considered the safest usually produce the smallest returns and assets with higher returns also tend to have more risk.

Yield spread is an important indicator that investors consider when acquiring investments for their portfolios, as it measures additional return for an asset above a risk-free rate. Absolute yield spread for a bond is calculated by subtracting the yield of a “risk-free” bond¹ from the yield of that bond. Although the yield spread for a bond provides important information about the return on the investment, it does not account for embedded redemption structures, such as call options, which allow the issuer to redeem, or call, the bond prior to maturity.

Option-adjusted spread (OAS) is a measure of yield spread for a bond that accounts for embedded redemption structures. OAS is an improvement on the standard calculation of yield spread for a bond because it accounts for the possibility of a change in the bond’s cash flows due to changes in interest rates. This issue brief discusses what OAS is, how to interpret OAS values, modeling assumptions, and the limitations of applications of OAS in public portfolio management.²

WHAT IS OAS?

OAS is a measure of yield spread that accounts for embedded call options in the valuation of bonds. The OAS for a bond is computed using price and projections of interest rate volatility to account for the possibility of early redemption. The OAS value is interpreted as the constant spread that can be earned on the asset compared to the risk-free option. Most commonly, the OAS is expressed as a spread over the Treasury curve.³

The main benefit and purpose of OAS is that it allows for comparability between bonds with different redemption structures. For the majority of public agencies, the most common application of OAS relates to agency investments in callable bonds. For example, an agency might want to compare the yield for a callable bond with the yield for a noncallable, or bullet, bond. Without OAS, an investor can only compare the nominal rate of return for each bond without being able to consider a potential lower return in cases where the callable bond is redeemed before maturity. When used correctly, OAS can help investors

EFFECTIVE DURATION

Additional benefits of OAS include applications to calculating duration for a bond in a way that accounts for an embedded option. Duration is a measure of estimating the price (market value) change in a bond given a change in interest rates. Effective duration is a byproduct of the option models that produce OAS and it accounts for ways that changes in interest rates have the potential to change a bond’s cash flows. Similar to how OAS is an improved measure of yield spread, effective duration is an improvement over modified duration, as it is a more reliable indicator of a callable bond’s price sensitivity to changes in interest rates.

make more informed decisions about which assets to include in their portfolios that balance their different investment objectives of safety, liquidity, and return.

INVESTMENT RISKS OF CALLABLE BONDS

Callable bonds have an embedded option for early redemption, which is associated with additional investment risks. For example, one of the main risks of investing in callable bonds is the possibility that the bond could be redeemed, or “called,” earlier than its

¹ A common benchmark security for calculating yield spread is an on-the-run Treasury issue with the same maturity as the bond being compared.

² This issue brief is meant to be used as general guidance about what OAS is and how to interpret OAS values. It is not intended to be used as investment advice.

³ Robert Ingenito, Kelly Joy, and Kevin Webb, “Issue Brief: Investing in Callable Securities – September 2020 Update,” California Debt and Investment Advisory Commission, 5, Published September 2020, Accessed September 23, 2020, www.treasurer.ca.gov/cdiac/publications/issue-brief/2020/20-07.pdf.

4 <GO> to Set Current Selection as Default

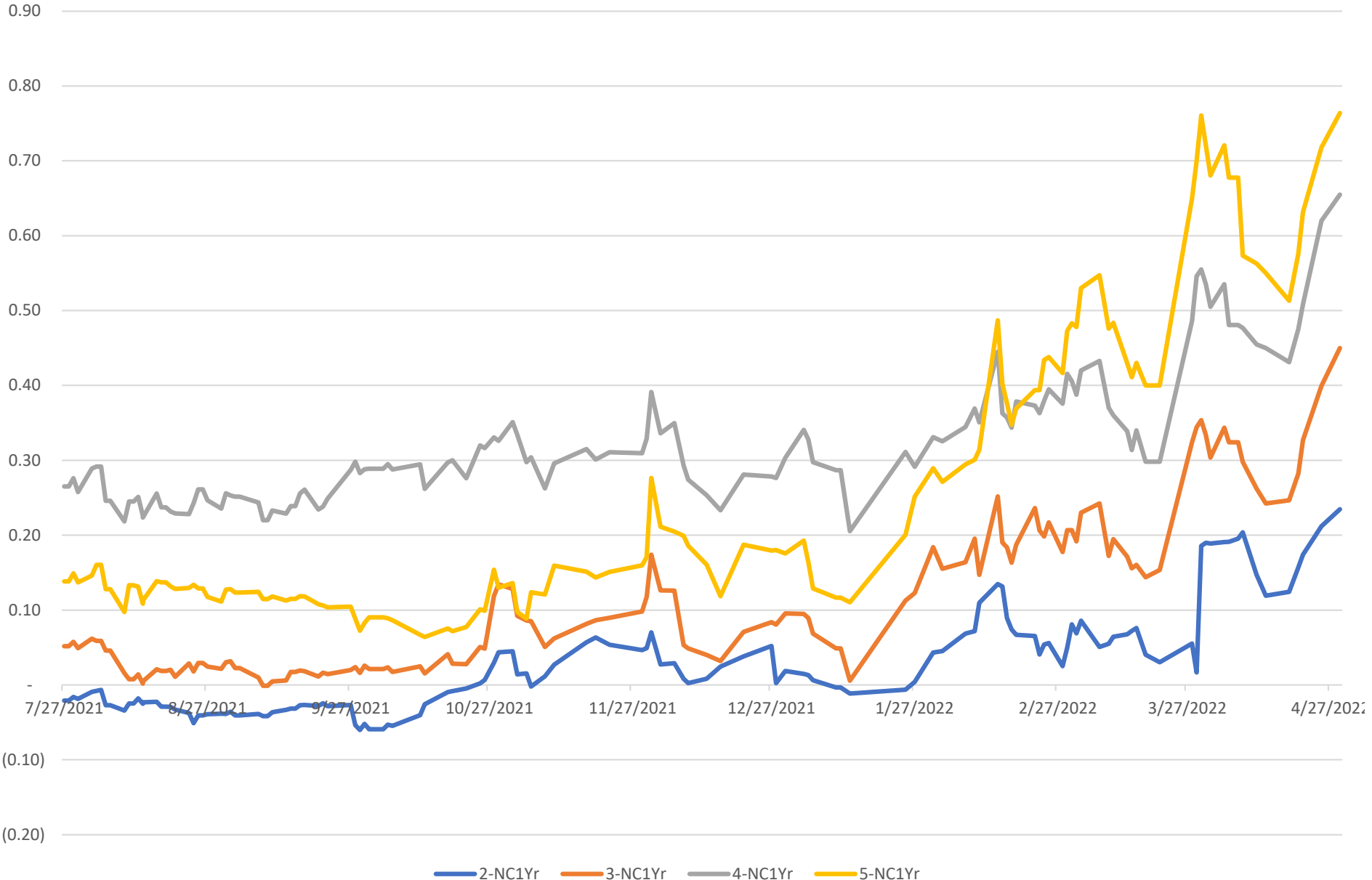
95) Actions ▾ 96) Alerts ▾ 97) Summary 98) Set Homepage 99) Export ▾ [New Issue Monitor](#)

Selection U.S. Agencies (NIM 2) ▾ 1) Show Filters 2) Clear Filters Issues & News ▾

Real Time Issue History Date Range 04/03/22 - 05/03/22 6) Prelim Bonds | PREL

	Date ↓	Issuer/Headline	Coupon	Maturity	Spread	Curr	Outst	Book Mgr	Note
			All ▾	All ▾	All ▾	All ▾	All ▾		
101	14:00	FED HOME LN BANK	STEP	11/24/23		USD	15	TSI-sole	1.5-NC1 1X
102	13:21	FED HOME LN BANK	STEP	08/11/23		USD	15	PIPR-sole	1.25-NC3MBER
103	13:20	FED HOME LN BANK	2.200	05/25/23		USD	55	JOINT LEADS	1-NC6MO INC
104	12:57	FED HOME LN BANK	STEP	08/25/23		USD	20	JOINT LEADS	1.25-NC6MO1X
105	12:42	FED HOME LN BANK	4.000	05/26/27		USD	130	JOINT LEADS	5-NC3MO INC
106	11:56	FED FARM CREDIT	2.900	05/09/25		USD	300	JOINT LEADS	3-NC
107	11:51	FED HOME LN BANK	2.700	11/24/23		USD	25	JOINT LEADS	1.5-NC1 1INC
108	11:42	FED HOME LN BANK	3.625	06/12/37		USD	3	RBS-sole	15-NC
109	11:38	FED HOME LN BANK	2.125	05/05/23		USD	35	JOINT LEADS	1-NC
110	10:39	FED HOME LN BANK	4.120	05/10/32		USD	5	TSI-sole	10-NC1 CONT
111	10:26	FED HOME LN BANK	3.400	09/09/25		USD	10	LOOPCM-sole	3.25-NC3MBER
112	10:00	FED HOME LN BANK	STEP	05/26/27		USD	30	FHN-sole	5-NC3MO INC
113	9:40	FED HOME LN BANK	4.000	05/26/27		USD	35	RWB,STONEX	5-NC3MO INC
114	9:15	FED HOME LN BANK	STEP	05/25/27		USD	50	WFS-sole	5-NC1 BERM
115	9:03	FED HOME LN BANK	3.400	05/23/25		USD	15	MIZ-sole	3-NC1 BERM
116	8:59	FARMER MAC	3.080	05/11/26		USD	20	INSPRX,MSRV	4-NC
117	8:58	FED HOME LN BANK	3.400	05/23/25		USD	28	FHN-sole	3-NC1 BERM
118	8:58	FARMER MAC	3.100	05/13/27		USD	20	OPP,RAM	5-NC
119	8:49	FED HOME LN BANK	3.125	11/26/24		USD	15	JOINT LEADS	2.5-NC1 1X

2nc1 | 3nc1 | 4nc1 | 5nc1 Berm Call Nominal Spread History
7/27/21 to 4/29/22



Source: RW Baird Agency Desk 4/29/22

Yield Spread Analysis

“Given that Treasury securities do not expose investors to credit risk, market participants look at the yield offered on an on-the-run Treasury security as the minimum interest rate required on a non-Treasury security with the same maturity. ... it is commonplace to refer to the additional yield over the benchmark Treasury issue of the same maturity as the yield spread.

$$\textit{yield spread} = \textit{yield on bond X} - \textit{yield on bond Y}$$

where bond Y is considered the reference bond (or benchmark) against which bond X is measured.

When a yield spread is computed in this manner it is referred to as an absolute yield spread and it is measured in basis points.”

Option Adjusted Spread Analysis

“Unlike yield analysis, OAS analysis does not attempt to predict a bond’s likely redemption date. Instead, it treats a bond’s early-redemption provisions—whether puts, calls, sinking funds, or a combination of the three—as options on its cash flows. Since such provisions are built into the cash-flow structure of a bond, they are referred to as the embedded options of a bond. Specifically, the OAS model measures the issue’s spread, in basis points, relative to risk-free rates of return, after adjusting for the effects of any embedded options.

...the spread says nothing about whether the bond is rich, cheap, or appropriately priced; instead, it measures the extent to which the issue’s expected rate of return exceeds risk-free returns. Ultimately, it is the investor who must decide whether the magnitude of such incremental returns provides adequate compensation for the risks contained in the bond.”

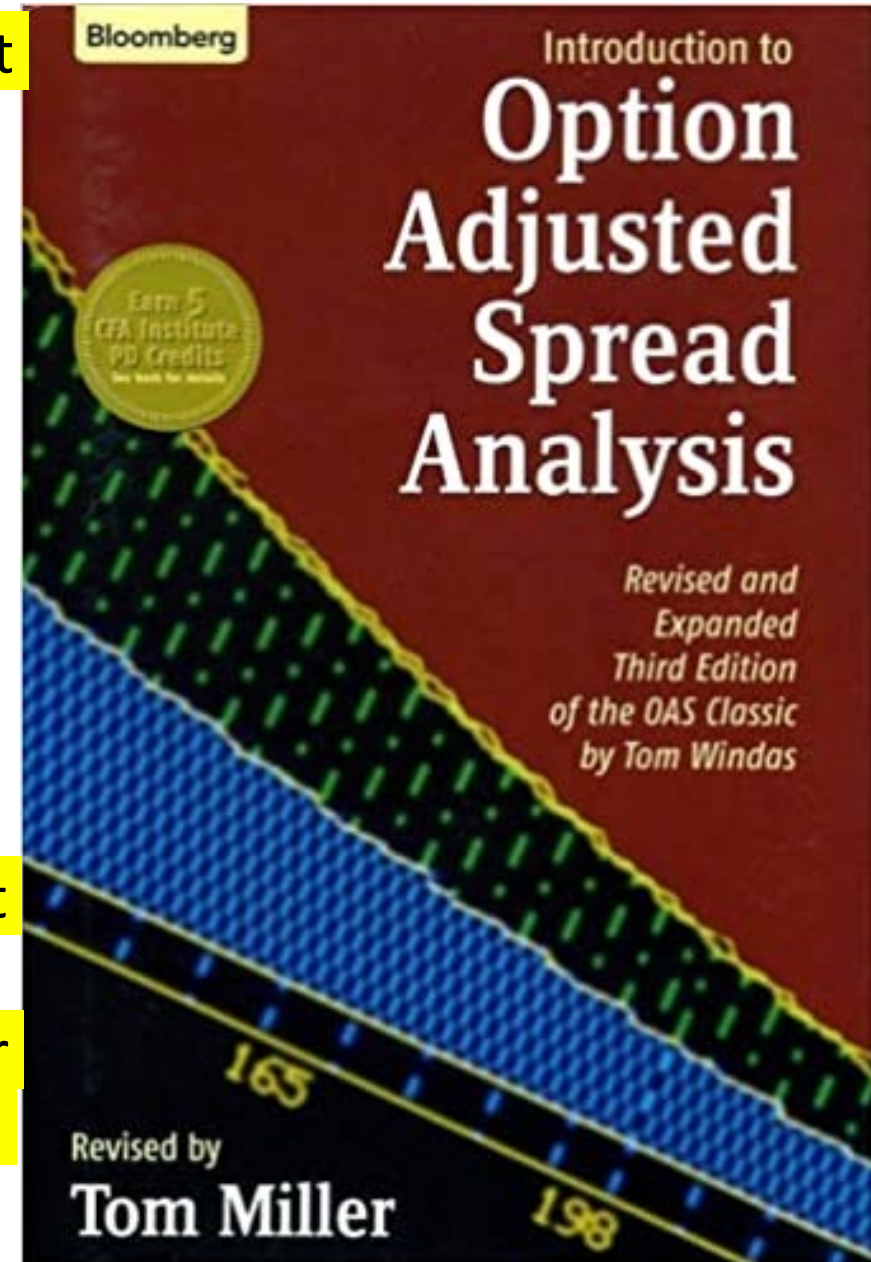
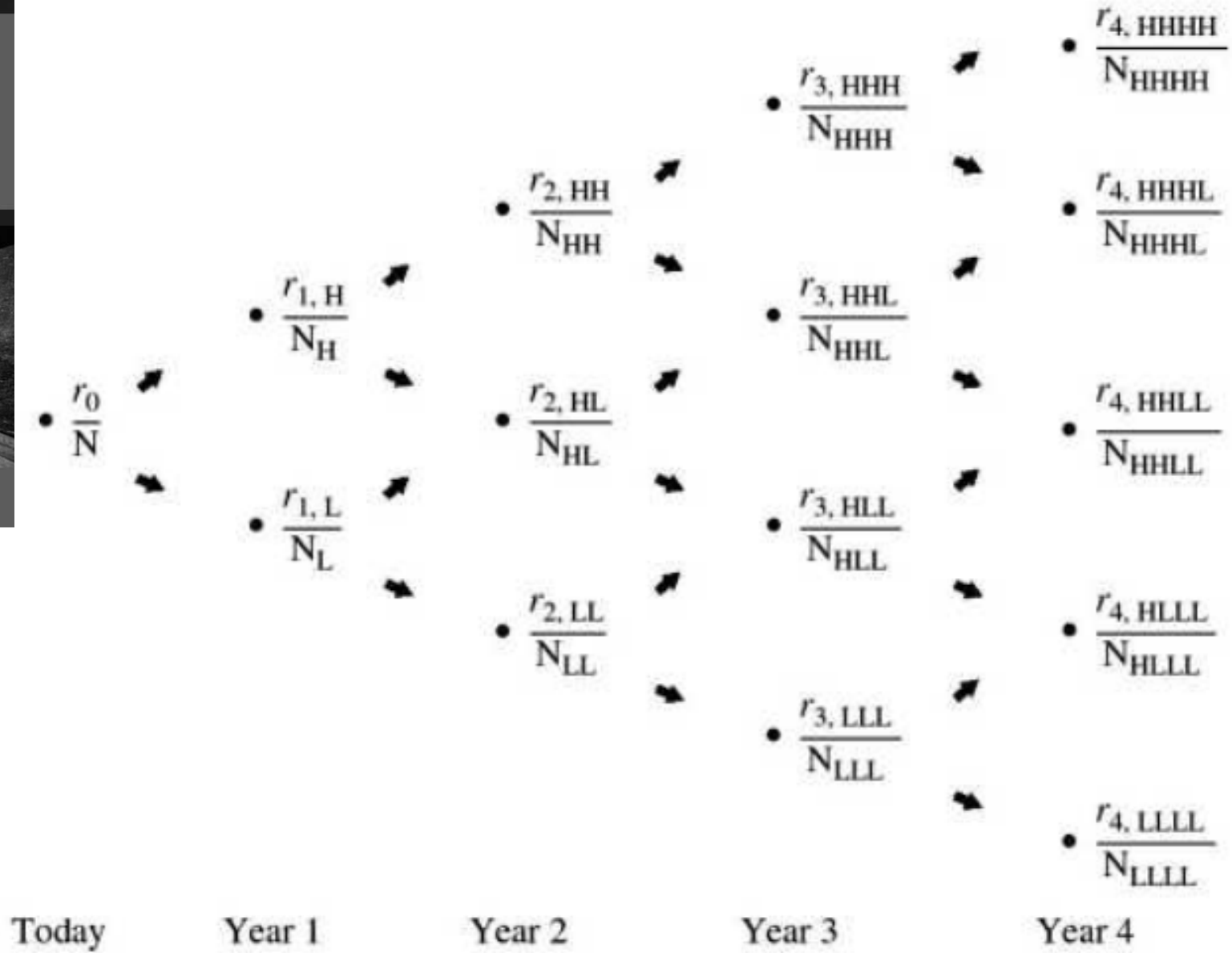
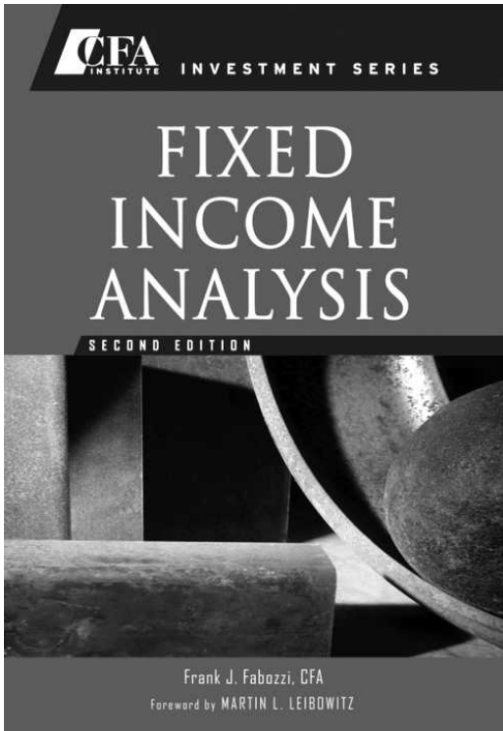


EXHIBIT 3 Four-Year Binomial Interest Rate Tree



Generic New Issue Agency Webb: 5/3/2022

Years To Maturity: 2.00 to 15.00 | Years To Call: 0.25 to 5.00

These are estimates of where new issue callables could potential be issued.

These levels are indications only and continually subject to change.

Time (yrs)	Spot Yield (%)	Par Yield (%)
0.25	0.92	0.92
0.50	1.45	1.45
1.00	2.20	2.19
2.00	2.79	2.78
3.00	2.98	2.97
4.00	3.04	3.03
5.00	3.03	3.02
7.00	3.04	3.03
10.00	2.92	2.93
15.00	2.98	2.97
20.00	3.32	3.23
25.00	3.25	3.20
30.00	3.02	3.05

Call Type

○ DBer

✕ DEur

OAS(bp)



(232.9) (27.0)

Volatility Parameters ✕

Options:

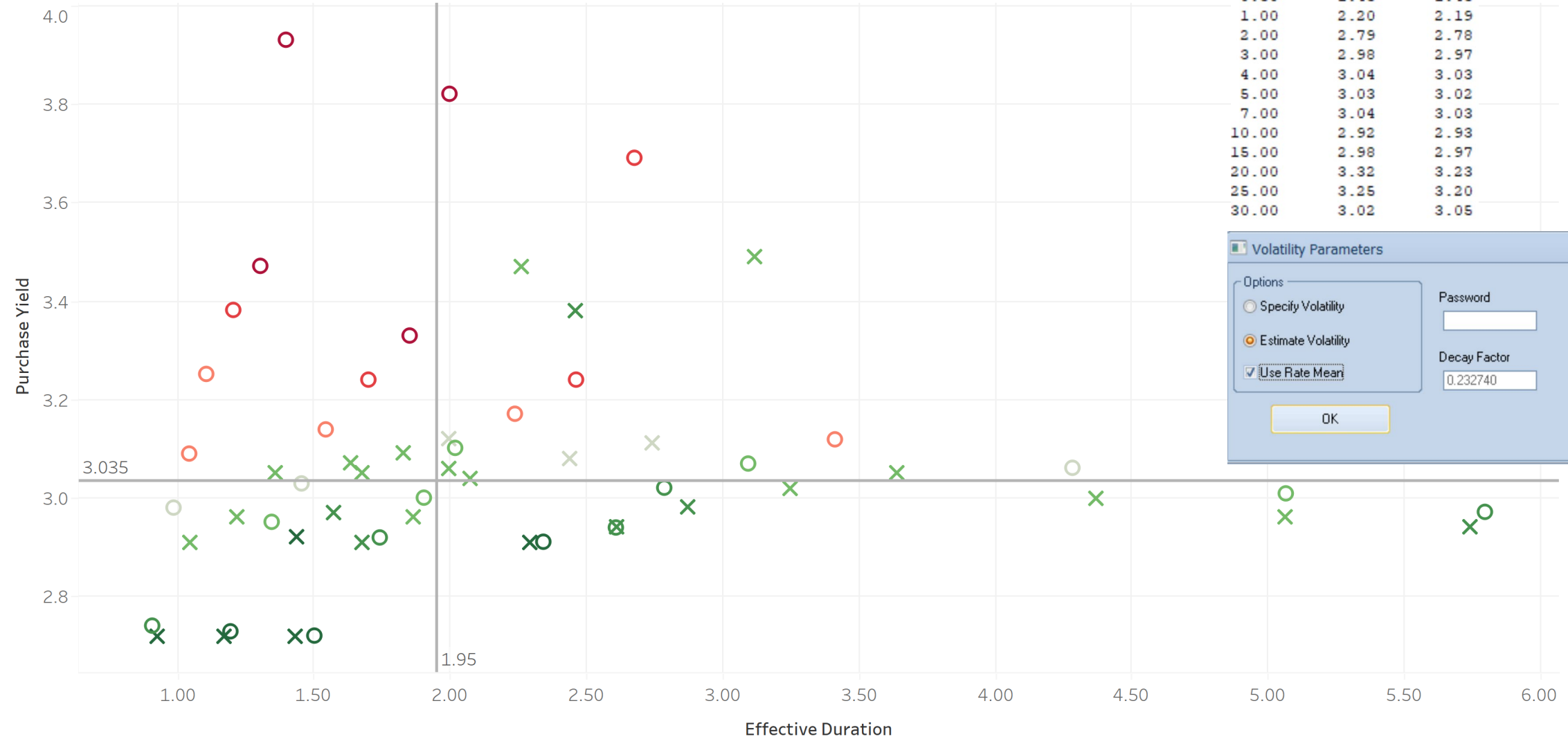
- Specify Volatility
- Estimate Volatility
- Use Rate Mean

Password:

Decay Factor:

Short Rate Vol: %

Long Rate Vol: %

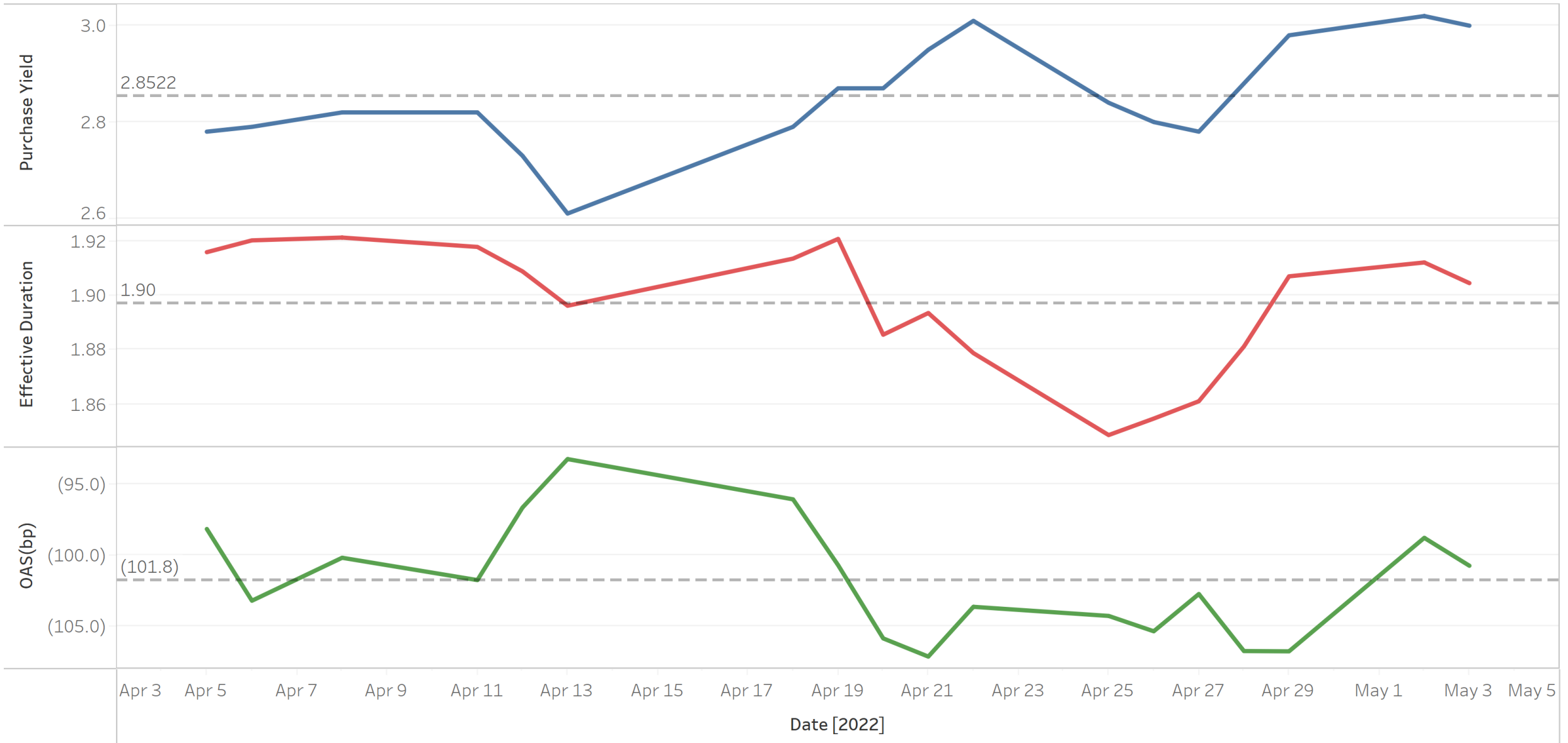


Generic New Issue Agency 04Y1YB

4/5/2022 to 5/3/2022

This is a historical estimate of where new issue 04Y1YB could have been issued.

These levels are indications only and continually subject to change.





A bit about OAS and Volatility

This is a product of Sales & Trading. This is not a product of Research. Disclaimer inside.



Agency Callables Boot Camp

November, 2003

LEHMAN BROTHERS

Where vision gets built.™

Valuing callables on an OAS1 14 vol on Bloomberg: Why 14 vol?

- ◆ **Most common method** of quoting Bermudan and American callables.
- ◆ American and Bermudan callables **contain more than one call option**.
 - Hence require multiple volatility inputs
- ◆ Bloomberg pricing analytics **can handle only 1 volatility input**.
- ◆ Over the past 10 years, market players have come to use **14% volatility as a standard** to quote all callables
 - Vols used to be around 14% across the board when the curve was more flat and rates higher
- ◆ While 14% volatility is not currently close to market vol, it has been **universally adopted** as the standard by market participants
- ◆ Since 14% volatility is well below current market levels, **the call option is undervalued** hence OAS1 14% overstates the Option Adjusted Spread of the bond

Data not provided by Bloombe...

94) No Notes

95) Buy

96) Sell

25) Bond Description

26) Issuer Description

Pages

- 11) Bond Info
- 12) Addtl Info
- 13) Reg/Tax
- 14) Covenants
- 15) Guarantors
- 16) Bond Ratings
- 17) Identifiers
- 18) Exchanges
- 19) Inv Parties
- 20) Fees, Restrict
- 21) Schedules
- 22) Coupons
- Quick Links
- 32) ALLQ Pricing
- 33) QRD Qt Recap
- 34) TDH Trade Hist
- 35) CACS Corp Action
- 36) CF Prospectus
- 37) CN Sec News
- 38) HDS Holders
- 66) Send Bond

Issuer Information

Name FEDERAL HOME LOAN BANK
Industry Government Sponsored (BCLASS)

Security Information

Mkt Iss US DOMESTIC
Ctry/Reg US **Currency** USD
Rank Unsecured **Series**
Coupon 4.000000 **Type** Fixed
Cpn Freq S/A
Day Cnt 30/360 **Iss Price** 100.0000
Maturity 05/26/2027
CALL 08/26/22@100.00
Iss Sprd
Calc Type (1)STREET CONVENTION
Pricing Date 04/29/2022
Interest Accrual Date 05/26/2022
1st Settle Date 05/26/2022
1st Coupon Date 11/26/2022

Identifiers

FIGI BBG0174TM7D1
CUSIP 3130ARYA3
ISIN US3130ARYA38

Bond Ratings

Moody's Aaa
S&P AA+
Composite AA+

Issuance & Trading

Amt Issued/Outstanding
 USD 130,000.00 (M) /
 USD 130,000.00 (M)
Min Piece/Increment
 10,000.00 / 5,000.00
Par Amount 5,000.00
Book Runner RJA,RBCCM,STFL
Reporting TRACE

Security created by firm RAYMOND JAMES & ASSOCIATES INC

Enter 1<GO> to save assumptions.

OPTION-ADJUSTED SPREAD ANALYSIS

FED HOME LN BANK FHLB 4 05/26/27

Calculate (P,O,V) <input type="radio"/>	Price P) 100	OAS (bp) O) +75.63	Volatility V) 14.00
---	------------------------	------------------------------	-------------------------------

Cusip / ID# 3130ARYA3 Option Px Value: -1.02
 Settle 5/26/2022 Bench settle 5/ 4/2022 Vega: -0.06
 Spread 121.8bp vs 2Y T 2 1/2 04/30/24 Govt@99-14⁵₈ (2.782)

{NUM}<GO> for:
 3) Call Schedule
 8/26/22 100.00
 11/26/22 100.00
 2/26/23 100.00
 5/26/23 100.00
 8/26/23 100.00
 11/26/23 100.00
 2/26/24 100.00
 5/26/24 100.00
 8/26/24 100.00
 11/26/24 100.00
 ...more...

	OAS Method	Option Free	To Call on 8/26/2022	To Mty
Yld		3.774	4.000	4.000
Sprd		75.2	310.2	97.8
M Dur	2.37		0.49	4.49
Risk	2.37		0.49	4.49
Cnvx	-3.88		0.00	0.23

Model L=Lognormal
 Exercise Premium 0.00

2) Customize
 Curve Semi
 US On/Off The Run
 Dated 5/ 3/2022
 Settle 5/26/2022
 None
 Shift +0(bps)
 Yield Spread

3m	0.894
6m	1.406
1y	2.097
2y	2.782
3y	2.968
4y	3.028
5y	3.022
7y	3.040
10y	2.971
20y	3.220
30y	3.009

88) REFRESH

Australia 61 2 9777 8600 Brazil 5511 2395 9000 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
 Japan 81 3 4565 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000
 Copyright 2022 Bloomberg Finance L.P. SN 1923535 EDT GMT-4:00 G683-6590-170 03-May-2022 17:08:50

OPTION-ADJUSTED SPREAD ANALYSIS

FED HOME LN BANK FHLB 4 05/26/27

Calculate (P,O,V) **Price** **OAS (bp)** **Volatility**
 (P) 100 (O) -22.90 (V) 41.37

Cusip / ID# 3130ARYA3 Option Px Value: -5.61
 Settle 5/26/2022 Bench settle 5/4/2022 Vega: -0.05
 Spread 121.8bp vs 2Y T 2 1/2 04/30/24 Govt @ 99-14⁵/₈ (-2.782)

{NUM}<GO> for:
 3) Call Schedule
 8/26/22 100.00
 11/26/22 100.00
 2/26/23 100.00
 5/26/23 100.00
 8/26/23 100.00
 11/26/23 100.00
 2/26/24 100.00
 5/26/24 100.00
 8/26/24 100.00
 11/26/24 100.00
 ...more...

	OAS Method	Option Free	To Call on 8/26/2022	To Mty
Yld		2.790	4.000	4.000
Sprd		-23.2	310.2	97.8
M Dur	1.86		0.49	4.49
Risk	1.86		0.49	4.49
Cnvx	-1.56		0.00	0.23

Model L=Lognormal
 Exercise Premium 0.00

2) Customize
 Curve I111 Semi
 US On/Off The Run
 Dated 5/3/2022
 Settle 5/26/2022

N None
 Shift +0(bps)
 Yield Spread

3m	0.894
6m	1.406
1y	2.097
2y	2.782
3y	2.968
4y	3.028
5y	3.022
7y	3.040
10y	2.971
20y	3.220
30y	3.009

88) REFRESH

Australia 61 2 9777 8600 Brazil 5511 2395 9000 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
 Japan 81 3 4565 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000
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