# Simulation Analyses of Performance-Based Fees


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# Performance-Based Fees (PBFs)

## Overview

- **Content of the presentation**
  - **Simulation-based analyses of performance-based fees (PBFs)**




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# Analyze PBFs As an Option on Ex-Post Portfolio Performance

- **Use option pricing techniques to “price” performance-based fees**
- **Evaluate the sensitivity of performance fees to underlying assumptions**
- **Study the issues of manager gaming, high water marks and revenue stability**




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# Performance-Based Fees

## Introduction

- **Conceptually very simple**
  - **Pay active managers based on realized performance**
  - **Performance-based fees generally consist of a modest base fee plus a percentage of realized performance above a pre-specified threshold target**
- **In theory, PBFs should be commonplace**
  - **Managers can signal to clients that they are confident of producing excess returns in order to win mandates**
  - **Clients would only pay above the base fee when performance threshold targets are met**
  - **In aggregate, to the extent that alpha is a zero-sum game, clients should expect to pay less fees**
- **In reality, PBFs are uncommon**
  - **We estimate that only 5-15% of institutional clients use PBFs**
  - **PBFs has gained more notice with the increased popularity of hedge funds – where PBFs are the standard**




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# Performance-Based Fees

## Introduction (continued)

- **Client concerns about PBFs**
  - **Fear that PBFs incentivize inappropriate risk behavior (manager gaming)**
    - **When performance is good, manager reduces risk to lock in profit**
    - **When performance is poor, manager increases risk in an attempt of "catch up"**
  - **Aversion to paying above normal fees when performance is good**
  - **A belief that asymmetric information about true alpha and risk profile favors the manager during fee negotiations**
  - **Technical difficulties such as added complexity of fee calculations, etc.**
- **Manager concerns with PBFs**
  - **Increased volatility in revenues associated with PBFs**
  - **Uncertainty about the sustainability of the excess return going forward**
- **Simulation-based analysis can be used to shed light on these concerns**




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# The PBF Structure

## The Basic PBF Formula

- **The fee formula is simple**

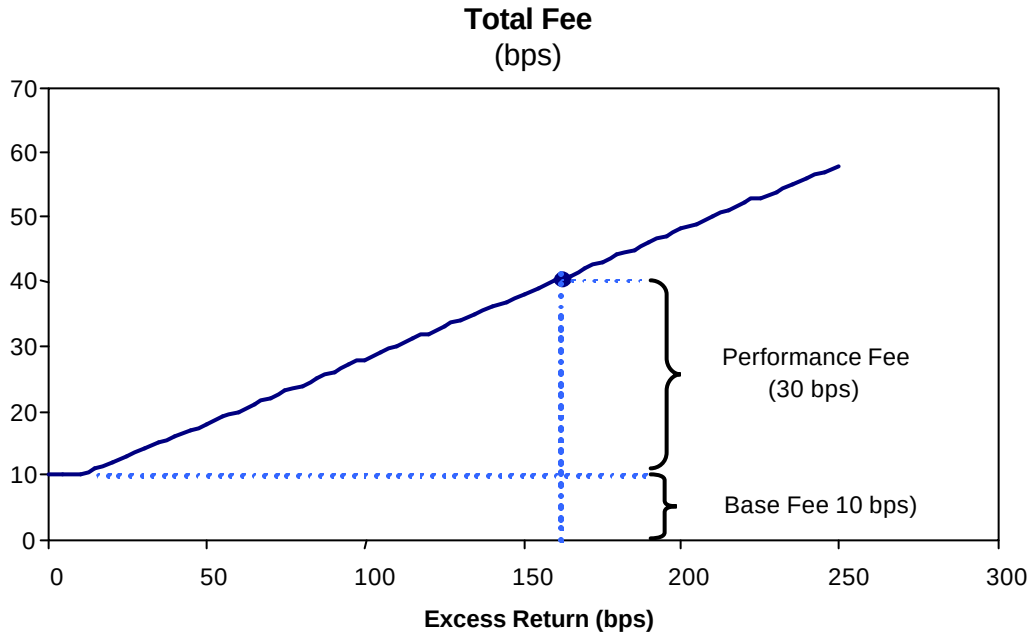
  **base fee = minimum fee level**

  **formula = performance participation rate (PPR) X**

  **(account return – benchmark return – threshold)**

  **performance fee = max{formula, 0}**

  **total fee = performance fee + base fee**







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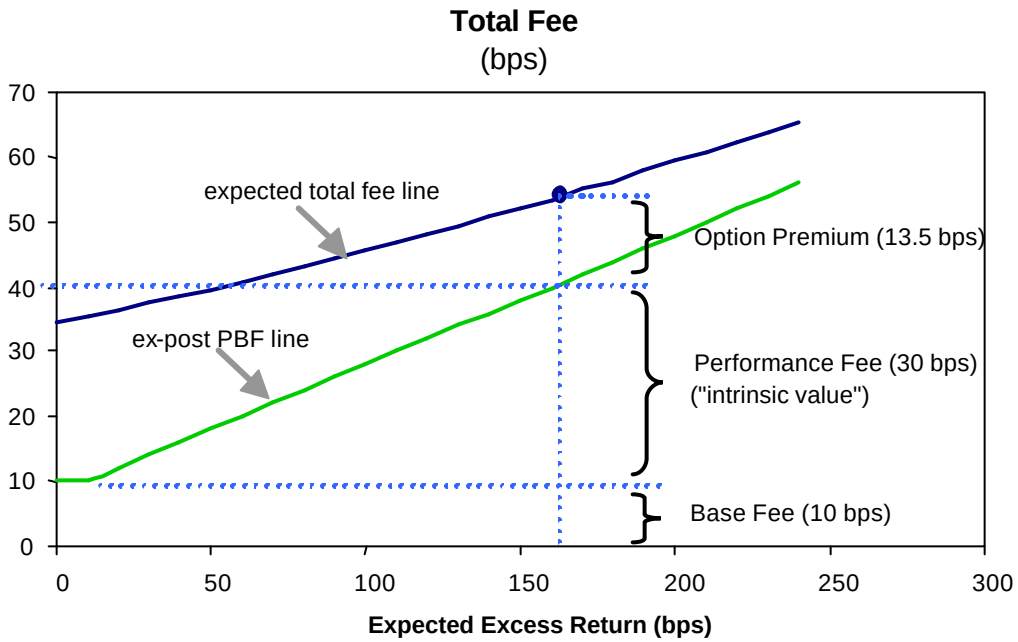
# The PBF Structure

## The PBF Formula Can Be Analyzed As an Option




- **The above graph was generated by "pricing" the performance-based formula at different levels of expected excess return**
  - **10,000 simulation paths (monthly returns for 10-years) generated at each expected excess return**
  - **Total fee is calculated for each simulation path**
  - **The expected total fee line represent the average of the total fees for the 10,000 samples**

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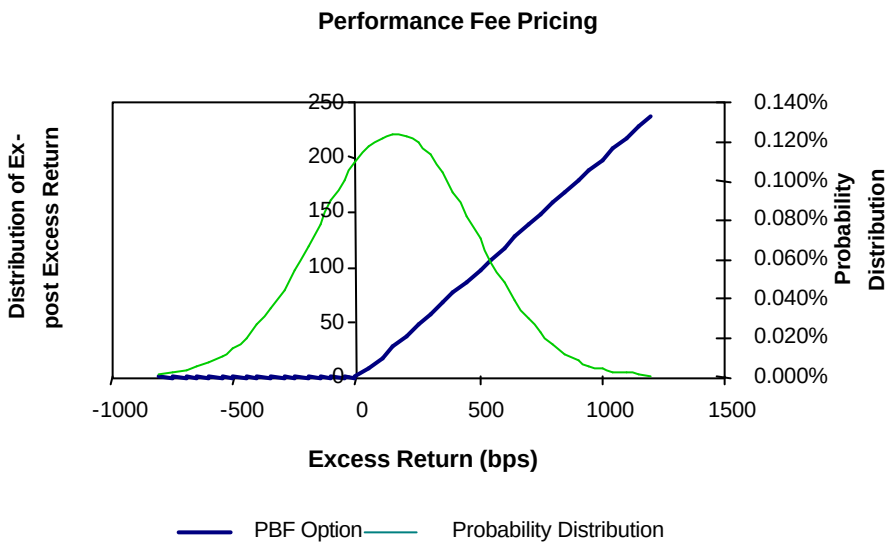
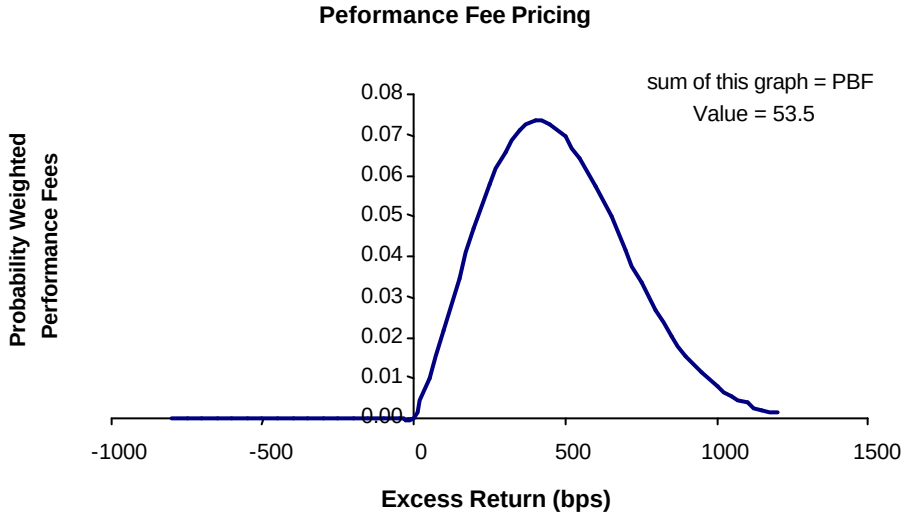
# The PBF Structure

## The PBF Formula Can be "Priced" or Valued as an Option




- **Expected excess return = 1.6%**
- **Tracking error = 3.2%**
- **10 bps base fee = threshold return**
- **20% performance participation rate**







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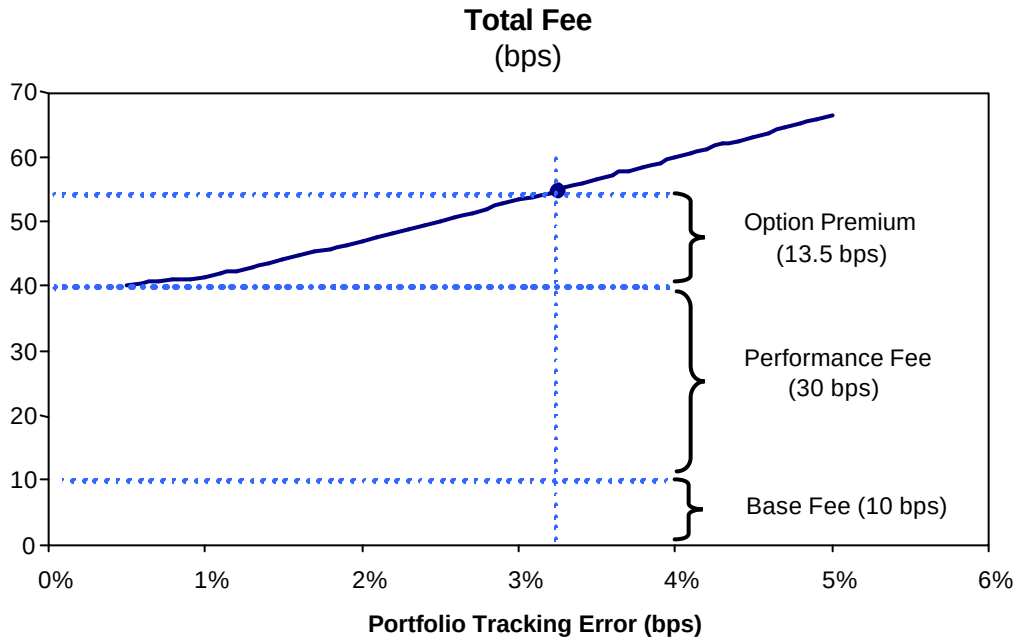
# The PBF Structure

## As in Options, Volatility Has Value




- **As in options, higher volatility – or tracking error – increases the expected value of the performance-fee option premium**
- **Upside volatility is rewarded, downside volatility is protected with the minimum base fee**
- **The basic fee structure provides incentives for the manager to increase risk**

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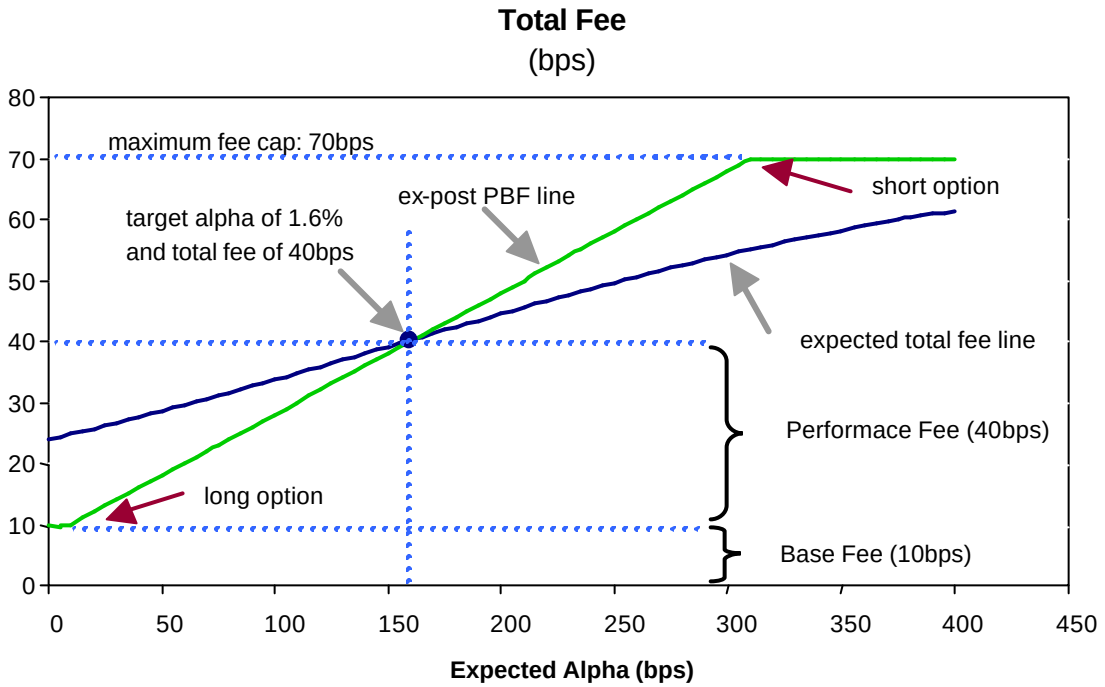
# The PBF Structure

## Imposing a Maximum Fee Cap




- **Maximum fee cap is equivalent to portfolio manager selling a call option to the client – with strike at maximum fee level**
- **Option premium is now symmetric around the target fee level, and the premium is zero at the target alpha**
  - **No longer has a free option effect**
- **Less incentive for the manager to increase risk**

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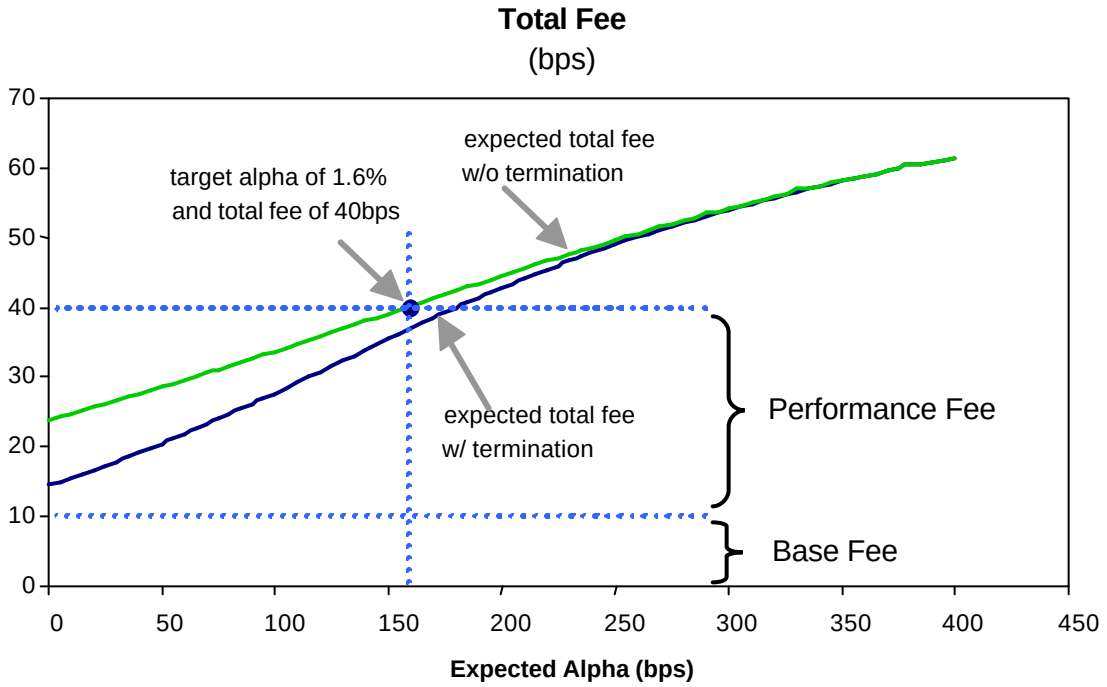
# The PBF Structure

## Impact of Termination Option




- **The decline in expected total fees is due to the fact that the average is measured over a 10-year horizon**
- **The impact is similar to the effect of "down-and-out" knock-out options**
- **At higher levels of expected alpha, the termination condition provides a strong disincentive against managers increasing portfolio risk**

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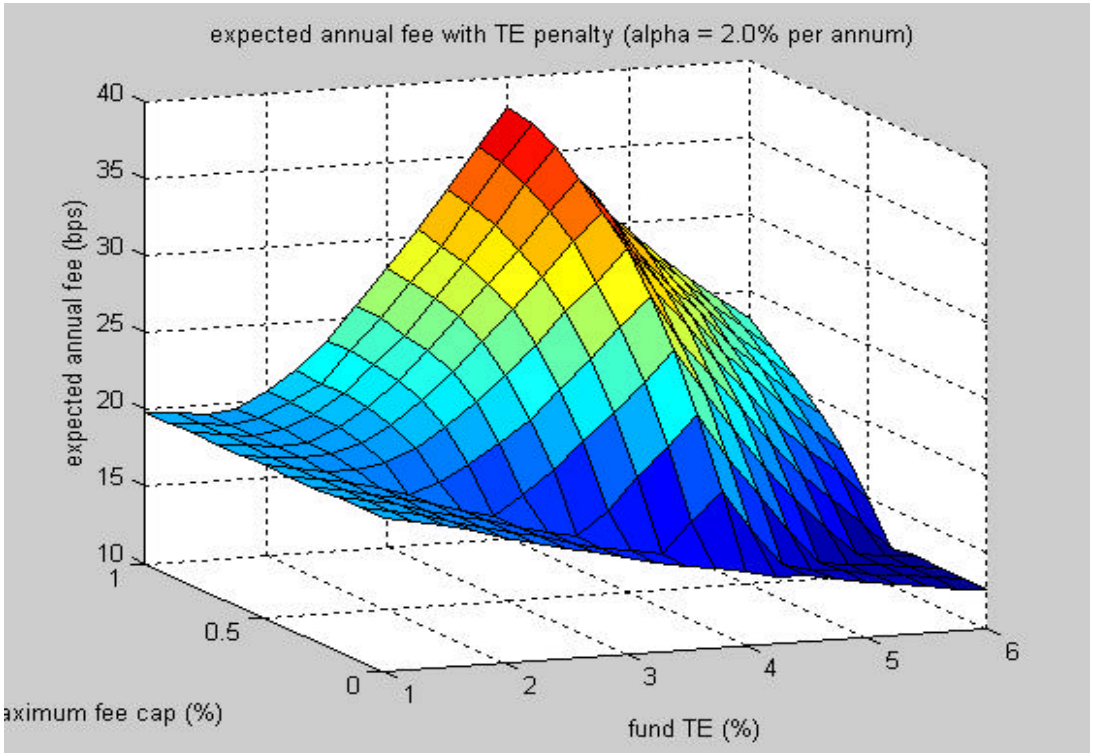
# The PBF Structure

## Adding Penalties on Tracking-Error Deviations

- **Add explicit cost function to the PBF formula to penalize deviations in tracking error**

**bonus fee = (PPR) x (account return – benchmark return – threshold)**

**– risk penalty rate (RPR) x abs(average risk – target risk)**







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# Valuing PBF Formulas

## A Specific (Hypothetical) PBF Example

| Item | Base Case Parameters |
|---|---|
| Performance Objective | Excess return = 1.6% per annum, tracking error 3.2% per annum |
| Base Fee | 10 basis points |
| Bonus Formula | 20 basis points per 1% net excess return<br>(after threshold equal to base fee) |
| Fee Maximum | 80 bps |
| Risk Penalty Rate | None |
| Performance Period | Simple 1-year excess return |
| Discount Rate | 7%. For calculating annualized expected PV of fees. |
| Benchmark Performance | Return: 8% per annum, volatility: 12% per annum |
| Excess Return Correlation to Benchmark Return | 0 |
| Excess Return Autocorrelation | 0. Autocorrelation is the correlation returns between two subsequent periods. It is a measure of “trends” in the excess portfolio return |
| Number of Simulations | 10,000 |
| Simulation Period | 10 years |




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# Valuing PBF Formulas

## Other Assumptions

- **Excess returns are normally distributed – no skewness or kurtosis**
- **No manager gaming**
- **No high water mark**
- **Termination condition:**

| Performance Period (Years) | Annualized Excess Return of Portfolio (%) | Probability of Termination |
|---|---|---|
| 1 | -6.0 | 0.5 |
| 2 | -2.0 | 0.5 |
| 3 | 0.0 | 0.5 |
| 4 | 0.5 | 0.5 |
| 5 | 1.0 | 0.5 |




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# Valuing PBF Formulas

## Valuation of the Specific Base Case

| Evaluation Metric | Asset-Based Fee Regime | PBF Regime (no fee cap & w/o termination) | PBF Regime (80bps fee cap & w/o termination) | PBF Regime (no fee cap & w/ termination) | PBF Regime (80bps fee cap & w/ termination) |
|---|---|---|---|---|---|
| **10-Year Horizon Stats** | | | | | |
| Avg Annual Fee (%) | 0.40 | 0.54 | 0.43 | 0.38 | 0.31 |
| Avg. Annual Fee (PV) (in % of initial value) | 0.38 | 0.58 | 0.46 | 0.41 | 0.33 |
| Std Dev PV Fee | 0.0 | 0.17 | 0.10 | 0.27 | 0.19 |
| **1-Year Horizon Stats (excluding termination)** | | | | | |
| Avg Annual Fee (%) | 0.40 | 0.54 | 0.43 | 0.54 | 0.43 |
| Std Dev Avg. Fee (%) | 0.0 | 0.48 | 0.30 | 0.48 | 0.30 |
| **Termination Stats** | | | | | |
| Termination Prob. | 0.0 | 0.0 | 0.0 | 62 | 62 |
| Avg. Life of Portfolio (years) | 10.0 | 10.0 | 10.0 | 7.3 | 7.3 |




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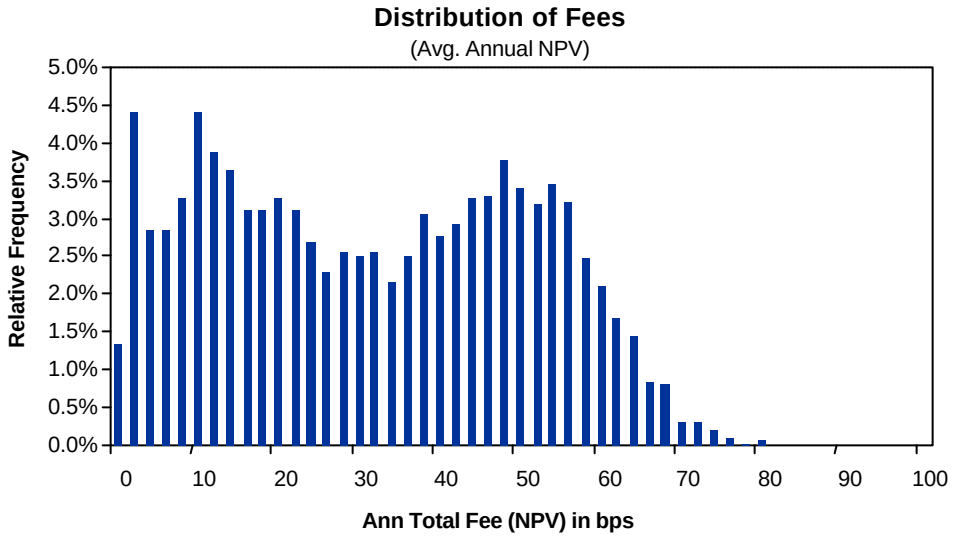
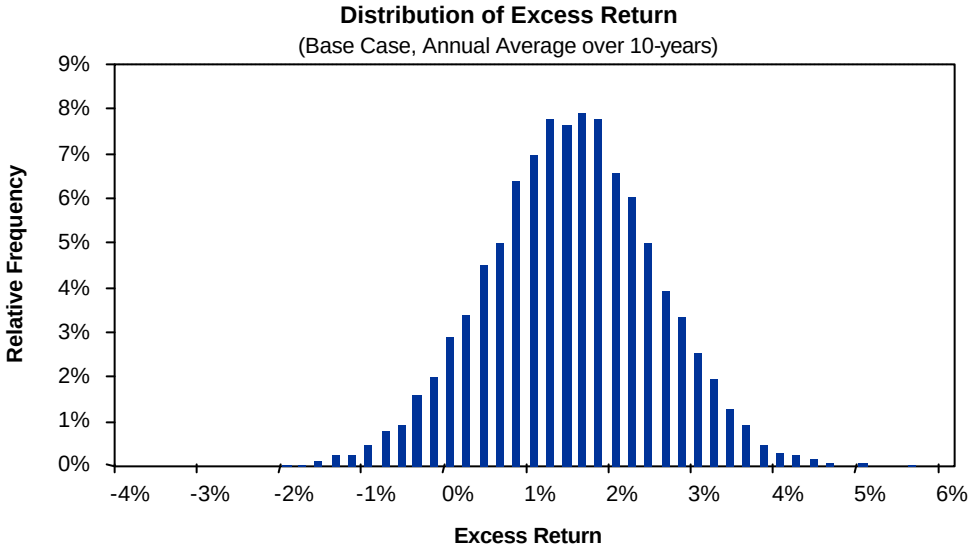
# Valuing PBF Formulas

## Distribution of Excess Returns and Total Fees







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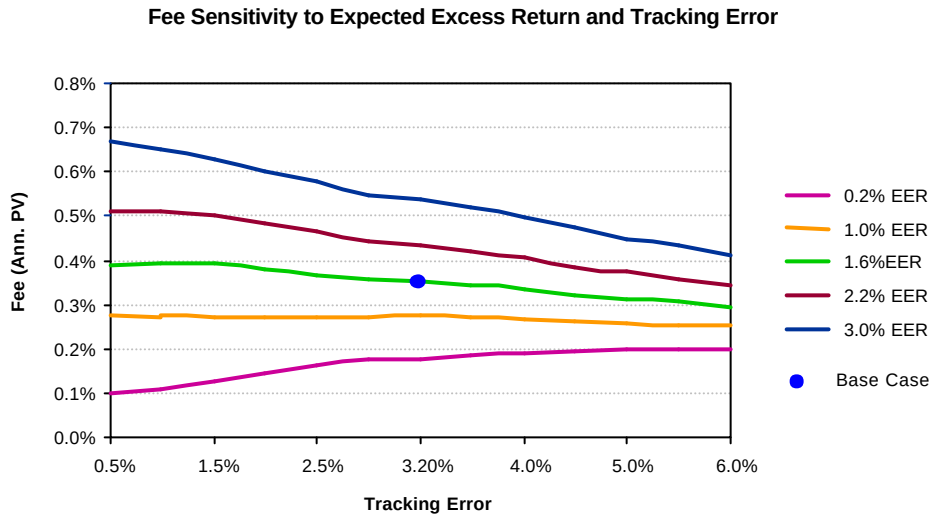
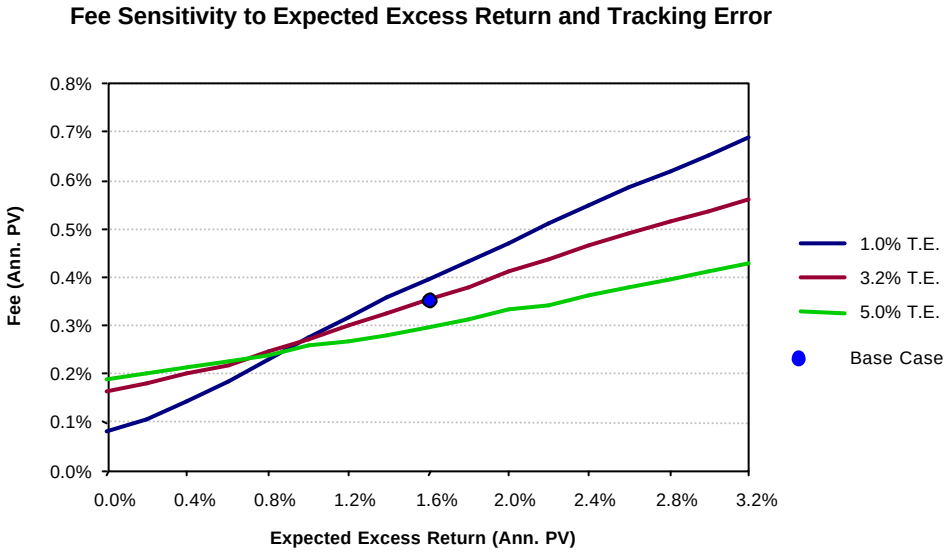
# PBF Formula Sensitivities

## Total Fee Sensitivity to Excess Return and Tracking Error







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# PBF Formula Sensitivities

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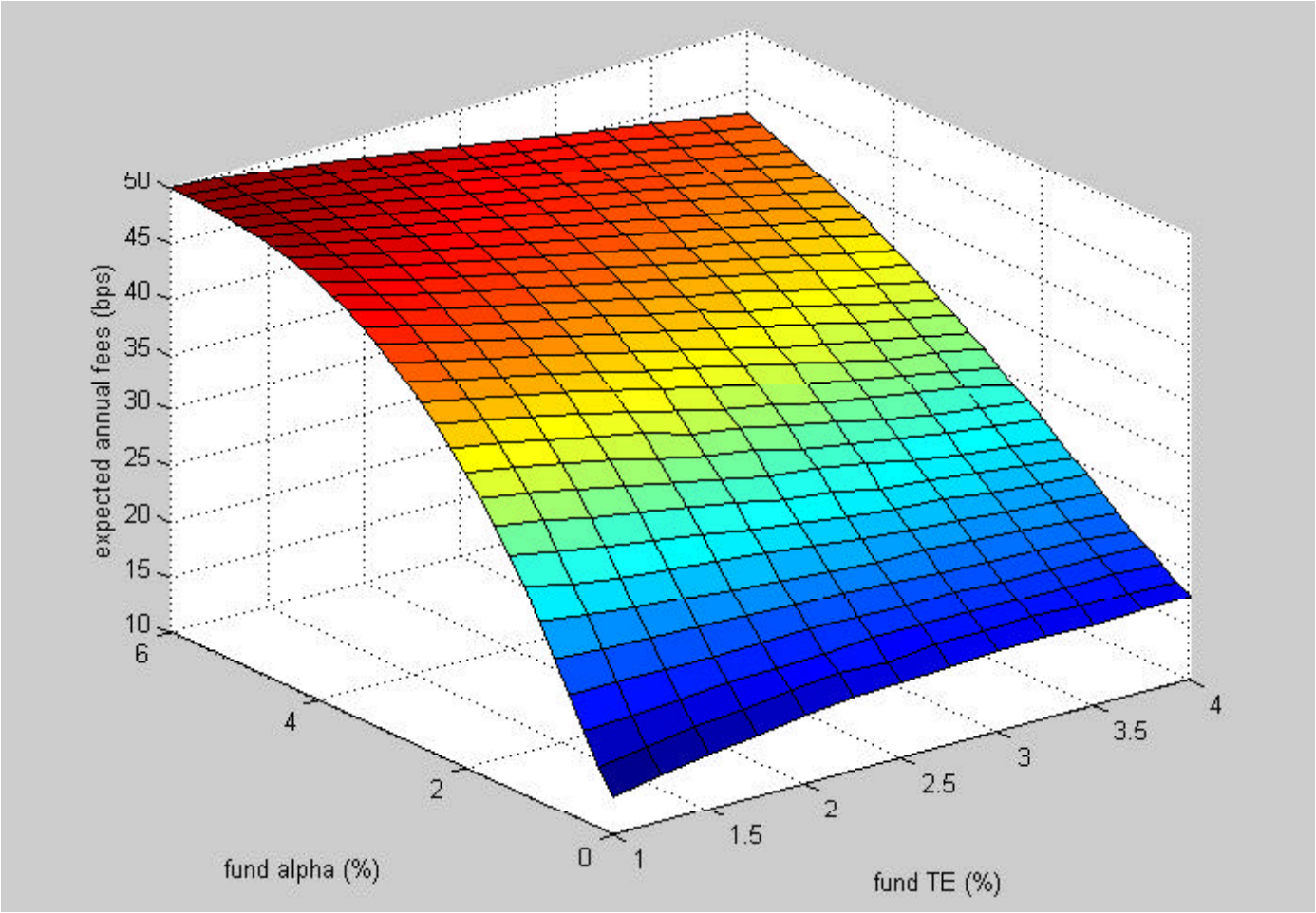





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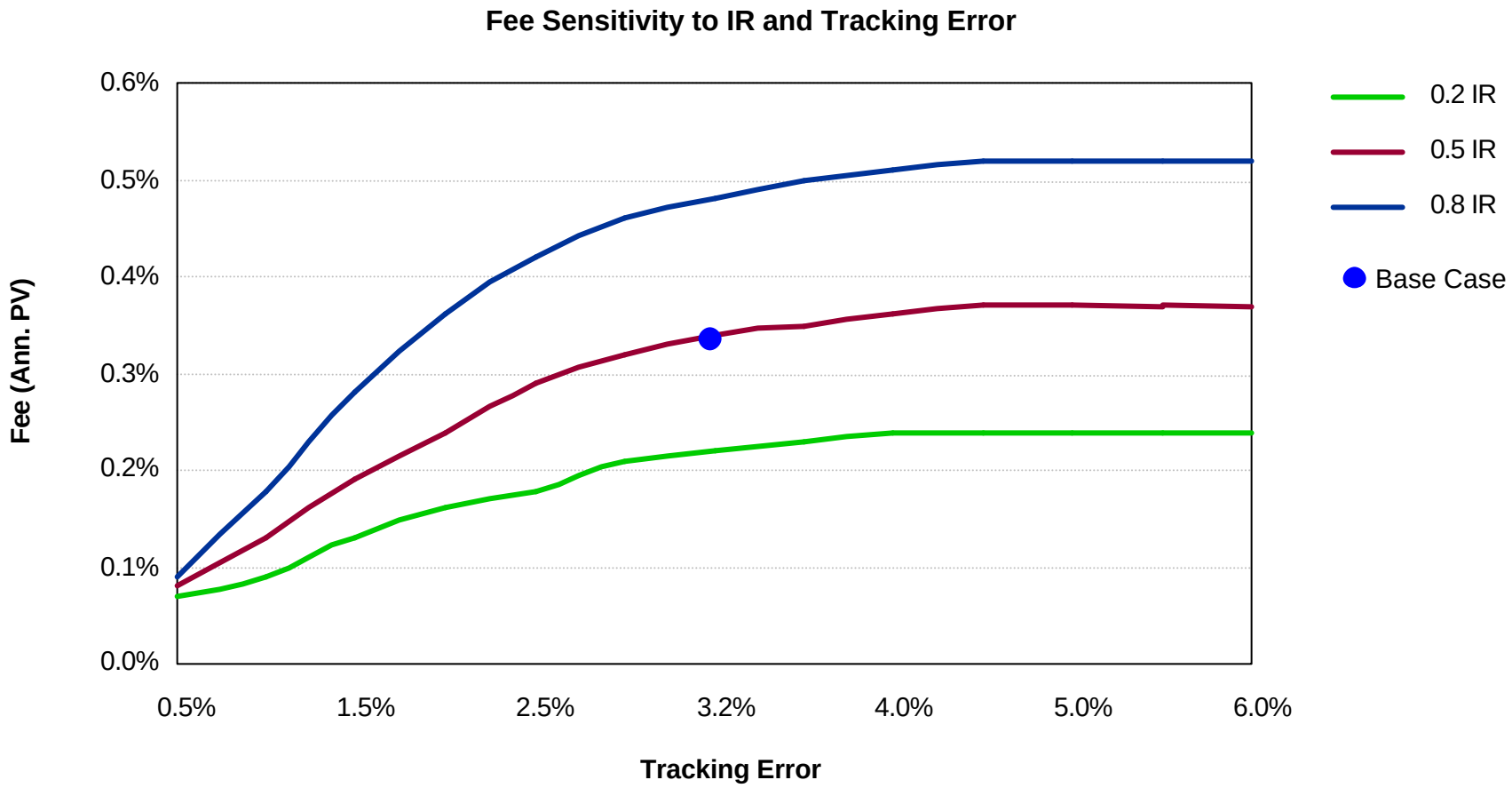
# PBF Formula Sensitivities

## Total Fee Sensitivity to Excess Information Ratio







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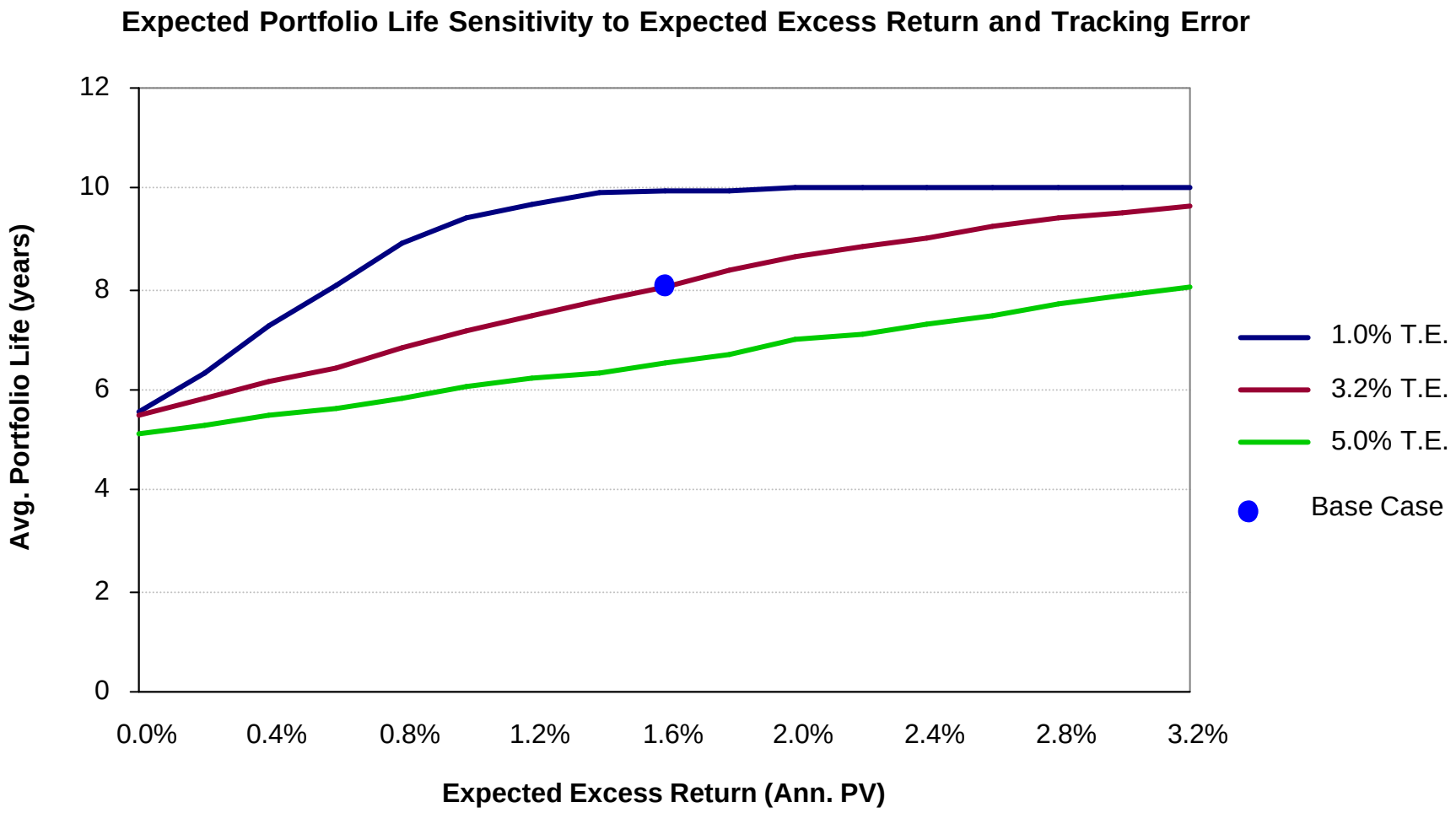
# PBF Formula Sensitivities

## Expected Life of the Portfolio vs. Excess Return and Tracking Error







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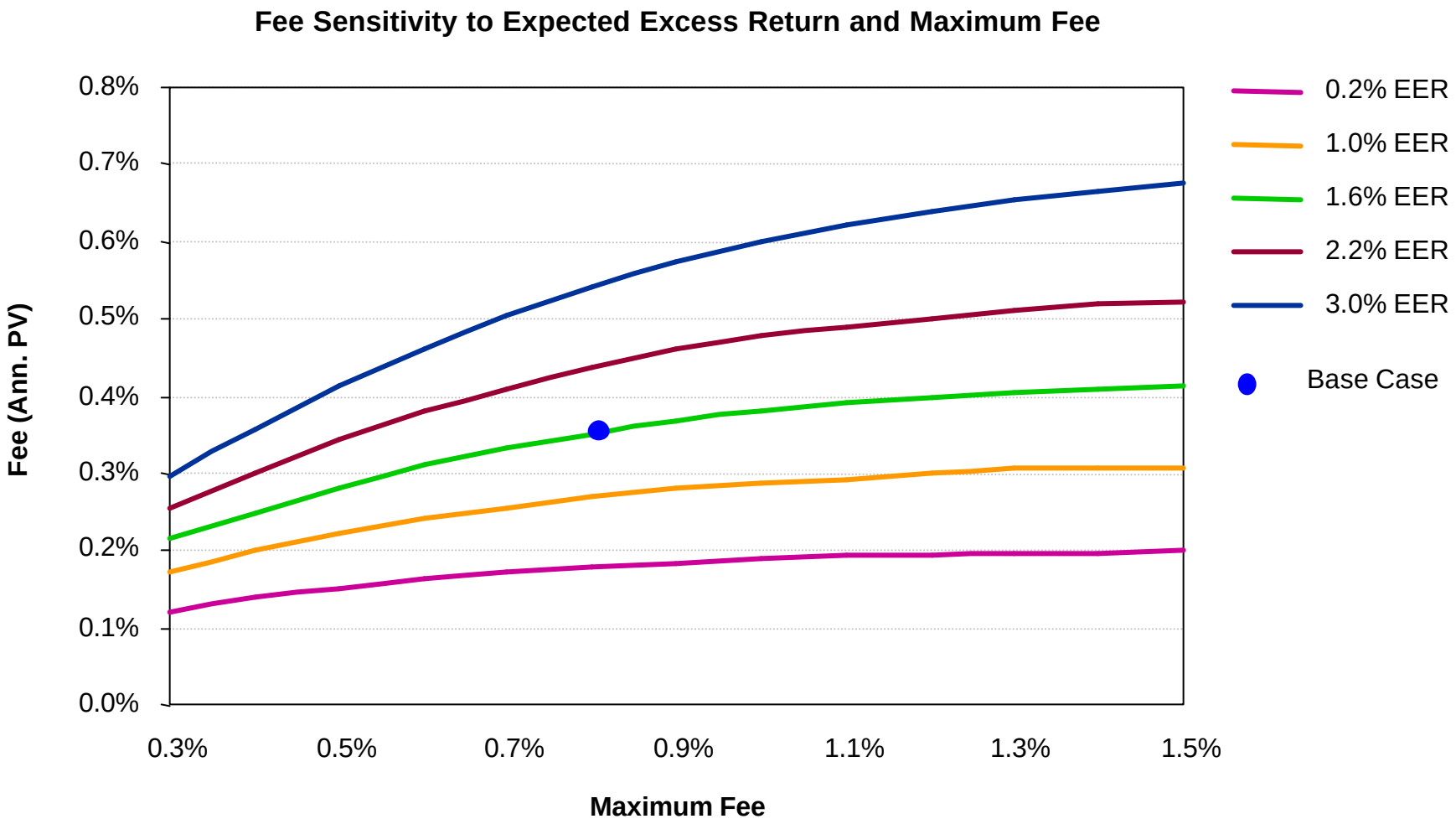
# PBF Formula Sensitivities

## Total Fee Sensitivity to Maximum Fee Cap







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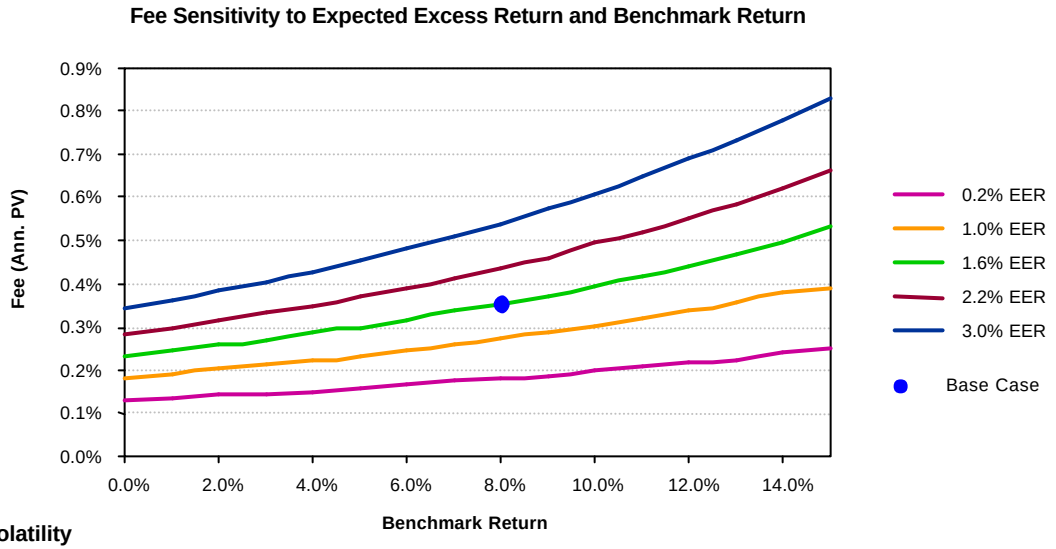
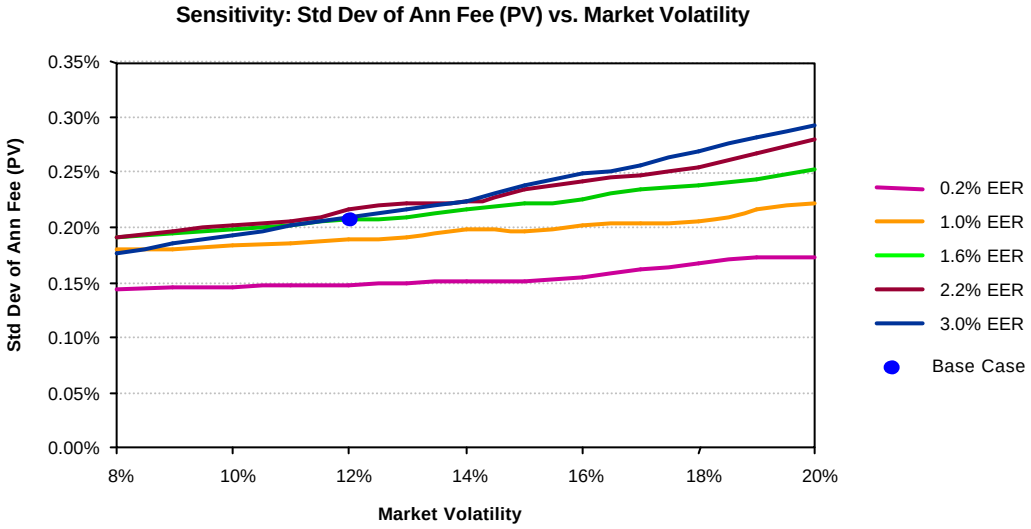
# PBF Formula Sensitivities

## Total Fee Sensitivity to Market Assumptions







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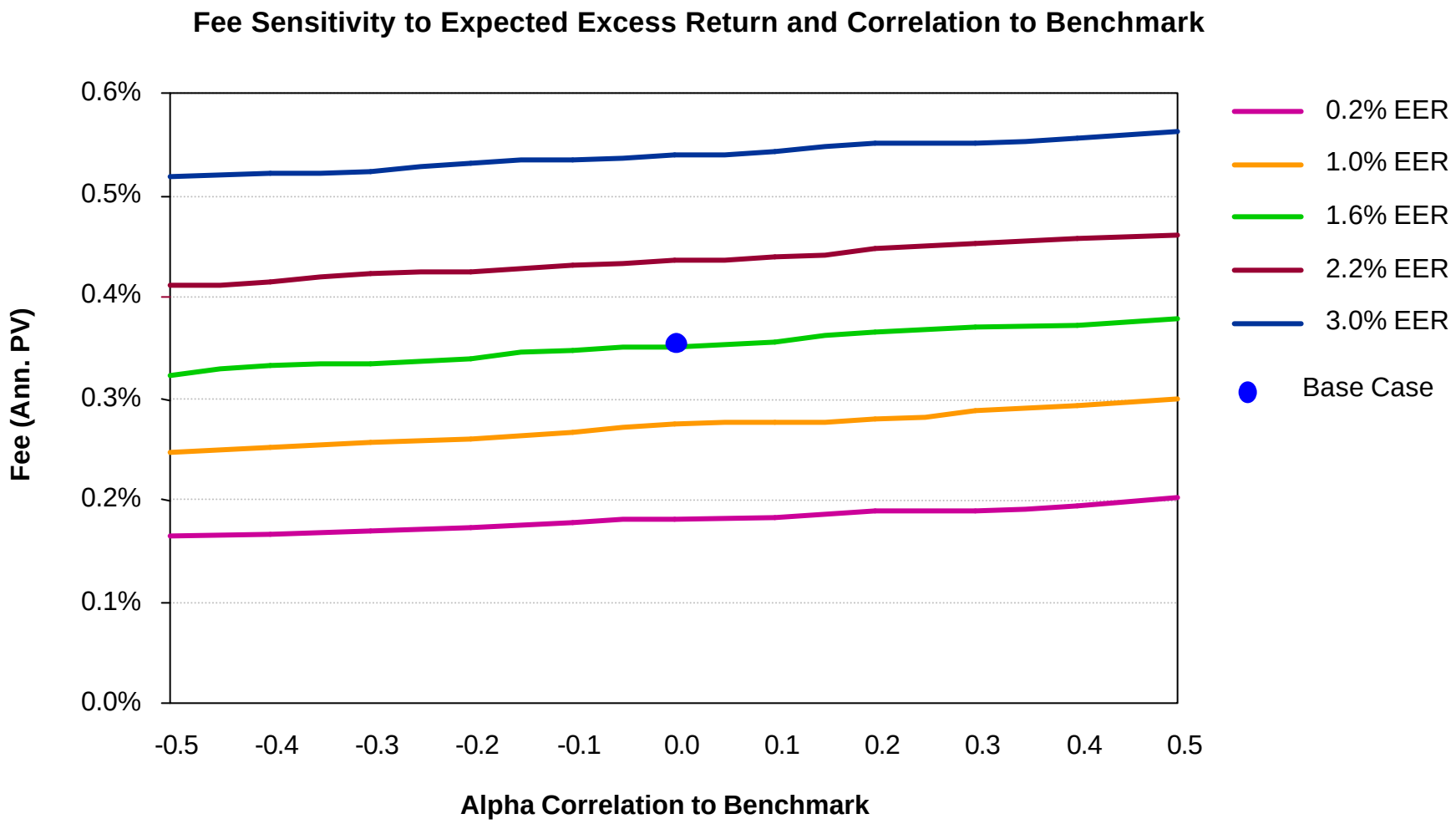
# PBF Formula Sensitivities

## Impact of Style Biases: Excess Return Correlation With the Market







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# PBF Formula and Manager Gaming

## Impact of Manager Gaming the PBF

- **Assume that a manager games the PBF formula by**
  - **Reducing risk by 50% after a positive performance**
  - **Increasing risk by 50% after a negative performance**

| | YTD Positive Performance (manager reduces risk by 50%) | YTD Negative Performance (manager increases risk by 50%) |
|---|---|---|
| Q1 | 4.0% | -4.0% |
| Q2 | 4.0% | -4.0% |
| Q3 | 3.0% | -2.0% |
| Q4 | 3.0% | -2.0% |




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# PBF Formula and Manager Gaming

## Impact of Manager Gaming the PBF

| Evaluation Metric | PBF w/ All Gaming (%) | PBF w/ Gaming in Up Periods (%) | PBF w/ Gaming in Down Periods (%) |
|---|---|---|---|
| Percent of Periods Gamed | 54 | 38 | 20 |
| **Stats With Gaming** | | | |
| Avg. Excess Return | 2.0 | 4.5 | -2.1 |
| Average Fee | 0.42 | 0.57 | 0.12 |
| **Stats Without Gaming** | | | |
| Avg. Excess Return | 2.2 | 4.1 | -2.4 |
| Average Fee | 0.39 | 0.54 | 0.09 |

- Above statistics apply only to the scenarios where gaming occurs
  - The average expected impact is less than that suggested by the above table
- Average fee is increased by 3 bps
- Average return is reduced by 3 bps
- Overall, no significant systematic impact
  - Specific impact may be larger and more significant




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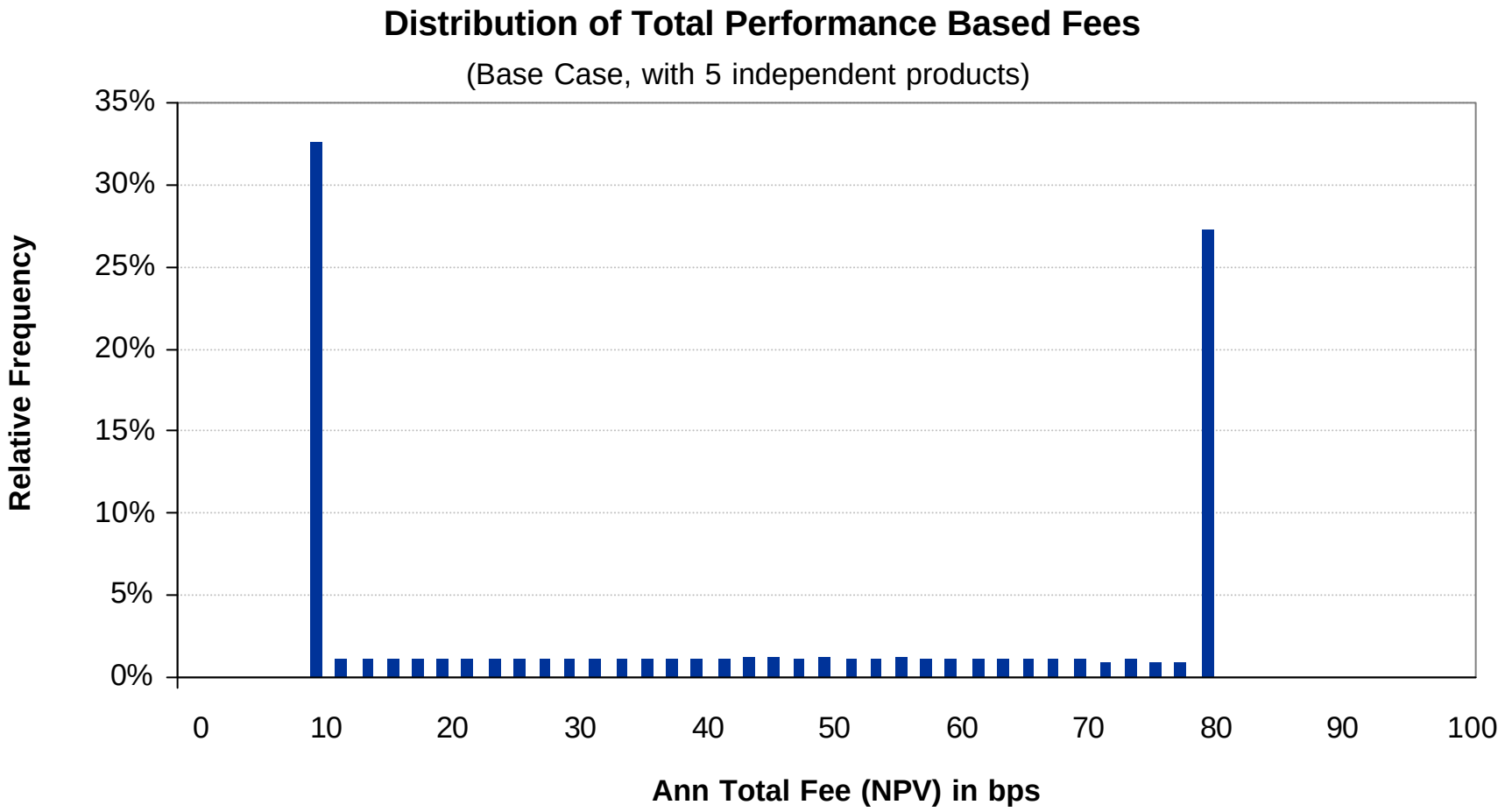
# PBF Formula and Revenue Stability

## PBF and Revenue Stability – Yearly Total Fee Distribution







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# PBF Formula and Revenue Stability

## PBF and Revenue Stability – Risk of Loss on Hypothetical Portfolio

| Tracking Error (%) | Expected Alpha (%) 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 |
|---|---|---|---|---|---|---|---|---|
| 1.0 | 43.6 | 25.5 | 12.4 | 5.0 | 1.6 | 0.4 | 0.1 | 0.0 |
| 2.0 | 46.4 | 36.8 | 27.9 | 20.4 | 14.3 | 9.5 | 6.0 | 3.6 |
| 3.0 | 47.5 | 40.8 | 34.6 | 28.9 | 23.6 | 19.1 | 15.0 | 11.5 |
| 4.0 | 47.6 | 42.6 | 37.6 | 33.3 | 29.0 | 25.0 | 21.3 | 17.8 |
| 5.0 | 46.7 | 43.1 | 39.0 | 35.3 | 31.8 | 28.6 | 25.2 | 22.1 |

- **The above statistics assume the base case and assumes that 15 bps is the break-even point for managing the hypothetical portfolio**
- **Conclusions**
  - **Revenue stability is a significant issue**
  - **Risk of loss on managing a portfolio is high if base fee does not cover all marginal costs**
- **Can this risk be mitigated?**




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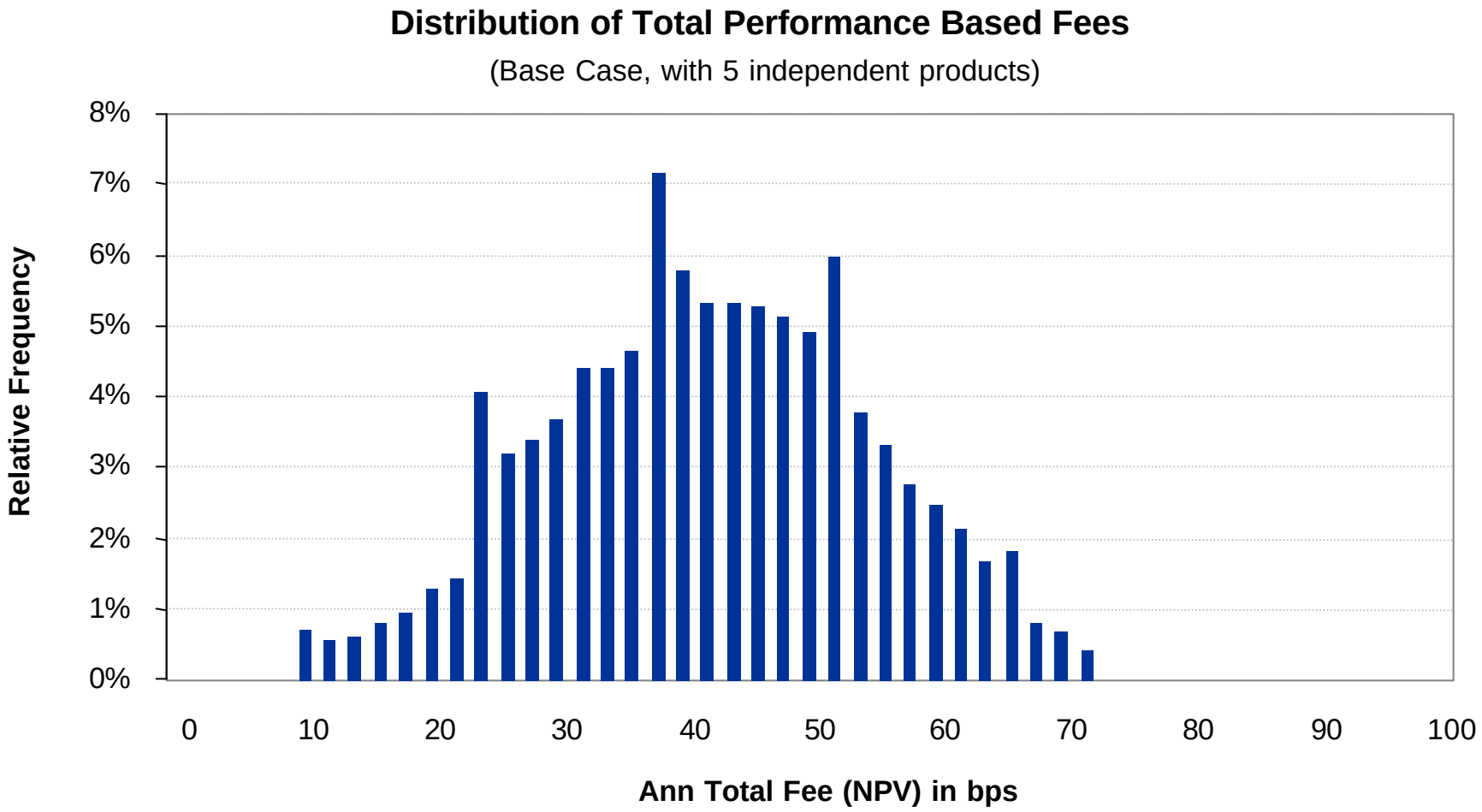
# PBF Formula and Revenue Stability

## PBF and Revenue Stability – Benefit of Diversification







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# PBF Formula and Revenue Stability

## PBF and Revenue Stability – Working With a Menu of PBF Formulas

| Evaluation Metric | PBF (w/10bps floor & 80bps fee cap) | PBF (w/15bps floor & 69bps fee cap) | PBF (w/20bps floor & 52bps fee cap) | PBF (w/25bps floor & 42bps fee cap) |
|---|---|---|---|---|
| Avg. Annual Fee (%) | 0.43 | 0.43 | 0.43 | 0.43 |
| Median Avg. Annual Fee (%) | 0.40 | 0.45 | 0.49 | 0.53 |
| Std. Dev. Avg. Annual Fee (%) | 0.30 | 0.24 | 0.19 | 0.15 |




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# PBF Formula and High Water Mark

## Impact of High Water Mark Condition on PBF Formula

| Evaluation Metric | PBF (w/o termination & no fee cap) | PBF (w/o termination & 80bps fee cap) | PBF (w/ termination & no fee cap) | PBF (w/ termination & 80bps fee cap |
|---|---|---|---|---|
| **Without High Water Mark** | | | | |
| Avg. Annual Fee (PV) (in bps of initial value) | 0.58 | 0.46 | 0.41 | 0.33 |
| Yearly Avg. Fee (%) (non-terminated periods) | 0.54 | 0.43 | 0.54 | 0.43 |
| Std Dev Yearly Fee (%) | 0.48 | 0.29 | 0.48 | 0.29 |
| % Prob. of Base Fees Only | 32 | 32 | 32 | 32 |
| **With High Water Mark** | | | | |
| Ann Avg PV of Fees (in bps of initial value) | 0.47 | 0.39 | 0.36 | 0.30 |
| Year Avg. Fee (%) (non-terminated periods) | 0.44 | 0.36 | 0.48 | 0.39 |
| Std Dev Yearly Fee (%) | 0.47 | 0.29 | 0.47 | 0.29 |
| % Prob. of Base Fees Only | 38 | 38 | 38 | 38 |




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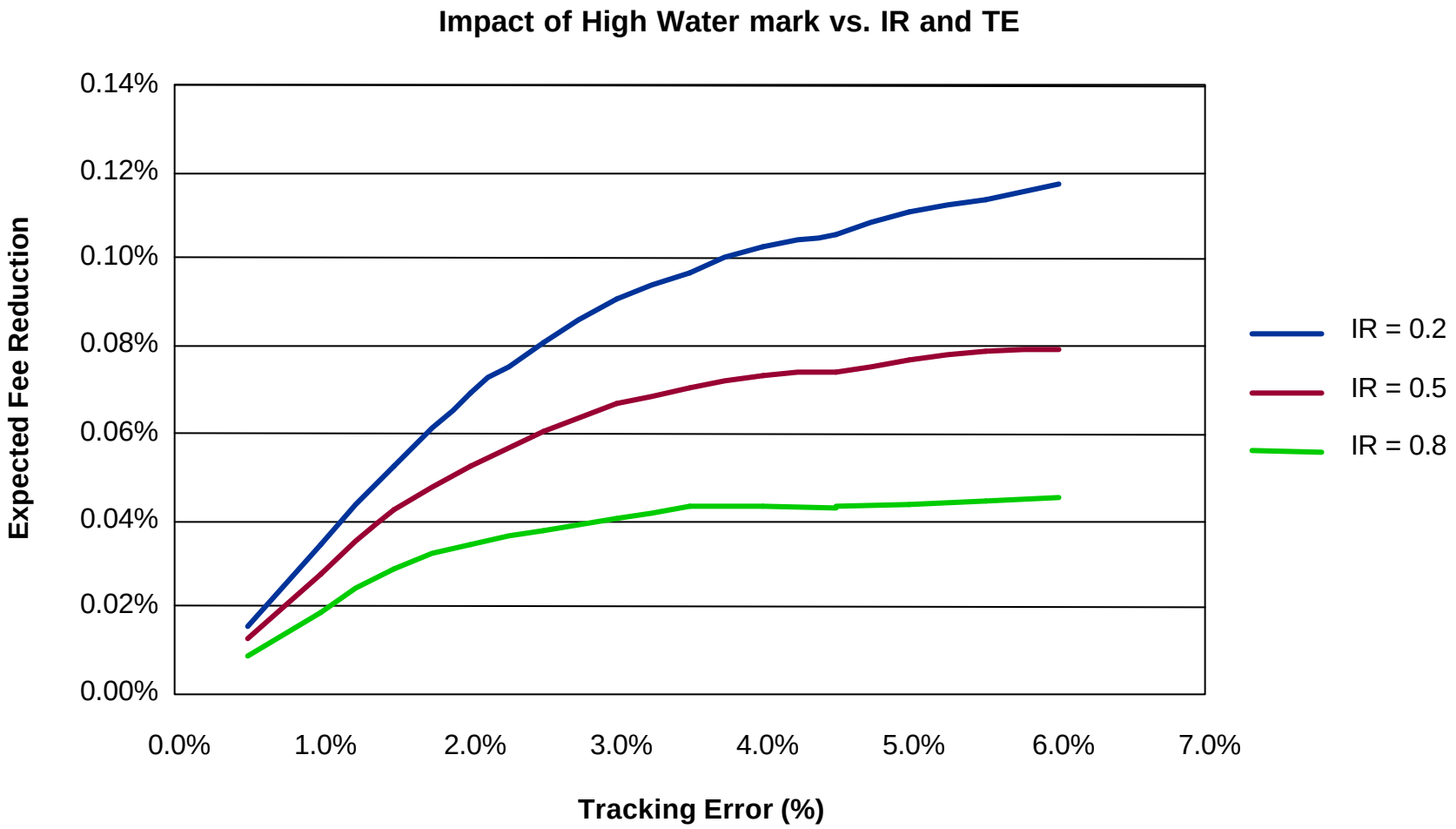
# PBF Formula and High Water Mark

## Impact of High Water Mark Condition on PBF Formula – Variation with IR and Tracking Error







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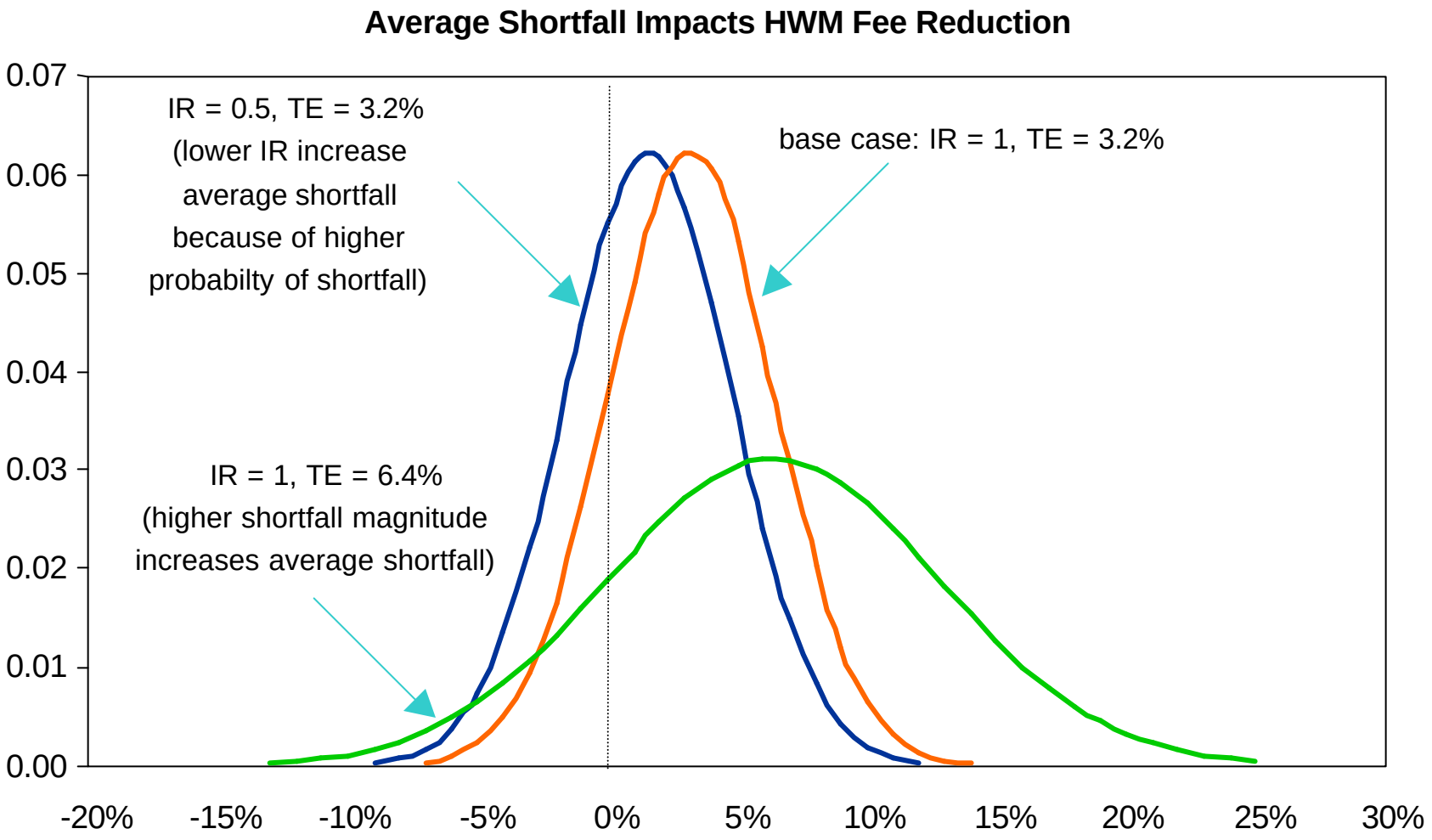
# PBF Formula and High Water Mark

## Understanding the Variation of High Water Mark Cost with Changes in IR and Tracking Error







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# PBF Formula and High Water Mark

## Some Conclusions

- **Imposing high water mark has significant fee revenue implications**
  - **Revenue decrease by over 15% (-7/46 bps) versus the hypothetical base case**
  - **Probability of being paid only the base fee increases from 32% to 38%**
  - **The negative impact of high water mark decreases with increasing IR**
  - **The negative impact of high water mark increases with higher tracking error**
  - **Both magnitude and frequency of shortfall versus the threshold return are positively related to the magnitude of high water mark impact on expected fees**
- **Aside from higher consistency of portfolio performance, very little can be done to mitigate the negative impact of high water mark conditions**
  - **In fee negotiations, it become more important that base fees be negotiated to a level that covers all marginal costs of managing the portfolio**
  - **Portfolio mandates with a high water mark should seek higher performance participation rates (base case = 20%)**




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# PBF Formula and High Water Mark

## Conclusions (continued)

- **For analysis, it is possible to treat performance-based fees as a call option on portfolio performance**
  - **It is possible to "price" this option as the average expected revenue from the portfolio mandate**
  - **With the given analytical framework, it becomes possible to study the impact of imposing various fee conditions and to study the sensitivities against various assumed parameters such as expected information ration, tracking error, market return, etc.**
- **From the client perspective, many of the common client concerns can be addressed through the transparency provided by the above analysis**
  - **Imposing maximum fees mitigate the concerns over excessive fees and "free option" effects**
  - **Imposing risk criteria (and possibly risk deviation penalties) should secure against risk deviations**
  - **Even when managers are allowed to game the PBF formula, the net expected impact is small**
- **From the manager perspective, the main concern relates to revenue stability**
  - **PBFs encumbers a significantly higher revenue volatility**
  - **Diversification of products using PBFs will significantly reduce this volatility**
  - **High water marks have significant negative impact on expected revenues**




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# Biography

## Martin Lee
## Director and Manager of Quantitative Research, Quantitative Fixed Income Research Group

- **Leads various research projects with particular emphasis on alpha forecasting models, quantitative credit research, and portfolio construction tools; part of the research group that provides fixed income portfolio managers with the tools and techniques that help maintain a consistent and disciplined investment process**
- **Private investment fund in Hong Kong, fixed income portfolio manager**
- ***Goldman, Sachs & Co.* – quantitative strategist with the Fixed Income & FX Proprietary Trading Group**
- **BS, Electrical Engineering, University of California (Berkeley)**
- **MS, Electrical Engineering and Applied Physics, Caltech**
- **MBA, The Wharton School**




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