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

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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	-0.58	1.97	12.51	2.44	0.38	4.12	2.78	5.48	1.55
	(1.56)	(0.91)	(1.02)	(1.71)	(0.83)	(0.67)	(0.77)	(1.49)	(0.97)	(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

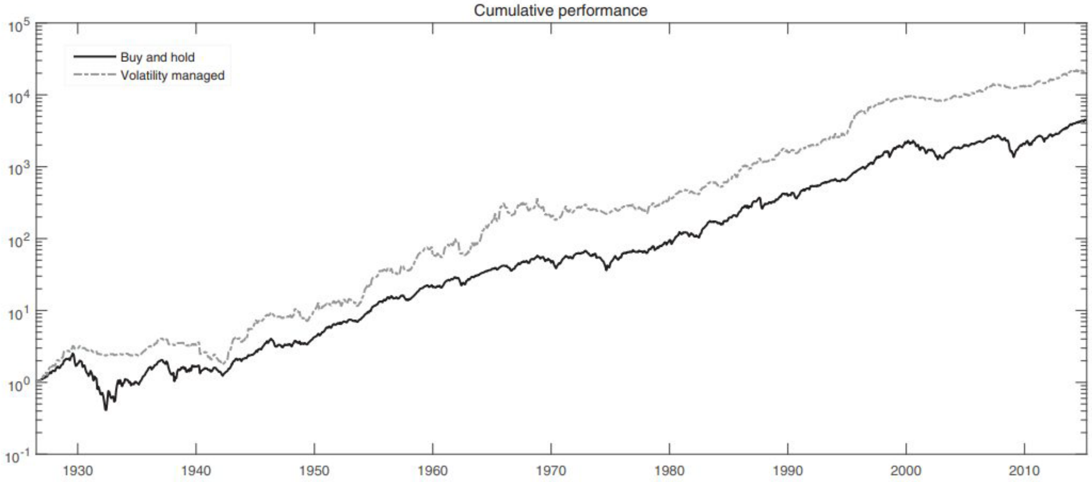
Volatility Managed Factors: alphas
Replication

Table 1: Regression results

	(1) Mkt	(2) SMB	(3) HML	(4) CMA	(5) RMW	(6) MOM	(7) ROE	(8) IA	(9) BAB
mktrf	0.616***								
	(0.024)								
smb		0.627***							
		(0.025)							
hml			0.568***						
			(0.026)						
cma				0.749***					
				(0.030)					
rmw					0.605***				
					(0.034)				
mom						0.471***			
						(0.028)			
r_roe							0.705***		
							(0.034)		
r_ia								0.737***	
								(0.031)	
bab									1.339***
									(0.061)
alpha	5.055***	-0.556	1.671	-0.087	2.820***	12.782***	5.275***	1.644**	0.170***
	(1.544)	(0.946)	(1.128)	(0.718)	(0.920)	(1.594)	(1.058)	(0.714)	(0.024)
Observations	1065	1065	1065	621	621	1060	579	579	1012
R-squared	0.389	0.381	0.302	0.508	0.338	0.215	0.426	0.497	0.325
RMSE	50.025	30.814	36.601	17.659	22.777	51.389	24.891	16.759	0.761

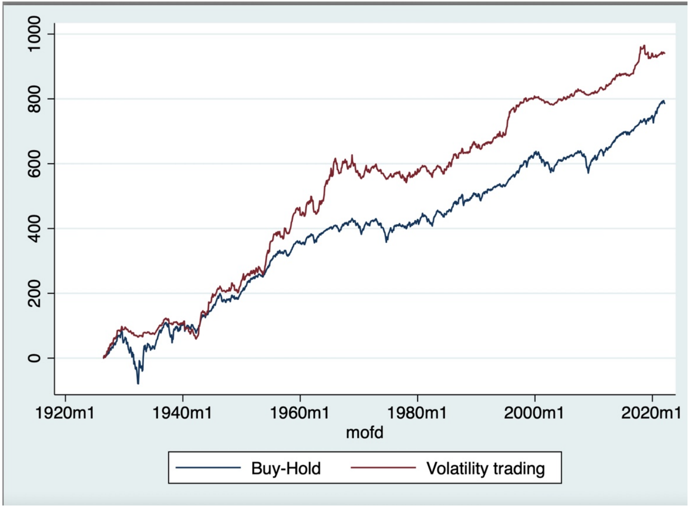
Standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Cumulative Performance



Cumulative Performance

Replication



Volatility Managed Factors: alphas

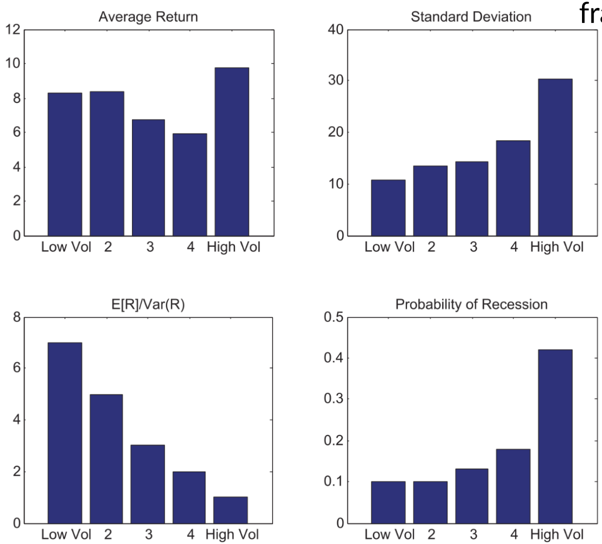
The appraisal ratio

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

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

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

- 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

MVE Portfolios: Replication

Table 2 : Regression results

	(1) FF3	(2) FF3MOM	(3) FF5	(4) FF5MOM	(5) HXZ	(6) HXZMOM
mveff3	0.574***					
	(0.025)					
mveff3_mom		0.591***				
		(0.025)				
mveff5			0.638***			
			(0.032)			
mveff5_mom				0.671***		
				(0.031)		
mvehxz					0.901***	
					(0.030)	
mvehxz_mom						0.943***
						(0.029)
alpha	18.137**	3.675***	0.326	-1.395	1.118*	1.326**
	(8.514)	(0.879)	(0.638)	(1.163)	(0.587)	(0.580)
Observations	1060	1060	621	621	579	579
R-squared	0.339	0.341	0.389	0.424	0.614	0.652
RMSE	276.037	27.763	15.731	28.987	12.299	12.854

Standard errors are in parentheses

**** p<.01, ** p<.05, * p<.1*

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

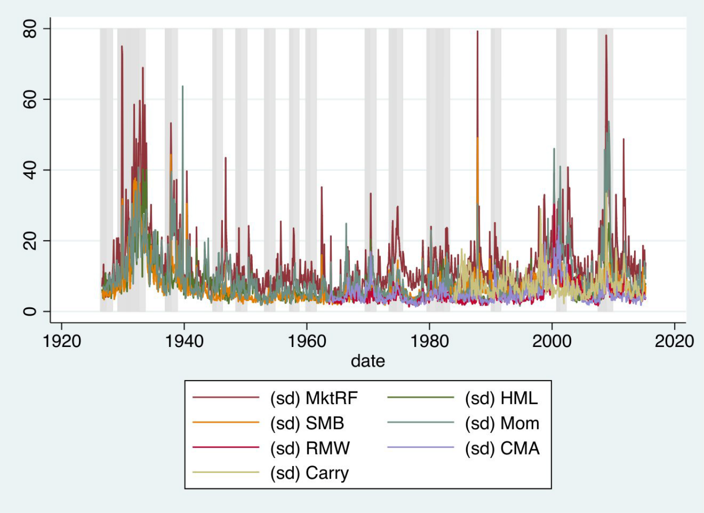
Take Less Risk in Recession

Replication

Table 3 : Regression results

	(1) Mkt	(2) SMB	(3) HML	(4) CMA	(5) RMW	(6) MOM	(7) ROE	(8) IA	(9) BAB
mktrf	0.846***								
	(0.030)								
mktrf_rec	-0.530***								
	(0.045)								
smb		0.654***							
		(0.027)							
smb_rec		-0.143**							
		(0.062)							
hml			0.735***						
			(0.033)						
hml_rec			-0.429***						
			(0.053)						
cma				0.800***					
				(0.033)					
cma_rec				-0.223***					
				(0.069)					
rmw					0.621***				
					(0.037)				
rmw_rec					-0.115				
					(0.099)				
mom						0.757***			
						(0.038)			
mom_rec						-0.554***			
						(0.053)			
r_roe							0.816***		
							(0.039)		
roe_rec							-0.412***		
							(0.074)		
r_ia								0.818***	
								(0.034)	
ia_rec								-0.371***	
								(0.071)	
bab									1.527***
									(0.069)
bab_rec									-0.754***
									(0.138)
alpha	2.692*	-0.612	1.081	-0.012	2.833***	10.747***	4.840***	1.714**	0.157***
	(1.467)	(0.945)	(1.098)	(0.713)	(0.920)	(1.529)	(1.035)	(0.699)	(0.024)
Observations	1065	1065	1065	621	621	1060	579	579	1012
R-squared	0.460	0.384	0.343	0.517	0.340	0.290	0.455	0.519	0.344
RMSE	47.088	30.752	35.521	17.526	22.770	48.910	24.271	16.391	0.750

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

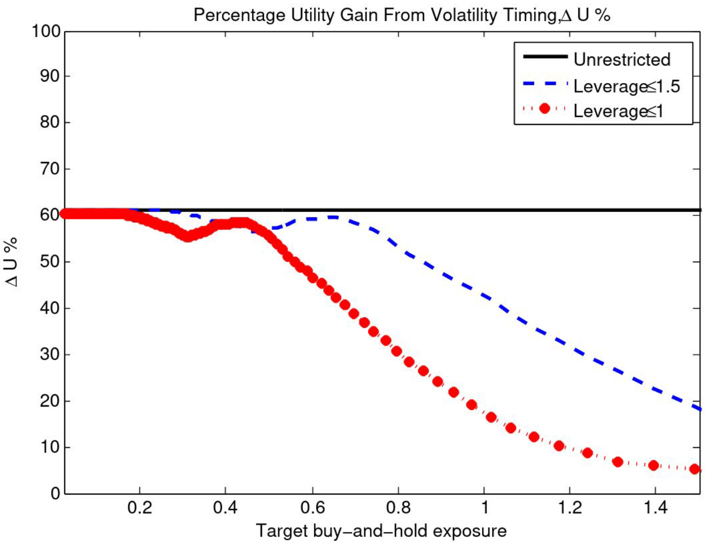
Panel A: Weights and Performance for Alternative Volatility Managed Portfolios

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)						

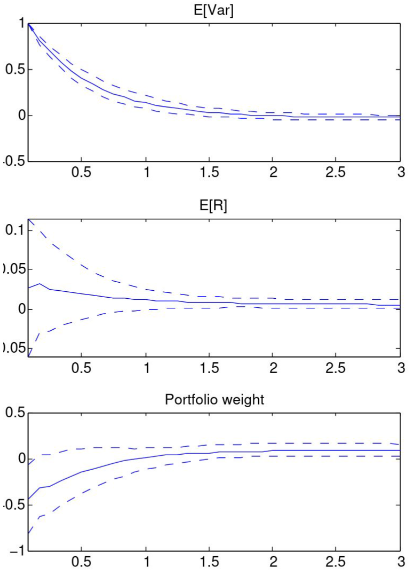
Panel B: Embedded Leverage Using Options: 1986-2012

	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

Works with Leverage Constraint



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