1. Shocks

March 8, 2007.

1.5. The Great Moderation

Many structural changes potentially important for fluctuations:

- Lower marginal cost, higher markup on many goods.
- Globalization and wage bargaining.
- Financial market development, investment, and consumption
- Many more.

So unlikely to have an unchanging underlying process, when looking at data from, say, 1970 to 2006.

One striking fact. Decrease in the volatility of output.

Measuring volatility

1. Rolling standard deviation of output growth. Figure 1 from Blanchard and Simon (BS). Quarterly, quarterly rate, sd computed over previous 20 quarters.

2. Time varying ARCH process. (Stock Watson (SW) Figure 1)

$$y_t = \sum_{j=1}^{p} \alpha_{jt}\ y_{t-j} + \sigma_t\ \epsilon_t \text{ where}$$

$$\alpha_{jt} = \alpha_{jt-1} + c_j \eta_{jt}$$

$$\log \sigma_t^2 = \log \sigma_{t-1}^2 + \xi_t$$

ξ_t mixed normal, with variances τ_1 with prob q, τ_2 with prob 1-q to allow for fat tails

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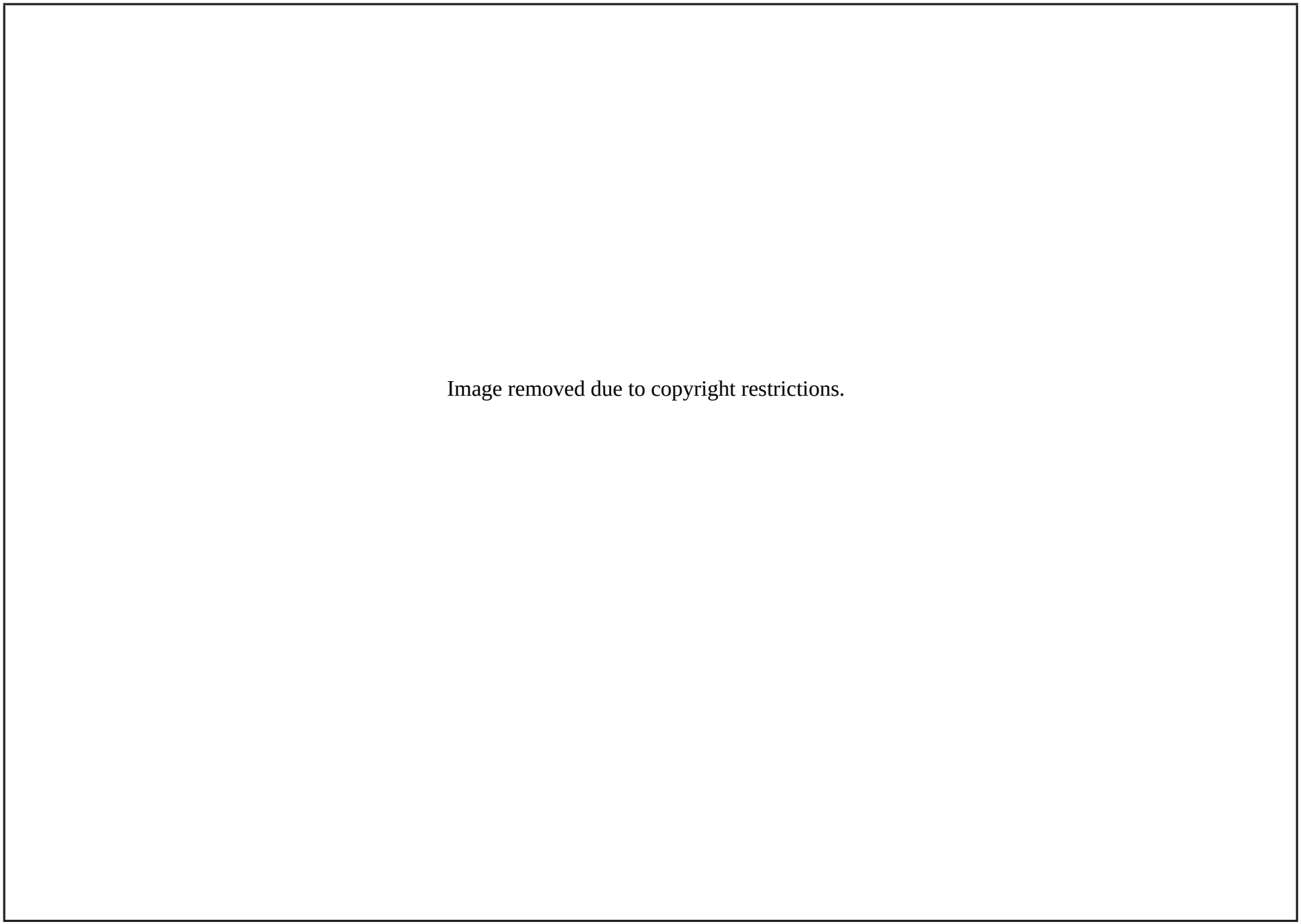
Figure 1. Volatility of Output Growth, 1952-2000. p. 138.

Blanchard, O., and J. Simon. "The Long and Large Decline in U.S. Output Volatility." *Brookings Papers on Economic Activity* 2001, no. 1 (2001): 135-164.



Looking at components

Figure 9 and 10 from BS

- Decline in most components. Down early, then up during the 1970s and early 1980s, then down again.
- Not so for net exports.
- Sharp early decline in government spending (end of Korean, Vietnam wars)
- Different timings for consumption and for investment

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Figure 9. Volatilities of Components of GDP, 1952-2000. p. 157.
Blanchard, O., and J. Simon. "The Long and Large Decline in U.S. Output Volatility." *Brookings Papers on Economic Activity* 2001, no. 1 (2001): 135-164.

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Figure 10. Volatilities of Components of Consumption and Investment, 1952-2000. p. 158.
Blanchard, O., and J. Simon. "The Long and Large Decline in U.S. Output Volatility." *Brookings Papers on Economic Activity* 2001, no. 1 (2001): 135-164.

Output and inflation volatility

- Economy could operate on a different point on the efficient inflation-output frontier.
- Evidence (BS Figure 6): Clearly not the case.
- Striking relation between output and inflation volatility (measured by rolling sds)

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Figure 6. Relationship Between Output Volatility and Inflation, 1952-2000. p. 150.
Blanchard, O., and J. Simon. "The Long and Large Decline in U.S. Output Volatility." *Brookings Papers on Economic Activity* 2001, no. 1 (2001): 135-164.

General or US specific?

Looking at each G7 country:

- General decrease, but different timing
- US, Canada, UK decrease in the 1980s
- Germany, France, Italy, much less
- Japan as the exception to the rule. The liquidity trap?

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Figure 7. Volatility of Output Growth in the G-7 Countries, 1965-2000. p. 152.
Blanchard, O., and J. Simon. "The Long and Large Decline in U.S. Output Volatility." *Brookings Papers on Economic Activity* 2001, no. 1 (2001): 135-164.

Break, or interrupted trend?

- An eye-test. BS Figure 5. Hard to tell.
- A formal test. SW Table 3.

$$y_t = \alpha + \phi(L) y_{t-1} + \epsilon_t$$

Allows for separate breaks in both process and variance, with and without trends for the variance.

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Figure 5. Alternative Estimates of the Trend in Output Volatility, 1952-2000. p. 148.
Blanchard, O., and J. Simon. "The Long and Large Decline in U.S. Output Volatility." *Brookings Papers on Economic Activity* 2001, no. 1 (2001): 135-164.

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Table 3. Tests for Changes in Autoregressive Parameters. p. 60.
Stock, J., and M. Watson. "Has the business cycle changed and why?" NBER Working Paper No. 9127, August 2002. pp. 1-80. (http://www.nber.org/papers/w9127)

Smaller shocks or changes in the propagation mechanism?

Monetary policy seems to be much better since the early/mid 1980s? How much credit should it get? First pass: Shocks versus propagation mechanism.

- Rolling AR on GDP growth (20 quarters). A surprisingly stable process. BS Figure 2, assuming AR(1): Clear conclusion: Smaller shocks.
- More sophisticated: Ahmed et al. Multivariate VARs. Tables 6 and 7.

  1960-79 vs 1984-2002.

  Monthly, or quarterly, 4 or 5 variables. with either IP (monthly), or GDP.

  GDP: roughly 2/3 variance. Inflation: roughly 4/5 prop mechanism
- So "good luck" rather than "better policy"? Not so fast.

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Figure 2. Time Variation of Key Parameters, 1952-2000. p. 140.
Blanchard, O., and J. Simon. "The Long and Large Decline in U.S. Output Volatility." *Brookings Papers on Economic Activity* 2001, no. 1 (2001): 135-164.

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Table 6. Innovations from Reduced-Form VAR. p. 830.
Ahmed, S., A. Levin, and B.A. Wilson. "Recent US Macroeconomic Stability: Good Policies, Good Practices, or Good Luck?" *Review of Economics and Statistics* 86, no. 3 (Aug. 2004): 824-832.

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Table 7. Explaining Stability. p. 830.
Ahmed, S., A. Levin, and B.A. Wilson. "Recent US Macroeconomic Stability: Good Policies, Good Practices, or Good Luck?" *Review of Economics and Statistics* 86, no. 3 (Aug. 2004): 824-832.

Shocks or policy? A closer look

Even if we correctly identify the model, policy can affect the variance of measured structural shocks. A simple NK example. (More elaborate/realistic model in Benati-Surico 2006). Structural model:

$$y_t = E[y_{t+1}|\Omega_t] - aR_{t-1} + x_t$$

$$x_t = \rho\ x_{t-1} + \epsilon_t$$

$$R_t = bx_t + \epsilon_{Rt}$$

- First equation: Aggregate demand (consumption), with R the real rate, assumed directly under the control of the central bank. R is assumed to work with a one-period lag to make the point below stronger.
- Second equation: x_t is a demand shock, with innovation x_t
- Third equation; A simplified Taylor rule, with an interest rate white noise shock ϵ_{Rt}

Solve under rational expectations to get the following true model in MA form:

$$y_t = \frac{1-ab}{1-\rho}\ \epsilon_t + \frac{\rho-ab}{1-\rho}\sum_{i=1}^{\infty}\rho^i\epsilon_{t-i} - a\epsilon_{Rt-1}$$

$$R_t = b\ \sum_{i=0}^{\infty}\rho^i\epsilon_{t-i} + \epsilon_{Rt}$$

What we shall estimate, if we achieve identification correctly is the following "structural model", in MA form:

$$y_t = e_t + \frac{\rho-ab}{1-ab}\sum_{i=1}^{\infty}\rho^i e_{t-i} - a\epsilon_{Rt}$$

$$R_t = b\frac{1-\rho}{1-ab}\ \sum_{i=0}^{\infty}\rho^i e_{t-i} + \epsilon_{Rt}$$

where $e_t \equiv \frac{1-ab}{1-\rho}\ \epsilon_t$

Implication: An increase in b will reduce the variance of e_t: Under a more active policy, a given shock to aggregate demand will have less effect on expected output ("Good policy" looks like "good luck".) Consider two extreme cases:

- $b = 0$:

$$y_t = \frac{1}{1-\rho}\,\epsilon_t + \frac{\rho}{1-\rho}\sum_{i=1}^{\infty}\rho^i\epsilon_{t-i} - a\epsilon_{Rt}$$

- $b = \rho/a$:

$$y_t = \epsilon_t$$

- Can changes in b have an effect mostly on the variance of e_t rather than on the propagation mechanism? Yes, for ρ close to 1, and b not too large. Close to

$$\frac{1-ab}{1-\rho}(1+\rho+\rho^2+...)$$

Another take. Looking at the effects of the price of oil

(From current work with JG. I could not resist...)

Do given observable shocks have the same effects as they used to?

Motivation: Oil price shocks in the 1970s and the 2000s. Basic evidence. Plot:

- Cumulative relative output loss: $\sum_{i=1}^{i=8}(g_i - \bar{g})$
- Cumulative relative inflation increase: $\frac{1}{8}\ \sum_{i=1}^{i=8}(\pi_i - \bar{\pi})$

  where i is the first quarter after a 50% increase in the dollar price of oil, and $\bar{g}$ and π are average growth and inflation over the previous 4 years. Average over 23 countries.

Counfounding various shocks? Decrease in productivity growth, labor unrest?

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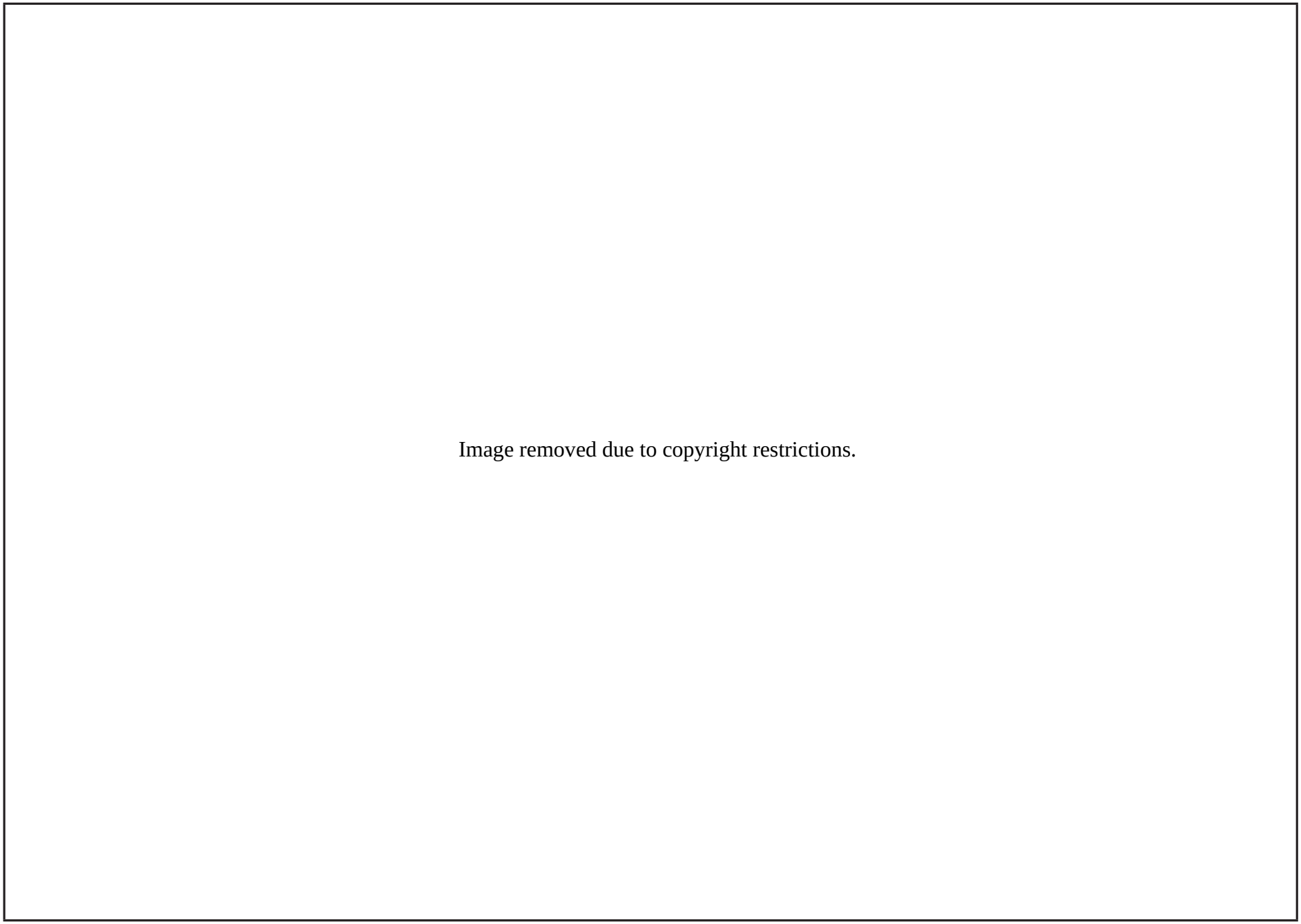
Using a structural VAR approach.

- VAR in oil price, GDP deflator, CPI, nominal wage, and output (logs), over 1970-1984, and 1986-2006, quarterly.
- Assuming that the price of oil is unaffected by other shocks within the quarter. (So oil price on lagged variables only, other variables on current oil price and lagged variables)
- Impulse responses: Very different. "First round effects". "Second round" effects in the first subsample, not in the second. Similar for other G7.
- Points to changes in propagation mechanism. Monetary policy and anchoring of expectations? Wage setting and real wage rigidity?



Tech and non-tech shocks, propagation mechanisms, and the great moderation

Simple exercise (conceptually):

Take description of fluctuations as coming from technological and other shocks (a la Gali). How have the variance of innovations and the propagation mechanisms changed over time?
Gali-Gambetti: Time-varying version of Gali:

- All VAR coefficients and the standard deviation of the residuals, follow random walks.
- Innovations to coefficients and to standard deviations can be cross correlated, but are uncorrelated with shocks at all leads and lags.
- Identification: Only the technology shock affects labor productivity in the long run.

Three main conclusions

- Large decline in the contribution of the non-technology shock to GDP. Fully accounts from the decline in overall volatility
- Much smaller non-technology shocks. Average initial response: 1.0 pre-1984, 0.5 post-84. But similar hump shaped response (propagation mechanism).
- Roughly similar technology shocks, and similar impulse responses. Average initial response: 0.4 pre-1984, 0.5 post-1984. Average long-run response: 0.8 in both cases.

So a decrease in the size of non-technological shocks, without much change in propagation mechanisms. Back to why? Policy, or luck?

Technology and Non-Technology Components of Output Volatility

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Technology and Non-Technology Components of Output Volatility. p. 31.
Gali, J., and L. Gambetti. "On the sources of the great moderation." mimeo, Barcelona, September 2006. pp. 1-43.

Non-Technology Shocks: Output Response

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Non-Technology Shocks: Output Response. p. 35.
Gali, J., and L. Gambetti. "On the sources of the great moderation." mimeo, Barcelona, September 2006. pp. 1-43.

Technology Shocks: Output Response

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Technology Shocks: Output Response.. p. 39.
Gali, J., and L. Gambetti. "On the sources of the great moderation." mimeo, Barcelona, September 2006. pp. 1-43.

Other avenues

- Increased diversification, higher micro-uncertainty and lower macro-uncertainty. (Philippon-Cummins/Davis et al)

  Facts: Increase in micro-uncertainty, as measured by variance of sales in Compustat. But not obviously true in larger universe of firms.

- Decrease in liquidity/credit constraints. More could be done here, on consumption, and on investment and credit constraints.

- More countercyclical behavior of inventories. Yes, but a small part of the story.

- Composition: more services, less manufacturing: No, at least in accounting sense.

- Demographics. (Jaimovich and Siu). Young have more cyclical employment behavior. Share of young (15-29) in LF has decreased (in the US, from a maximum of 38% in 1980 to 27% in 1999.