Good and Bad Uncertainty: Macroeconomic and Financial Market Implications

by Gill Segal, Ivan Shaliastovich, and Amir Yaron

Discussion

Pietro Veronesi

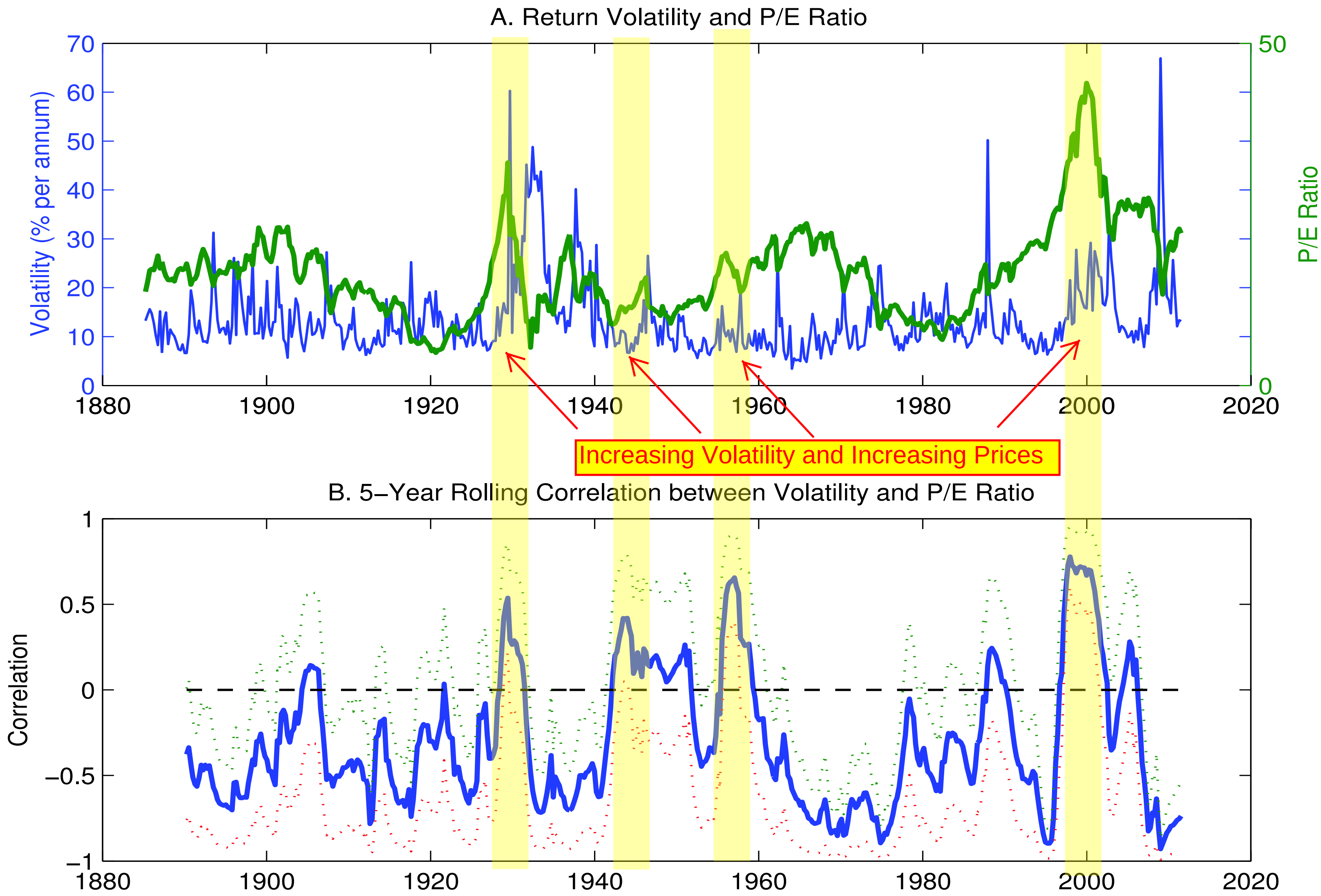
The University of Chicago Booth School of Business

Outline of Discussion (directed by the planner)

- Discuss SSY in light of my recent research.
  1. David and Veronesi (2013, JPE): "What Ties Return Volatilities to Price Valuations and Fundamentals?"
  2. Kelly, Pastor, and Veronesi (2014, WP): "The Price of Political Uncertainty: Theory and Evidence from the Option Market"
- Circle back to SSY to discuss some additional issues

Volatility and Asset Prices

- The correlation between P/E and stock volatility is strongly time varying



Log P/E is not related to return volatility.

C. Data

	Expected Earnings				Beliefs						
	RCP (1a)	RGDP (1b)	Boom (1c)	Model Expected (1d)	SPF($t+1$) (2a)	SPF(t) (2b)	Model (2c)	SPF($t+1$) (3a)	Model (3b)	(4)	(5)
Constant	18.96	23.15	41.52	21.90	12.45	13.27	12.45	10.41	12.15	14.28	275.74
	(7.04)	(6.17)	(5.46)	(4.84)	(10.70)	(11.16)	(11.42)	(5.14)	(7.97)	(.99)	(3.52)
ExpInf	−.85	−.95	−1.37	−1.51							
	(−1.83)	(−2.01)	(−3.31)	(−1.70)							
ExpEarn	−.22	−1.83	−.26	−1.44							
	(−2.84)	(−2.82)	(−3.56)	(−2.15)							
P_{HI}					3.28	2.16	4.21				
					(1.34)	(.92)	(1.29)				
P_{ZI}					46.87	29.48	24.06				
					(4.03)	(3.77)	(3.41)				
UncInf								−144.02	−75.01		
								(−1.56)	(−1.01)		
UncEarn								50.35	38.76		
								(3.66)	(1.50)		
$Y(5)$										−.23	−8.66
										(−.38)	(−2.75)
Log P/E										.43	−154.97
										(.11)	(−3.53)
$Y(5)^2$											−.03
											(−.34)
Log P/E^2											24.92
											(3.74)
$Y(5)^2 \times$ log P/E^2											.09
											(2.94)
Adjusted R^2	.12	.19	.33	.12	.14	.10	.18	.17	.04	.00	.17

Note.—Regression of (Stock Volatility)$_t = b_0 + b_1\mathbf{X}_t + \epsilon_t$, where Stock Volatility is the theoretical formula (panels A and B) or is estimated from daily stock returns (panel C). Explanatory variables $\mathbf{X}_t$ are identified on each row. ExpInf and ExpEarn are expected inflation and earnings, P_{HI} and P_{ZI} are the probabilities of high inflation or zero (or lower) inflation, UncInf and UncEarn are the inflation and earnings uncertainty, and $Y(5)$ denotes the 5-year zero-coupon bond yield. In panels A and B, all the quantities are computed from the regime-switching model. In panel A, the stand-alone coefficient is the population value from a simulation of 5,000 years of quarterly data, while the brackets contain the 5th–95th percentiles of the coefficient distribution obtained from 100 samples of 200 quarters each. In panel C, these quantities are empirical proxies either directly observable ($Y(5)$ and log P/E) or computed from the SPF or from the model's fitted probabilities, as indicated on the heading of each column. The sample in panel B is 1962–2010. The sample in panel C is also 1962–2010, except when SPF data are used (cols. 1a, 1b, 1c, 2a, 2b, and 3a), in which case the sample is 1968–2010. All t-statistics (in parentheses) are Newey-West adjusted for heteroskedasticity and autocorrelation using 12 lags.

Source: David and Veronesi "What ties return volatilities to price valuations and fundamentals?" (JPE, 2013)

Volatility and Asset Prices

- Most models that feature time-varying volatility (habit formation, long-run risk) would imply that log P/E would be highly correlated with return volatility.
  - The data just says otherwise.

Volatility and Asset Prices

- Most models that feature time-varying volatility (habit formation, long-run risk) would imply that log P/E would be highly correlated with return volatility.
  - The data just says otherwise.
- One possible explanation is the existence of non-linear dynamics and endogenous variation in volatility due to e.g. learning.

Volatility and Asset Prices

- Most models that feature time-varying volatility (habit formation, long-run risk) would imply that log P/E would be highly correlated with return volatility.
  - The data just says otherwise.
- One possible explanation is the existence of non-linear dynamics and endogenous variation in volatility due to e.g. learning.
- For instance, in David and Veronesi (2013), we have unobservable composite inflation / economic regime shifts.

Volatility and Asset Prices

- Most models that feature time-varying volatility (habit formation, long-run risk) would imply that log P/E would be highly correlated with return volatility.
  - The data just says otherwise.
- One possible explanation is the existence of non-linear dynamics and endogenous variation in volatility due to e.g. learning.
- For instance, in David and Veronesi (2013), we have unobservable composite inflation / economic regime shifts.
- We have three economic regimes: Low Growth, Medium Growth, and High Growth.

Volatility and Asset Prices

- Most models that feature time-varying volatility (habit formation, long-run risk) would imply that log P/E would be highly correlated with return volatility.
  - The data just says otherwise.
- One possible explanation is the existence of non-linear dynamics and endogenous variation in volatility due to e.g. learning.
- For instance, in David and Veronesi (2013), we have unobservable composite inflation / economic regime shifts.
- We have three economic regimes: Low Growth, Medium Growth, and High Growth.

$\Longrightarrow$ Uncertainty between LG and MG $\Longrightarrow$ low P/E and high volatility (standard business cycle – bad volatility)

Volatility and Asset Prices

- Most models that feature time-varying volatility (habit formation, long-run risk) would imply that log P/E would be highly correlated with return volatility.
  - The data just says otherwise.
- One possible explanation is the existence of non-linear dynamics and endogenous variation in volatility due to e.g. learning.
- For instance, in David and Veronesi (2013), we have unobservable composite inflation / economic regime shifts.
- We have three economic regimes: Low Growth, Medium Growth, and High Growth.

$\Longrightarrow$ Uncertainty between LG and MG $\Longrightarrow$ low P/E and high volatility (standard business cycle – bad volatility)

$\Longrightarrow$ Uncertainty between MG and HG $\Longrightarrow$ high P/E and high volatility (e.g. late 1920s, 1990s etc – good volatility)

Volatility and Asset Prices

- Most models that feature time-varying volatility (habit formation, long-run risk) would imply that log P/E would be highly correlated with return volatility.
  - The data just says otherwise.
- One possible explanation is the existence of non-linear dynamics and endogenous variation in volatility due to e.g. learning.
- For instance, in David and Veronesi (2013), we have unobservable composite inflation / economic regime shifts.
- We have three economic regimes: Low Growth, Medium Growth, and High Growth.

$\Longrightarrow$ Uncertainty between LG and MG $\Longrightarrow$ low P/E and high volatility
(standard business cycle – bad volatility)

$\Longrightarrow$ Uncertainty between MG and HG $\Longrightarrow$ high P/E and high volatility
(e.g. late 1920s, 1990s etc – good volatility)

- The model generates vast volatility variation (it is fitted to the data), but very hard to predict from observable quantities.

Model also does not explain volatility from log P/E

A. Model: Simulations

	(1)	(2)	(3)	(4)	(5)
Constant	11.52 [6.48, 20.10]	11.67 [9.43, 13.77]	9.60 [8.52, 12.27]	−.75 [−60.78, 160.58]	−1.08 [−3,599.2, 3,167.1]
ExpInf	.49 [−1.32, 2.51]				
ExpEarn	−.50 [−2.41, −.14]				
P_{HI}		7.48 [2.08, 79.01]			
P_{ZI}		2.61 [−.29, 45.95]			
UncInf			57.56 [−71.23, 110.88]		
UncEarn			29.28 [9.28, 46.56]		
$Y(5)$				.76 [−2.61, 2.43]	−7.11 [−70.31, 12.19]
Log P/E				3.11 [−50.93, 21.20]	33.13 [−2,200.3 2,625.4]
$Y(5)^2$					−31.30 [−4.10, 5.85]
Log P/E^2					−8.51 [−475.49, 396.24]
$Y(5)^2 \times$ log P/E^2					.15 [−.75, 1.18]
Adjusted R^2	.22 [.07, .85]	.13 [.06, .79]	.59 [.22, .97]	.12 [.04, .72]	.34 [.21, .94]

Source: David and Veronesi "What ties return volatilities to price valuations and fundamentals?" (JPE, 2013)

Model suggest a non-linear relation between volatility and log P/E (but far from perfect)

	A. Model: Simulations				
	(1)	(2)	(3)	(4)	(5)
Constant	11.52	11.67	9.60	−.75	−1.08
	[6.48, 20.10]	[9.43, 13.77]	[8.52, 12.27]	[−60.78, 160.58]	[−3,599.2, 3,167.1]
ExpInf	.49				
	[−1.32, 2.51]				
ExpEarn	−.50				
	[−2.41, −.14]				
P_{HI}		7.48			
		[2.08, 79.01]			
P_{ZI}		2.61			
		[−.29, 45.95]			
UncInf			57.56		
			[−71.23, 110.88]		
UncEarn			29.28		
			[9.28, 46.56]		
$Y(5)$				.76	−7.11
				[−2.61, 2.43]	[−70.31, 12.19]
Log P/E				3.11	33.13
				[−50.93, 21.20]	[−2,200.3 2,625.4]
$Y(5)^2$					−31.30
					[−4.10, 5.85]
Log P/E^2					−8.51
					[−475.49, 396.24]
$Y(5)^2 \times$ log P/E^2					.15
					[−.75, 1.18]
Adjusted R^2	.22	.13	.59	.12	.34
	[.07, .85]	[.06, .79]	[.22, .97]	[.04, .72]	[.21, .94]

Source: David and Veronesi "What ties return volatilities to price valuations and fundamentals?" (JPE, 2013)

Non-linear relation between volatility and log P/E is found in the data (but far from perfect)

C. Data

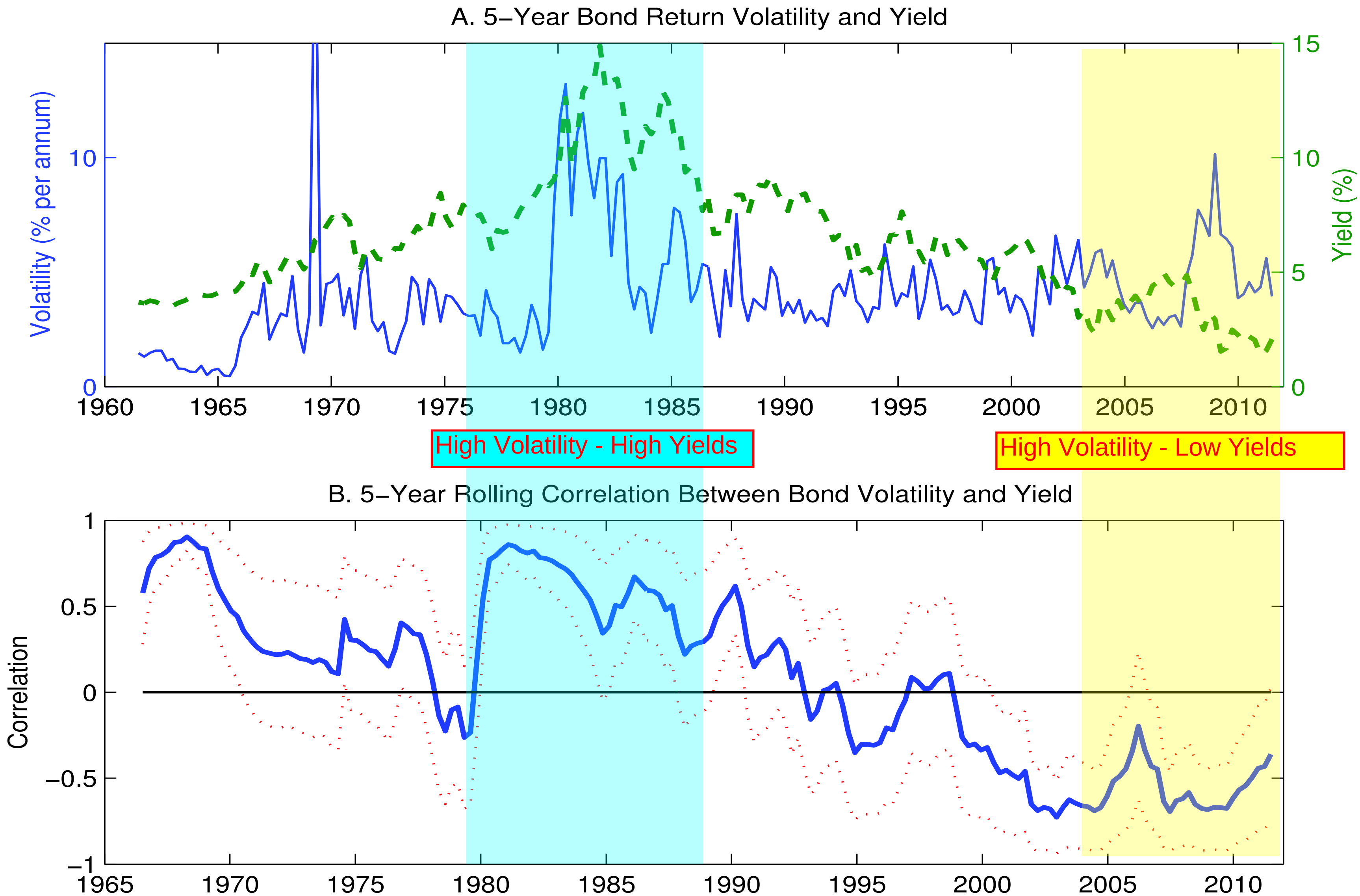
	Expected Earnings				Beliefs						
	RCP (1a)	RGDP (1b)	Boom (1c)	Model Expected (1d)	SPF(t + 1) (2a)	SPF(t) (2b)	Model (2c)	SPF(t + 1) (3a)	Model (3b)	(4)	(5)
Constant	18.96	23.15	41.52	21.90	12.45	13.27	12.45	10.41	12.15	14.28	275.74
	(7.04)	(6.17)	(5.46)	(4.84)	(10.70)	(11.16)	(11.42)	(5.14)	(7.97)	(.99)	(3.52)
ExpInf	−.85	−.95	−1.37	−1.51							
	(−1.83)	(−2.01)	(−3.31)	(−1.70)							
ExpEarn	−.22	−1.83	−.26	−1.44							
	(−2.84)	(−2.82)	(−3.56)	(−2.15)							
P_{HI}					3.28	2.16	4.21				
					(1.34)	(.92)	(1.29)				
P_{ZI}					46.87	29.48	24.06				
					(4.03)	(3.77)	(3.41)				
UncInf								−144.02	−75.01		
								(−1.56)	(−1.01)		
UncEarn								50.35	38.76		
								(3.66)	(1.50)		
$Y(5)$										−.23	−8.66
										(−.38)	(−2.75)
Log P/E										.43	−154.97
										(.11)	(−3.53)
$Y(5)^2$											−.03
											(−.34)
Log P/E^2											24.92
											(3.74)
$Y(5)^2 \times$ log P/E^2											.09
											(2.94)
Adjusted R^2	.12	.19	.33	.12	.14	.10	.18	.17	.04	.00	.17

NOTE.—Regression of (Stock Volatility)$_t$ = $b_0 + b_1\mathbf{X}_t + \epsilon_t$, where Stock Volatility is the theoretical formula (panels A and B) or is estimated from daily stock returns (panel C). Explanatory variables $\mathbf{X}_t$ are identified on each row. ExpInf and ExpEarn are expected inflation and earnings, P_{HI} and P_{ZI} are the probabilities of high inflation or zero (or lower) inflation, UncInf and UncEarn are the inflation and earnings uncertainty, and $Y(5)$ denotes the 5-year zero-coupon bond yield. In panels A and B, all the quantities are computed from the regime-switching model. In panel A, the stand-alone coefficient is the population value from a simulation of 5,000 years of quarterly data, while the brackets contain the 5th–95th percentiles of the coefficient distribution obtained from 100 samples of 200 quarters each. In panel C, these quantities are empirical proxies either directly observable ($Y(5)$ and log P/E) or computed from the SPF or from the model's fitted probabilities, as indicated on the heading of each column. The sample in panel B is 1962–2010. The sample in panel C is also 1962–2010, except when SPF data are used (cols. 1a, 1b, 1c, 2a, 2b, and 3a), in which case the sample is 1968–2010. All t-statistics (in parentheses) are Newey-West adjusted for heteroskedasticity and autocorrelation using 12 lags.

Source: David and Veronesi "What ties return volatilities to price valuations and fundamentals?" (JPE, 2013)

Volatility and Asset Prices

- This non-linearity between volatility and prices is there also for Treasury bonds



Volatility and Asset Prices

- The *same* mechanism is at play:
- Three regimes for inflation: High Inflation, Medium Inflation, Deflation

$\Longrightarrow$ Uncertainty between HI and MI $\Longrightarrow$ high yield and high volatility (1980s, bad volatility?)

$\Longrightarrow$ Uncertainty between MI and Def $\Longrightarrow$ low yield and high volatility (2000s, good volatility?)

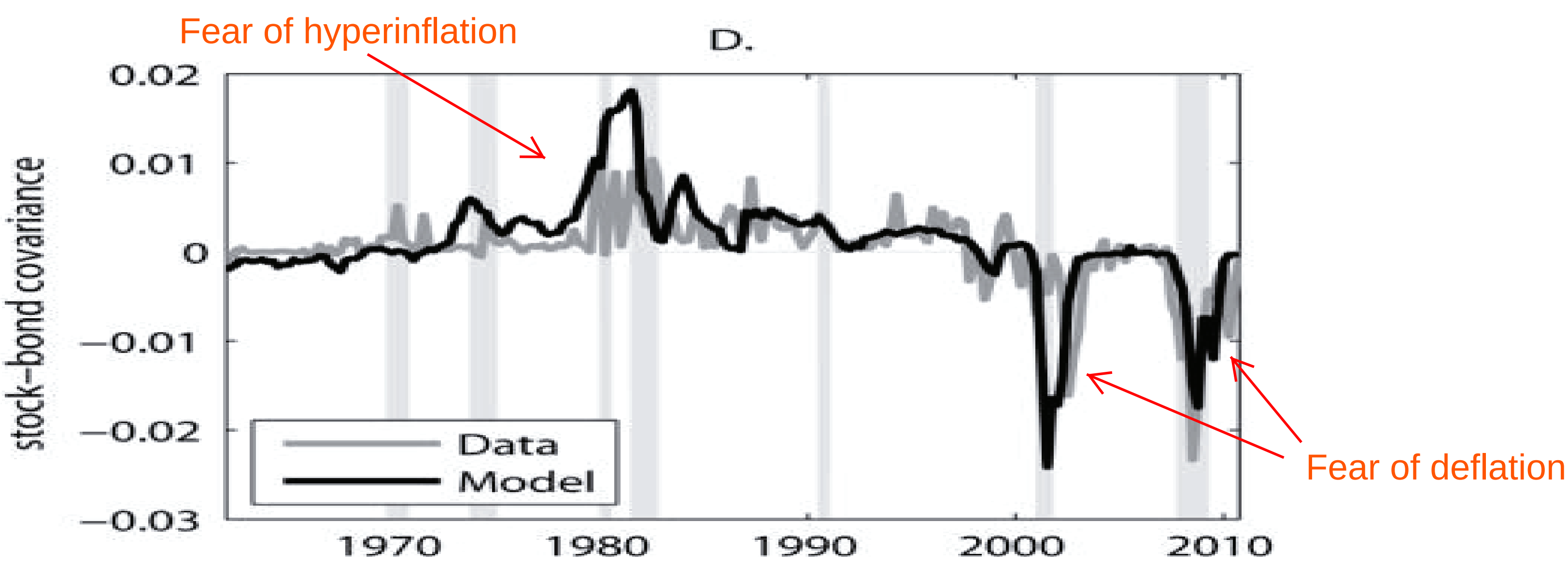
Volatility and Asset Prices

- The *same* mechanism is at play:
- Three regimes for inflation: High Inflation, Medium Inflation, Deflation

$\Longrightarrow$ Uncertainty between HI and MI $\Longrightarrow$ high yield and high volatility (1980s, bad volatility?)

$\Longrightarrow$ Uncertainty between MI and Def $\Longrightarrow$ low yield and high volatility (2000s, good volatility?)

- In fact, the same mechanism explains the time-variation in stock/bond covariance



Source: David and Veronesi "What ties return volatilities to price valuations and fundamentals?" (JPE, 2013)

Policy Regimes and Political Uncertainty

- Policy decisions affect the economic environment in which firms operate.

Policy Regimes and Political Uncertainty

- Policy decisions affect the economic environment in which firms operate.
- Such uncertainty affects the cross-section of firms

  $\Longrightarrow$ undiversifiable risk $\Longrightarrow$ risk premium.

Policy Regimes and Political Uncertainty

- Policy decisions affect the economic environment in which firms operate.
- Such uncertainty affects the cross-section of firms

  $\Longrightarrow$ undiversifiable risk $\Longrightarrow$ risk premium.
- Is political uncertainty priced? How?
  - Difficult question to tackle empirically:
    * Hard to disentangle political uncertainty from other sources of uncertainty
    * Endogeneity issues: e.g. political uncertainty may be large *because* of high return volatility, etc.

Policy Regimes and Political Uncertainty

- Policy decisions affect the economic environment in which firms operate.
- Such uncertainty affects the cross-section of firms

  $\Longrightarrow$ undiversifiable risk $\Longrightarrow$ risk premium.
- Is political uncertainty priced? How?
  - Difficult question to tackle empirically:
    * Hard to disentangle political uncertainty from other sources of uncertainty
    * Endogeneity issues: e.g. political uncertainty may be large *because* of high return volatility, etc.
- Kelly, Pastor and Veronesi (2014):
  - Use option prices and elections and global summits to estimate impact of political uncertainty on asset prices

Policy Regimes and Political Uncertainty

- Policy decisions affect the economic environment in which firms operate.
- Such uncertainty affects the cross-section of firms

  $\Longrightarrow$ undiversifiable risk $\Longrightarrow$ risk premium.
- Is political uncertainty priced? How?
  - Difficult question to tackle empirically:
    * Hard to disentangle political uncertainty from other sources of uncertainty
    * Endogeneity issues: e.g. political uncertainty may be large *because* of high return volatility, etc.
- Kelly, Pastor and Veronesi (2014):
  - Use option prices and elections and global summits to estimate impact of political uncertainty on asset prices
    * Why options? (a) short maturity; (b) different strikes;

Policy Regimes and Political Uncertainty

- Policy decisions affect the economic environment in which firms operate.
- Such uncertainty affects the cross-section of firms

  $\Longrightarrow$ undiversifiable risk $\Longrightarrow$ risk premium.
- Is political uncertainty priced? How?
  - Difficult question to tackle empirically:
    - Hard to disentangle political uncertainty from other sources of uncertainty
    - Endogeneity issues: e.g. political uncertainty may be large *because* of high return volatility, etc.
- Kelly, Pastor and Veronesi (2014):
  - Use option prices and elections and global summits to estimate impact of political uncertainty on asset prices
    - Why options? (a) short maturity; (b) different strikes;
    - Why elections/summits? (a) exogenous variation in political uncertainty; (c) can result in major policy shifts.

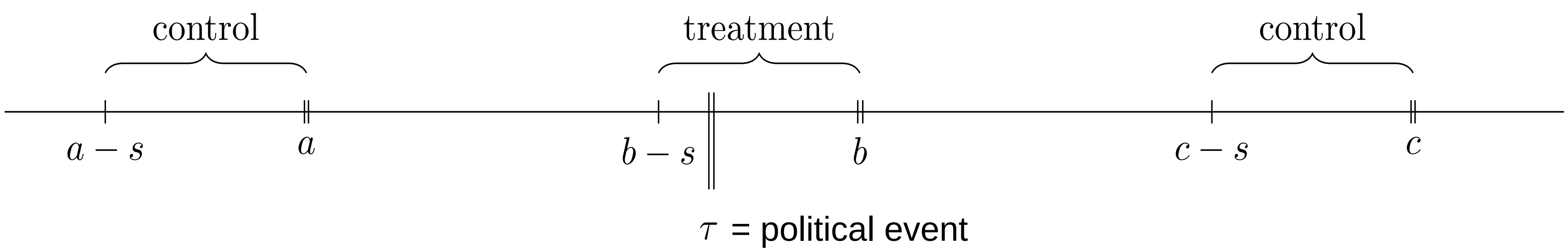
Policy Regimes and Political Uncertainty

- Policy decisions affect the economic environment in which firms operate.
- Such uncertainty affects the cross-section of firms

  $\Longrightarrow$ undiversifiable risk $\Longrightarrow$ risk premium.
- Is political uncertainty priced? How?
  - Difficult question to tackle empirically:
    * Hard to disentangle political uncertainty from other sources of uncertainty
    * Endogeneity issues: e.g. political uncertainty may be large *because* of high return volatility, etc.
- Kelly, Pastor and Veronesi (2014):
  - Use option prices and elections and global summits to estimate impact of political uncertainty on asset prices
    * Why options? (a) short maturity; (b) different strikes;
    * Why elections/summits? (a) exogenous variation in political uncertainty; (c) can result in major policy shifts.
- Analysis is guided by theory $\Longrightarrow$ Interpret results in light of our model.

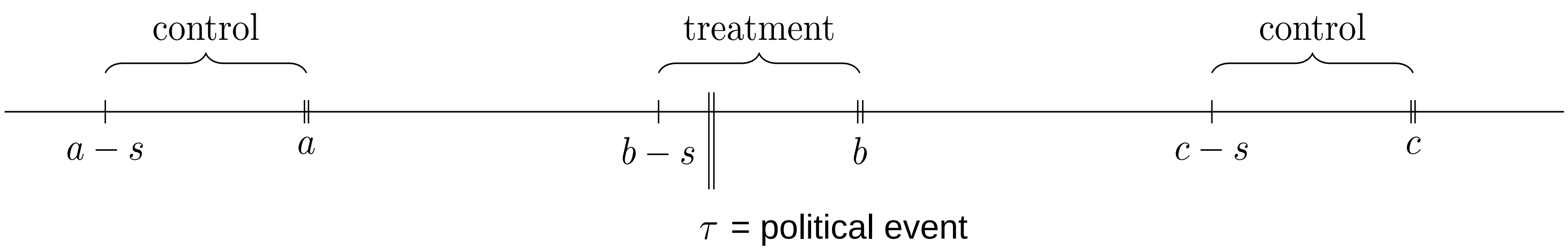
Policy Regimes and Political Uncertainty

- Issue: Option prices can be high for reasons different from policy uncertainty
  - $\Longrightarrow$ control using neighboring options that *do not* span the political event.



Policy Regimes and Political Uncertainty

- Issue: Option prices can be high for reasons different from policy uncertainty
  - $\Longrightarrow$ control using neighboring options that *do not* span the political event.

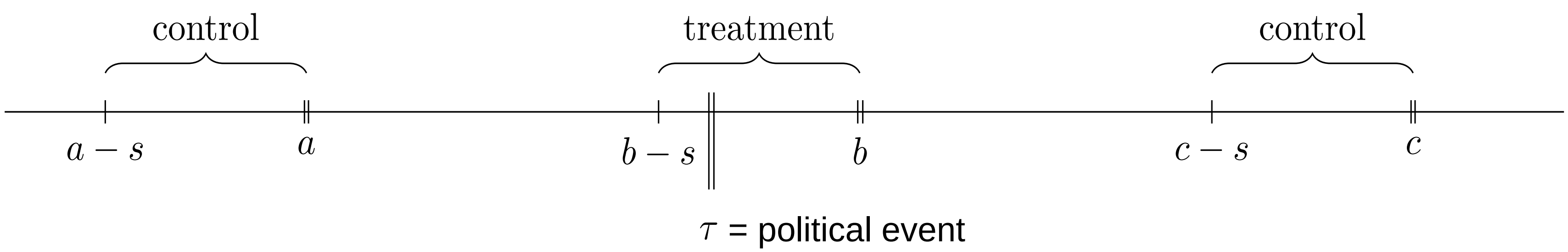


Empirical Results

- Options whose lives span political events are, on average
  * 5.5% more expensive

Policy Regimes and Political Uncertainty

- Issue: Option prices can be high for reasons different from policy uncertainty
  - $\Longrightarrow$ control using neighboring options that *do not* span the political event.

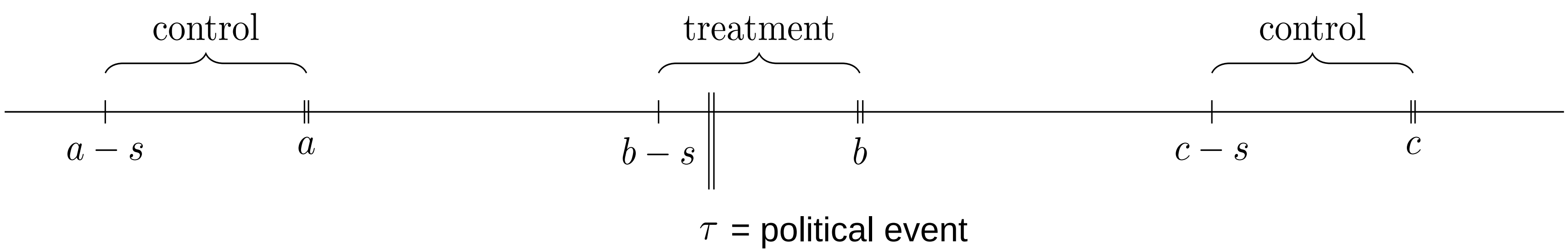


Empirical Results

- Options whose lives span political events are, on average
  * 5.5% more expensive
  * between 7% - 9% more expensive in downturns, but almost zero in booms.

Policy Regimes and Political Uncertainty

- Issue: Option prices can be high for reasons different from policy uncertainty
  - $\Longrightarrow$ control using neighboring options that *do not* span the political event.

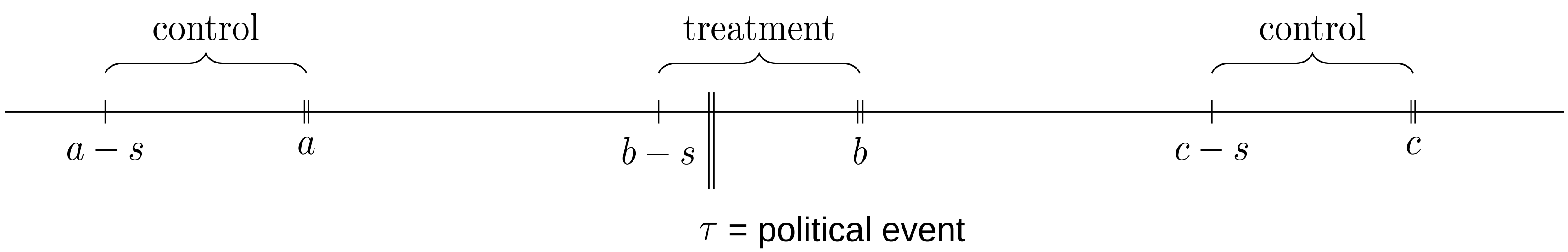


Empirical Results

- Options whose lives span political events are, on average
  - * 5.5% more expensive
  - * between 7% - 9% more expensive in downturns, but almost zero in booms.
  - * 10% more expensive to cover tail events (5% drop in stock prices)

Policy Regimes and Political Uncertainty

- Issue: Option prices can be high for reasons different from policy uncertainty
  - $\Longrightarrow$ control using neighboring options that *do not* span the political event.

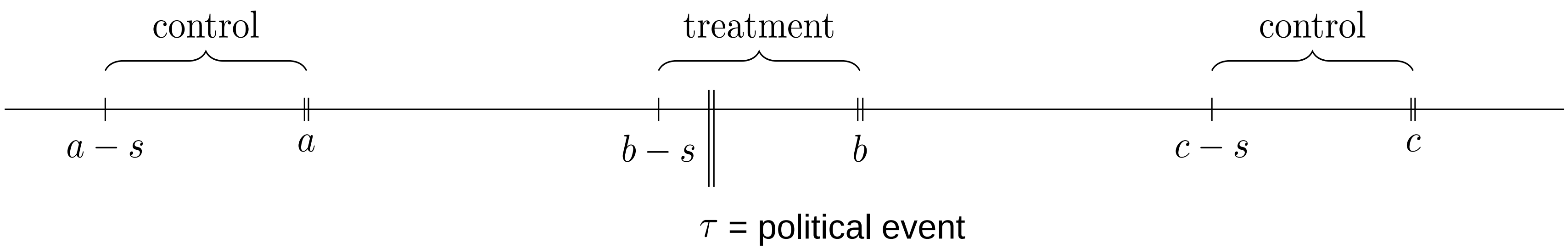


Empirical Results

- Options whose lives span political events are, on average
  - * 5.5% more expensive
  - * between 7% - 9% more expensive in downturns, but almost zero in booms.
  - * 10% more expensive to cover tail events (5% drop in stock prices)
  - * overpriced due to a positive political risk premium

Policy Regimes and Political Uncertainty

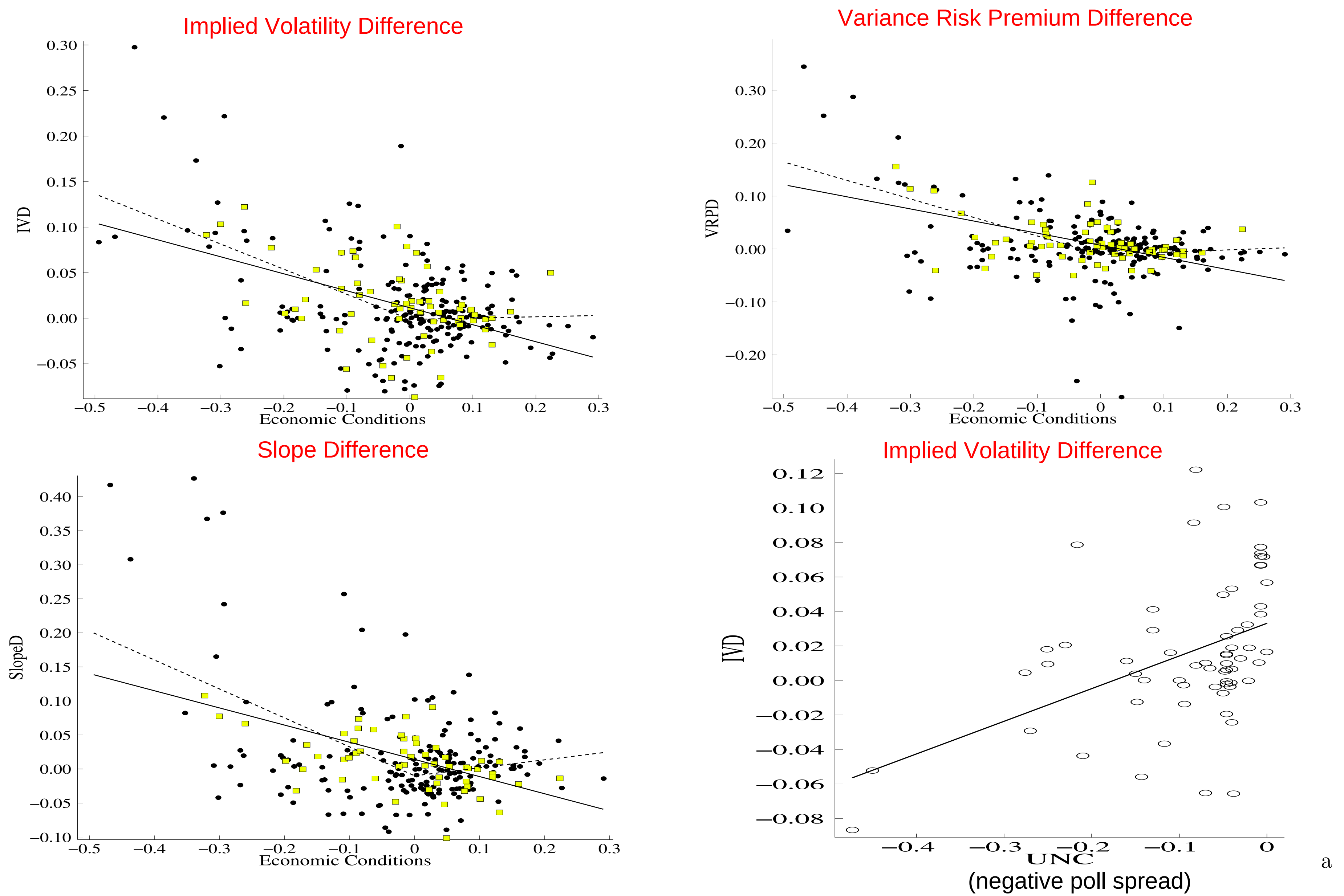
- Issue: Option prices can be high for reasons different from policy uncertainty
  - $\Longrightarrow$ control using neighboring options that *do not* span the political event.



Empirical Results

- Options whose lives span political events are, on average
  - * 5.5% more expensive
  - * between 7% - 9% more expensive in downturns, but almost zero in booms.
  - * 10% more expensive to cover tail events (5% drop in stock prices)
  - * overpriced due to a positive political risk premium
  - * more expensive when political uncertainty is higher

  than options whose lives *do not* span political events.


Implied Volatility Difference
IVD
Economic Conditions
Variance Risk Premium Difference
VRPD
Economic Conditions
Slope Difference
SlopeD
Economic Conditions
Implied Volatility Difference
IVD
UNC
(negative poll spread)
a

Back to Segal, Shaliastovich, Yaron

- This paper may be able to also explain the “flip-flop nature” of the relation between log P/E and stock return volatility.

Back to Segal, Shaliastovich, Yaron

- This paper may be able to also explain the "flip-flop nature" of the relation between log P/E and stock return volatility.
- The paper does not investigate this, but it seems that:
  - Higher bad uncertainty $\Longrightarrow$ return volatility increases and log(P/E) drops
  - Higher good uncertainty $\Longrightarrow$ return volatility increases and log(P/E) increases

Back to Segal, Shaliastovich, Yaron

- This paper may be able to also explain the "flip-flop nature" of the relation between log P/E and stock return volatility.
- The paper does not investigate this, but it seems that:
  - Higher bad uncertainty $\Longrightarrow$ return volatility increases and log(P/E) drops
  - Higher good uncertainty $\Longrightarrow$ return volatility increases and log(P/E) increases
- Why the last result? In long-run risk models, preferences for early resolution of uncertainty $\Longrightarrow$ price drops with good or bad uncertainty.

Back to Segal, Shaliastovich, Yaron

- This paper may be able to also explain the "flip-flop nature" of the relation between log P/E and stock return volatility.
- The paper does not investigate this, but it seems that:
  - Higher bad uncertainty $\Longrightarrow$ return volatility increases and log(P/E) drops
  - Higher good uncertainty $\Longrightarrow$ return volatility increases and log(P/E) increases
- Why the last result? In long-run risk models, preferences for early resolution of uncertainty $\Longrightarrow$ price drops with good or bad uncertainty.
  - Log(P/E) declines with high good uncertainty because of a built-in feedback effect from uncertainty to long-run growth:

$$
\begin{aligned}
\Delta c_{t+1} &= \mu_c + x_t + \sigma_c(\epsilon_{g,t+1} - \epsilon_{b,t+1}) \\
x_{t+1} &= \rho x_t + \tau_g V_{g,t} - \tau_b V_{b,t} + \sigma_x(\epsilon_{g,t+1} - \epsilon_{b,t+1})
\end{aligned}
$$

Back to Segal, Shaliastovich, Yaron

- This paper may be able to also explain the "flip-flop nature" of the relation between log P/E and stock return volatility.
- The paper does not investigate this, but it seems that:
  - Higher bad uncertainty $\Longrightarrow$ return volatility increases and log(P/E) drops
  - Higher good uncertainty $\Longrightarrow$ return volatility increases and log(P/E) increases
- Why the last result? In long-run risk models, preferences for early resolution of uncertainty $\Longrightarrow$ price drops with good or bad uncertainty.
  - Log(P/E) declines with high good uncertainty because of a built-in feedback effect from uncertainty to long-run growth:

$$\begin{aligned}\Delta c_{t+1} &= \mu_c + x_t + \sigma_c(\epsilon_{g,t+1} - \epsilon_{b,t+1}) \\ x_{t+1} &= \rho x_t + \tau_g V_{g,t} - \tau_b V_{b,t} + \sigma_x(\epsilon_{g,t+1} - \epsilon_{b,t+1})\end{aligned}$$

  - Paper provides evidence of the feedback effect.
    - Good (bad) uncertainty predicts higher (lower) future growth

Back to Segal, Shaliastovich, Yaron

- This paper may be able to also explain the "flip-flop nature" of the relation between log P/E and stock return volatility.
- The paper does not investigate this, but it seems that:
  - Higher bad uncertainty $\Longrightarrow$ return volatility increases and log(P/E) drops
  - Higher good uncertainty $\Longrightarrow$ return volatility increases and log(P/E) increases
- Why the last result? In long-run risk models, preferences for early resolution of uncertainty $\Longrightarrow$ price drops with good or bad uncertainty.
  - Log(P/E) declines with high good uncertainty because of a built-in feedback effect from uncertainty to long-run growth:

$$\begin{aligned} \Delta c_{t+1} &= \mu_c + x_t + \sigma_c(\epsilon_{g,t+1} - \epsilon_{b,t+1}) \\ x_{t+1} &= \rho x_t + \tau_g V_{g,t} - \tau_b V_{b,t} + \sigma_x(\epsilon_{g,t+1} - \epsilon_{b,t+1}) \end{aligned}$$

  - Paper provides evidence of the feedback effect.
    - Good (bad) uncertainty predicts higher (lower) future growth
- Uncertainty = Realized Fundamental Volatility
  - Different from belief-based uncertainty about long-term growth

Back to Segal, Shaliastovich, Yaron

- What is the micro-foundation of good uncertainty impacting growth?
  - In investment uncertainty literature, higher uncertainty may increase value to keep the option to invest alive
  - $\Longrightarrow$ investments decrease and less growth.
  - Such uncertainty is "bad uncertainty" in this paper.

Back to Segal, Shaliastovich, Yaron

- What is the micro-foundation of good uncertainty impacting growth?
  - In investment uncertainty literature, higher uncertainty may increase value to keep the option to invest alive
  - $\Longrightarrow$ investments decrease and less growth.
  - Such uncertainty is "bad uncertainty" in this paper.
- How does the good uncertainty work in an investment model?
  - Cross-sectional convexity effect?
    - Cross-sectional heterogeneity increase growth rate of aggregate capital.
    - It increase average prices.
    - It may plausibly be generated by innovation.

The Cross-sectional Standard Deviation of Profitability: Nasdaq vs NYSE/Amex

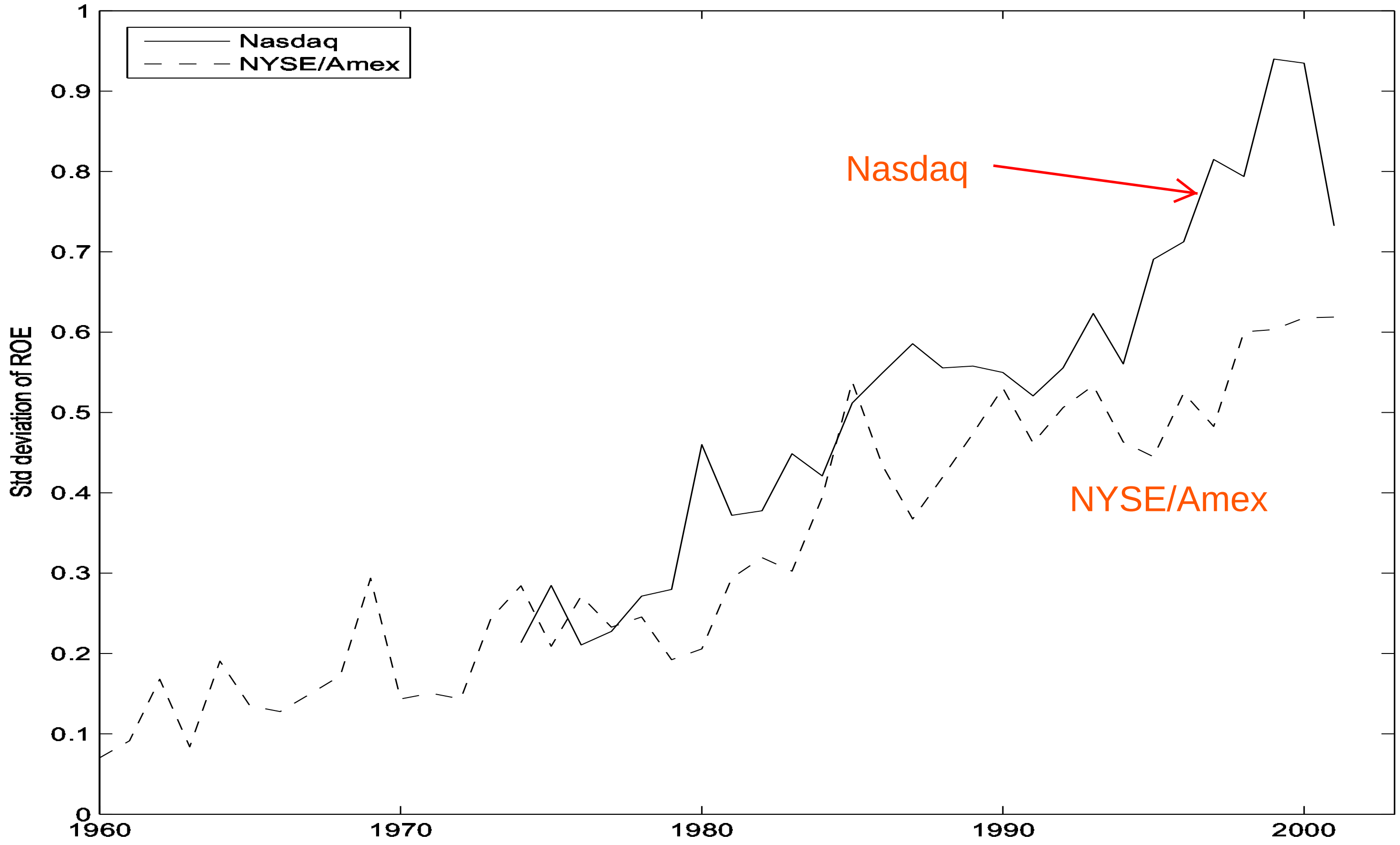


Fig. 9. Cross-sectional standard deviation of profitability for Nasdaq firms and for NYSE/Amex firms. Profitability (return on equity, ROE) of each firm in each year is computed as the firm's earnings in the given year divided by the firm's book equity at the end of the previous year. ROEs larger than 1,000% per year in absolute value are excluded.

Source: Pastor and Veronesi "Was There a Nasdaq Bubble in the late 1990s?" (JFE, 2006)

Good Uncertainty?

- Consider an economy with a continuum of firms with productivity $\theta^i \sim N(\overline{\theta}, \sigma_\theta^2)$.

Good Uncertainty?

- Consider an economy with a continuum of firms with productivity $\theta^i \sim N(\overline{\theta}, \sigma_\theta^2)$.
- Assume linear technologies: $dB_t^i/B_t^i = \theta_i dt + \sigma dW_t + \sigma_1 dW_{i,t}$

Good Uncertainty?

- Consider an economy with a continuum of firms with productivity $\theta^i \sim N(\overline{\theta}, \sigma_\theta^2)$.
- Assume linear technologies: $dB_t^i/B_t^i = \theta_i dt + \sigma dW_t + \sigma_1 dW_{i,t}$
- $\Longrightarrow$ aggregate capital $B_t = \int B_t^i dt$

Good Uncertainty?

- Consider an economy with a continuum of firms with productivity $\theta^i \sim N(\overline{\theta}, \sigma_\theta^2)$.
- Assume linear technologies: $dB_t^i/B_t^i = \theta_i dt + \sigma dW_t + \sigma_1 dW_{i,t}$
- $\Longrightarrow$ aggregate capital $B_t = \int B_t^i dt$
- The law of large numbers $\Longrightarrow$ $dB_t/B_t = \left(\overline{\theta} + \frac{1}{2}\sigma_\theta^2 t\right) dt + \sigma dW_t$

Good Uncertainty?

- Consider an economy with a continuum of firms with productivity $\theta^i \sim N(\overline{\theta}, \sigma_\theta^2)$.
- Assume linear technologies: $dB_t^i/B_t^i = \theta_i dt + \sigma dW_t + \sigma_1 dW_{i,t}$
- $\Longrightarrow$ aggregate capital $B_t = \int B_t^i dt$
- The law of large numbers $\Longrightarrow$ $dB_t/B_t = \left(\overline{\theta} + \frac{1}{2}\sigma_\theta^2 t\right) dt + \sigma dW_t$
  - $\Longrightarrow$ higher dispersion of productivity increase the drift rate of aggregate capital (and hence, investments, consumption etc).

Good Uncertainty?

- Consider an economy with a continuum of firms with productivity $\theta^i \sim N(\overline{\theta}, \sigma_\theta^2)$.
- Assume linear technologies: $dB_t^i / B_t^i = \theta_i dt + \sigma dW_t + \sigma_1 dW_{i,t}$
- $\Longrightarrow$ aggregate capital $B_t = \int B_t^i dt$
- The law of large numbers $\Longrightarrow dB_t / B_t = \left(\overline{\theta} + \frac{1}{2}\sigma_\theta^2 t\right) dt + \sigma dW_t$
  - $\Longrightarrow$ higher dispersion of productivity increase the drift rate of aggregate capital (and hence, investments, consumption etc).
- Moreover, aggregate price is increasing in σ_θ. Given a log-normal SDF and assuming only one dividend $D_T = B_T$ at T we have

$$\frac{M_t}{B_t} = e^{(\overline{\theta} - r - \sigma\sigma_M)(T-t) + \frac{1}{2}\sigma_\theta^2 (T-t)^2}$$

Good Uncertainty?

- Consider an economy with a continuum of firms with productivity $\theta^i \sim N(\overline{\theta}, \sigma_\theta^2)$.
- Assume linear technologies: $dB_t^i/B_t^i = \theta_i dt + \sigma dW_t + \sigma_1 dW_{i,t}$
- $\Longrightarrow$ aggregate capital $B_t = \int B_t^i dt$
- The law of large numbers $\Longrightarrow dB_t/B_t = \left(\overline{\theta} + \frac{1}{2}\sigma_\theta^2 t\right) dt + \sigma dW_t$
  - $\Longrightarrow$ higher dispersion of productivity increase the drift rate of aggregate capital (and hence, investments, consumption etc).
- Moreover, aggregate price is increasing in σ_θ. Given a log-normal SDF and assuming only one dividend $D_T = B_T$ at T we have

$$\frac{M_t}{B_t} = e^{(\overline{\theta} - r - \sigma\sigma_M)(T-t) + \frac{1}{2}\sigma_\theta^2 (T-t)^2}$$

- In this model:
  - $\sigma_\theta =$ Good uncertainty
  - σ, $\sigma_M =$ Bad uncertainty

Concluding Remarks

- The paper is quite interesting, as it builds in some non-linearities in the relation between uncertainty, fundamentals, and prices.

Concluding Remarks

- The paper is quite interesting, as it builds in some non-linearities in the relation between uncertainty, fundamentals, and prices.
- It would be important though to understand the mechanism
  - This is reduced form, and it is good to see it works. But what is good / bad uncertainty? Why do periods with large innovations (e.g. 1990s) have large *realized* volatility of fundamentals?

Concluding Remarks

- The paper is quite interesting, as it builds in some non-linearities in the relation between uncertainty, fundamentals, and prices.
- It would be important though to understand the mechanism
  - This is reduced form, and it is good to see it works. But what is good / bad uncertainty? Why do periods with large innovations (e.g. 1990s) have large *realized* volatility of fundamentals?
- The measurement of realized good / bad uncertainty uses realized volatility, but at monthly frequency it is hard to measure well.
  - There are now daily indices of economic activity (e.g. Auroba, Diebold, Scotti business conditions index) that perhaps may help to get a better high-frequency estimation of fundamental uncertainty.

Concluding Remarks

- The paper is quite interesting, as it builds in some non-linearities in the relation between uncertainty, fundamentals, and prices.
- It would be important though to understand the mechanism
  - This is reduced form, and it is good to see it works. But what is good / bad uncertainty? Why do periods with large innovations (e.g. 1990s) have large *realized* volatility of fundamentals?
- The measurement of realized good / bad uncertainty uses realized volatility, but at monthly frequency it is hard to measure well.
  - There are now daily indices of economic activity (e.g. Auroba, Diebold, Scotti business conditions index) that perhaps may help to get a better high-frequency estimation of fundamental uncertainty.
- How about the flip-flop nature of the relation between Treasury yields and bond return volatility? What is the mechanism there? good/bad monetary policy uncertainty?