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Duration Targeting and Yield Convergence

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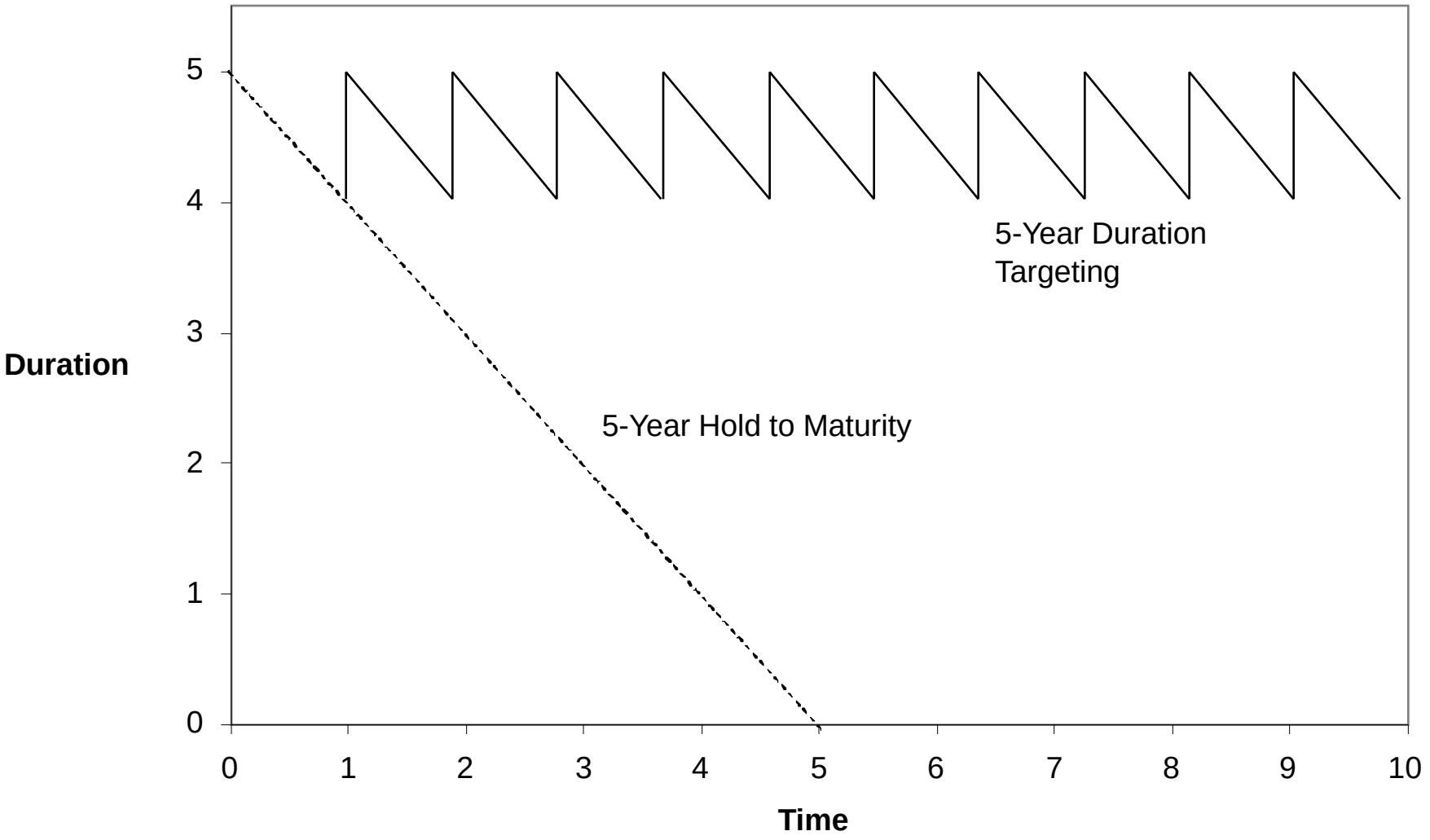
Martin L. Leibowitz, Morgan Stanley
Anthony Bova, Morgan Stanley
Stanley Kogelman, Advanced Portfolio Management

Acknowledgement: Terry Langetieg

Langetieg, Terence C., Martin L. Leibowitz and Stanley Kogelman
"Duration Targeting and the Management of Multiperiod Returns.
Financial Analysts Journal, September/October 1990

5-Year Duration Targeting vs. Hold-to-Maturity



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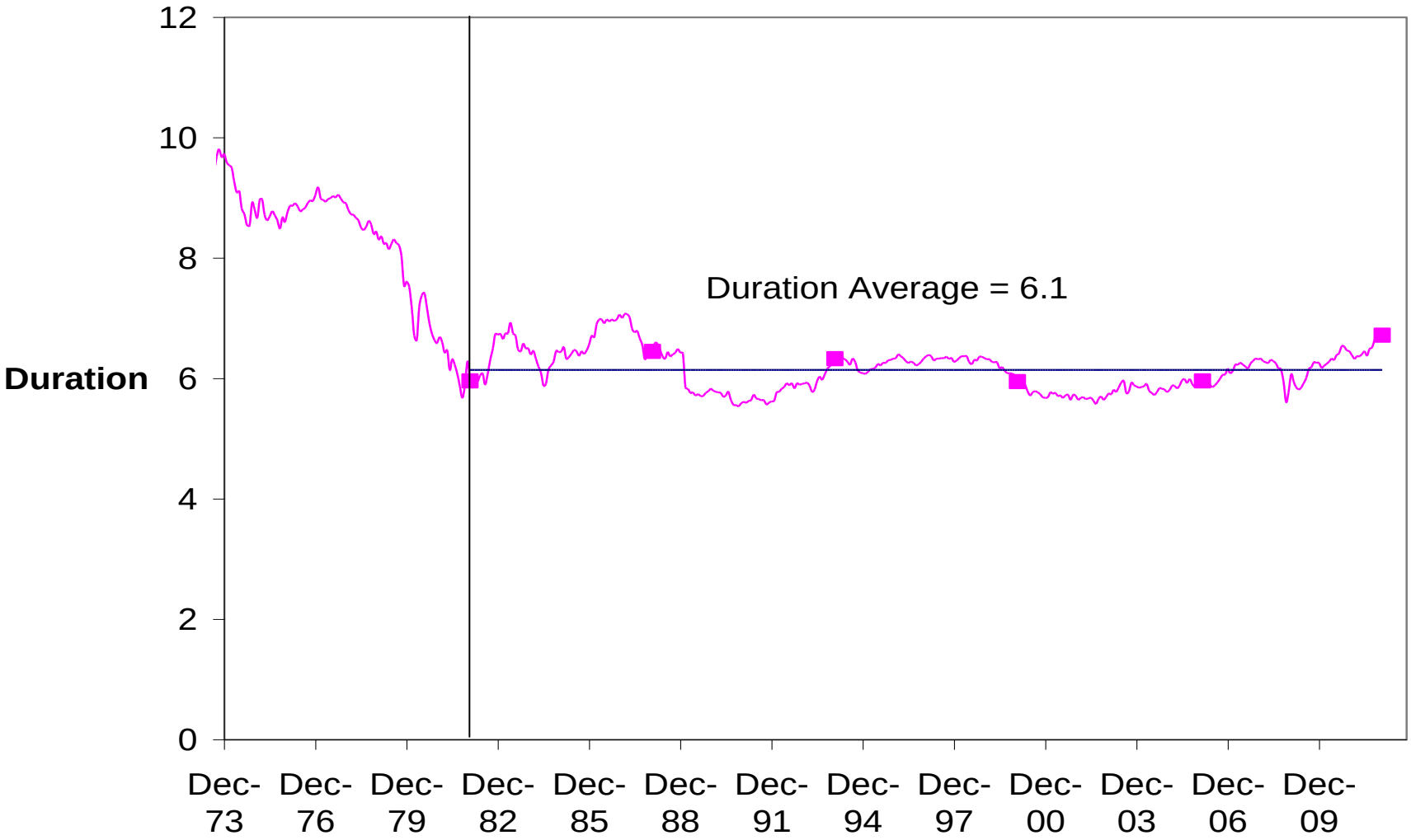
Types of Duration Targeting Bond Funds

- **Active Institutional Portfolios**
- **Bond Market Funds With Stable Maturity Structure**
- ***Bond Indices***
- **Passive Index Tracking Funds**
- ***Laddered Portfolios***
- **Rolling Buy and Hold Portfolios**

Credit Index Duration



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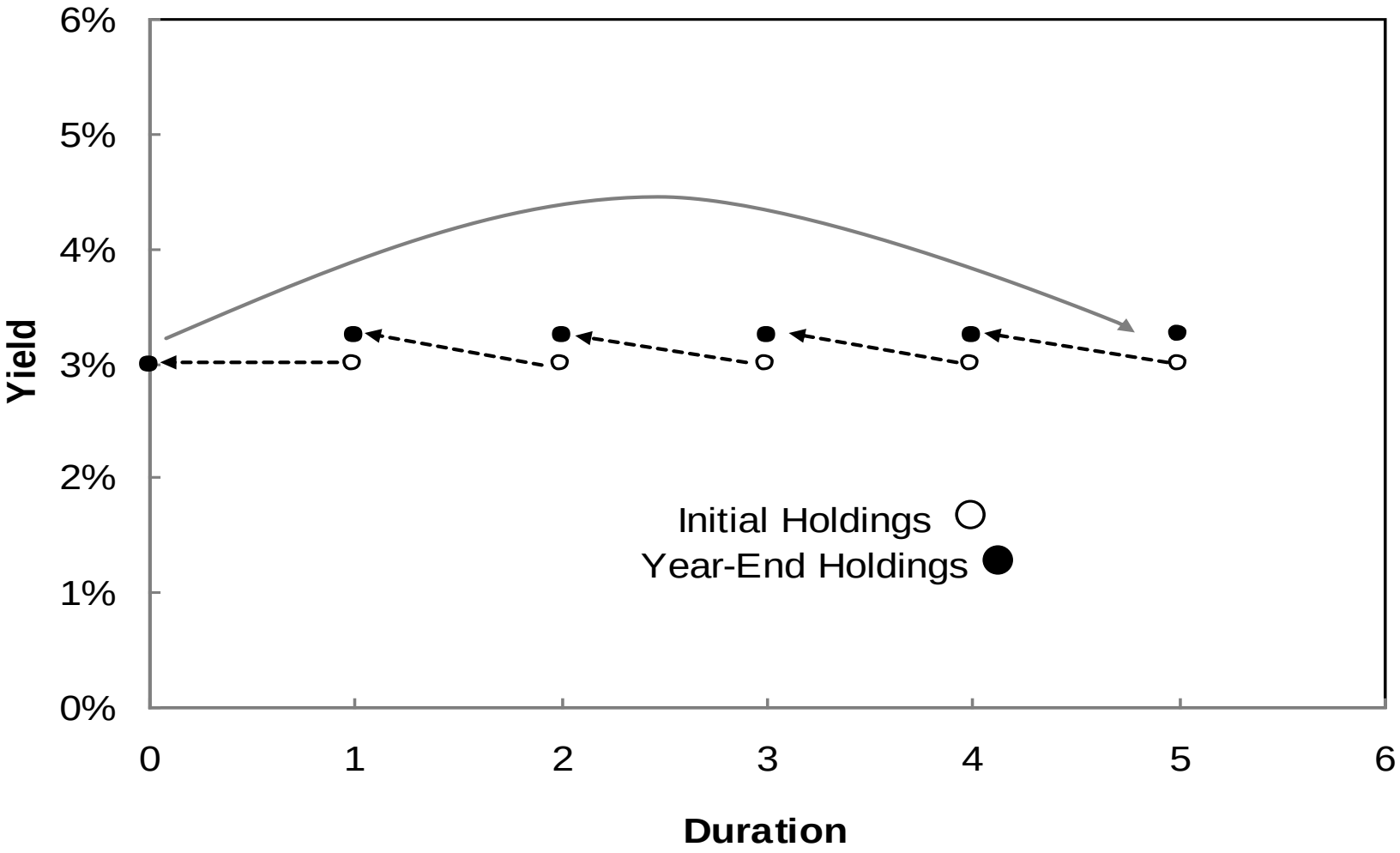
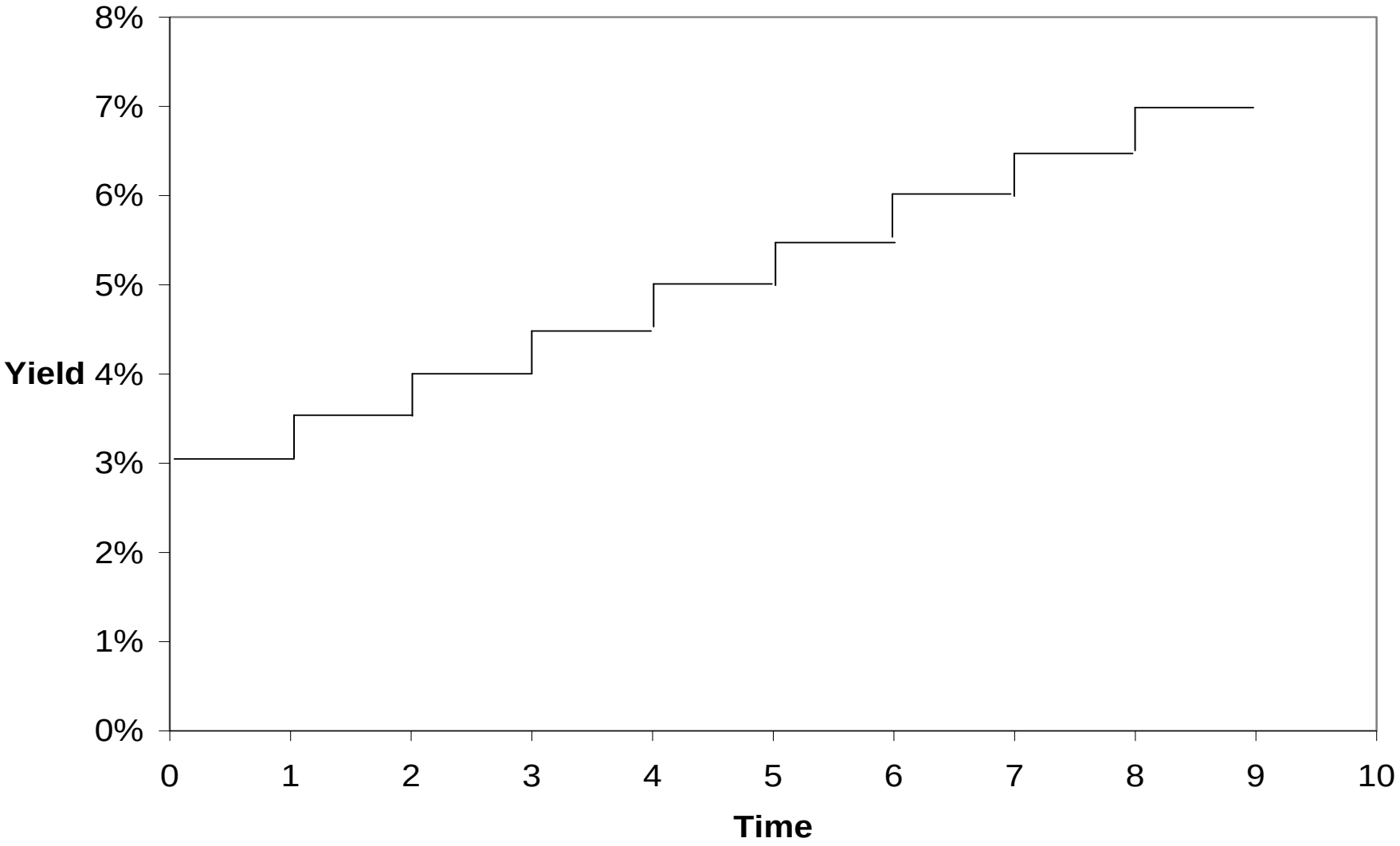
Rebalancing and Illiquid Ladders



Progression of Yields Along 50 bp/year Trendline



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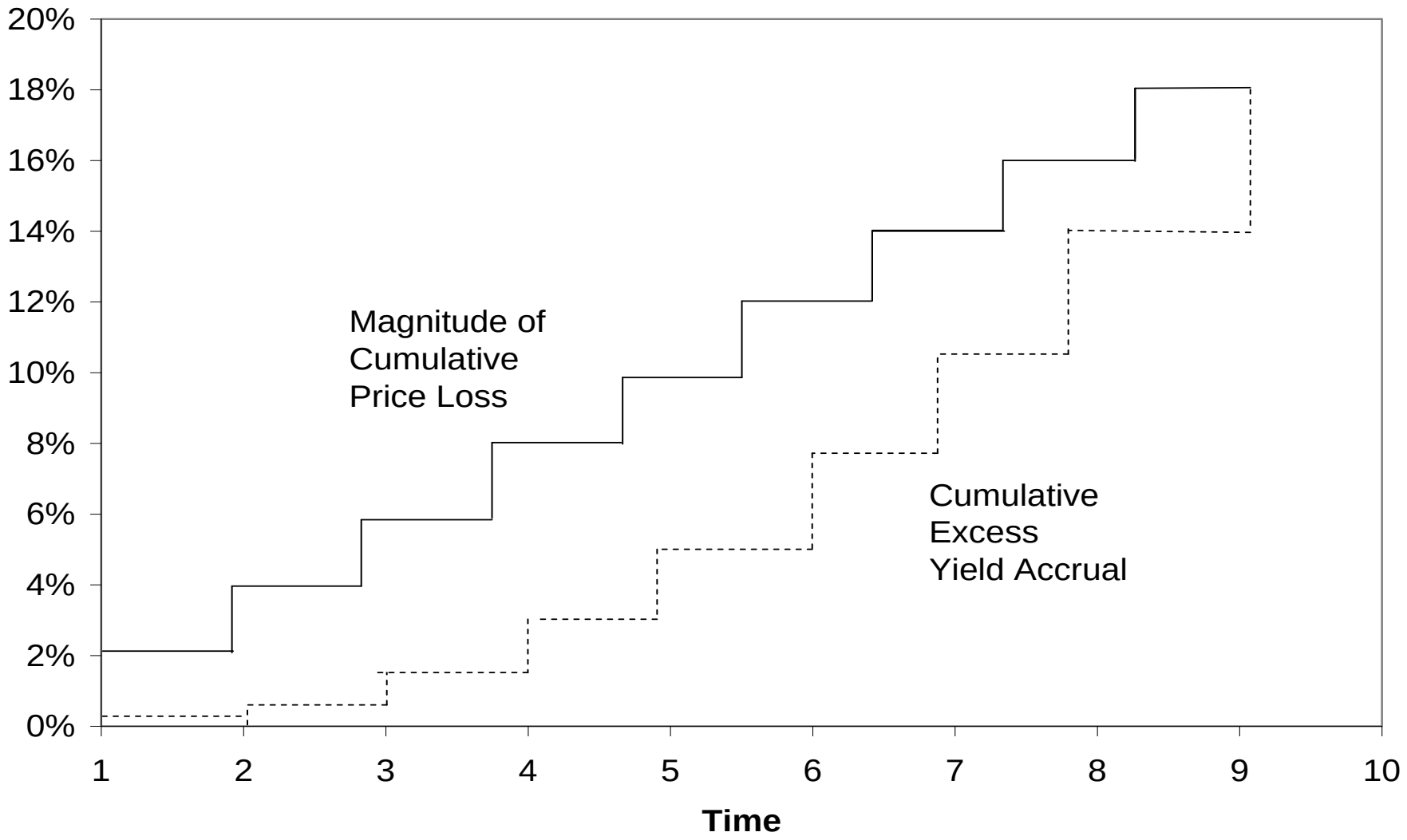
Trendline Returns with +50 bps Drift

Year	Yield At Beginning of Year	Excess Yield Accrual Over Year	Cumulative Excess Accrual	Price Loss Over Year	Cumulative Price Loss	Annual Return	Cumulative Return	Annualized Return
1	3.0%	0.0%	0.0%	-2.0%	-2.0%	1.00%	1.00%	1.00%
2	3.5%	0.5%	0.5%	-2.0%	-4.0%	1.50%	2.50%	1.25%
3	4.0%	1.0%	1.5%	-2.0%	-6.0%	2.00%	4.50%	1.50%
4	4.5%	1.5%	3.0%	-2.0%	-8.0%	2.50%	7.00%	1.75%
5	5.0%	2.0%	5.0%	-2.0%	-10.0%	3.00%	10.00%	2.00%
6	5.5%	2.5%	7.5%	-2.0%	-12.0%	3.50%	13.50%	2.25%
7	6.0%	3.0%	10.5%	-2.0%	-14.0%	4.00%	17.50%	2.50%
8	6.5%	3.5%	14.0%	-2.0%	-16.0%	4.50%	22.00%	2.75%
9	7.0%	4.0%	18.0%	-2.0%	-18.0%	5.00%	27.00%	3.00%

Higher Yield Accruals with +50 bps/yr Trendline



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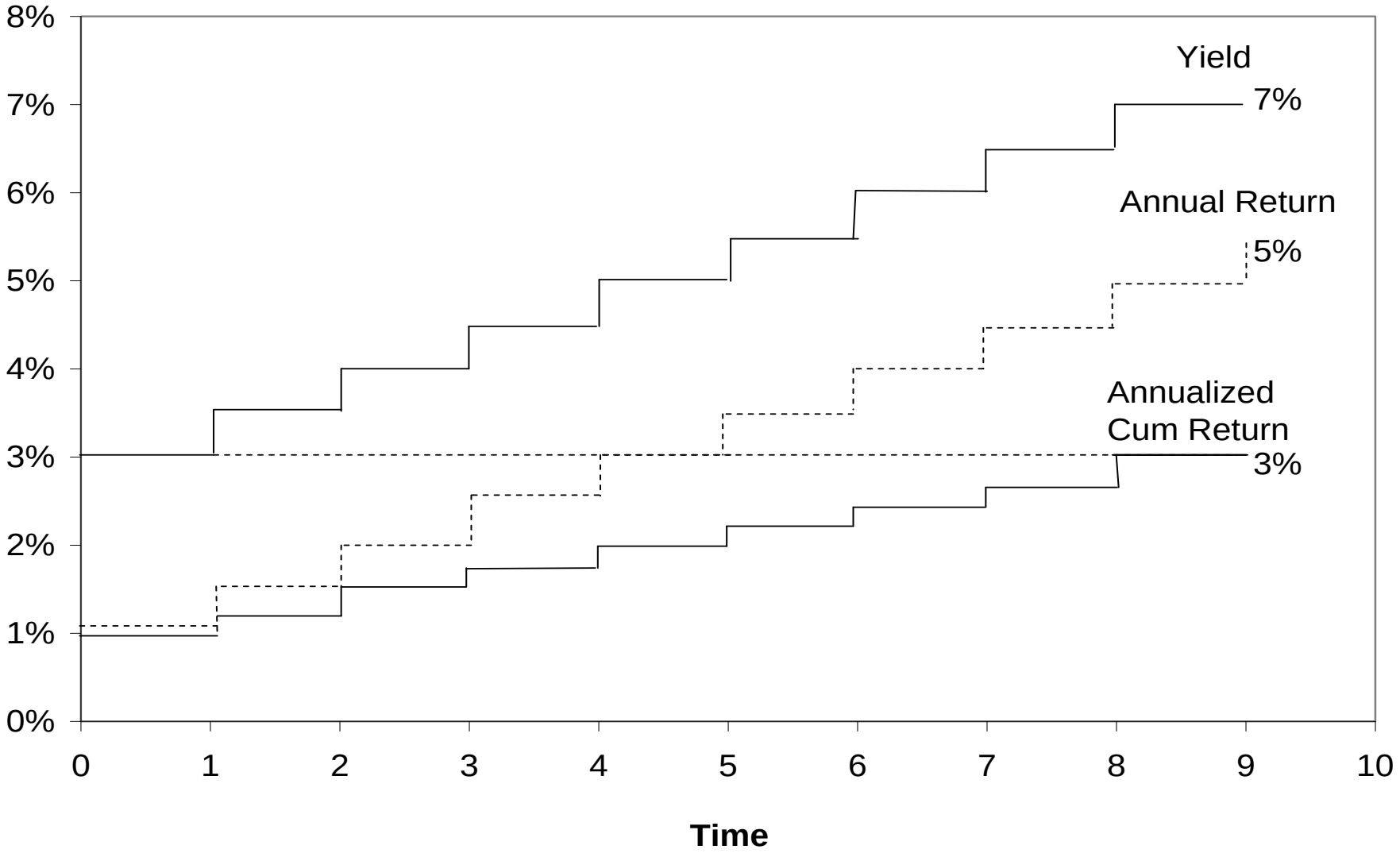
Yields, Annual Returns, Annualized Cumulative Returns



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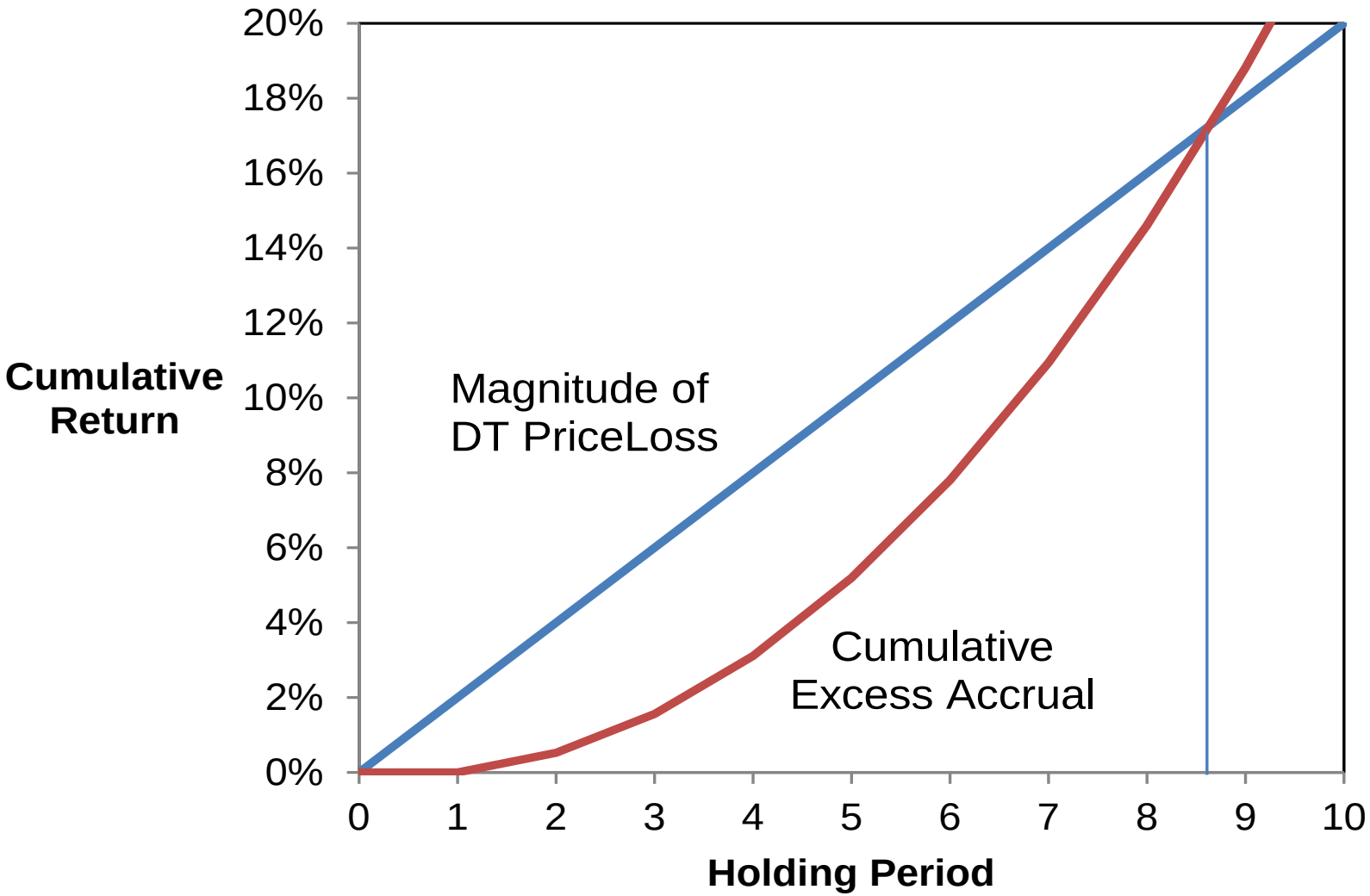
Continuous Excess Yield Accruals and Price Losses with +50 bps/year Trendline



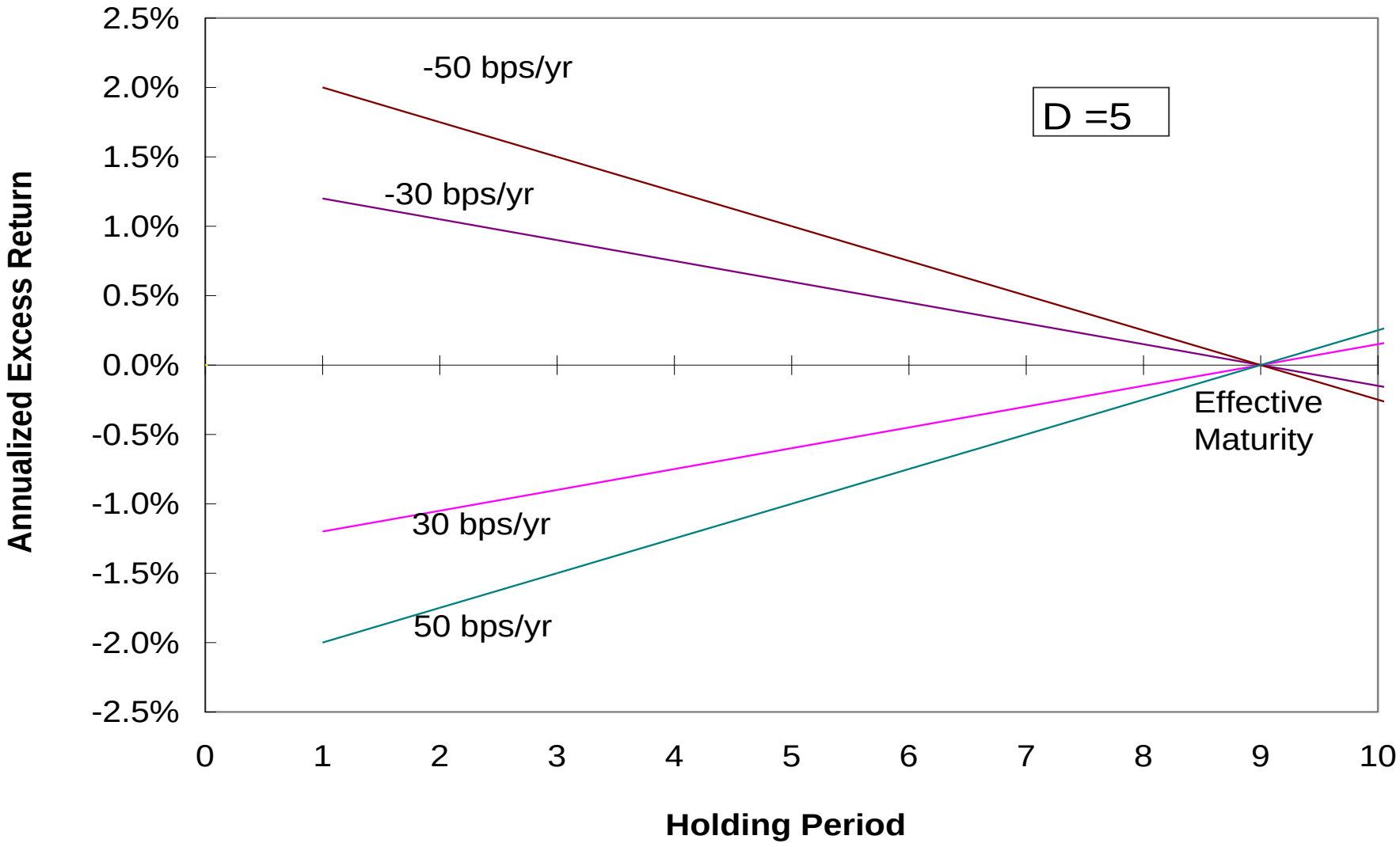
Trendline Returns

$$\text{Cum "Price Loss"} = (D-1)\Delta y + (D-1)\Delta y + \ldots$$
$$= N(D-1)\Delta y$$

$$\text{Cum Yield Accrual} = y_o + (y_o + \Delta y) + (y_o + 2\Delta y) + \ldots + (y_o + (N-1)\Delta y)$$
$$= N y_o + \Delta y[1 + 2 + \ldots + (N-1)]$$
$$= N y_o + \Delta y\left(\frac{N(N-1)}{2}\right)$$

$$\text{Approx Total Annual Return} = y_o + \Delta y\left\{\frac{(N-1)}{2} - (D-1)\right\}$$
$$= y_o + \Delta y\left\{\frac{(N+1)}{2} - D\right\}$$

Excess Returns for Various Trendline Drift Rates



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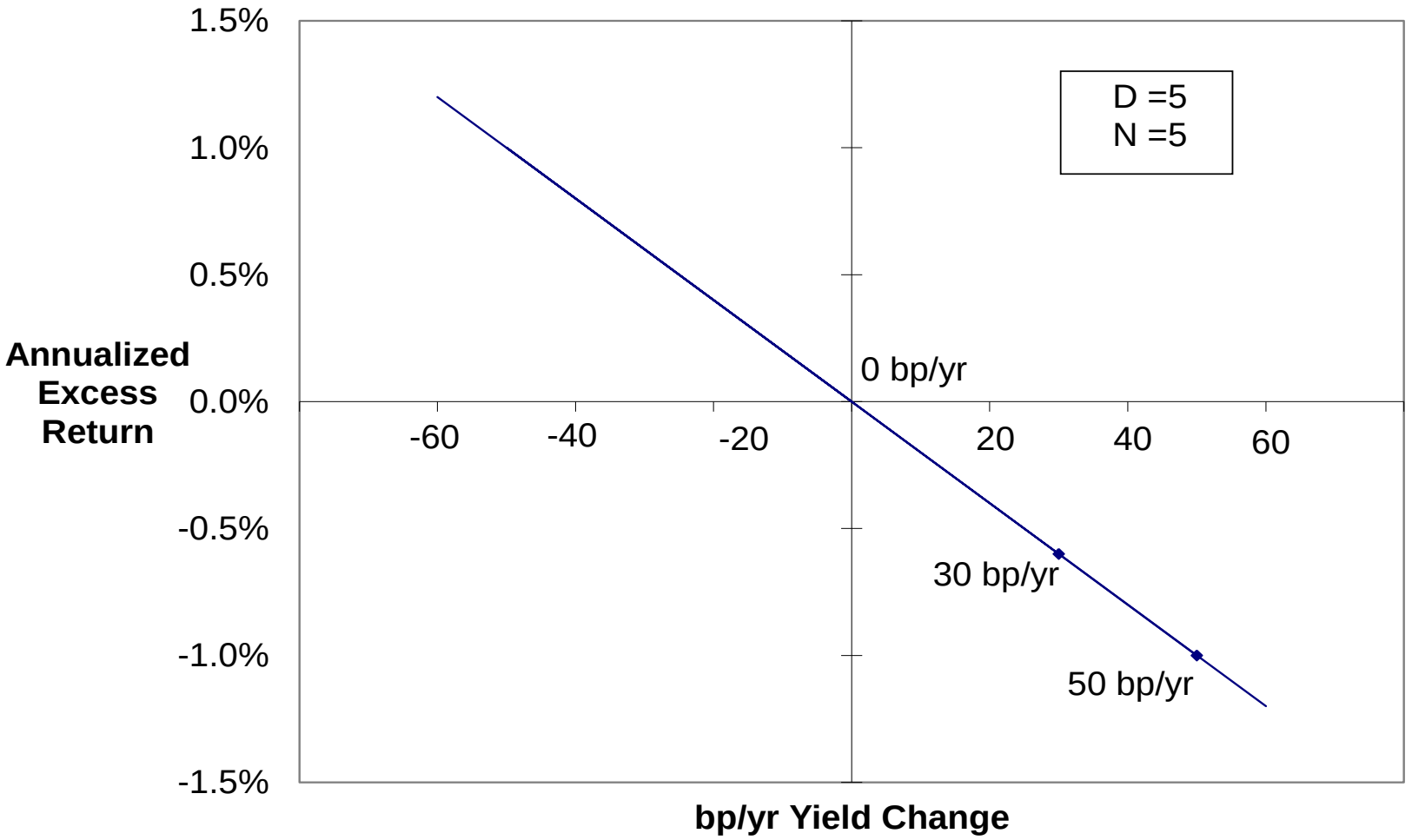
Excess Returns vs. Annual Yield Change



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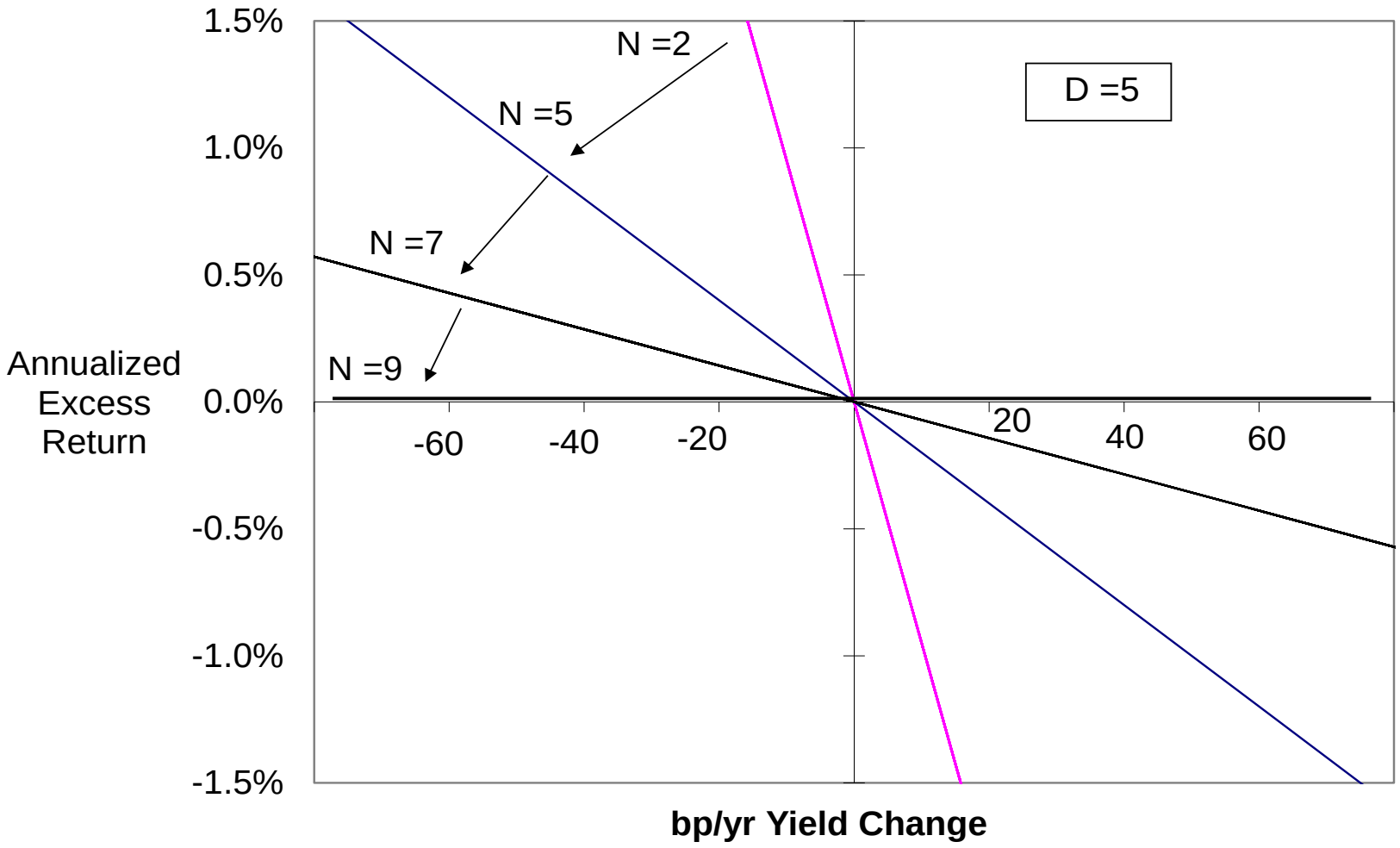
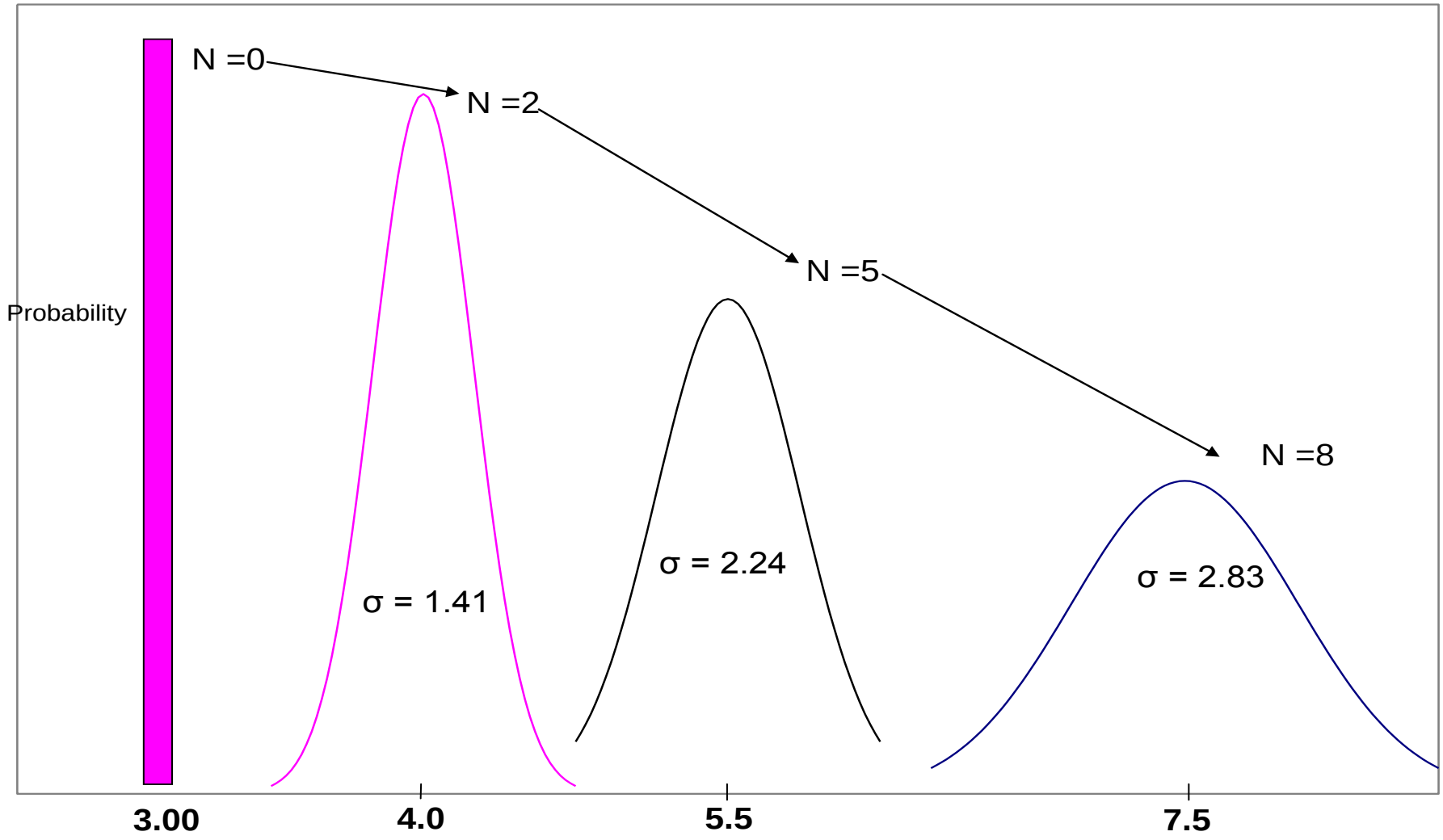
Theoretical Excess Returns vs. Annual Yield Change



Standard Deviation of Returns

$$\sigma(\text{Trendline}) = \sigma_{\Delta y}\sqrt{N}\left|\left(\frac{D}{N}\right) - \frac{(N+1)}{2N}\right|$$

The Progression of Yield Distributions Over Time



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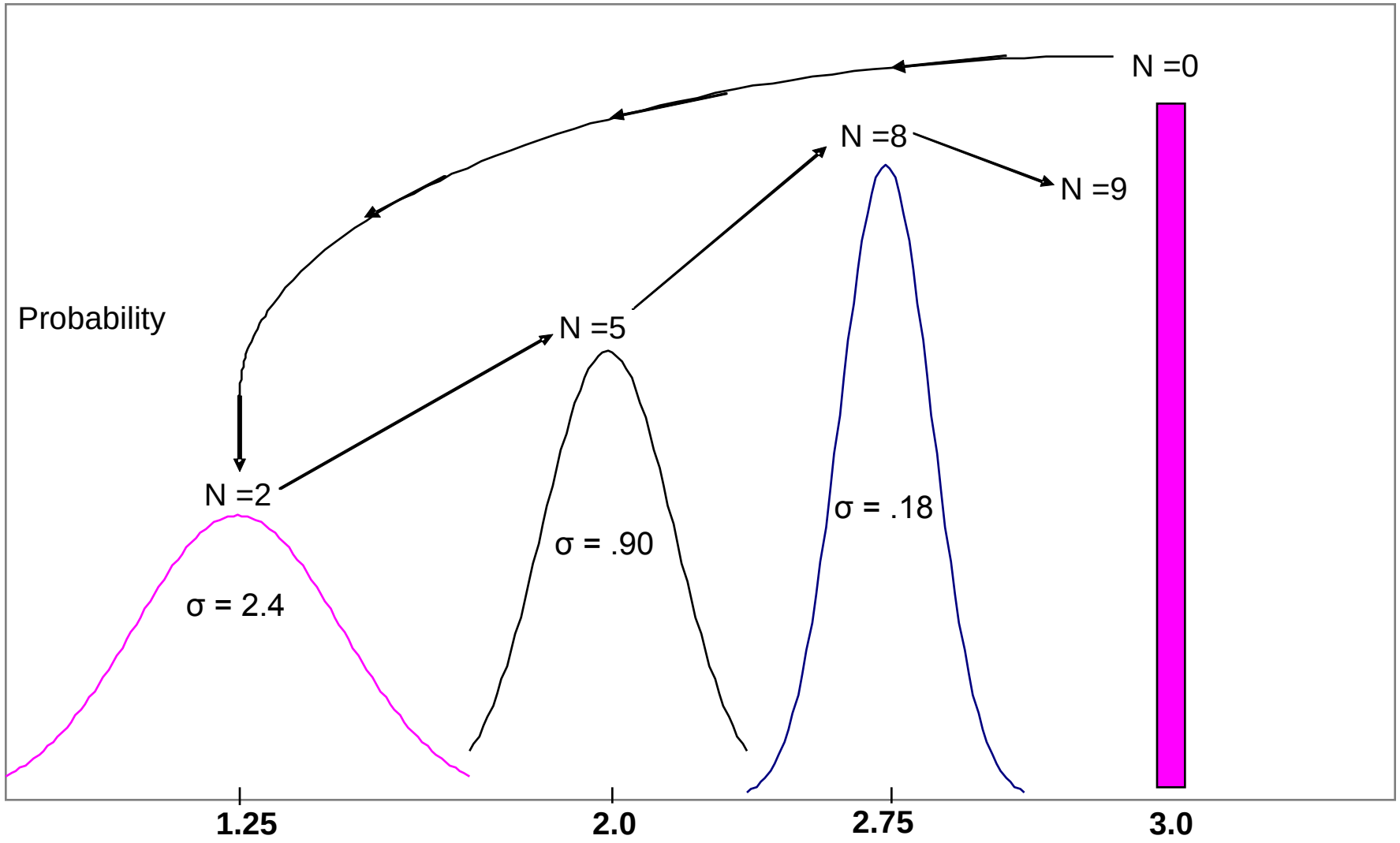
The Progression of Annualized Returns Over Time



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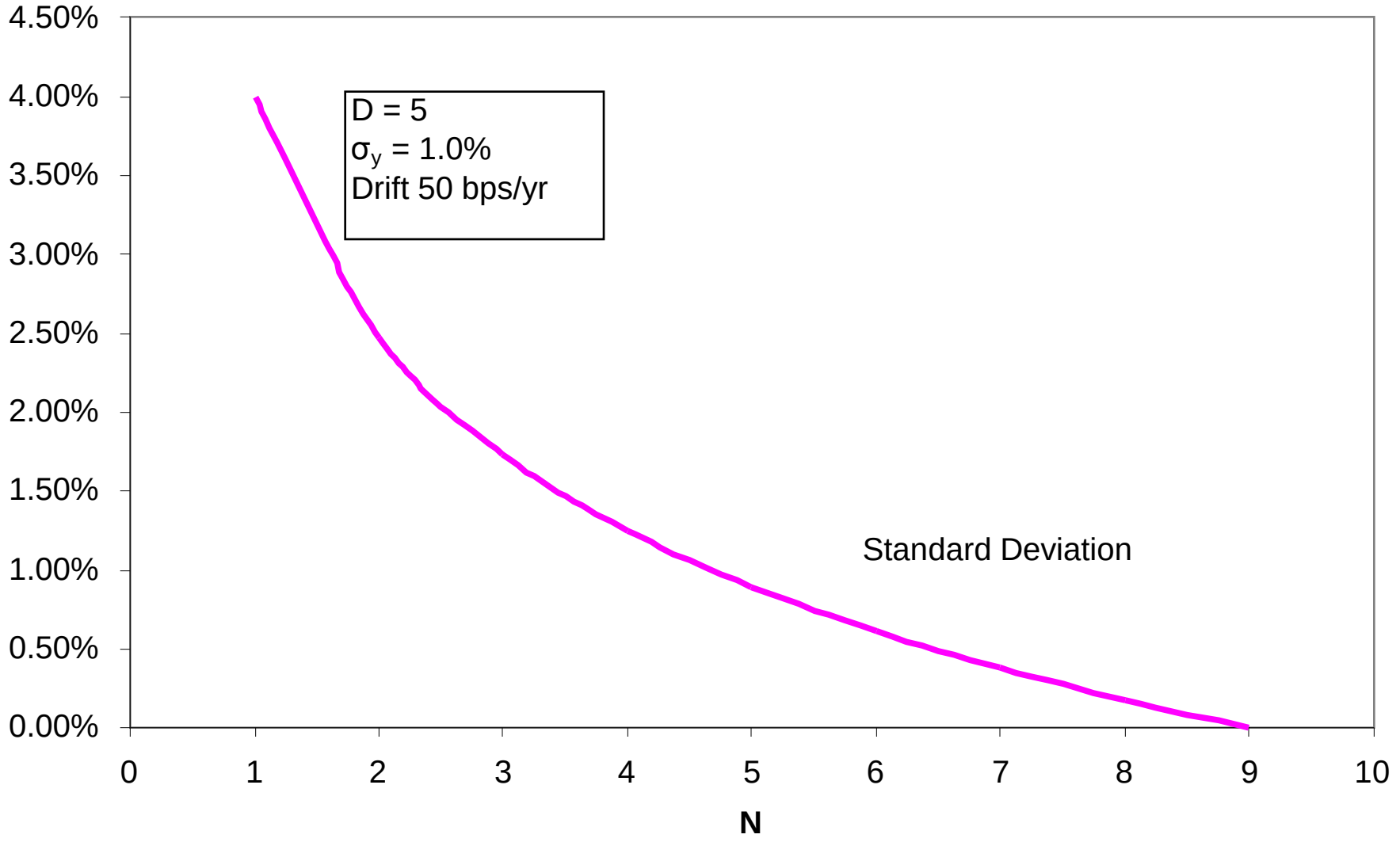
Standard Deviation of Trendline Returns for Range of Terminal Yields at Each Horizon



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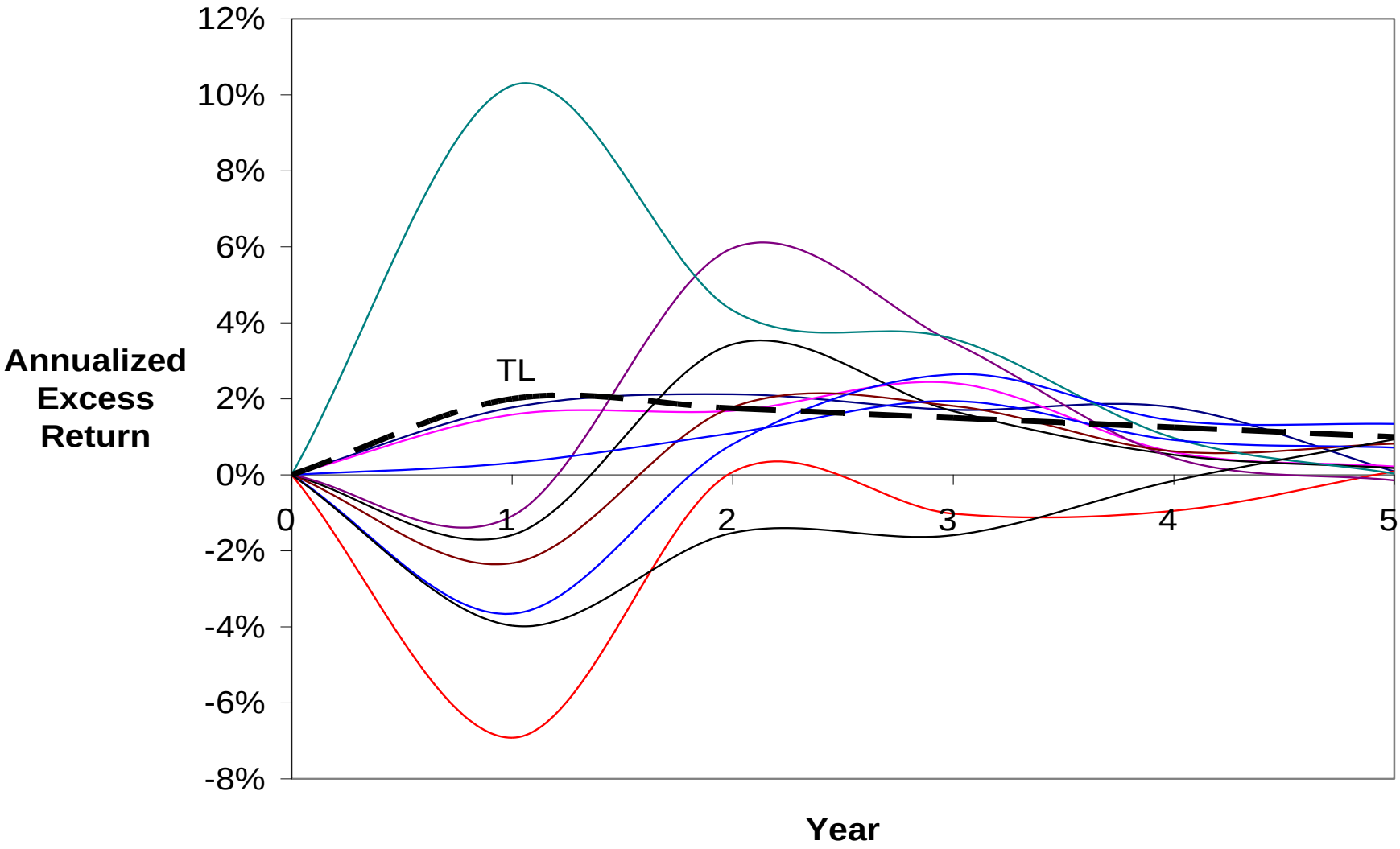
Returns for Simulation Paths with 2-3% Yield Declines



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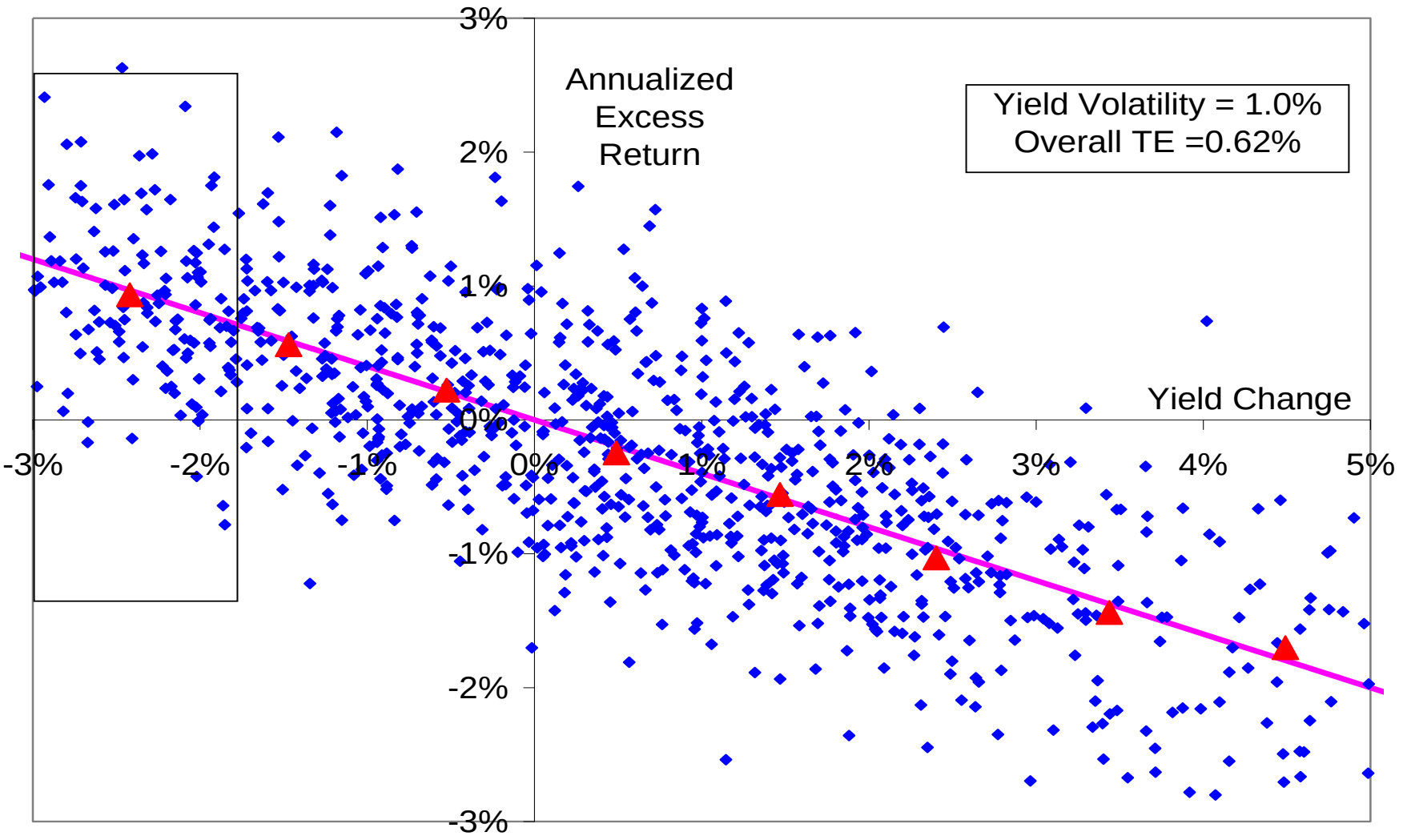
Simulation of Multiple Random Walk Pathways N =5



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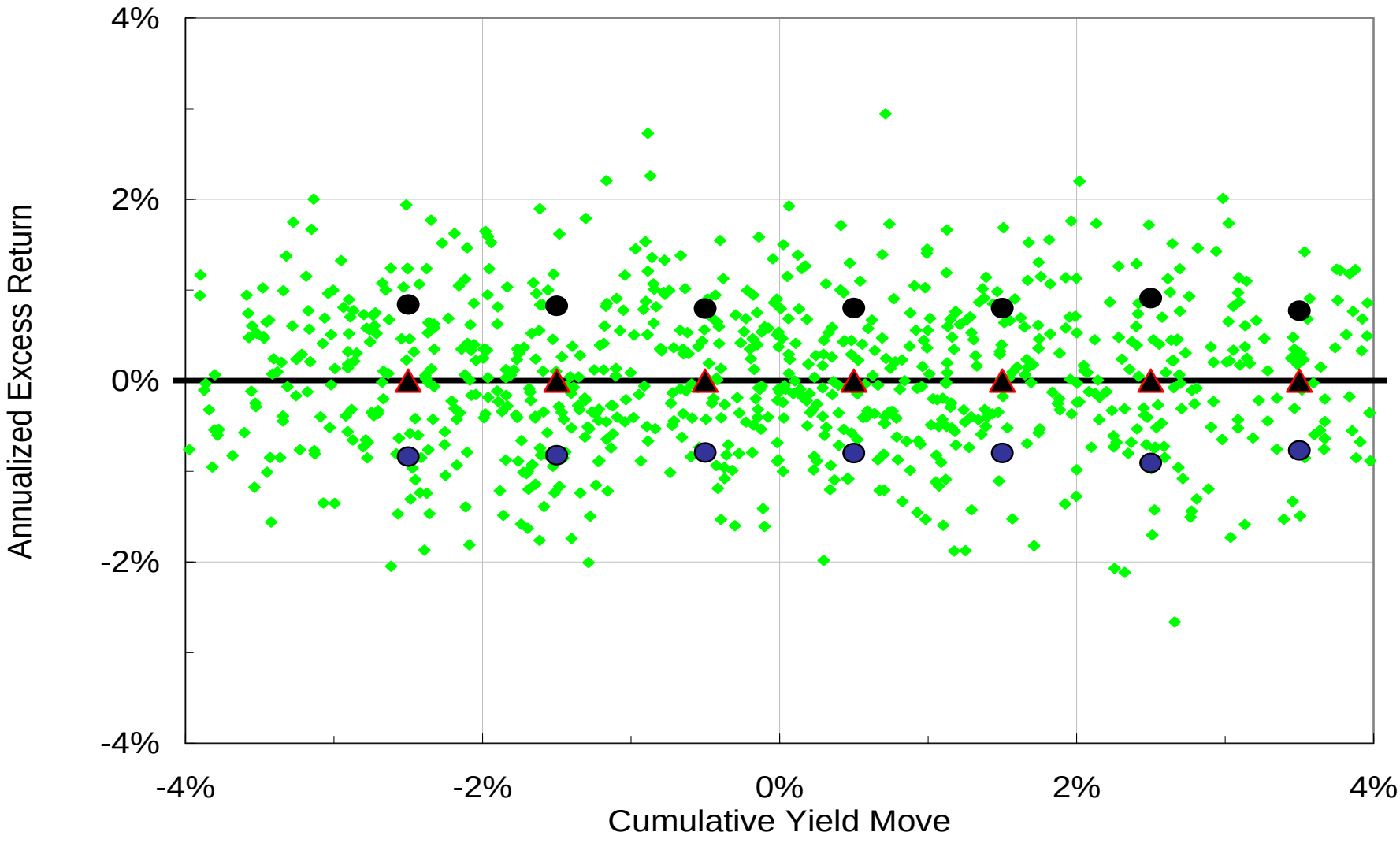
Simulation of Multiple Random Walk Pathways N =9



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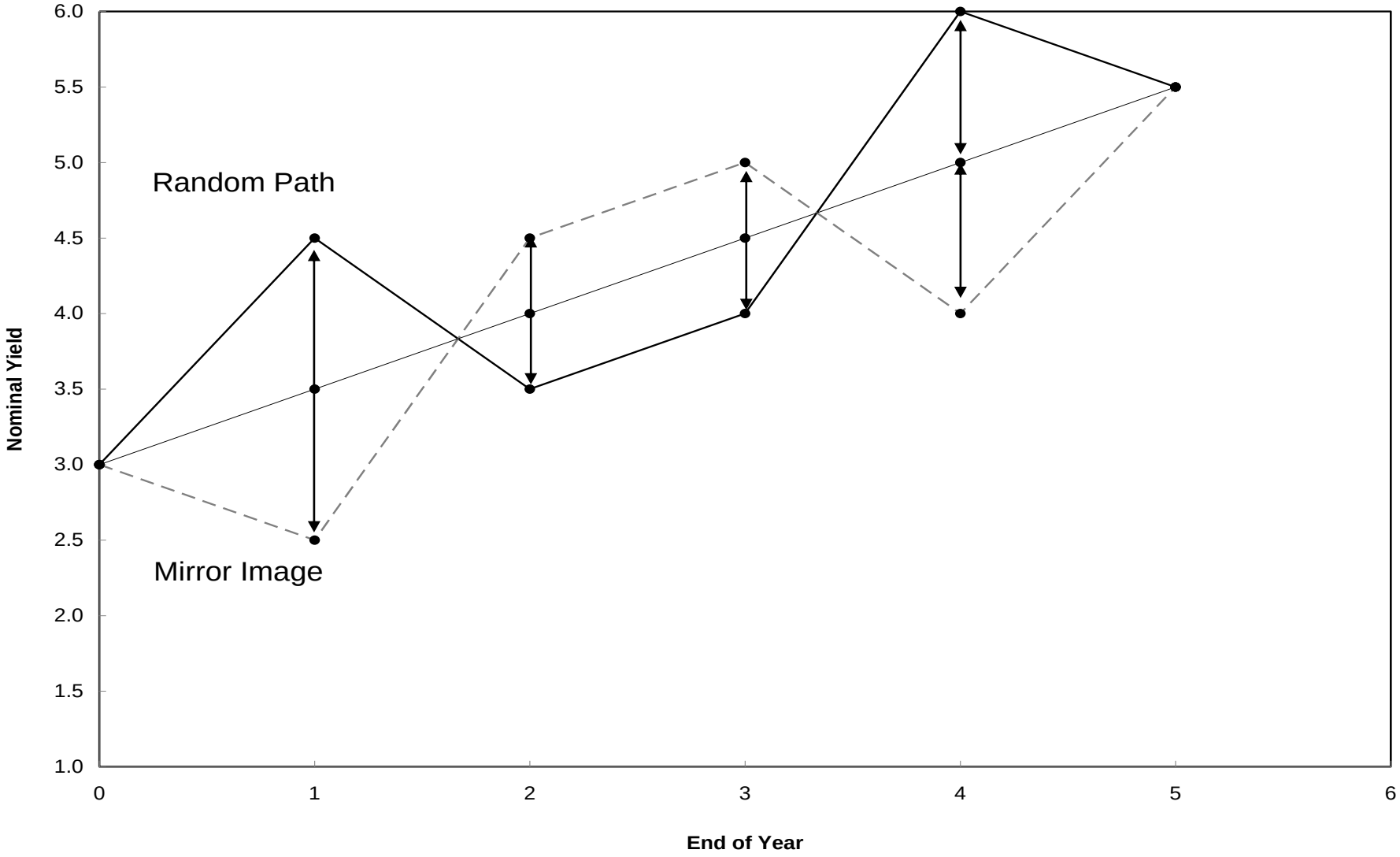
A Pair of Mirror Image Paths Around a Trendline



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TL and Mirror Path Returns

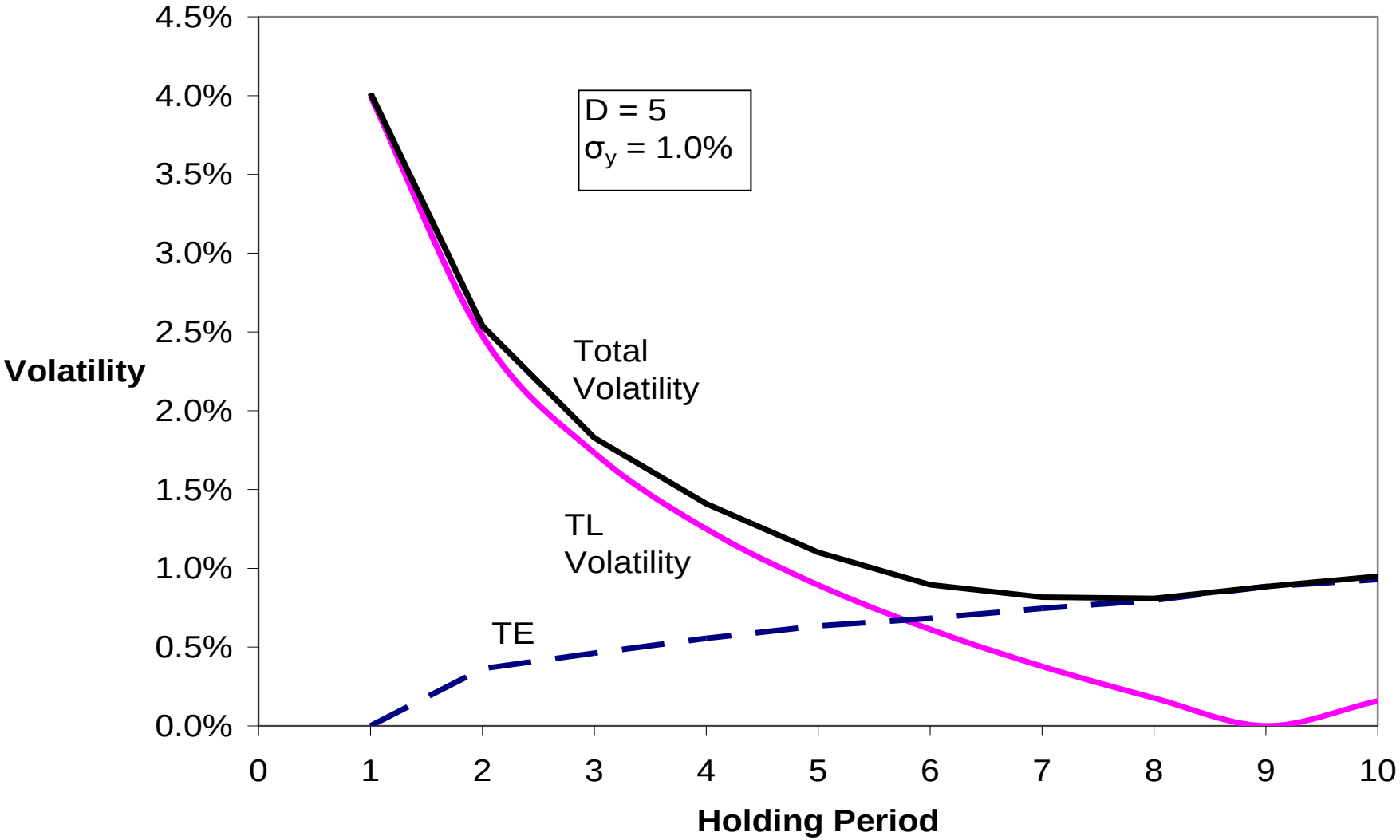
	Accruals			
	TL Path	Random Path	Mirror Image	Mirror Path Average
Year 1	3.0%	3.0%	3.0%	3.0%
Year 2	3.5%	4.5%	2.5%	3.5%
Year 3	4.0%	3.5%	4.5%	4.0%
Year 4	4.5%	4.0%	5.0%	4.5%
Year 5	5.0%	6.0%	4.0%	5.0%
Annualized Accrual	4.0%	4.2%	3.8%	4.0%
Annualized Price Effect	-2.0%	-2.0%	-2.0%	-2.0%
Excess Return	2.0%	2.2%	1.8%	2.0%

Standard Deviation of Returns

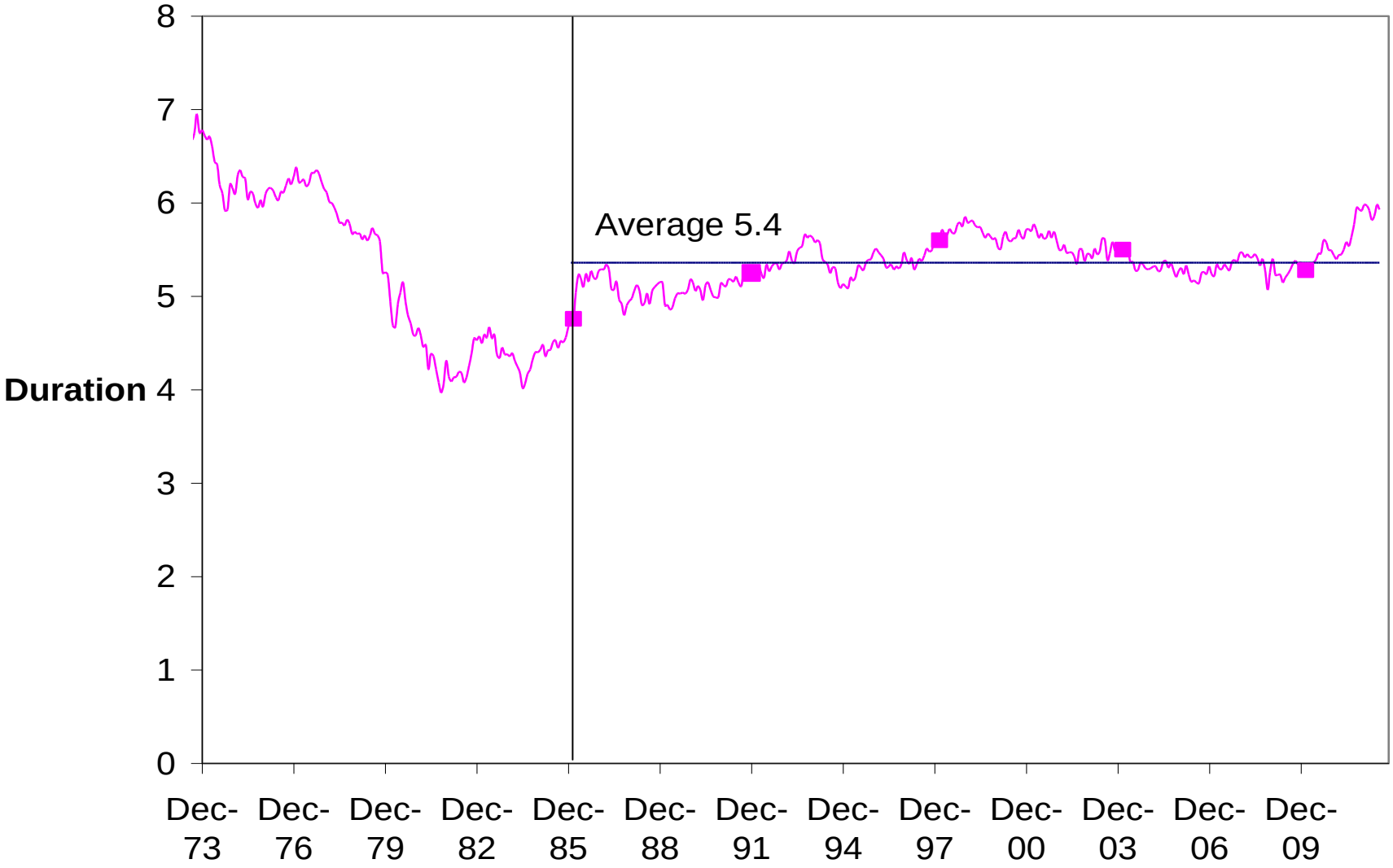
$$\sigma(\text{Trendline}) = \sigma_{\Delta y}\sqrt{N}\left|\left(\frac{D}{N}\right) - \frac{(N+1)}{2N}\right|$$

$$\sigma(\text{Including Mirror Paths}) = \sigma_{\Delta y}\sqrt{N}\sqrt{\left[\left(\frac{D}{N}\right) - \frac{(N+1)}{2N}\right]^2 + \left(\frac{N^2-1}{12N^2}\right)}$$

Total Return Volatility Including Tracking Error from Random Walk Paths



Barclays Government/Credit Index Duration (31 Dec 73 to 31 Dec 11)



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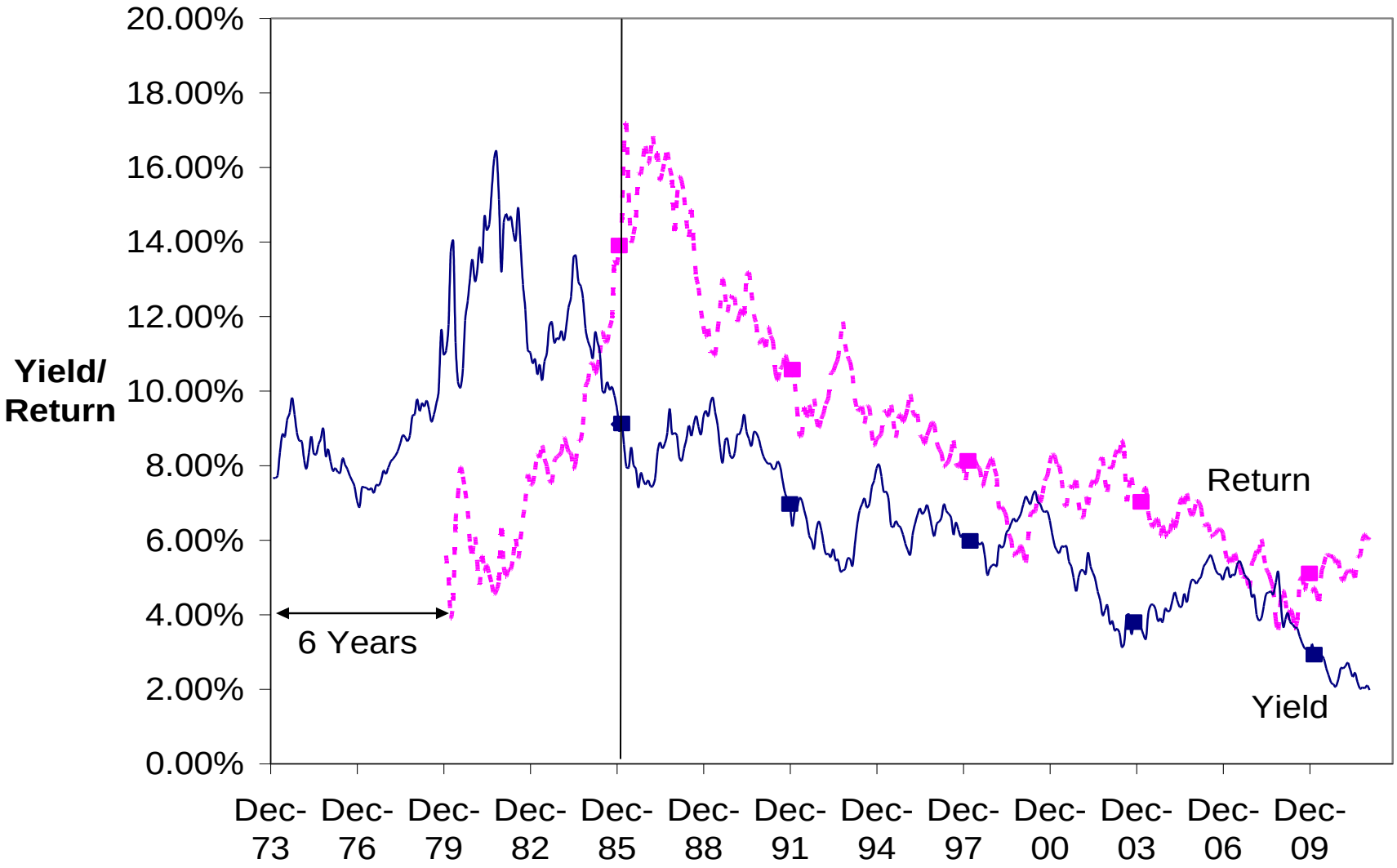
Government/Credit Index Yields and Returns Over 6-Year Holding Periods



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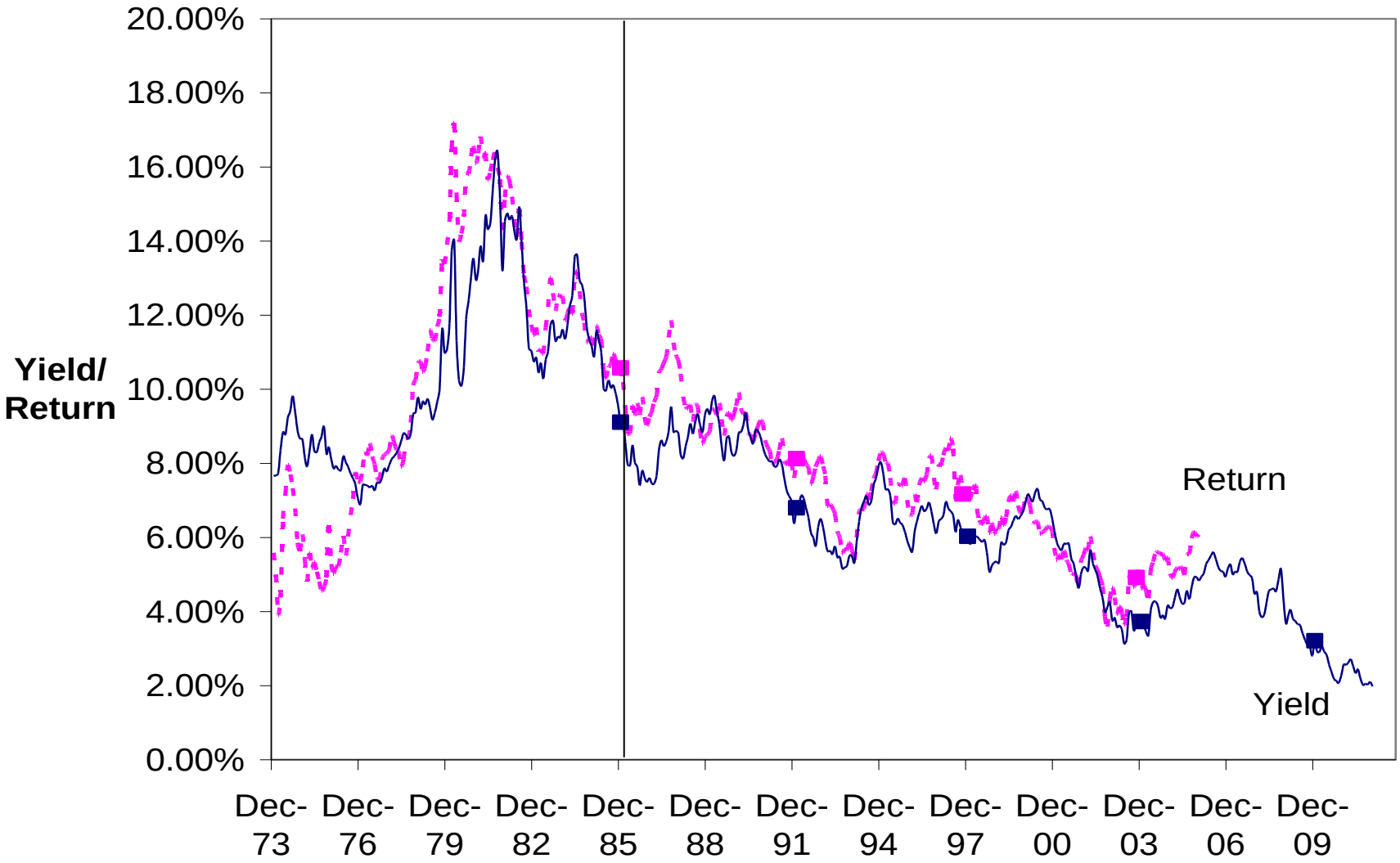
Government/Credit Index Yields and Shifted Returns Over 6-Year Holding Periods



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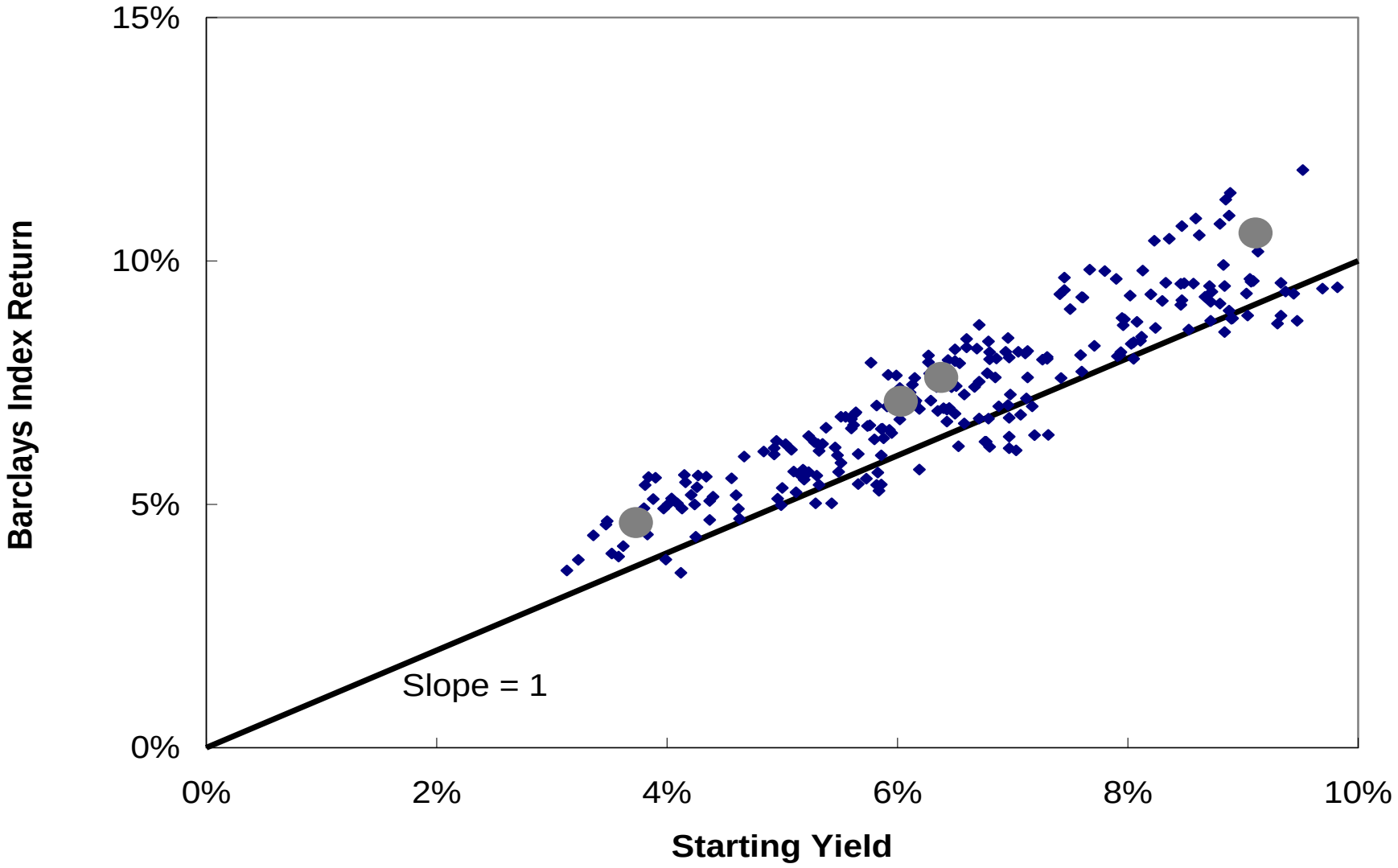
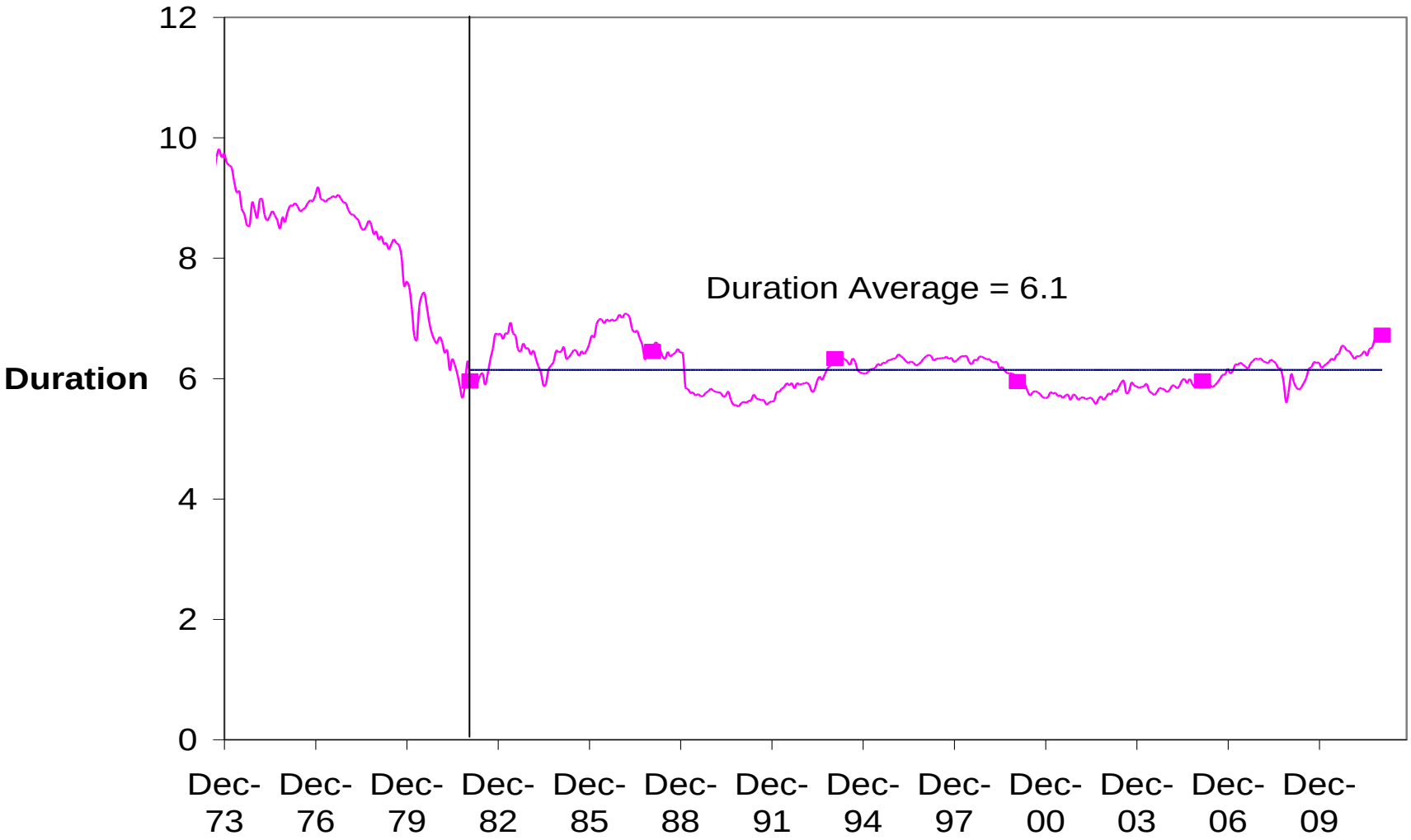
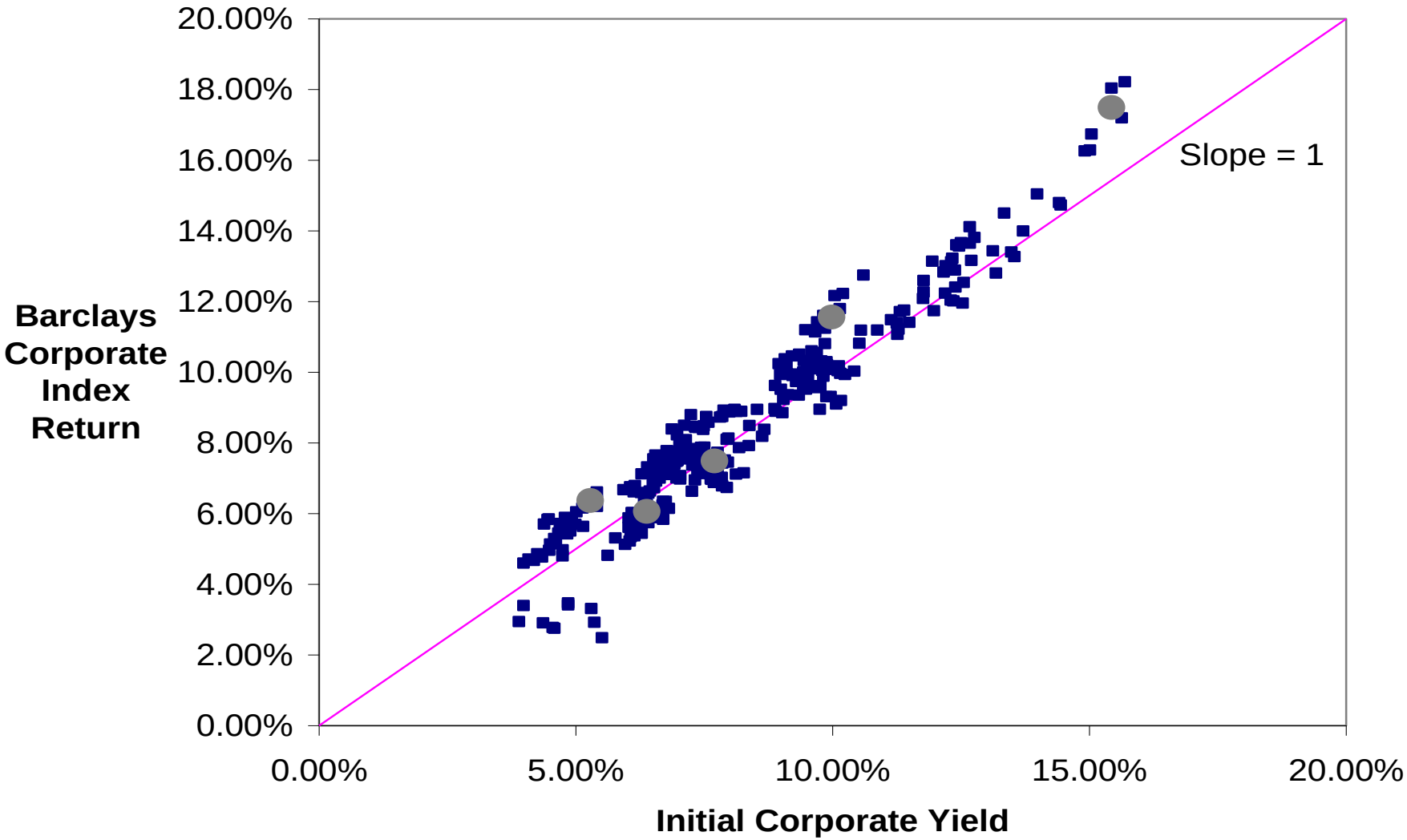
Government/Credit Returns Over 6-Year Holding Periods (1985-2006) vs. Yield Matching Line



Credit Index Duration



Credit Returns Over 6-Year Holding Periods (1982-2006) vs. Yield Matching Line



Implications

1. **Most Funds Essentially Follow a Duration Targeting (DT) Process**
2. **DT Funds Can Experience Significant Return Volatility in the Short-Term**
3. **With a Flat Yield Curve, DT Returns Tend to Converge Back Towards the Initial Yield Over the Longer-Term**
4. **With a Positive Yield Curve, the DT Returns Should Theoretically Converge Back to the Rolling Yield**
5. **Long-term DT Investors Who Are Content with Current Yields Can Have Some Assurance that Returns Will Be Close to the Initial Yield**
6. **But DT Investors Should Not Count on the Prospect of Higher (or Lower) Yields to Improve their Long-Term Returns**
7. **DT Funds have Lower Multi-Year Volatility than Generally Believed**
8. **In a Strategic Asset Allocation, the Bond Component's Duration Will Have a Relatively Muted Impact on the Expected Volatility of the Overall Fund**

References

1) Langetieg, Terence C., Martin L. Leibowitz and Stanley Kogelman "Duration Targeting and the Management of Multiperiod Returns. *Financial Analysts Journal*, September/October 1990

2) Leibowitz, Martin L. and Anthony Bova. "Duration Targeting Bond Returns", *Morgan Stanley Research*, October 12, 2011

3) Leibowitz, Martin L. and Anthony Bova. "Duration Targeting: A New Look at Bond Portfolios", *Morgan Stanley Research*, December 18, 2012

4) Leibowitz, Martin L., Sidney Homer, Anthony Bova and Stanley Kogelman. "Inside the Yield Book", 3rd Edition, *Wiley*, Forthcoming 2013

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The Americas
1585 Broadway
New York, NY 10036-8293
United States
Tel: +1 (1)212 761 4000

Europe
20 Bank Street, Canary Wharf
London E14 4AD
United Kingdom
Tel: +44 (0)20 7425 8000

Japan
4-20-3 Ebisu, Shibuya-ku
Tokyo 150-6008
Japan
Tel: +81 (0)3 5424 5000

Asia/Pacific
1 Austin Road West
Kowloon
Hong Kong
Tel: +852 2848 5200