NYU STERN

NEW YORK UNIVERSITY · LEONARD N. STERN SCHOOL OF BUSINESS

Asset Prices and Ambiguity
Empirical Evidence

Menachem Brenner
Stern School of Business, NYU

Yehuda Izhakian
Stern School of Business, NYU

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Outline

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- Risk and Return – Past Research
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- Measuring Ambiguity
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Motivation

Study the relationship between Risk-Ambiguity and Return in financial markets

Risk and Return

- Past Research:
  - Time Series-Cross Section (Portfolios of Stocks)
  - Starting with Black, Jensen and Scholes (1972) and Fama-MacBeth (1973) ... Amihud (2002), Acharya and Pedersen (2005)
- Time Series of the Market Portfolio:
  - Starting with Merton (1980) and French, Schwert and Stambaugh (1987)...
- In general, many tests produce “weak” results (e.g. low R^2) while some contain puzzling results (e.g. negative coeffiecients for the risk factor)

Risk-Ambiguity-Return

- Fundamental Relationship in the Mean-Variance paradigm

$$\mathrm{E}\left[r_m\right] - r_f = \gamma\left(\sigma_m^2\right)$$

- Missing Factor: Ambiguity. Based on a New Theoretical Model by Izhakian (2011)

$$\mathrm{E}\left[r_m\right] - r_f = \gamma\left(\sigma_m^2\right) + \eta\left(\mho^2\right)$$

- Related Research; Bawa, Brown and Klein (1979), Uppal and Wang (2003), Epstein and Schneider (2008), Drechsler (2010)

Measuring Ambiguity

The measure of ambiguity is

$$\mho^2\left[r\right] = 4\,\mathrm{Var}\left[\mathrm{P}_L\right],$$

where P_L is the random probability of loss ($r < r_f$)

The measure is in the [0,1] range

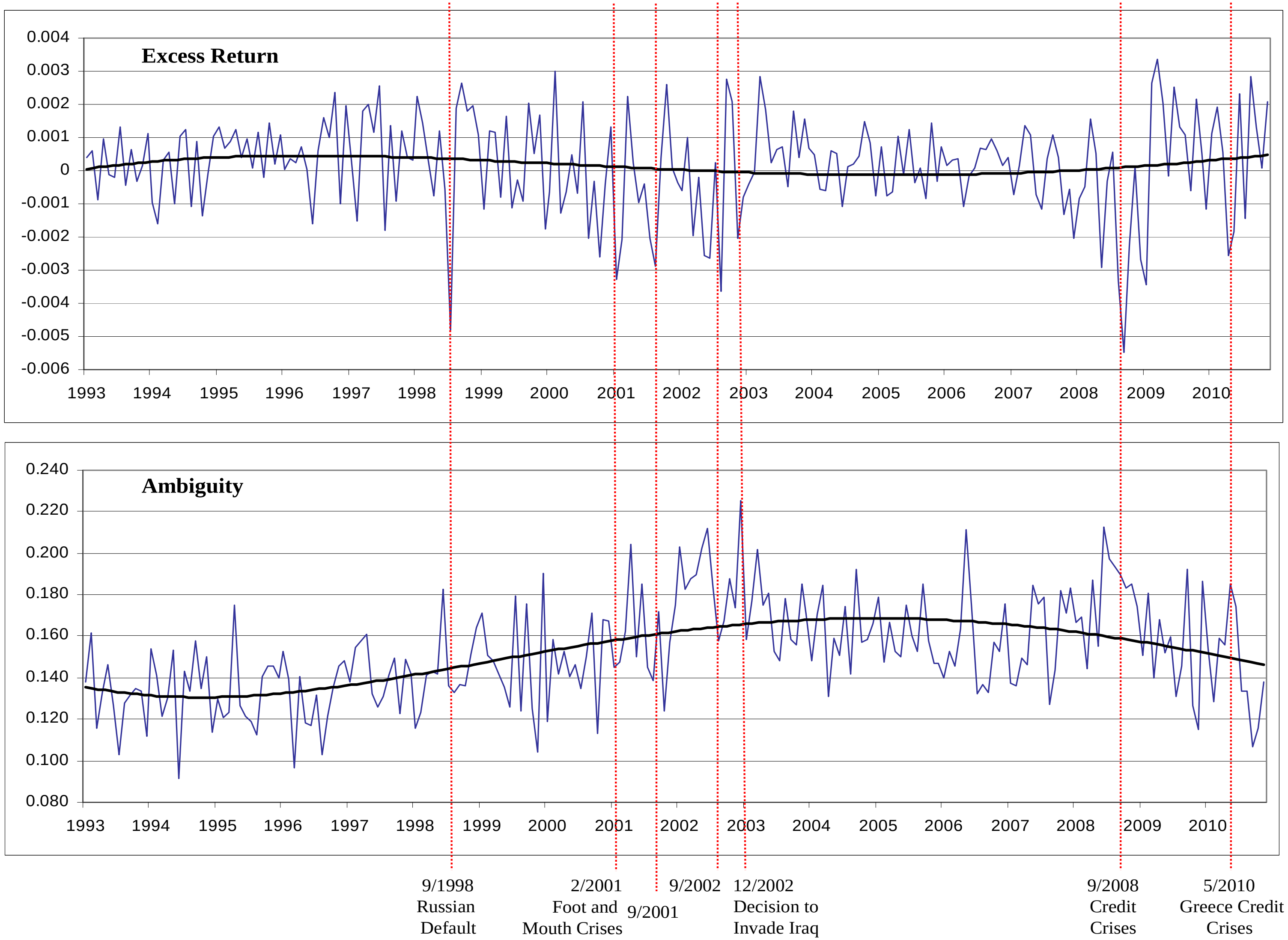
Data and Methodology

- **Intra-day data on the SPDR** (15 minute returns)
  - 26 daily returns, 18 years (1993-2010)
  - 1-month T-bills
  - VIX; daily observations

- **Measuring Ambiguity**
  - Computing daily mean and variance of intraday return
  - Computing the probability of loss per day
  - Computing the variance of the probability over the month to obtain a monthly measure of ambiguity

- **Measuring Risk**
  - Computing monthly variances using daily returns
  - Computing VIX^2 using end of the month VIX

Excess Return and Ambiguity



Regression Results (Prediction)

$$r_{m,t} = \alpha + \beta_1 \mho^2_{t-1} + \beta_2 MVAR_{t-1} + \beta_3 VVAR_{t-1} + \beta_4 MVIX^2_{t-1} + \beta_5 VVIX^2_{t-1} + \beta_6 CVAR_{t-1} + \beta_7 CVIX_{t-1} + \varepsilon_t$$

α	$\mho^2_{t-1}$	$MVAR_{t-1}$	$VVAR_{t-1}$	$MVIX^2_{t-1}$	$VVIX^2_{t-1}$	$CVAR_{t-1}$	$CVIX^2_{t-1}$	R^2	$Adj\ R^2$	DW
0.0013	-0.0451							0.0625	0.0581	1.9385
(4.0805)	(-3.7589)									
0.0013	-0.0466	0.3022						0.0642	0.0553	1.9069
(4.0798)	(-3.8004)	(0.6167)								
0.0013	-0.0455	-0.0396	1.1629					0.0677	0.0543	1.9068
(4.0854)	(-3.6806)	(-0.0635)	(0.8860)							
0.0013	-0.0475			0.3513				0.0646	0.0557	1.9256
(4.0379)	(-3.7991)			(0.6923)						
0.0010	-0.0492			2.6214	-24163.5678			0.1185	0.1059	2.0224
(3.0691)	(-4.0437)			(3.2638)	(-3.5833)					
0.0012	-0.0466					0.7915		0.0731	0.0644	1.8958
(3.9160)	(-3.8864)					(1.5573)				
0.0013	-0.0483						0.5225	0.0664	0.0575	1.9109
(3.9967)	(-3.8708)						(0.9383)			

Regression Results (unexpected changes)

$$r_{m,t} = \alpha + \beta_1 \mho^2_{t-1} + \beta_2 DVAR_t + \beta_3 DVIX^2_t + \varepsilon_t$$

α	$\mho^2_{t-1}$	$DVAR_t$	$DVIX^2_t$	R^2	$Adj\ R^2$	DW
0.0012	-0.0404	-2.1990		0.1947	0.1870	1.9517
(3.9799)	(-3.6142)	(-5.8852)				
0.0011	-0.0379		-8.4014	0.4642	0.4591	1.8360
(4.6313)	(-4.1587)		(-12.5774)			
0.0002		-2.2957		0.1448	0.1408	1.8091
(1.7097)		(-5.9918)				
0.0002			-8.5763	0.4203	0.4175	1.7145
(2.1103)			(-12.3971)			

Conclusions and Research in Progress

- Two Orthogonal Factors: Risk & Ambiguity
- The Effect of Risk is Positive
- The Effect of Ambiguity is Negative
- CRRA (5.24) => High Aversion to Risk
- CAAA (-0.2) => Ambiguity Loving

- R-I-P: Cross-Section Tests of Risk-Ambiguity and Return