Prospective Book-to-Market and Expected Stock Returns

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What we do

- Decompose bm into permanent and transitory components
- Transitory component $=$ sum of future demeaned (stock returns $+$ ROE $+$ bm)
- Define last term as *prospective* bm
- Estimate it from data and propose as a new return predictor
- Prospective bm outperforms original bm at three different levels: market, industry, and individual stocks

Findings

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- By various criteria

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  - Out-of-sample R^2, $\Delta RMSE$, $MSE\text{-}F$

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  - Large and significant α, against different asset pricing models

Literature

- Value decomposition: Asness, Porter, and Stevens (2000), Daniel and Titman (2006), Fama and French (2008), Gerakos and Linnainmaa (2018), Golubov and Konstantinidi (2019), ...
- Similar decomposition methodology: Engel (2016), ..., Dong, Goto, Hou, Xu, and Zhang (2024)

Decomposition

Denote P_t, D_t, R_t, B_t, ROE_t as the stock price, dividend, stock return, book value per share, and return on book equity, respectively, then

$$R_{t+1} = \frac{P_{t+1}}{P_t}\left(1 + \frac{D_{t+1}}{P_{t+1}}\right), ROE_{t+1} = \frac{B_{t+1}}{B_t}\left(1 + \frac{D_{t+1}}{B_{t+1}}\right)$$

Take log on both sides,

$$r_{t+1} = p_{t+1} - p_t + \delta_{t+1}$$

where δ_t is the log dividend-price ratio $\delta_t = \log(1 + D_t/P_t)$

Take expectations at time t and iterate forward,

$$\begin{aligned} E_t r_{t+1} &= E_t p_{t+1} - p_t + E_t \delta_{t+1} \\ E_t r_{t+2} &= E_t p_{t+2} - E_t p_{t+1} + E_t \delta_{t+2} \\ & \dots \\ E_t r_{t+j} &= E_t p_{t+j} - E_t p_{t+j-1} + E_t \delta_{t+j} \end{aligned}$$

Sum up, then

$$\sum_{n=1}^{j} E_t r_{t+n} = E_t p_{t+j} - p_t + \sum_{n=1}^{j} E_t \delta_{t+n}$$

Let return r_t be the sum of risk premium μ_t and risk-free rate i_t, $\tau = \bar{\mu} + \bar{i} - \bar{\delta}$, and assume the simplest dynamics

$$\begin{aligned}
\mu_t - \bar{\mu} &= \gamma\left(\mu_{t-1} - \bar{\mu}\right) + error \\
i_t - \bar{i} &= \phi\left(i_{t-1} - \bar{i}\right) + error \\
\delta_t - \bar{\delta} &= \beta\left(\delta_{t-1} - \bar{\delta}\right) + error
\end{aligned}$$

Decompose permanent and transitory components as

$$\sum_{n=1}^{j} E_t\left(\mu_{t+n} - \bar{\mu}\right) + \sum_{n=1}^{j} E_t\left(i_{t+n} - \bar{\imath}\right)$$

$$= \left(E_t p_{t+j} - p_t - j\tau\right) + \sum_{n=1}^{j} E_t\left(\delta_{t+n} - \bar{\delta}\right)$$

Let $j \to \infty$, then

$$\sum_{n=1}^{\infty} E_t\left(\mu_{t+n} - \bar{\mu}\right) + \sum_{n=1}^{\infty} E_t\left(i_{t+n} - \bar{\imath}\right)$$
$$= \underbrace{\lim_{n\to\infty}\left(E_t p_{t+n} - p_t - n\tau\right)}_{p_t^T} + \sum_{n=1}^{\infty} E_t\left(\delta_{t+n} - \bar{\delta}\right)$$

Simplify, then

$$\gamma\frac{\mu_t - \bar{\mu}}{1-\gamma} + \phi\frac{i_t - \bar{\imath}}{1-\phi} = p_t^T + \beta\frac{\delta_t - \bar{\delta}}{1-\beta} \tag{1}$$

Do the same to the log book equity $b_t = \log(B_t)$. Define the log dividend-book equity as $\psi_t = \log(1 + D_t/B_t)$, then

$$\xi \frac{g_t - \bar{g}}{1-\xi} + \phi \frac{i_t - \bar{\imath}}{1-\phi} = b_t^T + \beta \frac{\psi_t - \bar{\psi}}{1-\beta} \tag{2}$$

where

$$g_t = E_t\left[roe_{t+1}\right] - i_t; \text{ and } g_t - \bar{g} = \xi\left(g_{t-1} - \bar{g}\right) + e_t$$

Define bm as

$$\theta_t \equiv \log\left(B_t/P_t\right) = b_t - p_t$$

(1) - (2),

$$\gamma \frac{\mu_t - \bar{\mu}}{1-\gamma} - \xi \frac{g_t - \bar{g}}{1-\xi} = -\theta_t^T + \beta\left(\frac{\delta_t - \bar{\delta}}{1-\beta} - \frac{\psi_t - \bar{\psi}}{1-\beta}\right)$$

Conduct the Campbell and Shiller (1988) loglinearization and follow Vuolteenaho (2002)

$$\rho = 1/(1 + \frac{\bar{D}}{P}) = 1/(1 + \frac{\bar{D}}{B})$$

for both log dividend-price and log dividend-book equity ratios, then

$$\delta_t = \log(1 + D_t/P_t) \approx (1-\rho)\,(d_t - p_t) + \kappa$$

$$\psi_t = \log\left(1 + D_t/B_t\right) \approx (1-\rho)\,(d_t - b_t) + \kappa$$

Finally,

$$\gamma\frac{\mu_t - \bar{\mu}}{1-\gamma} \approx -\theta_t^T + \xi\frac{g_t - \bar{g}}{1-\xi} + (1-\rho)\frac{\beta\left(\theta_t - \bar{\theta}\right)}{1-\beta}$$

$$\gamma \frac{\mu_t - \bar{\mu}}{1-\gamma} \approx -\theta_t^T + \xi \frac{g_t - \bar{g}}{1-\xi} + (1-\rho) \underbrace{\frac{\beta\left(\theta_t - \bar{\theta}\right)}{1-\beta}}_{\text{prospective } bm}$$

The infinite sum of expected demeaned risk premium is the sum of

1. transitory component of bm
2. infinite sum of expected demeaned return on equity
3. infinite sum of expected demeaned log bm
4. $\rho = 0.96$ (Campbell and Shiller (1988), Campbell and Shiller (1991))

Empirical proxy of prospective bm

- Long-run trend $\bar{\theta}$: sample historical mean
- Persistence β: sample AR(1) coefficient of log bm
- Persistence estimated by both OLS (β) and RLS (β') [1]
- Extending window starting from first N obs, ensuring no look-ahead bias
- Baseline OLS and RLS prospective bm is

$$\pi = \frac{\beta(\theta - \bar{\theta})}{1 - \beta}, \;\; \pi' = \frac{\beta'(\theta - \bar{\theta})}{1 - \beta'}.$$

[1] many alternatives tried too

Market return

1. Annual bm from Goyal and Welch (2008) data, 1921-2022, for Dow Jones Industrial Average
2. bm of year T = book value ending in year T-1 / market value of December year T, to predict market return of T+1
3. Market return from Ken French's website

Summary statistics

	$\bar{\theta}$	β	β'	r	bm	π	π'
Mean	-0.548	0.786	0.782	0.085	-0.740	-1.258	-2.474
Std	0.093	0.098	0.108	0.201	0.520	14.178	8.330
Skew	-0.849	-0.367	-0.245	-0.341	-0.397	7.109	0.960
Kurt	-0.229	2.534	1.206	-0.142	-0.485	61.720	17.756
Min	-0.842	0.346	0.350	-0.465	-2.031	-33.706	-39.816
Max	-0.434	0.992	0.979	0.529	0.366	123.092	48.389
AR(1)	0.908	0.715	0.751	0.012	0.902	0.175	0.514
Obs	93	93	93	97	102	93	93
π					0.524		0.890
π'					0.765		

In-sample prediction

	Full sample			Post oil shocks (1975 to 2022)		
	bm	π	π'	bm	π	π'
a	0.130	0.091	0.103	0.112	0.125	0.126
	(3.83)	(4.71)	(5.23)	(2.72)	(5.01)	(5.12)
b	0.062	0.004	0.007	0.028	0.008	0.007
	(1.55)	(5.44)	(4.69)	(0.59)	(2.61)	(2.91)
R^2	0.02	0.07	0.08	-0.01	0.09	0.09

	1933 Winsorized			5% Winsorized		
	bm	π	π'	bm	π	π'
a	0.128	0.103	0.104	0.128	0.103	0.104
	(3.75)	(4.82)	(4.86)	(3.71)	(4.71)	(4.73)
b	0.059	0.007	0.006	0.058	0.007	0.006
	(1.46)	(2.23)	(2.46)	(1.43)	(1.81)	(1.91)
R^2	0.01	0.03	0.03	0.01	0.02	0.02

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Out-of-sample prediction

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	bm	π	π'		bm	π	π'
R^2	-0.079	0.038	0.042	R^2	-0.236	0.052	0.051
	(0.80)	(0.01)	(0.01)		(1.00)	(0.01)	(0.02)
$\Delta RMSE$	-0.007	0.003	0.004	$\Delta RMSE$	-0.020	0.005	0.005
	(0.77)	(0.01)	(0.01)		(1.00)	(0.02)	(0.02)
MSE-F	-5.737	3.045	3.420	MSE-F	-10.116	2.887	2.875
	(0.80)	(0.01)	(0.01)		(1.00)	(0.01)	(0.02)

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48 Industry Portfolios

- Lewellen (1999) finds that industry bm predict industry portfolio returns
- Industry classification, returns data, industry book values, and industry market values are all from Ken French
- Compute end-of-year industry bm by dividing book value at the end of the previous year to market value at the end of the current year
- The sample period for industry portfolio data are from 1926 to 2022 and we use the 48 industry portfolios[2]

[2] Results on 12 and 38 industry portfolios are very similar.

- Apply the same time-series out-of-sample methods to every industry
- Original bm: 5 (9) OOS R^2s out of 48 industries show a p-value lower than $5\%(10\%)$.
- π: 3 (3) OOS R^2s out of 48 industries show a p-value lower than $5\%(10\%)$.
- Not impressive. Focus on cross-industry portfolios

Cross-industry Portfolio Returns: 48 Industries

	Mean Excess Returns				FF three-factor α		
	bm	π	π'		bm	π	π'
Low	0.081	0.080	0.083	Low	0.006	-0.005	-0.002
	(4.30)	(4.04)	(4.18)		(0.87)	(-0.74)	(-0.28)
2	0.080	0.086	0.085	2	-0.003	-0.001	-0.004
	(4.10)	(4.48)	(4.38)		(-0.49)	(-0.24)	(-0.67)
3	0.089	0.077	0.077	3	-0.002	-0.013	-0.014
	(4.62)	(3.95)	(3.93)		(-0.38)	(-2.27)	(-2.37)
4	0.098	0.098	0.097	4	0.004	0.005	0.006
	(5.09)	(5.04)	(5.05)		(0.69)	(0.77)	(0.95)
High	0.113	0.120	0.118	High	0.002	0.023	0.021
	(5.30)	(6.17)	(6.09))		(0.35)	(3.78)	(3.55)
HML	0.033	0.040	0.036	HML	-0.004	0.028	0.023
	(2.67)	(4.12)	(3.67)		(-0.43)	(3.23)	(2.64)

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Cross-section of individual stocks

1. CRSP/Compustat
2. DFF (2000) book value divided by December market equity of the same year, known by June
3. 1959.07 - 2022.12 stock returns, firms SIC codes, and accounting information
4. Report out-of-sample results starts from 1962.07

Estimate of parameters

1. Assign Fama-French 48 industry β and long-run trend $\bar{\theta}$ for individual firms to alleviate noise and short sample period issues
2. 3-year-and-extending window from 1959
3. Tried many alternatives

π HML factor

1. Form portfolios at the beginning of July every year and hold it to next June
2. *two-way* sort controlling for size
3. Similar with FF HML, π HML return $= 1/2$ (Small High-π + Big High-π) - $1/2$ (Small Low-π + Big Low-π)
4. Compare with
    1. $HML^{A,L}$ (December market cap, original FF)
    2. $HML^{A,C}$ (June market cap, Asness, Porter, and Stevens (2000))
    3. $HML^{M,C}$ (monthly market cap, Asness, Porter, and Stevens (2000))

Portfolio sorts: monthly results

Panel A: π high-minus-low portfolio characteristics (%)

Mean	Std dev	Min	Max	Sharpe ratio
0.299	2.232	-11.344	12.017	0.464

Spanning π HML

	q4	FF3	FF3+MOM	FF5	FF5+MOM
MKT	-0.032	-0.020	-0.025	-0.009	-0.013
	(-1.370)	(-0.927)	(-1.209)	(-0.469)	(-0.679)
ME	0.106***				
	(2.875)				
IA	0.651***				
	(9.560)				
ROE	-0.233***				
	(-4.033)				
SMB		0.103***	0.102***	0.075**	0.076***
		(3.102)	(2.957)	(2.570)	(2.622)
HML		0.592***	0.584***	0.529***	0.516***
		(17.098)	(15.388)	(14.651)	(13.151)
MOM			-0.024		-0.026
			(-0.791)		(-1.010)
RMW				-0.125**	-0.120**
				(-2.215)	(-2.177)
CMA				0.155***	0.164***
				(2.652)	(2.891)
α	0.190**	0.121**	0.140**	0.132**	0.150**
	(2.384)	(2.134)	(2.433)	(2.385)	(2.499)
Obs	683	725	725	725	725

Regressing $\text{HML}^{A,L}$ on π HML

	$\text{HML}^{A,L}$	FF3	FF3+MOM	FF5	FF5+MOM
π HML	1.071***	1.075***	1.059***	0.847***	0.816***
	(26.629)	(22.250)	(24.040)	(16.080)	(16.706)
MKT		-0.032	-0.039	0.027	0.017
		(-1.100)	(-1.427)	(0.955)	(0.663)
SMB		-0.093	-0.093	-0.017	-0.014
		(-1.481)	(-1.555)	(-0.414)	(-0.355)
MOM			-0.037		-0.056**
			(-1.011)		(-2.072)
RMW				0.206***	0.210***
				(2.735)	(3.040)
CMA				0.436***	0.450***
				(8.785)	(8.754)
α	-0.035	0.001	0.032	-0.157**	-0.114
	(-0.470)	(0.009)	(0.393)	(-1.991)	(-1.483)
Obs	725	725	725	725	725

Regressing HML^{A,C} on π HML

	HML^{A,C}	FF3	FF3+MOM	FF5	FF5+MOM
π HML	1.123***	1.123***	1.039***	0.884***	0.763***
	(21.428)	(18.145)	(13.809)	(13.180)	(11.964)
MKT		-0.045	-0.084***	0.015	-0.022
		(-1.178)	(-2.586)	(0.399)	(-0.728)
SMB		-0.092	-0.087*	-0.017	-0.005
		(-1.405)	(-1.821)	(-0.398)	(-0.142)
MOM			-0.194***		-0.214***
			(-4.095)		(-6.005)
RMW				0.194**	0.210***
				(2.429)	(4.271)
CMA				0.455***	0.508***
				(7.138)	(9.986)
α	-0.064	-0.035	0.128	-0.192**	-0.026
	(-0.801)	(-0.417)	(1.454)	(-2.065)	(-0.301)
Obs	737	725	725	725	725

Redundancy test

	π HML	HML^{A,L}	HML^{A,C}	HML^{M,C}
MKT	-0.032	-0.016	-0.038	0.027
	(-1.370)	(-0.468)	(-0.954)	(0.576)
ME	0.106***	0.054	0.014	-0.055
	(2.875)	(0.789)	(0.196)	(-0.511)
IA	0.651***	1.007***	1.043***	0.939***
	(9.560)	(14.180)	(10.190)	(9.346)
ROE	-0.233***	-0.169**	-0.309***	-0.644***
	(-4.033)	(-2.482)	(-3.688)	(-6.839)
α	0.190**	0.008	0.073	0.303**
	(2.384)	(0.071)	(0.572)	(2.037)
Obs	683	684	683	684

Redundancy test

	π HML	HML^{A,L}	HML^{A,C}	HML^{M,C}
MKT	0.009	0.035	0.023	0.101*
	(0.344)	(0.956)	(0.486)	(1.737)
SMB	0.119***	0.086	0.088	0.089
	(2.766)	(1.443)	(1.417)	(0.977)
RMW	-0.029	0.180*	0.168	0.038
	(-0.366)	(1.717)	(1.372)	(0.217)
CMA	0.698***	1.029***	1.072***	0.981***
	(10.852)	(19.628)	(14.927)	(11.761)
α	0.089	-0.078	-0.114	-0.065
	(1.108)	(-0.708)	(-0.943)	(-0.436)
Obs	725	726	725	726

Redundancy test

	π HML	HML^{A,L}	HML^{A,C}	HML^{M,C}
MKT	-0.008	0.011	-0.027	0.008
	(-0.331)	(0.369)	(-0.832)	(0.270)
SMB	0.118***	0.085	0.085*	0.082
	(2.931)	(1.539)	(1.785)	(1.398)
RMW	-0.021	0.192**	0.194**	0.087
	(-0.284)	(2.189)	(2.384)	(1.045)
CMA	0.684***	1.009***	1.030***	0.901***
	(9.767)	(17.947)	(13.229)	(18.311)
MOM	-0.095***	-0.134***	-0.287***	-0.530***
	(-3.105)	(-3.957)	(-6.013)	(-13.138)
α	0.157*	0.018	0.094	0.315***
	(1.945)	(0.177)	(0.829)	(3.424)
Obs	725	726	725	726

New framework

1. Prospective bm ✓
2. Prospective interest rate differential ✓
3. More coming up...

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