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## Abstract


- For CCAPM to better hold, investors must revise their consumption decisions together
  - Fourth quarters
  - Contraction periods
- Consumption betas estimated using 4Q YOY consumption growth well explain the cross-section


- According to the past literature, low consumption beta stocks are considered as insurance, so high consumption beta stocks have high expected returns
  - Weak empirical support
  - One stream of papers has developed more general consumer preferences
  - Another stream says costly consumption adjustments
  - Lettau and Ludvigson (2005): CCAPM must hold under an economy with more general consumption-based asset pricing models
- Some papers argue that CCAPM better performs as the return frequency decreases
  - Consumption decisions may be made infrequently because costly
  - Rather consumers may revise their decisions at some specific periods or during contractions
    - Uncertainty about yearend bonuses/tax consequences of capital gains (losses)

## I. Other Related Literature

- CCAPM relates consumption growth to explain the cross-section, but is disadvantageous as macroeconomic factors are observed infrequently or with measurement errors
- CAPM adopts some portfolio returns such as the market returns as proxies, but the true market portfolio may be unobservable
- The authors use Fama–French model as a benchmark in evaluating the performance of CCAPM

## II. The Model

Nonlinear CCAPM uses

$$\begin{aligned}
m_{t,t+j} &= \delta^j g_{c,t+j}^{-\gamma} \\
E\left[R_{i,t+j}\right] &= \lambda_{c\gamma j}\beta_{ic\gamma,j} \\
\beta_{ic\gamma,j} &= \frac{\mathrm{Cov}\left[R_{i,t+j}, g_{c,t+j}^{-\gamma}\right]}{\mathrm{Var}\left[g_{c,t+j}^{-\gamma}\right]},
\end{aligned}$$

with both betas and the lambda to be negative. The linearized version of Breeden et al. (1989) uses

$$\begin{aligned}
E\left[R_{i,t+j}\right] &= \lambda_{cj}\beta_{icj} \\
\beta_{icj} &= \frac{\mathrm{Cov}\left[R_{i,t+j}, g_{c,t+j}\right]}{\mathrm{Var}\left[g_{c,t+j}\right]}.
\end{aligned}$$

with both betas and the lambda to be positive.

# III. Data and Empirical Analysis

| Panel A: Annual Consumption Growth (%) | | | | | | |
|---|---|---|---|---|---|---|
| | Q1-Q1 | Q2-Q2 | Q3-Q3 | Q4-Q4 | Annual-Annual | Dec-Dec |
| Mean | 2.38 | 2.38 | 2.41 | 2.44 | 2.40 | 2.49 |
| *SD* | 1.38 | 1.31 | 1.29 | 1.38 | 1.21 | 1.43 |
| Min | −0.36 | −0.27 | −0.49 | −0.78 | −0.07 | −0.79 |
| Max | 5.72 | 5.40 | 4.83 | 5.70 | 4.52 | 5.17 |
| **Panel B: Quarterly Consumption Growth (%)** | | | | | | |
| | Q4-Q1 | Q1-Q2 | Q2-Q3 | Q3-Q4 | | |
| Mean | 3.36 | 3.60 | 3.64 | 3.80 | | |
| *SD* | 1.96 | 1.80 | 1.72 | 2.08 | | |
| Min | −2.68 | −3.52 | −0.88 | −1.12 | | |
| Max | 7.20 | 7.24 | 6.84 | 10.84 | | |

| Panel C: Quarterly Consumption as Percentage of Annual Consumption (%) | | | | | |
|---|---|---|---|---|---|
| | | Q1 | Q2 | Q3 | Q4 |
| Not seasonally adjusted data | Mean | 23.55 | 24.63 | 25.06 | 26.76 |
| | *SD* | 0.26 | 0.12 | 0.16 | 0.31 |
| Seasonally adjusted data | Mean | 24.77 | 24.93 | 25.07 | 25.23 |
| | *SD* | 0.13 | 0.07 | 0.06 | 0.14 |

Table I. Q4-Q4 exhibits the least Min and the greatest Max

| | Low | | Book-to-market | | High |
|---|---|---|---|---|---|
| **Panel A: Average Annual Excess Returns (%)** | | | | | |
| Small | 6.19 | 12.47 | 12.24 | 15.75 | 17.19 |
| | 5.99 | 9.76 | 12.62 | 13.65 | 15.07 |
| Size | 6.93 | 10.14 | 10.43 | 13.23 | 13.94 |
| | 7.65 | 7.91 | 11.18 | 12.00 | 12.35 |
| Big | 7.08 | 7.19 | 8.52 | 8.75 | 9.50 |
| **Panel B: Consumption Betas** | | | | | |
| Small | 3.46 | 5.51 | 4.26 | 4.75 | 5.94 |
| | 2.89 | 3.03 | 4.79 | 4.33 | 5.21 |
| Size | 2.88 | 4.10 | 4.35 | 4.79 | 5.71 |
| | 2.57 | 3.35 | 3.90 | 4.77 | 5.63 |
| Big | 3.39 | 2.34 | 2.83 | 4.07 | 4.41 |
| **Panel C: *t*-values** | | | | | |
| Small | 0.93 | 1.71 | 1.59 | 1.83 | 2.08 |
| | 0.98 | 1.27 | 2.02 | 1.83 | 2.10 |
| Size | 1.15 | 1.93 | 2.17 | 2.07 | 2.39 |
| | 1.14 | 1.75 | 1.90 | 2.26 | 2.39 |
| Big | 1.71 | 1.32 | 1.67 | 2.15 | 2.00 |

Table II. Smaller firms and more growth firms have higher expected returns and Q4-Q4 betas

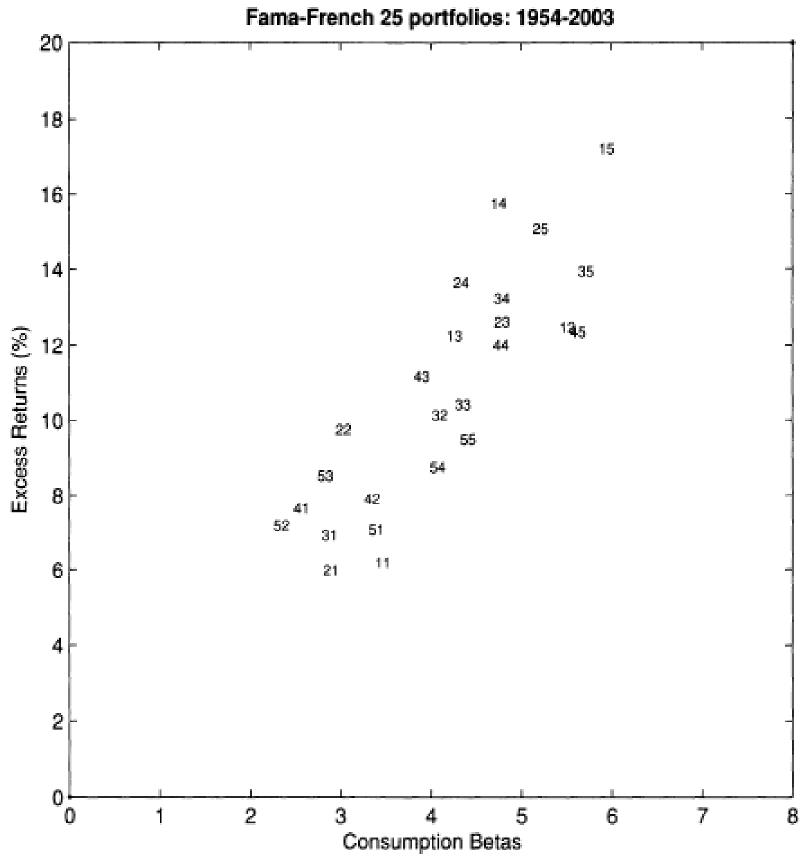

Figure 1. The expected returns and Q4-Q4 betas display a reasonably linear relation

| | Constant | $\Delta c$ | $R_m$ | SMB | HML | log(ME) | log(B/M) | $R^2$(adj $R^2$) |
|---|---|---|---|---|---|---|---|---|
| Estimate | 0.14 | 2.56 | | | | | | 0.73 |
| $t$-value | 0.05 | 3.89 | | | | | | 0.71 |
| Shanken-$t$ | 0.02 | 1.98 | | | | | | |
| Estimate | 11.31 | | −0.56 | | | | | 0.00 |
| $t$-value | 2.05 | | −0.09 | | | | | −0.04 |
| Shanken-$t$ | 2.05 | | −0.08 | | | | | |
| Estimate | 10.43 | | −3.26 | 3.12 | 5.83 | | | 0.80 |
| $t$-value | 2.66 | | −0.70 | 1.62 | 3.11 | | | 0.77 |
| Shanken-$t$ | 2.37 | | −0.57 | 1.03 | 2.12 | | | |
| Estimate | 11.75 | 1.58 | −3.76 | 3.00 | 5.75 | | | 0.87 |
| $t$-value | 2.98 | 3.64 | −0.81 | 1.56 | 3.07 | | | 0.84 |
| Shanken-$t$ | 1.95 | 2.26 | −0.50 | 0.83 | 1.71 | | | |
| Estimate | 16.20 | | | | | −0.87 | 3.46 | 0.84 |
| $t$-value | 2.95 | | | | | −1.43 | 3.00 | 0.83 |
| Estimate | 12.19 | 0.71 | | | | −0.71 | 2.66 | 0.86 |
| $t$-value | 2.41 | 1.62 | | | | −1.23 | 2.12 | 0.84 |
| Estimate | 22.22 | | −3.80 | −0.67 | 0.96 | −1.07 | 3.04 | 0.87 |
| $t$-value | 3.50 | | −0.88 | −0.23 | 0.37 | −1.51 | 2.87 | 0.84 |

Table III. Q4-Q4 betas survive solely and after Fama–French betas, but weaken after characteristics

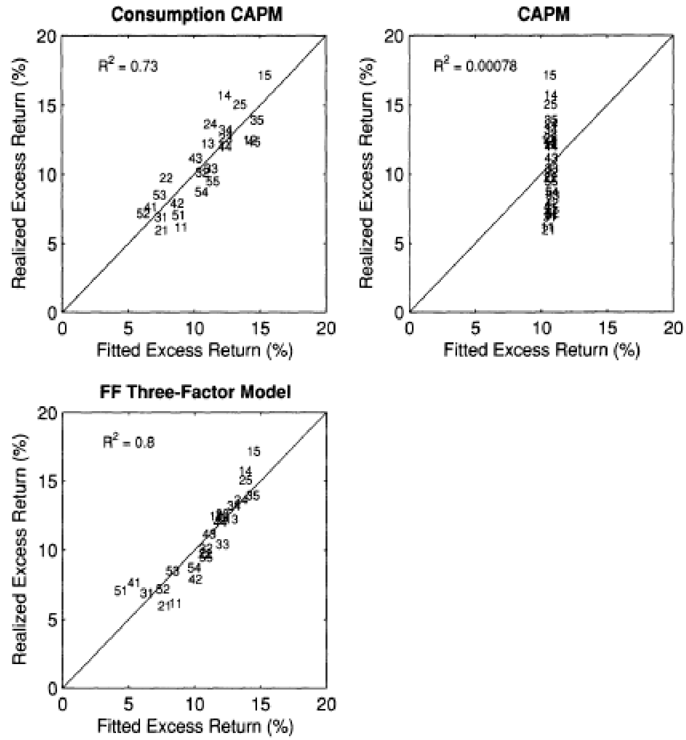


Figure 2. In terms of linearity, CCAPM and Fama–French model are matching

| Panel A: Pricing Errors | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | CCAPM $\alpha$ | | | | | $t$-value | | |
| −1.59 | 1.00 | 2.67 | 5.10 | 5.27 | −0.27 | 0.21 | 0.69 | 1.42 | 1.33 |
| −1.21 | 1.46 | 2.12 | 2.71 | 3.30 | −0.26 | 0.42 | 0.67 | 0.90 | 1.05 |
| 0.05 | 1.25 | 1.03 | 2.20 | 2.04 | 0.01 | 0.43 | 0.40 | 0.75 | 0.69 |
| 2.01 | 0.57 | 1.79 | 1.58 | 0.16 | 0.57 | 0.21 | 0.67 | 0.60 | 0.06 |
| −0.83 | 0.99 | 3.34 | −0.98 | −2.37 | −0.30 | 0.39 | 1.29 | −0.44 | −0.98 |
| | | $\text{CAPM}_\alpha$ | | | | | $t$-value | | |
| −5.14 | 1.84 | 3.84 | 7.65 | 8.08 | −1.38 | 0.61 | 1.45 | 2.90 | 2.82 |
| −3.99 | 1.51 | 4.58 | 5.87 | 6.79 | −1.62 | 0.79 | 2.12 | 2.64 | 2.90 |
| −2.23 | 2.45 | 3.36 | 5.33 | 6.31 | −1.34 | 1.52 | 1.97 | 2.56 | 2.55 |
| −0.55 | 0.90 | 3.68 | 4.65 | 3.98 | −0.36 | 0.66 | 2.41 | 2.48 | 1.96 |
| −0.46 | 0.40 | 2.22 | 1.85 | 1.88 | −0.38 | 0.44 | 1.99 | 1.26 | 0.98 |
| | | FF3 $\alpha$ | | | | | $t$-value | | |
| −3.98 | −0.83 | 0.36 | 2.81 | 2.23 | −2.18 | −0.72 | 0.38 | 2.76 | 2.49 |
| −2.80 | −0.71 | 1.09 | 0.42 | 0.70 | −2.41 | −0.71 | 0.96 | 0.42 | 0.74 |
| −0.31 | −0.13 | −0.79 | −0.06 | −0.22 | −0.39 | −0.13 | −0.82 | −0.05 | −0.19 |
| 2.19 | −1.54 | −0.17 | 0.03 | −1.13 | 2.09 | −1.28 | −0.16 | 0.02 | −0.82 |
| 1.93 | −0.22 | 1.06 | −1.70 | −2.97 | 2.01 | −0.24 | 0.96 | −1.93 | −2.50 |

| Panel B: Gibbons, Ross, and Shanken Test | | | |
|---|---|---|---|
| | CCAPM | CAPM | FF3 |
| GRS | 1.30 | 2.07 | 1.65 |
| $p$-value | 0.26 | 0.04 | 0.12 |

Table IV. In terms of absorbing alphas, CCAPM and Fama–French model are matching

*A.* *Implied Coefficient of Relative Risk Aversion*

| | $\Delta c$ | $R_m$ | SMB | HML | HJ distance | $p$-value |
|---|---|---|---|---|---|---|
| Estimate | 33.01 | | | | 0.29 | 0.69 |
| $t$-value | 25.45 | | | | | |
| Estimate | | 2.10 | | | 0.74 | 0.08 |
| $t$-value | | 6.44 | | | | |
| Estimate | | 1.90 | 0.56 | 2.61 | 0.63 | 0.10 |
| $t$-value | | 4.12 | 0.85 | 5.02 | | |

Table V. In terms of Hansen–Jagannathan distance, CCAPM outperforms the Fama–French model

Panel A: Annual Excess Returns and Consumption Betas

| Q1-Q1 Excess Returns (%) | | | | | Q1-Q1 Consumption Betas | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 3.88 | 9.80 | 10.75 | 13.93 | 14.69 | 5.10 | 6.02 | 4.30 | 4.83 | 5.80 |
| 4.34 | 8.62 | 11.29 | 12.21 | 13.14 | 2.64 | 3.02 | 3.99 | 3.23 | 4.60 |
| 5.90 | 9.04 | 9.55 | 11.64 | 12.22 | 2.03 | 2.52 | 3.17 | 3.74 | 4.25 |
| 7.12 | 6.93 | 10.24 | 10.51 | 10.78 | 2.39 | 1.68 | 2.44 | 3.77 | 5.23 |
| 6.63 | 6.59 | 7.83 | 8.01 | 8.29 | 3.11 | 1.84 | 2.15 | 3.60 | 4.55 |
| **Q2-Q2 Excess Returns (%)** | | | | | **Q2-Q2 Consumption Betas** | | | | |
| 4.61 | 10.95 | 11.54 | 14.83 | 15.67 | 5.31 | 4.81 | 4.28 | 4.38 | 5.14 |
| 5.58 | 9.55 | 12.08 | 12.78 | 13.90 | 2.03 | 2.46 | 3.23 | 2.64 | 3.60 |
| 6.85 | 10.06 | 10.32 | 12.23 | 12.82 | 1.93 | 1.70 | 2.83 | 2.51 | 2.95 |
| 7.66 | 7.91 | 10.94 | 11.16 | 11.38 | 1.90 | 0.60 | 1.24 | 2.81 | 3.10 |
| 7.18 | 7.00 | 8.44 | 8.60 | 8.79 | 3.03 | 0.15 | 0.89 | 1.88 | 2.73 |
| **Q3-Q3 Excess Returns (%)** | | | | | **Q3-Q3 Consumption Betas** | | | | |
| 5.52 | 11.81 | 12.05 | 15.51 | 16.56 | 3.30 | 2.76 | 2.62 | 2.98 | 3.63 |
| 6.01 | 9.64 | 12.62 | 13.25 | 14.44 | −0.02 | 0.54 | 1.84 | 1.11 | 2.52 |
| 7.35 | 10.64 | 10.45 | 13.03 | 13.33 | 0.01 | 0.34 | 1.41 | 0.66 | 2.80 |
| 8.51 | 8.26 | 11.37 | 11.99 | 11.81 | 0.19 | 0.11 | 0.10 | 1.95 | 2.09 |
| 7.64 | 7.47 | 8.67 | 8.75 | 9.10 | 1.41 | −0.13 | 1.04 | 1.34 | 1.55 |

Panel B: Cross-Sectional Regression

| | Constant | Q1-Q1 | Q2-Q2 | Q3-Q3 | $R^2$(adj $R^2$) |
|---|---|---|---|---|---|
| Estimate | 4.98 | 1.17 | | | 0.27 |
| $t$-value | 2.03 | 2.38 | | | 0.24 |
| Estimate | 7.52 | | 0.87 | | 0.18 |
| $t$-value | 3.08 | | 1.67 | | 0.14 |
| Estimate | 8.61 | | | 1.36 | 0.30 |
| $t$-value | 3.10 | | | 2.69 | 0.27 |

Panel C: Bootstrap Simulation $p$-values

| | Q1-Q1 | Q2-Q2 | Q3-Q3 | Q4-Q4 |
|---|---|---|---|---|
| CSR intercept | 4.98 | 7.52 | 8.61 | 0.14 |
| $p$-value | 0.046 | 0.136 | 0.177 | 0.0003 |
| CSR slope | 1.17 | 0.87 | 1.36 | 2.56 |
| $p$-value | 0.196 | 0.254 | 0.137 | 0.023 |
| CSR adj $R^2$ | 0.24 | 0.14 | 0.27 | 0.71 |
| $p$-value | 0.279 | 0.394 | 0.209 | 0.010 |
| HJ-distance | 0.31 | 0.33 | 0.31 | 0.29 |
| $p$-value | 0.815 | 0.620 | 0.682 | 0.886 |
| CMP Sharpe ratio | 0.45 | −0.44 | −0.64 | 0.70 |
| $p$-value | 0.135 | 0.977 | 0.998 | 0.012 |
| GRS | 2.76 | 1.96 | 1.92 | 1.30 |
| $p$-value | 0.892 | 0.859 | 0.966 | 0.981 |

Table VI. Findings from the rest quarters are noisier with low $R^2$ and significant γ

## B. *Alternative Empirical Specifications*

| Panel A: Consumption Growth | | | |
|---|---|---|---|
| | Monthly Consumption Data | Quarterly Consumption Data | Annual Consumption Data |
| Monthly growth | Month-Month | | |
| Quarterly growth | Dec–Mar, Mar–Jun Jun–Sep, Sep–Dec | Quarter-Quarter | |
| Annual growth | Dec-Dec | Q4-Q4 | Annual-Annual |

| Panel B: Cross-Sectional Regression Results | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Monthly Consumption Data | | | Quarterly Consumption Data | | | Annual Consumption Data | | |
| | $\lambda_0$ | $\lambda_1$ | $R^2$ | $\lambda_0$ | $\lambda_1$ | $R^2$ | $\lambda_0$ | $\lambda_1$ | $R^2$ |
| Monthly return | 7.70 | 0.02 | 0.00 | | | | | | |
| $t$-value | 2.61 | 0.17 | −0.04 | | | | | | |
| Quarterly return | 8.34 | 0.03 | 0.00 | 4.52 | 0.33 | 0.22 | | | |
| $t$-value | 2.80 | 0.15 | −0.04 | 1.83 | 1.59 | 0.18 | | | |
| Annual return | −1.83 | 2.01 | 0.41 | −1.19 | 2.68 | 0.69 | 10.12 | 1.32 | 0.21 |
| $t$-value | −0.51 | 2.33 | 0.38 | −0.37 | 3.49 | 0.68 | 3.70 | 1.61 | 0.18 |

Table VII. Results deteriorate as the return frequency increases

| | Constant | $\Delta c$ | $R_m$ | SMB | HML | $R^2$(adj $R^2$) |
|---|---|---|---|---|---|---|
| Estimate | −1.10 | 2.81 | | | | 0.89 |
| $t$-value | −0.33 | 3.86 | | | | 0.86 |
| Shanken-$t$ | −0.16 | 1.84 | | | | |
| Estimate | 9.07 | | −1.46 | 2.64 | 5.76 | 0.87 |
| $t$-value | 1.94 | | −0.27 | 1.39 | 3.11 | 0.68 |
| Shanken-$t$ | 1.75 | | −0.23 | 0.88 | 2.12 | |

Table VIII. The cross-sectional regression with 2×3 Fama–French portfolios—CCAPM outperforms

### C. *Other Portfolios*

| | CCAPM | | | Fama-French Three-Factor Model | | | | |
|---|---|---|---|---|---|---|---|---|
| | Constant | $\Delta c$ | $R^2$ | Constant | $R_m$ | SMB | HML | $R^2$ |
| **18 Size Portfolios** | | | | | | | | |
| Estimate | −0.44 | 2.60 | 0.81 | 9.09 | −1.01 | 3.36 | −0.05 | 0.99 |
| $t$-value | −0.09 | 1.68 | 0.80 | 0.78 | −0.09 | 1.43 | −0.01 | 0.99 |
| Shanken-$t$ | −0.04 | 0.85 | | 0.75 | −0.08 | 1.05 | −0.01 | |
| **18 B/M Portfolios** | | | | | | | | |
| Estimate | 2.62 | 1.79 | 0.80 | −0.58 | 8.53 | 0.27 | 4.62 | 0.95 |
| $t$-value | 0.97 | 2.94 | 0.79 | −0.10 | 1.37 | 0.05 | 1.80 | 0.94 |
| Shanken-$t$ | 0.63 | 1.87 | | −0.09 | 1.08 | 0.04 | 1.29 | |
| **19 E/P Portfolios** | | | | | | | | |
| Estimate | 1.94 | 2.09 | 0.53 | −1.96 | 10.05 | −0.02 | 6.44 | 0.96 |
| $t$-value | 0.93 | 3.85 | 0.50 | −0.36 | 1.67 | 0.00 | 2.75 | 0.95 |
| Shanken-$t$ | 0.55 | 2.22 | | −0.27 | 1.21 | 0.00 | 1.81 | |
| **19 CF/P Portfolios** | | | | | | | | |
| Estimate | 2.81 | 1.72 | 0.59 | −1.33 | 9.41 | 1.64 | 6.09 | 0.90 |
| $t$-value | 1.19 | 3.46 | 0.56 | −0.27 | 1.69 | 0.40 | 2.61 | 0.88 |
| Shanken-$t$ | 0.79 | 2.22 | | −0.21 | 1.25 | 0.29 | 1.75 | |

Table IX. CCAPM and Fama–French model are comparable in explaining some other portfolios

### D. *Contraction Beta and Expansion Beta*

| Panel A: Time-Series Regression and GRS Test | | | | |
|---|---|---|---|---|
| | CCAPM (CMP) | | Fama–French Model | |
| | $\alpha$ | $t$-value | $\alpha$ | $t$-value |
| 1 | 2.45 | 0.99 | 3.26 | 1.54 |
| 2 | 3.08 | 0.78 | −0.96 | −0.30 |
| 3 | 5.28 | 1.61 | 1.58 | 0.69 |
| 4 | −3.42 | −0.91 | −4.08 | −1.70 |
| 5 | 1.05 | 0.31 | 0.06 | 0.02 |
| 6 | −0.79 | −0.29 | −0.98 | −0.59 |
| 7 | 4.38 | 1.47 | 6.24 | 2.73 |
| 8 | −0.38 | −0.12 | −1.18 | −0.91 |
| 9 | −2.83 | −0.74 | −4.59 | −1.71 |
| 10 | 0.39 | 0.14 | −0.98 | −0.64 |
| 11 | 1.40 | 0.37 | 1.68 | 0.96 |
| 12 | −4.51 | −1.39 | −4.79 | −2.06 |
| 13 | −1.13 | −0.36 | −2.70 | −1.51 |
| 14 | 0.54 | 0.21 | −1.59 | −0.91 |
| 15 | −1.83 | −0.61 | 0.59 | 0.25 |
| 16 | 0.19 | 0.07 | −1.25 | −0.74 |
| 17 | 0.98 | 0.33 | 1.46 | 1.15 |
| GRS | 1.51 | | 2.93 | |
| $p$-value | 0.15 | | 0.00 | |

| Panel B: Cross-Sectional Regression | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Constant | CMP | $R_m$ | SMB | HML | log(ME) | log(B/M) | $R^2$ |
| Estimate | 6.90 | 3.61 | | | | | | 0.09 |
| $t$-value | 2.83 | 0.54 | | | | | | 0.06 |
| Shanken-$t$ | 2.81 | 0.44 | | | | | | |
| Estimate | 6.01 | | 2.60 | −1.24 | −0.68 | | | 0.12 |
| $t$-value | 1.53 | | 0.53 | −0.48 | −0.30 | | | −0.08 |
| Shanken-$t$ | 1.51 | | 0.47 | −0.37 | −0.23 | | | |
| Estimate | 5.75 | | | | | 0.00 | 0.66 | −0.33 |
| $t$-value | 1.83 | | | | | 1.06 | 0.26 | −0.52 |

Table X. 17 industry portfolios—the consumption mimicking portfolio as the factor

$$R_{i,t+4} = \alpha_{i,cont} I_t + \alpha_{i,exp}(1 - I_t) + \beta_{i,cont}\Delta c_{t+4} I_t + \beta_{i,exp}\Delta c_{t+4}(1 - I_t) + \varepsilon_{i,t+4}. \tag{13}$$

| | Intercept | Contraction | Expansion | $R^2$(adj $R^2$) |
|---|---|---|---|---|
| Estimate | 0.86 | 0.98 | 0.23 | 0.65 |
| $t$-value | 0.50 | 6.11 | 0.67 | 0.62 |
| Estimate | 0.84 | 1.06 | | 0.65 |
| $t$-value | 0.50 | 7.51 | | 0.62 |
| Estimate | 6.10 | | 1.40 | 0.33 |
| $t$-value | 4.71 | | 4.78 | 0.26 |

Table XI. Betas estimated during contraction explain the cross-section more precisely

## E. *Further Comparison of CCAPM and the Fama and French Three-Factor Model*

| | $\Delta$c | $R_m$ | SMB | HML | log(ME) | log(B/M) | $R^2$(adj $R^2$) |
|---|---|---|---|---|---|---|---|
| Estimate | 2.59 | | | | | | 0.73 |
| $t$-value | 3.72 | | | | | | 0.73 |
| Shanken-$t$ | 1.88 | | | | | | |
| Estimate | | 9.71 | | | | | −0.26 |
| $t$-value | | 3.49 | | | | | −0.26 |
| Shanken-$t$ | | 2.42 | | | | | |
| Estimate | | 7.09 | 3.03 | 6.24 | | | 0.73 |
| $t$-value | | 2.79 | 1.58 | 3.31 | | | 0.71 |
| Shanken-$t$ | | 1.79 | 0.95 | 2.13 | | | |
| Estimate | 1.67 | 7.78 | 2.92 | 6.21 | | | 0.79 |
| $t$-value | 3.84 | 3.06 | 1.52 | 3.30 | | | 0.76 |
| Shanken-$t$ | 2.39 | 1.70 | 0.81 | 1.84 | | | |
| Estimate | | | | | 1.88 | 3.20 | 0.81 |
| $t$-value | | | | | 9.67 | 2.03 | 0.76 |
| Estimate | 2.75 | | | | 0.01 | 0.29 | 0.74 |
| $t$-value | 3.09 | | | | 0.03 | 0.18 | 0.72 |
| Estimate | | −1.13 | 7.27 | 3.04 | 1.29 | 2.39 | 0.77 |
| $t$-value | | −0.29 | 3.26 | 1.17 | 3.28 | 2.06 | 0.72 |

Table XII. Cross-sectional regressions without γ

| CCAPM: $\hat{\alpha}$ | | | | | CCAPM: $\tilde{\alpha}$ | | | | |
|---|---|---|---|---|---|---|---|---|---|
| −2.82 | −1.77 | 1.20 | 3.45 | 1.85 | −2.78 | −1.80 | 1.21 | 3.44 | 1.80 |
| −1.55 | 1.87 | 0.23 | 2.41 | 1.59 | −1.50 | 1.91 | 0.22 | 2.42 | 1.57 |
| −0.58 | −0.48 | −0.85 | 0.85 | −0.81 | −0.53 | −0.47 | −0.85 | 0.83 | −0.86 |
| 0.95 | −0.79 | 1.07 | −0.35 | −2.18 | 1.01 | −0.76 | 1.08 | −0.37 | −2.23 |
| −1.74 | 1.06 | 1.14 | −1.81 | −1.93 | −1.71 | 1.12 | 1.20 | −1.80 | −1.93 |
| Three-Factor model: $\hat{\alpha}$ | | | | | Three-Factor model: $\tilde{\alpha}$ | | | | |
| −2.36 | 0.87 | −0.55 | 1.92 | 2.73 | −3.30 | −0.45 | 0.55 | 2.90 | 2.29 |
| −1.74 | −1.03 | 0.52 | 0.13 | 1.20 | −2.18 | −0.42 | 1.27 | 0.46 | 0.72 |
| 0.52 | −0.71 | −1.68 | 0.25 | −0.49 | 0.33 | 0.11 | −0.70 | −0.01 | −0.27 |
| 2.23 | −2.14 | 0.08 | 0.06 | 0.32 | 2.85 | −1.32 | −0.03 | 0.11 | −1.03 |
| 2.65 | −0.40 | 0.20 | −1.22 | −1.37 | 2.54 | 0.13 | 1.34 | −1.56 | −2.88 |
| Four-Factor model: $\hat{\alpha}$ | | | | | Four-Factor model: $\tilde{\alpha}$ | | | | |
| −1.64 | −0.01 | −0.54 | 1.73 | 1.94 | −2.77 | −1.36 | 0.68 | 2.84 | 1.57 |
| −0.82 | 0.48 | −0.46 | 1.07 | 1.45 | −1.43 | 0.95 | 0.50 | 1.31 | 0.88 |
| 0.58 | −1.20 | −2.06 | 0.60 | −1.38 | 0.36 | −0.22 | −0.92 | 0.26 | −1.02 |
| 1.66 | −1.72 | 0.86 | −0.37 | −0.42 | 2.42 | −0.86 | 0.64 | −0.26 | −1.82 |
| 0.73 | 0.71 | 0.36 | −1.13 | −0.44 | 0.86 | 1.15 | 1.60 | −1.52 | −2.24 |

Table XIII. Pricing errors from cross-sectional regressions—$\hat{\alpha}$ with γ and $\tilde{\alpha}$ without γ

| | Intercept | $R_m$ | SMB | HML | $R^2$(adj $R^2$) |
|---|---|---|---|---|---|
| | | Fitted Beta | | | |
| Estimate | 5.01 | 5.52 | 5.04 | 9.35 | 0.57 |
| $t$-value | 1.73 | 2.24 | 0.95 | 2.91 | 0.51 |
| | | Residual Beta | | | |
| Estimate | 10.71 | −9.93 | 1.57 | 2.33 | 0.14 |
| $t$-value | 3.59 | −1.96 | 0.80 | 1.14 | 0.02 |

Table XIV. Regress Fama–French betas on consumption betas

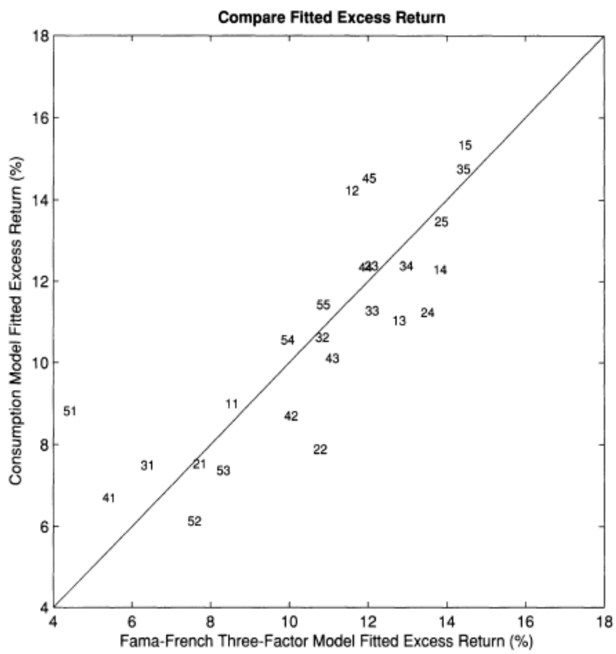


Figure 3. CCAPM E[R]×Fama–French E[R]

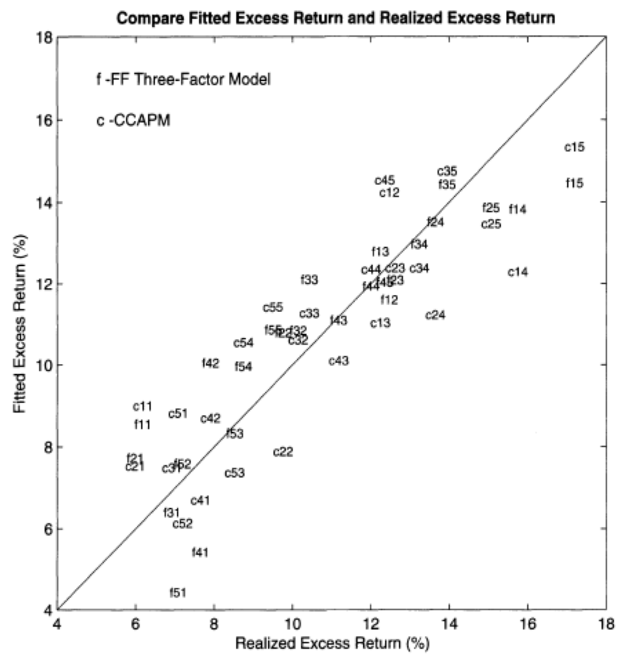


Figure 4. R×E[R] from both models

## IV. Conclusion

- Betas estimated (i) with 4Q-4Q consumption growth and (ii) during contraction periods are better in explaining the cross-section—consumption decisions might be made mainly at that time
- There are two interesting findings—(i) the estimated consumption risk premium is high, and (ii) the significance of the fourth quarter betas disappears when the book-to-market ratio is added

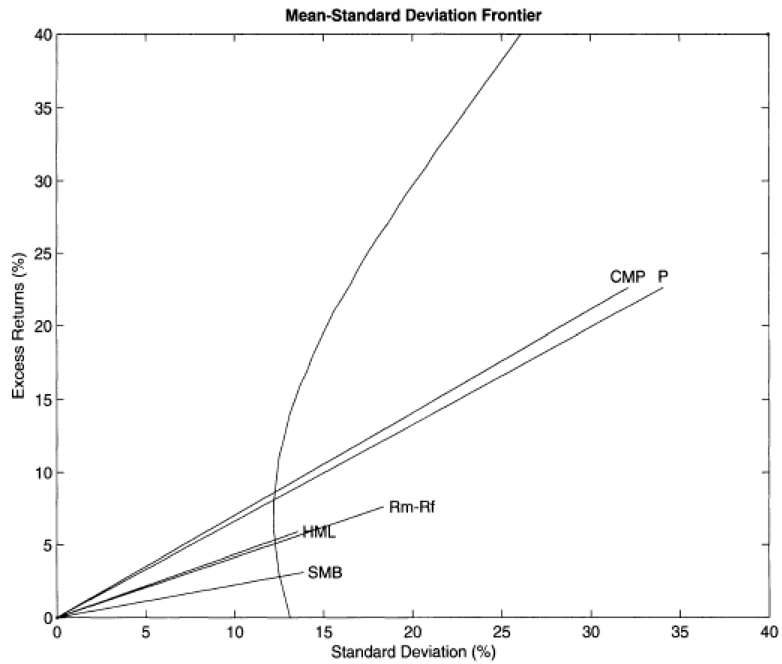


Figure 5. CMP as the most efficient portfolio versus Fama–French factors

Panel A: Time-Series Regression $R^2$'s

| CCAPM | | | | | Three-Factor Model | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.10 | 0.27 | 0.27 | 0.35 | 0.36 | 0.91 | 0.96 | 0.96 | 0.95 | 0.97 |
| 0.13 | 0.26 | 0.40 | 0.45 | 0.46 | 0.94 | 0.94 | 0.92 | 0.94 | 0.95 |
| 0.16 | 0.37 | 0.45 | 0.47 | 0.50 | 0.96 | 0.93 | 0.92 | 0.93 | 0.92 |
| 0.14 | 0.31 | 0.43 | 0.49 | 0.53 | 0.92 | 0.86 | 0.91 | 0.87 | 0.89 |
| 0.33 | 0.27 | 0.20 | 0.54 | 0.60 | 0.92 | 0.91 | 0.85 | 0.93 | 0.90 |
| **HML** | | | | | **CAPM** | | | | |
| 0.08 | 0.00 | 0.00 | 0.02 | 0.03 | 0.56 | 0.63 | 0.58 | 0.56 | 0.58 |
| 0.09 | 0.00 | 0.01 | 0.07 | 0.08 | 0.69 | 0.72 | 0.66 | 0.63 | 0.63 |
| 0.12 | 0.00 | 0.05 | 0.08 | 0.12 | 0.81 | 0.76 | 0.70 | 0.66 | 0.57 |
| 0.17 | 0.01 | 0.04 | 0.07 | 0.07 | 0.80 | 0.79 | 0.77 | 0.68 | 0.70 |
| 0.11 | 0.00 | 0.00 | 0.07 | 0.11 | 0.84 | 0.88 | 0.81 | 0.75 | 0.68 |

Panel B: Cross-Sectional Regression

| | Intercept | CMP | $R_m$ | SMB | HML | $R^2$(adj $R^2$) |
|---|---|---|---|---|---|---|
| Estimate | −0.40 | 26.86 | | | | 0.65 |
| $t$-value | −0.12 | 3.66 | | | | 0.64 |
| Shanken-$t$ | −0.09 | 2.53 | | | | |
| Estimate | 10.43 | | −3.26 | 3.12 | 5.83 | 0.80 |
| $t$-value | 2.66 | | −0.70 | 1.62 | 3.11 | 0.77 |
| Shanken-$t$ | 2.37 | | −0.57 | 1.03 | 2.12 | |
| Estimate | 10.24 | | | | 5.23 | 0.53 |
| $t$-value | 3.41 | | | | 2.70 | 0.51 |
| Shanken-$t$ | 3.14 | | | | 1.90 | |
| Estimate | 11.31 | | −0.56 | | | 0.00 |
| $t$-value | 2.05 | | −0.09 | | | −0.04 |
| Shanken-$t$ | 2.05 | | −0.08 | | | |

Table XV. CMP moderately performs in both time-series and cross-sectional regressions

## Appendix A: Linear Consumption Factor Model

The important point is

$$\frac{u'(c_{t+j})}{u'(c_t)} \approx 1 - \left(-\frac{u''(c_t)}{u'(c_t)}c_t\right)\frac{c_{t+j}-c_t}{c_t} = 1 - \gamma\left(g_{c,t+j}-1\right),$$

by a Taylor approximation. Therefore,

$$E\left[R_{i,t+j}\right] = \frac{\gamma \mathrm{Var}\left[g_{c,t+j}\right]}{1-\gamma E\left[g_{c,t+j}-1\right]}\frac{\mathrm{Cov}\left[g_{c,t+j}, R_{i,t+j}\right]}{\mathrm{Var}\left[g_{c,t+j}\right]} = \lambda_{cj}\beta_{icj}.$$

## Appendix B: A Model with Infrequent Adjustment of Consumption and Investment Plans

One group of utility maximizers will derive

$$E\left[R_{i,t+j}\left(1-\gamma\left(g^1_{c,t+j}-1\right)\right)\right] = 0, \tag{B1}$$

while another group will not maximize, so

$$E\left[R_{i,t+j}\left(1-\gamma\left(g^2_{c,t+j}-1\right)\right)\right] = \epsilon_{it}. \tag{B2}$$

Mix them proportionally, so

$$\begin{aligned}
g^A_{c,t+j} &= w_t g^1_{c,t+j} + (1-w_t)g^2_{c,t+j}.\\
\Rightarrow E\left[R_{i,t+j}\left(1-\gamma\left(g^A_{c,t+j}-1\right)\right)\right] &= \gamma(1-w_t)E\left[\left(g^1_{c,t+j}-g^2_{c,t+j}\right)R_{i,t+j}\right].\\
\Rightarrow E\left[R_{i,t+j}\right] &= \frac{\gamma(1-w_t)E\left[\left(g^1_{c,t+j}-g^2_{c,t+j}\right)R_{i,t+j}\right]}{1-\gamma E\left[g^A_{c,t+j}-1\right]} + \frac{\gamma \mathrm{Cov}\left[\left(g^A_{c,t+j}-1\right), R_{i,t+j}\right]}{1-\gamma E\left[g^A_{c,t+j}-1\right]}\\
&= \frac{\gamma(1-w_t)\epsilon_{it}}{1-\gamma E\left[g^A_{c,t+j}-1\right]} + \frac{\gamma \mathrm{Cov}\left[\left(g^A_{c,t+j}-1\right), R_{i,t+j}\right]}{1-\gamma E\left[g^A_{c,t+j}-1\right]}\\
&= \varepsilon_{it} + \lambda_t\frac{\mathrm{Cov}\left[g^A_{c,t+j}, R_{i,t+j}\right]}{\mathrm{Var}\left[g^A_{c,t+j}\right]},
\end{aligned} \tag{B6}$$

since $(B1) - (B2) = \epsilon_{it}$. Note that $\frac{\partial|\varepsilon_{it}|}{\partial w_t} < 0$.