# Expanding your knowledge of risk-adjusted performance


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June 22, 2021

## What we'll cover

- What <u>is</u> risk-adjusted performance
- Why it's important to adjust returns
- "The usual suspects"
- Let's reconsider what we think we know
- Your questions; my answers

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# Risk-Adjusted Return

A risk-adjusted return measures an investment's return after taking into account the degree of risk that was taken to achieve it. [Source: Investopedia]

A return that has been adjusted for risk [An obvious conclusion? Intuitive?]





# Why is it important to adjust returns?

# Returns & Risks w/o Adjustments

| | Portfolio | Benchmark |
|---|---|---|
| Returns (annualized) | 16.77% | 14.07% |
| Returns (cumulative) | 59.21% | 48.41% |
| Excess (rel. ann) | 2.70% | |
| Excess (rel. cum) | 10.80% | |
| Risks | | |
| Beta | 1.05 | 1.00 |
| Standard Deviation | 6.05% | 5.40% |
| Downside Deviation | 3.35% | 3.33% |
| Tracking Error | 1.66% | |





# The data we'll use for today's session

| | Dec-11 | Nov-11 | Oct-11 | Sep-11 | Aug-11 | Jul-11 | Jun-11 | May-11 | Apr-11 | Mar-11 | Feb-11 | Jan-11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Portfolio | -0.71% | -1.24% | 11.40% | -9.87% | -6.32% | -3.58% | -2.98% | 0.11% | 3.78% | 1.06% | 1.79% | 2.52% |
| Benchmark | 1.02% | -0.23% | 10.95% | -7.04% | -5.44% | -2.04% | -1.67% | -1.14% | 2.97% | 0.03% | 3.42% | 2.38% |

| | Dec-10 | Nov-10 | Oct-10 | Sep-10 | Aug-10 | Jul-10 | Jun-10 | May-10 | Apr-10 | Mar-10 | Feb-10 | Jan-10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Portfolio | 7.09% | 0.25% | 3.77% | 9.12% | -4.41% | 8.64% | -4.95% | -7.63% | 0.83% | 4.25% | 2.44% | -3.95% |
| Benchmark | 6.68% | 0.01% | 3.80% | 8.92% | -4.51% | 7.00% | -5.23% | -7.99% | 1.57% | 6.03% | 3.06% | -3.59% |

| | Dec-09 | Nov-09 | Oct-09 | Sep-09 | Aug-09 | Jul-09 | Jun-09 | May-09 | Apr-09 | Mar-09 | Feb-09 | Jan-09 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Portfolio | 3.30% | 7.32% | -3.83% | 4.37% | 3.00% | 8.85% | -0.67% | 7.01% | 15.81% | 10.93% | -9.32% | -4.90% |
| Benchmark | 1.92% | 6.00% | -1.85% | 3.73% | 3.61% | 7.55% | 0.21% | 5.61% | 9.56% | 8.74% | -10.66% | -8.43% |





# Jack Treynor was the first to offer an approach

$$TR = \frac{\bar{r}_p - \bar{r}_F}{\beta}$$





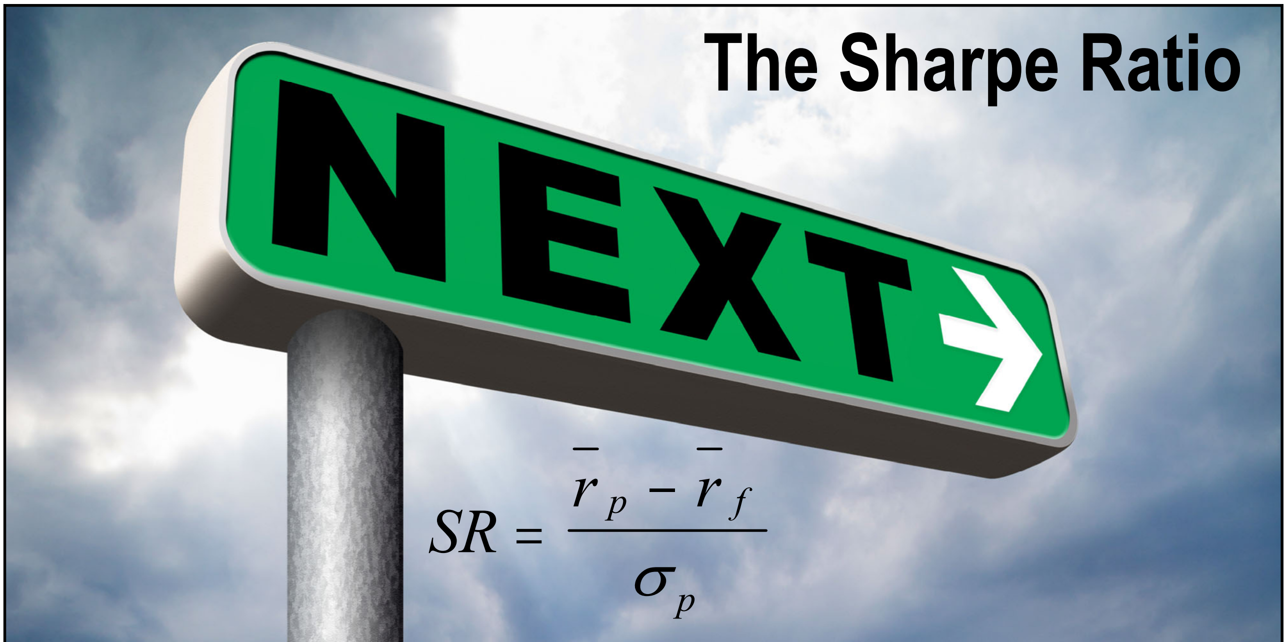

# We calculate Beta, then the Treynor ratios

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | Portfolio | Benchmark | | | |
| 2 | Dec-11 | -0.71% | 1.02% | Covariance | 0.00315 | =COVAR(B2:B37,C2:C37) |
| 3 | Nov-11 | -1.24% | -0.23% | Variance$_B$ | 0.002999 | =VAR(C2:C37) |
| 4 | Oct-11 | 11.40% | 10.95% | Beta | 1.05 | =E2/E3 |
| 5 | Sep-11 | -9.87% | -7.04% | | | |
| 6 | Aug-11 | -6.32% | -5.44% | | | |
| 7 | Jul-11 | -3.58% | -2.04% | | | |
| 8 | Jun-11 | -2.98% | -1.67% | | | |
| 9 | May-11 | 0.11% | -1.14% | | | |
| 10 | Apr-11 | 3.78% | 2.97% | | | |
| 11 | Mar-11 | 1.06% | 0.03% | | | |
| 33 | May-09 | 7.01% | 5.61% | | | |
| 34 | Apr-09 | 15.81% | 9.56% | | | |
| 35 | Mar-09 | 10.93% | 8.74% | | | |
| 36 | Feb-09 | -9.32% | -10.66% | | | |
| 37 | Jan-09 | -4.90% | -8.43% | | | |
| 38 | Averages | 1.48% | 1.25% | Average Risk-Free Rate | | 0.36% |
| 39 | | | | **Treynor Ratio$_P$** | | **0.011** |
| 40 | | | | **Treynor Ratio$_B$** | | **0.009** |

$$\beta_p = \frac{Cov(r_p, r_b)}{Var(r_b)}$$

$$TR = \frac{\bar{r}_p - \bar{r}_F}{\beta}$$

# The Sharpe Ratio



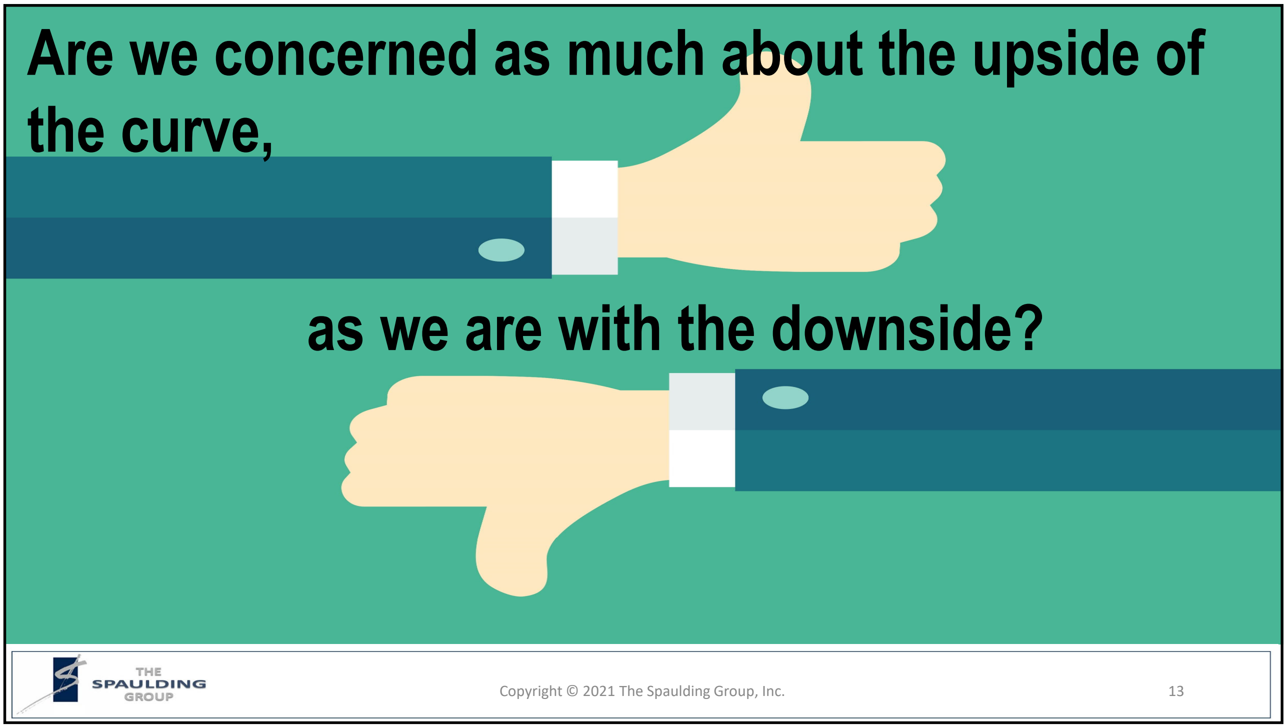

$$SR = \frac{\bar{r}_p - \bar{r}_f}{\sigma_p}$$





# Calculating the Sharpe ratios

| | Portfolio | Benchmark | Risk-Free |
|---|---|---|---|
| Dec-11 | -0.71% | 1.02% | 0.08% |
| Nov-11 | -1.24% | -0.23% | 0.08% |
| Oct-11 | 11.40% | 10.95% | 0.08% |
| Sep-11 | -9.87% | -7.04% | 0.08% |
| [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible]09 | [illegible] | [illegible]1% | [illegible] |
| May-09 | 7.01% | 5.61% | 0.08% |
| Apr-09 | 15.81% | 9.56% | 0.08% |
| Mar-09 | 10.93% | 8.74% | 0.08% |
| Feb-09 | -9.32% | -10.66% | 0.08% |
| Jan-09 | -4.90% | -8.43% | 0.08% |
| Averages | 1.48% | 1.25% | 0.08% |
| Standard Dev | 6.05% | 5.40% | |
| Sharpe | 0.23 | 0.22 | |
| Annualized Sharpe | 0.80 | 0.75 | |


Are we concerned as much about the upside of the curve,
as we are with the downside?
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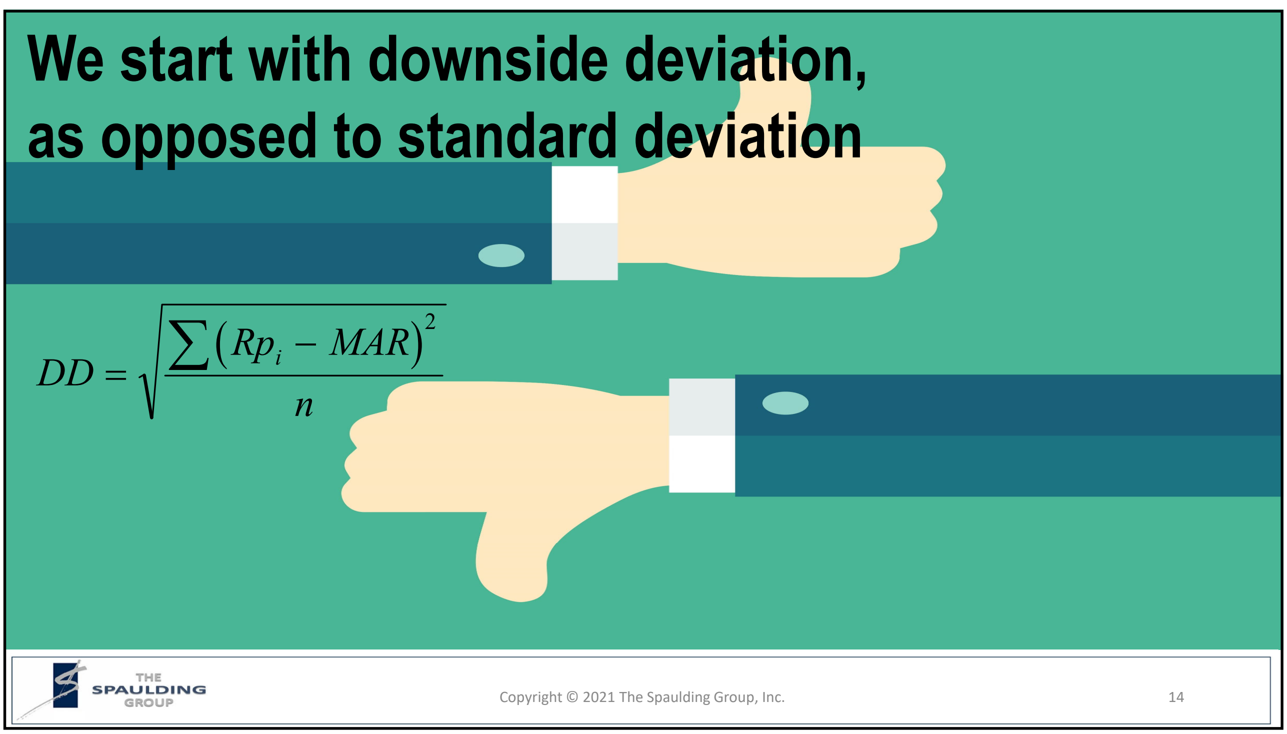
We start with downside deviation,
as opposed to standard deviation
$DD = \sqrt{\frac{\sum \left( Rp_i - MAR \right)^2}{n}}$
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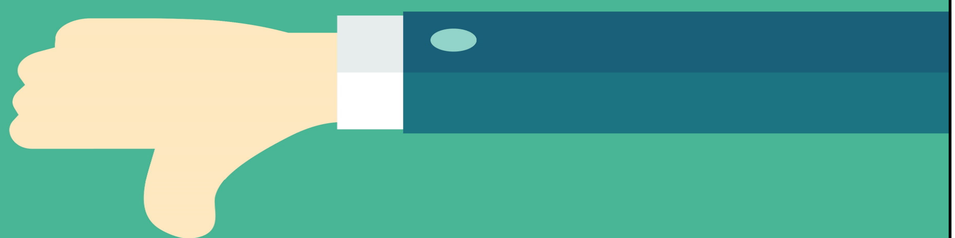
# And now, the Sortino ratio

$$SortinoRatio = \frac{\bar{r}_p - \bar{r}_{MAR}}{\sigma_{Downside}}$$



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# Calculate the downside deviations

| | Portfolio | Target | $Target^2$ | Benchmark | Target | $Target^2$ |
|---|---|---|---|---|---|---|
| Dec-11 | -0.71% | -0.71% | 0.01% | 1.02% | | |
| Nov-11 | -1.24% | -1.24% | 0.02% | -0.23% | -0.23% | 0.00% |
| Oct-11 | 11.40% | | | 10.95% | | |
| Sep-11 | -9.87% | -9.87% | 0.97% | -7.04% | -7.04% | 0.50% |
| Aug-11 | -6.32% | -6.32% | 0.40% | -5.44% | -5.44% | 0.30% |
| Jul-11 | -3.58% | -3.58% | 0.13% | -2.04% | -2.04% | 0.04% |
| Jun-11 | -2.98% | -2.98% | 0.09% | -1.67% | -1.67% | 0.03% |
| May-11 | 0.11% | | | -1.14% | -1.14% | 0.01% |
| Apr-11 | 3.78% | | | 2.97% | | |
| Mar-11 | 1.06% | | | 0.03% | 0.03% | 0.00% |
| Jun-09 | -0.67% | -0.67% | 0.00% | 0.21% | 0.21% | 0.00% |
| May-09 | 7.01% | | | 5.61% | | |
| Apr-09 | 15.81% | | | 9.56% | | |
| Mar-09 | 10.93% | | | 8.74% | | |
| Feb-09 | -9.32% | -9.32% | 0.87% | -10.66% | -10.66% | 1.14% |
| Jan-09 | -4.90% | -4.90% | 0.24% | -8.43% | -8.43% | 0.71% |
| | | Sum | 4.05% | | Sum | 4.00% |
| | | ÷ 36 | 0.11% | | ÷ 36 | 0.11% |
| | | Square Root | 3.35% | | Square Root | 3.33% |

| | | |
|---|---|---|
| Annual Target | | 5.00% |
| Monthly Equivalent | | 0.41% |

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# And now, the Sortino ratio

| | Portfolio | Target | Target$^2$ | Benchmark | Target | Target$^2$ |
|---|---|---|---|---|---|---|
| Dec-11 | -0.71% | -0.71% | 0.01% | 1.02% | | |
| Nov-11 | -1.24% | -1.24% | 0.02% | -0.23% | -0.23% | 0.00% |
| Oct-11 | 11.40% | | | 10.95% | | |
| Sep-11 | -9.87% | -9.87% | 0.97% | -7.04% | -7.04% | 0.50% |
| Aug-11 | -6.32% | -6.32% | 0.40% | -5.44% | -5.44% | 0.30% |
| Jul-11 | -3.58% | -3.58% | 0.13% | -2.04% | -2.04% | 0.04% |
| Jun-11 | -2.98% | -2.98% | 0.09% | -1.67% | -1.67% | 0.03% |
| May-11 | 0.11% | | | -1.14% | -1.14% | 0.01% |
| Apr-11 | 3.78% | | | 2.97% | | |
| Mar-11 | 1.06% | | | 0.03% | 0.03% | 0.00% |
| Jun-09 | -0.67% | -0.67% | 0.00% | 0.21% | 0.21% | 0.00% |
| May-09 | 7.01% | | | 5.61% | | |
| Apr-09 | 15.81% | | | 9.56% | | |
| Mar-09 | 10.93% | | | 8.74% | | |
| Feb-09 | -9.32% | -9.32% | 0.87% | -10.66% | -10.66% | 1.14% |
| Jan-09 | -4.90% | -4.90% | 0.24% | -8.43% | -8.43% | 0.71% |
| | | Sum | 4.05% | | Sum | 4.00% |
| | | ÷ 36 | 0.11% | | ÷ 36 | 0.11% |
| | | Square Root | 3.35% | | Square Root | 3.33% |

| | | | |
|---|---|---|---|
| Annual Target | | | 5.00% |
| Monthly Equivalent | | | 0.41% |
| | Portfolio | | Benchmark |
| Averages | 1.48% | | 1.25% |
| Sortino | 0.32 | | 0.25 |




# Jensen's Alpha

$$\alpha_J = (R_P - R_F) - \beta(R_B - R_F)$$

# Jensen's Alpha $\alpha_J = (R_P - R_F) - \beta(R_B - R_F)$

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | Portfolio | Benchmark | | | |
| 2 | Dec-11 | -0.71% | 1.02% | Covariance | 0.003149739 | =COVAR(B2:B37,C2:C37) |
| 3 | Nov-11 | -1.24% | -0.23% | $\text{Variance}_B$ | 0.002999293 | =VAR(C2:C37) |
| 4 | Oct-11 | 11.40% | 10.95% | Beta | 1.05 | =E2/E3 |
| 5 | Sep-11 | -9.87% | -7.04% | | | |
| 6 | Aug-11 | -6.32% | -5.44% | | | |
| 7 | Jul-11 | -3.58% | -2.04% | | | |
| 8 | Jun-11 | -2.98% | -1.67% | | | |
| 9 | May-11 | 0.11% | -1.14% | | | |
| 10 | Apr-11 | 3.78% | 2.97% | | | |
| 11 | Mar-11 | 1.06% | 0.03% | | | |
| 32 | [illegible] | [illegible] | [illegible] | | | |
| 33 | May-09 | 7.01% | 5.61% | | | |
| 34 | Apr-09 | 15.81% | 9.56% | | | |
| 35 | Mar-09 | 10.93% | 8.74% | | | |
| 36 | Feb-09 | -9.32% | -10.66% | | | |
| 37 | Jan-09 | -4.90% | -8.43% | | | |
| 38 | Returns | 59.21% | 48.41% | Risk-free cumulative return | | 13.81% |
| 39 | | | | Excess Return | | 10.80% |
| 40 | | | | **Jensen's alpha** | | **9.07%** |

$$\beta_p = \frac{Cov(r_p, r_b)}{Var(r_b)}$$

$$\alpha_J = (R_P - R_F) - \beta(R_B - R_F)$$



# Information ratio

$$IR = \frac{\bar{r}_P - \bar{r}_B}{\sigma(r_P - r_B)}$$

# Calculating Tracking Error & Information Ratio

| | Portfolio | Benchmark | Excess Rtn |
|---|---|---|---|
| Dec-11 | -0.71% | 1.02% | -1.73% |
| Nov-11 | -1.24% | -0.23% | -1.01% |
| Oct-11 | 11.40% | 10.95% | 0.45% |
| Sep-11 | -9.87% | -7.04% | -2.83% |
| [illegible] | [illegible] | [illegible] | [illegible] |
| Mar-09 | 10.93% | 8.74% | 2.19% |
| Feb-09 | -9.32% | -10.66% | 1.34% |
| Jan-09 | -4.90% | -8.43% | 3.53% |
| Averages | 1.48% | 1.25% | |
| Tracking Error (Standard Deviation) | | | 1.66% |
| Annualized | | | 5.76% |
| Information Ratio | | 0.139 | |
| Annualized | | 0.482 | |

$$IR = \frac{\bar{r}_P - \bar{r}_B}{\sigma(r_P - r_B)} =$$

$$\frac{0.0148 - 0.0125}{0.0166} = 0.139$$

$$IR^{Annualized} =$$

$$0.139 \times \sqrt{12} = 0.482$$





# What's our next measure?

## Hint!

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## M-Squared … Of course ☺

$$\left(\frac{\sigma r_{B_i}}{\sigma r_{P_i}}\right) \times r_i + \left[1 - \left(\frac{\sigma r_{B_i}}{\sigma r_{P_i}}\right)\right] \times r_f$$

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# Applying M² to our portfolio

$$\left(\frac{\sigma r_{B_i}}{\sigma r_{P_i}}\right) \times r_i + \left[1-\left(\frac{\sigma r_{B_i}}{\sigma r_{P_i}}\right)\right] \times r_f$$

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | Portfolio | Benchmark | Risk Free | $M^2$ |
| 2 | Dec-11 | -0.71% | 1.02% | 0.08% | **-0.63%** |
| 3 | Nov-11 | -1.24% | -0.23% | 0.08% | **-1.10%** |
| 4 | Oct-11 | 11.40% | 10.95% | 0.08% | **10.18%** |
| 5 | Sep-11 | -9.87% | -7.04% | 0.08% | **-8.80%** |
| 6 | Aug-11 | -6.32% | -5.44% | 0.08% | **-5.63%** |
| 33 | May-09 | 7.01% | 5.61% | 0.08% | **6.27%** |
| 34 | Apr-09 | 15.81% | 9.56% | 0.08% | **14.12%** |
| 35 | Mar-09 | 10.93% | 8.74% | 0.08% | **9.77%** |
| 36 | Feb-09 | -9.32% | -10.66% | 0.08% | **-8.31%** |
| 37 | Jan-09 | -4.90% | -8.43% | 0.08% | **-4.37%** |
| 38 | Cumulative | 59.21% | 48.41% | | **52.89%** |
| 39 | Annualized | 16.77% | 14.07% | | **15.20%** |
| 40 | Average ($r_{ave}$) | 1.48% | 1.25% | | |
| 41 | Standard Dev | 6.05% | 5.40% | | |
| 42 | Annualized | 20.96% | 18.71% | | |
| 43 | Risk-free Ave | 0.08% | | | |
| 44 | **% of RP to retain** | | **89.26%** | **=C41/D41** | |
| 45 | **% of RF to get** | | **10.74%** | **=1-(C41/D41)** | |

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# Reporting our results

| Annualized Results | |
|---|---|
| **Portfolio** | **16.77%** |
| **Index** | **14.07%** |
| **$M^2$** | **15.20%** |

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## Risk-Adjusted Return

A risk-adjusted return me… …fter taking into accoun… achieve it [c…

A r… …[An obvious con…

**What measures apply?**

# Returns & Risks w/ Adjustments

| | Portfolio | Benchmark |
|---|---|---|
| **Returns (annualized)** | 16.77% | 14.07% |
| **Returns (cumulative)** | 59.21% | 48.41% |
| **Excess (rel. ann)** | 2.70% | |
| **Excess (rel. cum)** | 10.80% | |
| **Risks** | | |
| **Beta** | 1.05 | 1.00 |
| **Standard Deviation** | 6.05% | 5.40% |
| **Downside Deviation** | 3.35% | 3.33% |
| **Tracking Error** | 1.66% | |
| **Risk-Adjusted** | | |
| **Treynor Ratio** | 0.011 | 0.009 |
| **Sharpe Ratio** | 0.80 | 0.75 |
| **Sortino Ratio** | 0.32 | 0.25 |
| **Jensen's Alpha** | 9.07% | |
| **Informatio Ratio** | 0.482% | |
| **M-Squared** | 15.20% | |

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# And let’s not forget risk-adjusted attribution!









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