So what do you think about bonds and interest rates?

Joseph O Arata
Agriculture Economics
Kansas State University

Risk & Profit

Cost	-$185.00
AgBrazil CEO	+$25.00
Dr. Flinchbaugh	-$30.00
Dr. Mintert	+$25.00
Dr. Tierney	+$25.00
20 Sessions @ $7	+$140.00

The Plan

- Bond Basics
  - What is a bond
  - How to read a bond table
  - How to value a bond
- Interest rates
  - Interest rates
  - The yield curve
  - Commodity prices

Bond Basics:

Main Street		Wall Street
Make a loan	→	Buy a bond - note
Principle	→	Par value, face value
Interest payment	→	Coupon
Interest rate	→	Yield
Length	→	Maturity
Riskiness	→	Default and interest rate risk

Issuers of Bonds

- US Treasury
- Municipal Governments
- Corporations
- Foreign Governments
- Euro bonds

The Least and Most Risky Countries

Safest countries	Riskiest countries
1. Switzerland	141. Afghanistan
2. Germany	142. Sudan
3. Netherlands	143. Sierra Leone
4. Luxembourg	144. Liberia
5. France	145. North Korea
6. United States	

source: Merrill Lynch

Eurobond market

- Underwritten by international syndicates
- Offered simultaneously to investors in several countries
- Issued outside of corporation's country but in home currency
- Unregistered - in bearer form
- Sometimes issued in dual currencies
- Convertible Eurobond
- Usually at floating rates based on LIBOR (London Interbank Offered Rate)

Treasury Securities

- No default risk - full faith & credit – risk free
- "Benchmark" for other interest rates in US & international capital markets
- Treasury issues – called Treasuries
  - T-Bills - one year or less - Discount
  - T-Notes - ten years or less - Coupon
  - T-Bonds - greater than 10 years
  - 2 year auctioned last Tuesday/Wednesday of month
  - 5, 10, 30 auctioned at Quarterly refunding - Feb, May, Aug, Nov - but last 30 year auction was Feb 2000

Federal Agency Securities

- Federally sponsored agencies
  - Privately owned, publicly chartered entities created by Congress to reduce cost of capital for borrowing sectors deemed important enough to warrant assistance
  - Issue securities directly to market place
- Federally related institutions
  - Obtain most of borrowing from Federal Financing Bank
  - Exempt from SEC registration, except Private Export Funding Corporation & Tennessee Valley Authority
  - Backed by full faith & credit of US

Federally Sponsored Agency

- Federal Farm Credit Bank System
- Farm Credit Financial Association System 1987
- Federal Agricultural Mortgage Corporation (Farmer Mac)
- Federal Home Loan Bank
- Financing Corporation - 1987
- Resolution Trust Corporation - 1989
- Student Loan Marketing Association (Sallie Mae)
- Federal Home Loan Mortgage Corporation (Freddie Mac)
- Federal National Mortgage Association (Fannie Mae)

State and Local Government Bonds
Muni Bonds

- Types of Municipal Bonds
  - General obligation - G.O. - backed by taxing power of political entity - revenues limited if maximum property-millage amounts are stated
  - Revenue - financed and paid back from a specific project - riskier since source of cash flow to service debt is NOT as predictable
  - Industrial revenue bonds – IRB - public financing of private business.
  - hybrid limited-tax G.O.
- Term Maturity 20-40 years; sinking/fund 5-10 years before maturity

Municipal Bond Risk

- Credit Risk
  - Bankruptcy - default due to insolvency - New York City, Cleveland, Bridgeport
  - Limited Bond Rights - WPPS (Washington Public Power System) - courts limited bondholder rights during periods of default
  - Institutional investors: in-house credit research or rely on ratings
- Tax Risk
  - Federal income tax rates will be reduced, lessening value of tax-exempt feature - reducing bond's price
  - IRS may declare the issue taxable - "flat tax proposal"

Municipal Bond Yields

- Relation between Municipals and Taxable Yields
  - Interest on municipal bonds is federally tax exempt
  - Muni bonds and taxable corporates are similar except for the taxation of interest
  - The after (Federal) tax yield on municipals, Y_m, equals the before tax yield on municipals Y_m; the after tax yield on taxables, Y_{AT}, equals the before tax yield on taxables times one minus the marginal tax rate, T
  - After tax $Y_{AT} = Y_{BT} (1-T)$
  - ETY = $\frac{\text{tax-exempt yield}}{1 - T}$ where T = marginal tax rate

Kansas Municipal Bonds

- http://www.municipalbonds.com/archive/KS/20030814.html

Corporate Bonds

- Private firms obtain their long term debt capital in the corporate bond market. Corporate bond backing comes in the following forms:
  - debentures
  - equipment obligations
  - subordinated debentures
  - collateral trust bonds
  - mortgage bonds
- The bond indenture details the type of backing and other legal technicalities associated with the bond

Classification by type of issuer

- Utilities
- Transportations
- Industrials
- Banks & finance companies

Bond Ratings and Default Risk

- Bond ratings are based in a large part on the risk of default - lots of rating agencies:
  - Duff and Phelps
  - Egan Jones
  - Fitch Investors Service
  - Moody's
  - Standard & Poor's
- Moody’s and S&P are the two main rating agencies

Speculative Grade or Junk Bonds

- Determinants of bond safety:
  - coverage ratios — Times interest earned (TIE)
  - leverage ratios — Debt/equity
  - liquidity ratios — Current or quick ratio
  - profitability ratios — ROA or ROE
  - cash flow to debt ratio — Discriminant analysis

Bond Ratings

	Moodys	S&P	Fitch
Investment-Grade			
Gilt edge, prime, maximum safety	Aaa	AAA	AAA
Very high grade, high quality	Aa	AA	AA
Upper medium grade	A	A	A
Lower medium grade	Baa	BBB	BBB
Not Investment-Grade			
Somewhat speculative	Ba	BB	BB
Speculative	B	B	B
Highly speculative	Caa	CCC	CCC
Most speculative	Ca	CC	CC
Imminent default	C	C	C
Default	D	D	D

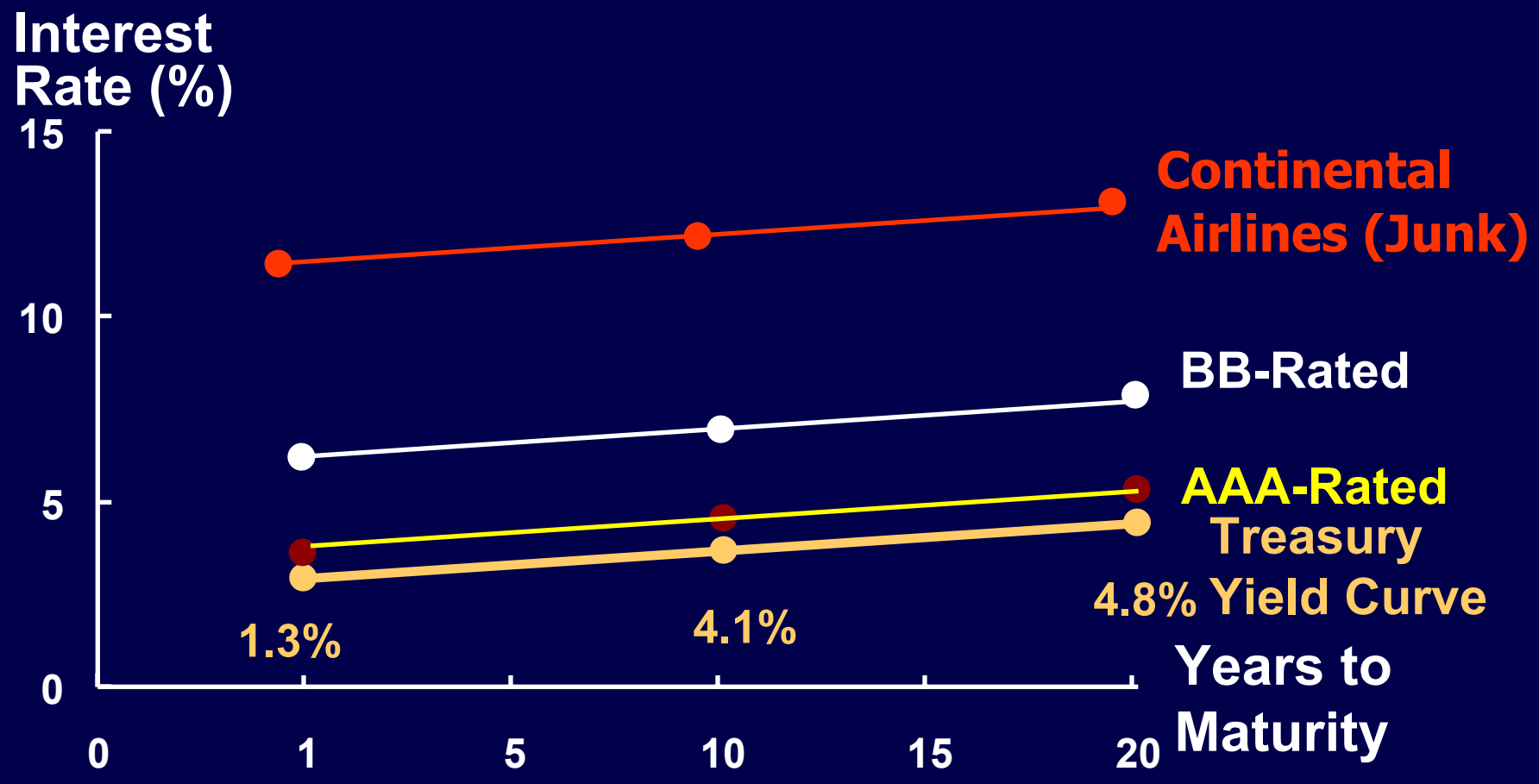
Note Ratings and Average Yield Spreads vs. Treasuries

- Yield spreads
  - The difference in yield between two bonds that are similar in all aspects except default risk

Risk & Return

- Because of the credit risk associated with corporate bonds, it is expected that the performance of this sector of the market would outperform Treasury securities.
- Within the corporate bond market, it is expected that the high-yield – junk - bonds would outperform the investment-grade bonds, because of the greater credit risk associated with high yield bonds

Hypothetical Treasury and Corporate Yield Curves



source: Merrill Lynch

Bond Ratings and Average Yield Spreads vs. Treasuries

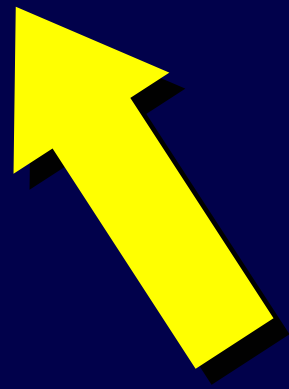
Rating	Spread	Rating	Spread
AAA	0.20%	B+	2.50%
AA	0.50%	B	3.25%
A+	0.80%	B-	4.25%
A	1.00%	CCC	5.00%
A-	1.25%	CC	6.00%
BBB	1.50%	C	7.50%
BB	2.00%	D	10.00%

source: ***Bond Buyer***

Bond Quotes

Company	Coupon	Maturity	Price	Last Yield	Last Spread	Est UST	Vol
GMAC	5.125	5/9/08	96.314	5.140	266	5	57.4
Kraft Food	5.625	11/1/11	106.980	4.602	93	10	59.8
Bellsouth	6.000	10/15/11	113.929	4.000	31	10	45.3
WaltDisne c	2.125	4/15/23	105.451	0.949	na	na	50.4

Source: *Wall Street Journal*



Company Issuing the Bond

Bond Quotes

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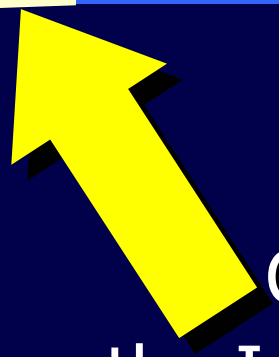

Coupon Interest Rate

Determines the Investor's Periodic Cash Flow

Cash Flow = Interest Payment =

Coupon Rate x Par = 0.05125 x 1000 = 51.25/Year

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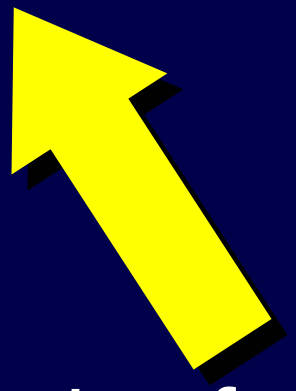

Year of Maturity

Determines the time frame for the investment

In 2003, the GMAC bond is a 5 year investment

Bond Quotes

Company	Coupon	Maturity	Price	Last Yield	Last Spread	Est UST	Vol
GMAC	5.125	5/9/08	99.727	5.140	266	5	57.4
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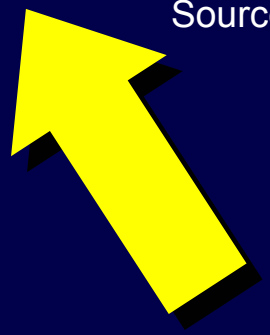

Daily Closing Market Price
Expressed as a % of Par
$Price = 99.727 x 10 = $997.27

Bond Quotes

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Current Yield (%)

$$\text{Current Yield} = \frac{\text{Coupon Rate}}{\text{Market Price}} = \frac{5.125}{99.727} = .0514 = 5.14\%$$

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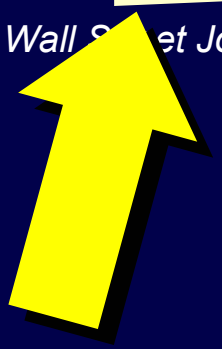

Spread

Difference in return over hot run Treasury note/bond

Bond Quotes

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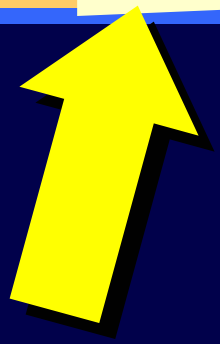

Daily Trading Volume (000,000)

Bond Valuation

- Bond Valuation is an application of Present Value
- Value of the bond is the present value of all the cash flows the investor receives as a result of holding the bond

Bond Valuation

- Three Cash Flows
  - Amount that is paid to purchase the bond (PV)
  - Periodic Interest Payments made to the bondholders (PMT)
  - Repayment of Par value at end of Bond's life
- Other Terminology
  - Time frame for cash flows (N) = Bond's Maturity
  - Interest Rate for Time Value is the rate at which future cash flows are being discounted to present
  - The difference in yield between two bonds that are similar in all aspects except default risk

Bond Quotes

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GMAC Bond Timeline:

Investor that purchases bond today (2003) for $997.27 will receive 5 annual interest payments of $51.25 and a $1,000 payment in 5 years.

Bond Valuation

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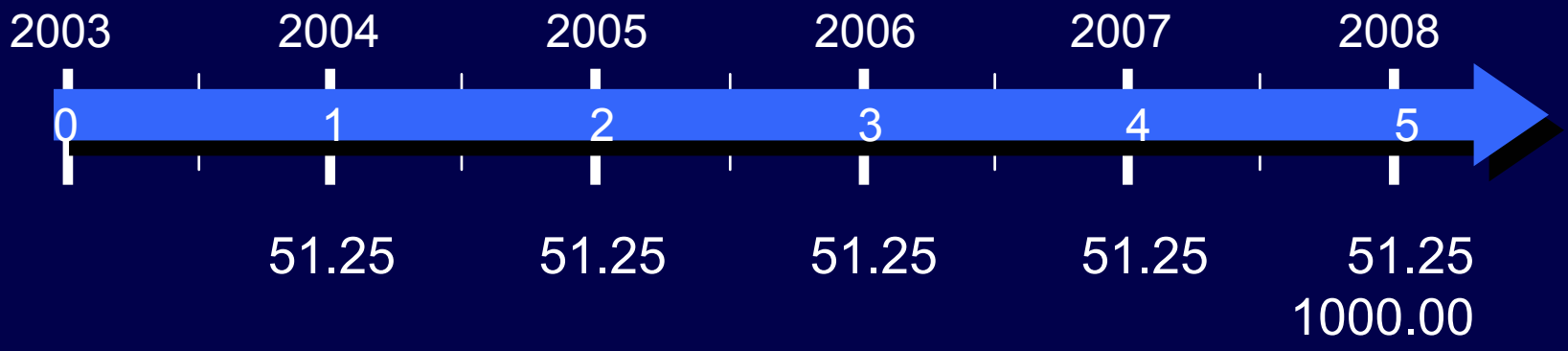
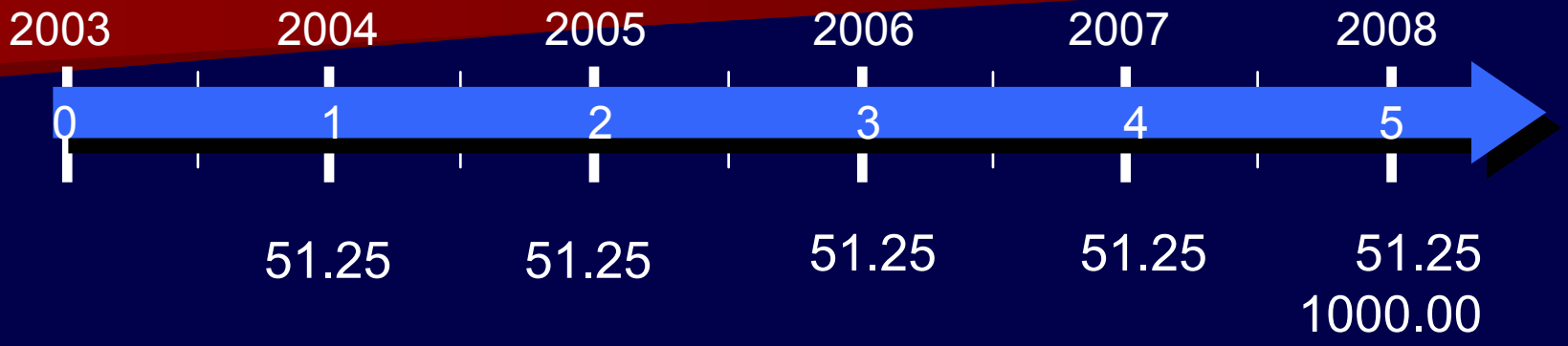


Bond Valuation

Compute Bond's Intrinsic Value



Compute the Intrinsic Value for the GMAC Bond given that you require a 6% return on your investment.

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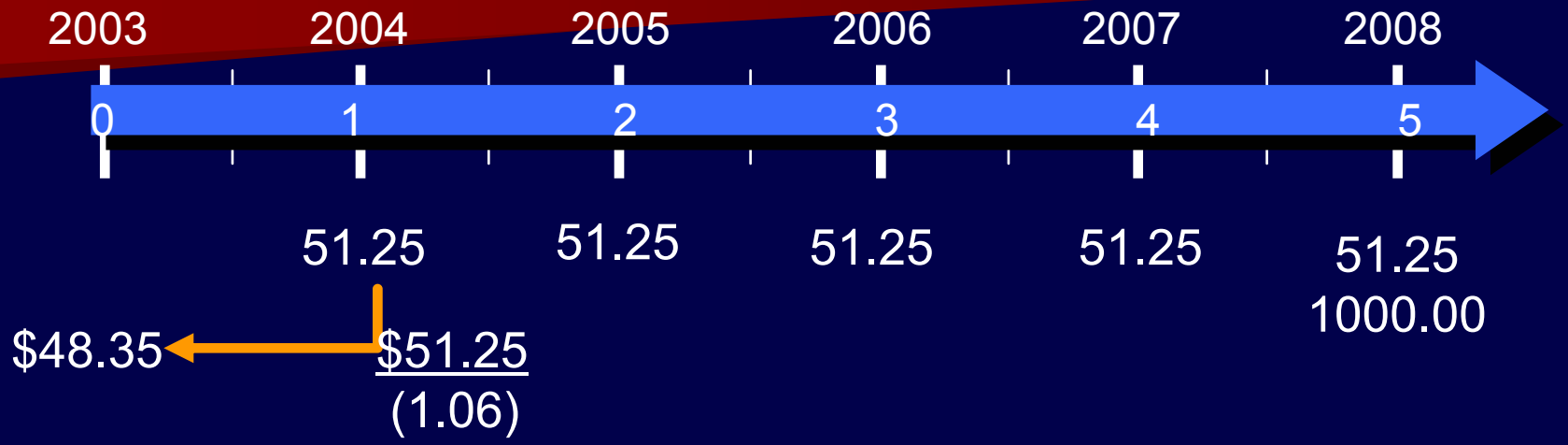

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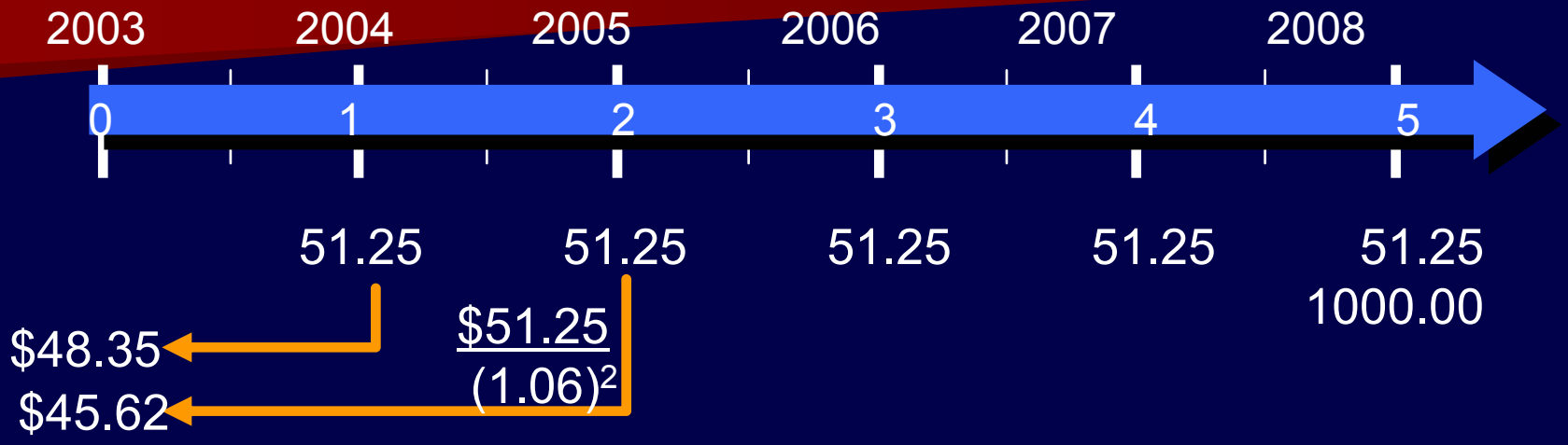

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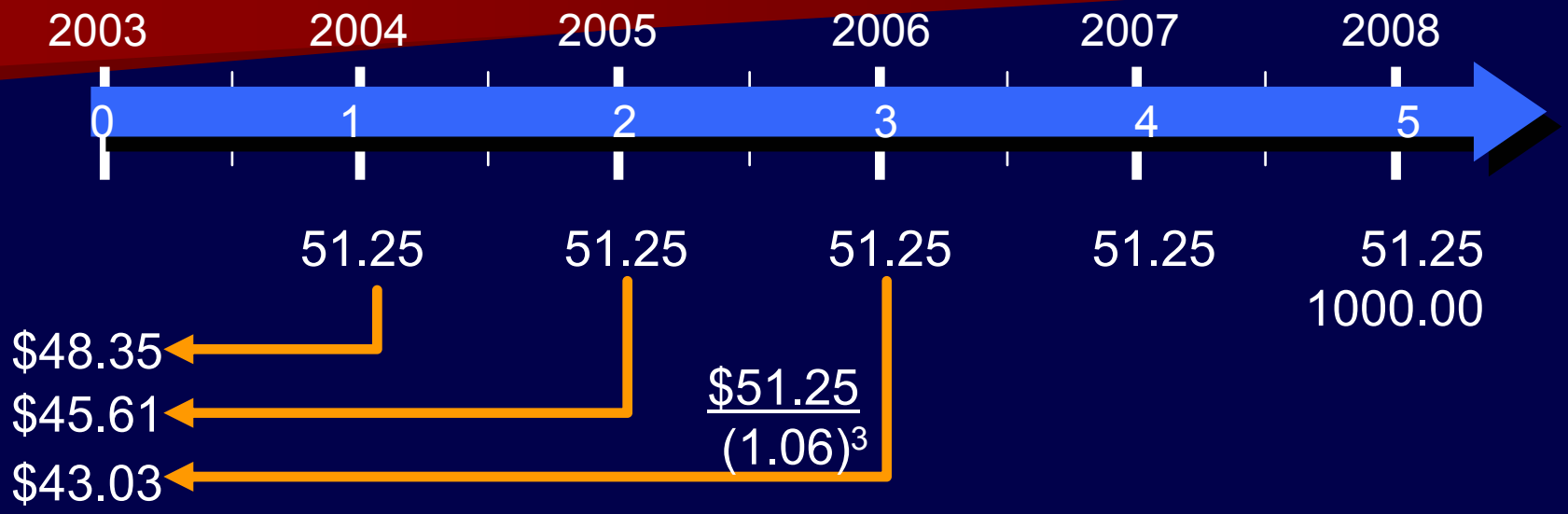

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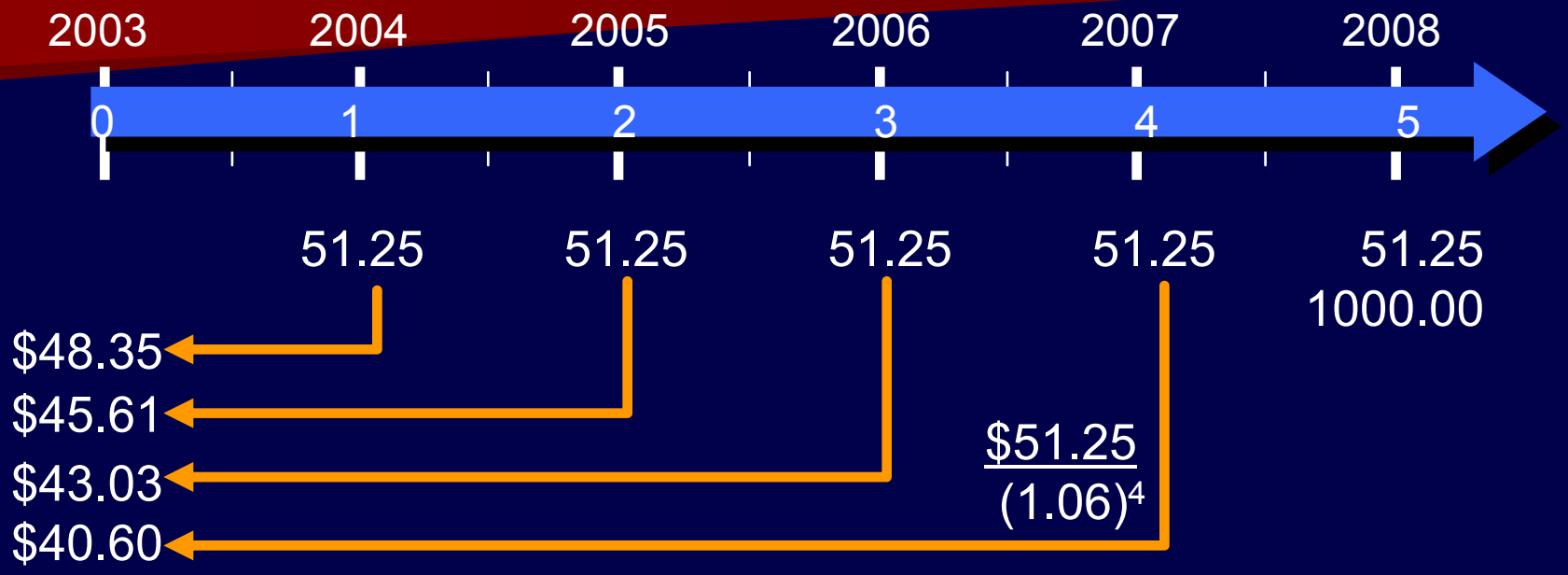

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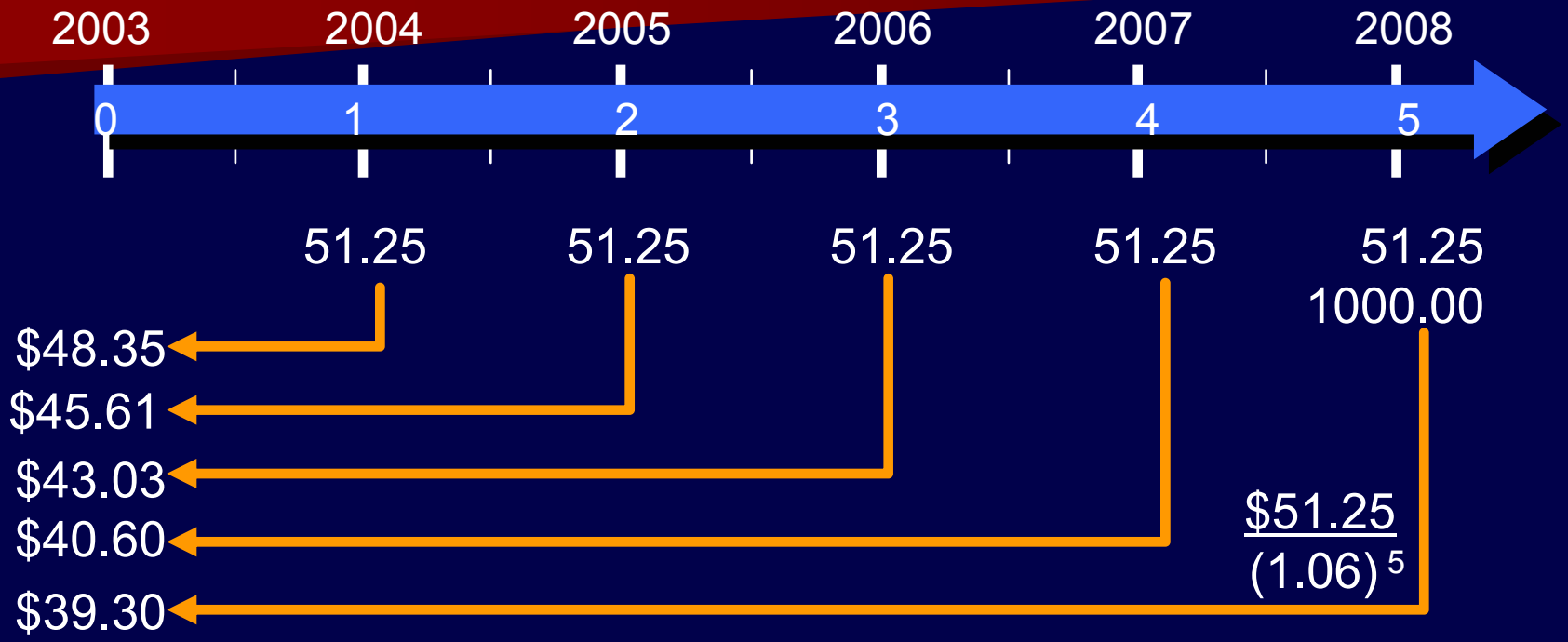

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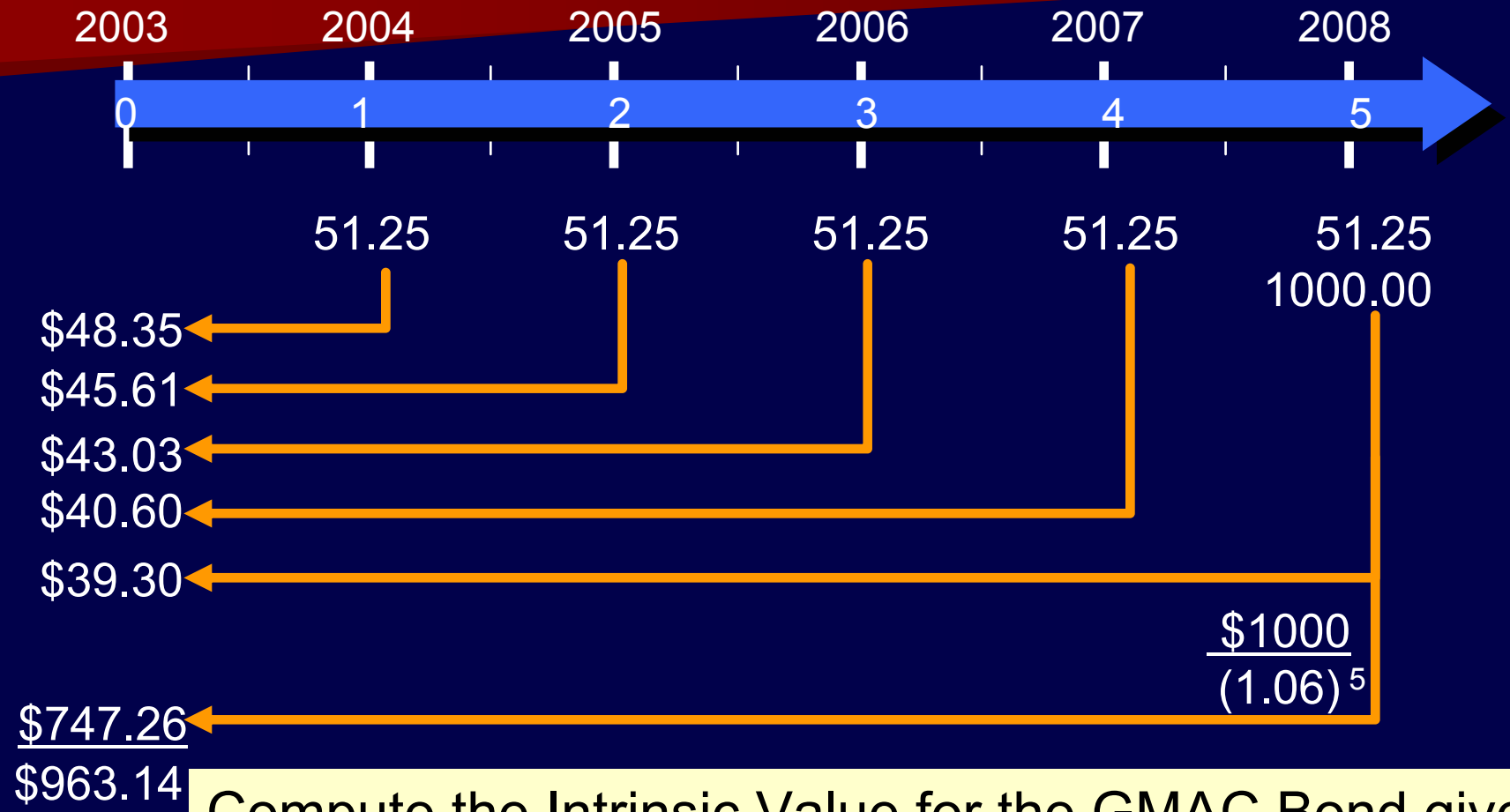

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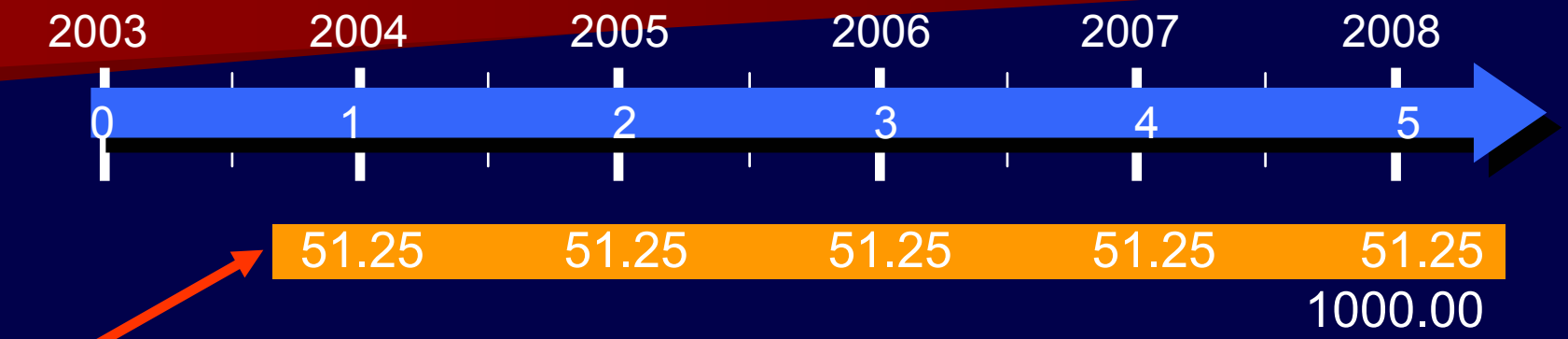

$51.25 Annuity for 5 years

Bond Valuation

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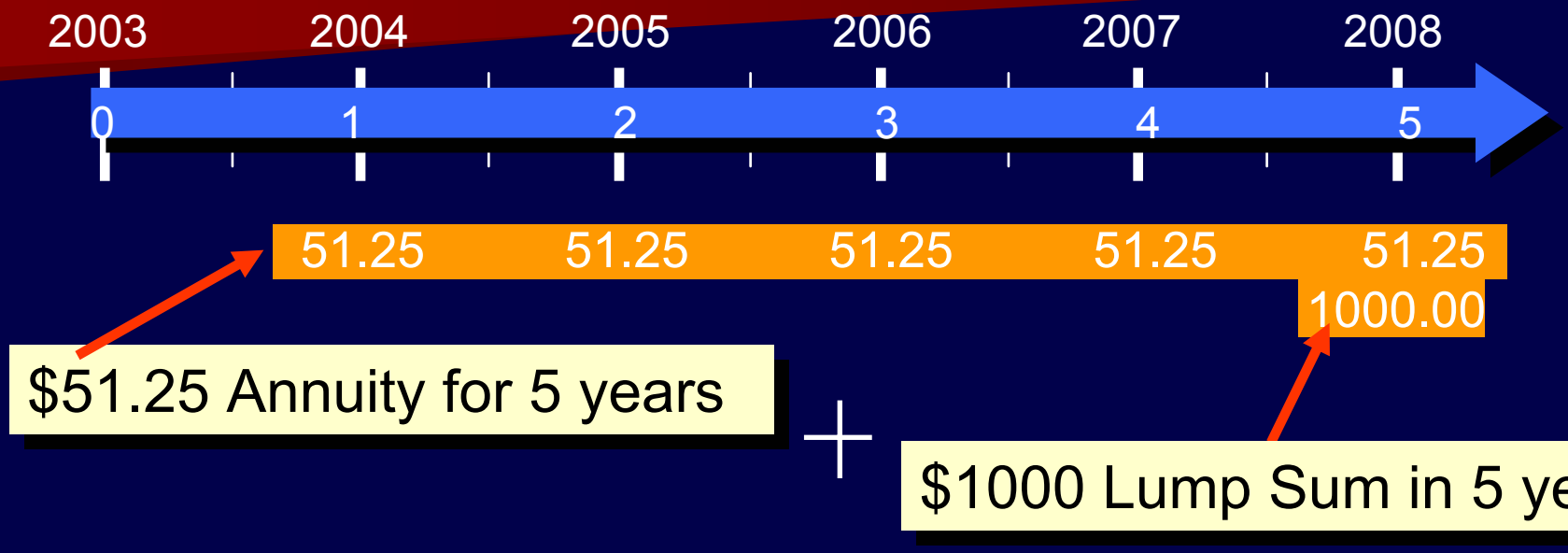

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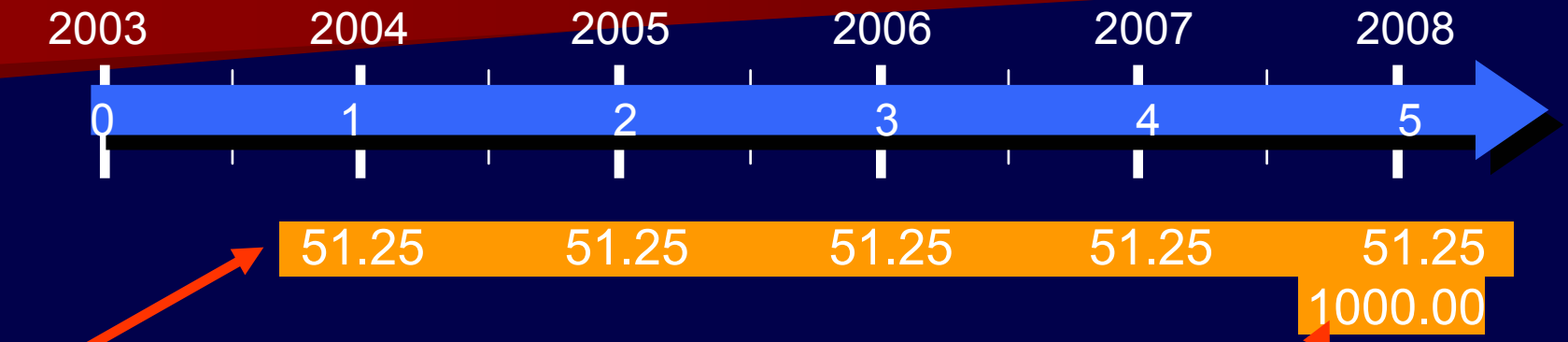


$51.25 Annuity for 5 years

+

$1000 Lump Sum in 5 years

$$V_b = I(\text{PV of Annuity}) + \text{PV of Par}$$

$$V_b = I\left(\frac{1}{\hat{k}_b} - \frac{1}{\hat{k}_b(1+\hat{k}_b)^n}\right) + \frac{\text{Par}}{(1+\hat{k}_b)^n}$$

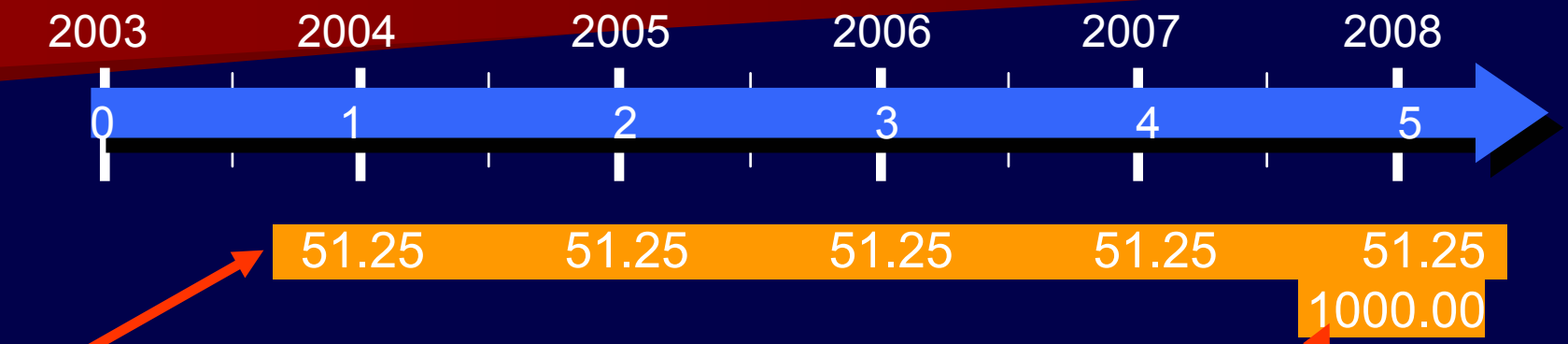
Where:

I = Periodic Interest Payment

k_b = Investor's Required Rate of Return

Bond Valuation

Compute Bond's Intrinsic Value



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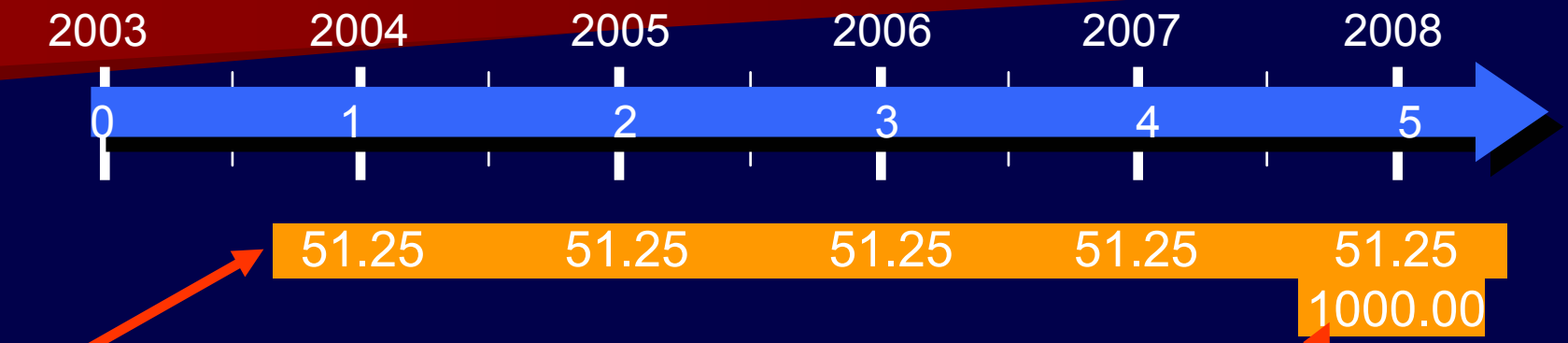
$$V_b = I(\text{PV of Annuity}) + \text{PV of Par}$$

$$= 51.25\left(\frac{1}{.06} - \frac{1}{.06(1+.06)^5}\right) + \frac{1000}{(1+.06)^5}$$

Bond Valuation

Compute Bond's Intrinsic Value



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$$= 51.25\left(\frac{1}{.06} - \frac{1}{.06(1+.06)^5}\right) + \frac{1000}{(1+.06)^5}$$

$$= 51.25(3.9927) + 747.26$$

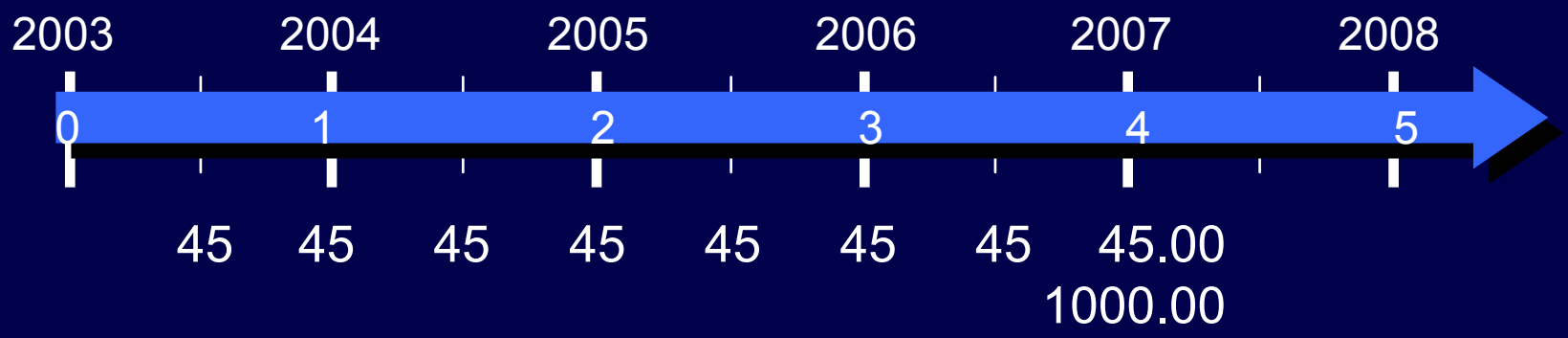
$$= 215.88 + 747.26 = 963.14$$

Bond Valuation

Some Bonds Pay Interest Semi-Annually:

Bonds	Cur Yld	Vol	Close	Net Chg
AMR6¼24	cv	6	91¼	-1½
ATT 8.35s25	8.3	110	102¾	+¼
IBM 6⅜ 09	6.6	228	96⅝	-⅛
Kroger 9s07	8.8	74	101⅞	-¼

Source: *Daily News*



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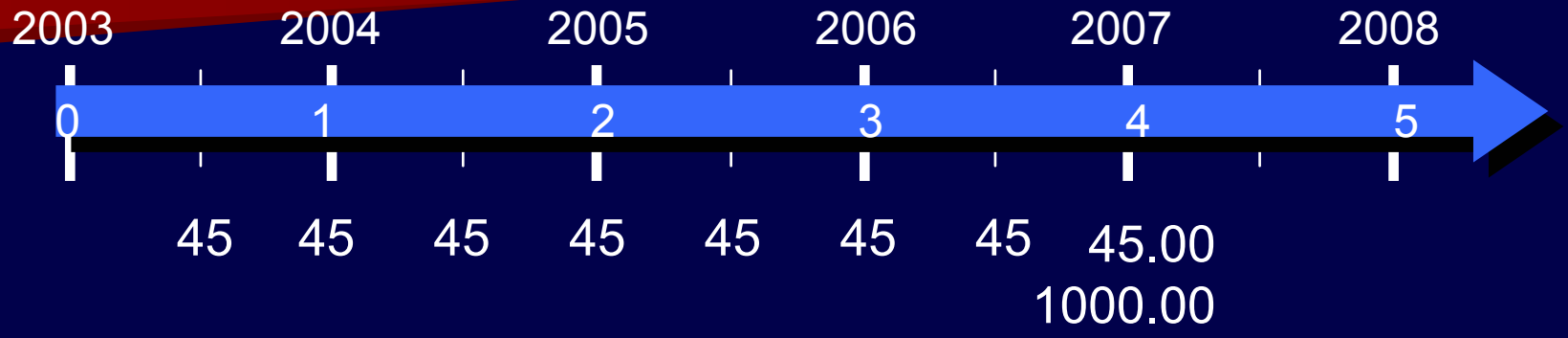

Compute the Intrinsic Value for the Kroger Bond given that you require a 10% return on your investment.

Since interest is received every 6 months, need to use semi-annual compounding

Bond Valuation

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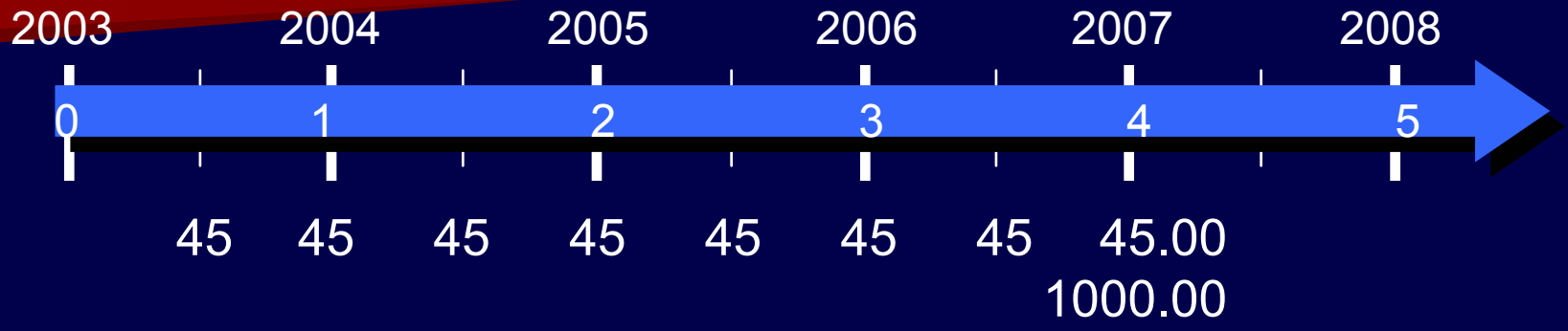

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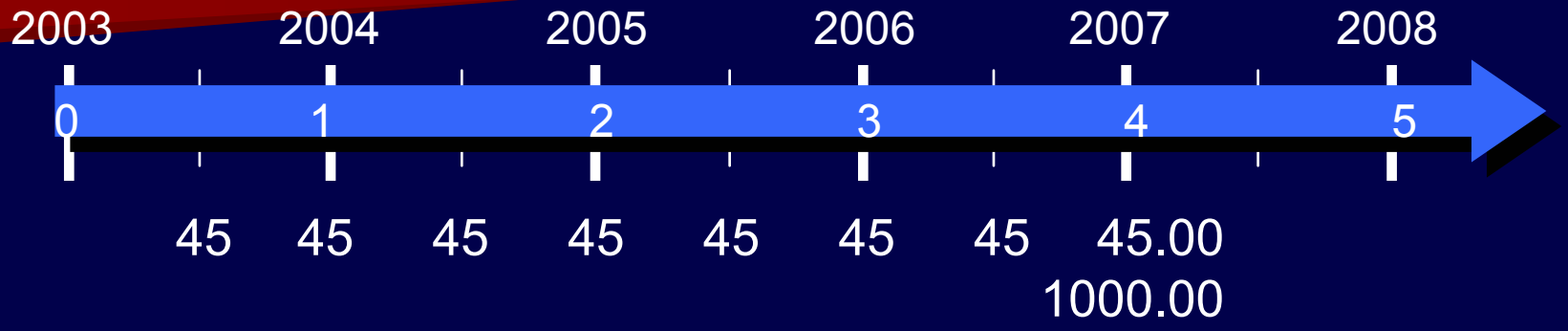
Since interest is received every 6 months, need to use semi-annual compounding

$$V_b = 45\left(\frac{1}{.05} - \frac{1}{.05(1+.05)^8}\right) + \frac{1000}{(1+.05)^8}$$

Semi-Annual Compounding $\frac{10\%}{2}$

Bond Valuation

Some Bonds Pay Interest Semi-Annually:



Compute the Intrinsic Value for the Kroger Bond given that you require a 10% return on your investment.

Since interest is received every 6 months, need to use semi-annual compounding

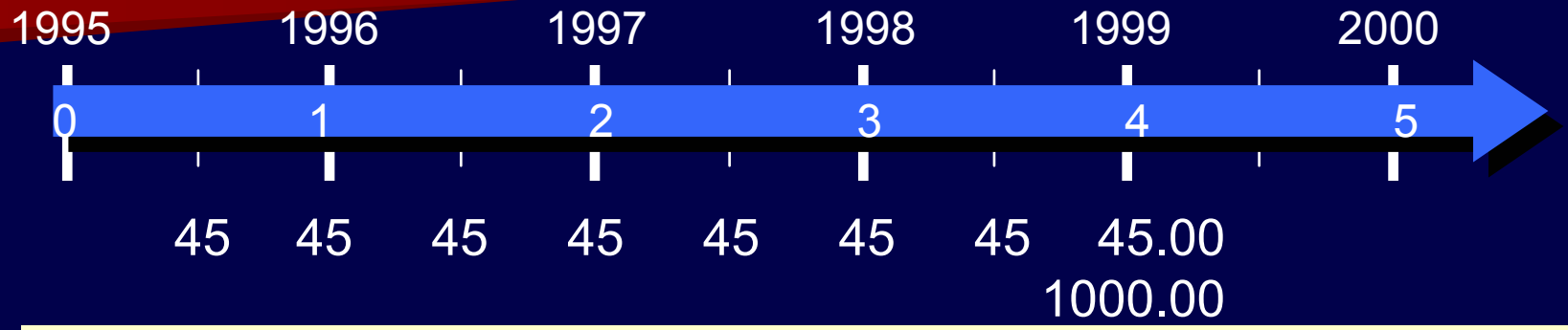
$$V_b = 45\left(\frac{1}{.05} - \frac{1}{.05(1+.05)^8}\right) + \frac{1000}{(1+.05)^8}$$

$$= 45(6.4632) + 676.84$$

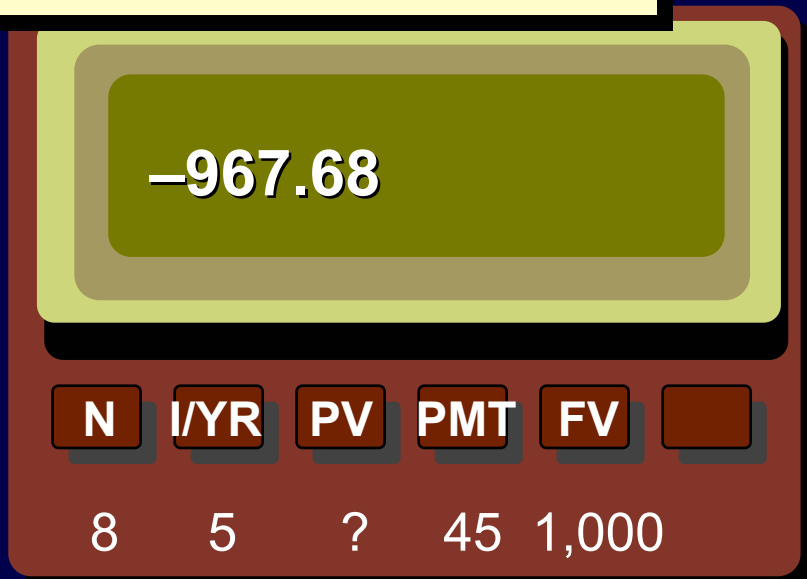
$$= 290.85 + 676.84 = 967.68$$

Bond Valuation

Some Bonds Pay Interest Semi-Annually:

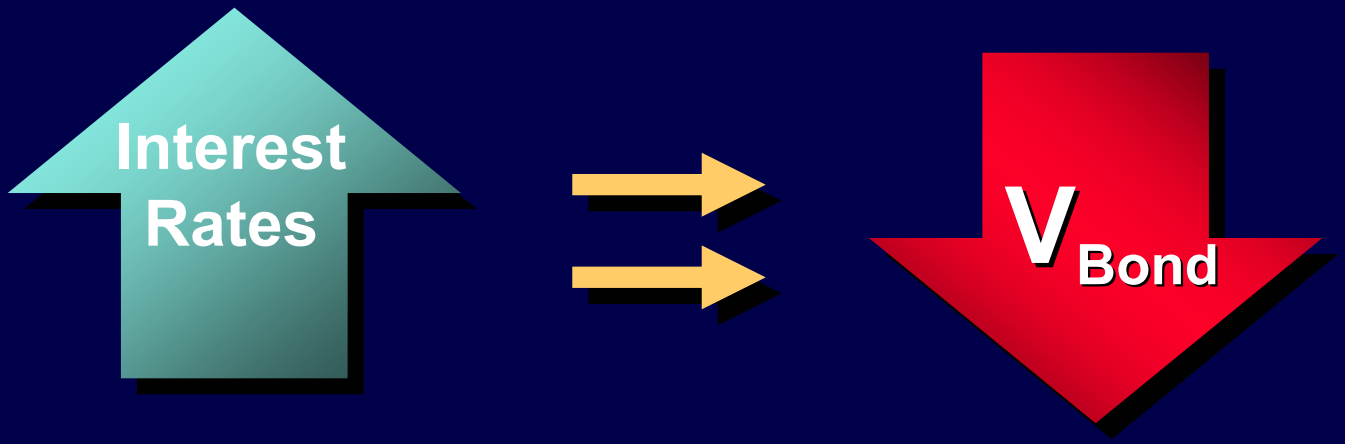


Compute the Intrinsic Value for the Kroger Bond given that you require a 10% return on your investment.



Interest Rate Risk

- **Bond Prices fluctuate over Time**
  - As interest rates in the economy change, required rates on bonds will also change resulting in changing market prices



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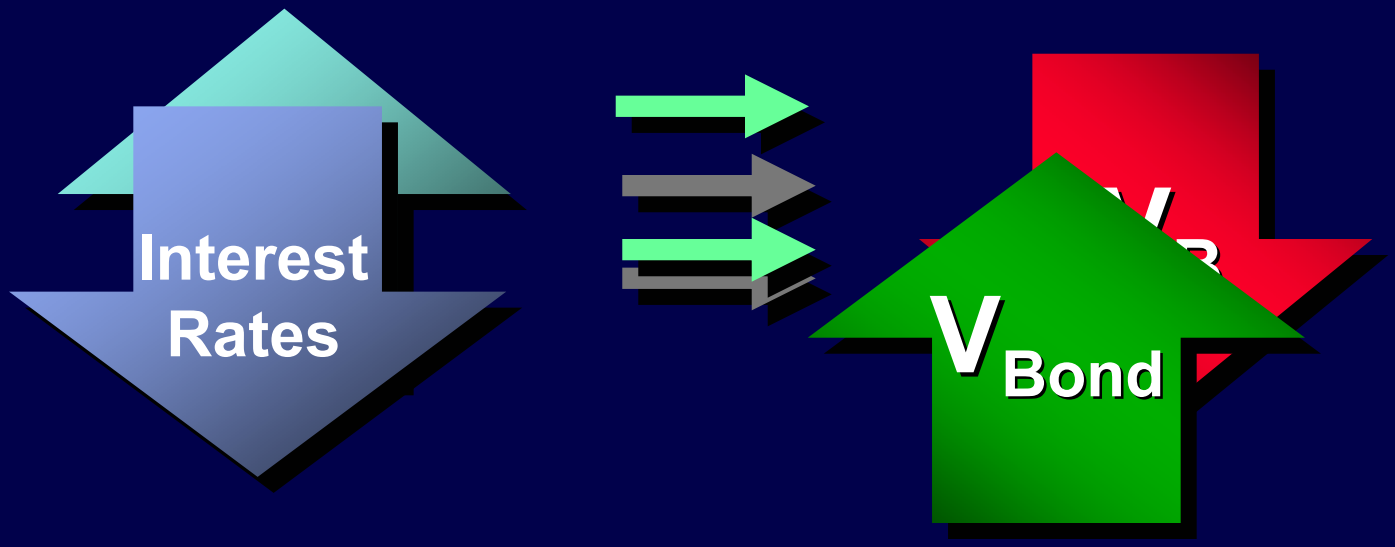

Interest Rate Risk

- Bond Prices fluctuate over Time
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  - Over time, the prevailing rates may change, but the coupon rate is fixed
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1995	AAA Bonds are currently yielding 6%
	Purchase ATT 6s2015 Bond for $1000.00

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1995	AAA Bonds are currently yielding 6%
	Purchase ATT 6s2015 Bond for $1000.00

$$V_b = 60\left(\frac{1}{.06} - \frac{1}{.06(1+.06)^{20}}\right) + \frac{1000}{(1+.06)^{20}}$$
$$= \$1{,}000$$

1995 AAA Bonds are currently yielding 6%

Purchase ATT 6s2015 Bond for $1000.00

1998 AAA Bonds are currently yielding 9%

If you want to sell the the ATT 6s2015 Bond, it must be priced to earn the purchaser a competitive rate (required rate = 9%)

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$$V_b = 60\left(\frac{1}{.09} - \frac{1}{.09(1+.09)^{17}}\right) + \frac{1000}{(1+.09)^{17}}$$

$$= \$743.69$$

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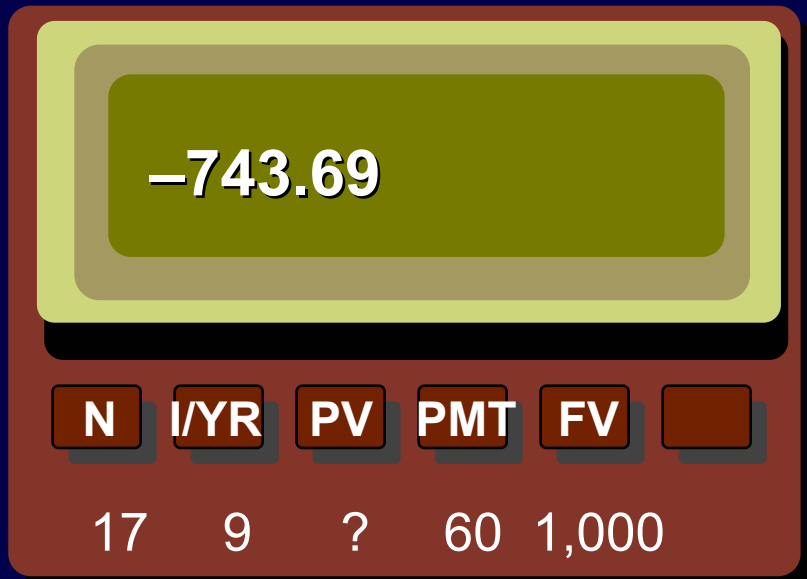

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Market Price for ATT6s2015 is now $743.69

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$$V_b = 60\left(\frac{1}{.05} - \frac{1}{.05(1+.05)^{14}}\right) + \frac{1000}{(1+.05)^{14}} = \$1{,}098.99$$

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Purchase ATT 6s2015 Bond for $1000.00

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Market Price for ATT6s2015 is now $1,098.99

Bond Prices fall during periods of rising interest rates and rise during periods of falling interest rates.

Interest Rate Risk

2001 A Bonds are currently yielding 5%

If you want to sell the the ATT 6s2015 Bond, it must be priced to earn the purchaser a competitive rate (required rate = 5%)

Market Price for ATT6s2015 is now $1,098.99

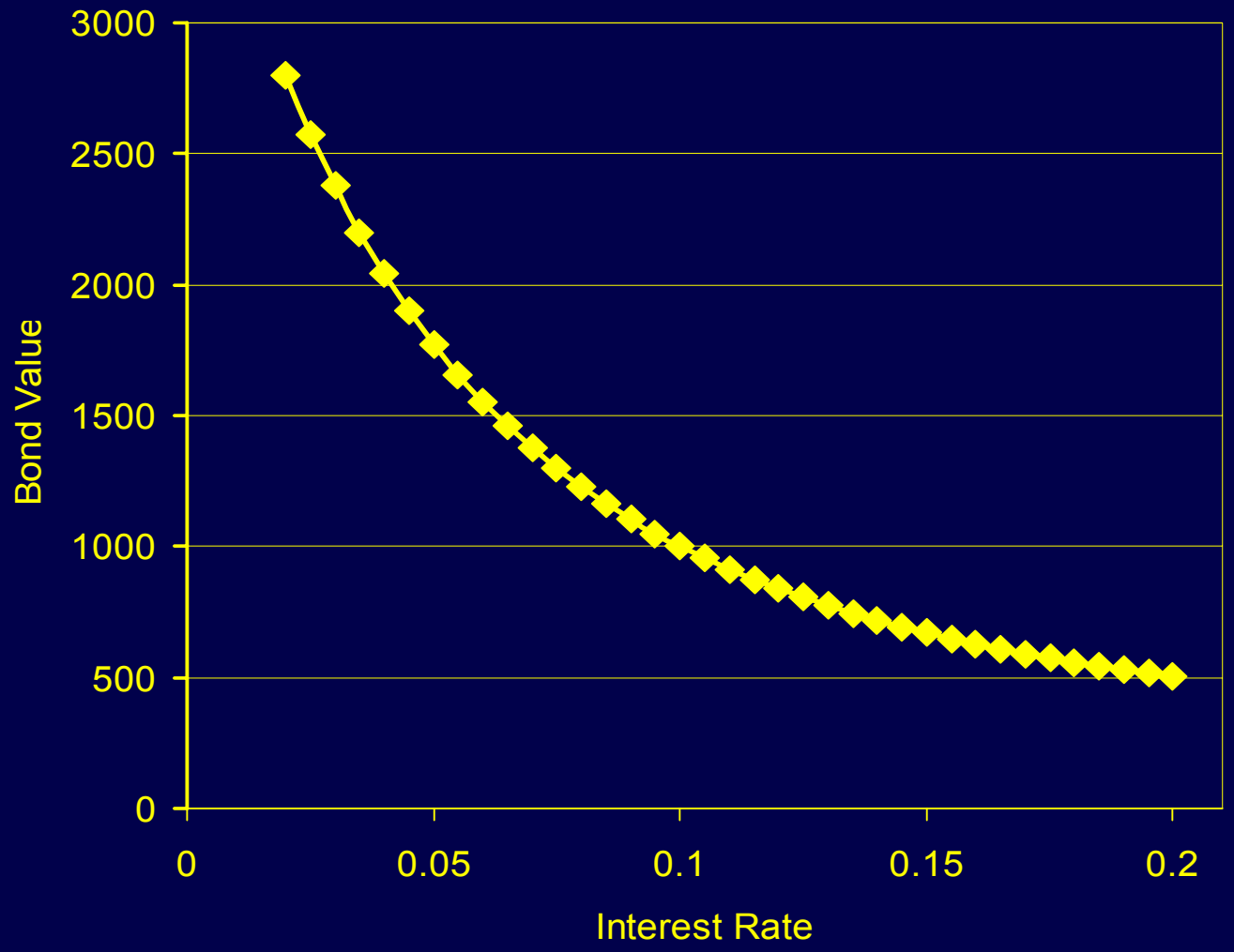
2003 BBB Bonds are currently yielding 4%

If you want to sell the the ATT 6s2015 Bond, it must be priced to earn the purchaser a competitive rate (required rate = 4%)

Market Price for ATT6s2015 is now $1,187.70

Bond Prices fall during periods of rising interest rates and rise during periods of falling interest rates.

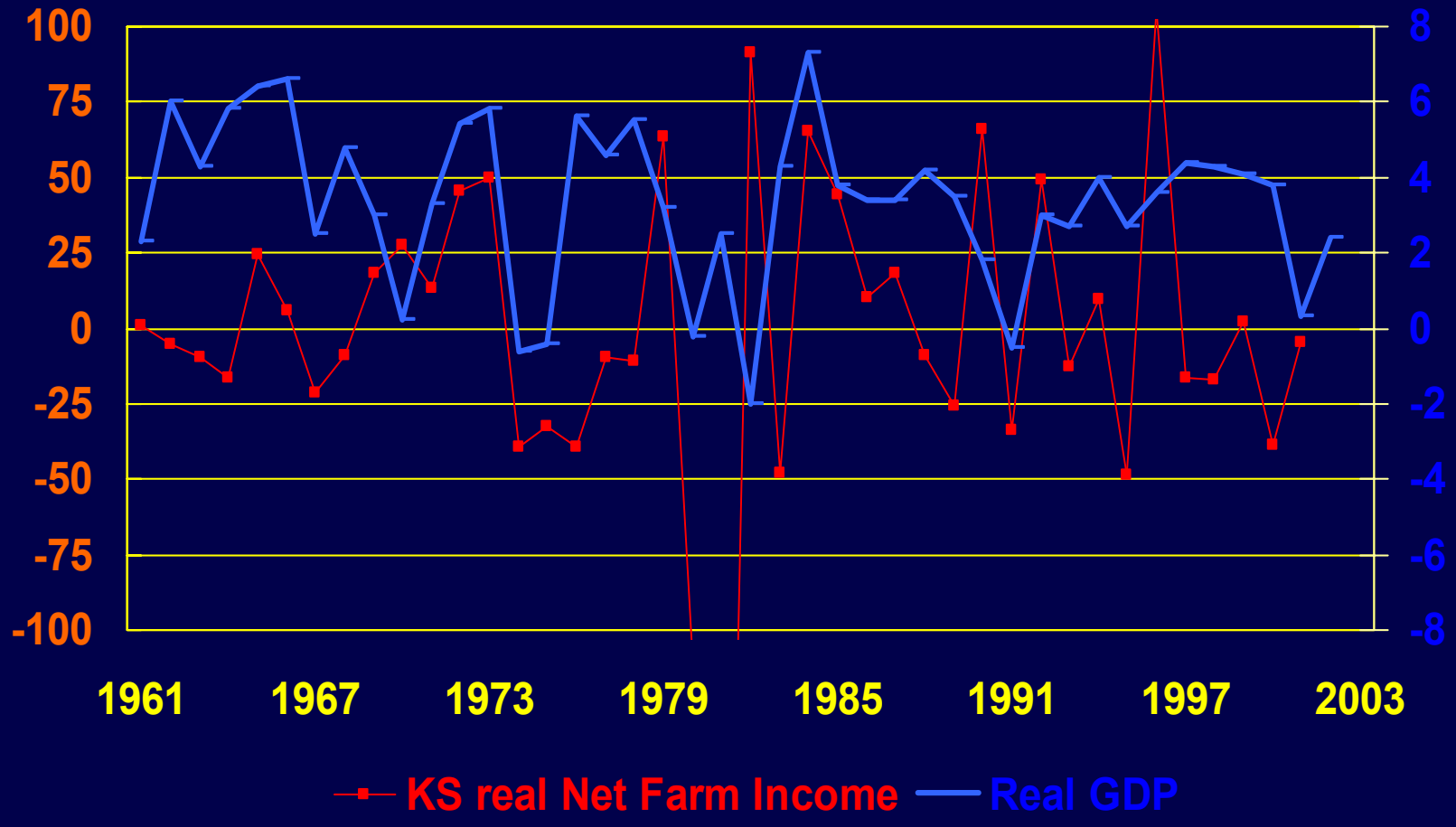
Impact of Change in Rates



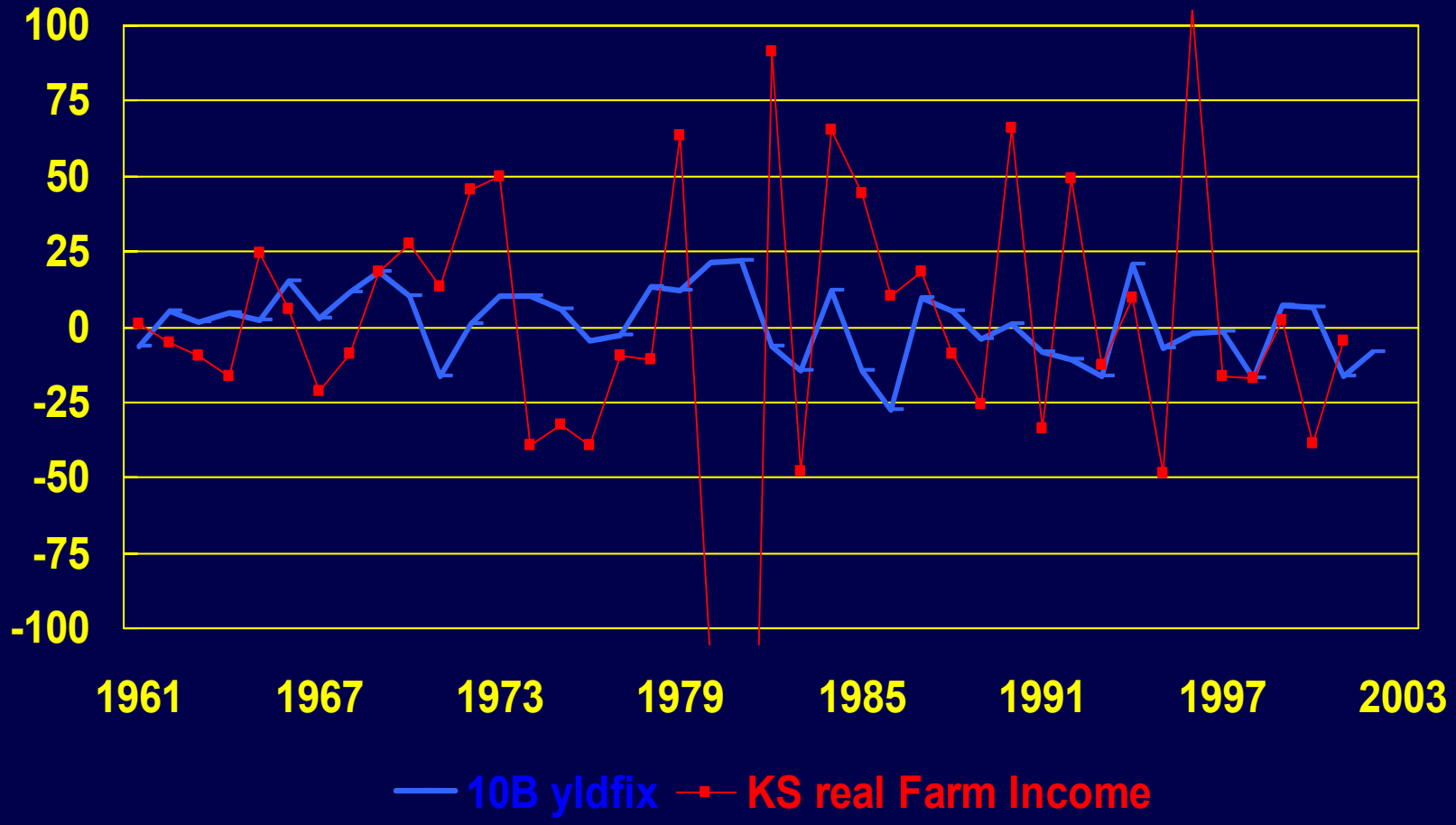
Malkiel's Theorems

1) Bond prices move inversely with interest rates
2) The longer the maturity of a bond, the more sensitive is it's price to a change in interest rates
3) The price sensitivity of any bond increases with it's maturity, the increase occurs at a decreasing rate
4) The lower the coupon rate on a bond, the more sensitive is it's price to a change in interest rates
5) For a given bond, the volatility of a bond is not symmetrical, i.e. a decrease in interest rates raises bond prices more than a corresponding increase in interest rates lowers prices

Year to Year Change



Year to Year Change



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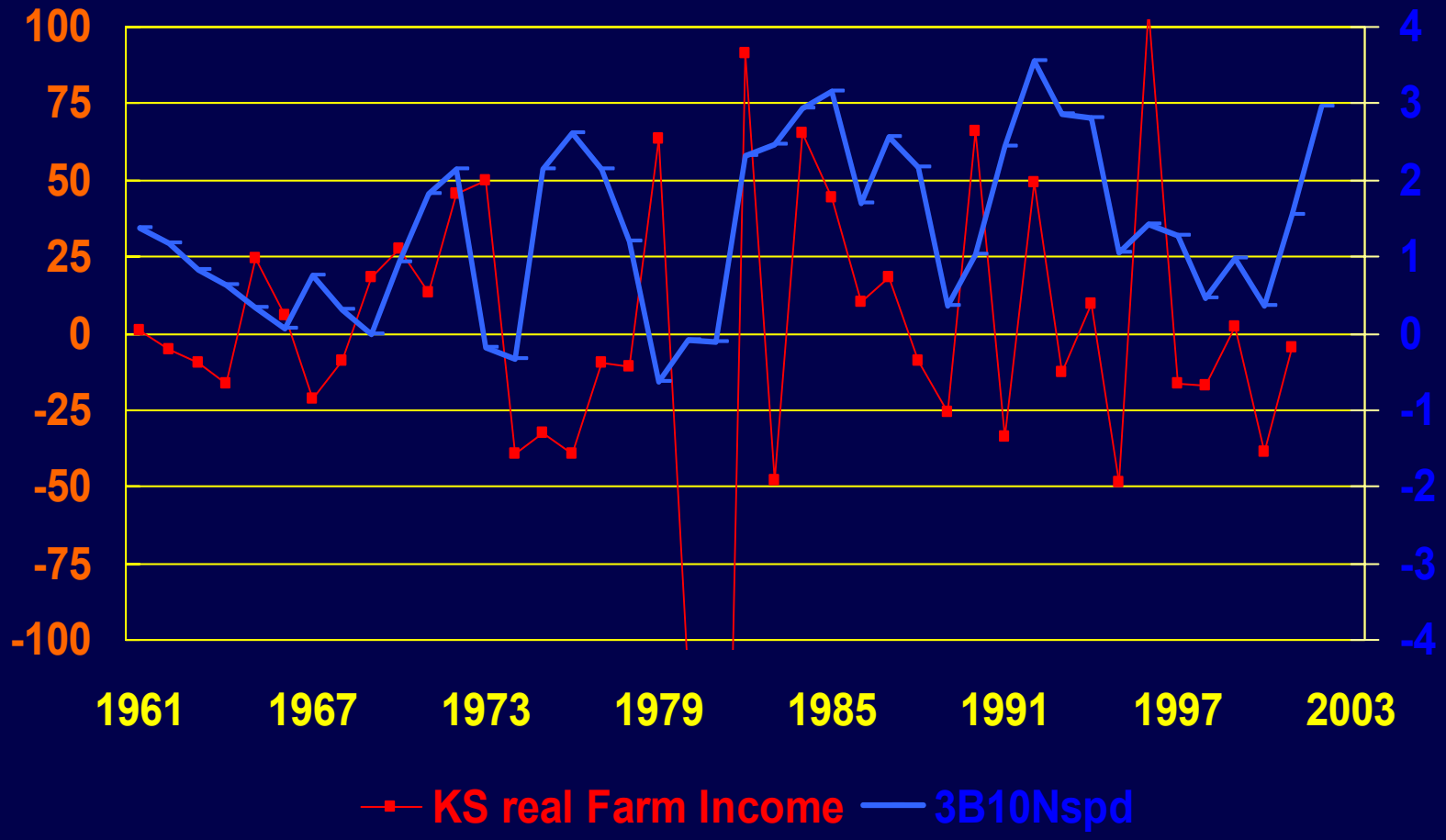
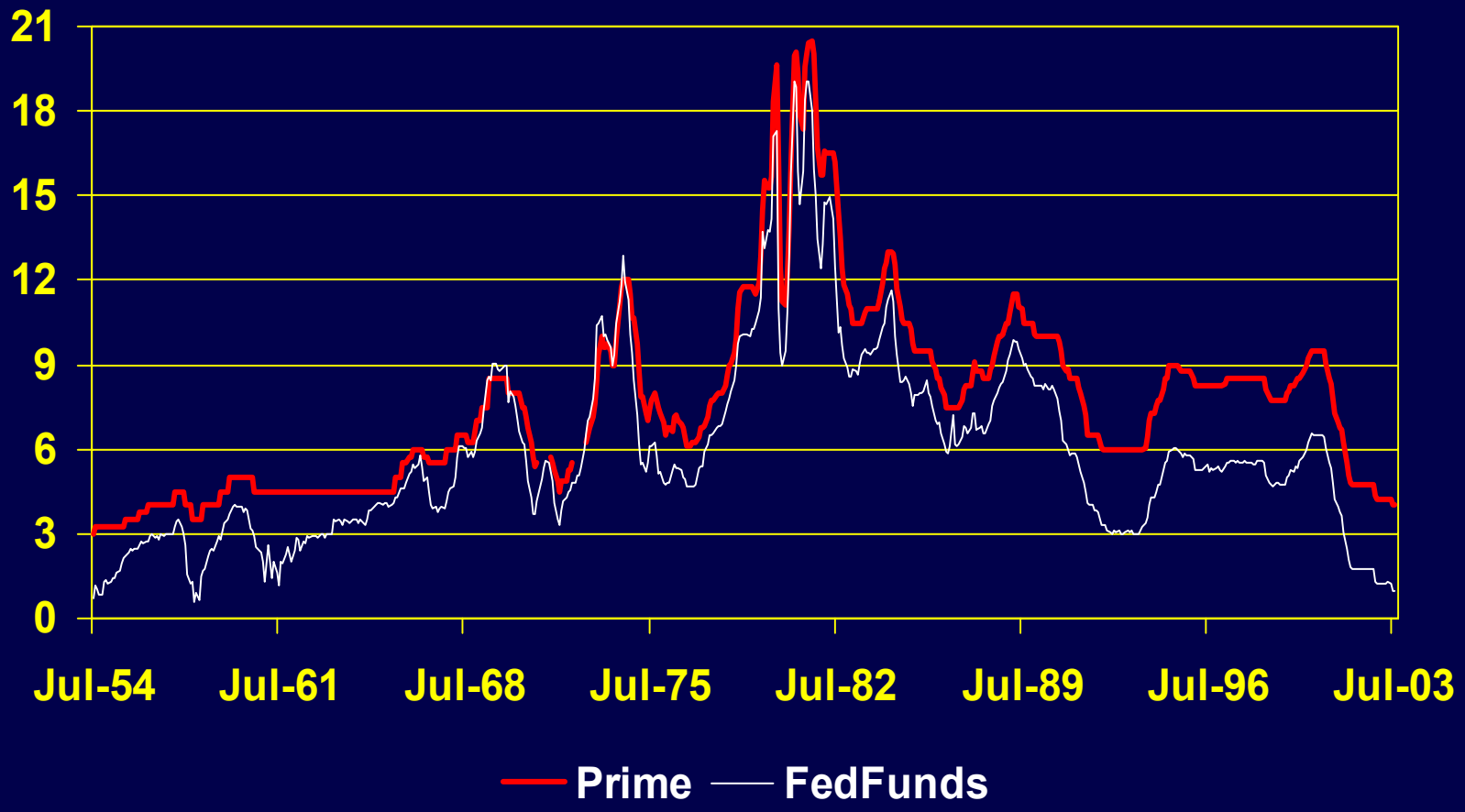


Interest Rates



source: Merrill Lynch & *Bond Buyer*

Interest Rates

- Money in a free economy is allocated through a price system
- The interest rate is the price paid to borrow capital

What are Interest Rates?

- Rental price for money
- The time value of consumption
- Opportunity cost
- Expressed in terms of annual rates
- As with any price, interest rates serve to allocate funds to alternative uses.

Interest Rate Movements

- Interest rate movements affect all securities
  - Direct influence on debt instruments
    - Bonds, Mortgages
  - Indirect influence on stocks and exchange rates
- Interest rates affect the value of financial institutions
  - Managers of financial institutions closely monitor rates

Interest Rates

- Level of interest rate is determined by supply of & demand for investment capital
- Demand for investment capital is determined by production opportunities available & rates of return producers can expect to earn on invested capital
- Supply of investment capital depends on consumers' time preferences for current & future consumption.

Interest rate determinants

- Level of interest rates also depends on risk & inflation
- Higher perceived risk, higher required rate of return
- Higher expected inflation - higher required return

Interest rate determinants

- Real risk free rate of interest (k*) is interest rate that would exist on a riskless security if no inflation were expected; - Interest on short term Treasury securities in an inflation-free world
- Quoted or nominal risk free rate
  - (k_{RF}) = k* + IP, where IP is Inflation premium IP = (avg. inflation rate expected over life of security) & compensates investors for expected loss of purchasing power.

Interest Rate Determinants

- Default risk premium - DRP - compensates for risk of default & non payment of interest or principal - credit risk premium
- Liquidity premium - LP - added to real rate for securities that are not liquid (liquid security can be sold & quickly converted to cash at a fair market value)
- Maturity risk premium – MR - added to longer-term securities to compensate investors for interest rate risk - longer term securities are more price sensitive to interest rate changes than are short-term securities

"Real" versus "nominal" rates

k^* = real risk-free rate.
T-Bond rate if no inflation;
1% to 4%.

k = any nominal rate.

k_{RF} = Rate on T-securities.

The Real Rate of Interest

- There is a preference for "real" applications for savings such as consumption or real investment
  - Real interest rate compensates for delayed consumption.
  - The higher the desire for consumption, the higher the real rate of interest.

Risk Premium

- interest rate = base interest rate + spread
- interest rate = base interest rate + risk premium:
  - type of issuer
  - issuer's perceived creditworthiness
  - term or maturity of instrument
  - provisions that grant either issuer or investor the option to do something
  - taxability of the interest received by investors
  - expected liquidity of the issue

$k = k^* + IP + DRP + LP + MRP$

Here:

k^*	=	Real risk-free rate
IP	=	Inflation premium
DRP	=	Default risk premium
LP	=	Liquidity premium
MRP	=	Maturity risk premium

Premiums Added to k* for Different Types of Debt:

- S-T treasury: only IP for S-T inflation
- L-T treasury: IP for L-T inflation, MRP
- S-T corporate: S-T IP, DRP, LP
- L-T corporate: IP, DRP, MRP, LP

Yield Curve Construction

Find the average expected inflation rate over years 1 to n:

$$IP_n = \frac{\sum_{t=1}^{n} INFL_t}{n}.$$

Expected inflation is 2% next year, 2.5% the following year, and 4% thereafter

IP_1 = 2%/1.0 = 2.00%.

IP_{10} = [2 + 2.5 + 4(8)]/10 = 3.65%.

IP_{20} = [2 + 2.5 + 4(18)]/20 = 3.83%.

Must earn these IPs to break even against inflation; these IPs would permit you to earn k* (before taxes)

Find MRP Based

$$\mathbf{MRP_t = 0.1\%(t - 1)}$$

$MRP_1 = 0.1\% \times 0 = 0.0\%$

$MRP_{10} = 0.1\% \times 9 = 0.9\%$

$MRP_{20} = 0.1\% \times 19 = 1.9\%$

Add the IPs and MRPs to k*:

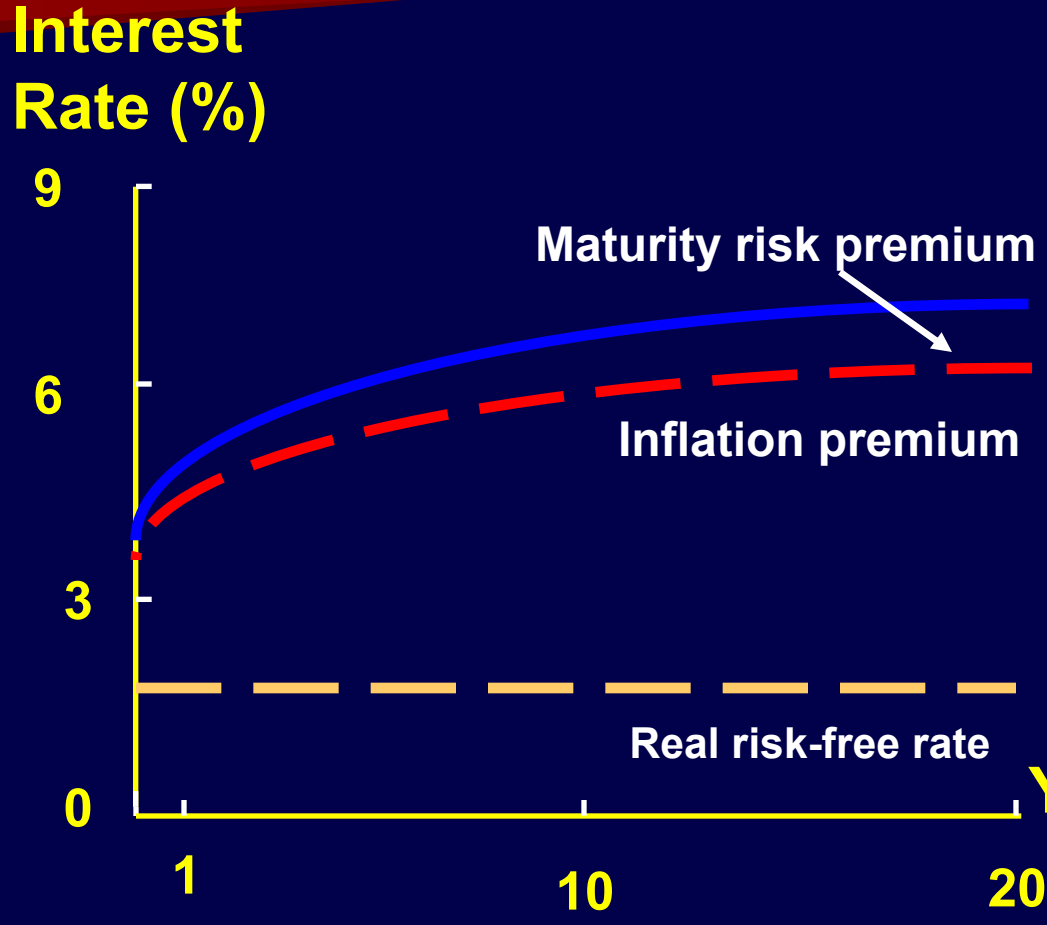
$$k_{RF_t} = k^* + IP_t + MRP_t.$$

k_{RF} = Quoted market interest rate on treasury securities.

Assume $k^* = 2\%$:

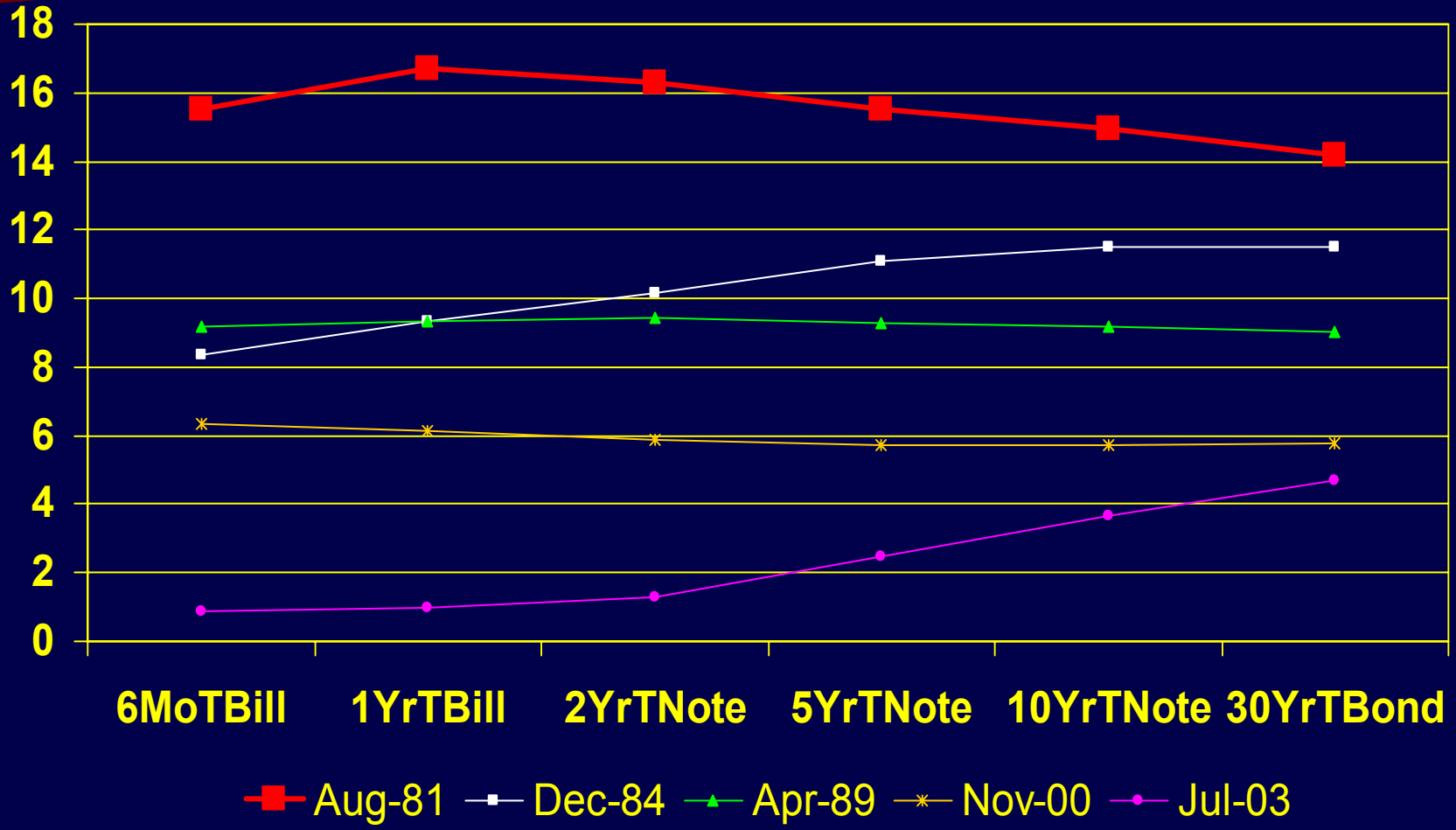
$k_{RF1} = 2.0\% + 2.0\% + 0.0\% = 4.0\%.$
$k_{RF10} = 2.0\% + 3.65\% + 0.9\% = 6.55\%.$
$k_{RF20} = 2.0\% + 3.83\% + 1.90\% = 7.73\%.$

Hypothetical **Treasury Yield Curve**

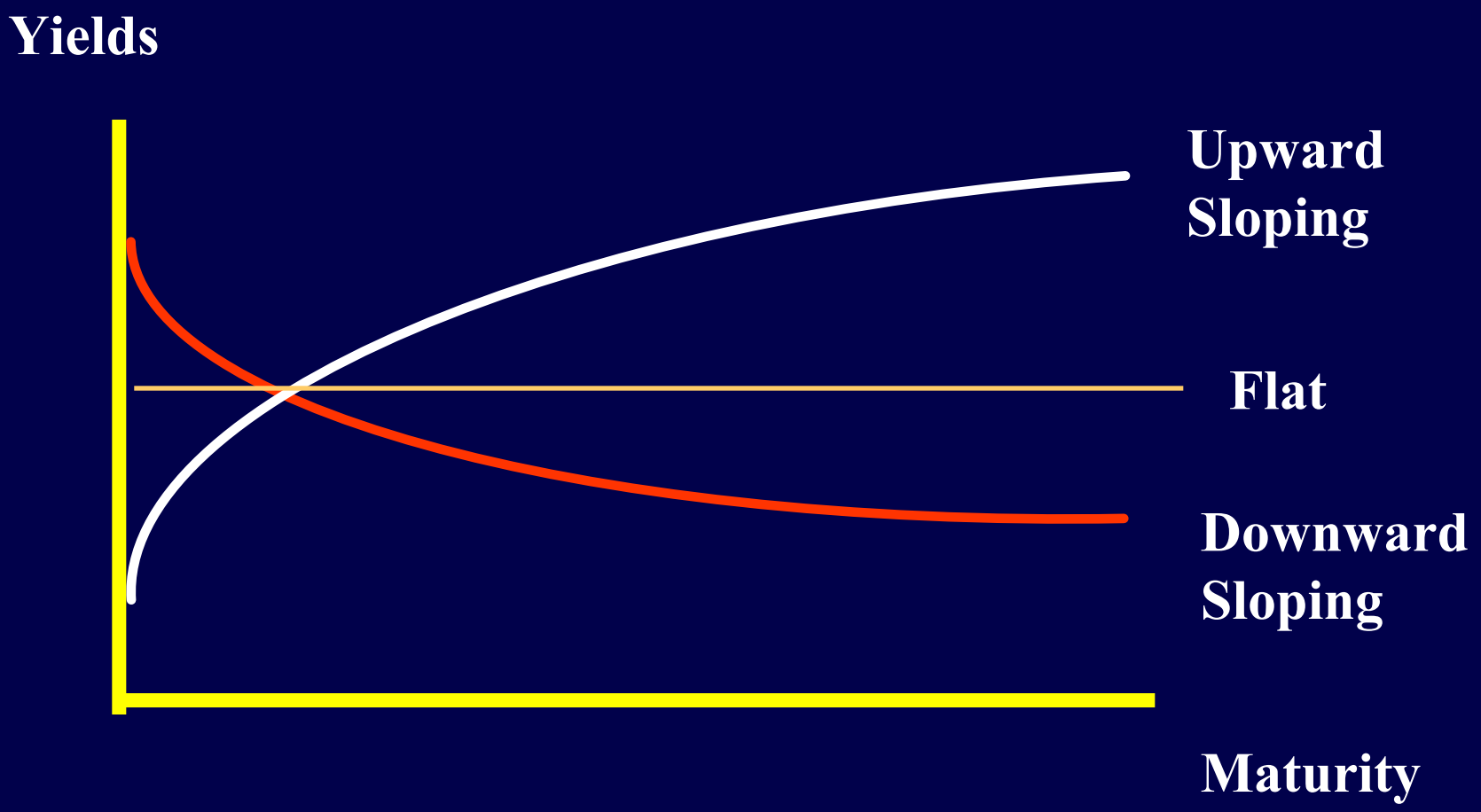


1 yr	4.00%
10 yr	6.55%
20 yr	7.73%

Historical **Treasury Yield Curve**



Treasury Yield Curve



Summary Statistics for Historical Rates
1953-2002

Shape

Normal	Inverted	Humped	Other
66.9%	10.7%	15.3%	7.1%

Yield Statistics

	1 yr.	3 yr.	5 yr.	10 yr.
Mean	6.04	6.42	6.58	6.74
S.D.	2.93	2.82	2.78	2.75
Skewness	1.03	0.90	0.84	0.76
Exc. Kurtosis	1.35	0.90	0.67	0.34

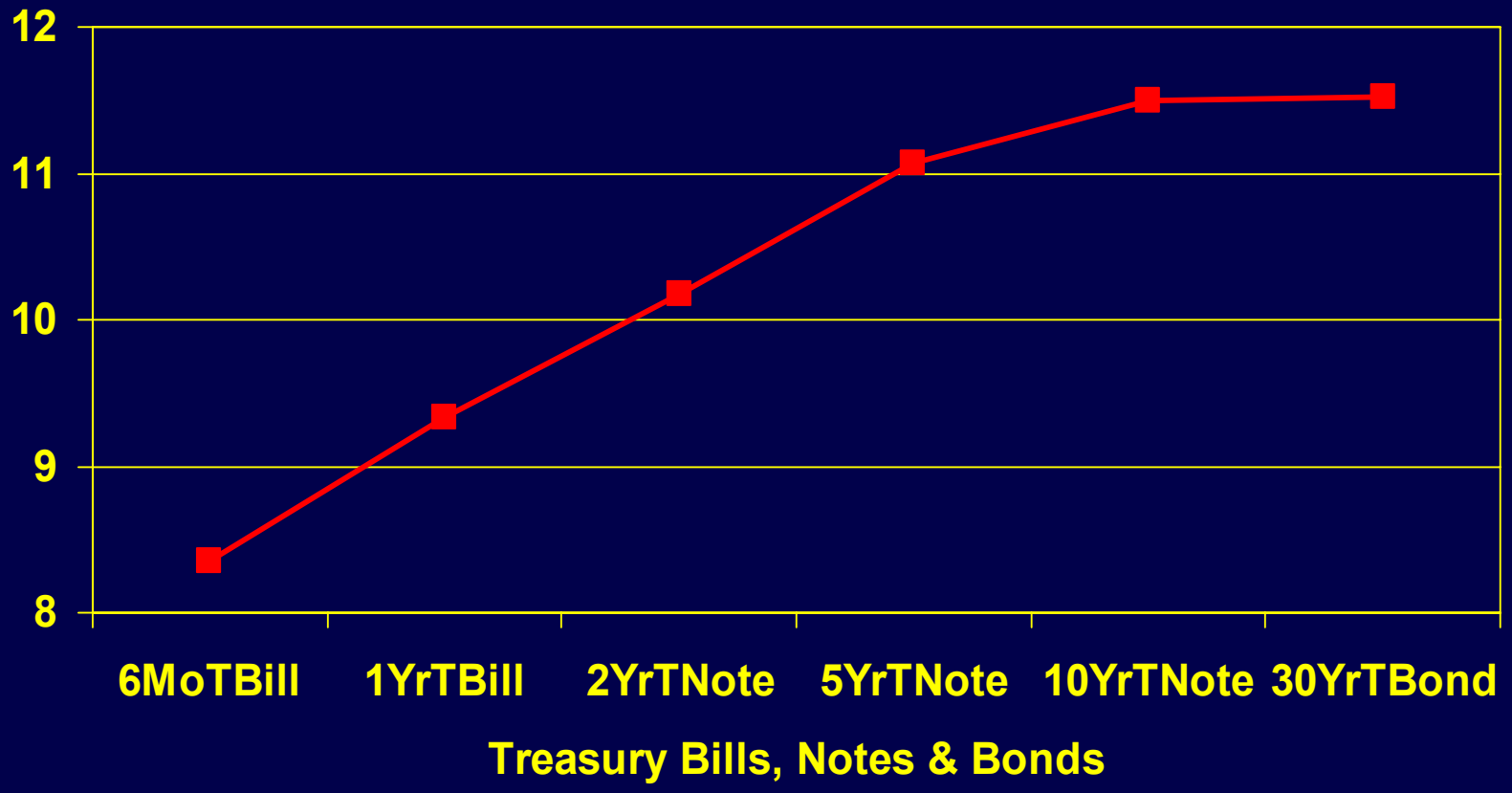
Percentiles

	1 yr.	3 yr.	5 yr.	10 yr.
1%	1.11	1.60	1.95	2.38
5%	2.26	2.58	2.75	2.92
95%	12.04	12.09	12.40	12.43
99%	15.00	14.66	14.56	14.28

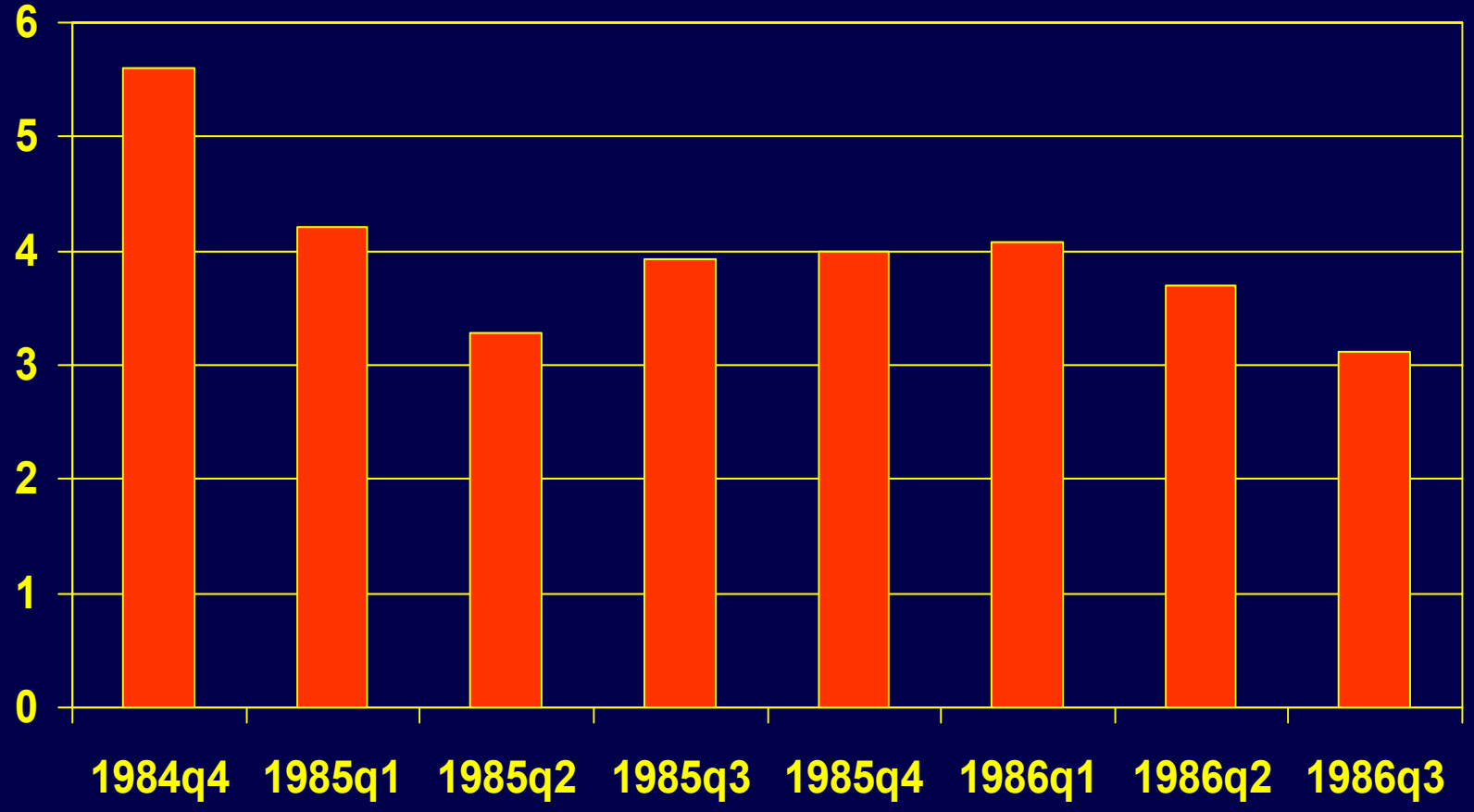
Corr (1 yr,10 yr) = 0.943

http://www.federalreserve.gov/releases/H15/data.htm

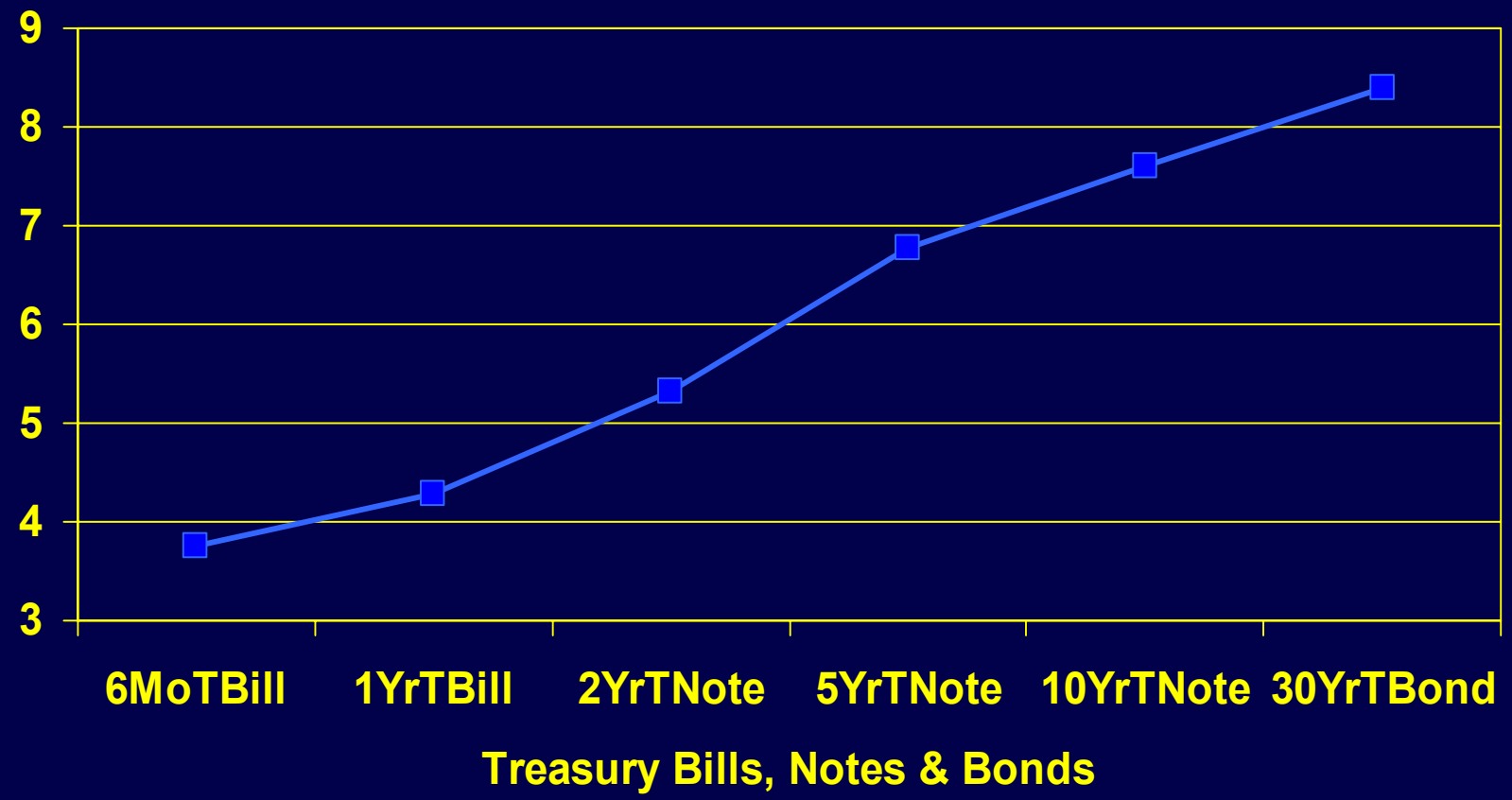
December 1984 Treasury Yield Curve
Normal



Real GDP Percent Change
Normal Yield Curve

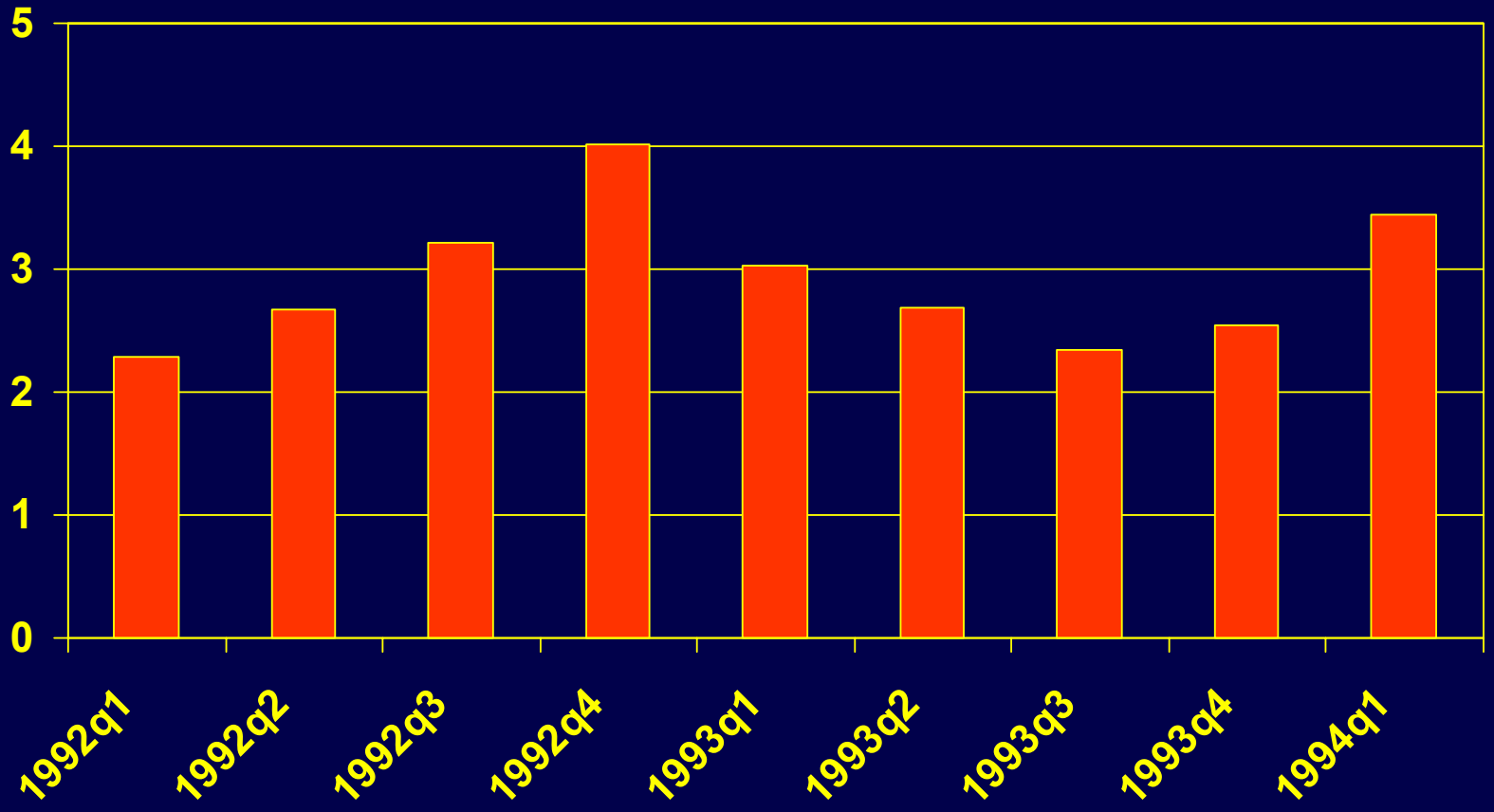


April 1992 Treasury Yield Curve Steep

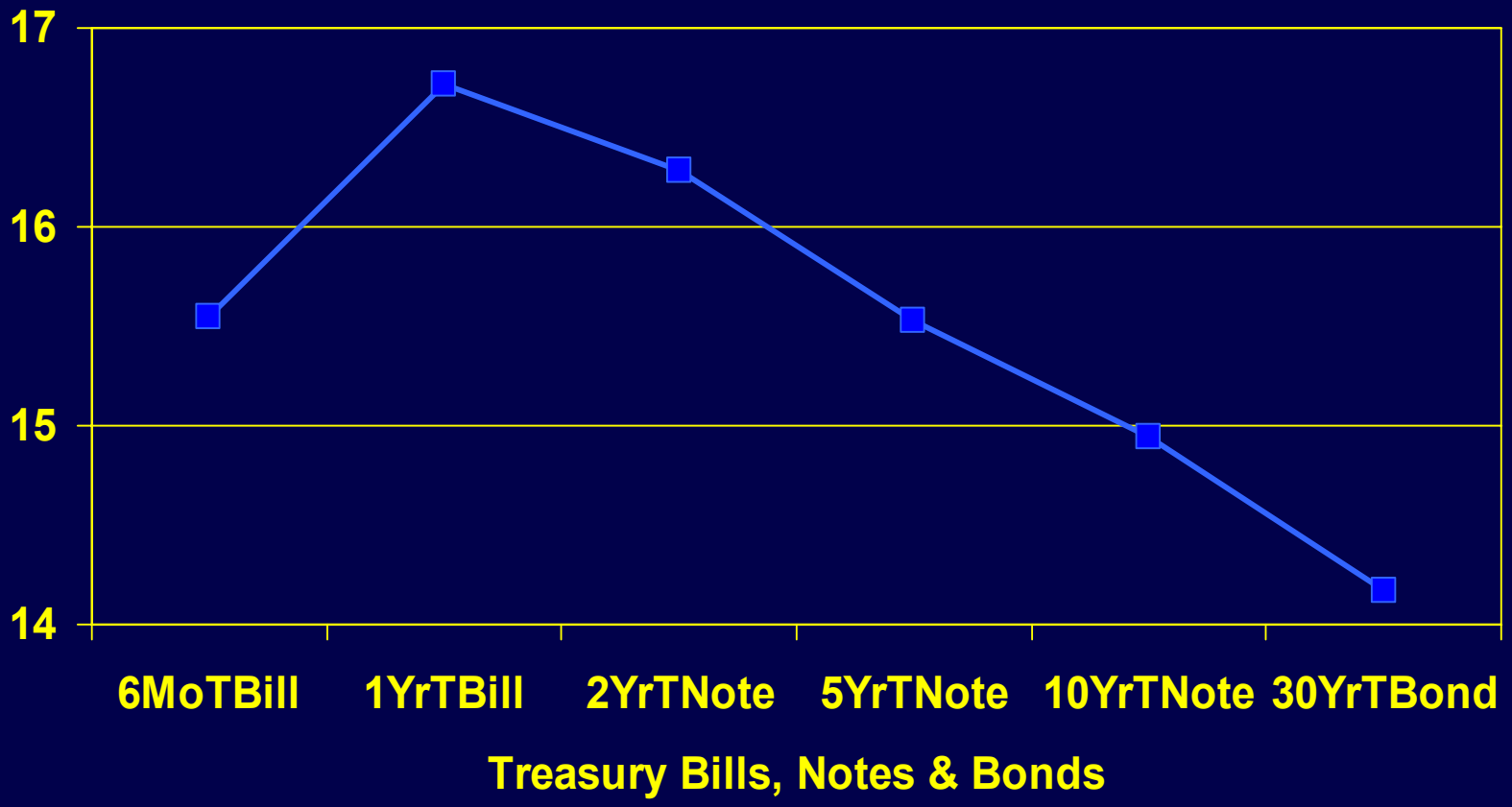


Real GDP Percent Change

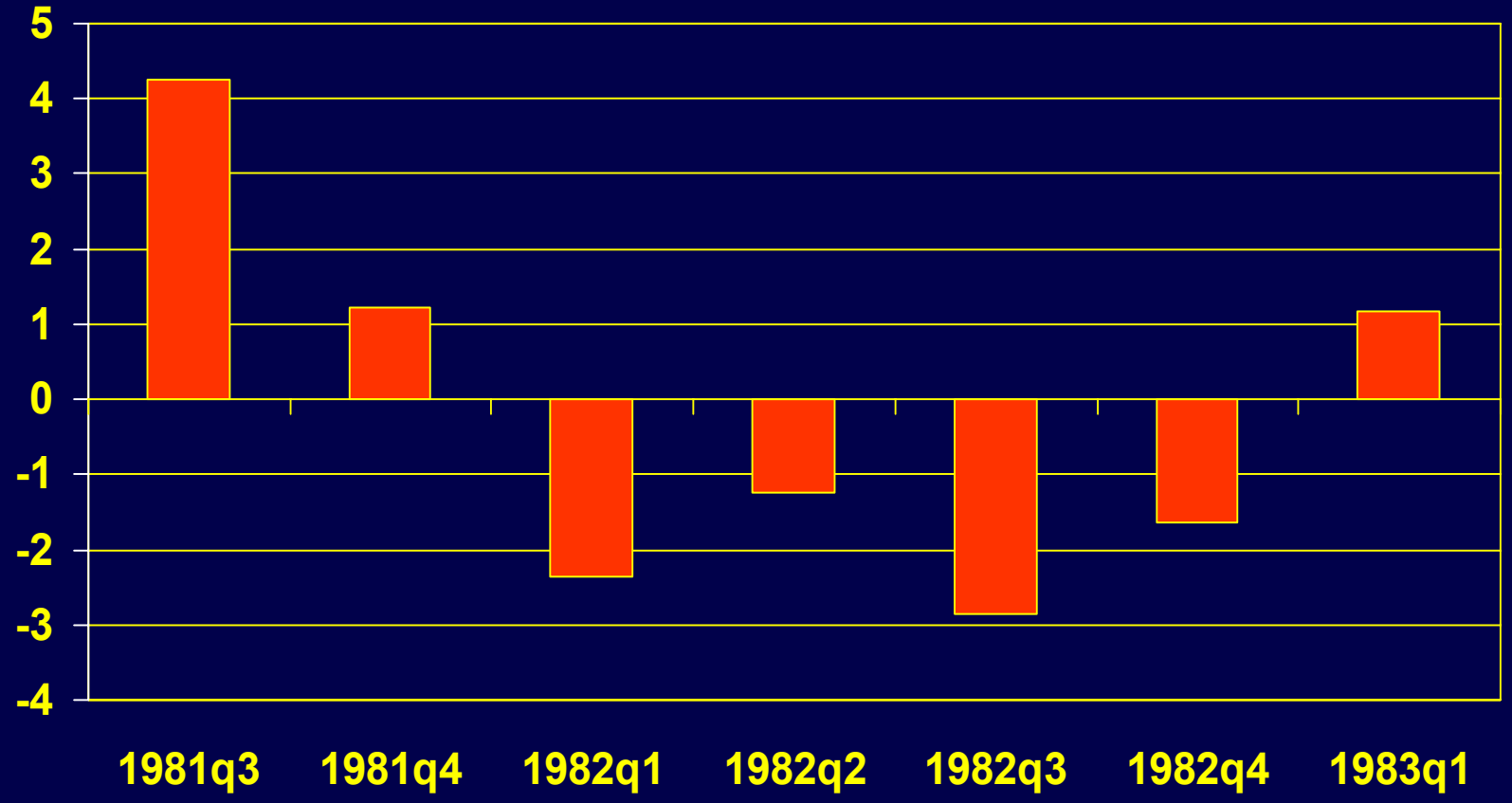
Steep Yield Curve



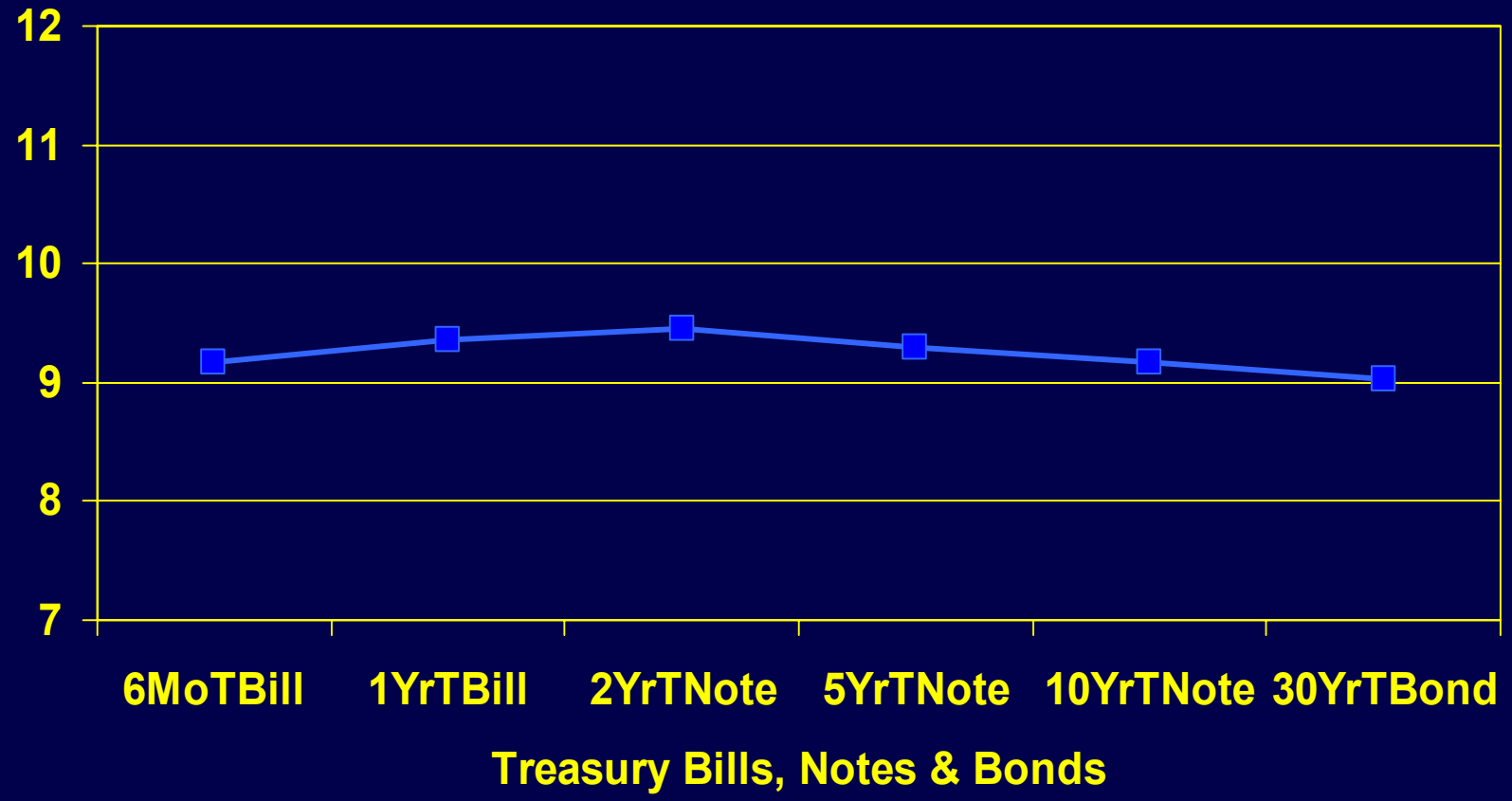
August 1981 Treasury Yield Curve Inverted



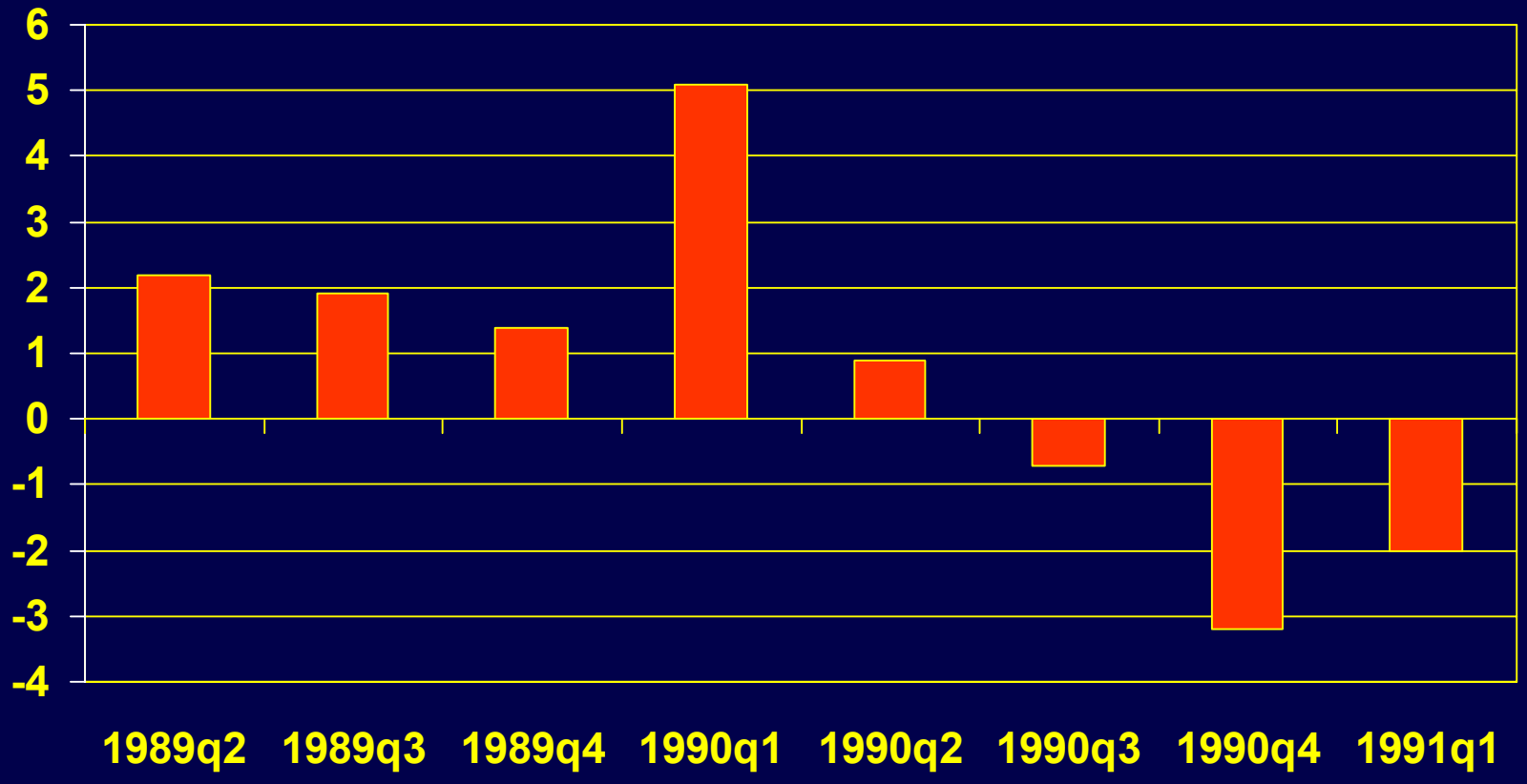
Real GDP Percent Change
Inverted Yield Curve



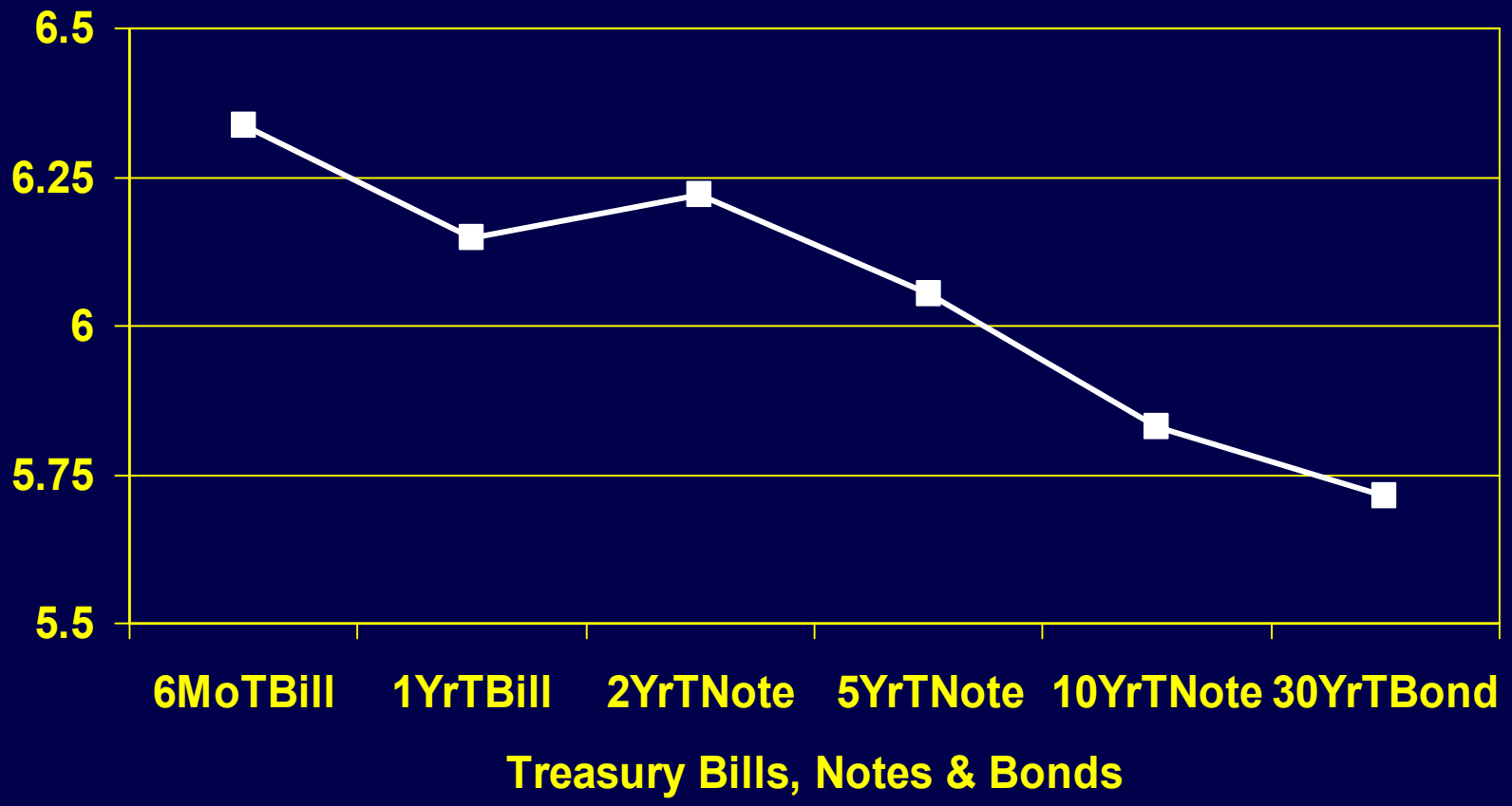
April 1989 Treasury Yield Curve Flat



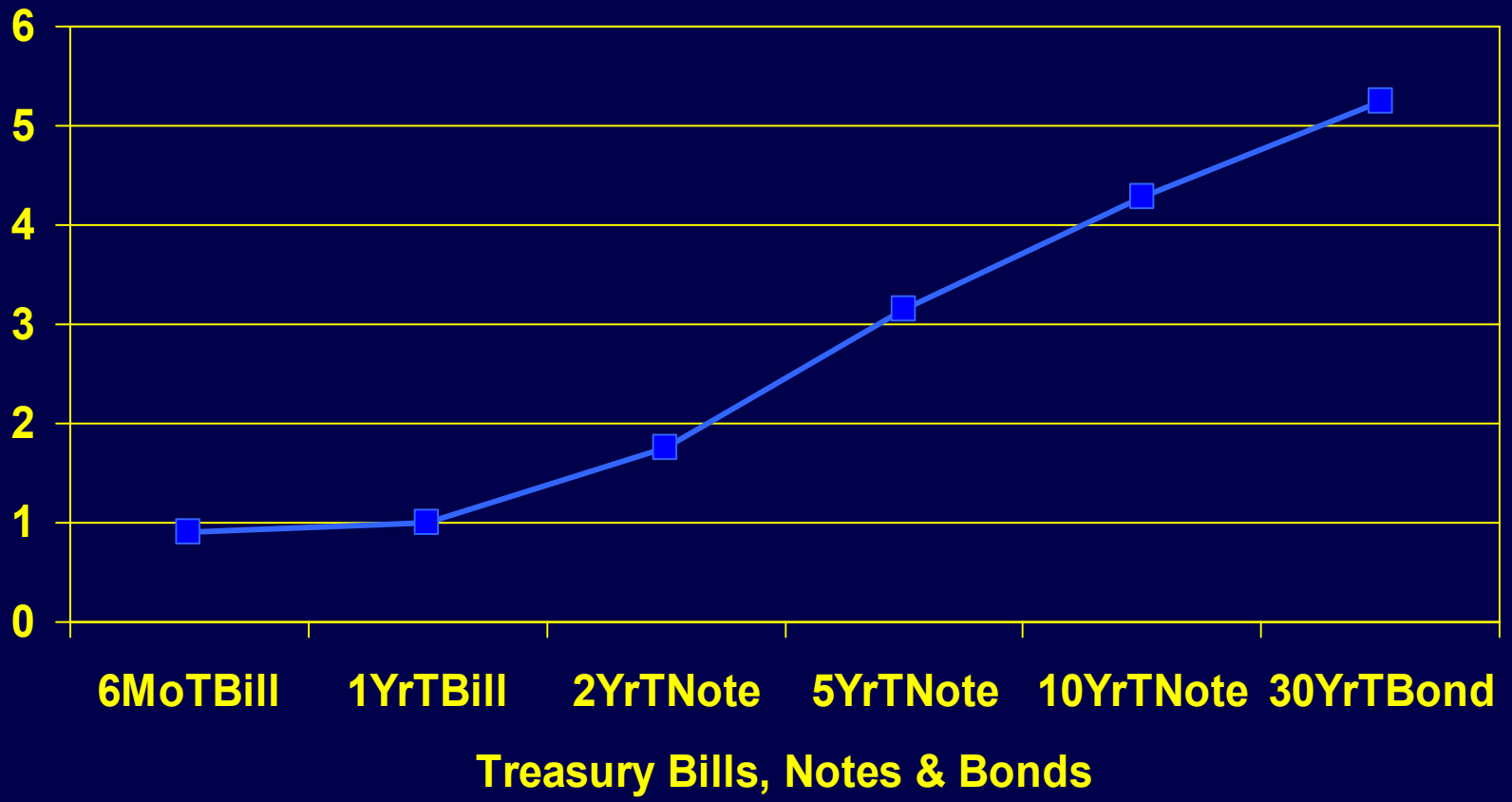
Real GDP Percent Change
Flat Yield Curve



August 2000 Treasury Yield Curve



August 2003 Treasury Yield Curve



Bonds

General Information

- http://www.smartmoney.com/onebond/index

Kansas Municipal

- http://www.municipalbonds.com/archive/KS/20030814.html

Explanations of the Term Structure

- Three popular explanations of why the yield curve is shaped the way it is (i.e., the term structure of interest rates):
  - The expectations hypothesis
  - The liquidity preference hypothesis
  - The market segmentation hypothesis (preferred habitats)

Yield Curve Theories

- Expectations theory
  - investors indifferent between one long-term and a series of short-term investments
  - price investments so that both will give rise to the same expected return
  - if short-term rates are expected to rise, curve will slope up and vice versa
  - example using zero coupon rates

Yield Curve Theories

- Liquidity preference
  - innate preference for short-term stocks: more liquid and capital more secure
  - investors require higher expected return from long-term investments
  - upward bias on expectations yield curve

Yield Curve Theories

- Market segmentation
  - Generalizes liquidity preference
  - Different investors have different preferences: preferred habitat
  - Yields determined by supply and demand in each term to redemption segment
  - Investors at the margin will leave preferred habitat if yields too out of line with expectations
- Inflation risk premium
- Supply side

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