Valuing Private Equity Investments Strip by Strip

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UNC
Private Universe is Expanding vs Public Stocks, Complicating Risk Assessment
Measurement Problems in Assessment of Risk and Return in Private Equity

1. The shift in capital towards private markets, especially for small growth firms, means that we need to know how risk is priced in private markets.
1. The shift of capital towards private markets, especially for small growth firms, means that we need to know how risk is priced in private markets.

2. Existing approaches to private equity valuation have not taken into account the multivariate nature of risk nor the temporal composition of risk.
   - Standard approaches:
     - TVPI (no discounting, no risk)
     - IRR (no risk)
     - PME (beta = 1)
     - GPME (beta constant)
   - Limitations to all approaches: only one aggregate source of risk
     - If a bad assumption in equities (CAPM fails), why good assumption in PE?
     - Especially in “alternative” categories like Real Estate Funds
1. Shift to private markets

2. Literature has struggled with cross-section and term structure of risk

3. **To address these limitations, we draw from asset pricing literature emphasizing rich cross-section of factors and term structure of risk**

   - Multifactor models: Fama and French (2016, 2018) and Hou, Xue, and Zhang (2015, 2017, 2018) and a budding literature on machine learning and the XS (e.g., Kozak, Nagel, and Santosh, 2017, Gu, Kelly, and Xiu, 2018)

     - Term structure of risk potentially upward or downward sloping, depending on factor
     - Term structure of strips on other factors not known or traded
Measurement Problems in Assessment of Risk and Return in Private Equity

1. Shift to private markets

2. Literature has struggled with cross-section and term structure of risk

3. We draw from other asset pricing literature emphasizing multifactor models

4. **Problem: Observe cash flows, not returns**
1. Shift to private markets

2. Literature has struggled with cross-section and term structure of risk

3. We draw from other asset pricing literature emphasizing multifactor models

4. Problem: Observe **cashflows**, not **returns**

5. **Our Solution:**
   - Estimate exposures of PE fund cash flows to cash flows on bond and cross-section of **stock strips**
   - Use asset pricing model to price these strips

**Delivers PE factor exposure, expected return, risk-adjusted profit, NAV**
1. Alternative PE Categories have sector-specific factor loadings in the cross-section
Key Takeaways

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2. Substantial small and growth factor exposure, suggesting these factor loadings are prominent in PE
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Key Takeaways

1. Alternative PE Categories have sector-specific factor loadings in the cross-section

2. Decreasing realized profits and expected returns in more recent vintages

3. Substantial small and growth factor exposure, suggesting these factor loadings are prominent in PE

4. Rich risk adjustment results in much lower average risk-adjusted profits across all fund categories
Roadmap

1. Estimate Private Equity fund exposure to public market assets

2. Price public market assets. Model delivers term structure of risk in bond and stock market, including for cross-sectional risk factors

3. Value the replicating portfolios of PE fund exposures using the bond and stock strip prices

4. Use asset pricing model to understand private equity risk/return characteristics and risk-adjusted profits
1. Private Equity Fund Exposures

Estimate fund exposure to multi-factor model
Want to Understand Cash-Flow Profiles of Private Equity Funds

Cash Flows by Age

Distribution Amount Relative to $1 Commitment

Future Cash Flow
Actual Cash Flow
Cash-Flow Variation Across Horizon and Vintage – VC

Capital Distribution Relative to $1 Invested

Vintage
- 1990
- 1991
- 1992
- 1993
- 1994
- 1995
- 1996
- 1997
- 1998
- 1999
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
Break out Factor Exposure Strip by Strip to Match PE Cash Distributions to LPs

- Construct $F_{t,t+h}$ cash flows on replicating portfolio:
  - Bond strips, pay $1$ for sure at horizon $t + h$
  - Dividend strips, pay one risky cash flow at $t + h$: $D_{t+h}/D_t$
  - Gain strips, pays one risky cash flow at $t + h$: $P_{t+h}/P_t$

- $h$-period stochastic discount factor chains one-period SDFs:

$$M_{t,t+h} = \prod_{k=1}^{h} M_{t+k}$$

- Defining prices of these strips:

$$P_{t,h} = \mathbb{E}_t[M_{t,t+h}F_{t,t+h}]$$
Estimate Factor Exposure Strip-by-Strip

- $X_{t+h}^i$ is the distribution cash flow of PE fund $i$ of vintage $t$ at time $t + h$

- Factor model fitting quarterly PE fund cash flows with quarterly strip cash flows

\[ X_{t+h}^i = \beta_{t,h}^i F_{t,t+h} + e_{t+h}^i \]

Factors $F$ are:

- Zero Coupon Bond (constant)
- Dividend Strips: market index, small, growth, value, REIT, infrastructure, and natural resource stocks
- Gain Strips: market index, small, growth, value, REIT, infrastructure, and natural resource stocks
- 15 factors at each horizon $h$
Shrinkage Estimators Measure Factor Exposure

Structure of exposure (e.g., Buyout funds):

\[ X_{t+h}^{i \in c} = \beta_{t,h}^{\text{bond}} + \beta_{t,h}^{\text{equity}} F_{t,t+h}^{\text{equity}} + e_{t+h}^{i} \]

\[ = a_{pd_{t}}^{\text{bond}} + b_{h}^{\text{bond}} + \left( a_{pd_{t}}^{\text{equity}} + b_{h}^{\text{equity}} \right) F_{t,t+h}^{\text{equity}} + e_{t+h}^{i}. \]

Allow \( b_{h} \) to vary for each horizon (year)

\( a_{t} \) varies for each quartile of the P/D distribution of vintage quarter

Two estimation techniques: 

1. OLS (only stock market dividend strips and zero coupon bonds)
2. Elastic Net:

\[ \hat{\beta}_{\text{ElasticNet}} = \arg \min_{\beta \in \mathbb{R}^{KH}} \| X_{t+h}^{i} - \beta_{t,h}^{i} F_{t,t+h} \|^2 + \lambda_0 \mathbb{1}\{ \beta < 0 \} + \lambda_1 \| \beta \|_1 + \lambda_2 \| \beta \|^2, \quad \lambda_0 = \infty \]
Estimation Enables Novel Understanding of PE Asset Pricing

- Use model to understand expected returns, where $w_{t,h}^k = \beta_{t,h}^k P_{t,h}$

$$
\mathbb{E}_t \left[ R^i \right] = \sum_{h=1}^{H} \sum_{k=1}^{K} w_{t,h}^k \mathbb{E}_t \left[ R_{t+h}(k) \right]
$$

- Profit corrects for risk (may include premium for illiquidity):

$$
e_{t+h}^i = X_{t+h}^i - \beta_{t,h}^i F_{t+h}$$

$$
RAP_t^i = \left( \sum_{h=1}^{H} X_{t+h}^i P_{t+h}^\$ - 1 \right) - \left( \sum_{h=1}^{H} \sum_{k=1}^{K} \beta_{t,h}^k F_{t+h} P_{t+h}^\$ - \beta_{t,h}^k P_{t,h} \right)
\sim TVPI$$

$$
= \sum_{h=1}^{H} e_{t+h}^i P_{t+h}^\$ + \sum_{h=1}^{H} \sum_{k=1}^{K} \beta_{t,h}^k P_{t,h} - 1
$$
2. Price Public Assets

Asset pricing model fits capital market assets
Asset Pricing Model

• State variables follow Gaussian first-order VAR:

\[ z_t = \Psi z_{t-1} + \Sigma^{1/2} \varepsilon_t, \quad \varepsilon_t \sim i.i.d. \mathcal{N}(0, 1) \]

• Bond variables: inflation, real GDP growth, nominal short rate, five year - three month Treasury yield spread

• Stock variables: log price-dividend ratio and log real dividend growth for: CRSP vw-aggregate market, NAREIT real estate, listed infrastructure, small stocks (ME Q1), growth stocks (BM Q1), value stocks (BM Q5), natrl. resources

• Log SDF:

\[
\begin{align*}
m^s_{t+1} &= -y^s_t(1) - \frac{1}{2} \Lambda'_t \Lambda_t - \Lambda'_t \varepsilon_{t+1} \\
\Lambda_t &= \Lambda_0 + \Lambda'_1 z_t
\end{align*}
\]
Model Matches Time-Series of Bond Yields

Nom. yield 1-qtr bond

% per year

1980 1990 2000 2010

Nom. yield 1-yr bond

% per year

1980 1990 2000 2010

Nom. yield 5-year bond

% per year

1980 1990 2000 2010

Nom. yield 10-year bond

% per year

1980 1990 2000 2010
Also Matches underlying Components of Bond Yield: Real + Nominal
Fits Equity Risk *Premia* as well as Stock Price *Levels*
Fits Equity Risk Premia as well as Stock Price Levels

REITs risk premium

Infra risk premium

NR risk premium

Price-Dividend Ratio on REITs

Price-Dividend Ratio on Infra

Price-Dividend Ratio on NR
Rich Patterns in Temporal Pricing of Risk

<table>
<thead>
<tr>
<th>Risk Premium Type</th>
<th>Graph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average zero-coupon bond risk premium</td>
<td><img src="image1" alt="Graph" /></td>
</tr>
<tr>
<td>Average Small div strip risk premium</td>
<td><img src="image2" alt="Graph" /></td>
</tr>
<tr>
<td>Average Value div strip risk premium</td>
<td><img src="image3" alt="Graph" /></td>
</tr>
<tr>
<td>Average Growth div strip risk premium</td>
<td><img src="image4" alt="Graph" /></td>
</tr>
<tr>
<td>Average Infra div strip risk premium</td>
<td><img src="image5" alt="Graph" /></td>
</tr>
<tr>
<td>Average REIT div strip risk premium</td>
<td><img src="image6" alt="Graph" /></td>
</tr>
<tr>
<td>Average NR div strip risk premium</td>
<td><img src="image7" alt="Graph" /></td>
</tr>
</tbody>
</table>

The graphs above illustrate the average risk premiums for different types of dividend strips, along with their corresponding spot and futures risk premiums. The x-axis represents the maturity in quarters, while the y-axis shows the percentage per annum.
Imputed Dividend Strip Model Matches Data when Available
Outcome of Model: Bond + Dividend Strip Prices

- Zero-coupon Bond Prices
- Dividend Strip Prices - Stock Market
  - Dividend Strip Prices - Small
  - Dividend Strip Prices - Growth
  - Dividend Strip Prices - Value
  - Dividend Strip Prices - REITS
  - Dividend Strip Prices - Infrastructure
  - Dividend Strip Prices - Nat. Res.
3. Replicating Portfolios

Construct cash-flow replicating portfolios for Private Equity Funds
Factor Exposure in PE Funds by Horizon — Buyout, Elastic Net

Factor Exposure by Horizon

Years from Fund Inception

b Coefficient

0.0000
0.0025
0.0050
0.0075

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Bond  Infra  REIT  Stock  Dividend  Gain
Growth  Natural Resources  Small  Value
Factor Exposure in PE Funds by Horizon — Buyout, OLS

Factor Exposure by Horizon

b Coefficient

Bond
Stock Gain

Years from Fund Inception
Factor Exposure in PE Funds by Horizon – VC, Elastic Net

Factor Exposure by Horizon

Years from Fund Inception

- Growth
- Natural Resources
- Small
- Infra
- REIT
- Stock
- Dividend
- Gain

b Coefficient

0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.10
0.11
0.12
0.13
0.14
0.15
0.16

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Factor Exposure in PE Funds by Horizon — Real Estate, Elastic Net

Factor Exposure by Horizon

Years from Fund Inception

Bond    Infra    REIT    Stock    Dividend    Gain
Growth  Natural Resources  Small  Value
4. Private Equity Fund Characteristics

Use fitted model to understand risk and characteristics of private equity funds
## Model Comparison

<table>
<thead>
<tr>
<th></th>
<th>Buyout</th>
<th>VC</th>
<th>Real Estate</th>
<th>Fund of Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>St Dev</td>
<td>Mean</td>
<td>St Dev</td>
</tr>
<tr>
<td>TVPI</td>
<td>0.62 (0.74)</td>
<td>0.39 (1.69)</td>
<td>0.17 (0.52)</td>
<td>0.23 (0.51)</td>
</tr>
<tr>
<td>IRR (%)</td>
<td>0.09 (0.10)</td>
<td>0.03 (0.20)</td>
<td>0.04 (0.11)</td>
<td>0.05 (0.07)</td>
</tr>
<tr>
<td>PME-1</td>
<td>0.36 (0.67)</td>
<td>0.22 (1.49)</td>
<td>-0.04 (0.44)</td>
<td>0.17 (0.40)</td>
</tr>
<tr>
<td>RAP 2-factor (NPV Call)</td>
<td>0.28 (0.53)</td>
<td>-0.15 (1.36)</td>
<td>0.09 (0.45)</td>
<td>0.24 (0.50)</td>
</tr>
<tr>
<td>RAP 15-factor (NPV Call)</td>
<td>-0.06 (0.51)</td>
<td>-0.09 (1.27)</td>
<td>-0.16 (0.38)</td>
<td>-0.19 (0.35)</td>
</tr>
<tr>
<td>RAP 2-factor (Sum Call)</td>
<td>0.20 (0.53)</td>
<td>-0.25 (1.36)</td>
<td>0.04 (0.45)</td>
<td>0.15 (0.51)</td>
</tr>
<tr>
<td>RAP 15-factor (Sum Call)</td>
<td>-0.14 (0.51)</td>
<td>-0.18 (1.27)</td>
<td>-0.20 (0.38)</td>
<td>-0.28 (0.36)</td>
</tr>
<tr>
<td></td>
<td>Restructuring</td>
<td>Debt Fund</td>
<td>Infrastructure</td>
<td>Natural Resources</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------</td>
<td>-----------</td>
<td>----------------</td>
<td>------------------</td>
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<td></td>
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<td>Mean</td>
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</tr>
<tr>
<td>TVPI</td>
<td>0.44</td>
<td>(0.57)</td>
<td>0.30</td>
<td>(0.27)</td>
</tr>
<tr>
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<td>0.07</td>
<td>(0.04)</td>
</tr>
<tr>
<td>PME-1</td>
<td>0.20</td>
<td>(0.56)</td>
<td>0.12</td>
<td>(0.17)</td>
</tr>
<tr>
<td>RAP 2-factor (NPV Call)</td>
<td>0.17</td>
<td>(0.47)</td>
<td>0.34</td>
<td>(0.55)</td>
</tr>
<tr>
<td>RAP 15-factor (NPV Call)</td>
<td>-0.001</td>
<td>(0.46)</td>
<td>-0.13</td>
<td>(0.30)</td>
</tr>
<tr>
<td>RAP 2-factor (Sum Call)</td>
<td>0.13</td>
<td>(0.47)</td>
<td>0.31</td>
<td>(0.56)</td>
</tr>
<tr>
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<td>-0.04</td>
<td>(0.46)</td>
<td>-0.16</td>
<td>(0.31)</td>
</tr>
</tbody>
</table>
Histogram of Fund-Level Profit Relative to Replicating Portfolio

TVPI is: 0.622  Risk-Adj Profit is: -0.063  Risk Adj Fraction above 10% is: 0.346
2-factor OLS Model

Full-factor Elastic Net Model

Average Fund-level profit by Vintage

<table>
<thead>
<tr>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>RAP Profit</td>
<td>0.0</td>
<td>0.5</td>
<td>1.0</td>
<td>0.5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>
VC Fund Risk-Adjusted Profits — Buyout, OLS + Elastic Net

2-factor OLS Model

Full-factor Elastic Net Model
2-factor OLS Model

Expected Return by Vintage

Average: 0.085

Full-factor Elastic Net Model

Expected Return by Vintage

Average: 0.095

Other Models  Duration  Betas
PE Comparison with PME – Buyout

RAP from Elastic Net Model against PME−1. Correlation: 0.78
Takeaways

1. Develop methodology to value and understand risk/return characteristics when only cash flows, not returns, are available.

2. Find PE funds take asset-specific exposure. Small, growth, real estate, infra exposure has migrated to PE.

3. Risk-adjusted profit, as well as expected return on replicating portfolios, declining over time.

4. Lower and less persistent RAP suggest that LPs do not earn abnormal returns; maybe even illiquidity premium for convenience of not marking to market.

Dividend strip data:
https://github.com/arpitrage/Dividend_Strip
Factor Exposure in PE Funds by P/D Ratio — Buyout, Elastic Net
Factor Exposure in PE Funds by P/D Ratio – Buyout

Factor Exposure by P/D Quartile

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>PD Quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.010</td>
<td>1</td>
</tr>
<tr>
<td>0.005</td>
<td>2</td>
</tr>
<tr>
<td>0.000</td>
<td>3</td>
</tr>
<tr>
<td>0.005</td>
<td>4</td>
</tr>
</tbody>
</table>

PD Quartile 1 to 4 represent increasing quartiles of P/D ratios.
Factor Exposure in PE Funds by P/D Ratio – VC
Factor Exposure in PE Funds by P/D Ratio – Real Estate

Factor Exposure by P/D Quartile

![Graph showing factor exposure by P/D quartile.](image-url)
Factor Exposure in PE Funds by P/D Ratio – Infrastructure

Factor Exposure by P/D Quartile

-0.01
0.00
0.01
0.02

1 2 3 4
PD Quartile

a Coefficient

Factor Exposure by P/D Quartile
Factor Exposure in PE Funds by P/D Ratio – VC, Elastic Net

Factor Exposure by P/D Quartile

- Growth Gain

PD Quartile
- Coefficient
- Growth Gain
- Factor Exposure by P/D Quartile
Factor Exposure in PE Funds by P/D Ratio – Real Estate, Elastic Net

Factor Exposure by P/D Quartile

- REIT
- REIT Gain
- Stock
- Stock Gain

PD Quartile 1 2 3 4

Coefficient

Factor Exposure by P/D Quartile

41
Factor Exposure in PE Funds by P/D Ratio — Infrastructure, Elastic Net
Factor Exposure in PE Funds by Horizon – VC, OLS

Factor Exposure by Horizon

Years from Fund Inception

b Coefficient

Bond
Stock Gain

43
Factor Exposure in PE Funds by Horizon — Buyout, Elastic Net

<table>
<thead>
<tr>
<th>Factor Exposure by P/D Quartile</th>
<th>Bond</th>
<th>Growth Gain</th>
<th>Natural Resources (NR)</th>
<th>Stock</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD Quartile</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>coefficent</td>
<td>0.000</td>
<td>0.002</td>
<td>0.004</td>
<td>0.006</td>
<td></td>
</tr>
</tbody>
</table>

### Diagram Description
- The diagram illustrates the factor exposure by P/D Quartile for various factors.
- The x-axis represents PD Quartile, ranging from 1 to 4.
- The y-axis represents the coefficient, ranging from 0.000 to 0.006.
- Different factors are represented by distinct colors:
  - Bond: Red
  - Growth Gain: Green
  - Natural Resources (NR): Cyan
  - Stock: Purple
  - Value: Pink
- Each line indicates the exposure of the respective factor across the quartiles.
Factor Exposure in PE Funds by Horizon – VC, Elastic Net

Factor Exposure by P/D Quartile

- Growth Gain
- Natural Resources (NR)
- Small Gain

PD Quartile
- 1
- 2
- 3
- 4

Coefficient
- 0.0000
- 0.0005
- 0.0010
- 0.0015

Graph showing the factor exposure for different P/D quartiles with coefficients for Growth Gain, Natural Resources (NR), and Small Gain.
Factor Exposure in PE Funds by Horizon — Real Estate, Elastic Net

Factor Exposure by P/D Quartile

- NR Gain
- REIT Gain
- Small Gain
- REIT
- Small
- Stock

PD Quartile vs. Coefficient

1 2 3 4
PE Fund Risk-Adjusted Profits — VC, Elastic Net

Histogram of Fund-Level Profit Relative to Replicating Portfolio

TVPI is: 0.394  Risk-Adj Profit is: -0.088  Risk Adj Fraction above 10% is: 0.263

Model
- Elastic Net Full Factor
- OLS Two Factors

Profit Relative to $1 Committed to Replicating Portfolio
Histogram of Fund-Level Profit Relative to Replicating Portfolio

TVPI is: 0.175   Risk-Adj Profit is: -0.154   Risk Adj Fraction above 10% is: 0.259

Model
- Elastic Net Full Factor
- OLS Two Factors

Profit Relative to $1 Committed to Replicating Portfolio
Histogram of Fund-Level Profit Relative to Replicating Portfolio

TVPI is: 0.17  Risk-Adj Profit is: -0.062  Risk Adj Fraction above 10% is: 0.378

Model
- Elastic Net Full Factor
- OLS Two Factors

Profit Relative to $1 Committed to Replicating Portfolio
PE Fund Risk-Adjusted Profits — VC, Elastic Net

Average Fund-level profit by Vintage

RAP Profit

Vintage

1980 1990 2000 2010

Buyout Venture Capital Real Estate Infrastructure


Back
Average Fund–level profit by Vintage

RAP Profit vs. Vintage

-0.3
-0.2
-0.1
0.0
0.1
1995 2000 2005 2010

RAP Profit

Average Fund–level profit by Vintage

Vintage

1995 2000 2005 2010

Back
Average Fund-level profit by Vintage

RAP Profit

Vintage

1995 2000 2005 2010
Average Fund-level Profit by Vintage, Lasso
Average Fund-level Profit by Vintage, Lasso
Average Fund-level Profit by Vintage, Lasso

Risk-Adjusted Profit (R&F)

Vintage

1995  2000  2005  2010
Average Fund-level Profit by Vintage, Lasso
Average Fund-level profit by Vintage

RAP Profit

Vintage
Average Fund-level profit by Vintage

RAP Profit

RAP Profit

1980 1990 2000 2010

Vintage

Average Fund-level profit by Vintage
Average Fund–level profit by Vintage

-0.5
0.0
0.5
1.0
1995 2000 2005 2010

RAP Profit

Vintage

62
Cash-Flow Variation Across Horizon and Vintage — Venture Capital

Capital Distribution Relative to $1 Invested

Vintage
- 1990
- 1991
- 1992
- 1993
- 1994
- 1995
- 1996
- 1997
- 1998
- 1999
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015
Expected Return by Vintage

Average: 0.058
Expected Return by Vintage

Average: 0.067
Expected Return by Vintage

Average: 0.047
Expected Return by Vintage
Average: 0.095
PE Expected Return — VC, Elastic Net

Expected Return by Vintage
Average: 0.084
Expected Return by Vintage

Average: 0.087
PE Expected Return — Infrastructure, Elastic Net

Expected Return by Vintage
Average: 0.059
RAP from Elastic Net Model against PME−1. Correlation: 0.78
RAP from Elastic Net Model against PME−1. Correlation: 0.87
RAP from Elastic Net Model against PME−1. Correlation: 0.72
RAP from Elastic Net Model against PME−1. Correlation: 0.71
PE Comparison with PME – VC, Elastic Net

RAP from Elastic Net Model against PME−1. Correlation: 0.87
PE Comparison with PME – Real, Elastic Net Estate

RAP from Elastic Net Model against PME−1. Correlation: 0.72
PE Comparison with PME — Infrastructure, Elastic Net

RAP from Elastic Net Model against PME−1. Correlation: 0.71
Cash-flow weighted average maturity

4 6 8 10 12

PE Duration
Implied Stock and Bond Betas

Stock beta of PE funds

Bond beta of PE funds
Factor Exposure in PE Funds by Horizon – Infrastructure, Elastic Net
RAP from Elastic Net Model against IRR. Correlation: 0.84
RAP from Elastic Net Model against IRR. Correlation: 0.83
RAP from Elastic Net Model against IRR. Correlation: 0.84
RAP from Elastic Net Model against IRR. Correlation: 0.87
Factor Exposure by HML Quartile

Individual Stock $R^2$: 0.258. Portfolio $R^2$: 0.88
Factor Exposure by SMB Quartile

Individual Stock R^2: 0.259. Portfolio R^2: 0.865
Factor Exposure by Mkt Quartile

Individual Stock $R^2$: 0.257. Portfolio $R^2$: 0.838