
JACOBS LEVY EQUITY MANAGEMENT CENTER
for Quantitative Financial Research

# Active Quant: Applied Investment Research

PRESENTER
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# Questions to be Answered

1. What is the role of Financial Anomalies in Portfolio Construction and Management?
2. What is the Role of Forecasted Earnings in creating Expected Returns?
3. What are our investment results?
4. Can the models be implemented in the world of business?
5. What are the limitations of our work?

# Portfolio Construction and The Efficient Markets Hypothesis

(Early) Research Includes

- Roberts (1959)
- Sharpe (1964)
- Mossin (1966)
- Treynor and Mazuy (1966)
- Brealey (1966)
- Fama (1970, 1976, 1991)

The Market was held to be **Semi-Strong Efficient**!

# Earnings Forecasting and Expected Returns: The Early Literature

## Research Includes:

- Cragg and Malkiel (1968)
- Elton, Gruber, and Gultekin (1981)
- Dimson (1986)
- Brush (1983, 2001, 2006)
- Wheeler (1991)
- Brown (IJF 1993)
- Blin, Bender, and Guerard (1995, IJF 1998)
- Guerard (1997)
- Guerard, Gultekin, and Stone (1997)
- Ramnath, Rock, and Shane (IJF 2008)
- Guerard, Markowitz, and Xu (2014)
- Guerard, Markowitz, and Xu (2015)
- Guerard and Markowitz (2018)

# Public Model Expected Returns Stock Selection Model

$$TR_{t+1} = a_0 + a_1 EP_t + a_2 BP_t + a_3 CP_t + a_4 SP_t + a_5 REP_t + a_6 RBP_t + a_7 RCP_t + a_8 RSP_t + a_9 CTEF_t + a_{10} PM_t + e_t, \quad (1)$$

where: EP = [earnings per share]/[price per share] = earnings-price ratio;

BP = [book value per share]/[price per share] = book-price ratio;

CP = [cash flow per share]/[price per share] = cash flow-price ratio;

SP = [net sales per share]/[price per share] = sales-price ratio;

REP = [current EP ratio]/[average EP ratio over the past five years];

RBP = [current BP ratio]/[average BP ratio over the past five years];

RCP = [current CP ratio]/[average CP ratio over the past five years];

RSP = [current SP ratio]/[average SP ratio over the past five years];

CTEF = consensus earnings-per-share I/B/E/S forecast, revisions and breadth;

PM = price momentum; and

$e$ = randomly distributed error term.

# Markowitz Mean Variance Portfolio Selection

The Markowitz mean-variance (MV) portfolio construction and management can be summarized as:

$$\text{minimize} \quad w^T C w - \lambda \mu^T w, \tag{2}$$

where $\mu$ is the expected return vector, $C$ is the variance-covariance matrix, $w$ is the portfolio weights, and $\lambda$ is the risk-return tradeoff parameter. The estimation of $C$ is usually done by a multifactor model, in which the individual stock return $R_j$ of security $j$ at time $t$, dropping the subscript $t$ for time, may be written like this:

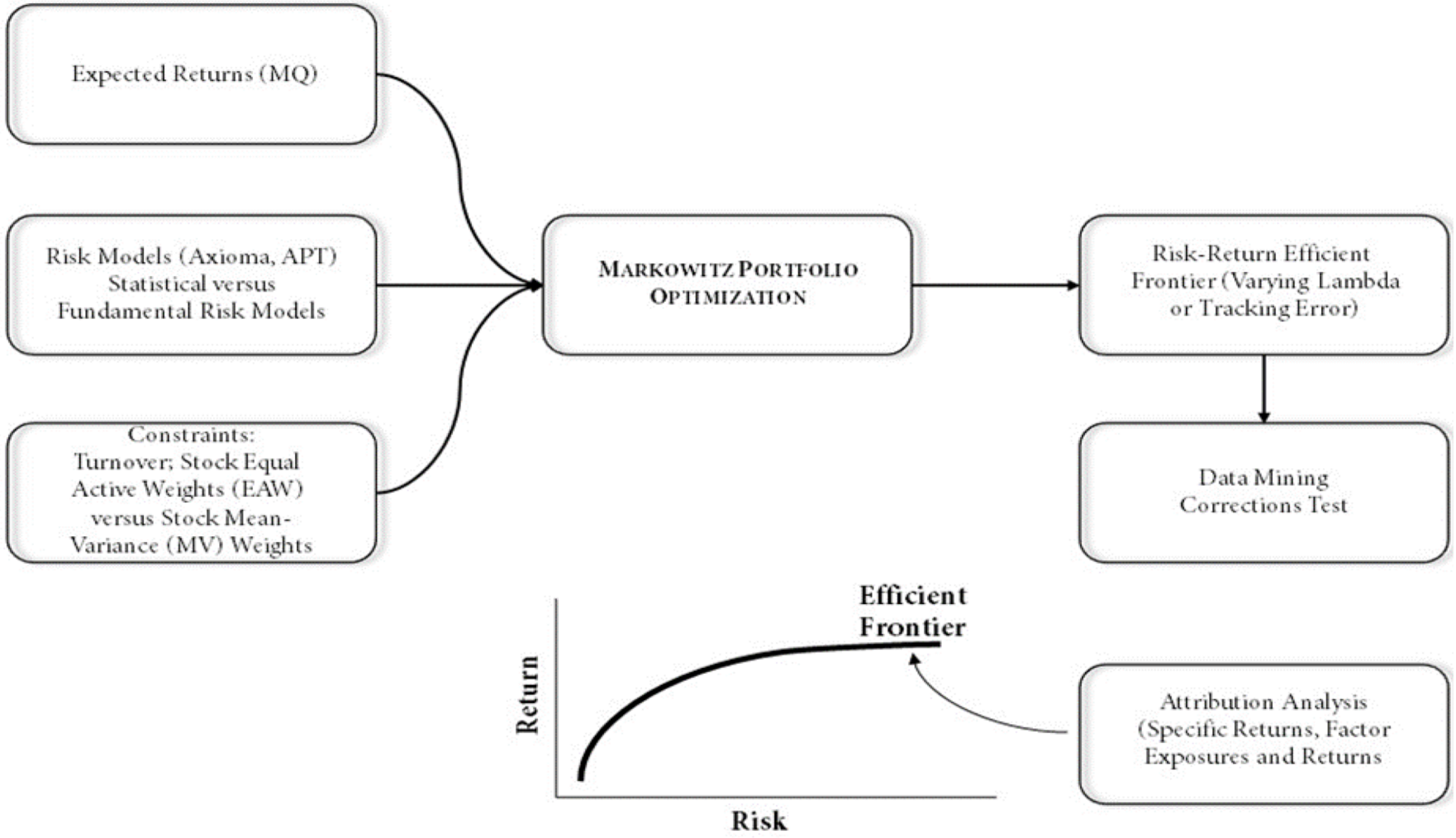
$$R_j = \sum_{k=1}^{K} \beta_{jk} \tilde{f}_k + \tilde{e}_j. \tag{3}$$

The nonfactor, or asset-specific, return on security $j$, $\tilde{e}_j$, is the residual risk of the security after removing the estimated impacts of the $K$ factors. The term $f_k$ is the rate of return on factor $k$. The factor model simplifies the $C$ as the sum of the systematic risk covariance and diagonal specific variances,

# What do Practitioners Believe?

- Diversified Portfolios can offer **Positive Active Returns**
- Financial Anomalies, known in 1986, have Existed and Persisted
- Portfolio Construction requires **Statistically Significant** tilt.
- Portfolio Constraints are useful with several Anomalies.
- The Vast Source of Active Management is Derived from Forecasted Earnings Acceleration in Stock Selection
- **Stronger** in Non-U.S. and EM universes than in U.S. universes
- Price Momentum Risk Premium is **MUCH** Larger in Non-U.S. and EM universes than in U.S. universes!

# Portfolio Construction and Modeling Process



# Guerard, Markowitz, and Xu Tilts, 1997-2011

**Table 2: Top/Bottom decile spreads of FSGLER**

1997 - 2011

| Variable | Top 3 decile spreads (*t*) | Annualized Top 3 decile spreads | Top decile spread (*t*) | Annualized Top decile spread |
|---|---|---|---|---|
| EP | 0.42% (1.66) | 4.43% | 0.20% (0.66) | 1.40% |
| BP | 0.50 (1.67) | 5.21 | 0.96 (1.45) | 9.54 |
| FEP | 0.50 (1.95) | 5.38 | 0.54 (2.02) | 5.11 |
| CTEF | 0.72 (5.85) | 8.85 | 1.16 (7.27) | 14.54 |
| EWC | 0.70 (3.67) | 8.37 | 1.06 (3.55) | 12.36 |
| GLER | 1.12 (4.54) | 13.55 | 1.48 (3.67) | 17.19 |

2003 – 2011

| Variable | Top 3 decile spreads (*t*) | Annualized Top 3 decile spreads | Top decile spread (*t*) | Annualized Top decile spread |
|---|---|---|---|---|
| EP | 0.23% (0.80) | 2.267 | 0.25% (1.08) | 2.65 |
| BP | 0.80 (1.78) | 8.74 | 0.47 (1.57) | 5.21 |
| FEP | 0.38 (1.33) | 4.12 | 0.23 (1.39) | 2.66 |
| CTEF | 1.07 (6.48) | 3.37 | 0.58 (4.88) | 7.12 |
| EWC | 0.97 (5.79) | 12.07 | 0.60 (1.83) | 7.41 |
| GLER | 1.33 (3.98) | 16.32 | 0.96 (4.59) | 11.78 |

Source: FactSet and SAS. Data provided may represent varying time periods depending on the concept being discussed.

Guerard, J.B., Jr., Markowitz, H.M., & Xu, G. (2015). Earnings forecasting in a global stock selection model and efficient portfolio construction and management. International Journal of Forecasting, 31, 550-560.

# Guerard, Markowitz, and Xu (2015) Risk Preferences, 1999-2011

**Table 3: Efficient Frontier of the Global Stock Selection Model with Various Portfolio Optimization Techniques**

1999 – 2011

Axioma Statistical Risk Model

| Earnings Model or Component | Mean Variance Methodology | Lambda | Annualized Return | Standard Deviation | Sharpe Ratio | Information Ratio | Tracking Error |
|---|---|---|---|---|---|---|---|
| GLER | M59 | 1000 | 15.84 | 24.97 | 0.590 | 0.78 | 13.11 |
| | | 500 | 16.34 | 24.85 | 0.590 | 0.82 | 12.08 |
| | | 200 | 16.37 | 24.38 | 0.610 | 0.85 | 12.68 |
| | | 100 | 15.90 | 24.61 | 0.580 | 0.81 | 12.66 |
| | | 5 | 10.11 | 19.36 | 0.440 | 0.51 | 8.81 |
| Benchmark | | | 5.59 | | 0.240 | | |
| GLER | TaR | 1000 | 16.10 | 21.93 | 0.660 | 0.94 | 11.18 |
| | | 500 | 15.91 | 21.99 | 0.651 | 0.90 | 11.44 |
| | | 200 | 16.09 | 20.95 | 0.691 | 0.97 | 10.83 |
| | | 100 | 14.18 | 21.24 | 0.591 | 0.77 | 11.23 |
| | | 5 | 8.51 | 20.03 | 0.344 | 0.33 | 8.75 |
| GLER | EAWTaR2 | 1000 | 14.80 | 21.96 | 0.600 | 0.94 | 11.07 |
| | | 500 | 14.30 | 21.65 | 0.590 | 0.80 | 10.87 |
| | | 200 | 14.15 | 20.92 | 0.600 | 0.85 | 10.04 |
| | | 100 | 13.49 | 20.82 | 0.570 | 0.80 | 9.84 |
| | | 5 | 10.77 | 20.79 | 0.440 | 0.43 | 12.18 |

Source: FactSet and APT. Past performance is not indicative of future returns.

Guerard, J.B., Jr., Markowitz, H.M., & Xu, G. (2015). Earnings forecasting in a global stock selection model and efficient portfolio construction and management. International Journal of Forecasting, 31, 550-560.

Table 1: Forecasted Earnings Acceleration and Stock Selection Modeling in Global, Non-US, and EM Universes

MSCI Index Constituents-only

Axioma Statistical Risk Model and Optimizer

Mean-Variance Analysis

Model: Global CTEF GLER TE
Period: 2003-01-31 to 2016-12-30 (Monthly) Benchmark: ACWG

| | Portfolio | Active | | Specific | | Momentum | | Value | |
|---|---|---|---|---|---|---|---|---|---|
| | Return | Return | T-Stat | Return | T-Stat | Return | T-Stat | Return | T-Stat |
| GLOBAL_CTEF-TE4 | 12.44% | 3.89% | 2.28 | 1.36% | 1.28 | 1.18% | 6.47 | 1.66% | 4.22 |
| GLOBAL_CTEF-TE6 | 15.87% | 7.32% | 3.32 | 3.89% | 2.89 | 1.65% | 7.07 | 1.84% | 4.15 |
| GLOBAL_CTEF-TE8 | 16.31% | 7.77% | 3.13 | 4.13% | 2.92 | 1.63% | 6.54 | 1.85% | 3.93 |
| GLOBAL_GLER-TE4 | 13.28% | 4.73% | 2.95 | 1.54% | 1.42 | 0.66% | 3.86 | 2.53% | 4.49 |
| GLOBAL_GLER-TE6 | 16.03% | 7.49% | 3.61 | 3.26% | 2.44 | 0.94% | 3.88 | 2.76% | 4.62 |
| GLOBAL_GLER-TE8 | 16.87% | 8.32% | 3.45 | 4.27% | 2.98 | 0.92% | 3.59 | 2.73% | 4.68 |

Model: XUS CTEF GLER TE
Period: 2003-01-31 to 2016-12-30 (Monthly) Benchmark: ACWXUSG

| | Portfolio | Active | | Specific | | Momentum | | Value | |
|---|---|---|---|---|---|---|---|---|---|
| | Return | Return | T-Stat | Return | T-Stat | Return | T-Stat | Return | T-Stat |
| XUS_CTEF_TE4 | 14.11% | 6.17% | 3.59 | 3.55% | 3.10 | 1.27% | 6.64 | 1.69% | 4.35 |
| XUS_CTEF_TE6 | 16.27% | 8.32% | 3.89 | 3.87% | 2.85 | 1.61% | 6.67 | 1.79% | 4.32 |
| XUS_CTEF_TE8 | 18.05% | 10.10% | 4.28 | 4.78% | 3.15 | 1.73% | 6.45 | 1.85% | 4.37 |
| XUS_GLER_TE4 | 13.78% | 5.83% | 3.67 | 1.93% | 1.81 | 0.84% | 4.22 | 2.37% | 4.44 |
| XUS_GLER_TE6 | 15.11% | 7.17% | 3.52 | 3.10% | 2.27 | 0.84% | 3.76 | 2.58% | 4.40 |
| XUS_GLER_TE8 | 16.22% | 8.28% | 3.82 | 4.36% | 2.94 | 0.78% | 3.36 | 2.66% | 4.58 |

Model: EM CTEF GLER TE
Period: 2003-01-31 to 2016-12-30 (Monthly) Benchmark: EMG

| | Portfolio | Active | | Specific | | Momentum | | Value | |
|---|---|---|---|---|---|---|---|---|---|
| | Return | Return | T-Stat | Return | T-Stat | Return | T-Stat | Return | T-Stat |
| EM_CTEF_TE4 | 16.15% | 5.43% | 3.37 | 4.08% | 3.27 | 0.95% | 6.17 | 1.43% | 4.21 |
| EM_CTEF_TE6 | 17.34% | 6.62% | 3.00 | 3.76% | 2.27 | 1.31% | 5.90 | 1.79% | 4.32 |
| EM_CTEF_TE8 | 19.76% | 9.04% | 3.67 | 5.17% | 2.97 | 1.68% | 5.99 | 2.01% | 4.48 |
| EM_GLER_TE4 | 17.72% | 7.00% | 4.90 | 4.69% | 3.97 | 0.04% | 0.32 | 1.88% | 4.05 |
| EM_GLER_TE6 | 19.81% | 9.09% | 4.59 | 6.21% | 3.91 | 0.11% | 0.56 | 2.22% | 3.97 |
| EM_GLER_TE8 | 20.92% | 10.20% | 4.43 | 6.55% | 3.81 | 0.19% | 0.80 | 2.39% | 4.06 |

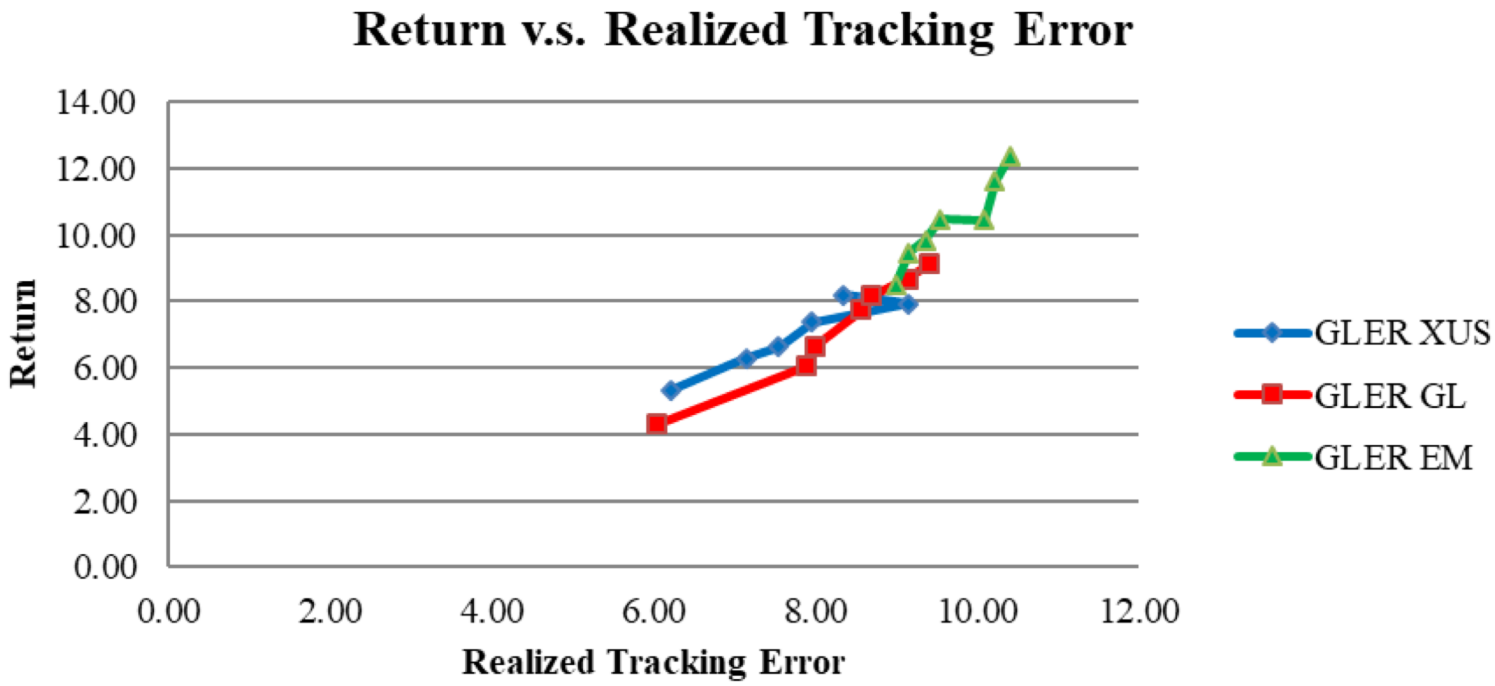
Source: FactSet and Axioma. Past performance is not indicative of future returns.

Guerard, J.B., Jr., & Chettiappan, S. (2017). Active quant: Applied investment analysis in emerging markets", Journal of Investing 26, 138-152.

**Table 2: Axioma Statistical Risk Model and Optimizer**
**January 2003 – December 2016**

| | STAT Risk Model Tracking Error | | | | | | |
|---|---|---|---|---|---|---|---|
| Model: XUS GLER | 4.00 | 5.00 | 6.00 | 7.00 | 8.00 | 9.00 | 10.00 |
| **Ann. Port Return** | 13.18 | 14.13 | 14.47 | 15.22 | 15.80 | 15.95 | 15.95 |
| **Ann. STD** | 20.16 | 20.56 | 20.66 | 20.99 | 21.20 | 21.63 | 21.63 |
| **Ann. Active Return** | 5.33 | 6.29 | 6.62 | 7.37 | 7.94 | 8.10 | 8.10 |
| **Ann. Active Risk** | 6.22 | 7.14 | 7.55 | 7.96 | 9.16 | 8.64 | 8.64 |
| **ShR** | 0.573 | 0.605 | 0.619 | 0.645 | 0.668 | 0.662 | 0.662 |
| **IR** | 0.856 | 0.880 | 0.876 | 0.925 | 0.975 | 0.937 | 0.937 |
| Model: GL GLER | | | | | | | |
| **Ann. Port Return** | 12.42 | 14.17 | 14.78 | 15.88 | 16.30 | 16.80 | 17.24 |
| **Ann. STD** | 17.82 | 18.92 | 19.60 | 19.98 | 20.12 | 20.54 | 20.64 |
| **Ann. Active Return** | 4.29 | 6.04 | 6.65 | 7.75 | 8.17 | 8.67 | 9.11 |
| **Ann. Active Risk** | 6.04 | 7.88 | 8.00 | 8.57 | 8.69 | 9.14 | 9.41 |
| **ShR** | 0.601 | 0.659 | 0.667 | 0.710 | 0.726 | 0.775 | 0.753 |
| **IR** | 0.710 | 0.852 | 0.832 | 0.905 | 0.940 | 0.949 | 0.968 |
| Model: EM GLER | | | | | | | |
| **Ann. Port Return** | 18.79 | 19.79 | 20.15 | 20.76 | 21.16 | 21.82 | 22.67 |
| **Ann. STD** | 26.09 | 26.22 | 26.34 | 26.45 | 26.74 | 26.95 | 27.25 |
| **Ann. Active Return** | 8.48 | 9.47 | 9.84 | 10.46 | 10.45 | 11.61 | 12.36 |
| **Ann. Active Risk** | 8.99 | 9.16 | 9.36 | 9.55 | 10.09 | 10.22 | 10.40 |
| **ShR** | 0.655 | 0.689 | 0.708 | 0.721 | 0.751 | 0.746 | 0.769 |
| **IR** | 0.944 | 1.033 | 1.062 | 1.095 | 1.085 | 1.128 | 1.180 |

Source: FactSet and Axioma. Past performance is not indicative of future returns.
Guerard, J.B., Jr., & Chettiappan, S. (2017). Active quant: Applied investment analysis in emerging markets", Journal of Investing 26, 138-152.

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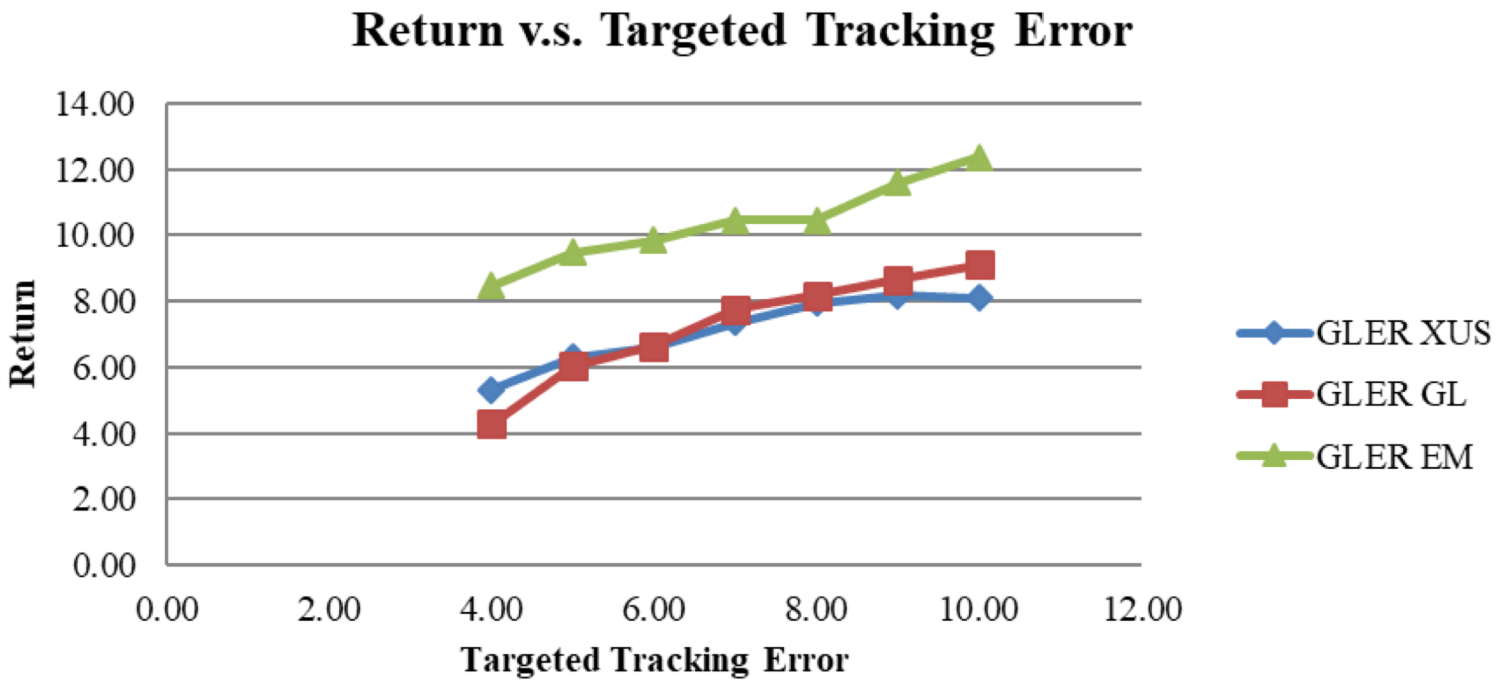


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# Updated Guerard and Markowitz (2018) Tilts, 2003 -11/2018

**Mean-Variance Anomalies Portfolios**

**Robust Regression Models with Tukey OIF99%**

**Time Period: 12/2002 -11/2018**

| Portfolios | Risk Stock Specific Effect | Risk Stock Specific Effect T-Stat | Risk Factors Effect | Risk Factors Effect T-Stat | Risk Total Effect | Earnings Yield | Risk Factor Returns Medium-Term Momentum | Size | Value | Volatility |
|---|---|---|---|---|---|---|---|---|---|---|
| **Universe: MSCI ex US** | | | | | | | | | | |
| **REG8_TE4** | 5.48 | 2.73 | 1.31 | 1.72 | 6.79 | 0.12 | -0.91 | 0.95 | 1.21 | -0.70 |
| **REG8_TE6** | 6.94 | 2.76 | 0.78 | 1.71 | 7.72 | 0.07 | -1.18 | 1.31 | 1.82 | -1.86 |
| **REG8_TE8** | 7.96 | 2.75 | 0.29 | 1.73 | 8.26 | -0.04 | -0.92 | 1.40 | 2.25 | -2.77 |
| **REG9_TE4** | 5.38 | 2.61 | 2.35 | 2.80 | 7.73 | 0.37 | -0.20 | 0.84 | 1.24 | -0.49 |
| **REG9_TE6** | 5.49 | 2.13 | 2.60 | 2.93 | 8.09 | 0.36 | -0.21 | 1.20 | 1.89 | -1.62 |
| **REG9_TE8** | 5.52 | 1.87 | 2.57 | 2.80 | 8.09 | 0.31 | -0.01 | 1.31 | 2.39 | -2.36 |
| **REG10_TE4** | 3.07 | 1.65 | 3.93 | 3.62 | 7.00 | 0.46 | 0.56 | 0.74 | 1.12 | -0.31 |
| **REG10_TE6** | 3.03 | 1.49 | 5.04 | 3.66 | 8.08 | 0.54 | 0.90 | 1.04 | 1.65 | -1.31 |
| **REG10_TE8** | 2.95 | 1.37 | 5.72 | 3.47 | 8.67 | 0.57 | 1.17 | 1.03 | 1.89 | -1.64 |
| **EP_TE4** | 7.32 | 3.70 | 1.75 | 2.34 | 9.07 | 0.58 | 0.91 | 0.08 | -0.44 | -0.22 |
| **EP_TE6** | 8.78 | 3.68 | 1.03 | 2.04 | 9.81 | 0.68 | 0.88 | 0.07 | -0.23 | -0.37 |
| **EP_TE8** | 9.78 | 3.71 | 1.31 | 2.22 | 11.09 | 0.64 | 0.72 | 0.12 | -0.05 | -0.49 |
| **CTEF_TE4** | 5.90 | 3.35 | 4.02 | 3.55 | 9.92 | 0.76 | 0.67 | -0.13 | 1.78 | 0.30 |
| **CTEF_TE6** | 6.56 | 3.33 | 4.79 | 3.29 | 11.34 | 0.92 | 0.62 | -0.03 | 2.55 | 0.44 |
| **CTEF_TE8** | 6.82 | 3.26 | 5.35 | 3.07 | 12.17 | 1.00 | 0.55 | -0.10 | 3.07 | 0.61 |

Source: FactSet and Axioma.
Past performance is not indicative of future returns.

# Updated Guerard and Markowitz (2018) Tilts, 2003 -11/2018

**Mean-Variance Anomalies Portfolios**

**Robust Regression Models with Tukey OIF99%**

**Time Period: 12/2002 -11/2018**

| Portfolios | Risk Stock Specific Effect | Risk Stock Specific Effect T-Stat | Risk Factors Effect | Risk Factors Effect T-Stat | Risk Total Effect | Earnings Yield | Risk Factor Returns Medium-Term Momentum | Size | Value | Volatility |
|---|---|---|---|---|---|---|---|---|---|---|
| **Universe: MSCI EM** | | | | | | | | | | |
| **REG8_TE4** | 3.99 | 2.38 | 1.79 | 2.11 | 5.78 | 0.25 | -0.85 | 0.61 | 1.61 | 0.18 |
| **REG8_TE6** | 3.30 | 1.64 | 2.32 | 2.17 | 5.63 | 0.13 | -0.99 | 1.00 | 2.46 | -0.37 |
| **REG8_TE8** | 3.37 | 1.36 | 2.59 | 2.27 | 5.96 | 0.00 | -0.78 | 1.20 | 2.84 | -0.74 |
| **REG9_TE4** | 3.45 | 2.20 | 3.28 | 3.60 | 6.73 | 0.43 | -0.19 | 0.49 | 1.69 | 0.27 |
| **REG9_TE6** | 2.62 | 1.54 | 4.37 | 3.49 | 6.99 | 0.41 | -0.09 | 0.82 | 2.57 | -0.23 |
| **REG9_TE8** | 3.40 | 1.73 | 5.09 | 3.31 | 8.50 | 0.38 | 0.25 | 1.04 | 3.21 | -0.62 |
| **REG10_TE4** | 2.25 | 1.58 | 4.06 | 4.24 | 6.31 | 0.44 | 0.53 | 0.43 | 1.68 | 0.21 |
| **REG10_TE6** | 1.33 | 1.07 | 5.63 | 4.17 | 6.96 | 0.41 | 0.93 | 0.73 | 2.60 | -0.30 |
| **REG10_TE8** | 0.30 | 0.59 | 6.34 | 3.68 | 6.64 | 0.39 | 1.32 | 0.87 | 3.16 | -0.61 |
| **EP_TE4** | 2.06 | 1.28 | 2.66 | 3.21 | 4.72 | 0.52 | -0.71 | 0.61 | 1.40 | 0.36 |
| **EP_TE6** | 3.85 | 1.98 | 2.96 | 3.06 | 6.81 | 0.63 | -0.71 | 0.81 | 1.92 | 0.02 |
| **EP_TE8** | 3.20 | 2.16 | 3.84 | 4.42 | 7.04 | 0.63 | 1.51 | 0.30 | 0.47 | -0.06 |
| **CTEF_TE4** | 3.67 | 2.13 | 4.67 | 4.02 | 8.34 | 0.90 | 2.13 | 0.49 | 0.73 | -0.70 |
| **CTEF_TE6** | 3.67 | 2.13 | 4.67 | 4.02 | 8.34 | 0.90 | 2.13 | 0.49 | 0.73 | -0.70 |
| **CTEF_TE8** | 3.54 | 2.18 | 5.76 | 3.64 | 9.30 | 0.87 | 2.69 | 0.62 | 0.93 | -1.37 |

Source: FactSet and Axioma.
Past performance is not indicative of future returns.

**Model: Donut_EM**
**Period: 2002-12-31 to 2018-07-31 (Monthly)**

| | Portfolio | Active | | | Specific | | Momentum | | |
|---|---|---|---|---|---|---|---|---|---|
| | Return | Return | IR | T-Stat | Return | T-Stat | Return | Exposure | T-Stat |
| DONUT_EM_Proprietary Model | 19.73% | 7.94% | 1.37 | 5.40 | 2.08% | 2.13 | 1.85% | 0.40 | 5.92 |
| DONUT_EM__Proprietary Model_Group | 19.27% | 7.48% | 1.28 | 5.06 | 1.85% | 1.86 | 1.82% | 0.40 | 5.72 |
| DONUT_EM_E' | 18.56% | 6.77% | 1.15 | 4.54 | 2.39% | 2.24 | 1.04% | 0.17 | 8.13 |
| DONUT_EM_E'_group | 18.03% | 6.24% | 1.06 | 4.20 | 2.07% | 1.90 | 1.00% | 0.17 | 7.76 |

| Value | | | Growth | | | Profitability | | | Tracking Err | Risk Model |
|---|---|---|---|---|---|---|---|---|---|---|
| Return | Exposure | T-Stat | Return | Exposure | T-Stat | Return | Exposure | T-Stat | | |
| 0.19% | 0.10 | 2.82 | 0.11% | -0.07 | 2.76 | 0.51% | 0.18 | 6.22 | 5.81% | WW4AxiomaMH |
| 0.19% | 0.10 | 2.71 | 0.11% | -0.08 | 2.69 | 0.47% | 0.16 | 5.80 | 5.83% | WW4AxiomaMH |
| 0.43% | 0.22 | 4.05 | 0.10% | 0.00 | 3.42 | 0.53% | 0.20 | 4.57 | 5.89% | WW4AxiomaMH |
| 0.36% | 0.21 | 3.34 | 0.08% | 0.01 | 3.05 | 0.52% | 0.19 | 4.65 | 5.86% | WW4AxiomaMH |

Source: FactSet and Axioma. Past performance is not indicative of future returns.

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