

Really Uncertain Business Cycles

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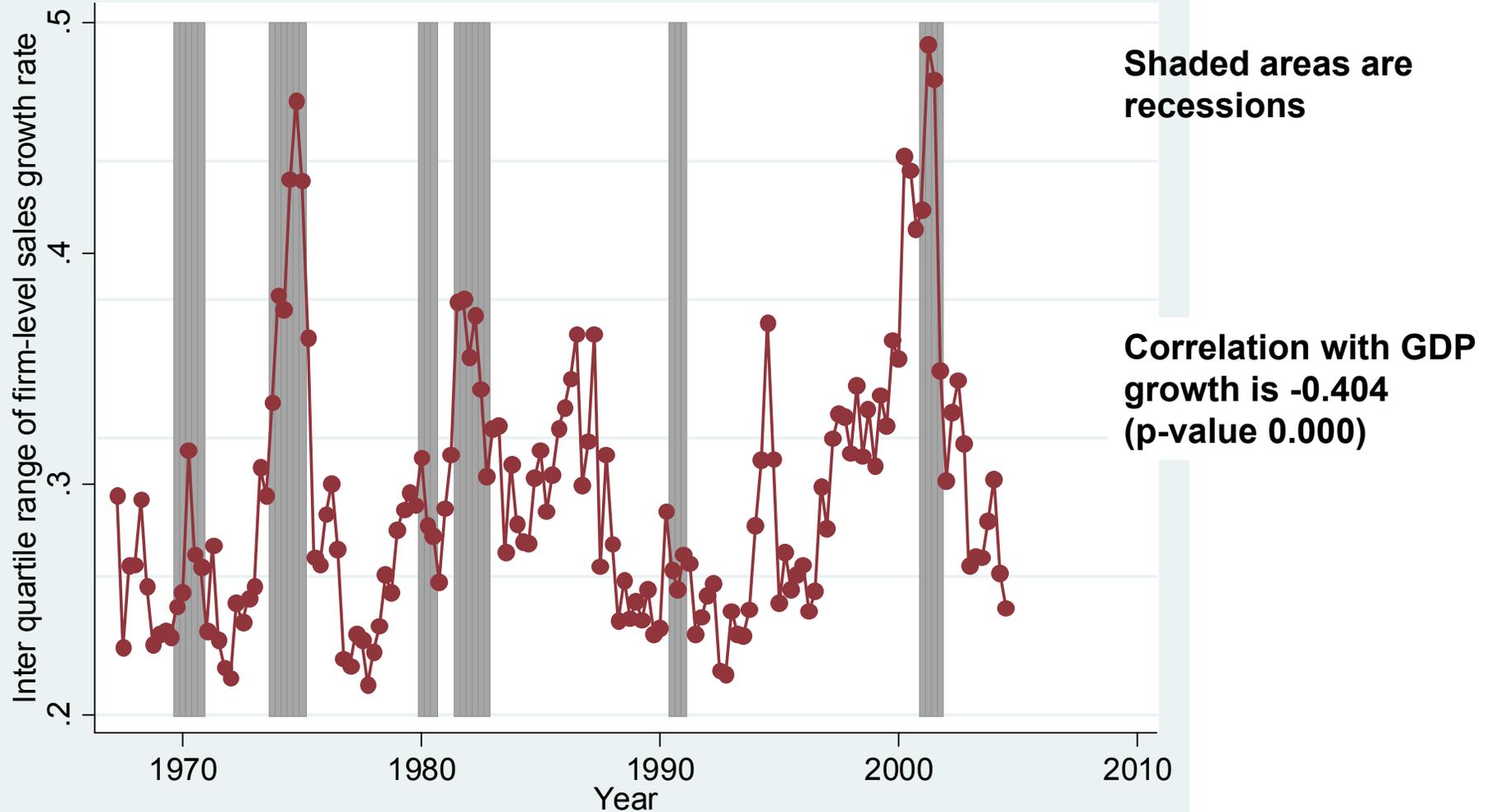
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Firm uncertainty appears to be counter-cyclical

Firm-linked uncertainty appears to rise in recessions:

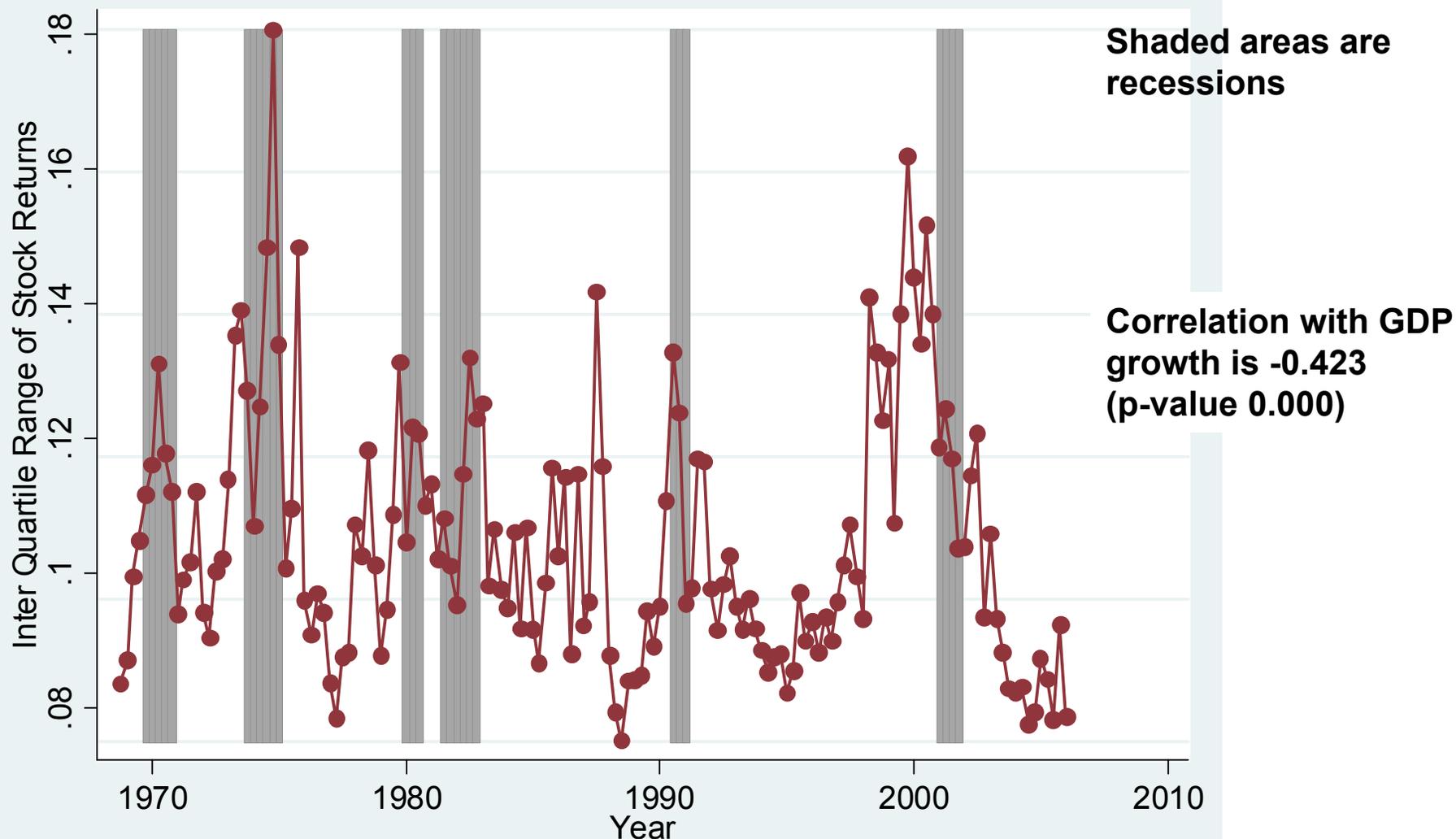
- Cross-section variation across firms (micro)
- Time-series variation over months/quarters (macro)
- Cross-forecaster disagreement (signal?)

Cross-sectional spread: sales growth



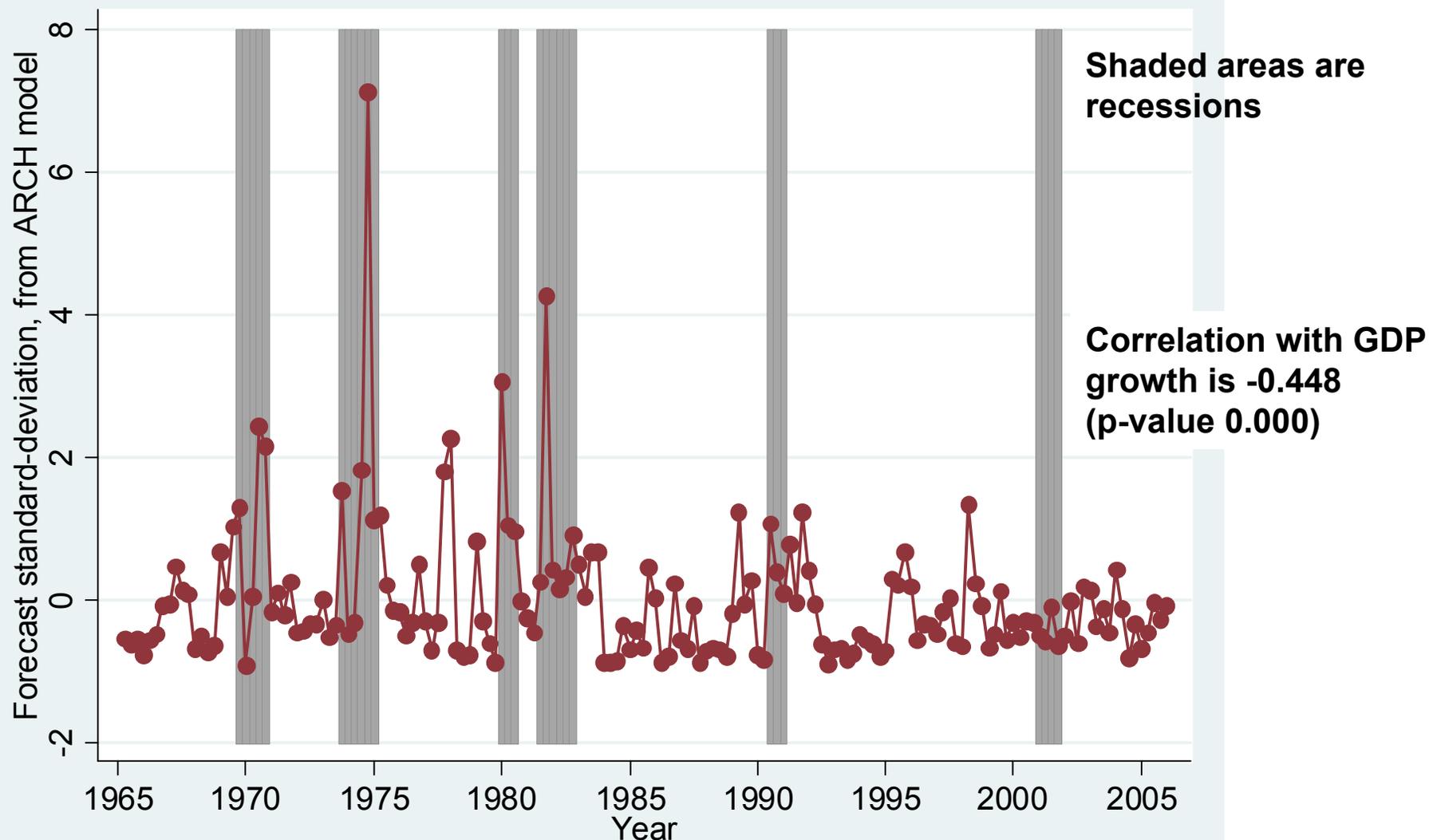
Notes: All firms with at least 25 years of quarterly accounts used (to reduce the impact of compositional changes). Only quarters with at least 500 firms kept to ensure sufficient sample size. Produces a continuous quarterly series from 1967Q2 until 2004Q2. Sales growth spread is defined as the inter-quartile range (IQR) across firms within each quarter, where the IQR is used to minimize the impact of large outliers (mergers, acquisitions, disposals, etc.). Sales growth is defined over a four quarter period to remove the effects of the quarterly accounting cycle, with this centered around the current quarter so that $(\text{Sales Growth})_t = (\text{Sales}_{t+2} - \text{Sales}_{t-2}) / (0.5 \times \text{Sales}_{t+2} + 0.5 \times \text{Sales}_{t-2})$. Quarterly recession indicator defined as starting the first quarter after the (NBER defined) business cycle-peak and ending at the (NBER defined) business cycle-trough. GDP growth correlations defined using real quarterly GDP growth.

Cross-sectional spread: firm stock returns



Notes: All firms with at least 25 years of quarterly returns used (to reduce the impact of compositional changes). Only quarters with at least 1000 firms kept to ensure sufficient sample size. Produces a continuous quarterly series from 1968Q3 until 2006Q1. Stock returns spread calculation using the inter-quartile range (IQR) across firms within each quarter, where the IQR is used to minimize the impact of large outliers (mergers, acquisitions, disposals, etc.). Quarterly recession indicator defined as starting the first quarter after the (NBER defined) business cycle-peak and ending at the (NBER defined) business cycle-trough. GDP growth correlations defined using real quarterly GDP growth.

Time-series volatility: industrial-production growth



Notes: Industrial production standard-deviation (SD) defined as predicted SD from a regression of monthly log industrial production (Final products and non-industrial supplies seasonally adjusted, FRB Statistics) on its own 12 lags, with an ARCH(2) error term. Longer lags in industrial productions or the ARCH error term were not significant (nor was a GARCH MA error term). Quarterly values of SD averaged over the monthly values within the quarter. Recession indicator defined as starting the first month after the (NBER defined) business cycle-peak and ending at the (NBER defined) business cycle-trough. GDP growth correlations defined using real quarterly GDP growth.

Note on estimation of industrial-production volatility (plotted in previous slide)

Estimated an AR(12) forecast for log industrial production with an ARCH(2) variance, using monthly data

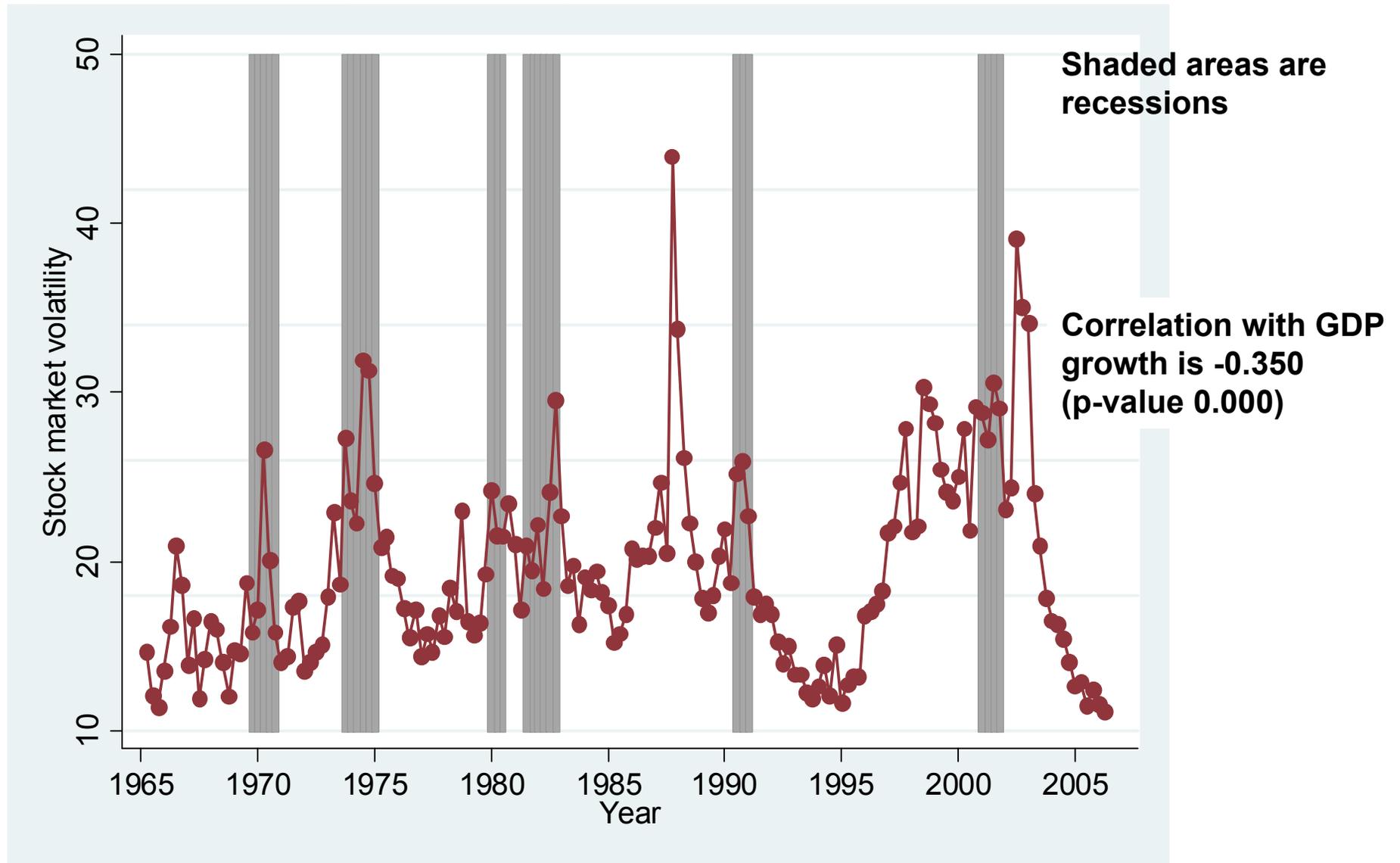
$$p_t = \alpha_0 + \alpha_1 p_{t-1} + \alpha_2 p_{t-2} + \dots + \alpha_{12} p_{t-12} + e_t \quad \text{where } e_t \sim N(0, \sigma_t)$$

$$\sigma_t^2 = \beta_0 + \beta_1 \sigma_{t-1}^2 + \beta_2 \sigma_t^2 + v_t \quad \text{where } v_t \sim N(0, 1)$$

σ_t is the measure of uncertainty plotted in the previous Figure

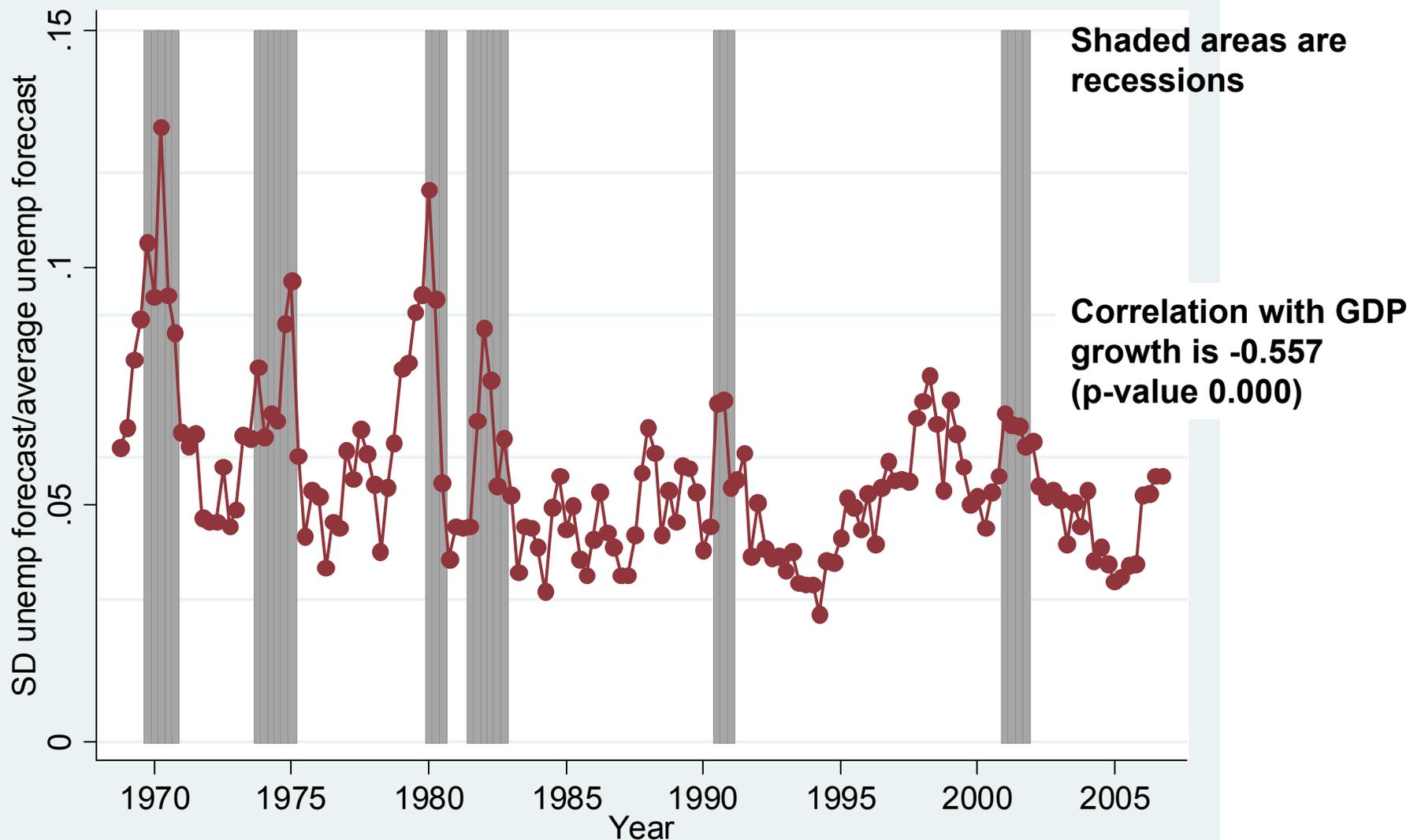
Selected AR(12) and ARCH(2) by testing down from higher order lags and MA series in the AR and GARCH processes

Time-series volatility: stock-market volatility



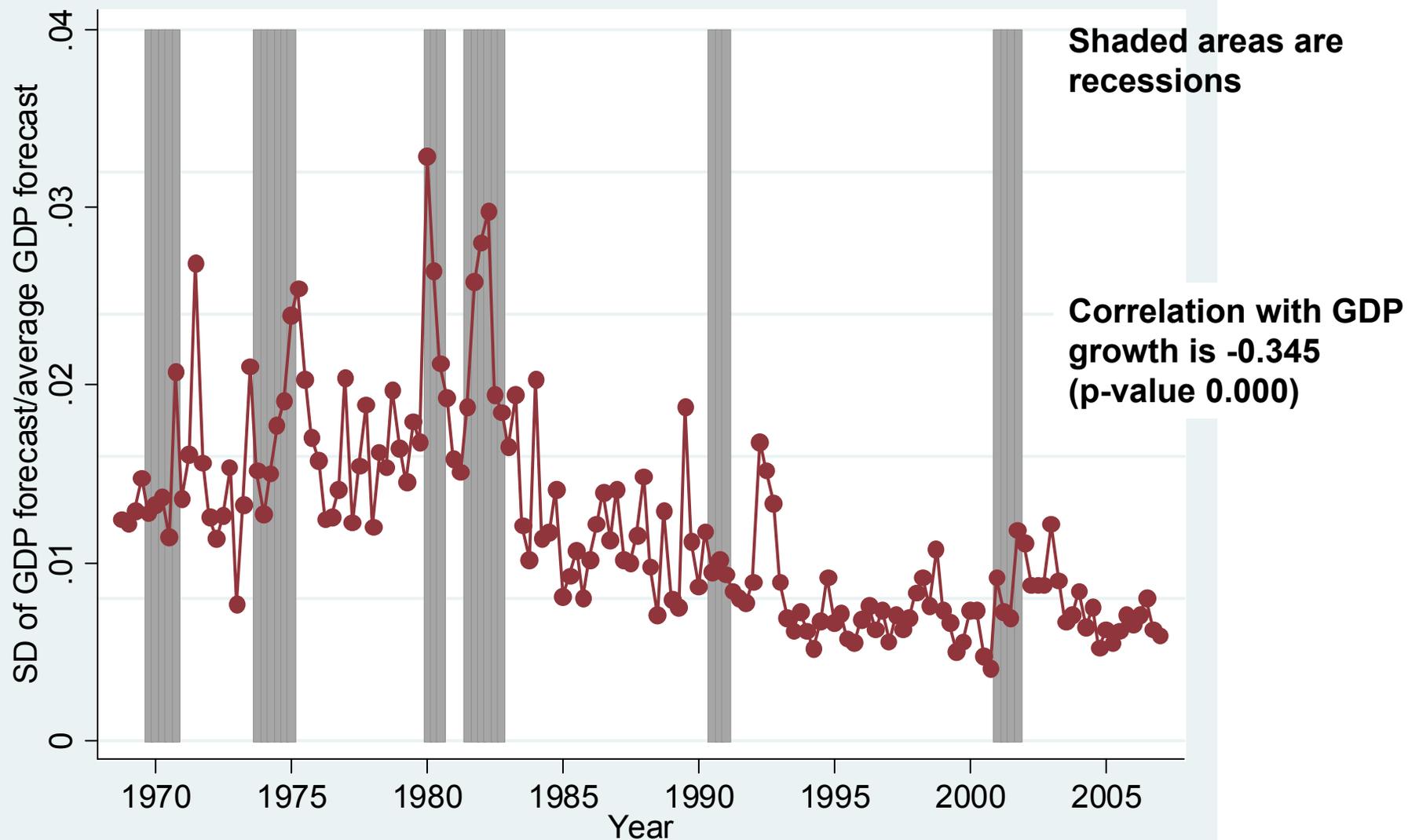
Notes: Stock market volatility used actual quarterly standard deviation of daily returns until 1987, and average quarterly implied volatility from 1987 onwards (see Bloom, 2007 for details). Quarterly recession indicator defined as starting the first quarter after the (NBER defined) business cycle-peak and ending at the (NBER defined) business cycle-trough. GDP growth correlations defined using real quarterly GDP growth.

Forecaster dispersion: Unemployment (SD/Mean)



Notes: Standard deviation of cross-sectional forecasts divided by average of cross-sectional forecasts, 4 quarters ahead unemployment rates from the Survey of Professional Forecasters. Forecasts collected quarterly with an average of 41 forecasters per period. Quarterly recession indicator defined as starting the first quarter after the (NBER defined) business cycle-peak and ending at the (NBER defined) business cycle-trough. GDP growth correlations defined using real quarterly GDP growth.

Forecaster dispersion: GDP (SD/Mean)



Notes: Standard deviation of cross-sectional forecasts of 4 quarters ahead GDP growth (nominal) from the Survey of Professional Forecasters. Forecasts collected quarterly with an average of 41 forecasters per period. Quarterly indicator defined as starting the first quarter after the (NBER defined) business cycle-peak and ending at the (NBER defined) business cycle-trough. GDP growth correlations defined using real quarterly GDP growth.

Using these measures we generated a principal-component-factor proxy for 'uncertainty'

Each of the previous measures looks like a noisy proxy of uncertainty

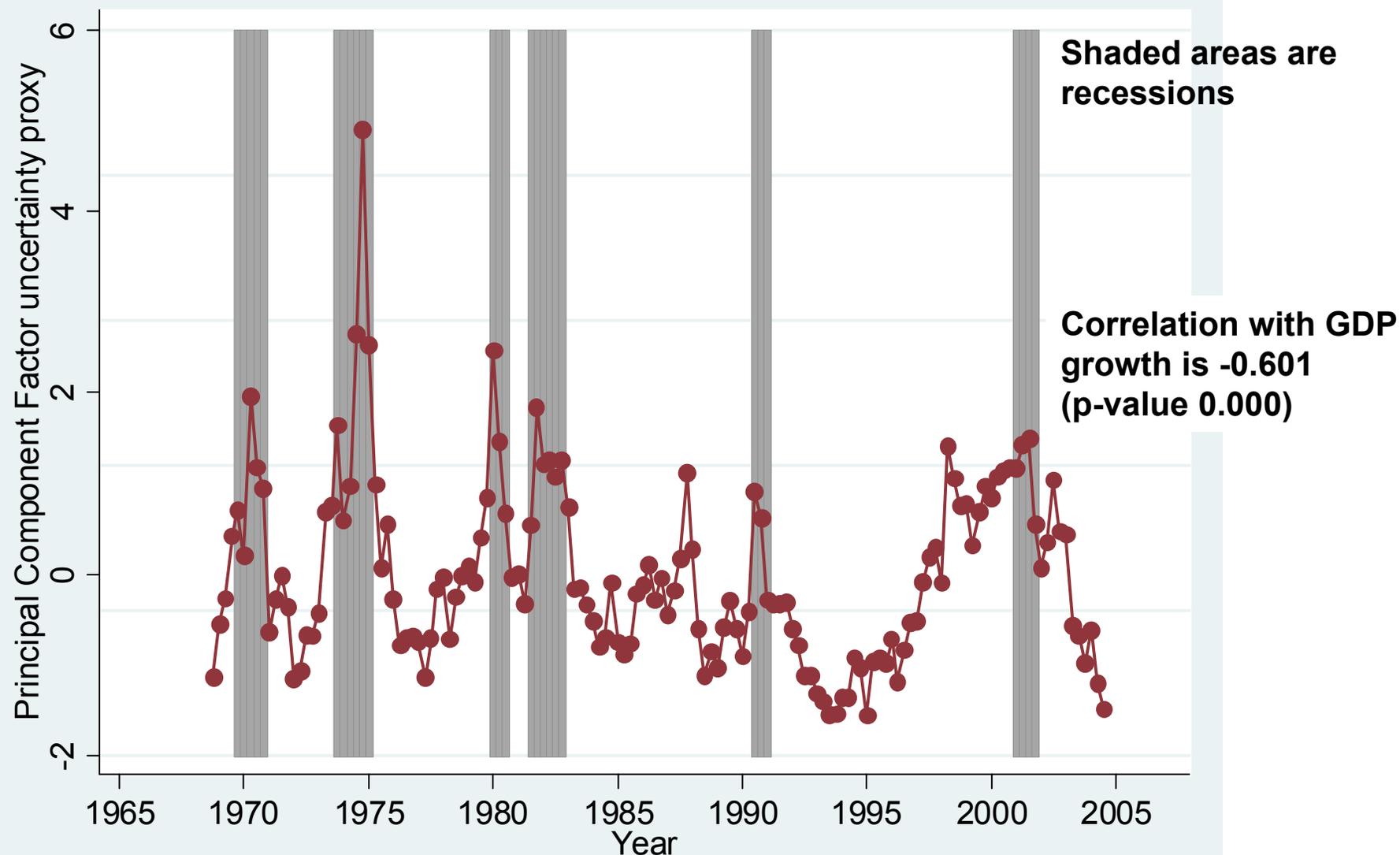
We combined these into a principal-component-factor series to give us an average proxy for 'uncertainty'

The first PCF accounted for 42% of the common variance, weighting reasonably evenly across the measures:

- 0.313 on firm stock returns spread
- 0.273 on firm sales spread
- 0.269 on time-series stock market volatility
- 0.266 on forecaster unemployment spread
- 0.241 on time-series industry production volatility
- 0.167 on forecaster GDP spread

Results very similar using $1/6^{\text{th}}$ weighting on all six (SD normalized) series

The combined uncertainty proxy and recessions



Notes: Uncertainty proxy defined as first PCF in factor analysis on the cross-sectional spread of sales growth and stock returns, the time-series volatility of industrial production and stock-returns, and the forecast-spread of unemployment and GDP. Recession indicator defined as starting the first quarter after the (NBER defined) business cycle-peak and ending at the (NBER defined) business cycle-trough. GDP growth correlations defined using real quarterly GDP growth.

Clearly some difficult issues in thinking about time-varying uncertainty – for example

Causation:

- Some of the variation appears exogenous (OPEC 1) – so seems reasonable to think of this as a 2nd moment shock
- Other movement may be more endogenous – so can think of this as an accelerator for 1st moment shocks

Structure:

- None of these measures of uncertainty is ideal, e.g.
 - forecast dispersion is non-monotonic in ‘uncertainty’
 - firm-level measures are realized volatility

Starting point is simply that uncertainty appears to be counter cyclical

Currently building this into a business cycle model with heterogeneous firms

Need to add two key things to standard RBC type models:

- Time varying volatility/uncertainty
- Heterogeneous firms in order to investigate reallocation and quantitative impacts

Requires solving a model involving tracking cross-sectional moments (building on papers like Krusell and Smith, 1998; Kahn and Thomas, 2003, Bachman, Caballero and Engel 2006)

Adding counter-cyclical uncertainty in a GE framework could help thinking about

Recessions without negative TFP shocks

- Rising uncertainty can generate short-recessions

Short, sharp recessions

- Short - delaying impact of uncertainty is temporary
- Sharp - rapid rebound due to pent-up investment and hiring, and impact of higher volatility

Time varying impulse response functions

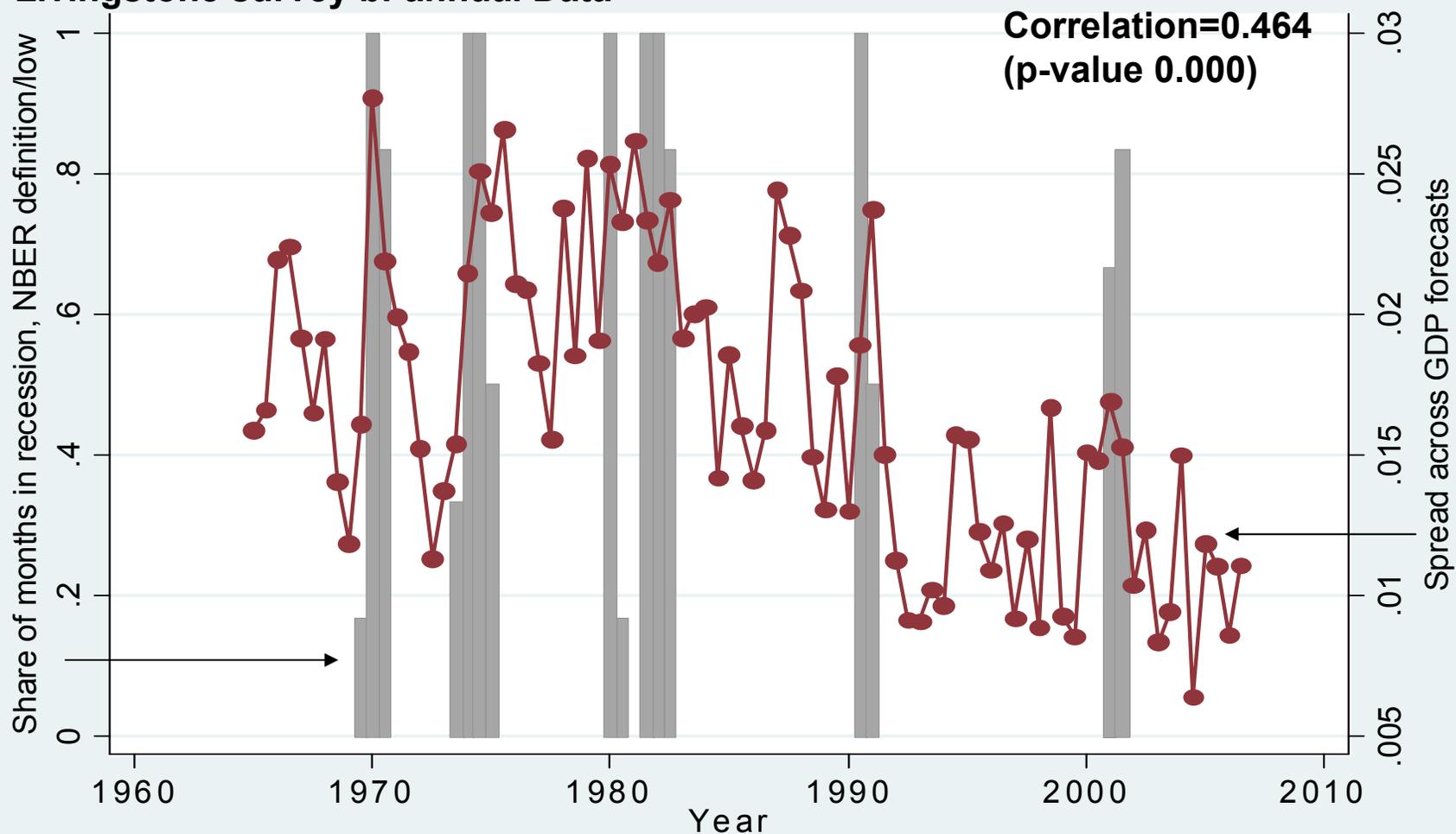
- High uncertainty reduces responsiveness to shocks

Most speculatively, the impact of more permanent changes in uncertainty like the Great Depression and Great Moderation

BACKUP

Recessions are also periods of higher average spread across macro forecasters

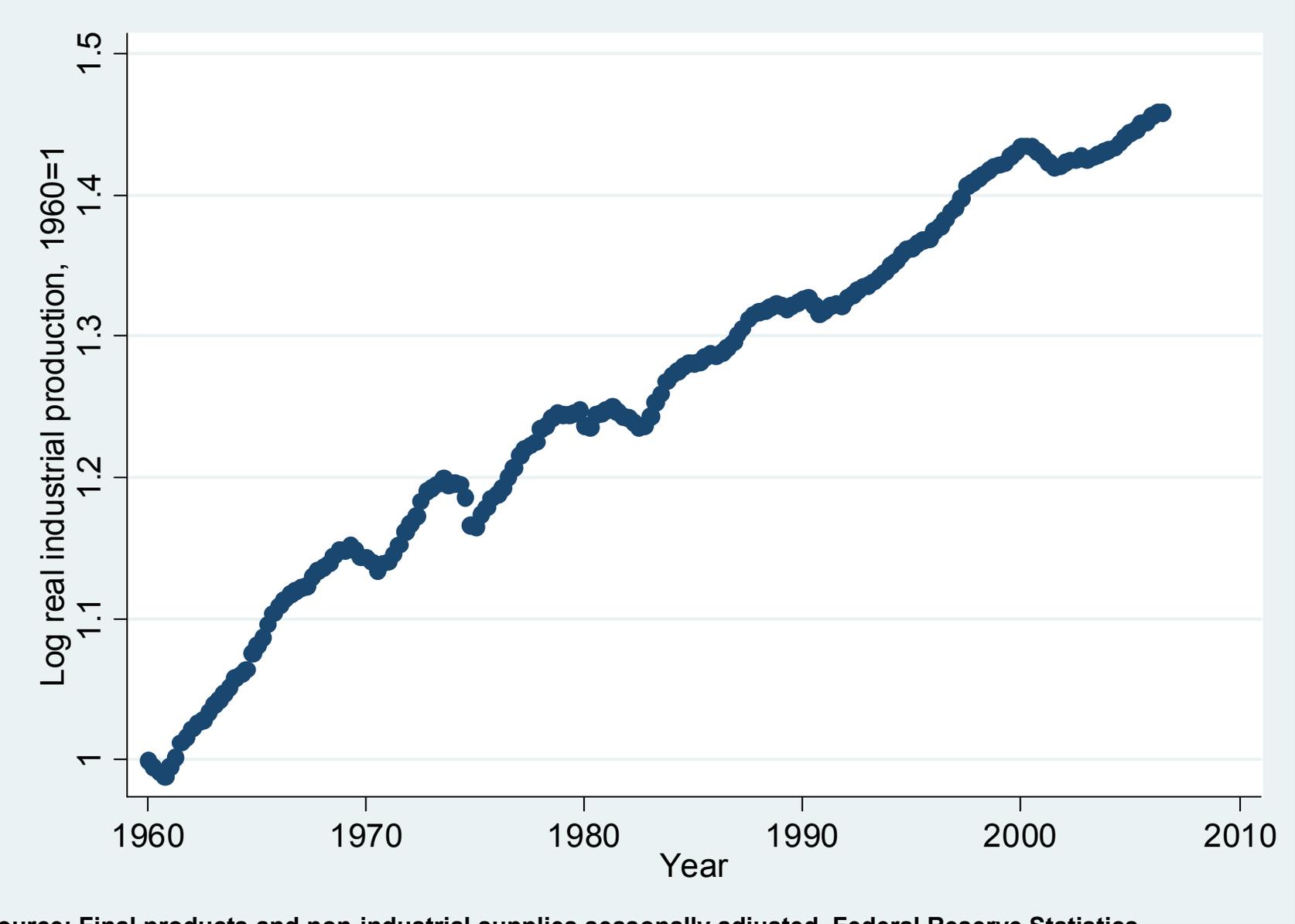
Livingstone survey bi-annual Data



Notes: Standard deviation of cross-sectional forecasts of 1 year ahead GDP growth (nominal) from the Livingstone survey. Forecasts collected bi-annually with an average of 53 forecasters per period. Recession variable averaged over all months within the year, with recessions defined as starting the first month after the (NBER defined) business cycle-peak and ending at the (NBER defined) business cycle-trough.

Long-run real industrial production growth

Quarterly data



Source: Final products and non-industrial supplies seasonally adjusted, Federal Reserve Statistics