Analysis of Risk and Return Perceptions

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March, 2018

Learning through market perception

- Perception is a learning process
  - Market participants tend to draw perceptions or opinions from multiple statistic indicators on return and risk.
  - Those perceptions will affect the behavior of market participants.
- Complications
  - Indicators:
    - For a given target market measure or perception, there tend to be multiple correlated indicators
    - Each indicator only reflects a certain aspect.
  - Interpretation:
    - The interpretation of market indicators is fully at the discretion of market participants who might use the indicators for different purposes.
    - For example, with the same set of market indicators, long-term investors would have quite a different interpretation from short-term investors.
  - With the availability of “Big Data”, this above issue becomes pronounced.

Overview

- Research questions:
  - How market form perceptions of return and risk
  - How such perceptions would affect the future returns
- Paper overview
  - With SP500 index as an equity market proxy, this paper uses Partial Least Square Structural Equation Modelling (PLS-SEM) approach to estimate the perceptions and explain their relationship with future returns.
  - The test reveals a positive intertemporal relationship between current risk and return (momentum) perceptions with future returns.
  - The details of extracting market perceptions show how market participants read thorough multiple market indicators.

Review: Risk-return relationship

- Most asset pricing models suggests a positive relationship between a stock portfolio's expected return and risk (e.g. Sharpe 1964, Linter 1965, Merton 1973, Ross 1976, Lucas 1978, and Breeden 1979).
- The related empirical studies results do not provide any conclusive evidence.
  - For example, French et al. (1987) and Chou (1988) showed that the risk-return relationship for the US stock market is positive and significant.
  - Baillie and DeGennaro (1990) suggests the risk-return relationship could be insignificant due to the t-distribution of the error term.
  - On the contrary, Campbell (1987) and Nelson (1991) found that the US risk-return relation is negative but insignificant when asymmetric volatility is taken into account. Glosten, Jagannathan, and Runkle (1993) documented a significantly negative relationship.
- To address the seemingly conflict, studies worked on the issues with model misspecification, yet the risk-return tradeoff remains a puzzle.
  - It includes studies with semi-parametric models (e.g. French et al., 1987; Ghysels, Santa-Clara, Valkanov, 2005; Guo and Whitelaw, 2006; Bali, Demirtas, and Levy, 2009), and
  - Studies with no-parametric models (Pagan and Hong, 1991; Harvey, 2001; Harrison and Zhang, 1999).
  - They produced mixed results on risk-return relationship.
- Other studies have pointed out that the risk–return relationship might be time-varying
  - (see e.g., Campbell, 1987; Harvey, 1989; Chou, Engle, & Kane, 1992; Harvey, 2001; Lettau & Ludvigson, 2010, Kim and Lee, 2008; Nyberg, 2012)

Example of study, French, et al (1987)

Table 6b

Comparison of ARIMA with GARCH predictions of stock market volatility and their relations to monthly CRSP value-weighted excess holding period returns.

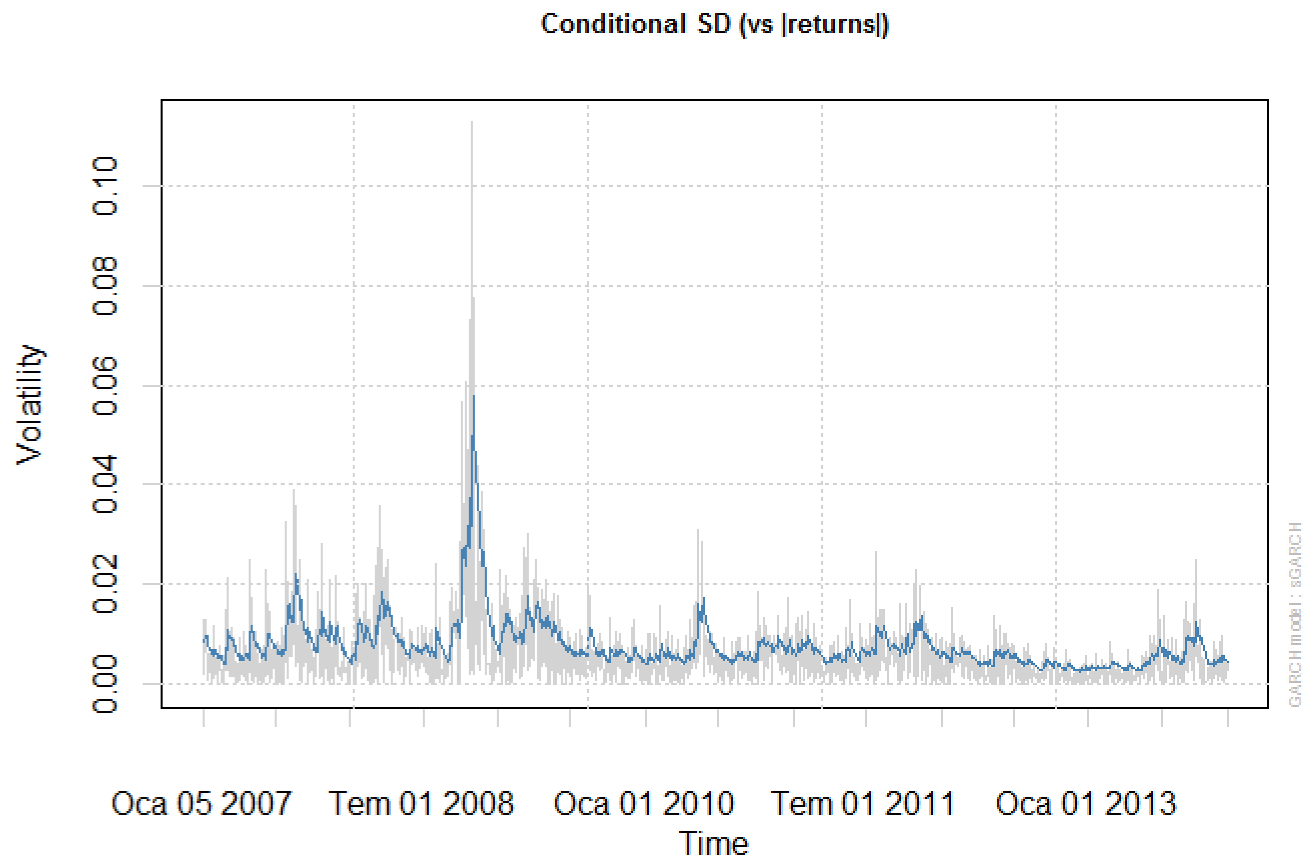
Weighted least squares regressions of monthly CRSP value-weighted excess holding period returns against the predicted standard deviation or variance of stock returns from the monthly GARCH-in-mean model.[a]

$$(R_{mt} - R_{ft}) = \alpha - \beta\sigma_t + \varepsilon_t \qquad (10a)$$

$$(R_{mt} - R_{ft}) = \alpha - \beta\sigma_t^2 + \varepsilon_t \qquad (10b)$$

Volatility measure	α	β	$S(\varepsilon)$	R^2	$Q(12)$	$SR(\varepsilon)$
(A) February 1928 to December 1984, T = 683						
Monthly GARCH Std. dev.	0.0035 (0.0057) [0.0057]	0.049 (0.133) [0.133]	0.0580	0.0005	20.9	6.83
Monthly GARCH Variance	0.0049 (0.0025) [0.0024]	0.349 (0.989) [0.973]	0.0580	0.0005	20.8	6.81
(B) February 1928 to December 1952, T = 299						
Monthly GARCH Std. dev.	0.0209 (0.0090) [0.0089]	−0.233 (0.179) [0.179]	0.0750	0.0180	12.9	6.75
Monthly GARCH Variance	0.0121 (0.0042) [0.0041]	−0.884 (1.152) [1.107]	0.0749	0.0144	13.4	6.71
(C) January 1953 to December 1984, T = 384						
Monthly GARCH Std. dev.	−0.0108 (0.0093) [0.0087]	0.372 (0.237) [0.218]	0.0408	0.0035	16.5	5.99
Monthly GARCH Variance	−0.0034 (0.0045) [0.0043]	4.423 (2.655) [2.381]	0.0408	0.0044	16.6	5.99

Example, fit Garch(1,1) with index returns



Disconnection b/w academia and practice

- A common investor will face multiple indicators about of market volatility and momentum. Those indicators could be different in method of calculation, time horizon, frequency (daily, monthly, or yearly), etc.
  - Take risk measure as an example, the volatility indicators could be calculated from both complicated GARCH models and simple statistical measures such as standard deviations.
  - Since those different indicators measure the same market features, they tend to be highly correlated with each other. The investors read thorough multiple correlated indicators and draw an opinion or perception of the overall risk level. This opinion in turn will affect market behavior. Similar, investor would face multiple momentum measure. The reasoning flows as follows.
- An investor collects and calculates multiple technical indicators (long and short-term return and risk measure in our case.)
  - The investor will comprehend the indicators and reach a perception on current market volatility and return. Clearly, the perception on risk and return are not directly observable despite the many indicators.
- Such perceptions then will affect the investor’s behavior.

Review: measurement of perceptions

- Correlated indicators
  - Different indicators measures the same phenomenon from different perspectives
  - They tend to be correlated
  - Instead of seeking uncorrelated indicators, we can extra the shared component among indicators
- Perception:
  - Defined as the shared component by indicators for return and risk
  - High correlation could lead to more significant perception.
- Discretion of perception
  - The formation also affected by he purpose of learning.
  - For example, different perception interpretation for forecasting of daily, monthly, and yearly.
  - This is addressed by the inner model among the perceptions.
- How to measure the perception?
  - Instead of normal (causal) relation that is vulnerable to collinearity issues
    - Multiple indicators → Perceptions
  - We model, indictors are reflections of perceptions
    - ***Perceptions → multiple indicators***

Perception with reflective indicators

Model	Indicators	Variable	Description	PVOL	PCHG	FRET
outer	XCHG_1	mret.01	Return (1-month)		reflective	
outer	XCHG_2	mret.04	Return (4-month)		reflective	
outer	XCHG_3	mret.12	Return (12-month)		reflective	
outer	XCHG_4	uprc.09	Return from last 9-month low		reflective	
outer	XCHG_5	uprc.12	Return from last 12-month low		reflective	
outer	XCHG_6	uprc.24	Return from last 24-month low		reflective	
outer	XVOL_1	mstd.24	Rolling monthly stdev (24-month)	reflective		
outer	XVOL_2	mstd.36	Rolling monthly stdev (36-month)	reflective		
outer	XVOL_3	mstd.60	Rolling monthly stdev (60-month)	reflective		
outer	FRET	mret.f6	Return (next 6-month)			reflective

Stats: correlation matrix among indicators

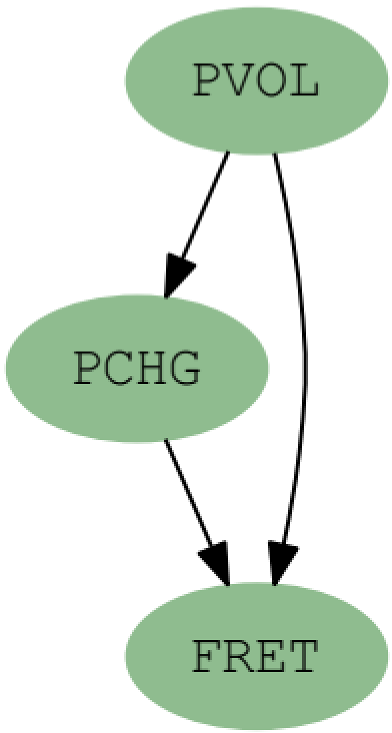
	mret.01	mret.04	mret.12	uprc.09	uprc.12	uprc.24	mstd.24	mstd.36	mstd.60	mret.f6
mret.01	1.00	0.54	0.30	0.51	0.44	0.38	0.00	0.01	0.11	0.11
mret.04	0.54	1.00	0.60	0.73	0.70	0.65	-0.07	-0.01	0.14	0.12
mret.12	0.30	0.60	1.00	0.38	0.56	0.75	-0.30	-0.16	0.01	0.05
uprc.09	0.51	0.73	0.38	1.00	0.90	0.63	0.31	0.31	0.31	0.21
uprc.12	0.44	0.70	0.56	0.90	1.00	0.73	0.28	0.29	0.30	0.20
uprc.24	0.38	0.65	0.75	0.63	0.73	1.00	0.05	0.17	0.21	0.26
mstd.24	0.00	-0.07	-0.30	0.31	0.28	0.05	1.00	0.88	0.61	0.17
mstd.36	0.01	-0.01	-0.16	0.31	0.29	0.17	0.88	1.00	0.77	0.18
mstd.60	0.11	0.14	0.01	0.31	0.30	0.21	0.61	0.77	1.00	0.35
mret.f6	0.11	0.12	0.05	0.21	0.20	0.26	0.17	0.18	0.35	1.00

Modelling with perceptions

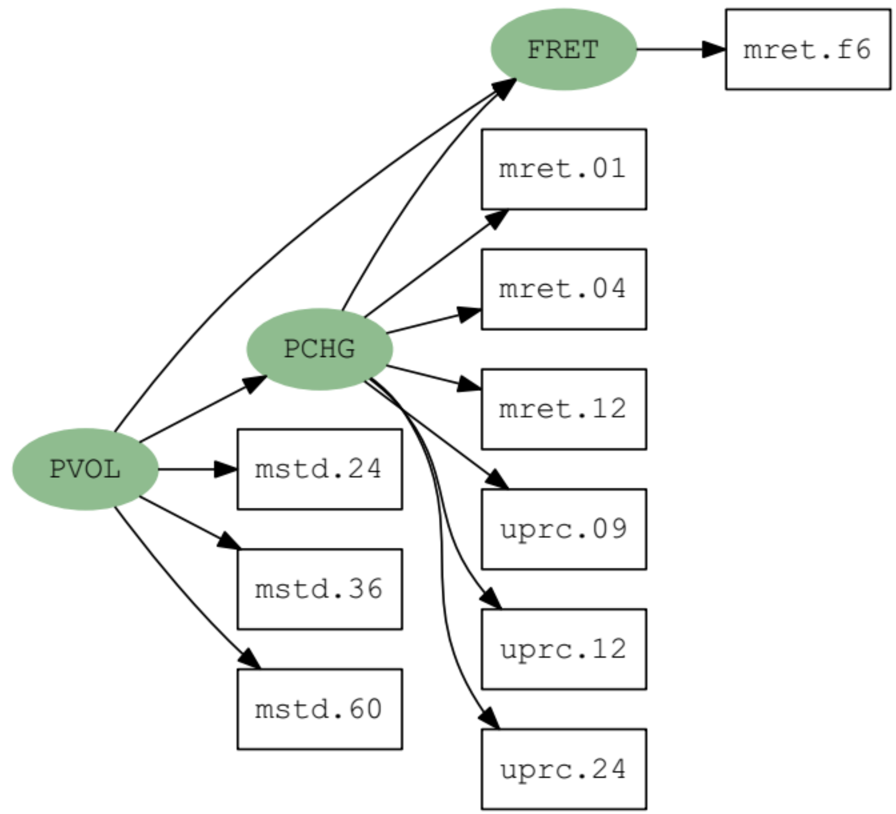
- Inner model: relationship among perceptions
  - $PCHG_t = a0 + a1 * PVOL_t + \varepsilon_a = [1, PVOLt] * A + \varepsilon_a$
  - $FRET_t = b0 + b1 * PVOL_t + b2 * PCHG_t + \varepsilon_b$
  - Overview of latent constructs:
    - $FRET_t = \log(P_{t+1} / P_t)$ is the return for the next month
    - $PCHG_t$ is the current return or momentum perception.
    - $PVOL_t$ is the current perception of volatility.
- Outer model: measurements of perceptions
  - The perceptions is modelled as common component shared by indicators, and is calculated as the weighted average of the indicators.
    - $PVOL = [XVOL\_1, XVOL\_2, \ldots] * W_V' = XVOL * W_V' + \varepsilon_v$
    - $PCHG = [XCHG\_1, XCHG\_2, \ldots] * W_R' = XCHG * W_V' + \varepsilon_p$
  - Meanwhile, the common component explains the variability of indicators.
    - $XVOL = [XVOL\_1, XVOL\_2, \ldots] = PVOL * L_V + \varepsilon_{xv}$
    - $XCHG = [XCHG\_1, XCHG\_2, \ldots] = PCHG * L_R + \varepsilon_{xc}$
    - FRET = next month return
- Goal:
  - maximize the variance of FRET explained by perceptions
  - Maximize the common component shared by the indicators
    - PVOL -> XVOL
    - PCHG -> XCHG

PLS-SEM model

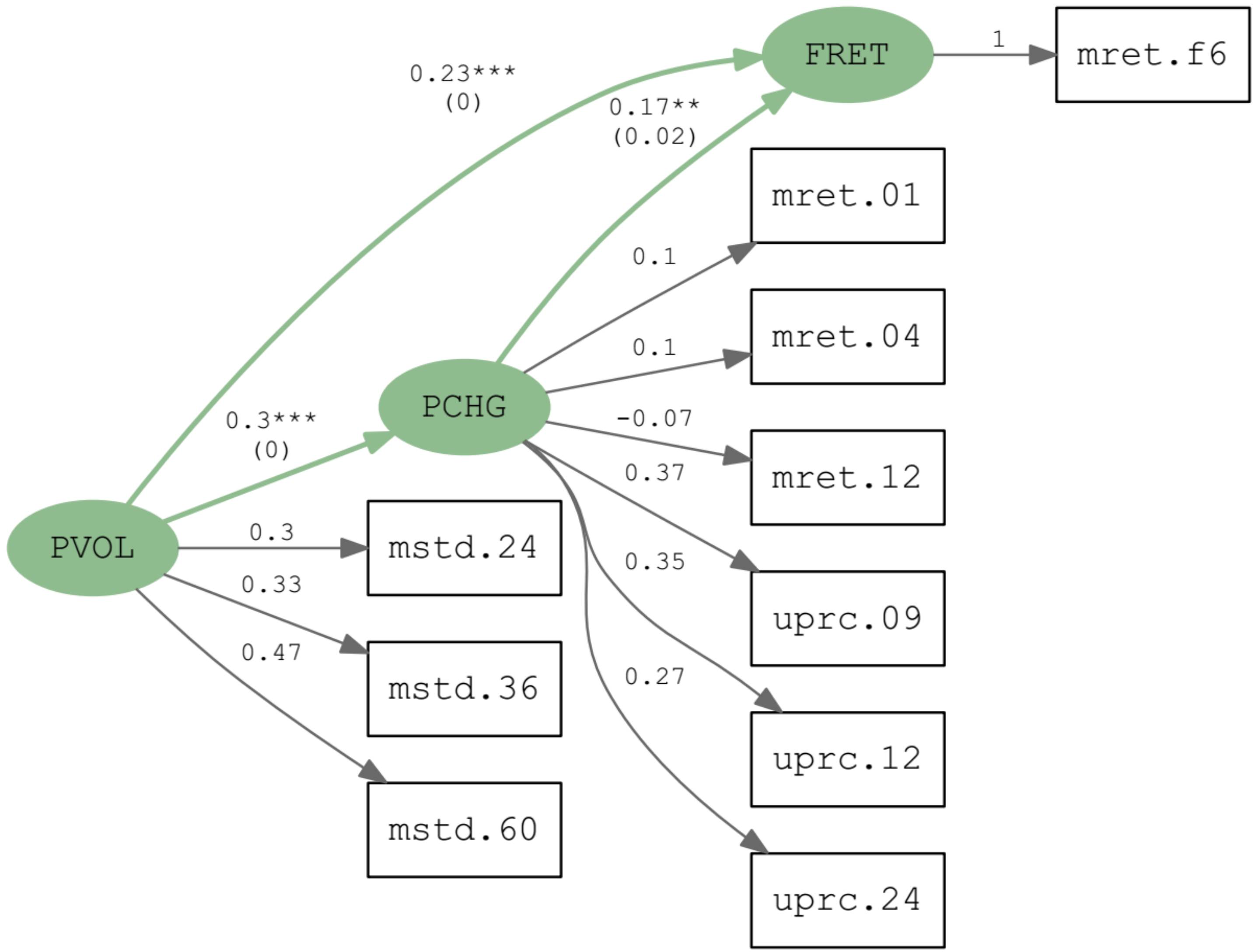
Inner model among perceptions



With outer measurements



PLS-SEM: measurement and Results



Inner model between market perceptions

$FRET = b0 + b1*PVOL + b2*PCHG + \varepsilon_b$

$PCHG = a0 + a1*PVOL + \varepsilon_a$

	Estimate	Stdev	t-value	p-value
a0	0.00	6.90%	0.00	1.00
a1	0.30	6.90%	4.39	0.00
b0	0.00	0.07	0.00	1.00
b1	0.23	0.07	3.13	0.00
b2	0.17	0.07	2.32	0.02

Summary of regressions

	Type	R^2	Avg R^2 of Indicators
PVOL	Exogenous	0.00%	83.2%
PCHG	Endogenous	8.25%	63.5%
FRET	Endogenous	8.41%	100.0%

- Significant regression coefficient
  - current risk and return perceptions have a significant impact over future return
- FRET ~ PVOL + PCHG
  - PVOL → FRET: 0.23, pv = 0.00
  - PRET → FRET: 0.17, pv = 0.02
  - R^2 = 8.41%
- PCHG ~ PVOL
  - PVOL → PCHG: 0.30, pv = 0.00
  - R^2 = 8.25%
- Improvement compared with relevant studies
  - Higher R^2
  - The weight of indicators is reflection of the learning among multiple indicators.

Stats: validity and consistency check

Outer model

Internal consistency reliability

	Cronback's alpha	Composite reliability	Avg R^2 of Indicators
PVOL	90.30%	94.00%	83.2%
PCHG	89.50%	92.10%	63.5%
FRET	100.00%	100.00%	100.0%

Convergency validity

PVOL		Weight	Loading	Community	Redundancy
	mstd.24	0.2978	0.8760	0.8760	0.0000
	mstd.36	0.3316	0.9550	0.9550	0.0000
	mstd.60	0.4666	0.9050	0.9050	0.0000
PCHG					
	mret.01	0.1021	0.5790	0.5790	0.0307
	mret.04	0.1001	0.8030	0.8030	0.0591
	mret.12	-0.0719	0.5560	0.5560	0.0283
	uprc.09	0.3681	0.9520	0.9520	0.0832
	uprc.12	0.3481	0.9520	0.9520	0.0832
	uprc.24	0.2709	0.8070	0.8070	0.0597
FRET					
	mret.f6	1.0000	1.0000	1.0000	0.1019

Discriminant validity

		PVOL	PCHG	FRET
PVOL				
	mstd.24	0.88	0.24	0.17
	mstd.36	0.96	0.28	0.18
	mstd.60	0.90	0.30	0.35
PCHG				
	mret.01	0.06	0.58	0.11
	mret.04	0.04	0.80	0.12
	mret.12	-0.14	0.56	0.05
	uprc.09	0.34	0.95	0.21
	uprc.12	0.32	0.95	0.20
	uprc.24	0.17	0.81	0.26
FRET				
	mret.f6	0.28	0.24	1.00

Correlatons among latent perceptions

	PVOL	PCHG	FRET
PVOL	1.0000	0.3030	0.2770
PCHG	0.3030	1.0000	0.2350
FRET	0.2770	0.2350	1.0000

Bootstrap Validation

Weights

	Original	Mean.Boot	Std.Error	perc.025	perc.975
PVOL-mstd.24	0.30	0.30	0.05	0.20	0.40
PVOL-mstd.36	0.33	0.34	0.02	0.29	0.37
PVOL-mstd.60	0.47	0.46	0.06	0.33	0.59
PCHG-mret.01	0.10	0.09	0.08	-0.05	0.20
PCHG-mret.04	0.10	0.09	0.08	-0.14	0.18
PCHG-mret.12	-0.07	-0.10	0.14	-0.47	0.08
PCHG-uprc.09	0.37	0.38	0.07	0.28	0.55
PCHG-uprc.12	0.35	0.35	0.06	0.28	0.52
PCHG-uprc.24	0.27	0.27	0.05	0.18	0.37
FRET-mret.f6	1.00	1.00	0.00	1.00	1.00

Loadings

	Original	Mean.Boot	Std.Error	perc.025	perc.975
PVOL-mstd.24	0.88	0.88	0.03	0.82	0.92
PVOL-mstd.36	0.96	0.96	0.01	0.93	0.97
PVOL-mstd.60	0.91	0.90	0.02	0.86	0.94
PCHG-mret.01	0.58	0.56	0.09	0.35	0.70
PCHG-mret.04	0.80	0.78	0.08	0.55	0.86
PCHG-mret.12	0.56	0.52	0.15	0.09	0.77
PCHG-uprc.09	0.95	0.94	0.02	0.89	0.98
PCHG-uprc.12	0.95	0.94	0.03	0.85	0.97
PCHG-uprc.24	0.81	0.78	0.09	0.54	0.87
FRET-mret.f6	1.00	1.00	0.00	1.00	1.00

Paths

	Original	Mean.Boot	Std.Error	perc.025	perc.975
PVOL->PCHG	0.30	0.32	0.06	0.20	0.43
PVOL->FRET	0.23	0.23	0.08	0.07	0.36
PCHG->FRET	0.17	0.18	0.06	0.06	0.27

R^2

	Original	Mean.Boot	Std.Error	perc.025	perc.975
PCHG	0.09	0.11	0.04	0.04	0.18
FRET	0.10	0.12	0.05	0.05	0.21

Total effects

	Original	Mean.Boot	Std.Error	perc.025	perc.975
PVOL->PCHG	0.30	0.32	0.06	0.20	0.43
PVOL->FRET	0.28	0.29	0.07	0.14	0.41
PCHG->FRET	0.17	0.18	0.06	0.06	0.27

Summary

- This paper uses Partial Least Square Structural Equation Modelling (PLS-SEM) approach to study:
  - gauging perceptions of return and risk
  - explaining their relationship with future returns.
- The test reveals:
  - a positive intertemporal relationship between current risk and return (momentum) perceptions with future returns.
  - The details of extracting market perceptions show how market participants read thorough multiple market indicators.