# Economics 442
# Macroeconomic Policy
## Lecture 27
## 12/7/2020

Instructor: Prof. Menzie Chinn
UW Madison
Fall 2020

# Outline

- Expectations (I) – Chapter 14
- Expectations (II) – Chapter 15
- Risk and Uncertainty
- Applications
    - Investment
    - Economic activity

# Expectations (I)

# Expectations (I)

- The price of a durable item depends on expectations
- Durable items include goods (e.g., a car)
- They also include assets (e.g., a house, or a share of stocks)
- Flows like consumption also depend on “permanent income” = present discounted value of expected income stream

# Expectations (I)

- Let's view implications of expectations for stocks
- First define "present discounted value"
- Apply to stock prices
- And then consider expectations for aggregate demand components (e.g, consumption, investment)

# 14.1 Expected Present Discounted Values

- The **expected present discounted value** or **present value** of a payment $\$z$ and its expected payment $\$z^e$ in the future ($\$z means we are talking about nominal values):

$$\$V_t = \$z_t + \frac{1}{(1+i_t)}\$z^e_{t+1} + \frac{1}{(1+i_t)(1+i^e_{t+1})}\$z^e_{t+2} + \ldots \qquad (14.1)$$

- For constant interest rates $i$:

$$\$V_t = \$z_t + \frac{1}{(1+i_t)}\$z^e_{t+1} + \frac{1}{(1+i_t)}\$z^e_{t+2} + \ldots \qquad (14.2)$$

- For constant interest rates and constant payments $\$z$:

$$\$V_t = \$z\left[1 + \frac{1}{(1+i)} + \ldots + \frac{1}{(1+i)^{n-1}}\right]$$

# 14.1 Expected Present Discounted Values

- For constant interest rates and payment forever :

$$\$V_t = \frac{\$z}{i}$$

- If $i = 0$, then the present discounted value of a sequence of expected payments is just the sum of those expected payments.
- The present value of a sequence of real payments (discounted by real interest rates $r_t$):

$$V_t = z_t + \frac{1}{(1+r_t)} z_{t+1}^e + \frac{1}{(1+r_t)(1+r_{t+1}^e)} z_{t+2}^e + \ldots \qquad (14.3)$$

- Notice when $r_{t+i}$ goes up, V goes down; when $z^e$ goes up V goes up.

# 14.3 The Stock Market and Movements in Stock Prices

- Equilibrium requires that the expected rate of return from holding stocks for one year (left side) be the same as the rate of return on one-year bonds plus the equity premium $x$ (right side):

$$\frac{\$D^e_{t+1} + \$Q^e_{t+1}}{\$Q_t} = 1 + i_{1t} + x$$

Risk free rate

or

$$\$Q_t = \frac{\$D^e_{t+1}}{(1 + i_{1t} + x)} + \frac{\$Q^e_{t+1}}{(1 + i_{1t} + x)} \qquad (14.14)$$

# 14.3 The Stock Market and Movements in Stock Prices

- If the expected prices in *n* years equal the present values of the expected prices and dividends:

$$\$Q_t = \frac{\$D^e_{t+1}}{(1+i_{1t}+x)} + \frac{\$D^e_{t+2}}{(1+i_{1t}+x)(1+i^e_{1t+1}+x)} + \dots + \frac{\$D^e_{t+n}}{(1+i_{1t}+x)\dots(1+i^e_{1t+n-1}+x)} + \frac{\$Q^e_{t+n}}{(1+i_{1t}+x)\dots(1+i^e_{1t+n-1}+x)} \quad (14.15)$$

- If the interest rate is positive, then it reduces to:

$$\$Q_t = \frac{\$D^e_{t+1}}{(1+i_{1t}+x)} + \frac{\$D^e_{t+2}}{(1+i_{1t}+x)(1+i^e_{1t+1}+x)} + \dots + \frac{\$D^e_{t+n}}{(1+i_{1t}+x)\dots(1+i^e_{1t+n-1}+x)} \quad (14.16)$$

# 14.3 The Stock Market and Movements in Stock Prices (6 of 8)

- Replacing the *nominal* interest rates with the *real* interest rates, then the real stock price is:

$$Q_t = \frac{D_{t+1}^e}{(1 + r_{1t} + x)} + \frac{D_{t+2}^e}{(1 + r_{1t} + x)(1 + r_{1t+1}^e + x)} + \ldots \qquad (14.17)$$

- Implications:
  - Higher expected future real dividends lead to a higher real stock price.
  - Higher current and expected future one-year real interest rates lead to a lower real stock price.
  - A higher equity premium leads to a lower stock price.

  Notice equity risk premium *x* is important

# Expectations (II)

# 15.1 Consumption (2 of 4)

- Consumption decision:

$$C_t = C(\text{total wealth}_t) \qquad (15.1)$$

- If you want to consume the same amount every year, the constant level of consumption that you can afford equals your total wealth divided by your expected remaining life.

$$(\text{total wealth}_t) = Net\ Assets + \text{Present Value}\ \ \Sigma \text{Y}_{t+i}$$

- However, you might:
  - not want to plan for constant consumption over your lifetime
  - make consumption decisions in a less forward-looking fashion
  - become unemployed or sick
  - not be able to get a loan from a bank when you need to borrow

# 15.1 Consumption

- Consumption function with after-tax labor income:

$$C_t = C(\text{total wealth}_t, Y_{Lt} - T_t) \qquad (15.2)$$
$$(+, +)$$

- Expectations affect consumption:
  - Directly through human wealth
  - Indirectly through nonhuman wealth
- Implications of expectations of the relation between consumption and income:
  - *Consumption is likely to respond less than one-for-one in current income.*
  - *Consumption may move even if current income does not change.*

# 15.2 Investment

- Firm invests as a function of present value of expected profits.
- To compute the present value of expected profits the firm must first estimate how long the machine will last or the depreciation rate δ.
- The *present value of expected profits* from buying the machine in year *t* is:

$$V(\prod_t^e) = \frac{1}{1+r_t}\prod_{t+1}^e + \frac{1}{(1+r_t)(1+r_{t+1}^e)}(1-\delta)\prod_{t+2}^e + \ldots \qquad (15.3)$$

- The investment function becomes:

$$I_t = \underset{(+)}{I}[V(\prod_t^e)] \qquad (15.4)$$

# 15.2 Investment (3 of 5)

- Assume **static expectations**:

$$\prod_{t+1}^{e} = \prod_{t+2}^{e} = \ldots = \prod_{t}$$
$$r_{t+1}^{e} = r_{t+2}^{e} = \ldots = r_t$$

so that equation (15.3) becomes:

$$V(\prod_t) = \frac{\prod_t}{r_t + \delta} \qquad (15.5)$$

- Replacing equation (15.5) in equation (15.4) gives:

$$I_t = I\left(\frac{\prod_t}{r_t + \delta}\right) \qquad (15.6)$$

where ($r_t$ + $\delta$) is rental cost (user cost), or shadow cost of capital.

# FOCUS: Profitability versus Cash Flow

- **Profitability** is the expected present discount value of future profits.
- **Cash flow** is net flow of cash the firm receives now (current profit).
- An economist found that in 1986 when the declines in the oil price led to large losses in oil-related activities, investment spending in nonoil activities also reduced.
- This suggests that current cash flow matters in investment.

# 15.2 Investment

- Investment depends both on the expected present value of future profits and on the current level of profit:

$$I_t = I[V(\prod_t^e), \prod_t] \qquad (15.7)$$
$$(+,+)$$

Uncertainty reduces sensitivity to expected profits

- Profit per unit of capital is an increasing function of the ratio of sales or output (*Y*) to the capital stock (*K*):

$$\prod_t = \prod\left(\frac{Y_t}{K_t}\right) \qquad (15.8)$$
$$(+)$$

# Implications

- Consumption depends on expectations of the future disposable income, discounted
- Investment depends on expectations of future cash flow/profits, discounted

# 16.1 Expectations and Decisions: Taking Stock

- Recall Chapter 6, the *IS* relation:

$$Y = C(Y - T) + I(Y, r + x) + G$$

- Assume **aggregate private spending** (**private spending**, *A,* equals the sum of consumption and investment spending:

$$A(Y, T, r, x) \equiv C(Y - T) + I(Y, r + x)$$

so the *IS* relation becomes:

$$\underset{(+,-,-,-)}{Y = A(Y, T, r, x)} + G \qquad (16.1)$$

# 16.1 Expectations and Decisions: Taking Stock

- Let primes denote future values and the superscript *e* denote an expectation, so

$$Y = A(Y, T, r, Y'^{e}, T'^{e}, r'^{e}) = + G \qquad (16.2)$$
$$(+, -, -, +, -, -)$$

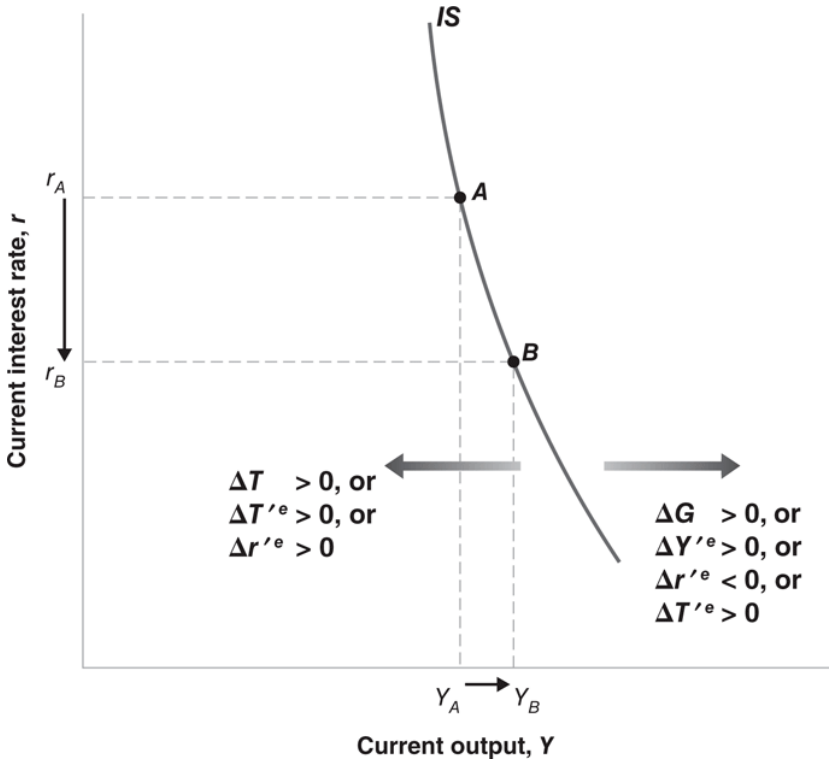
which means that

$$Y \text{ or } Y'^{\mathrm{e}} \text{ increase} \Rightarrow A \text{ increases}$$
$$T \text{ or } T'^{\mathrm{e}} \text{ increase} \Rightarrow A \text{ decreases}$$
$$r \text{ or } r'^{\mathrm{e}} \text{ increase} \Rightarrow A \text{ decreases}$$

# 16.1 Expectations and Decisions: Taking Stock

**Figure 16.2** The New *IS* Curve

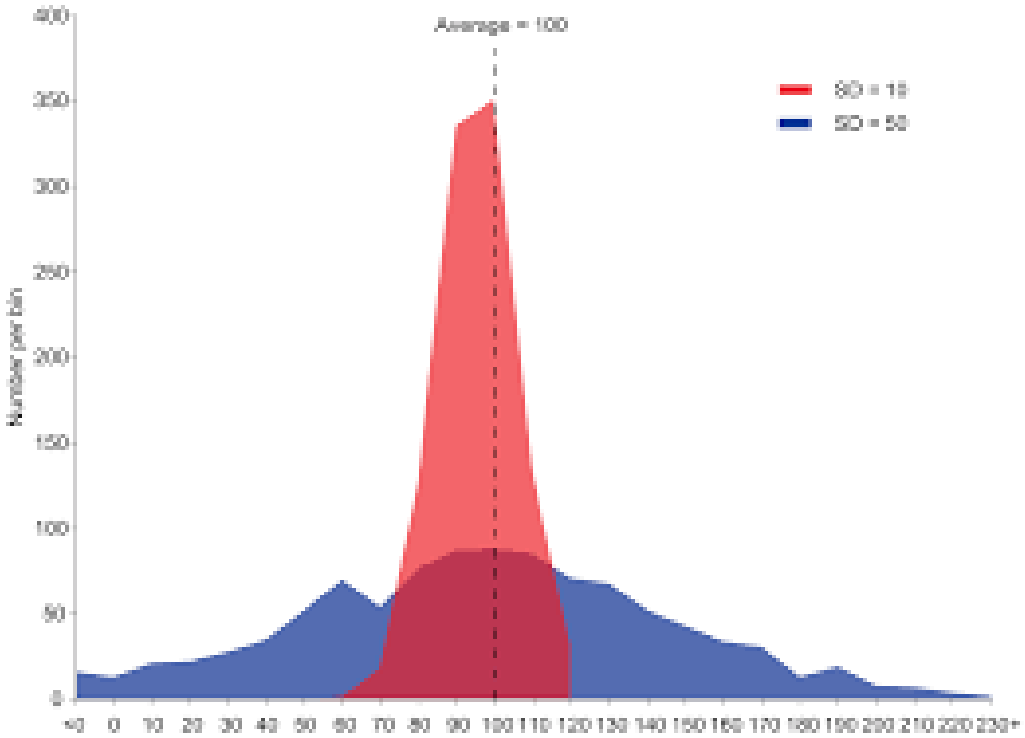
Given expectations, a decrease in the real policy rate leads to a small increase in output. The *IS* Curve is steeply downward sloping. Increases in government spending, or in expected future output, shift the *IS* curve to the right. Increases in taxes, in expected future taxes, or in the expected future real policy rate shift the *IS* curve to the left.



# Risk and Uncertainty

# Risk vs. Uncertainty

- …the chance that an outcome's actual gains will differ from an expected gains or return.
- Could be in dollar terms or in utility terms




Risk is greater when the spread of the distribution is greater

"Knightian" uncertainty pertains to shape of the distribution

# Risk vs. Uncertainty

- So risk pertains to losses, perhaps maximal losses
- Knightian (or deep) uncertainty pertains to not knowing the distribution so that one can’t assess the risk
- In practice, the distinction is often not made

# 14.3 The Stock Market and Movements in Stock Prices (6 of 8)

- Assume risk premium can vary

$$Q_t = \frac{D^e_{t+1}}{(1 + r_{1t} + x_t)} + \frac{D^e_{t+2}}{(1 + r_{1t} + x)(1 + r^e_{1t+1} + x^e_{1t+1})} + \ldots \qquad (14.17')$$

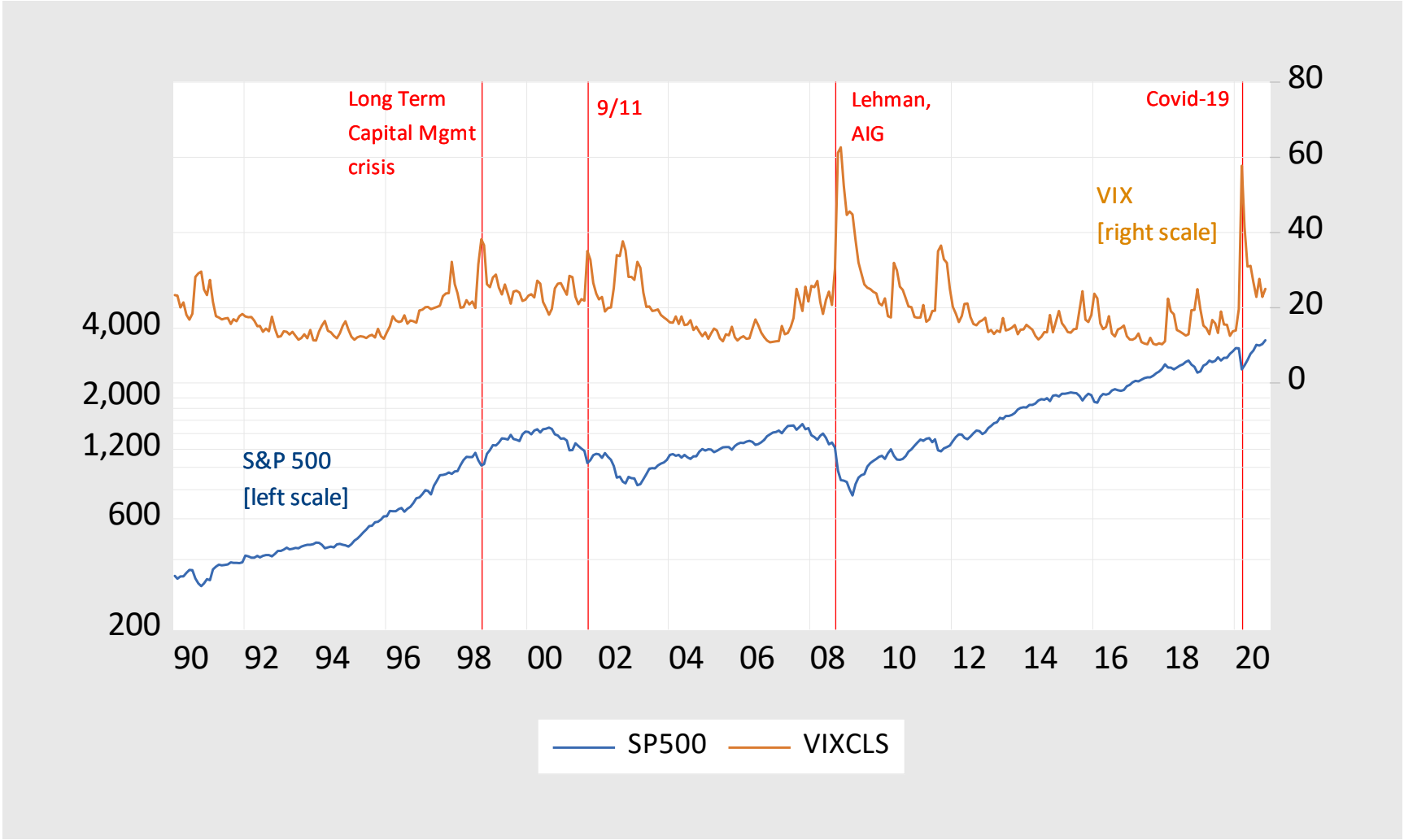
- Implications:
  - Higher expected future real dividends lead to a higher real stock price.
  - Higher current and expected future one-year real interest rates lead to a lower real stock price.
  - A higher time varying equity premium leads to a lower stock price.

  We need a measure of risk

# Risk Measure

- VIX - Created by the Chicago Board Options Exchange, the Cboe Volatility Index, or VIX, is a real-time market index that represents the market's expectation of 30-day forward-looking volatility. Derived from the price inputs of the S&P 500 index options, it provides a measure of market risk and investors' sentiments. It is also known by other names like "Fear Gauge" or "Fear Index.

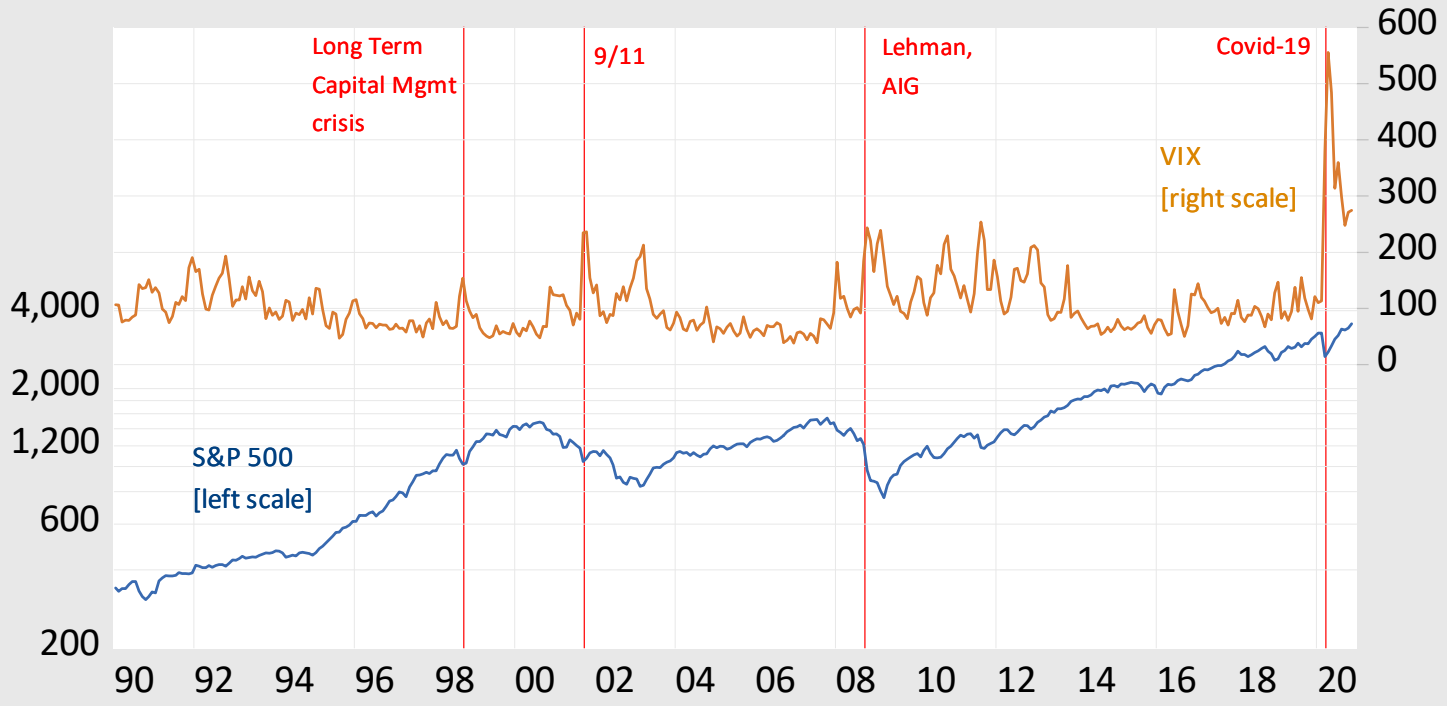
# Stock Prices and VIX



# Policy Uncertainty Measure

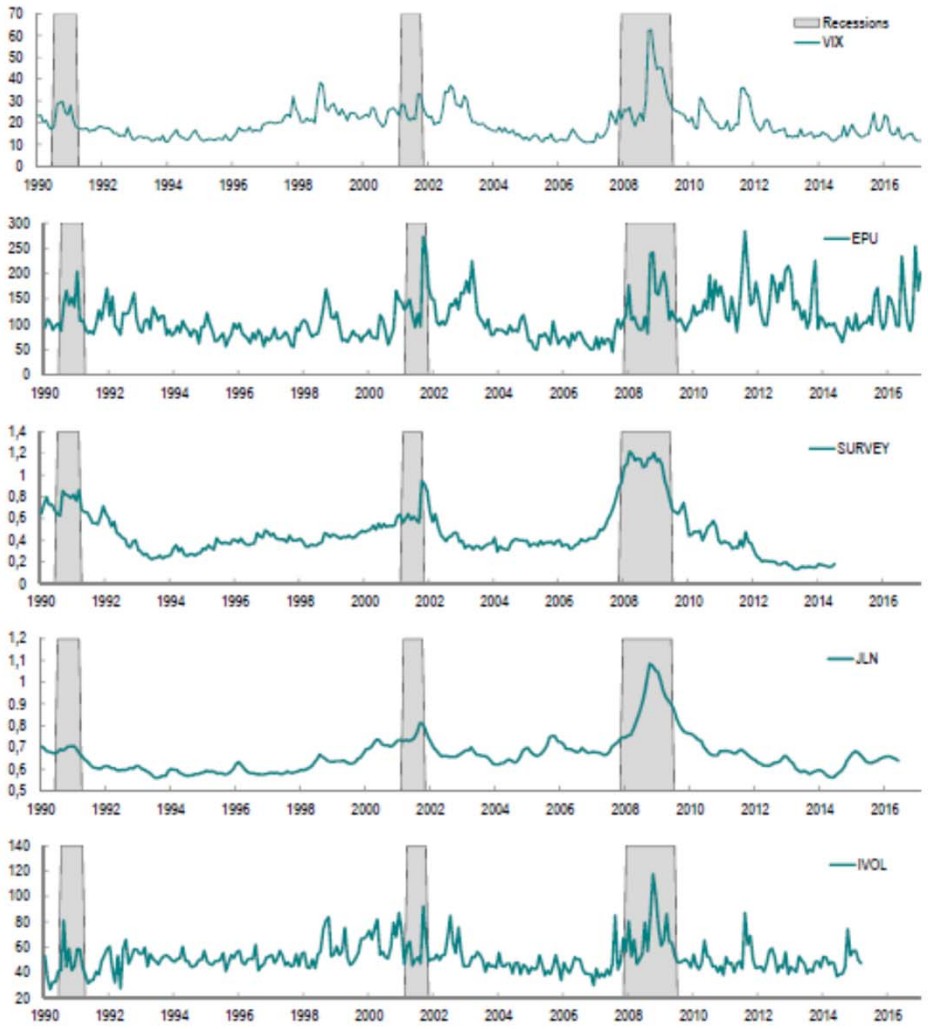
- Economic Policy Uncertainty index (news based) – based on "search results from 10 large newspapers. From these papers, we construct a normalized index of the volume of news articles discussing economic policy uncertainty."
- Baker, Bloom and Davis compile at policyuncertainty.com
- Was not possible before advent of machine readable text

# Stock Prices and Policy Uncertainty



# Some Other Measures Compared

Figure 1 – Comparison of various measures of uncertainty for the US economy since 1990: VIX, EPU , JLN, Survey and IVOL




Source: Jurado, Ludvingson and Ng (2015) JLN, Ozturk and Sheng (2017) Survey and Gilchrist *et al.* (2015) IVOL (shaded areas corresponds to US recessions).

Based on prices of stock options that depend on expectations of Stock prices hitting floors, ceiling

Based on word counts of “economic” “policy” “uncertainty” normalized Baker, Bloom & Davis

Based on dispersion of survey Forecasts for macro variables Sheng & Ozturk

Based on variance of time series forecast errors for macro variables Jurado et al.

Based on common component of volatility of firm specific Stock prices Gilchrist et al.

Source: Ferrara et al.

# Measures Compared

Table 1 – Linear correlation coefficients between various monthly measures of uncertainty for the US economy since 1990: VIX, EPU, JLN

| Correlation | VIX | EPU | Survey | JLN | IVOL |
|---|---|---|---|---|---|
| VIX | 1 | | | | |
| EPU | 0.45 | 1 | | | |
| Survey | 0.58 | 0.19 | 1 | | |
| JLN | 0.65 | 0.32 | 0.76 | 1 | |
| IVOL | 0.66 | 0.40 | 0.33 | 0.37 | 1 |

Source: JLN: Jurado, Ludvingson and Ng, 2015, Survey: Ozturk and Sheng, 2017 and IVOL: Gilchrist *et al.*, 2015.

Source: Ferrara et al.

# Applications

# Applications

- To investment (a component of aggregate demand)
- To economic activity overall

# 15.2 Investment

- Investment depends both on the expected present value of future profits and on the current level of profit:

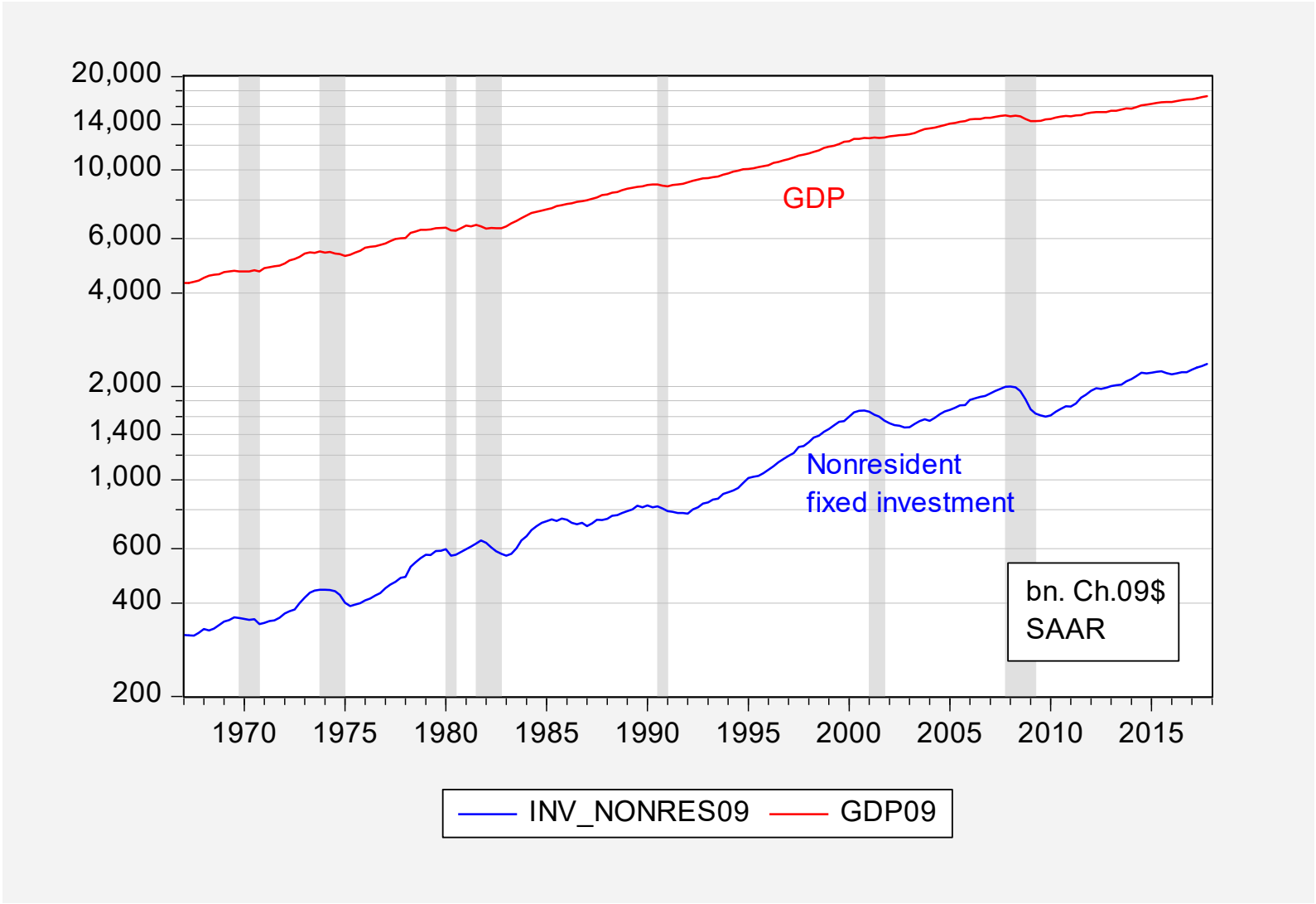
$$I_t = I[V(\prod_t^e), \prod_t] \qquad (15.7)$$
$$(+,+)$$

Uncertainty reduces sensitivity to expected profits

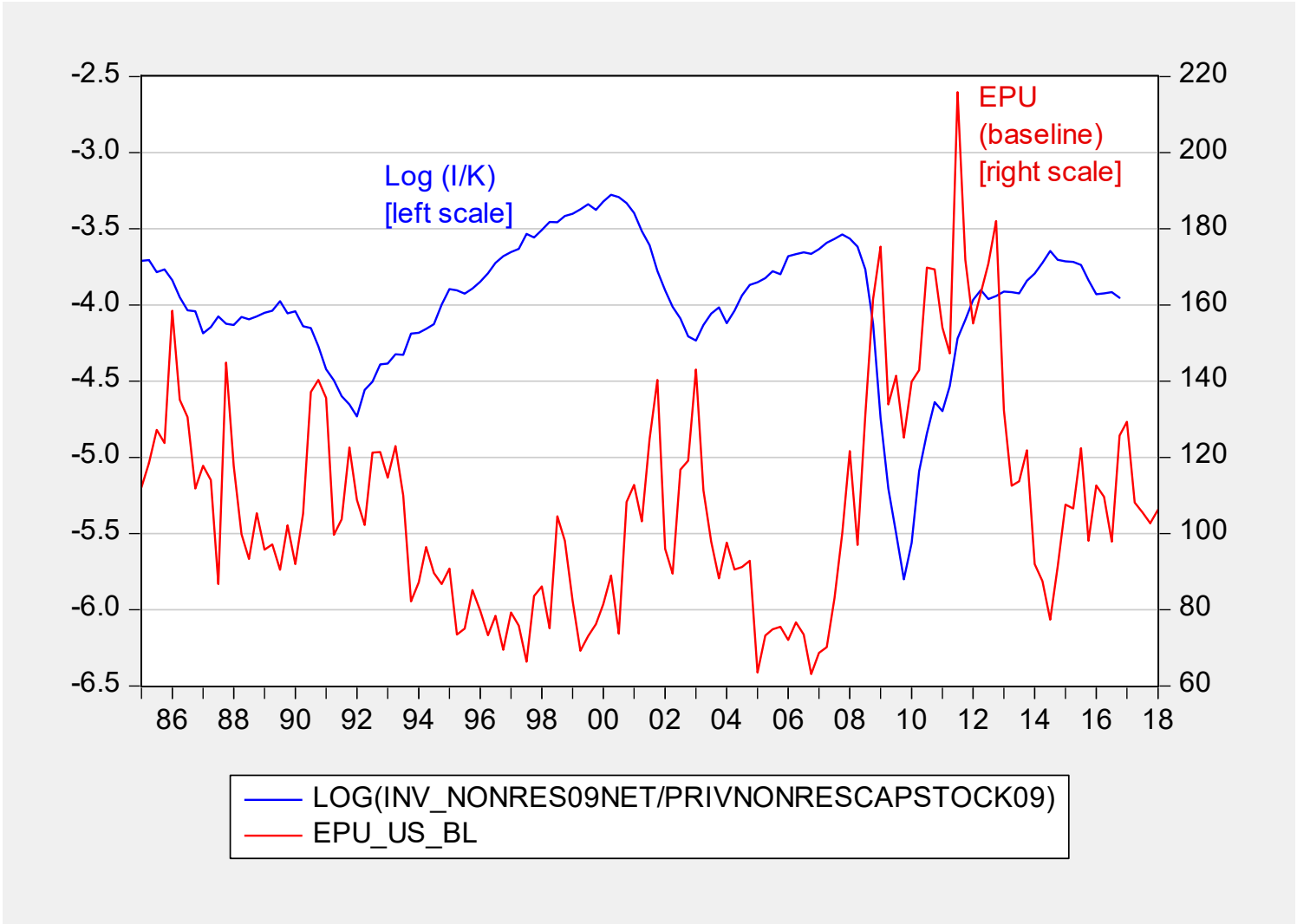
- Profit per unit of capital is an increasing function of the ratio of sales or output (*Y*) to the capital stock (*K*):

$$\prod_t = \prod\left(\frac{Y_t}{K_t}\right) \qquad (15.8)$$
$$(+)$$

# Nonresidential Fixed Investment



# Log Ratio I/K, EPU



Dependent Variable: LOG(INV_NONRES09NET/PRIVNONRESCAPSTOCK09)
Method: Least Squares
Date: 04/17/18 Time: 17:41
Sample (adjusted): 1982Q1 2016Q4
Included observations: 140 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -40.77943 | 10.32160 | -3.950883 | 0.0001 |
| LOG(GDP09) | 4.222458 | 1.241362 | 3.401472 | 0.0009 |
| REALGS10/100 | 12.61764 | 6.008650 | 2.099912 | 0.0376 |
| @TREND | -0.023121 | 0.010528 | -2.196061 | 0.0298 |

| | | | |
|---|---|---|---|
| R-squared | 0.204037 | Mean dependent var | -3.989210 |
| Adjusted R-squared | 0.186479 | S.D. dependent var | 0.433635 |
| S.E. of regression | 0.391118 | Akaike info criterion | 0.988543 |
| Sum squared resid | 20.80442 | Schwarz criterion | 1.072590 |
| Log likelihood | -65.19800 | Hannan-Quinn criter. | 1.022697 |
| F-statistic | 11.62073 | Durbin-Watson stat | 0.092549 |
| Prob(F-statistic) | 0.000001 | Wald F-statistic | 7.381465 |
| Prob(Wald F-statistic) | 0.000128 | | |

Dependent Variable: LOG(INV_NONRES09NET/PRIVNONRESCAPSTOCK09)
Method: Least Squares
Date: 04/17/18 Time: 17:42
Sample (adjusted): 1985Q1 2016Q4
Included observations: 128 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

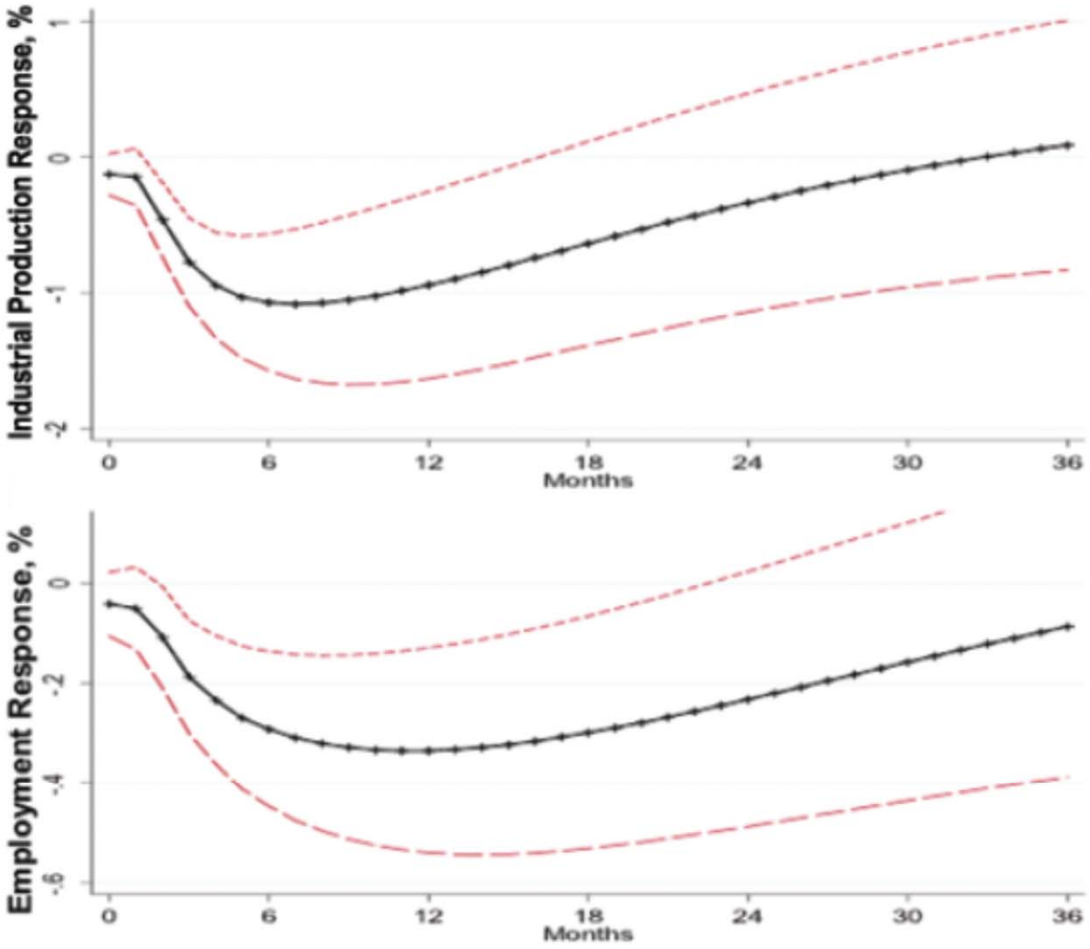
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -27.67160 | 12.11655 | -2.283786 | 0.0241 |
| LOG(GDP09) | 2.888203 | 1.447150 | 1.995787 | 0.0482 |
| REALGS10/100 | -4.618192 | 14.34929 | -0.321841 | 0.7481 |
| EPU_US_BL | -0.005801 | 0.002231 | -2.599818 | 0.0105 |
| @TREND | -0.019674 | 0.012327 | -1.596083 | 0.1130 |

| | | | |
|---|---|---|---|
| R-squared | 0.310326 | Mean dependent var | -3.985452 |
| Adjusted R-squared | 0.287897 | S.D. dependent var | 0.448091 |
| S.E. of regression | 0.378127 | Akaike info criterion | 0.931104 |
| Sum squared resid | 17.58652 | Schwarz criterion | 1.042512 |
| Log likelihood | -54.59068 | Hannan-Quinn criter. | 0.976370 |
| F-statistic | 13.83626 | Durbin-Watson stat | 0.185164 |
| Prob(F-statistic) | 0.000000 | Wald F-statistic | 4.710933 |
| Prob(Wald F-statistic) | 0.001430 | | |

# Economic Activity

- Baker, Bloom and Davis develop an index of economic *policy* uncertainty (EPU)
- Uses analysis of frequency of words, normalized by total words, in news accounts, on a daily basis
- Imbed in a Vector Autoregression (VAR) estimated on EPU, log(SP500), Fed funds rate, log(employment), log(industrial production), using that ordering

# Economic Policy Uncertainty & Macro Activity

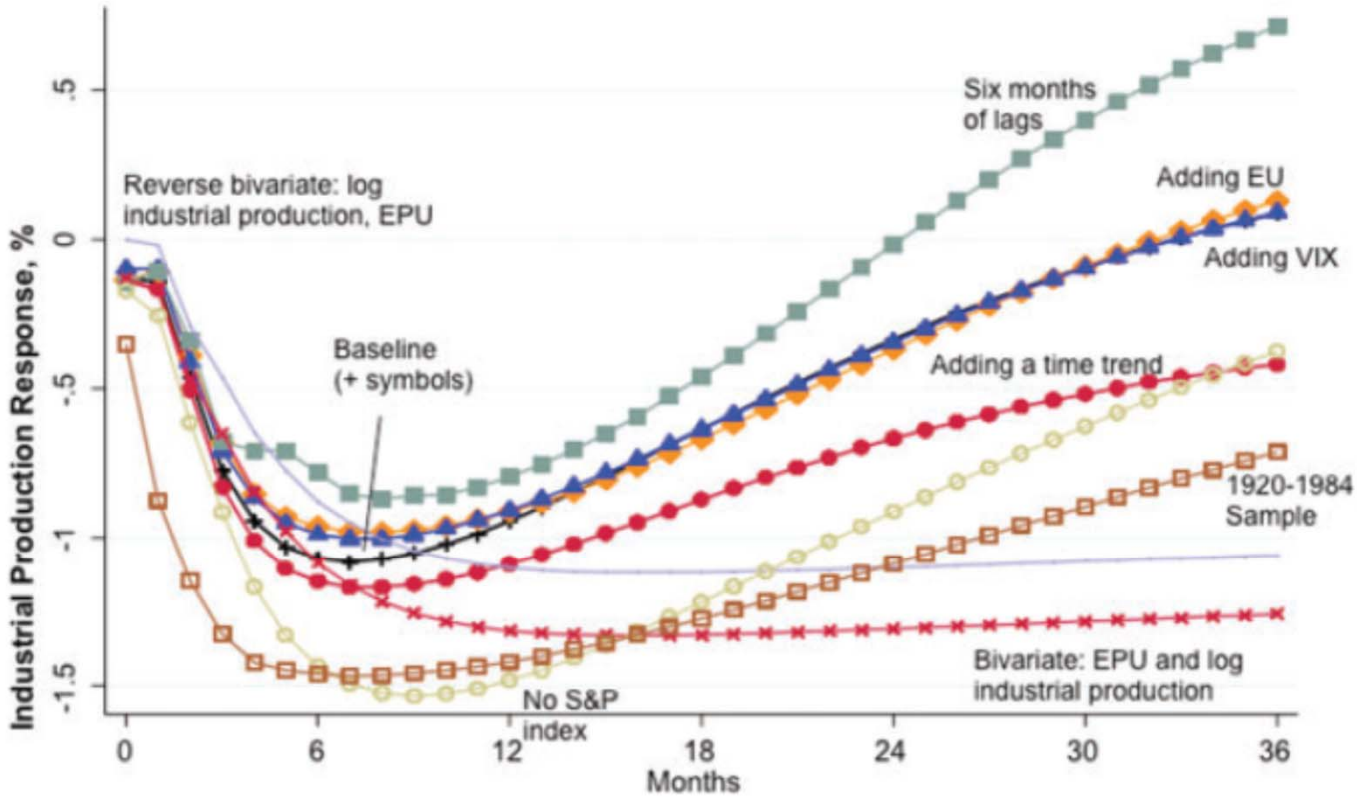



VAR-estimated impulse response functions for industrial production and employment to an EPU innovation equal to the increase in the EPU index from its 2005-2006 to its 2011-2012 average value, with 90 percent confidence bands. Identification based on three lags and a Cholesky decomposition with the following ordering: EPU index, log(S&P 500 index), federal reserve funds rate, log employment, log industrial production. Fit to monthly data from 1985 to 2014.

FIGURE VIII

Industrial Production and Employment Responses to EPU Shock, VAR Fit to Monthly U.S. Data

# Robustness




The baseline case involves the same sample period, VAR specification and identification as in Figure VIII. The other cases depart from the baseline as indicated. We place EU and VIX after EPU in the ordering. For the "1920-1984" response function, we use monthly data from 1920 to 1984 on log industrial production and EPU in a bivariate VAR with EPU ordered first.

FIGURE IX

U.S. Industrial Production Response to an EPU Shock, Alternative Samples, Specifications, and Identification Assumptions

# High Current Level of Policy Uncertainty