Discussion of:
Hedging Risk Factors

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Paper Outline

- HMM's exercise is to try reduce the "risk" of various factor portfolios.
  - Risk can mean either (1) total variance, or (2) the exposure of the factor portfolio to innovations in macroeconomic quantities.
- HMM propose the construction of *hedge portfolios* using *ex-ante*/pre-formation estimates of individual asset $\beta_{i,f}$s.
- They then combine the original factor portfolios with the hedge portfolios.
- In almost all cases, the hedged factor portfolio has the same average return.

Discussion Outline

In this discussion, I want to do two things:

1. Talk about why this is an important result.
2. A bunch of AP tests have gotten results that these results seem to contradict. Why?
   - The geometry of asset-pricing tests.
   - The importance of expanding the dimensionality of the asset-return space
     - Lewellen, Nagel, and Shanken (2010), Daniel and Titman (2012).
   - How to optimally expand the dimensionality of the asset-return space.

Why do we care?

- The FOC for portfolio optimization is:

$$\mathbb{E}_{t-1}[\tilde{m}_t \tilde{R}_{i,t}] = 1 \quad \text{or} \quad \mathbb{E}_{t-1}[\tilde{m}_t \tilde{R}^e_{i,t}] = 0$$

- A little rearranging of this relation, for *any* excess return $\tilde{R}^e_i$, gives:

$$\begin{aligned}
\Rightarrow cov(\tilde{m}, \tilde{R}^e_i) &= \underbrace{\mathbb{E}[\tilde{m}\tilde{R}^e_i]}_{=0} - \underbrace{\mathbb{E}[\tilde{m}]}_{=1/R_f} \cdot \mathbb{E}[\tilde{R}^e] \\
\Rightarrow \mathbb{E}[\tilde{R}^e_i] &= -R_f \cdot cov(\tilde{m}, \tilde{R}^e_i) \\
\Rightarrow \frac{\mathbb{E}[\tilde{R}^e_i]}{\sigma(\tilde{R}^e_i)} &\approx -\rho_{i,m}\sigma_m \\
SR_i &\approx -\rho_{i,m}\sigma_m
\end{aligned}$$

where:

- $\rho_{i,m} = \rho(\tilde{R}^e_i, \tilde{m})$
- R_f, the gross riskfree rate, ≈ 1.

Why do we care?

$$SR_i \approx -\rho_{i,m}\sigma_m$$

- This implies that the return of any high SR long-short portfolio must be really negatively correlated with innovations in marginal utility for all investors.
  - If this is violated for *any* investor, then that investor's FOC for portfolio optimization is violated.
- Empirically the annualized portfolio SRs (1963:07–2018:09) are:

	w^*	EW
CRSP-VW	0.43	–
FF5	1.09	0.95
FF5+UMD	1.60	1.19

- The high SRs suggest that these anomaly portfolios must be strongly negatively correlated with m.u. innovations.
  - and thus strongly correlated with innovations in macro variables like consumption, production, etc..

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What the literature (mostly) does

- Over the last few decades, a "standard" asset pricing test has been to introduce a new factor, and see if it can price characteristic-sorted portfolios
  - e.g., the Fama and French (1993) 25 Size-BM sorted portfolios.
- This means, does some linear combination of the factor-betas line up with the average returns to these 25 portfolios?
  - The factor risk-premia are generally left as free parameters to be estimated.

What the literature (mostly) does

from Daniel and Titman (2012):

Paper	Factor(s)	Cond. Vars.
Conditional (C)CAPM Models		
Ferson and Harvey (1999)	VW	S&P 500 Dividend Yield
Lettau and Ludvigson (2001)	VW or Cons Growth	cay
Santos and Veronesi (2005)	VW + Labor Income Growth	Labor Income to Cons Ratio (s)
Petkova and Zhang (2005)	VW Index	$E[R_m]$ based on BC Vars
Alternative-Factor Models		
Fama and French (1993)	VW, HML, SMB	
Jagannathan and Wang (1996)	Labor Income Growth	DEF
Heaton and Lucas (2000)	Proprietary Income Growth	
Piazzesi, Schneider, and Tuzel (2007)	Cons Growth +ΔNH Expenditure Ratio ($\Delta log(\alpha)$)	Non-Housing Expenditure Ratio (α)
Lustig and Van Nieuwerburgh (2005)	Scaled Rental Price Change ($A\Delta log\rho$)	Housing Collateral Ratio
Aït-Sahalia, Parker, and Yogo (2004)	Luxury Good Consumption	
Li, Vassalou, and Xing (2006)	Sector Inv. Growth Rates	
Parker and Julliard (2005)	Innovations in Future Long Horizon Consumption Growth	
Campbell and Vuolteenaho (2004)	CF and DR news	

- See also Dechow, Sloan, and Soliman (2004), Bansal, Dittmar, and Lundblad (2005), Ai and Kiku (2013), Kogan and Papanikolaou (2014), Da (2009), Chen (2017)

25 FF Portfolio R^2s

- Fama and French (1993) (Table 6) run time-series regressions for each of the 25 SZ/BM sorted portfolios:

$$R_{i,t} - RF_t = a + b \cdot (R_{m,t} - RF_t) + h \cdot \text{HML}_t + s \cdot \text{SMB}_t + \epsilon_t$$

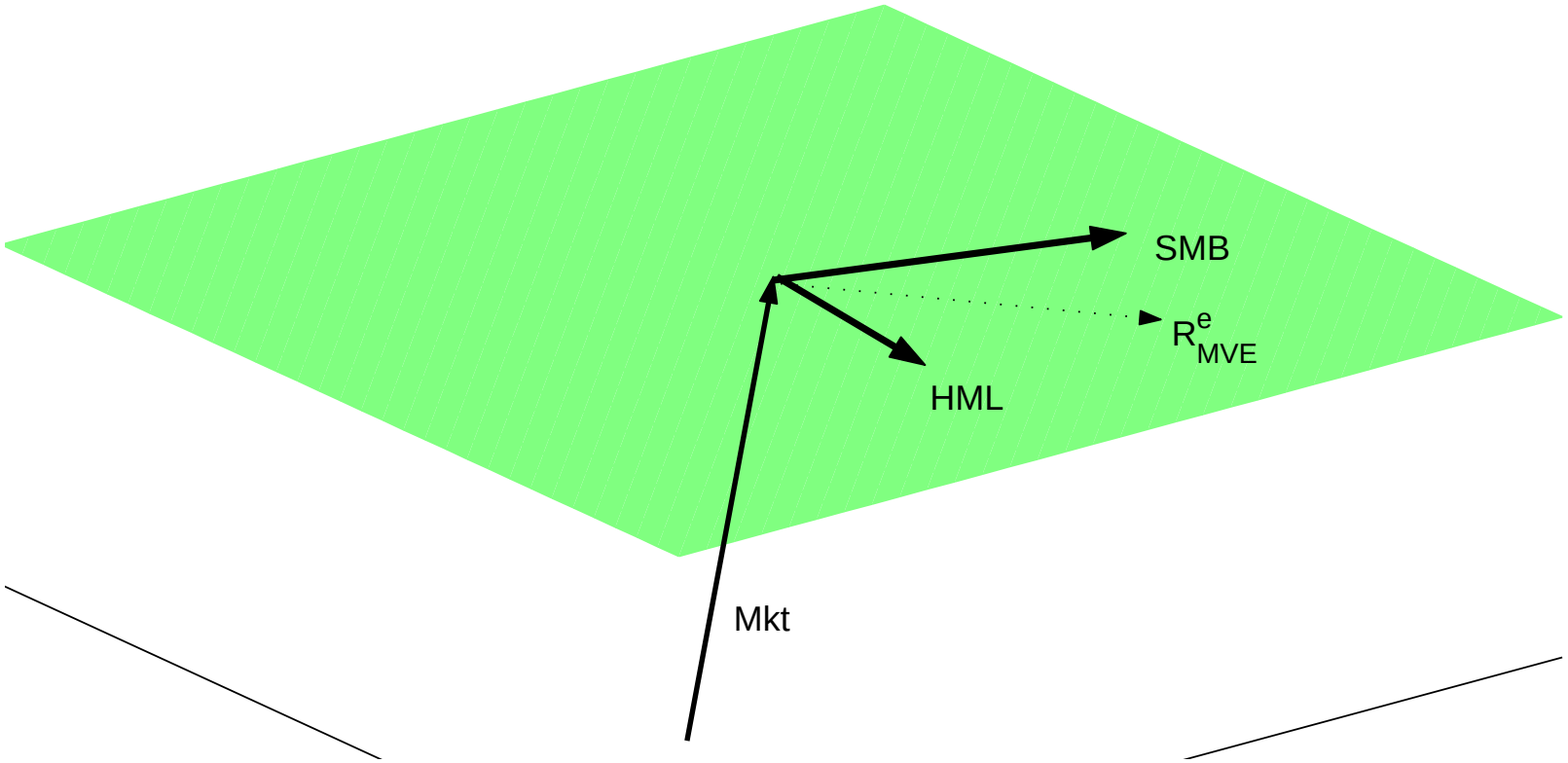
- The R^2s are:

	Low	2	3	4	High
Small	0.94	0.96	0.97	0.97	0.96
2	0.95	0.96	0.95	0.95	0.96
3	0.95	0.94	0.93	0.93	0.93
4	0.94	0.93	0.91	0.89	0.89
Big	0.94	0.92	0.88	0.90	0.83

- In addition, the estimates of b range from 0.91 to 1.18 (std-dev = 0.06).

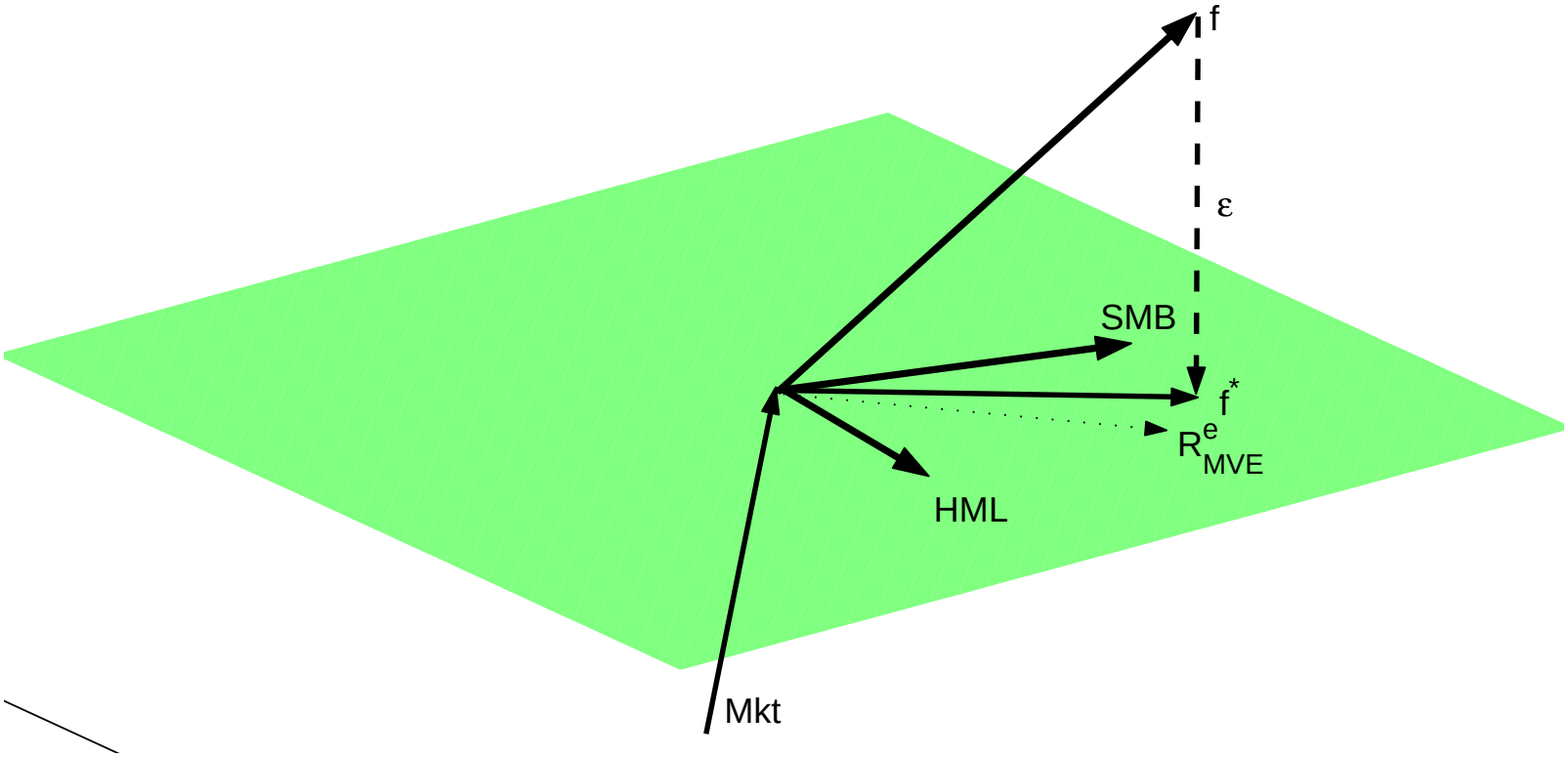
Return Space Geometry

- This means that the returns of these 25 portfolios, net of the market return, lie *approximately* in the 2-dimensional excess return space $\underline{\mathbf{R}}^{e*}$ spanned by HML and SMB:



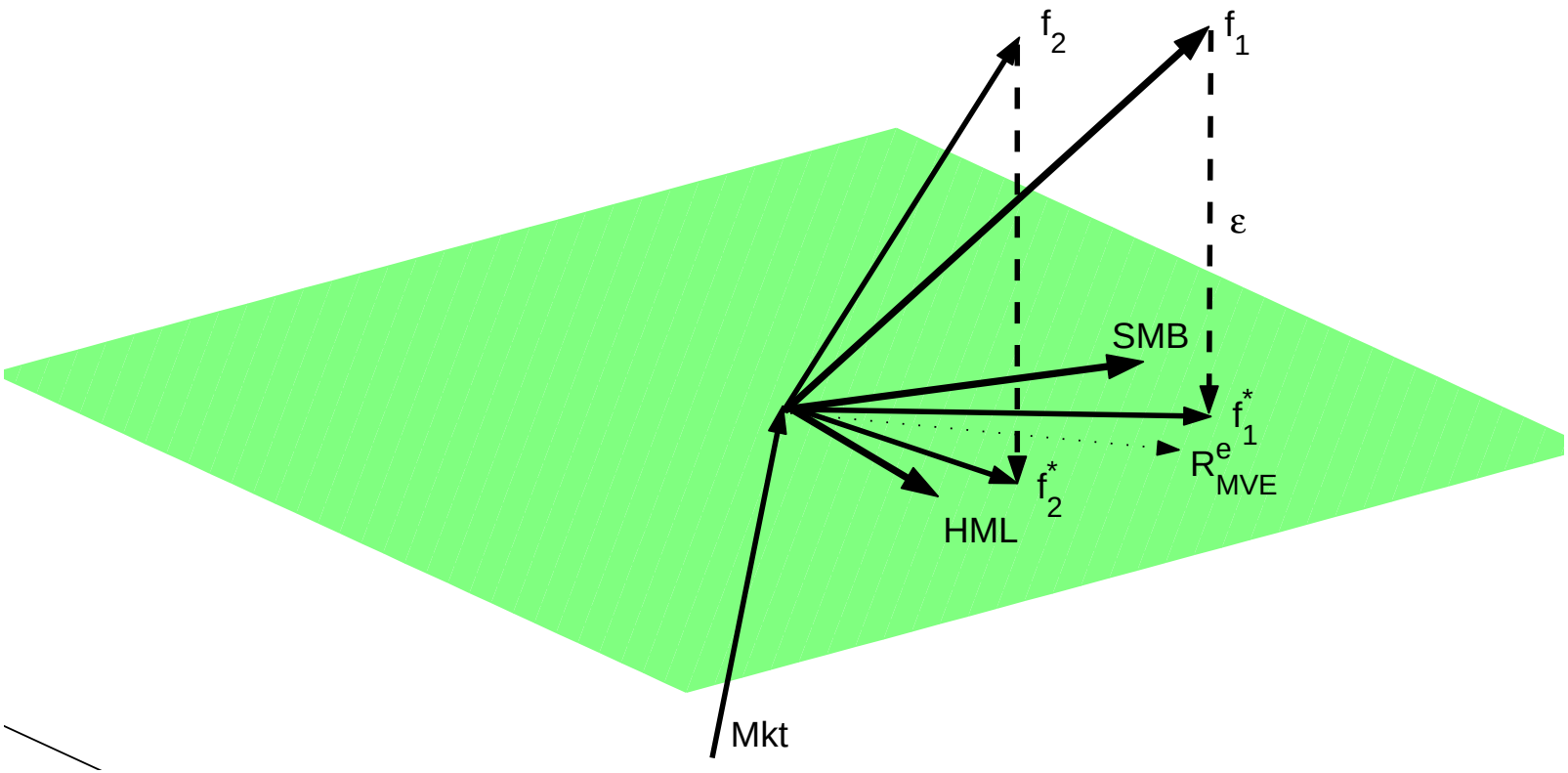
Test Geometry

- In any test where the λs are free parameters, a test of a single-factor model with the 25 FF portfolios is a test of whether $corr(f^*, R^e_{MVE}) = 1$

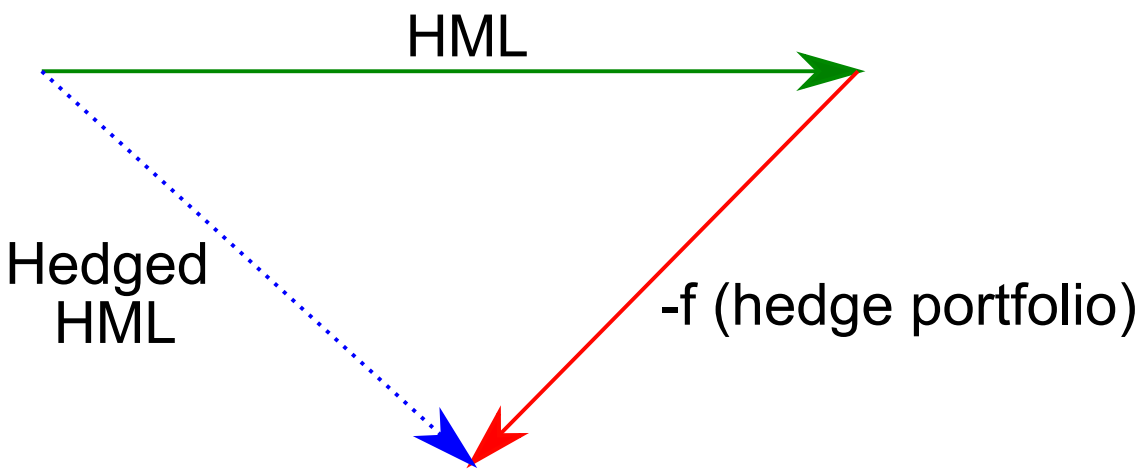


Test Geometry – multiple factors

- Moreover, with two factors, assuming $f_1^* \neq k \cdot f_2^*$, some linear combination of the $\tilde{f}$s will always price the assets.
  - Any f_1^* and f_2^* form a basis for the subspace.



Test Geometry – with hedged factors



Testing New Asset Pricing Models

- This is a really good way of expanding the asset-return space.
  - likely more powerful than adding industry returns, etc.
- Any new factor model proposed as an explanation of the observed characteristic-premia should clearly be subjected to such a test.
- Given my priors, it doesn't surprise me that "standard" sources of macro risk are not priced.
- It would be interesting to see whether agent specific measures of risk are priced, e.g., the ICR measures proposed in the literature.
  - He and Krishnamurthy (2013), Adrian, Etula, and Muir (2014), He, Kelly, and Manela (2017), and others.

Why does this econometric exercise work?

- The individual stock covariance structure is relatively constant
  - That is, IBM's covariance with GOOG, and with innovations is productivity, is relatively constant over time.
- In contrast the covariance matrix of proposed "factor portfolios" (e.g., HML, SMB, UMD) is much less stable.
  - The makeup of the factor portfolios is constantly changing.
  - For example, IBM's covariance with UMD will depend on it's return over the past year
- Thus, to build a portfolio that is highly correlated with a macro variable, you should sort on lagged $\rho_{i,t}$s, not on the characteristics used to build factor portfolios (like BM).

Econometric Issues

- In Daniel, Mota, Rottke, and Santos (2017), we follow Frazzini and Pedersen (2014) and estimate volatilities and correlations over different horizons.
- For us, this makes a substantial difference in the power to forecast future individual firm betas.
    - I suspect that this would improve the forecast power here as well.

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