GRAFF & YOUNG INVESTMENT THEORY RESEARCH PROGRAM

BY

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BASIC THEMES OF GRAFF & YOUNG RESEARCH PROGRAM

- **Investment Theory Must be Tailored to Individual Market Environments**
- **Real Estate Market Structure is Totally Different from Stock Market Structure**
  - **It is Reasonable to Expect Appropriate Real Estate Investment Theory to be Correspondingly Different**
- **Empirical Analysis is Necessary Precursor to Development of Real Estate Investment Theory**
- **Large Data Sets Contain Clues about How to Analyze the Data**
  - **Creative Analysis Usually Proceeds as the Data Suggests**
  - **Data Analysis Leads to Theory Synthesis**

MODERN PORTFOLIO THEORY (MPT) AND STOCK MARKETS

- **Quantitative Portfolio Optimization Model for Stock Market Investment**

- **Model Derivation is Based on Assumptions**
  - **Price Determination is Exogenous to Individual Market Transactions**
  - **Accurate Current Transaction-Based Asset Prices Available to Investors**
  - **Transaction Costs are Not Material Market Friction Sources**
  - **Normally Distributed Asset Investment Risk**
  - **Reasonably Accurate Unbiased Asset Risk Estimators Available to Investors**
    - **Linear Estimators Based on Transaction Prices**
  - **Asset Risk Has Significant Systematic and/or Sector Components**
    - **If Not, Any Naive Diversification Methodology is Just as Effective at Risk Reduction**

- **Quantitative Diversification is Key to Efficient Investing Under the Above Conditions**

KEY CHARACTERISTICS OF STOCK MARKET INDEX BENCHMARKS

- **Index Portfolios Can Be Replicated by Market Participants**
  - **Stocks are Fungible**
  - **Index Stock Components are Traded and Available**
- **Index Returns are Based on Actual Transaction Prices**
- **Returns of Index-Replicating Portfolios Automatically Track Index Returns**

REAL ESTATE MARKET DOES NOT SATISFY MPT MODEL REQUIREMENTS

- **Price Determination is Not Exogenous to Individual Investors**
- **Price Data is Usually Appraisal-Based**
- **Transaction Costs and Times are Significant Sources of Market Friction**
- **Investment Risk Estimators are Appraisal-Based**
  - **Whether Investment Risk is Normally Distributed was Unknown**
  - **Whether Investment Risk has Significant Systematic and/or Sector Components was Unknown**
  - **Whether Risk Estimators are Unbiased was Unknown**
  - **Whether Risk Estimators are Reasonably Accurate was Unknown**
- **Whether MPT Strategies Have Any Value in Real Estate Market Environment was Unknown**

KEY CHARACTERISTICS OF REAL ESTATE INDEX BENCHMARKS

- **Index Portfolios Can Not be Replicated**
  - **Index Components are Not Fungible**
  - **Index Component Properties are Neither Traded Nor Available**
- **Index Returns are Usually Based on Most Recent Appraisal Valuations**
- **Whether Actual Portfolios Can Approximate Index Returns Reasonably Accurately was Unknown**
  - **How Effective is Diversification in Real Estate Market Environment?**

GRAFF & YOUNG RESEARCH ADDRESSES MPT APPLICABILITY TO REAL ESTATE PORTFOLIO STRATEGY

- **Is Real Estate Investment Risk Normally Distributed?**
- **Does Investment Risk Have Significant Systematic and/or Sector Components?**
- **Are Real Estate Returns Serially Independent?**
- **Are Appraisal-Based Valuations Reasonably Accurate?**
- **Are Appraisal-Based Valuations Unbiased?**

GRAFF & YOUNG RESEARCH ADDRESSES VALUE OF INDEX BENCHMARKS TO REAL ESTATE INVESTMENT

- **Can Actual Portfolios Be Constructed That Will Track Index Returns with Reasonable Accuracy?**

IS REAL ESTATE INVESTMENT RISK NORMALLY DISTRIBUTED?
IF NOT, CAN THE RETURN DISTRIBUTION BE CHARACTERIZED IN ANY WAY?

- **G&Y Study #1 Tests Shape of Risk Distribution with 13,958 Annual NCREIF Returns**
  - **Return Distributions are Stable but Fat-Tailed**
  - **Return Distributions are Heteroscedastic**
    - **Skewness and Volatility/Scale Vary from Year to Year**
  - **Value of Characteristic Exponent is Invariant**
    - **Measure of Fat-Tailedness**
    - **Unchanging from Year to Year and across Property Type**
    - **Verification That Test Result is Not a Statistical Fluke of the Data Set**

ARE REAL ESTATE RETURNS OUTSIDE OF THE U.S. STABLE AND FAT-TAILED?

- **G&Y Study #6 Retests Shape of Risk Distribution with 4,593 Property Council of Australia Annual Returns**
  - **Different Time Interval and Completely Separate Market**
- **Results of Australian Study Confirm Initial Study**
  - **Australian Returns are Not Normally Distributed**
  - **Australian Return Distributions are Stable but Fat-Tailed**
  - **Australian Return Distributions are Heteroscedastic**
    - **Skewness and Volatility/Scale Vary from Year to Year**
  - **Value of Characteristic Exponent for Australian Returns is Invariant**
- **U.S. and Australian Return Distributions Have Same Characteristic Exponent**
  - **Confirms That Characteristic Exponent Value Reflects Real Estate Economic or Market Characteristics**

DOES REAL ESTATE INVESTMENT RISK HAVE SIGNIFICANT SYSTEMATIC AND/OR SECTOR COMPONENTS?

- **G&Y Study #2 Tests Correlation Magnitudes with 38,679 Correlations Between NCREIF Annual Return Series**
  - **Implicitly tests Value Added by quantitative MPT diversification**
- **Study Assumes Returns are Independent, Identically and Normally Distributed**
  - **Same assumptions as made in nearly all previous quantitative portfolio analyses**
    - **Implicitly Retests Conclusions of Earlier Real Estate MPT Studies**
- **Best Estimate for Correlation Between Individual Property Returns is 0.20**
  - **Most Volatility in Investment Returns is Idiosyncratic**
  - **Typical Return Series Have Only 4% of Volatility in Common**
- **Quantitative MPT Diversification Has No More Value Than Naive Diversification**

ARE REAL ESTATE RETURNS SERIALLY INDEPENDENT?

- G&Y Study #3 Tests Serial Persistence in NCREIF Database Annual Returns
  - Extreme Returns Exhibit Strong Year-to-Year Persistence Tendency
  - Moderate Returns Exhibit No Significant Evidence of Year-to-Year Persistence
- Hypothesis Test Based on Nonparametric Statistics
  - Better than Joint Test of Hypothesis and Model Based on Parametric Statistics
  - Evidence is Strongest When Returns are Grouped into Quartiles
- Some Real Estate Returns are Serially Independent and Others are Dependent
  - Sample Standard Deviation for I.I.D. Samples is Inadequate Risk Estimator
  - No ARMA Time Series Model is Adequate Risk Estimator

DO REAL ESTATE RETURNS OUTSIDE OF THE U.S. EXHIBIT PERSISTENCE?

- **G&Y Study #7 Retests Serial Persistence with Property Council of Australia Annual Returns**
  - **Different Time Interval and Completely Separate Market**
  - **Same Qualitative Results as Study of U.S. Returns**
    - **Extreme Returns Exhibit Similar Evidence of Serial Persistence**
    - **Moderate Returns Exhibit No Significant Evidence of Serial Persistence**
- **Persistence in Australian Returns Seems Related to Institutional Investor Participation**
  - **Suburban Office Market Exhibited No Persistence in Extreme Returns Until Institutions Entered Market**
  - **Will Persistence in Extreme Returns Continue to Increase as Institutional Participation Matures?**
    - **Persistence Test in Subsequent Sample Period is Required to Determine Answer**
    - **Affirmative Answer Would Support Agency Cost Persistence Explanation in Graff & Webb Study**

ARE COMMERCIAL PROPERTY APPRAISALS ACCURATE AND/OR UNBIASED?

- **G&Y Study #5 Examines Random Appraisal Error by Testing 747 Samples from the RREEF Database**
  - **Each Sample is the Numerical Difference between Two Simultaneous Appraisals of a Single Property**
    - **Methodology Avoids Contamination by Transaction Illiquidity Signal Noise**
- **Appraisal Error Can be Decomposed into Components**
  - **White Noise**
    - **Best Standard Deviation Estimate is 2.0%**
    - **Constant Except in Years of Extreme Market Transaction Gridlock**
  - **Nonrandom Bias**
    - **Observable in Less Than Half of the Samples**
    - **Bias is Infrequently Much Larger Than White Noise**
    - **Infrequent Large Occurrences are Consistent with Serial Persistence and Fat-Tailed Returns**
- **Nonrandom Bias Error Sources are Excessive Agency Costs and Appraiser Bias**
    - **Excessive Agency Costs Can be Detected and Eliminated by Investment Control Systems**
    - **Appraiser Bias Error Can be Minimized by Better Professional Training**
- **Empirical Support for Agency Cost Explanation of Persistence and Fat-Tailedness in Graff & Webb Study**

CAN REAL ESTATE PORTFOLIOS TRACK INDEX RETURNS?

- G&Y Study #1 Addresses This Question
- Fat-Tailed Return Distributions Imply Diversification is Minimally Effective Portfolio Risk Reduction Strategy
- Idiosyncratic Risk Declines with Cube Root of Number of Assets
  - Risk Declines with Square Root of Number of Assets in Case of Normally Distributed Risk
- 1000 Portfolio Assets are Required to Reduce Idiosyncratic Risk by Factor of 10
  - Only 100 Assets are Required if Risk is Normally Distributed
- Only Huge Portfolios Can Possibly Track Well-Diversified Real Estate Indexes
- This Response Can be Improved with Results from Subsequent G&Y Studies

DO REIT RETURNS REFLECT REAL ESTATE RETURNS?

- **Previous Studies by Other Researchers Partially Answer This Question**
  - **REIT Returns Reflect Small-Cap Stock Returns More Than Real Estate Returns**
    - **See Graff (2001) Comprehensive REIT Study for Discussion and References**
- **G&Y Study #4 Tests Serial Persistence in REIT Returns with Annual, Quarterly and Monthly Returns**
- **Annual REIT Returns Exhibit Same Serial Persistence in Extreme Returns as Annual NCREIF Returns**
  - **Serial Persistence is Less Pronounced Than in Individual Property Returns**
  - **Evidence Supports Assertion That REIT Returns Reflect Real Estate Returns**
- **Institutional Investors Prevent REITs from Reflecting Real Estate Investment Characteristics**
  - **Serial Persistence in Annual Returns Declines Once Institutional Investors Enter REIT Market**
  - **No Serial Persistence in Returns of Large-Cap REITs That Institutional Investors Prefer**
- **No Evidence of Serial Persistence in Quarterly REIT Returns**
  - **Possibility of Another Effect such as Seasonality That Masks Persistence**
  - **Result Warrants Further Investigation**

DO REIT RETURNS REFLECT MARKET INEFFICIENCIES?

- **Suggested by Analysis of Monthly Returns in G&Y Study #4**
- **Negative Persistence in Extreme Monthly Returns**
  - **Negative Persistence Confined to Large-Cap REITs**
    - **Institutional Investor Activity Confined to Large-Cap REITs**
  - **Effect Only Observed in Large-Cap Returns Once Institutional Investors Enter Market**
- **Evidence of Inadequate Institutional Investor Information**
  - **Negative Persistence Suggests Similarly-Timed Analogous Portfolio Adjustments by Investors**
  - **Counterproductive Investor Behavior Predicted by Grossman and Stiglitz**
- **Evidence of Excessive Institutional Investor REIT Commitments**
  - **Negative Persistence in Extreme Returns Suggests Large Successive REIT Share Price Jumps**
    - **Large Price Change Reflects Corresponding Shift in Supply-and-Demand Equilibrium**
    - **Price Bounces Back in Following Month after Institutions Complete Portfolio Adjustments**
- **Price Responses to Portfolio Adjustments Reduce Institutional Investment Returns from REITs**
  - **Buy-and-Hold Investment Strategies Minimize Effect of Price Responses**
  - **Better Investor Information about REITs Improves Price Discovery and Reduces Price Responses**

GRAFF & YOUNG SCHOLARLY PUBLICATIONS

1. **Real Estate is Not Normal: A Fresh Look at Real Estate Return Distributions, *Journal of Real Estate Finance and Economics,* 1995, 10:3, 225-259.**

2. **Real Estate Return Correlations: Real-World Limitations on Relationships Inferred from NCREIF Data, *Journal of Real Estate Finance and Economics,* 1996, 13:2, 121-142.**

(1994 ARES Foundation Manuscript Award, Best Research Paper Presented at the ARES Annual Meeting by a Practicing Real Estate Professional)

3. **Systematic Behavior in Real Estate Investment Risk: Performance Persistence in NCREIF Returns, *Journal of Real Estate Research,* 1996, 12:3, 369-381.**

(1996 RREEF Manuscript Award, Best Research Paper on Real Estate Investment/Portfolio Management Presented at the ARES Annual Meeting)

4. **Serial Persistence in Equity REIT Returns, *Journal of Real Estate Research,* 1997, 14:3, 183-214.**

(1997 ARES Foundation Manuscript Award, Best Research Paper Presented by a Practicing Real Estate Professional at the ARES Annual Meeting)

5. **The Magnitude of Random Appraisal Error in Commercial Real Estate Valuation, *Journal of Real Estate Research,* 1999, 17:1/2, 33-54.**

(1998 Appraisal Institute Manuscript Award, Best Research Paper Presented on Real Estate Valuation at the ARES Annual Meeting)

GRAFF & YOUNG SCHOLARLY PUBLICATIONS
(CONTINUED)

(with Adrian Harrington)

6. **The Shape of Australian Real Estate Return Distributions and Comparisons to the United States, *Journal of Real Estate Research,* 1997, 14:3, 291-308.**

(1997 LaSalle Investment Management Manuscript Award, Best Paper on International Real Estate Investment/Portfolio Management Presented at the ARES Annual Meeting)

7. **Serial Persistence in Disaggregated Australian Real Estate Returns, *Journal of Real Estate Portfolio Management,* 1999, 5:2, 113-127.**

(with David M. Geltner)

8. **Random Disaggregate Appraisal Error in Commercial Property: Evidence from the Russell-NCREIF Database, *Journal of Real Estate Research,* 1994, 9:4, 403-419.**