Profitability Anomaly and Aggregate Volatility Risk

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August 10, 2016

Profitability Anomaly

- Profitability anomaly: high ROA firms beat low ROA firms in terms of future returns (see, e.g., Haugen and Baker, JFE 1996)
- Recent development: Fama and French (JFE 2015) suggest a five-factor model instead of the three-factor one
- The profitability factor is one of the two factors they add
- Other papers like Hou, Xue, and Zhang (RFS 2015) also suggest factor models with profitability factor

Sources of Profitability Anomaly

- On the surface, the profitability anomaly looks puzzling: why would highly profitable, successful firms be high-risk ones, and unprofitable, distressed firms be low-risk ones?
- Mispricing explanation comes to mind: probably investors do not pay enough attention to profitability and do not realize at first how good/bad profitable/unprofitable firms are
- "Q-theory approach" - high-risk firms have high cost of capital, thus they will undertake only the most profitable projects and have high profitability
- Fama and French (JFE 2015): the positive link between ROA and future returns follows directly from the dividend discounting model plus clean surplus accounting

Profitability Anomaly and Risk

- It is plausible that the profitability is risk, but the current literature does not say which risk is that
- If you hold high ROA firms, what is the bad thing that tends to happen to you in bad periods of time?
- The fact that the profitability anomaly follows from an accounting equality (FF 2015) implies that rational and behavioral explanations are essentially indistinguishable

Profitability Anomaly and Volatility Risk

- This paper suggests that low ROA firms do abnormally well when market volatility increases, and high ROA firms do abnormally poorly then
- Low ROA firms are distressed and their equity is like a call option on the assets: volatility is their friend
- Low ROA do lose when volatility goes up, because when volatility is up, market is down
- But, when volatility goes up, low ROA firms lose less than what their market beta implies

Johnson (JF 2004) Model

$$\beta_E = E(E, A) \cdot \beta_A, \qquad \frac{\partial E(E, A)}{\partial AD} < 0$$

- Consider firm equity E as an option on its assets A (the strike is the nominal value of debt)
- As disagreement about the assets increases, the beta of the assets does not change
- The elasticity of equity value wrt assets value decreases, since assets value is less "informative" about what the value of equity will be at "expiration"
- Hence, higher disagreement (about assets value) means lower systematic risk (of equity)
- But: the effect seems to be in the betas, why do we still see it in the alphas?

Extending the Johnson Model

- Both idiosyncratic volatility and aggregate volatility are high in recessions
- All else constant, higher idiosyncratic volatility has two effects, both stronger for firms with more option-like equity:
  - Risk exposure of option-like equity decreases
  - Value of option-like equity increases
- Therefore, distressed firms are hedges against aggregate volatility risk
- In volatile periods, they still lose, but much less than what their beta would imply

Aggregate Volatility Risk

- Volatility increase means worse future investment opportunities (Campbell, 1993)
- Volatility increase means the need to increase precautionary savings (Chen, 2002)
- Firms with most positive return sensitivity to aggregate volatility changes have lower expected returns (Ang et al, 2006)

Aggregate Volatility

- Aggregate volatility is measured by VIX index (old definition, current ticker VXO) from CBOE
- VIX index is defined as the implied volatility of S&P100 one-month near-the-money options
- Innovations to expected aggregate volatility - proxied by daily change in VIX
- Sample: January 1986 - December 2014 (VIX availability)

FVIX Factor

- FVIX mimics daily changes in VIX
- I regress daily changes in VIX on excess returns to five quintile portfolios sorted on prior month sensitivity to VIX changes
- The fitted part of the regression less the constant is the FVIX factor
- The correlation between FVIX and the change in VIX is 0.71

More about the FVIX Factor

- Negative FVIX beta is volatility risk (losing money when volatility increases)
- FVIX factor loses 1.34% per month, t-statistic -4.28 - FVIX hedges against volatility risk and has negative market beta
- CAPM alpha of FVIX is -47 bp per month, t-statistic -4.47
- Using other base assets for factor mimicking does not change the results

Necessary Conditions

- My explanation of the profitability anomaly assumes that low ROA firms are close to bankruptcy and high ROA firms are very far from it
- My explanation also needs significant idiosyncratic volatility / disagreement for low ROA firms
- If their IVol/AD are low, economy-wide shifts in IVol/AD will not affect them much, and the hedging mechanisms will not work
- The data confirm that both distress and IVol/AD are negatively associated with ROA

Profitability and Distress

	Low	Prof2	Prof3	Prof4	High	L-H
Lev	0.253	0.269	0.238	0.179	0.102	0.151
t-stat	*9.49*	*15.2*	*14.3*	*14.1*	*16.5*	*6.69*
O-Score	-0.623	-1.758	-1.918	-2.157	-2.362	1.739
t-stat	*-7.42*	*-25.4*	*-25.4*	*-24.0*	*-38.2*	*20.9*
-Z-Score	-2.753	-3.039	-3.378	-3.870	-4.687	1.934
t-stat	*-46.0*	*-74.4*	*-51.1*	*-39.0*	*-45.9*	*21.4*
Cred	12.718	10.410	9.169	8.006	8.139	4.579
Rating	*BB-*	*BBB-*	*BBB*	*BBB+*	*BBB+*	
t-stat	*100.2*	*36.0*	*33.1*	*35.9*	*36.7*	*28.7*
-DD	-4.587	-5.879	-6.863	-7.636	-8.153	3.567
t-stat	*-17.7*	*-18.6*	*-20.3*	*-23.0*	*-22.1*	*20.3*
EDP	0.033	0.020	0.017	0.016	0.017	0.016
t-stat	*16.8*	*18.5*	*20.2*	*21.0*	*21.5*	*10.8*

Profitability and Idiosyncratic Volatility

	Low	Prof2	Prof3	Prof4	High	L-H
IVol	0.023	0.018	0.017	0.017	0.018	0.005
t-stat	*21.0*	*25.8*	*25.6*	*26.4*	*29.7*	*7.89*
Disp	0.145	0.060	0.038	0.031	0.030	0.115
t-stat	*11.1*	*13.1*	*16.0*	*16.4*	*17.6*	*9.75*
CVEarn	1.851	0.894	0.538	0.458	0.480	1.372
t-stat	*17.5*	*13.3*	*21.4*	*29.8*	*28.0*	*13.5*
CVCFO	1.498	1.095	0.899	0.788	0.740	0.757
t-stat	*16.8*	*33.7*	*46.4*	*48.9*	*43.5*	*8.45*
Error	0.332	0.161	0.112	0.087	0.082	0.250
t-stat	*10.1*	*14.1*	*10.2*	*18.7*	*22.5*	*8.35*

Volatility Risk Explains Profitability Factor

Panel A. RMW on FVIX

	Raw	CAPM	ICAPM	FF	FF4	Carhart	FF5
α	0.362	0.482	0.119	0.413	0.180	0.374	0.134
t-stat	*2.41*	*3.35*	*0.70*	*3.05*	*1.44*	*2.84*	*1.13*
β_{MKT}		-0.184	-1.236	-0.102	-0.836	-0.089	-0.832
t-stat		*-3.84*	*-3.55*	*-2.18*	*-5.18*	*-2.19*	*-4.99*
β_{SMB}				-0.309	-0.220	-0.312	-0.222
t-stat				*-3.29*	*-2.81*	*-3.20*	*-2.71*
β_{HML}				0.208	0.170	0.225	0.189
t-stat				*2.26*	*2.18*	*2.58*	*2.52*
β_{Mom}						0.048	0.054
t-stat						*1.02*	*1.27*
β_{FVIX}			-0.789		-0.536		-0.543
t-stat			*-3.15*		*-4.58*		*-4.55*

Profitability Factor Does Not Explain FVIX

Panel B. FVIX on RMW

	Raw	CAPM	FF	+RMW	+CMA	Carhart	+RMW	+CMA
α	-1.342	-0.468	-0.445	-0.357	-0.300	-0.453	-0.371	-0.314
t-stat	*-4.28*	*-4.47*	*-3.69*	*-3.49*	*-3.59*	*-3.68*	*-3.58*	*-3.73*
β_{MKT}		-1.333	-1.370	-1.391	-1.410	-1.367	-1.387	-1.405
t-stat		*-36.0*	*-32.8*	*-38.4*	*-48.2*	*-32.1*	*-37.5*	*-47.3*
β_{SMB}			0.165	0.100	0.102	0.165	0.097	0.098
t-stat			*4.72*	*3.72*	*3.77*	*4.89*	*3.78*	*3.89*
β_{HML}			-0.071	-0.027	0.043	-0.068	-0.019	0.062
t-stat			*-1.32*	*-0.55*	*0.60*	*-1.30*	*-0.38*	*0.85*
β_{Mom}						0.010	0.021	0.030
t-stat						*0.58*	*1.36*	*1.91*
β_{RMW}				-0.211	-0.236		-0.216	-0.246
t-stat				*-4.62*	*-5.16*		*-4.75*	*-5.25*
β_{CMA}					-0.157			-0.174
t-stat					*-2.24*			*-2.43*

FVIX in Profitability Sorts

	Low	Prof2	Prof3	Prof4	High	H-L
α_{CAPM}	-0.366	-0.055	0.007	0.017	0.200	0.566
t-stat	*-1.85*	*-0.52*	*0.09*	*0.19*	*2.22*	*2.44*
α_{ICAPM}	0.078	0.006	0.124	-0.057	0.078	0.000
t-stat	*0.51*	*0.06*	*1.34*	*-0.56*	*0.82*	*0.00*
β_{FVIX}	0.960	0.121	0.227	-0.169	-0.265	-1.226
t-stat	*3.09*	*1.14*	*3.11*	*-1.98*	*-3.78*	*-3.40*
α_{FF}	-0.228	-0.076	0.032	0.055	0.245	0.473
t-stat	*-1.50*	*-0.75*	*0.36*	*0.64*	*3.04*	*2.38*
α_{FF4}	-0.013	-0.099	0.104	-0.004	0.158	0.170
t-stat	*-0.09*	*-0.91*	*1.17*	*-0.04*	*1.79*	*0.89*
β_{FVIX}	0.495	-0.064	0.140	-0.143	-0.199	-0.694
t-stat	*2.35*	*-0.60*	*2.00*	*-1.75*	*-2.36*	*-2.57*

FVIX in Gross Profitability Sorts

	Low	GProf2	GProf3	GProf4	High	H-L
α_{CAPM}	-0.272	0.020	-0.101	0.130	0.198	0.469
t-stat	*-1.93*	*0.20*	*-0.77*	*1.60*	*2.10*	*2.48*
α_{ICAPM}	-0.063	0.181	-0.029	0.065	0.057	0.120
t-stat	*-0.46*	*1.73*	*-0.25*	*0.82*	*0.55*	*0.65*
β_{FVIX}	0.426	0.331	0.149	-0.146	-0.304	-0.729
t-stat	*2.66*	*2.87*	*1.43*	*-2.06*	*-3.01*	*-3.04*
α_{FF}	-0.252	0.083	-0.010	0.176	0.223	0.475
t-stat	*-1.79*	*0.80*	*-0.10*	*2.32*	*2.35*	*2.56*
α_{FF4}	-0.114	0.174	0.027	0.088	0.098	0.211
t-stat	*-0.77*	*1.58*	*0.28*	*1.12*	*0.91*	*1.09*
β_{FVIX}	0.289	0.192	0.081	-0.204	-0.285	-0.574
t-stat	*1.67*	*2.29*	*0.86*	*-2.52*	*-2.14*	*-2.07*

Cross-Sectional Regressions

	Panel A. Price $>$ 5					Panel B. All Firms			
	1	**2**	**3**	**4**		**1**	**2**	**3**	**4**
Beta	0.070	-0.001	0.033	-0.007	**Beta**	0.051	0.005	0.031	0.003
t-stat	*0.60*	*-0.03*	*0.28*	*-0.22*	**t-stat**	*0.48*	*0.21*	*0.28*	*0.12*
Size	-0.536	-0.237	-0.387	-0.186	**Size**	-0.893	-0.820	-0.722	-0.741
t-stat	*-2.38*	*-0.96*	*-1.71*	*-0.74*	**t-stat**	*-3.32*	*-2.54*	*-2.41*	*-1.91*
MB	-0.855	-0.373	-0.816	-0.273	**MB**	-0.858	-0.443	-0.861	-0.504
t-stat	*-3.99*	*-1.15*	*-4.19*	*-0.99*	**t-stat**	*-3.96*	*-1.32*	*-4.21*	*-1.49*
Mom	1.269	1.035	1.214	0.978	**Mom**	0.968	0.618	0.925	0.545
t-stat	*5.64*	*2.66*	*5.34*	*2.49*	**t-stat**	*3.86*	*1.35*	*3.69*	*1.18*
Rev	-1.837	-1.140	-1.860	-1.109	**Rev**	-2.519	-1.783	-2.536	-1.779
t-stat	*-10.0*	*-4.69*	*-10.0*	*-4.60*	**t-stat**	*-11.1*	*-5.95*	*-11.1*	*-5.90*
Prof	0.532	0.314			**Prof**	0.416	0.181		
t-stat	*3.31*	*1.21*			**t-stat**	*2.19*	*0.55*		
GProf			0.615	0.367	**GProf**			0.495	0.131
t-stat			*4.37*	*1.63*	**t-stat**			*3.36*	*0.72*
γ_{VIX}		-0.239		-0.206	γ_{VIX}		-0.189		-0.196
t-stat		*-2.23*		*-2.04*	**t-stat**		*-1.96*		*-1.99*

Profitability and Volatility Risk: Recap

- FVIX explains the alpha of the new Fama-French profitability factor (RMW), but not the other way around
- FVIX also explains the returns in the sorts on profitability and gross profitability
- Since the explanation leans on the option-likeness of distressed firms, FVIX expectedly helps more on the short side (unprofitable firms)

Hypotheses Development

- My explanation of the profitability anomaly leans on the option-likeness of distressed firms and the fact that low ROA firms tend to be distressed
- Hence, the profitability anomaly should be stronger for distressed firms
- Volatility of volatile firms is more responsive, in absolute magnitude, to market-wide volatility shifts
- The hedging power of option-like equity is stronger if the equity (or assets) are volatile
- Hence, there will be more profitability anomaly for volatile firms and this regularity will be explained by FVIX

Profitability Anomaly across O-Score Quintiles

	Low	O2	O3	O4	High	H-L
α_{CAPM}	-0.080	0.041	0.127	0.152	0.680	0.760
t-stat	*-0.56*	*0.27*	*0.78*	*0.86*	*2.27*	*2.98*
α_{ICAPM}	-0.248	-0.299	-0.252	-0.236	0.136	0.385
t-stat	*-1.59*	*-1.72*	*-1.39*	*-1.25*	*0.46*	*1.48*
β_{FVIX}	-0.358	-0.726	-0.809	-0.828	-1.160	-0.801
t-stat	*-1.73*	*-3.90*	*-4.05*	*-3.22*	*-3.18*	*-3.62*

- Profitability anomaly exists only in top two distressed firms quintiles (much stronger in the top quintile)
- FVIX explains it everywhere, including the top quintile, and also explain the top-minus-bottom quintile spread in profitability anomaly

Profitability Anomaly across IVol Quintiles

	Low	IVol2	IVol3	IVol4	High	H-L
α_{CAPM}	0.073	0.326	0.186	0.241	0.918	0.846
t-stat	*0.36*	*1.60*	*0.76*	*0.86*	*2.96*	*2.19*
α_{ICAPM}	-0.016	0.244	0.006	-0.038	0.337	0.353
t-stat	*-0.06*	*1.15*	*0.03*	*-0.13*	*1.13*	*0.78*
β_{FVIX}	-0.190	-0.175	-0.383	-0.595	-1.242	-1.052
t-stat	*-0.79*	*-0.99*	*-1.55*	*-1.96*	*-2.08*	*-1.60*

- Similarly, profitability anomaly exists only in the top IVol quintile, and FVIX explains why
- One does not want to short low ROA firms if they are volatile and/or distressed, because such firms are good hedges against VIX increases

Conclusion

- Profitability factor is driven by volatility risk
- Low ROA firms are distressed, their equity is option-like
- Their risk does not increase as much and their value does not drop as much when market becomes more volatile
- Consistent with that, the high-minus-low ROA strategy has higher alphas in distressed and volatile subsamples, and this regularity is explained by FVIX
- So, we finally know which exact risk the profitability factor stands for