

Macroeconomic Content of Characteristics-Based Asset Pricing Models: A Machine Learning Analysis

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Summary of the Paper

Numerous characteristics-based factor models (**CFM**) are available

- ▶ **Examples:** Fama & French (1992,2015), Hou, Xue, and Zhang (2015), Stambaugh & Yuan (2017), Barillas & Shanken (2018)

Economic motivation behind these CFMs is less clear

- ▶ The ICAPM gives researchers the factor-fishing license
- ▶ Empirical success + ICAPM-license \implies CFMs are widely popular

This paper: Investigates whether CFMs are related to macroeconomic factors

- ▶ Estimates SDFs of popular CFMs
- ▶ Regresses SDFs on a wide range of macroeconomic factors
- ▶ Tests whether R_{00S}^2 of the SDF regressions are significant

Main Findings of the Paper

Main findings:

1. The paper decomposes SDFs of CFM as
$$\text{SDF} = \text{Mkt-SDF} + \text{Non-Mkt-SDF}$$
2. Non-Mkt-SDFs of all CFMs are unrelated to macroeconomic factors
3. That is, R^2_{OOS} in the **Elastic-Net** regressions of the Non-Mkt-SDFs on macroeconomic factors are not significant
4. Thus, the paper argues that CFMs do not have macroeconomic motivation beyond the market factor

1. Convincing readers that CFMs do not have macroeconomic content at all will be an uphill task
2. Even if the paper can successfully establish that CFMs do not have macroeconomic motivation, it is unclear how this helps in
 - 2.1 Validating/Invalidating CFMs
 - 2.2 Understanding whether the success of CFMs is due to “characteristics” or “risk”
3. The contribution appears limited in terms of both economics and econometrics
4. So, the authors benefit from motivating the paper in a completely different direction that provides clear economic/asset pricing takeaways

Why convincing that CFMs do not have macroeconomic content will be difficult?

1. Momentum shown to be related to business cycles (Chordia & Shivakumar (JF 2002))
2. The macroeconomic factor “Industrial production growth” explains more than half of momentum profits Liu and Zhang (RFS 2008)
3. HML and SMB are correlated with innovation in investment opportunity variables Petkova (JF 2005)

Thus, empirically, convincing that CFMs do not relate to macroeconomic factors would be difficult

Of course, authors differently focus on

1. SDFs rather than individual factors
2. non-market SDFs rather than SDFs

But still reconciling the paper results with existing findings is important

Why convincing that CFMs do not have macroeconomic content will be difficult?

Authors document insignificant R_{OOS}^2 in the Elastic-net regression of non-mkt-SDF on a large of macroeconomic factors

But this will not rule out the possibility that macroeconomic factors **non-linearly** impact SDFs

Why non-linearity is expected in “linear factor models?”

1. Because factors are characteristics-sorted portfolios and the sorting procedure is highly non-linear

Suggestion: Investigate R_{OOS}^2 of non-linear models such as Random Forests or Neural Nets

Why convincing that CFMs do not have macroeconomic content will be difficult?

(GMM-Based) Estimated SDFs are usually very imprecise

Thus, uncovering the true role of macroeconomic factors would be extremely difficult

Suggestion: Rather than estimating SDF via GMM, estimate it more precisely (by penalizing factor loadings) using Machine Learning

Suggestion: Establish that the estimated SDF is precise enough to make inferences

Minor points: Come up with better explanations for

- ▶ Why macroeconomic variables like S&P P/E ratio, S&P dividend yield, S&P industrials are excluded from the data?
- ▶ Why AR(1), rather than VAR(1), innovations are considered for constructing macroeconomic factors

Why coming up with a better motivation is important?

Even if the paper ends up rigorously documenting that CFMs do not have macroeconomic interpretation, the economic message is still unclear

Related papers that have clear economic message

1. Kelly, Pruitt, and Su (JFE 2019): Characteristics are covariances
2. Boons (JFE 2016): Factor models are consistent with ICAPM sign restrictions
3. Chen, Pelger, and Zhu (2021): Macroeconomic-based SDF explains cross-section of expected returns much better than existing SDFs

Thus, it is important to come up with a better motivation explaining

1. Why documenting no association between CFMS and macroeconomic factors is important?
2. Would that invalidate existing CFMs?
3. Or would that challenge our existing interpretations of CFMs?

1. Kudos to the authors for investigating CFMs in a new perspective
2. More work needs to be done in better motivating the paper
3. Look forward to reading the updated version