Aggregate Volatility Risk

Explaining the Small Growth Anomaly and the New Issues Puzzle

Alexander Barinov

Terry College of Business
University of Georgia

November 20, 2008

Playing Field

- **Small growth anomaly** - the smallest growth portfolio has the FF alpha of -0.3% per month (Fama and French, 1993)
- **New issues puzzle** - IPOs and SEOs have the FF alpha of -0.4% per month (Loughran and Ritter, 1995)
- **Cumulative issuance puzzle** - long high net issuance, short low net issuance has CAPM alpha of -0.5% per month (Daniel and Titman, 2006)
- Brav, Geczy, and Gompers (2000): Returns to small growth firms and IPOs/SEOs are driven by a common factor

Contribution

- The common explanation to all three anomalies is aggregate volatility risk
- Small growth firms earn low returns, because they hedge against aggregate volatility risk
- Firm-type story: recent issuers and routine heavy issuers seem to underperform, because they are small growth
- The liquidity explanation of the new issues puzzle (Eckbo and Norli, 2005) in fact picks up aggregate volatility risk

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)

Model Setup - Barinov (2007)

- A firm consists of assets in place, B, and growth options (call option on S)

$$dB_t = (r + \pi_B)B_t dt + \sigma_B B_t dW_B$$

$$dS_t = (r + \pi_S)S_t dt + \sigma_S S_t dW_S + \sigma_I S_t dW_I$$

- Growth options volatility consists of the systematic part and the idiosyncratic part
- dW_S and dW_B can be correlated

Main Mechanism: Cross-Section

$$\beta_P = E(P,S) \cdot \beta_S, \qquad \frac{\partial E(P,S)}{\partial \sigma_I} < 0$$

- As idiosyncratic volatility goes up
  - The beta of the asset behind the growth option stays constant
  - The growth option elasticity wrt the underlying asset value declines
- Therefore, the growth options beta declines in idiosyncratic volatility

Main Mechanism: Time-Series

- Both IVol and aggregate volatility are high in recessions
- All else constant, higher IVol has two effects, both stronger for high volatility growth firms
  - Risk exposure of growth options decreases
  - Value of growth options increases
- Therefore, high volatility firms are hedges against aggregate volatility risk
- The same is true about small growth firms and new issues

Data 1: Aggregate Volatility

- Aggregate volatility is measured by VIX index (old definition) from CBOE
- VIX index is defined as the implied volatility of S&P100 one-month near-the-money options
- Return sensitivity to VIX changes is from daily regressions of stock excess return on the market excess return and the VIX change, run each firm-month

Data 2: BVIX Factor

- VIX sensitivity portfolios use previous month sensitivity and are held for one month
- BVIX factor is the value-weighted return differential between the most negative and the most positive VIX sensitivity quintiles
- Sample: February 1986 - December 2006 (BVIX availability)

Data 3: Other

- Returns, listing, market value from CRSP
- New issues, their dates, after-issue book and market values from SDC
- IPO/SEO portfolios are held for 3 years starting 1 month after the issue
- Factors, 25 size-B/M portfolios from Kenneth French's website
- Sample: January 1986 to December 2006

Table 1: Is BVIX Priced?

- BVIX earns a bit less than 1% per month of abnormal return
- BVIX betas are significant for 25 Size-B/M portfolios, 25 IVol-M/B portfolios, 48 industry portfolios
- BVIX factor significantly improves the GRS statistic for the alphas
- CAPM+BVIX performs better than FF for 25 IVol-M/B and 48 industry portfolios

Table 1A&1B: Three Puzzles and Business Cycle

- I regress the smallest growth portfolios on MKT and business cycle variables
- In Table 1B I subtract return to the largest value portfolio from LHS
- TARCH is forecast of MKT volatility from TARCH model, TARCH and VIX are logs
- BC is 1 if NBER says recession, HVIX is 1 if VIX in top 25%, HTARCH is 1 if TARCH in top 25%

Table 1A: Three Puzzles and Business Cycle

	BC	VIX	HVIX	TARCH	HTARCH
S1G1	0.735	0.615	0.588	1.285	1.293
t-stat	*0.52*	*0.56*	*0.41*	*1.90*	*1.22*
S2G1	1.454	0.695	0.604	1.048	1.399
t-stat	*1.59*	*1.01*	*0.78*	*2.29*	*2.29*
IPO	1.264	0.291	0.001	0.957	1.447
t-stat	*0.90*	*0.34*	*0.00*	*1.65*	*1.86*
SEO	0.716	0.224	0.456	0.774	1.017
t-stat	*0.87*	*0.38*	*0.78*	*1.94*	*1.93*
CumIss	0.287	0.423	0.751	0.431	0.198
t-stat	*0.38*	*0.65*	*0.87*	*1.14*	*0.35*
MKT	-0.449	-3.539	-2.537	0.114	-0.074
t-stat	*-0.27*	*-3.37*	*-3.08*	*0.22*	*-0.10*

Table 1B: Three Puzzles vs. Large Value across Business Cycle

	BC	VIX	HVIX	TARCH	HTARCH
S1G1	1.512	1.620	0.970	1.662	2.069
t-stat	*1.03*	*1.13*	*0.49*	*2.26*	*1.95*
S2G1	2.231	1.700	0.987	1.425	2.175
t-stat	*2.33*	*1.65*	*0.75*	*2.50*	*3.18*
IPO	2.042	1.296	0.383	1.334	2.223
t-stat	*1.39*	*1.08*	*0.25*	*1.96*	*2.65*
SEO	1.493	1.229	0.838	1.151	1.792
t-stat	*1.46*	*1.43*	*0.80*	*2.51*	*3.23*
CumIss	1.064	1.428	1.134	0.808	0.974
t-stat	*1.02*	*1.33*	*0.78*	*1.49*	*1.37*

Table 2A: Aggregate Volatility Risk and the Small Growth Anomaly

VW Returns, January 1986 - December 2006

	Small	Size2	Size3	Size4	Big	S-B
α_{CAPM}	-0.926	-0.525	-0.369	-0.058	0.004	-0.930
t-stat	*-2.74*	*-2.35*	*-1.89*	*-0.32*	*0.03*	*-2.42*
α_{FF}	-0.645	-0.280	-0.025	0.225	0.233	-0.879
t-stat	*-3.55*	*-2.57*	*-0.28*	*1.77*	*2.96*	*-4.37*
α_{ICAPM}	-0.440	-0.158	-0.046	0.207	-0.066	-0.374
t-stat	*-0.95*	*-0.53*	*-0.18*	*0.86*	*-0.51*	*-0.74*
β_{BVIX}	-0.495	-0.374	-0.330	-0.270	0.072	-0.567
t-stat	*-1.96*	*-2.22*	*-2.40*	*-2.58*	*2.54*	*-2.11*

Table 2A: Aggregate Volatility Risk and the Negative Size Effect

VW Returns, January 1986 - December 2006

	Small	Size2	Size3	Size4	Big	S-B
α_{CAPM}	-0.926	-0.525	-0.369	-0.058	0.004	-0.930
t-stat	*-2.74*	*-2.35*	*-1.89*	*-0.32*	*0.03*	*-2.42*
α_{FF}	-0.645	-0.280	-0.025	0.225	0.233	-0.879
t-stat	*-3.55*	*-2.57*	*-0.28*	*1.77*	*2.96*	*-4.37*
α_{ICAPM}	-0.440	-0.158	-0.046	0.207	-0.066	-0.374
t-stat	*-0.95*	*-0.53*	*-0.18*	*0.86*	*-0.51*	*-0.74*
β_{BVIX}	-0.495	-0.374	-0.330	-0.270	0.072	-0.567
t-stat	*-1.96*	*-2.22*	*-2.40*	*-2.58*	*2.54*	*-2.11*

BVIX Factor and Small Growth

- The CAPM and the Fama-French model produce large and significant alphas in the two smallest growth quintiles and negative size effect for growth firms
- The ICAPM with BVIX halves the alphas and makes them insignificant
- The results are even stronger if I drop the January 2001 outlier, when the smallest growth firms make 55%

Table 3: Aggregate Volatility Risk and the New Issues Puzzle

	Panel A. IPOs			Panel B. SEOs		
	CAPM	**ICAPM**	**FF**	**CAPM**	**ICAPM**	**FF**
α	-0.578	-0.326	-0.406	-0.436	-0.245	-0.415
t-stat	*-2.01*	*-1.08*	*-2.11*	*-2.25*	*-1.22*	*-3.16*
β_{MKT}	1.466	1.423	1.228	1.318	1.286	1.203
t-stat	*16.4*	*15.7*	*16.7*	*23.2*	*23.2*	*21.6*
β_{SMB}			1.048			0.775
t-stat			7.46			7.54
β_{HML}			-0.211			0.019
t-stat			*-1.30*			*0.20*
β_{BVIX}		-0.281			-0.203	
t-stat		*-1.99*			*-2.65*	
$\Delta\alpha/\alpha$	44%		20%	44%		41%

Table 4: New Issues Puzzle in Cross-Section

IPO	MB1	MB2	MB3	3-1	Size1	Size2	Size3	1-3
α_{CAPM}	0.315	-0.463	-0.835	1.150	-0.639	-0.505	0.270	0.909
t-stat	*1.14*	*-1.60*	*-2.30*	*3.70*	*-2.02*	*-1.69*	*0.95*	*2.37*
α_{ICAPM}	0.364	-0.338	-0.483	0.846	-0.372	-0.257	0.341	0.713
t-stat	*1.41*	*-1.13*	*-1.27*	*2.60*	*-1.12*	*-0.84*	*1.16*	*1.68*
β_{BVIX}	-0.094	-0.135	-0.385	0.291	-0.291	-0.299	-0.100	0.191
t-stat	*-1.04*	*-1.13*	*-2.11*	*2.53*	*-1.86*	*-2.29*	*-1.90*	*1.17*

SEO	MB1	MB2	MB3	3-1	Size1	Size2	Size3	1-3
α_{CAPM}	0.022	-0.262	-0.665	0.686	-0.495	-0.376	-0.215	0.280
t-stat	*0.10*	*-1.17*	*-2.80*	*2.91*	*-2.04*	*-1.94*	*-1.52*	*1.14*
α_{ICAPM}	0.022	-0.177	-0.340	0.362	-0.269	-0.171	-0.234	0.036
t-stat	*0.11*	*-0.83*	*-1.25*	*1.40*	*-1.01*	*-0.90*	*-1.61*	*0.12*
β_{BVIX}	-0.010	-0.092	-0.339	0.329	-0.232	-0.217	0.008	0.240
t-stat	*-0.15*	*-1.61*	*-3.06*	*4.04*	*-2.07*	*-3.44*	*0.12*	*1.55*

New Issues Puzzle Explained!

- BVIX explains about 40% of the new issues puzzle and leaves the rest insignificant
- New issues underperformance is driven primarily by small and growth new issues
- BVIX is successful to explain their abysmal returns and why they are different from large and value new issues
- The results are even stronger if I drop January 2001, when IPOs make 39%, and SEOs make 24%

Cumulative Issuance Puzzle

- Cumulative issuance - log growth in market value minus log cumulative returns in the past five years
- It shows the net effect of all equity issuing and retiring activity (but no IPOs!)
- Daniel and Titman (2006) show that firms with high cumulative issuance earn abnormally low future returns
- They say it is managers taking advantage of intangible information mispricing
- I need to show high cumulative issuance means small growth

Table 5B: Size, Market-to-Book, and Cumulative Issuance

	Small	Size2	Size3	Size4	Big
Low	0.104	0.079	0.112	0.069	0.005
t-stat	*5.4*	*3.8*	*5.3*	*3.8*	*0.1*
MB2	0.194	0.162	0.122	0.084	0.043
t-stat	*7.2*	*5.9*	*4.3*	*3.5*	*1.0*
MB3	0.309	0.262	0.170	0.124	0.031
t-stat	*8.0*	*9.4*	*9.0*	*5.8*	*1.1*
MB4	0.450	0.445	0.316	0.210	0.049
t-stat	*9.8*	*9.5*	*8.3*	*8.0*	*1.9*
High	0.662	0.721	0.563	0.354	0.074
t-stat	*16.8*	*18.8*	*11.8*	*14.7*	*2.9*

Table 6A: Aggregate Volatility Risk and the Cumulative Issuance Puzzle

Panel A. EW Returns

	LowIss	MedIss	HighIss	H-L
α_{CAPM}	0.574	0.513	-0.065	-0.639
t-stat	*3.00*	*2.37*	*-0.23*	*-2.66*
α_{ICAPM}	0.503	0.586	0.126	-0.378
t-stat	*2.70*	*2.61*	*0.41*	*-1.31*
β_{BVIX}	0.070	-0.081	-0.203	-0.273
t-stat	*1.41*	*-1.19*	*-1.65*	*-2.09*

Table 7: Cumulative Issuance Puzzle in Cross-Section

	MB1	MB2	MB3	1-3
α_{CAPM}	0.124	-0.319	-1.063	1.187
t-stat	*0.55*	*-1.37*	*-2.67*	*4.30*
α_{ICAPM}	0.232	-0.118	-0.456	0.688
t-stat	*0.97*	*-0.43*	*-0.85*	*1.77*
β_{BVIX}	-0.117	-0.211	-0.624	0.507
t-stat	*-1.34*	*-1.84*	*-2.44*	*2.58*

Explaining the Cumulative Issuance Puzzle

- High cumulative issuance firms are usually small growth
- BVIX factor explains about 45% of the cumulative issuance puzzle and makes the alphas insignificant
- Cumulative issuance puzzle is stronger for growth firms
- BVIX can explain the cross-section of the cumulative issuance puzzle

Liquidity Factor vs. BVIX Factor

- Eckbo and Norli (2005) show that a turnover-based liquidity factor explains IPO underperformance
- Liquidity factor and BVIX have large positive correlation of 0.45
  - Strange, because small firms load negatively on BVIX and should load positively on liquidity risk
  - If turnover picks up uncertainty, the liquidity factor can be a proxy for BVIX
- In two-factor models, BVIX explains returns to the liquidity factor, but not vice versa

Table 9: Horse Race

	S1G1	S2G1	IPO	SEO	CumIss
α	-0.088	0.090	0.043	-0.019	-0.088
t-stat	*-0.23*	*0.39*	*0.16*	*-0.10*	*-0.46*
β_{BVIX}	-0.064	-0.070	0.171	0.073	0.082
t-stat	*-0.51*	*-0.71*	*1.79*	*1.07*	*1.56*
β_{LMH}	-1.049	-0.738	-1.099	-0.670	-0.861
t-stat	*-7.50*	*-7.57*	*-8.94*	*-9.77*	*-10.77*

Table 9: Horse Race

	S1G1	S2G1	IPO	SEO	CumIss
α	-0.088	0.090	0.043	-0.019	-0.088
t-stat	*-0.23*	*0.39*	*0.16*	*-0.10*	*-0.46*
β_{BVIX}	-0.064	-0.070	0.171	0.073	0.082
t-stat	*-0.51*	*-0.71*	*1.79*	*1.07*	*1.56*
β_{LMH}	-1.049	-0.738	-1.099	-0.670	-0.861
t-stat	*-7.50*	*-7.57*	*-8.94*	*-9.77*	*-10.77*

Table 10A: Liquidity Factor and Cross-Section of New Issues Puzzle

	Size1	Size2	Size3	3-1
α_{IPO}	0.150	0.199	0.379	0.229
t-stat	*0.46*	*0.75*	*1.35*	*0.64*
β_{LMH}	-1.069	-0.953	-0.148	0.922
t-stat	*-8.64*	*-6.37*	*-1.72*	*5.73*
α_{SEO}	0.037	0.079	-0.121	-0.158
t-stat	*0.14*	*0.39*	*-0.76*	*-0.60*
β_{LMH}	-0.720	-0.616	-0.126	0.594
t-stat	*-12.30*	*-6.19*	*-1.27*	*6.05*

Liquidity Factor vs. BVIX: Conclusion

- Eckbo and Norli's liquidity factor picks up aggregate volatility risk, not liquidity risk
  - Liquidity factor and BVIX factor are strongly and counterintuitively positively correlated
  - BVIX factor explains returns to the liquidity factor, but not vice versa
  - Smallest growth firms seem to be extraordinary hedges against "liquidity risk"
  - "Liquidity risk" is much lower for the smallest new issues than for the largest ones

Summary

- Aggregate volatility risk measured by the BVIX factor is the common explanation of
  - Small growth anomaly
  - New issues puzzle
  - Cumulative issuance puzzle
- BVIX factor explains the cross-section of the new issues puzzle and cumulative issuance puzzle
- Liquidity factor of Eckbo and Norli (2005) captures aggregate volatility risk, not liquidity risk
- January 2001 is a powerful outlier for small growth