Presentation and Discussion of "**Volatility Managed Portfolio**" A. Moreira, T. Muir, JF 2017

Giovanni Aiello

Rice University

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Overview

What do they do

- They construct **Volatility Managed Portfolio**: the weights of the portfolio are determined by $1/\sigma_t^2$
  - Take more risk when volatility is low and viceversa

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- They use the weak relationship between volatility and returns

What do they find

Volatility managed portfolios

- Generate large alpha on original factors
- Take less risk in recession when σ is high
- Sell after market crashes (1929, 1987, 2008)

Volatility Managed Portfolio Empirically

Data

- Factors:
  - **FF3:** Excess Mkt Return (Mkt), size (SMB), value (HML); **FF5:** profitability (RMW), investment (CMA), **Momentum** (Mom)
  - **HXZ:** Investment (IA), ROE
  - **Lustig et al 2011** Currency return (Carry or FX)
- **Daily** and Monthly data for each factor
- Sample: 1926-2015 (Mkt, SMB, HML, Momentum), Post 1960 for the rest
- All numbers annualized

Managed Volatility Factors

- Let f_{t+1} be an excess return, construct

$$f^{\sigma}_{t+1} = \frac{c}{\sigma^2_t(f)} \times f_{t+1}$$

  - $\sigma_t(f)$ previous month realized volatility (daily data)
  - choose c so f^{σ} has same unconditional volatility as f

- Regression:

$$f^{\sigma}_{t+1} = \alpha + \beta f_{t+1} + \epsilon_{t+1}$$

Volatility Managed Factors: alphas

	(1) Mkt^{σ}	(2) SMB^{σ}	(3) HML^{σ}	(4) Mom^{σ}	(5) RMW^{σ}	(6) CMA^{σ}	(7) MVE^{σ}	(8) FX^{σ}	(9) ROE^{σ}	(10) IA^{σ}
MktRF	0.61 (0.05)									
SMB		0.62 (0.08)								
HML			0.57 (0.07)							
Mom				0.47 (0.07)						
RMW					0.62 (0.08)					
CMA						0.68 (0.05)				
MVE							0.58 (0.03)			
Carry								0.71 (0.08)		
ROE									0.63 (0.07)	
IA										0.68 (0.05)
α	4.86 (1.56)	-0.58 (0.91)	1.97 (1.02)	12.51 (1.71)	2.44 (0.83)	0.38 (0.67)	4.12 (0.77)	2.78 (1.49)	5.48 (0.97)	1.55 (0.67)
N	1,065	1,065	1,065	1,060	621	621	1,060	360	575	575
R2	0.37	0.38	0.32	0.22	0.38	0.46	0.33	0.51	0.40	0.47
rmse	51.39	30.44	34.92	50.37	20.16	17.55	25.34	21.78	23.69	16.58

Volatility Managed Factors: alphas

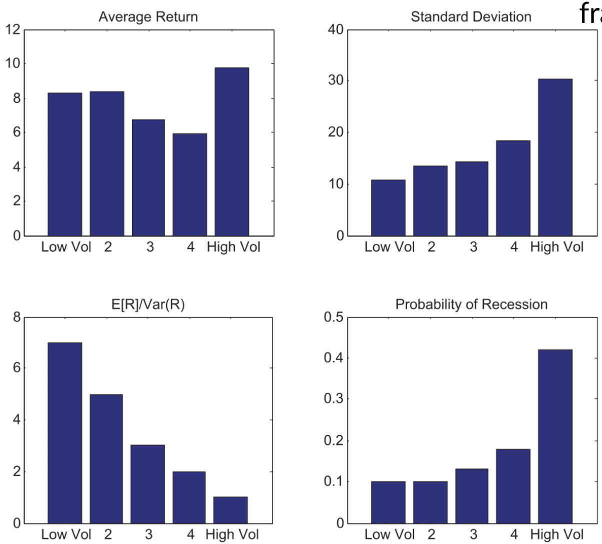
The appraisal ratio

$$\frac{\alpha}{\sigma_\epsilon}$$

gives us a measure of the extent to which we are expanding the slope of the MVE frontier

- MKT (0.33), HML (0.20), MOM (0.88), Profitability (0.41), Carry (0.44), ROE (0.80), Investment (0.32)

Volatility timing works due to weak risk-return trade-off (market)



They show in a continuous theoretical framework

$$\alpha = -\operatorname{cov}\left(\frac{\mu_t}{\sigma_t^2}, \sigma_t^2\right)\frac{c}{E\left[\sigma_t^2\right]}$$

- The mean-variance trade-off weakens in periods of high volatility.
- A standard mean-variance investor should take more (less) risk when volatlity is low (high)

Multiple Factors

- Some investors invest in multiple factors beyond the market
- Extend our approach to the (static) MVE portfolio
  - For given set of factors construct in sample MVE: $f^*_{t+1} = b^* F_{t+1}$
  - Volatility time the MVE portfolio: $f^{\sigma,*}_{t+1} = \frac{c}{\sigma^2_t(f^*)} f^*_{t+1}$

MVE Portfolios

	(1) Mkt	(2) FF3	(3) FF3 Mom	(4) FF5	(5) FF5 Mom	(6) HXZ	(7) HXZ Mom
Alpha (α)	4.86	4.99	4.04	1.34	2.01	2.32	2.51
	(1.56)	(1.00)	(0.57)	(0.32)	(0.39)	(0.38)	(0.44)
Observations	1,065	1,065	1,060	621	621	575	575
R-squared	0.37	0.22	0.25	0.42	0.40	0.46	0.43
rmse	51.39	34.50	20.27	8.28	9.11	8.80	9.55
Original Sharpe	0.42	0.52	0.98	1.19	1.34	1.57	1.57
Vol Managed Sharpe	0.51	0.69	1.09	1.20	1.42	1.69	1.73
Appraisal Ratio	0.33	0.50	0.69	0.56	0.77	0.91	0.91

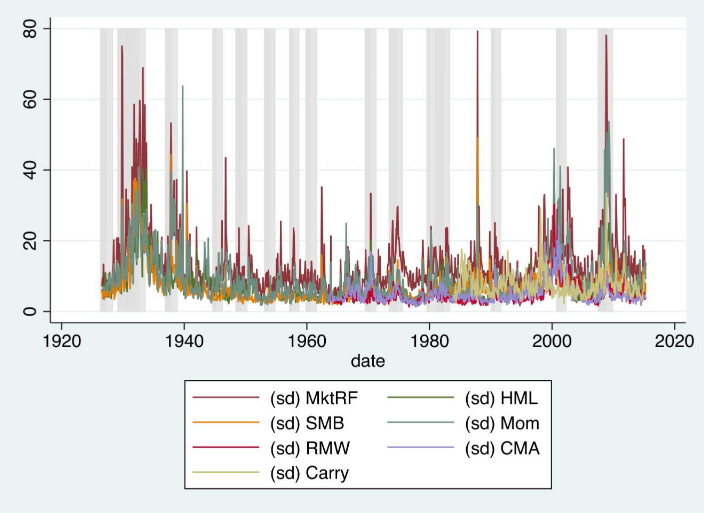
- A positive MVE alpha implies that our volatility-managed strategy increases Sharpe ratios relative to the best buy-and-hold Sharpe ratio achieved by someone with access to the multiple factors

Robustness/ Additional Empirical Results

Take Less Risk in Recession

	(1) Mkt^{σ}	(2) HML^{σ}	(3) Mom^{σ}	(4) RMW^{σ}	(5) CMA^{σ}	(6) FX^{σ}	(7) ROE^{σ}	(8) IA^{σ}
MktRF	0.83							
	(0.08)							
MktRF $\times 1_{rec}$	-0.51							
	(0.10)							
HML		0.73						
		(0.06)						
HML $\times 1_{rec}$		-0.43						
		(0.11)						
Mom			0.74					
			(0.06)					
Mom $\times 1_{rec}$			-0.53					
			(0.08)					
RMW				0.63				
				(0.10)				
RMW $\times 1_{rec}$				-0.08				
				(0.13)				
CMA					0.77			
					(0.06)			
CMA $\times 1_{rec}$					-0.41			
					(0.07)			
Carry						0.73		
						(0.09)		
Carry $\times 1_{rec}$						-0.26		
						(0.15)		
ROE							0.74	
							(0.08)	
ROE $\times 1_{rec}$							-0.42	
							(0.11)	
IA								0.77
								(0.07)
IA $\times 1_{rec}$								-0.39
								(0.08)
Observations	1,065	1,065	1,060	621	621	362	575	575
R-squared	0.43	0.37	0.29	0.38	0.49	0.51	0.43	0.49

Take Less Risk in Recession



Transaction Costs

- Results for the market portfolio
- Transaction cost from Frazzini, Israel and Moskovitz (2015)

w	Description	$\mid \Delta w \mid$	$E[R]$	α	α After Trading Costs			
					1bps	10bps	14bps	Break Even
$\frac{1}{RV_t^2}$	Realized Variance	0.73	9.47%	4.86%	4.77%	3.98%	3.63%	56bps
$\frac{1}{RV_t}$	Realized Vol	0.38	9.84%	3.85%	3.80%	3.39%	3.21%	84bps
$\frac{1}{E_t[RV_{t+1}^2]}$	Expected Variance	0.37	9.47%	3.30%	3.26%	2.86%	2.68%	74bps
$min\left(\frac{c}{RV_t^2}, 1\right)$	No Leverage	0.16	5.61%	2.12%	2.10%	1.93%	1.85%	110bps
$min\left(\frac{c}{RV_t^2}, 1.5\right)$	50% Leverage	0.16	7.18%	3.10%	3.08%	2.91%	2.83%	161bps

Works with Leverage Constraint

Volatility Timing and Leverage

Panel A: Weights and Performance for Alternative Volatility Managed Portfolios

w_t	Description	α	Sharpe	Appraisal	Distribution of Weights w: P50	P75	P90	P99
$\frac{1}{RV_t^2}$	Realized Variance	4.86	0.52	0.34	0.93	1.59	2.64	6.39
		(1.56)						
$\frac{1}{RV_t}$	Realized Volatility	3.30	0.53	0.33	1.23	1.61	2.08	3.36
		(1.02)						
$\frac{1}{E_t[RV_{t+1}^2]}$	Expected Variance	3.85	0.51	0.30	1.11	1.71	2.38	4.58
		(1.36)						
$min\left(\frac{c}{RV_t^2}, 1\right)$	No Leverage	2.12	0.52	0.30	0.93	1	1	1
		(0.71)						
$min\left(\frac{c}{RV_t^2}, 1.5\right)$	50% Leverage	3.10	0.53	0.33	0.93	1.5	1.5	1.5
		(0.98)						

Panel B: Embedded Leverage Using Options: 1986-2012

	Buy and hold	Vol Timing	Vol Timing With Embedded Leverage: Calls	Calls + puts
Sharpe Ratio	0.39	0.59	0.54	0.60
α	–	4.03	5.90	6.67
$s.e.(\alpha)$	–	(1.81)	(3.01)	(2.86)
β	–	0.53	0.59	0.59
Appraisal Ratio	–	0.44	0.39	0.46

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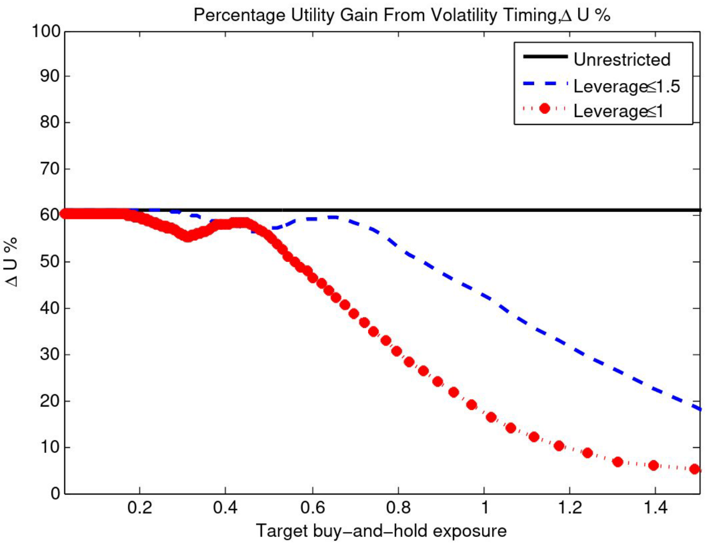
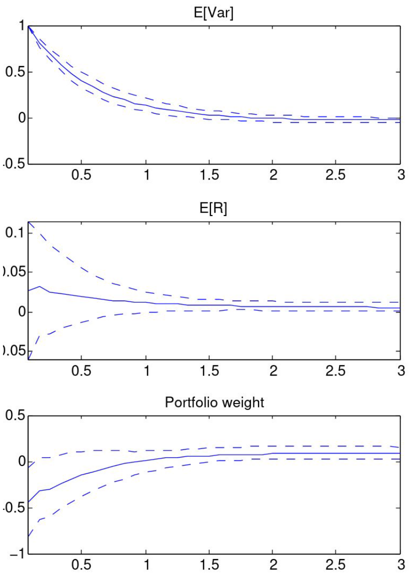


The dynamics



Discussion

- Substantial implication: higher return with lower risks
- Cederburg et al (2020) show they do not outperform their unmanaged counterparts out of sample
- Barroso and Detzel (2020) show that they don't survive transaction costs