

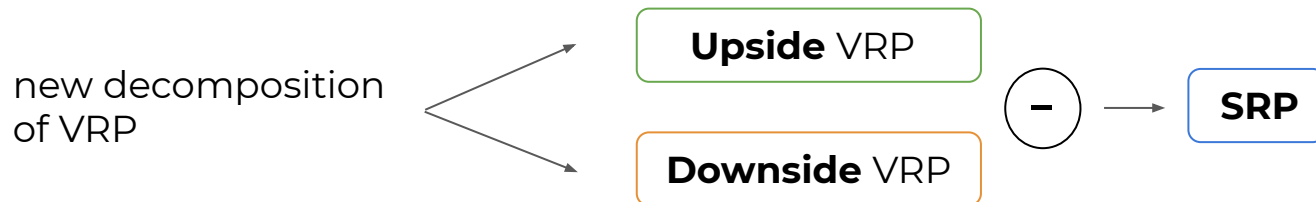
A VARIANCE CHAOS

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OVERVIEW “DOWNSIDE VARIANCE RISK PREMIUM”

GOAL

investigate the **short-term relationship** between **risk and return**



evaluate the effectiveness of these measures as **equity market returns predictors**

FINDINGS

- downside VRP is the main **driver** of the VRP
- **positive relation:** Downside VRP & equity premium
- **robust** to inclusion of common pricing factors
- SRP: significant prediction power for excess returns, beyond reach of VRP
- theoretical framework

CONSTRUCTION OF MEASURES

GOAL

construct non-parametric measures of

Upside VRP

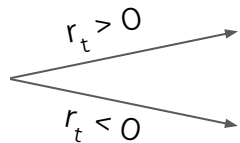
Downside VRP

SRP

HOW?

separate positive and negative excess log returns [$k=0$]

$$\mathbf{VRP} = \mathbf{IV} - \mathbf{RV}$$



$$\mathbf{VRP_U} = \mathbf{IV_U} - \mathbf{RV_U}$$

$$\mathbf{VRP_D} = \mathbf{IV_D} - \mathbf{RV_D}$$



$$\mathbf{SRP} = \mathbf{VRP_U} - \mathbf{VRP_D}$$

RV (P-expectation):

intraday squared returns +
overnight returns + scaling + RW

IV (Q-expectation):

option prices + model-free
approach + NA conditions +
Fengler Algorithm

DATA

→ WHARTON DATABASE

Excess Returns

- R_f: 3-month Treasury Bill rate
- Aggregate Market Portfolio: S&P 500 composite index

CRSP

RV

- HF SPY consolidated quotes

TAQ

Cleaning:

- ☐ delete zero entries
- ☐ delete duplicate entries
- ☐ average bid & ask
- ☐ create 5-min bins [median]
- ☐ NAN: interpolation

IV

- SPX EU call and put options
- Zero Coupon Yield Curve
- S&P 500 dividend yield

OptionMetrics

Cleaning:

- ☐ average bid & ask
- ☐ delete ITM options
- ☐ delete options < \$ $\frac{3}{8}$
- ☐ delete options > 1 year & < 7 days
- ☐ delete options not traded for more than 3 days
- ☐ NAN: interpolation

2007-2017 sample period

SUMMARY STATISTICS

Table 1: summary statistics

	VRP	VRP^U	VRP^D	RV^U	RV^D	IV^U	IV^D	excess return
mean	0.067227	-0.034161	0.101388	0.147523	0.168599	0.112790	0.268409	0.460595
std	0.250356	0.135721	0.165122	0.246959	0.321733	0.155481	0.347752	4.809556
min	-3.344685	-1.812280	-1.532405	0.008506	0.004881	0.006662	0.043216	-35.874178
max	1.911116	0.397544	1.513572	2.346593	3.166236	1.732368	3.522595	20.273505



METHODOLOGY

Predictive Regressions

Examine the explanatory power of

Upside VRP

Downside VRP

VRP

SRP

$$r_{t \rightarrow t+k}^e = \beta_0 + \beta_1 x_t(h) + \epsilon_{t \rightarrow t+k}$$

$h=1,2,3,6,9,12$

$k=1,2,3,6,9,12$

$$r_{t \rightarrow t+k}^e = \beta_0 + \beta_1 x_t^U(h) + \beta_2 x_t^D(h) + \epsilon_{t \rightarrow t+k}$$

Robust standard errors

OOS Analysis

Evaluate the forecast ability of

Upside VRP

Downside VRP

VRP

→ Expanding Window Regressions & generate one-step ahead predictions

→ Accuracy Measure: **RMSE**

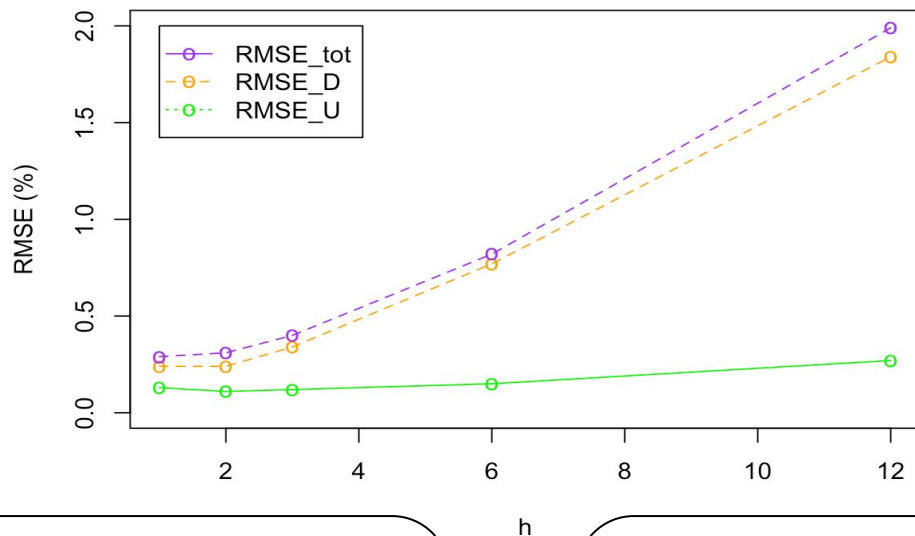
$h=1,2,3,6,12$

$k=1$ -day ahead

RESULTS: Predictive Regressions

	REFERENCE PAPER	OUR RESULTS
VRP	<ul style="list-style-type: none">• best prediction horizon for $k=3$• R^2 decreases as $h>6$	same
VRP_D	<ul style="list-style-type: none">• highest predictive power: $k=3, 6$• still significant with $h=12$	same
VRP_U	<ul style="list-style-type: none">• low predictive power• not significant when $h>3$	more predictive power than VRP_D
SRP	<ul style="list-style-type: none">• high predictive power	low predictive power
IV/RV	<ul style="list-style-type: none">• excess returns driven by IV	same

RESULTS: OOS



RESULTS

- best: **VRP_U**
- low RMSE for all $h \rightarrow$ good predictive ability
- performance decreases with h
- peak $h=2$

OUTLOOK

- k-step ahead forecasts
- evaluate best forecast horizon
- robustness of standard errors

CONCLUSIONS

Extended Time Period
[2007-2017]

P-Expectation of the RV using
historical intraday returns

Q-Expectation using EU Call and Put
option data observed in the market

Analysis of **predictability** of excess returns using

Upside VRP

Downside VRP

VRP

SRP

→ **Upside VRP**: main driver of future excess returns

→ **Risk-neutral** expectations contribute stronger to the predictability than realized measures

OOS: Evaluation of one-step ahead prediction accuracy through expanding window regressions

→ **Low RMSE** values across all construction horizons [peak: $h=2$]

→ Best Results for **Upside VRP**

DISCUSSION OF REFERENCE

PROS

- **comprehensive** and **innovative** investigation of the predictability of excess returns;
- **Medium term** predictor;
- support empirical results with **theoretical framework**;
- **robustness tests**.

CONS

- **option data treatment** not described in detail;
- **models** not described in detail;
- **overlapping** data.

FURTHER WORK

- replicate models using **non overlapping** data;
- investigate impact of the threshold **k**;
- **ML** approach:
 - kernels and penalization;
 - unsupervised learning.



THANK YOU FOR YOUR ATTENTION