Innovative Originality, Profitability, and Stock Returns (Hirshleifer et al., 2018)

Topic：Corporate innovation

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Overview

Part 1 Literature review

Part 2 Empirical analysis

Part 3 The brief plan of my dissertation

1.1 The standing of literature:

- Previous research focuses on innovative input, output and efficiency.
  (Eberhart et al., 2004; Lanjouw & Schankerman, 2004; Hsu, 2009;Hirshleifer et al.,2013)
- This paper examines the relationship between innovation and future firm profitability and stock returns from the perspective of innovative originality.

1.2 Contribution:

- The measure of innovative originality *(InnOrig)*: the average range of knowledge built by recently granted patents
  - Averaging reduces the influence of extreme values and the correlation between *InnOrig* measure and firm size.
  - The InnOrig measure reflects the breadth of knowledge directly
    VS Herfindahl-Hirschman index (HHI) (Hall et al., 2001)
  - The *InnOrig* measure can predict abnormal returns
    VS the product uniqueness measure (Hoberg & Phillips, 2012)

2.1 Data (1981-2006)

- Data resources:
  - Compustat: accounting data
  - CRSP: stock return data
  - NBER patent database: patent-related data (1976-2006)
  - Harvard Business School Patent Database: secondary technology classes
  - I/B/E/S: analyst earnings forecast data
  - Thomson Reuters 13F: institutional ownership data
- Data processing:
  - Remove financial firms (SIC 6000–6999) & utility firms (SIC 4900–4999)
  - Exclude closed-end funds and firms with negative BV (Fama & Kenneth, 1993)
  - Require firms to be listed on Compustat for two years to mitigate backfilling bias
  - Use recently granted patents instead of patent applications to measure *InnOrig* to avoid look-ahead bias
  - Choose a five-year rolling window

2.2 Methods

- *InnOrig* and future profitability --Annual Fama-MacBeth regressions
  - Persistence (measured by ROE & ROA): examine the interaction between InnOrig and mean reversion of profitability (Fama & Kenneth, 2000)
  - Volatility: regress standard deviation of profitability in year *t+1* to *t+5* on *InnOrig* and other controls (Kothari et al.,2002)

- *InnOrig* and future stock returns
  - Portfolio sorts
    - single sort
    - double sorts：valuation uncertainty (*VU*), investor attention (*ATT*), and the sensitivity of future profitabilit (*Sen*)
  - Monthly Fama-MacBeth regressions
    - full sample
    - subsamples

2.3 Results -- Table 1 *InnOrig* and the persistence of future profitability

Panel A1. InnOrig and mean reversion of future ROE

Dependent	$InnOrig_t$	ΔROE_t	$InnOrig_t * \Delta ROE_t$	$CIE_t * \Delta ROE_t$	ROE	ADV_t	$R\&D_t$	$Capex_t$	CIE_t	MTB_t	Intercept	R^2	Firms	DepMean
ΔROE_{t+1}	2.18 (7.43)	−13.57 (−13.81)	1.97 (3.49)	−0.92 (−1.69)	−19.43 (−5.66)	0.72 (2.42)	−7.04 (−4.86)	0.75 (1.49)	0.13 (0.47)	0.77 (0.97)	−2.79 (−2.67)	0.19	3047	−0.05
Dependent	$InnOrig_t$	ΔROE_t	$InnOrig_t * \Delta ROE_t$	$PIE_t * \Delta ROE_t$	ROE	ADV_t	$R\&D_t$	$Capex_t$	PIE_t	MTB_t	Intercept	R^2	Firms	
ΔROE_{t+1}	2.27 (7.63)	−13.69 (−13.63)	1.34 (2.08)	1.62 (2.49)	−19.32 (−5.61)	0.69 (2.37)	−7.04 (−4.84)	0.75 (1.49)	−0.20 (−0.71)	0.83 (1.04)	−2.83 (−2.67)	0.19	3047	

Panel A2. InnOrig and mean reversion of future ROA

Dependent	$InnOrig_t$	ΔROA_t	$InnOrig_t * \Delta ROA_t$	$CIE_t * \Delta ROA_t$	ROA	ADV_t	$R\&D_t$	$Capex_t$	CIE_t	MTB_t	Intercept	R^2	Firms	
ΔROA_{t+1}	0.49 (7.11)	−3.04 (−7.63)	0.22 (2.10)	−0.17 (−1.75)	−4.92 (−6.26)	0.28 (2.85)	−1.40 (−3.88)	0.11 (0.68)	0.05 (1.05)	0.48 (2.33)	−0.05 (−0.16)	0.21	3049	−0.01
Dependent	$InnOrig_t$	ΔROA_t	$InnOrig_t * \Delta ROA_t$	$PIE_t * \Delta ROA_t$	ROA	ADV_t	$R\&D_t$	$Capex_t$	PIE_t	MTB_t	Intercept	R^2	Firms	
ΔROA_{t+1}	0.53 (7.33)	−3.06 (−7.63)	0.16 (1.72)	−0.04 (−0.71)	−4.91 (−6.26)	0.27 (2.67)	−1.41 (−3.88)	0.12 (0.71)	−0.11 (−1.47)	0.49 (2.32)	−0.06 (−0.18)	0.21	3049	

△ROE/ROA significantly negative but *InnOrig* *△ROE/ROA significantly positive

➡ Firms with high *InnOrig* exhibit significantly slower mean reversion

2.3 Results -- Table 2 *InnOrig* and the volatility of future profitability

Panel B1. InnOrig and volatility of future ROE

Dependent	$InnOrig_t$	CIE_t	ADV_t	$R\&D_t$	$Capex_t$	MTB_t	$ROE\_VOL_{t-4,t}$	Intercept	R^2	Firms	depmean	Economic Magnitude (%)
$ROE\_VOL_{t+1,t+5}$	−2.79	0.65	0.39	15.12	−0.99	−0.29	12.56	25.11	0.12	1745	24.53%	−11.36
	(−4.62)	(1.22)	(1.06)	(6.31)	(−1.30)	(−0.34)	(11.16)	(10.70)				
Dependent	$InnOrig_t$	PIE_t	ADV_t	$R\&D_t$	$Capex_t$	MTB_t	$ROE\_VOL_{t-4,t}$	Intercept	R^2	Firms		
$ROE\_VOL_{t+1,t+5}$	−2.79	0.87	0.38	15.11	−0.99	−0.31	12.58	25.11	0.12	1745	0.25	−11.38
	(−4.52)	(1.44)	(1.01)	(6.31)	(−1.33)	(−0.36)	(11.15)	(10.86)				

Panel B2. InnOrig and volatility of future ROA

Dependent	$InnOrig_t$	CIE_t	ADV_t	$R\&D_t$	$Capex_t$	MTB_t	$ROA\_VOL_{t-4,t}$	Intercept	R^2	Firms	depmean	Economic Magnitude (%)
$ROA\_VOL_{t+1,t+5}$	−0.68	0.12	−0.08	2.76	−0.32	0.08	3.09	6.07	0.32	1745	6.56%	−10.34
	(−7.19)	(1.96)	(−1.34)	(5.93)	(−2.57)	(0.52)	(12.03)	(15.35)				
Dependent	$InnOrig_t$	PIE_t	ADV_t	$R\&D_t$	$Capex_t$	MTB_t	$ROA\_VOL_{t-4,t}$	Intercept	R^2	Firms		
$ROA\_VOL_{t+1,t+5}$	−0.68	0.17	−0.08	2.76	−0.33	0.08	3.09	6.06	0.32	1745	0.07	−10.32
	(−6.80)	(2.34)	(−1.34)	(5.92)	(−2.63)	(0.52)	(12.07)	(15.31)				

The slopes on *InnOrig* are always significantly negative at the 1% level

➡ Firms with higher *InnOrig* have more stable future profitability

2.3 Results -- Table 3 *InnOrig* and future gross margin (GM)

Panel A. InnOrig and persistence of gross margin (GM)

Dependen$_t$	InnOrig$_t$	GM$_t$	InnOrigt*GM$_t$	CIE$_t$	ADV$_t$	R&D$_t$	Capex$_t$	MTB$_t$	Intercept	R^2	Firms
GMt+1	−0.16 (−1.37)	23.90 (16.41)	0.71 (1.97)	0.06 (2.78)	0.46 (10.39)	−0.29 (−1.44)	0.06 (0.43)	0.81 (3.34)	29.19 (51.85)	0.70	2374
Dependent	InnOrig$_t$	GM$_t$	InnOrigt*GM$_t$	PIE$_t$	ADV$_t$	R&D$_t$	Capex$_t$	MTB$_t$	Intercept	R^2	Firms
GMt+1	−0.11 (−0.98)	23.91 (16.40)	0.72 (1.99)	−0.01 (−0.16)	0.46 (10.12)	−0.29 (−1.41)	0.06 (0.47)	0.82 (3.33)	29.22 (51.76)	0.70	2374

The slopes on *InnOrig*GM* are significantly positive at the 5% level

➡ High *InnOrig* allows firms to maintain sustainable high gross margin

Panel B. InnOrig and volatility of future gross margin (GM)

Dependent	InnOrig$_t$	CIE$_t$	ADV$_t$	R&D$_t$	Capex$_t$	MTB$_t$	GM_VOL$_{t-4,t}$	Intercept	R^2	Firms
GM_VOLt+1,t+5	−0.28 (−3.42)	0.14 (2.12)	−0.28 (−7.17)	1.85 (4.56)	−0.17 (−1.81)	0.23 (1.87)	3.14 (8.98)	3.63 (17.88)	0.29	1735
Dependent	InnOrig$_t$	PIE$_t$	ADV$_t$	R&D$_t$	Capex$_t$	MTB$_t$	GM_VOL$_{t-4,t}$	Intercept	R^2	Firms
GM_VOLt+1,t+5	−0.27 (−3.46)	0.17 (4.56)	−0.29 (−7.37)	1.85 (4.56)	−0.18 (−1.89)	0.23 (1.84)	3.14 (8.87)	3.62 (18.03)	0.29	1735

The slopes on *InnOrig* are always significantly negative at the 1% level

➡ High *InnOrig* reduces volatility of future gross margin significantly.

2.3 Results -- Table 4 Return predictive power of *InnOrig* (single sort)

A. Excess returns and adjusted returns				B. Alphas from factor models								
InnOrig	Exret	Ind-adjret	Char-adjret	4F	4F + IMC	4F + LIQ	4F + citations-based EMI	4F + patents-based EMI	4F + RMW + CMA	4F + UMO	HXZ	Mispricing
Low	0.54	-0.14	-0.06	-0.10	-0.09	-0.11	-0.05	-0.03	-0.02	-0.06	-0.03	-0.03
	(1.83)	(-1.99)	(-0.25)	(-1.30)	(-1.22)	(-1.47)	(-0.61)	(-0.43)	(-0.25)	(-0.82)	(-0.31)	(-0.34)
Middle	0.73	0.05	0.08	0.18	0.19	0.19	0.11	0.09	0.19	0.18	0.16	0.11
	(2.86)	(1.12)	(0.32)	(2.80)	(2.79)	(2.86)	(1.73)	(1.44)	(2.91)	(2.69)	(2.55)	(1.53)
High	0.76	0.06	0.15	0.18	0.17	0.17	0.15	0.13	0.13	0.15	0.09	0.12
	(2.95)	(1.20)	(0.61)	(2.06)	(2.03)	(1.88)	(1.76)	(1.46)	(1.51)	(1.75)	(1.09)	(1.44)
High-Low	0.22	0.20	0.22	0.27	0.27	0.28	0.20	0.16	0.15	0.21	0.12	0.15
	(1.75)	(2.20)	(1.86)	(2.31)	(2.23)	(2.30)	(1.69)	(1.31)	(1.24)	(1.76)	(1.00)	(1.20)

The excess returns, industry- and characteristic-adjusted returns (Panel A) and alphas from different factor models (Panel B) generally increase with *InnOrig* from low to high.

➡ The relationship between InnOrig and abnormal returns is positive

High *InnOrig* firms are undervalued

2.3 Results -- Table 5 Return predictive power of *InnOrig* (double sorts)

Panel A. Return predictive power of InnOrig and valuation uncertainty (VU)

Panel A1. VU based on age and opacity

					Alphas from factor models				R^2 of different models			
VU	InnOrig	Exret	Ind-adjret	Char-adjret	4F	4F + RMW + CMA	HXZ	Mispricing	4F	4F + RMW + CMA	HXZ	Mispricing
Low	Low (L)	0.66	−0.04	0.03	−0.07	−0.19	−0.22	−0.20	0.83	0.85	0.85	0.83
		(2.68)	(−0.67)	(0.13)	(−0.61)	(−1.72)	(−1.95)	(−1.67)				
	Middle	0.74	0.03	0.06	0.13	0.08	0.05	0.03	0.92	0.93	0.93	0.92
		(3.06)	(0.50)	(0.29)	(1.66)	(1.07)	(0.63)	(0.39)				
	High (H)	0.73	0.05	0.12	0.12	−0.08	−0.13	−0.07	0.77	0.80	0.80	0.77
		(3.17)	(0.79)	(0.56)	(0.98)	(−0.69)	(−1.13)	(−0.62)				
	H-L	0.07	0.09	0.09	0.18	0.11	0.09	0.13	0.04	0.05	0.05	0.04
		(0.51)	(1.02)	(0.67)	(1.23)	(0.74)	(0.64)	(0.84)				
High	Low (L)	0.23	−0.45	−0.43	−0.23	0.15	0.08	0.10	0.86	0.88	0.86	0.83
		(0.47)	(−2.15)	(−0.99)	(−0.96)	(0.61)	(0.30)	(0.36)				
	Middle	0.89	0.10	0.22	0.40	0.67	0.49	0.78	0.74	0.75	0.74	0.76
		(1.95)	(0.44)	(0.51)	(1.43)	(2.28)	(1.71)	(2.60)				
	High (H)	1.32	0.54	0.74	0.84	1.00	0.90	1.08	0.72	0.71	0.69	0.72
		(2.60)	(2.02)	(1.52)	(2.77)	(3.08)	(2.68)	(3.16)				
	H-L	1.10	0.99	1.17	1.07	0.85	0.82	0.98	0.04	0.08	0.05	0.04
		(3.88)	(3.66)	(3.84)	(3.07)	(2.38)	(2.38)	(2.51)				

High *VU* firms are significant at the 1% level but low *VU* firms are insignificant

➡ *InnOrig* effect is stronger among firms with high *VU*

Similarly, the *InnOrig* effect is much stronger among firms with lower investor attention (*ATT*) or higher sensitivity of future profitability to *InnOrig* (*Sen*)

2.3 Results -- Table 6 Fama-MacBeth regressions (full sample)

	Model 1		Model 2		Model 3A		Model 3B		Model 4A		Model 4B		
Innovative originality (InnOrig)	0.15	(2.91)	0.15	(5.34)	0.10	(3.58)	0.12	(4.42)	0.09	(3.53)	0.12	(4.34)	Innovative originality (InnOrig)
Size			−0.24	(−1.88)	−0.13	(−1.50)	−0.12	(−1.45)	−0.11	(−1.24)	−0.11	(−1.21)	Size ($mn)
Book-to-market (BTM)			0.43	(5.41)	0.20	(2.75)	0.20	(2.75)	0.21	(2.96)	0.21	(2.94)	Book-to-market (BTM)
Momentum (MOM)			0.09	(1.00)	0.01	(0.09)	0.01	(0.09)	0.00	(0.05)	0.00	(0.05)	Momentum (MOM)
Institutional ownership (InstOwn)			0.09	(1.55)	0.09	(2.05)	0.09	(2.12)	0.08	(1.90)	0.09	(1.98)	Idiosyncratic volatility (IVOL)
Illiquidity (ILLIQ)			0.49	(6.47)	0.37	(3.74)	0.37	(3.74)	0.37	(3.71)	0.37	(3.71)	Skewness (SKEW)
Short-term return reversal (REV)			−1.03	(−9.77)	−1.12	(−10.71)	−1.12	(−10.71)	−1.11	(−10.50)	−1.11	(−10.50)	R&D/Market equity (RDME)
Asset growth (AG)					−0.22	(−4.60)	−0.22	(−4.50)	−0.22	(−4.68)	−0.22	(−4.58)	Patents/Assets (CTA)
Capex/Assets (IA)					−0.05	(−1.15)	−0.06	(−1.15)	−0.05	(−1.05)	−0.05	(−1.05)	Citations-based innovative efficiency (CIE)
Patents/Assets (CTA)					0.01	(0.28)	0.03	(0.75)	0.01	(0.23)	0.03	(0.68)	Patents-based innovative efficiency (PIE)
R&D/Market equity (RDME)					0.21	(2.98)	0.21	(2.99)	0.21	(3.06)	0.21	(3.08)	Return on assets (ROA)
Net stock issuance (NS)					−0.09	(−2.00)	−0.09	(−2.00)	−0.09	(−1.98)	−0.09	(−1.99)	Return on equity (ROE)
Return on assets (ROA)					0.10	(1.71)	0.10	(1.73)	0.08	(1.37)	0.08	(1.39)	Asset growth (AG)
Idiosyncratic volatility (IVOL)					0.31	(2.04)	0.31	(2.02)	0.31	(2.00)	0.31	(1.99)	Capex/Assets (IA)
Skewness (SKEW)					−0.10	(−2.72)	−0.10	(−2.69)	−0.10	(−2.78)	−0.10	(−2.75)	Net stock issuance (NS)
Citations-based IE (CIE)					0.06	(3.41)			0.06	(3.49)			Institutional ownership (InstOwn)
Patents-based IE (PIE)							−0.01	(−0.55)			−0.01	(−0.46)	Short-term return reversal (REV)
Number of sales segments (NSD)									−0.03	(−1.18)	−0.03	(−1.07)	
R^2	0.00		0.07		0.10		0.10		0.10		0.10		
Number of firms	4693		3789		3093		3093		3073		3073		

The *InnOrig* slopes remain statistically significant

➡ The *InnOrig* effect is robust to controlling for other commonly known return predictors, innovation-related variables, industry effects and sales diversity.

3. The brief plan of my dissertation

- Research question :
  - The relationship between innovation and the predictability of stock returns and profitability in the U.S. communication industry
- Data:
  - WRDS patent database: patent-related data from 2011-2019
  - Compustat: accounting data
  - CRSP: stock return data
- Methods:
  - Portfolio sorts
  - Fama-MacBeth regressions