Fundamental Extrapolation and Stock Returns

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Working paper
2020 08

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1. Introduction

Background

1. Price extrapolation has been proved to be a significant predictor of stock returns.
2. Fundamental extrapolation has received increasing attention in behavioral finance because firm fundamentals are important information that drives stock price movements.

1. Introduction

Motivation

1. Nowadays, the empirical evidence on how fundamental extrapolation predicts stock returns is mixed, and there are no theories available on the use of moving averages of fundamentals.

1. Introduction

Research question

1. Can fundamental extrapolation significantly predict future stock returns?

   Yes

2. Is there a difference between fundamental extrapolation and price extrapolation (price momentum)?

   Yes

1. Introduction

Research Contents

1. Using moving average method to extrapolate fundamentals can obtain significant excess returns.

2. We compare fundamental extrapolation with price extrapolation and find that fundamentals matter more after all, although they are complementary to each other in extracting return information.

1. Introduction

Related researches

1. A general prediction of literature is that fundamental extrapolation causes overvaluation and, therefore, negatively predicts future stock returns (Fuster et al., 2010, Malmendier and Nagel, 2011, Nagel and Xu, 2019).
2. Lakonishok et al. (1994) show that investors extrapolate sales growth, and this extrapolation leads to overvaluation, especially for growth firms.
3. Bordalo et al. (2019) show that the spread portfolio based on fundamental extrapolation is significant in the cross-section of stock returns.

1. Introduction

Contribution

1. We provide a pure fundamental extrapolation approach, which can be easily applied to all stocks in the US and global stock markets and can also be applied to bond and other asset classes.

1. Introduction

Framework

Investors extrapolate fundamentals

↓

This extrapolation can predict the future return of the stock

↓

Fundamental extrapolation is different from price momentum and performs better.

↓

Fundamental extrapolation works in financial markets all over the world

2. Research design: Variable

10 popular fundamental variables

ROE, return on assets (ROA), earnings per share (EAR), earnings to price ratio (ETP), operating profitability (OPP), cash-based operating profitability to assets (COP), earnings surprise (SUE), gross profitability to assets (GPA), revenue surprise (RS), and net payout ratio (NOP)

2. Research design: Data

Data Source： Compustat database and CRSP database.

Period： 1975 to 2018 monthly data.

Sample: All New York Stock Exchange (NYSE), American Stock Exchange (Amex), and Nasdaq. We exclude all financial and utility sector stocks.

2. Research design: Method

Constructing the FXR measure

We assume that investors use a moving average of past fundamental values to do fundamental extrapolation to forecast the future values.

$$\mathrm{E_t}\left[\mathrm{R_{i,t+1}}\right] = \mathrm{f_{i,t+1}} + \beta \mathrm{E_t}\left[\mathrm{F^1_{i,t+1}}\right] \qquad (1)$$

where $\mathrm{f_{i,t+1}}$ the required return based on the current fundamental value, $\mathrm{E_t}\left[\mathrm{F^1_{i,t+1}}\right]$ is the required return based on the future fundamental value.

Since the expected fundamental $\mathrm{E_t}\left[\mathrm{F^1_{i,t+1}}\right]$ is unobservable, we measure $\mathrm{E_t}\left[\mathrm{F^1_{i,t+1}}\right]$ as:

$$\mathrm{E_t}\left[\mathrm{F^1_{i,t+1}}\right] = \mathrm{MA_{i,t,L}} = \frac{\mathrm{F^1_{i,t}} + \mathrm{F^1_{i,t-1}} + \cdots + \mathrm{F^1_{i,t-L+1}}}{L} \qquad (2)$$

2. Research design: Method

Let $\{\mathrm{F}_{\mathrm{i,t+1}}^{\mathrm{k}}\}_{k=1}^{K}$ be K fundamental variables at time t.
We run four cross-sectional univariate regressions of $\mathrm{R}_{\mathrm{i,t}}$ on $\mathrm{MA}_{\mathrm{i,t-1,L}}^{\mathrm{k}}$

$$\mathrm{R}_{\mathrm{i,t}} = \alpha_{\mathrm{L}} + \beta_{\mathrm{t,L}}\mathrm{MA}_{\mathrm{i,t-1,L}}^{\mathrm{k}} + \varepsilon_{\mathrm{it}} \qquad (3)$$

For L=1, 2, 4, and 8, respectively. A simple way of choosing the optimal window L(k) is to select the one that yields the maximum adjusted R2.

$$\mathrm{E}_{\mathrm{t}}\left[\mathrm{R}_{\mathrm{i,t+1}}\right] = \beta_{\mathrm{i,t}}^{\mathrm{k}}\mathrm{MA}_{\mathrm{i,t,L}}^{\mathrm{k}} \qquad (4)$$

It should be noted that the expected values are based on information available at time t only.

2. Research design: Method

The combination forecasting simply aggregates the K individual forecasts by the average:

$$\mathrm{FXR}_{\mathrm{i,t}} = E\left[\mathrm{R}_{\mathrm{i,t+1}}\right] = \frac{1}{K}\sum_{k=1}^{K} \beta_{\mathrm{i,t}}^{\mathrm{k}} \mathrm{MA}_{\mathrm{i,t,L}}^{\mathrm{k}} \qquad (5)$$

which is what we call the firm-level fundamental extrapolation measure, or the fundamental extrapolated return (FXR).

3.1 Empirical result: FXR and stock return

	Low FXR	2	3	4	High FXR	H-L
Panel A: Value-weighted						
Excess	0.14	0.45**	0.50**	0.70***	0.94***	0.80***
	(0.52)	(2.18)	(2.49)	(3.53)	(4.09)	(5.02)
FF5	−0.43***	−0.21***	−0.18***	0.03	0.38***	0.81***
	(−3.74)	(−3.40)	(−3.23)	(0.51)	(4.12)	(4.26)
HXZ	−0.33***	−0.17**	−0.16***	0.08	0.40***	0.73***
	(−2.78)	(−2.50)	(−2.77)	(1.18)	(3.87)	(3.59)
SY	−0.32**	−0.15***	−0.10	0.06	0.39***	0.72***
	(−2.48)	(−2.33)	(−1.63)	(0.80)	(3.74)	(3.35)
DHS	−0.26*	−0.10	−0.13**	0.11	0.36***	0.61***
	(−1.92)	(−1.41)	(−2.10)	(1.45)	(3.16)	(2.79)

The average returns monotonically increase in FXR, from 0.14% for the low FXR portfolio to 0.94% for the high FXR portfolio, suggesting that a strategy that buys the high FXR portfolio and sells the low FXR portfolio earns a monthly average return of 0.80% (t-value = 5.02).

3.1 Empirical result: FXR and stock return

	DepVar: one-month-ahead stock returns (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
FXR	0.94***		0.86***	0.96***		0.90***
	(7.62)		(7.69)	(9.84)		(10.03)
$R_{(-12,-2)}$		0.005**	0.004**		0.006***	0.004**
		(2.46)	(2.12)		(3.49)	(2.58)
$R_{(-1)}$				−0.05***	−0.04***	−0.05***
				(−12.01)	(−10.69)	(−11.86)
$R_{(-60,-13)}$				−0.001***	−0.001***	−0.001***
				(−4.69)	(−2.97)	(−4.37)
log(Size)				−0.15***	−0.12***	−0.15***
				(−6.04)	(−4.41)	(−6.10)
log(B/M)				0.001	0.02**	0.02***
				(1.26)	(2.27)	(3.20)
IVOL				−0.08**	−0.13***	−0.08**
				(−2.14)	(−2.77)	(−1.98)
N	1,522,147	1,522,147	1,522,147	1,522,147	1,522,147	1,522,147
Adj-R^2 (%)	1.43	1.11	2.24	4.41	4.39	4.88

FXR generates a slope of 0.94.Its regression coefficient is still 0.90 after we include all the controls, suggesting that FXR contains incremental forecasting information beyond these widely used stock return predictors.

3.1 Empirical result: FXR and stock return

	Low FXR	2	3	4	High FXR	H-L
Panel A: 1975–2003						
Excess	0.16	0.38	0.51**	0.68***	1.05***	0.89***
	(0.54)	(1.58)	(2.13)	(2.85)	(3.64)	(4.38)
FF5	−0.33**	−0.27***	−0.18**	0.02	0.53***	0.86***
	(−2.14)	(−3.34)	(−2.54)	(0.21)	(4.56)	(3.34)
HXZ	−0.13***	−0.20**	−0.19**	0.01	0.48***	0.61**
	(−0.94)	(−2.22)	(−2.39)	(0.13)	(3.61)	(2.46)
Panel B: 2004–2018						
Excess	0.12	0.57	0.52	0.72**	0.75*	0.63**
	(0.23)	(1.50)	(1.37)	(2.05)	(1.93)	(2.43)
FF5	−0.44***	−0.05	−0.07	0.12*	0.15	0.59***
	(−3.66)	(−0.71)	(−0.88)	(1.60)	(1.10)	(2.58)

Existing studies show that anomalies decay over time or become weaker after becoming public.
The average returns of the FXR strategy are 0.89% and 0.63% in the two subperiods, respectively. The profitability of the FXR strategy does have a slight decay after 2003.

3.1 Empirical result: FXR and stock return

	%(months with optimal L)				%(Positive slopes with optimal L)
	$L=1$	$L=2$	$L=4$	$L=8$	
ROE	25.54	21.20	17.75	35.51	62.68
ROA	28.36	18.28	20.15	33.21	61.57
GPA	35.14	15.94	14.67	34.24	62.14
EAR	25.00	15.58	15.76	43.66	59.42
OPP	33.84	17.87	17.30	30.99	63.12
COP	13.69	20.91	24.71	40.68	69.20
NOP	17.03	18.84	21.74	42.39	57.07
SUE	27.72	14.86	21.56	35.87	69.20
RS	35.88	12.93	13.84	37.34	62.84
ETP	24.46	22.64	17.39	35.51	63.95

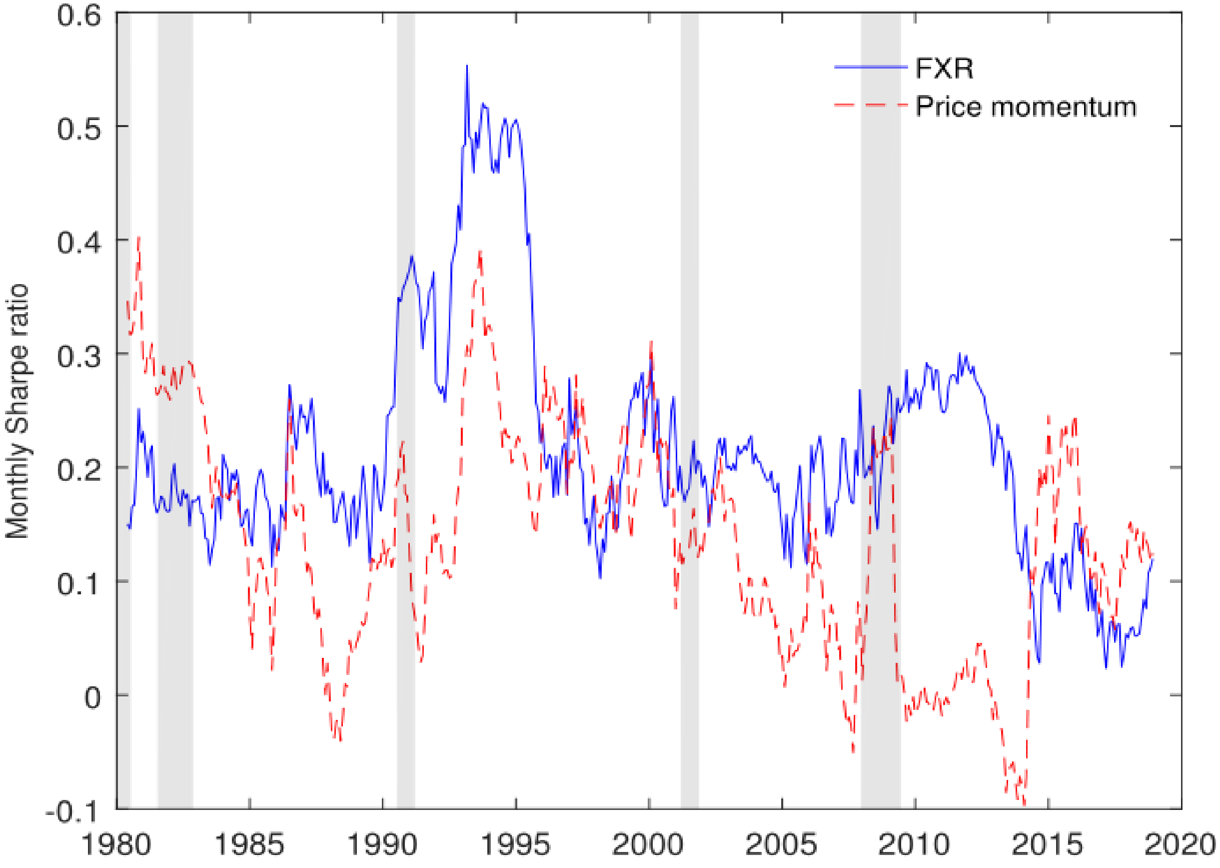
For each fundamental variable, we explore the frequency at which the moving average with an L-quarter window generates the maximum predictive power.
First, the moving average with a window of L = 8 quarters is more likely to be selected than other windows.

3.1 Empirical result: FXR and stock return

	%(months with optimal L)				%(Positive slopes with optimal L)
	$L = 1$	$L = 2$	$L = 4$	$L = 8$	
ROE	25.54	21.20	17.75	35.51	62.68
ROA	28.36	18.28	20.15	33.21	61.57
GPA	35.14	15.94	14.67	34.24	62.14
EAR	25.00	15.58	15.76	43.66	59.42
OPP	33.84	17.87	17.30	30.99	63.12
COP	13.69	20.91	24.71	40.68	69.20
NOP	17.03	18.84	21.74	42.39	57.07
SUE	27.72	14.86	21.56	35.87	69.20
RS	35.88	12.93	13.84	37.34	62.84
ETP	24.46	22.64	17.39	35.51	63.95

The last column shows that about 60% of time, the optimal moving average of each fundamental variable positively predicts future stock returns. Therefore, if one uses a single fundamental variable to predict future stock returns, it is possible to get mixed or insignificant results, which explains why the evidence of fundamental extrapolation is ad hoc in the literature.

3.2 Empirical result: FXR and price momentum



The 60-month rolling window Sharpe ratio of the FXR strategy is higher than the price momentum strategy in most of the time.

3.2 Empirical result: FXR and price momentum

	FXR	Price momentum	Market
Panel A: Summary statistics			
Mean (%)	0.80	0.70	0.61
Median (%)	0.70	1.07	1.03
Volatility (%)	4.18	5.54	4.38
Skewness	0.45	−1.16	−0.70
Kurtosis	3.06	7.58	2.29
Min (%)	−16.05	−39.06	−23.24
Max (%)	17.51	19.51	12.47
Pr(return $>$ 0)	58.24%	60.15%	60.92%
Pr(return $\leq -10\%$)	0.77%	2.87%	1.92%
Pr(return $\leq -30\%$)	0.00%	0.38%	0.00%

The FXR strategy has a higher average return, but a lower volatility.
The FXR strategy has a positive skewness of 0.45, whereas the counterparts of the price momentum strategy and the market portfolio are negative, which suggests that the FXR strategy does not suffer from the crash risk in the price momentum strategy.

3.2 Empirical result: FXR and price momentum

	FXR	Price momentum	Market
Panel A: Summary statistics			
Mean (%)	0.80	0.70	0.61
Median (%)	0.70	1.07	1.03
Volatility (%)	4.18	5.54	4.38
Skewness	0.45	−1.16	−0.70
Kurtosis	3.06	7.58	2.29
Min (%)	−16.05	−39.06	−23.24
Max (%)	17.51	19.51	12.47
Pr(return > 0)	58.24%	60.15%	60.92%
Pr(return ≤ −10%)	0.77%	2.87%	1.92%
Pr(return ≤ −30%)	0.00%	0.38%	0.00%

The two worst monthly returns in our sample period are -16.05% and -14.34% for the FXR strategy, -39.06% and -31.82% for the price momentum strategy.

3.2 Empirical result: FXR and price momentum

	Price momentum					
FXR	Loser	2	3	4	Winner	WML
Low	−0.22	−0.06	0.15	0.32	0.80***	1.02***
	(−0.61)	(−0.22)	(0.67)	(1.42)	(2.73)	(3.51)
2	0.15	0.33	0.45***	0.72***	0.93***	0.78***
	(0.48)	(1.43)	(2.33)	(3.77)	(3.74)	(3.01)
3	0.09	0.57**	0.52***	0.68***	0.85***	0.76***
	(0.30)	(2.59)	(2.55)	(3.67)	(3.59)	(3.19)
4	0.56*	0.68***	0.54***	0.73***	0.89***	0.32
	(1.87)	(3.06)	(2.60)	(3.91)	(3.54)	(1.14)
High	0.65**	0.88***	0.74***	0.87***	1.26***	0.61**
	(2.16)	(3.78)	(3.52)	(4.28)	(4.44)	(2.25)
H-L	0.87***	0.94***	0.58***	0.55***	0.46**	
	(4.11)	(5.09)	(3.68)	(3.30)	(2.50)	

Furthermore, the FXR strategy remains profitable after we control for price momentum.

3.3 Empirical result: FXR and size

	Size					
FXR	Small	2	3	4	Big	SMB
Low	0.09	0.31	0.37	0.34	0.09	0.01
	(0.31)	(1.07)	(1.32)	(1.29)	(0.31)	(0.04)
2	0.72***	0.73***	0.68***	0.58***	0.39*	0.33**
	(2.81)	(3.04)	(3.06)	(2.66)	(1.90)	(2.06)
3	0.98***	0.93***	0.77***	0.67***	0.42**	0.56***
	(3.97)	(4.03)	(3.54)	(3.24)	(2.03)	(3.12)
4	1.25***	1.08***	0.90***	0.89***	0.62***	0.62***
	(4.89)	(4.36)	(4.00)	(4.14)	(3.14)	(3.71)
High	1.70***	1.37***	1.14***	1.03***	0.87***	0.83***
	(4.89)	(4.36)	(4.00)	(4.14)	(3.14)	(3.71)
H-L	1.61***	1.06***	0.77***	0.69***	0.78***	
	(8.53)	(5.44)	(4.39)	(3.79)	(4.13)	

It is well-known that small firms tend to exhibit stronger mispricing.
While the average return of the FXR strategy decreases in firm size, but the FXR strategy is robust to firm size.

3.3 Empirical result: Mean-variance spanning test

A mean-variance spanning test is to explore whether the FXR strategy lies outside the mean-variance frontier spanned by an asset pricing model's factor returns.

We follow Kan and Zhou (2012) and carry out six tests.

	W	W_e	W_a	J_1	J_2	J_3
FF5	31.14	17.36	16.92	16.17	16.73	19.32
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HXZ	26.16	15.22	13.24	14.20	14.59	17.57
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SY	26.08	14.53	14.38	15.13	15.26	18.10
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
DHS	21.29	11.15	8.82	9.65	10.10	12.06
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)

The table suggests a strong rejection of the null hypothesis that the FXR strategy is inside the mean-variance frontier of any of the four asset pricing models.

3.3 Empirical result: FXR and transaction costs

	Turnover (in % per month)	Break-even costs (in % per month)	
		Zero return	5% insignificance
Excess	47.43	1.71	1.03
FF5	–	1.71	0.91
HXZ	–	1.54	0.68
SY	–	1.52	0.61
DHS	–	1.29	0.36

Active strategies usually have higher turnover ratios and transaction costs than passive strategies.
The Table shows that it takes 1.71% per month to make the FXR strategy deliver a net average return of zero, and that the transaction cost needs to be as high as 1.03% to render the return of the FXR strategy insignificant at the 5% level.

3.3 Empirical result: Alternative FXR

This section considers an alternative method for constructing FXR. We employ a two-step procedure.

First, we run four univariate cross-sectional regressions of $\mathrm{R}_{\mathrm{i,t}}$ on $\mathrm{MA}^{\mathrm{k}}_{\mathrm{i,t-1,L}}$. Second, we run a multivariate cross-sectional regression.

$$\mathrm{R}_{\mathrm{i,t}} = \alpha_{\mathrm{i}} + \sum_{k=1}^{K} \beta^{\mathrm{k}}_{\mathrm{t}}\, \mathrm{MA}^{\mathrm{k}}_{\mathrm{i,t-1,L}} + \varepsilon_{\mathrm{it}}$$

$$\mathrm{FXR}_{\mathrm{i,t}} = E\left[\mathrm{R}_{\mathrm{i,t+1}}\right] = \sum_{k=1}^{K} \beta^{\mathrm{k}}_{\mathrm{t}} \mathrm{MA}^{\mathrm{k}}_{\mathrm{i,t,L}}$$

3.3 Empirical result: Alternative FXR

	Low FXR	2	3	4	High FXR	H-L
Excess	0.26	0.46^{**}	0.62^{***}	0.72^{***}	0.94^{***}	0.68^{***}
	(1.08)	(2.34)	(3.23)	(3.60)	(4.19)	(4.03)
FF5	-0.38^{***}	-0.19^{***}	-0.01	0.08	0.34^{***}	0.72^{***}
	(-3.10)	(-2.77)	(-0.14)	(1.07)	(3.10)	(3.29)
HXZ	-0.26^{**}	-0.15^{**}	0.05	0.07	0.37^{***}	0.63^{***}
	(-2.22)	(-2.02)	(0.79)	(0.97)	(3.13)	(2.80)
SY	-0.19^{*}	-0.15^{**}	0.06	0.10	0.27^{**}	0.46^{**}
	(-1.74)	(-2.21)	(0.91)	(1.29)	(2.62)	(2.46)
DHS	-0.18	-0.08	0.06	0.08	0.27^{**}	0.45^{**}
	(-1.44)	(-1.22)	(1.04)	(1.02)	(2.27)	(2.07)

We conclude that the FXR strategy is robust to this alternative extrapolation method.

3.3 Empirical result: International evidence

	Low FXR	2	3	4	High FXR	H-L
Panel A: Advanced versus emerging markets						
Advanced	0.11	0.36	0.75*	1.18***	1.72***	1.61***
	(0.20)	(0.79)	(1.77)	(2.69)	(3.18)	(4.80)
Advanced excluding US	0.12	0.39	0.78*	1.14***	1.82***	1.69***
	(0.21)	(0.85)	(1.84)	(2.64)	(3.28)	(4.93)
Emerging	0.83	0.70	1.08*	1.63**	2.88***	2.05***
	(1.30)	(1.12)	(1.66)	(2.33)	(3.87)	(4.44)
Panel B: Regional markets						
North & South America	0.26	0.42	0.74*	1.15***	1.97***	1.71***
	(0.42)	(0.83)	(1.75)	(2.80)	(3.87)	(4.65)
Asia	0.52	0.68	1.04	1.60**	1.86**	1.34***
	(0.94)	(1.15)	(1.55)	(2.15)	(2.15)	(3.34)
Europe	0.22	0.73	1.12**	1.47***	1.86***	1.47***
	(0.37)	(1.39)	(2.12)	(2.85)	(3.41)	(2.85)
Other	0.73	0.81	0.97	1.76**	2.21***	1.47***
	(0.83)	(1.03)	(1.26)	(2.34)	(2.90)	(4.43)

We apply the FXR strategy to 33 international stock markets, including 22 advanced markets and 11 major emerging markets.
In sum, fundamental extrapolation works everywhere.

4. Conclusion

1. We propose a novel and parsimonious methodology to construct a fundamental extrapolation measure, FXR, from multiple fundamental variables, can gain return of 0.80% per month,
2. The FXR strategy is different from the traditional price momentum strategy, and performs better.
3. FXR strategy can generally obtain significant excess returns in the global stock markets.

4. Comment & Inspiration

1. This paper only use simple moving average to extrapolate the fundamentals. If we use machine learning method, we may get better results.