Discussion of "Fundamental Risk Sources and Pricing Factors" by Chen and Kim

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Summary

Two main findings:

1) Six aggregate productivity components trace 13 out of 15 priced factors
   $\rightarrow$ FF 5 factors, q-factor, mis-pricing factors.

2) At least one important factor is missing in existing factor models, which is related to labor risk.

Methodology

- Six aggregate productivity components
  - Estimated from a Principal Component Analysis (PCA)
  - First, get the residuals from a regression from:

$$y_{i,t} - k_{i,t} = \beta_l(l_{i,t} - k_{i,t}) + \beta_k k_{i,t} + z_{i,t}$$

  - Then, take the 1-6 PC of the residuals to get the series of productivity components
- Finally, construct factor mimicking portfolios for each PC, use as a six-factor model

Main Tables- I

1) Does the six PC explain the pricing of 'other' existing factors?

2) Do 'other' existing factors explain the pricing of the PCs?

Main Tables- I

1) Does the six PC explain the pricing of ‘other’ existing factors?
   - If yes, the alphas generated from ‘other’ existing factors should disappear controlling for the PC factors

Panel A: Full-sample estimation

	MKT	SMB	HML	CMA	RMW	UMD	Q_{ME}	Q_{IA}	Q_{ROE}	EG	MGMT	PERF	MIS	FIN	PEAD
α	0.10	0.05	0.02	-0.06	0.10	-0.35	0.02	-0.03	0.08	$\boxed{0.32}$	0.08	-0.02	-0.11	0.15	$\boxed{0.46}$
t-stat	0.49	0.44	0.11	-0.97	1.48	-1.60	0.17	-0.64	1.17	$\boxed{2.79}$	0.84	-0.11	-1.27	1.14	$\boxed{5.47}$
β_{PC1}	0.13	0.16	-0.14	-0.13	0.00	0.10	0.16	-0.10	0.07	-0.02	-0.17	0.08	-0.04	-0.20	0.04
t-stat	4.62	9.15	-6.21	-11.75	-0.32	2.28	8.97	-12.44	5.91	-0.98	-8.51	2.85	-2.55	-8.19	1.72
β_{PC2}	0.00	-0.52	0.25	0.19	0.02	-0.26	-0.62	0.15	-0.28	0.00	0.33	-0.12	0.15	0.37	-0.08
t-stat	0.03	-11.84	3.79	10.18	0.59	-2.14	-14.64	10.49	-9.54	-0.12	7.25	-1.64	3.70	4.89	-1.96
β_{PC3}	0.05	0.12	0.18	0.12	0.11	0.07	0.07	0.20	0.21	0.11	0.19	0.03	0.08	0.26	0.00

   - The alphas disappear for 13 out of 15 factors

2) Do ‘other’ existing factors explain the pricing of the PCs?

Main Tables -II

1) Does the six PC explain 'other' existing factors?

2) Do 'other' existing factors explain PC? (Table 8)
   - ▷ If yes, the alphas generated from the 6PCs should disappear after controlling for 'other' factors .

Panel A: Full-sample estimation	PC1	PC2	PC3	PC4	PC5	PC6
α^{FF6}	1.15 (3.53)	0.25 (2.09)	-0.67 (-2.56)	0.96 (3.26)	0.27 (3.26)	-0.09 (-0.65)
R^2	0.10	0.43	0.43	0.71	0.52	0.65
α^{SY}	0.91 (3.04)	0.15 (1.28)	-0.95 (-3.79)	0.28 (0.72)	0.06 (0.81)	0.26 (1.82)
R^2	0.12	0.39	0.27	0.50	0.63	0.66
α^{DHS}	1.27 (3.60)	-0.08 (-0.48)	-0.73 (-2.42)	2.09 (3.64)	0.15 (1.28)	-0.34 (-1.56)
R^2	0.02	0.16	0.28	0.09	0.33	0.28
α^{HXZ}	1.35 (4.20)	0.45 (3.59)	-0.11 (-0.37)	1.22 (3.41)	0.38 (3.29)	-0.15 (-0.94)
R^2	0.04	0.50	0.53	0.75	0.38	0.54
α^{HMXZ}	1.16 (3.90)	0.41 (3.34)	-0.42 (-2.01)	0.74 (2.68)	0.21 (1.95)	0.06 (0.34)
R^2	0.05	0.50	0.56	0.77	0.44	0.56

WAIT BUT WHY

Cochrane (1996 JPE)'s
Production-based Asset Pricing Model

Production-based Asset Pricing Models

$$y_t = f(k_t) - c(k_t, i_t)$$
$$k_{t+1} = (1-\delta)(k_t + i_t)$$

Cochrane (1996) shows that the return on the investment r_i is

$$r_{i,t+1} = (1-\delta)\frac{f'_{k,t+1} + c'_{i,t+1} - c'_{k,t+1}}{1 + c'_{i,t}}$$

- $r_{i,t+1}$ a function of k_{t+1} and i_{t+1}
- Since $E_t[m_{t+1} r_{i,t+1}] = 1$ need to be satisfied, SDF can be expressed as a linear function of $r_{i,t+1}$ along with the market returns
- Basis of many asset pricing models.
  (e.g., Profitability, Investment, q-factor, etc...)
- Related to the first principal component of this paper through f'_k

Production-based Asset Pricing Models Firm-specific TFP

$$y_{j,t} = A_{j,t} k_{j,t}^{\alpha} - c_j i_{j,t} - r k_{j,t}$$
$$k_{j,t+1} = (1-\delta)(k_{j,t} + i_{j,t})$$

The return of the investment for firm j ($r_{i,j}$) is

$$r_{i,j,t+1} = g(A_{j,t+1}, k_{j,t+1}, c_j)$$

- Since $E_t[m_{t+1} r_{i,j,t+1}] = 1$, for some α_j, β_j, one could conjecture that SDF is a function of some state variable $s_{t+1} = \sum_j \beta_j g(A_{j,t+1}, k_{j,t+1}, c_j)$.

$$m_{t+1} = \sum_j \alpha_j r_{j,t+1} + \beta_j g(A_{j,t+1}, k_{j,t+1}, c_j)$$

Production-based Asset Pricing Models: Firm-specific TFP

- It is typically assumed that the weights β_j of the state variable is monotonic in one of the production components
  - $A_{j,t}$: Imrohoroglu, and Tuzel (2014)
  - c_j: Belo, Lin, and Bazdresch (2014), Belo, Li, Lin, and Zhao (2017)
  - Type of k: Belo and Lin (2012), Jones and Tuzel (2013)
  - Many others...
- What do the 6 PCs imply within this context?

Comment 1: About the Motivation

Three possible ways to think about this paper

- ▷ Emphasize the importance of firm-level TFP shocks?
- ▷ Reduce the dimension of the priced risk factors?
- ▷ Provide a set of risk factors that performs better than the FF 5 factors?

Comment 1: About the Motivation

Three possible ways to think about this paper

- ▷ Emphasize the importance of firm-level TFP shocks?
  - What do each of the six PCs represent?
- ▷ Reduce the dimension of the priced risk factors?
  - None of the other models have more than 6 factors in a single model
- ▷ Provide a set of risk factors that performs better than the FF 5 factors?
  - Need a horse race among factor models

Horse Race Between Models

- Current horse race is asymmetric.
  - Significance of F tested using simultaneous estimation of the beta & alpha

$$F_t = \alpha + \beta' PC_t + \epsilon_t$$

  - The significance of PC is tested using the ex-post alphas (beta estimated pre-sample)

$$PC_{i,t} = \alpha_i + \hat{\beta}' F_t + \epsilon_{i,t}$$

- However, we know ex-ante beta $\neq$ ex-post beta
  e.g., Time-varying beta (Ferson and Harvey 1993) and Moreira, Muir, and Herskovic (Working Paper), etc.

- Also add the market factor for a fair comparison
  (The model suggests so according to Cochrane)

Comment 2: What is so special about the TFPs?

Why is it superior to applying PCA directly on returns (e.g., Connor and Korajczyk 1987)?

1) The investment model (Cochrane) suggests that SDF is a function of firm-level *stock* and *investment* returns

2) Stock returns are more direct since TFP adds another layer of estimation

3) All the standard criticisms of PCA also apply
   - Economic interpretation of the factors are difficult (Chen, Roll, and Ross 1986)
   - Equal-weighting for small firms
   - Time-varying weights

Comment 3: Some Arbitrary Choices....

Some arbitrary choices are not well grounded

- Choice of six principal components
  (Why not five, why not seven?)
  - What is the % of variation of TFPs explained by 5,6, and 7 principal components?
- Choice of portfolios used to construct the factor mimicking portfolios?
  - The authors choose *different* set of base portfolios for each factor
  - To avoid multi-collinearity problem

Other Comments

- ▷ PC1 is related to labor risk
  - Belo, Li, Lin, and Zhao (2017) already seems to using aggregate TFP shocks as a proxy for labor adjustment cost.
- ▷ Extending window → Expanding window?
- ▷ Table 4 is not convincing: it still has the high-low pattern and also some significant numbers.

Overall Comments

- "Ambitious" paper
- Well executed/ the paper has some strong results
  - Connect pricing factors that is difficult to explain within the 'rational investors' framework to economic fundamentals
  - Six PCs explain 78% of cross-sectional variation of average returns.
- Wish to see the next draft!