Business Cycles and Productivity: Is this Time Different?

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September 2025

Business Cycles: Is this Time Different?

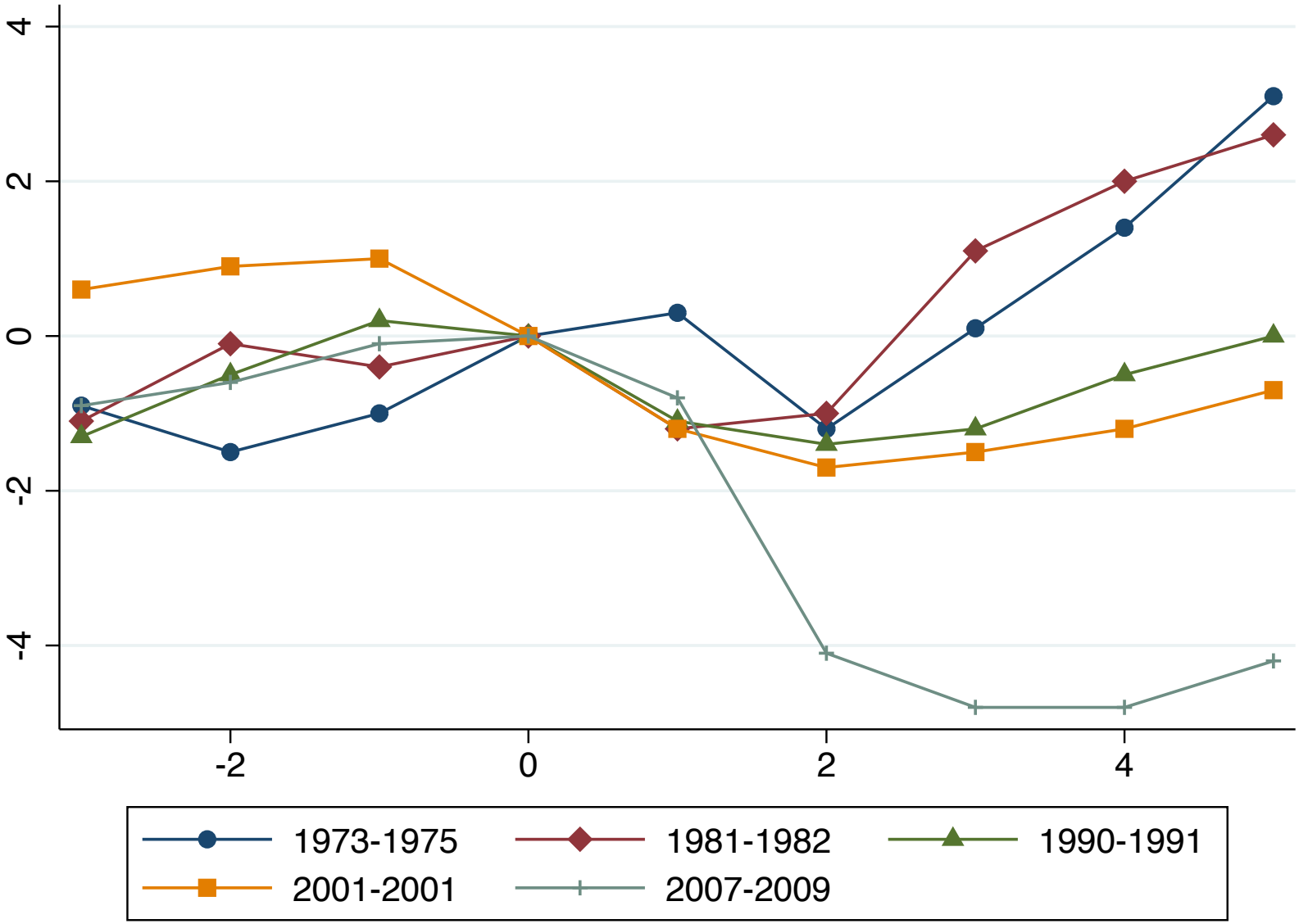
- Great Recession vs. earlier recessions
  - Stock and Watson (2012)
- Slow/jobless recoveries
- How do we measure productivity?
  - Simple methods (e.g., Solow Residual)
  - More sophisticated methods (Basu, Fernald and Kimball, 2006)
- Is productivity still procyclical?

Stock and Watson (2012)

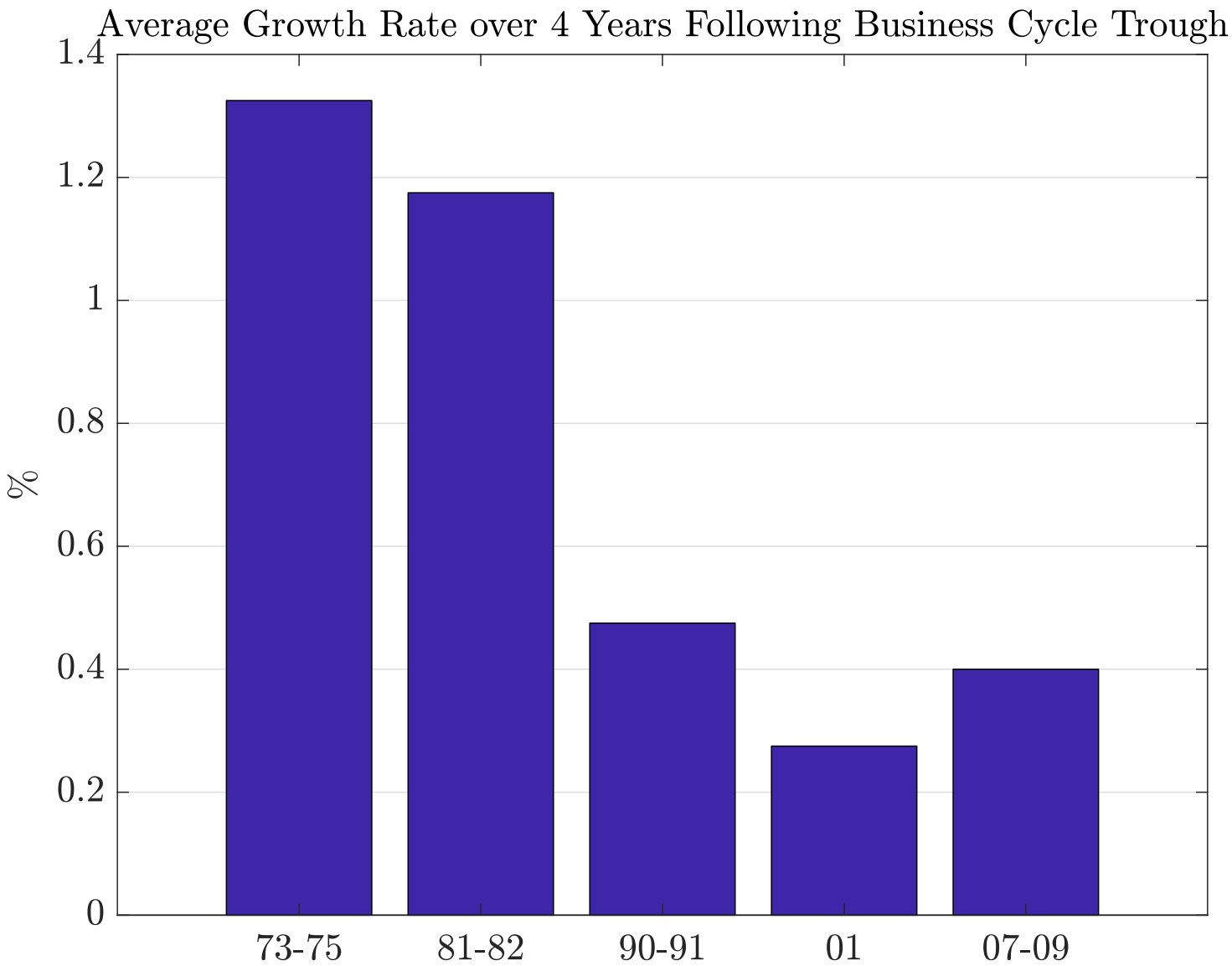
Often taken for granted that Great Recession was “different”

- Recovery was puzzlingly slow
- Financial shocks were more important
- (Many papers started with this contention, and moved onto theory)
- e.g., Mitman-Rabinovich 14; Jaimovich-Siu 14; Restrepo 15; Berger 16; Hall 16; Begnino-Fornaro 17; Schmitt-Grohe-Uribe 17

Slow Recoveries: Prime Age Employment



Slow Recoveries



Table

Stock and Watson (2012)

Reassess the "conventional wisdom"

- Were the shocks fundamentally different?
- Were the dynamics fundamentally different?
- Was the recovery slower?

Basic answer: No!

- But the shocks were bigger
- And the trend is changing

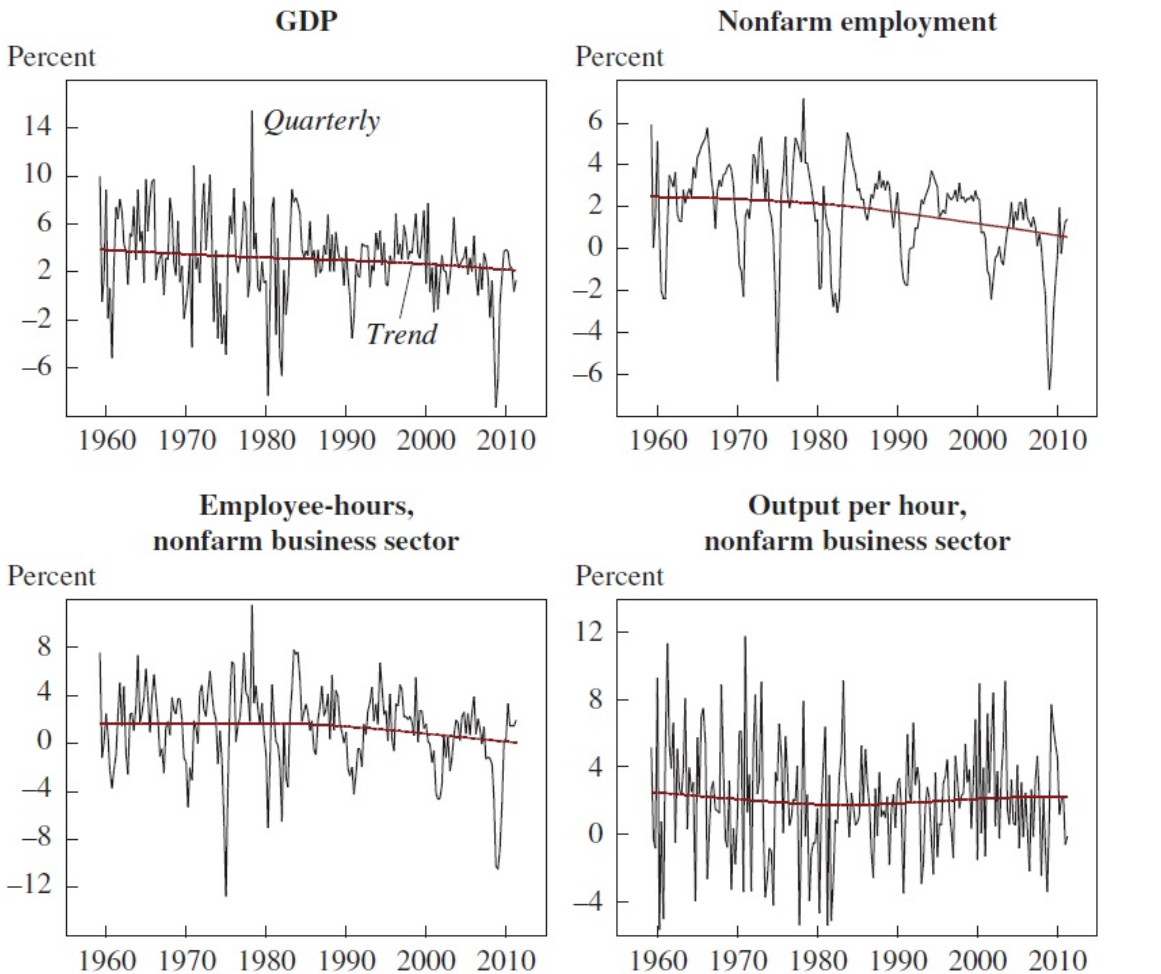
Stock and Watson (2012)

Methodology

- 6-factor, 200-variable dynamic factor model
- Estimate using data through 2007Q3
- Feed in realized values of factors post-2007 (but using pre-2007 loadings)
- Do not allow for any “extra” factors
- Apply to detrended data!

Stock and Watson (2012): Detrending

Figure 1. Growth Rates of GDP, Nonfarm Employment, Employee-Hours, and Labor Productivity, Quarterly and Trend, 1959Q1–2011Q2



Detrending Procedure

- Series were detrended to eliminate very low frequency variation
- Deviations from "local mean" estimated using a biweight kernel with a bandwidth of 100 quarters
  - Approximately same as taking averages over a centered moving window of +-30 quarters
  - Kernel avoids the sharp cutoff of a moving window
- Series also transformed to be stationary (e.g., log difference), mean zero

Dynamic Evolution of Factors

$$X_t = \Lambda F_t + e_t, \tag{1}$$

where $e_t = (e_{1t}, \ldots, e_{nt})'$ and Λ is an $n \times r$ matrix of coefficients called the factor loadings. The term ΛF_t is called the "common component" of X_t.

The factors are modeled as evolving according to a VAR:

$$\Phi(L) F_t = \eta_t, \tag{2}$$

What Are Factor Models?

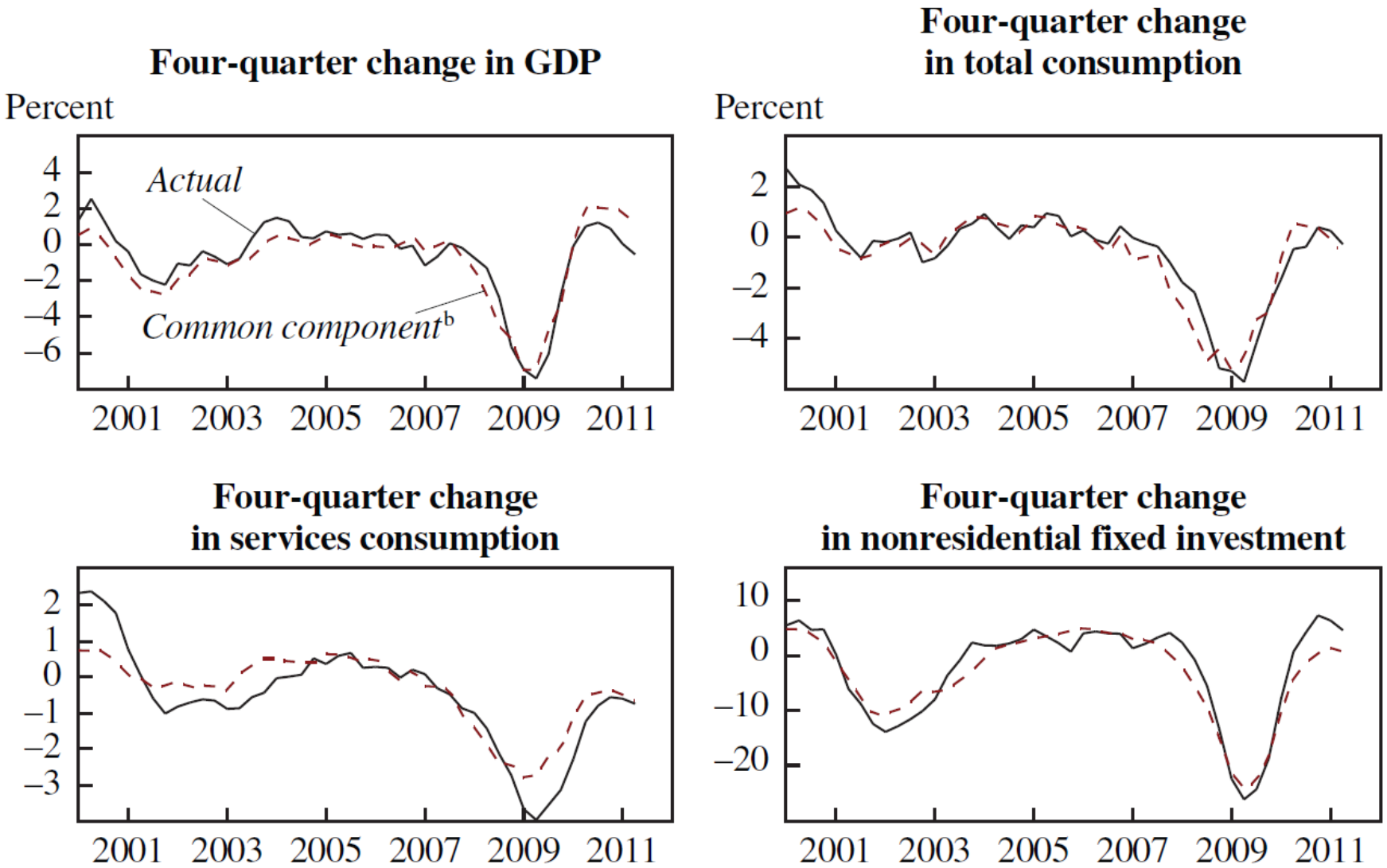
Key intuition:

- If there is only a single factor:
  - Factor can be estimated by cross-sectional average, up to scale
  - Can estimate factor loadings by regressing on average series
  - With enough series, “generated regressor” problem goes away
- Can generalize with principal components analysis for multiple factors
- Note: Only space spanned by factors is identified
- Factors themselves can be arbitrarily “rotated”

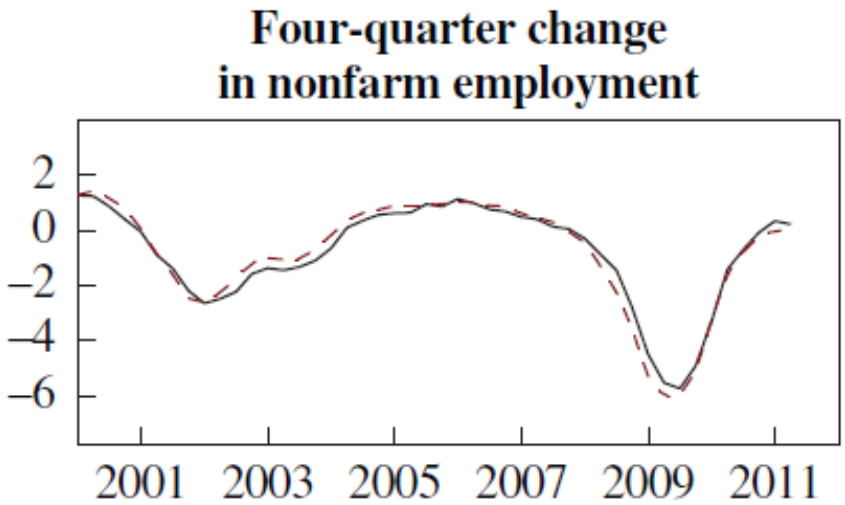
Data and Estimation

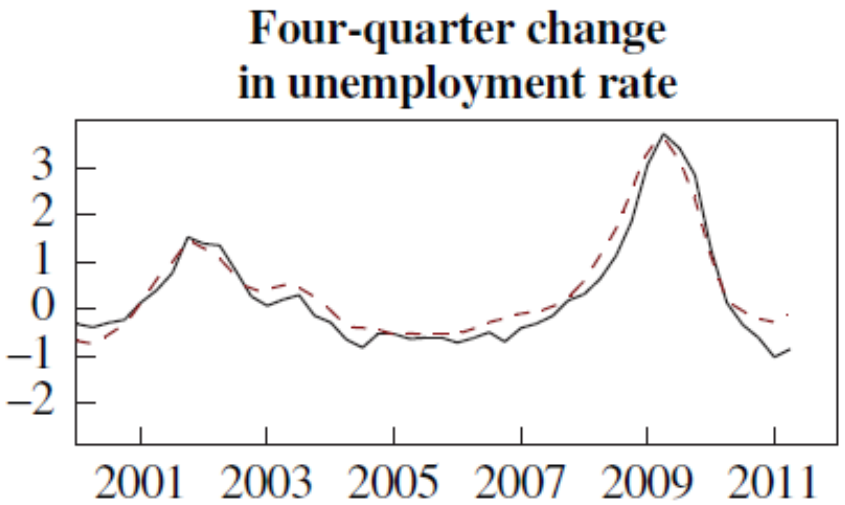
- Data: 200 macro time series X_t (1959-2011),
  drop aggregated series – yields 132 series
- Principal components analysis for 1959-2007
- Generate 6 "old factors":
  Pre-2007 factor loadings applied to X_t over full 1959-2011 sample
- Thought experiment: *Suppose forecaster was magically given a sneak preview of the six "old" factors for 2007-2011 (using actual values) and computes predicted values for all 200 series. How well would these predicted values track the actuals over the recession and recovery?*
  - If Great Recession was associated with new factors (financial crisis etc.) then R^2 of old factors would fall

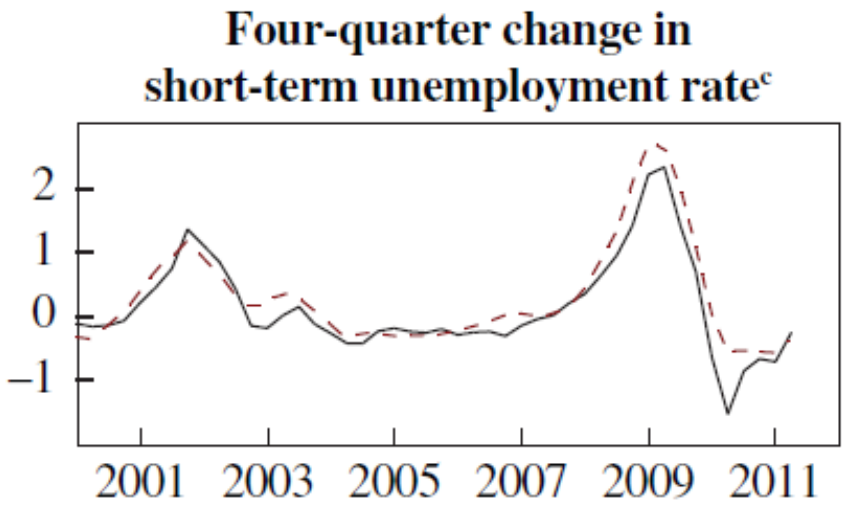
Stock and Watson (2012): Dynamic Factor Model

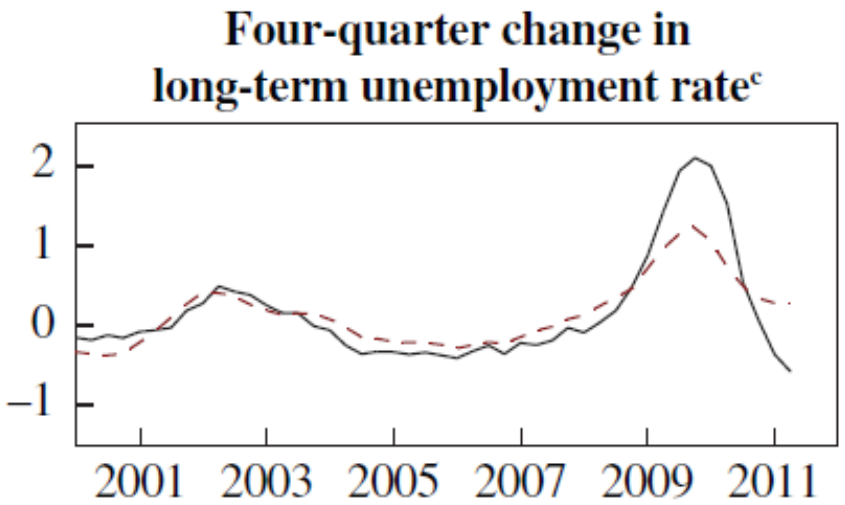


Stock and Watson (2012): Dynamic Factor Model









Stock and Watson (2012)

Findings

- Factor loadings did not break (Formal break tests)
- No extra factor needed (e.g. financial factor) to explain “slow” recovery
  - Employment: Recovery actually *faster* than would have been predicted based on historical estimates
- Underpredicts interest rate response during Great Recession
  - No surprise given model abstracts from ZLB
- But: Larger shocks needed

Interpreting the Shock

- Dynamic factor methodology is agnostic about interpretation of shocks
- Use “external instruments” to interpret
  - Mechanically: Regress instruments on VAR “innovations”
  - More later: Intuitively, error terms in stacked linear regressions
  - Converts non-structural error terms into structural shocks
    (up to scale/sign normalization)
- Nice list of instruments used in macro (as of this paper)
- Many instruments should be taken with a grain of salt

Stock and Watson (2012): External Instruments R-squared in GDP growth

Shock and instrument	*Cumulative percentage change in detrended GDP*[a]		
	2007Q4–2008Q3	*2007Q4–2009Q2*	*2007Q4–2011Q2*
Uncertainty shock			
Financial uncertainty (VIX)	–1.0	–4.1	0.2
Political uncertainty (BBD)	–2.3	–5.8	–4.8
Liquidity/financial risk shock			
Gilchrist-Zakrajšek spread	–1.5	–6.3	–1.2
TED spread	–1.2	–5.6	–4.9
Bassett and others bank loan	–2.0	–3.2	0.1

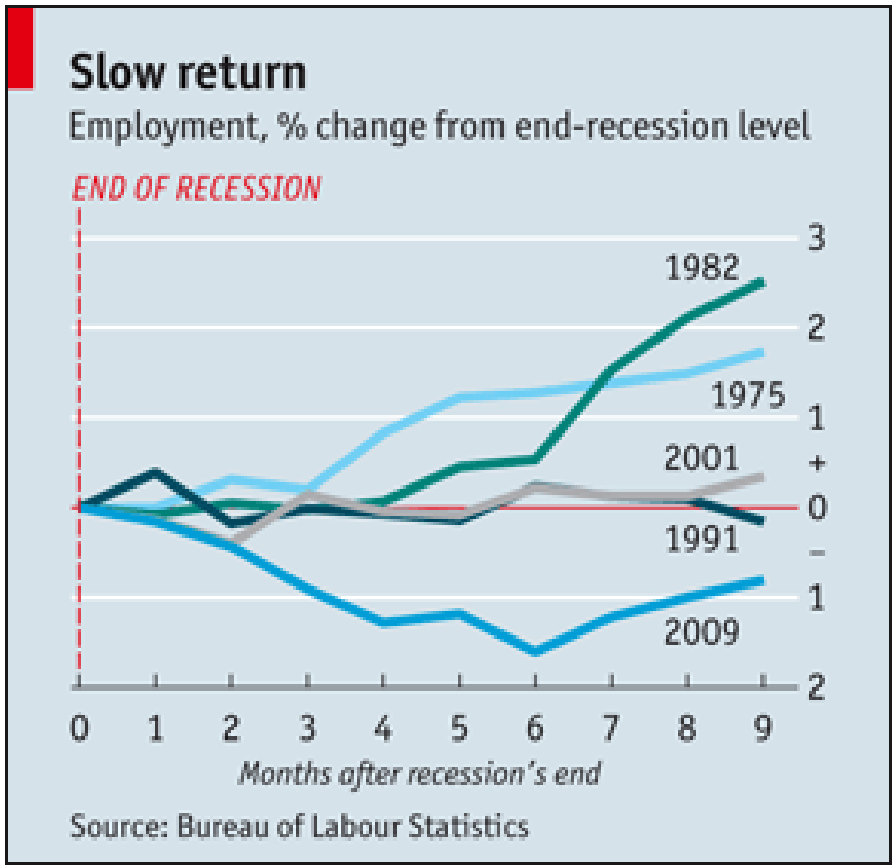
2007Q4: High R-squared for uncertainty, liquidity-financial shocks!

Stock and Watson (2012): External Instruments

Concerns raised:

- Many weak instruments
- Many instruments for the same thing uncorrelated
- Many instruments for different things correlated

Slow Recovery



Atlantic (2010): Derek Thompson- High corporate pay to blame?

Slow Recovery?

- Many observers saw recovery from Great Recession as slow!
- How to reconcile with Stock and Watson's (2012) finding that the Great Recession was "normal"
  - Recovery was actually *faster* than DFM predicted
  - Shock configuration did not predict particularly slow recovery
-
- Bigger shocks, but "typical" dynamics
- Recall the data pre-processing step!
- Huge role for "trend" as opposed to "cycle" in explaining slow recovery

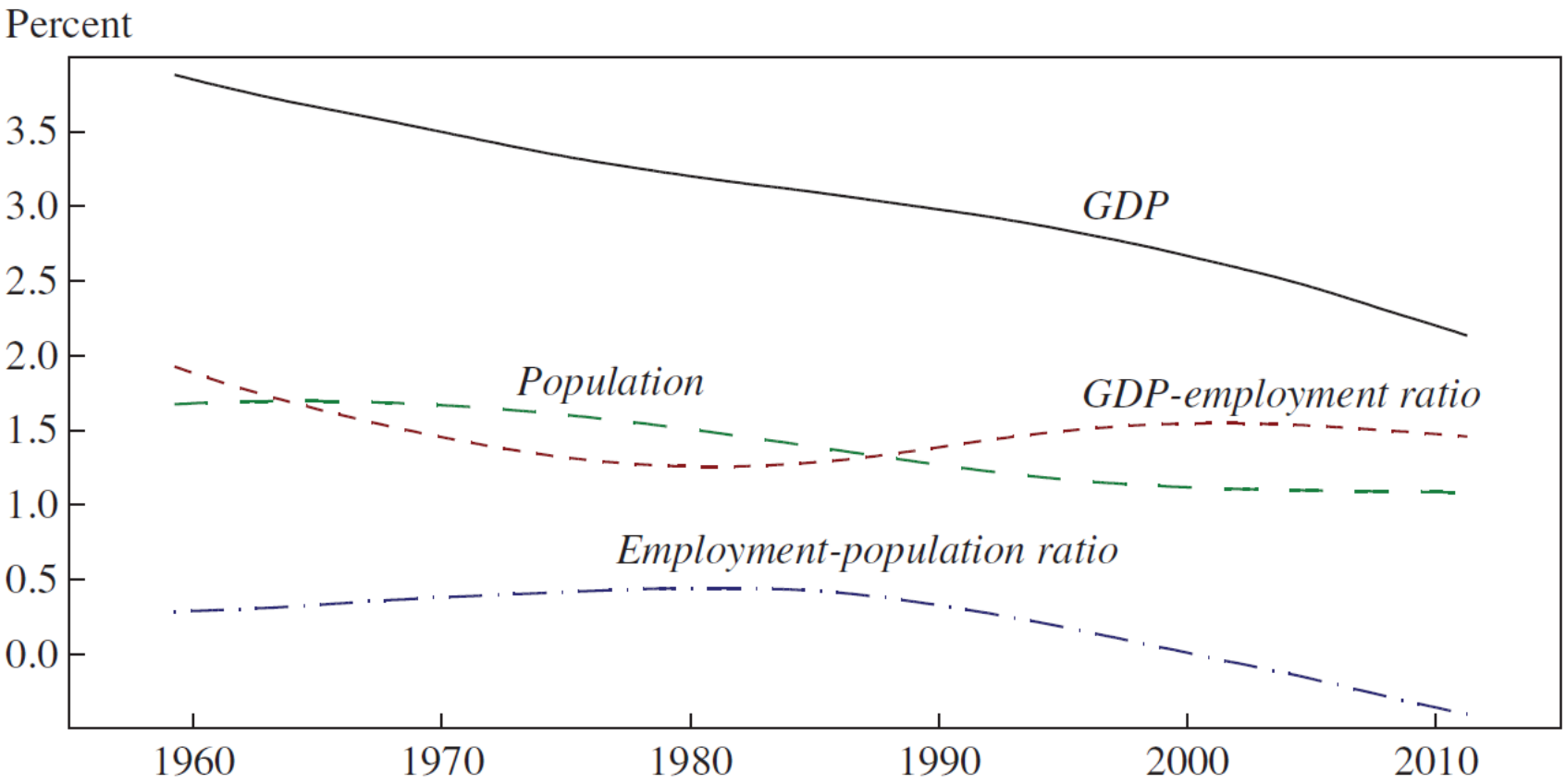
Stock and Watson (2012): Trend vs. Cycle

Differences			
2009Q2 minus	Cyclical	−0.6	−2.7
average, 1960–82	Trend	−2.4	−3.3
	Total	−3.0	−6.0

Post 2009Q2 growth: Great Recession vs. Earlier Recessions

Stock and Watson (2012): Trends

Figure 5. Trend Components of Growth of GDP, the GDP-Employment Ratio, the Employment-Population Ratio, and Population, 1959–2011



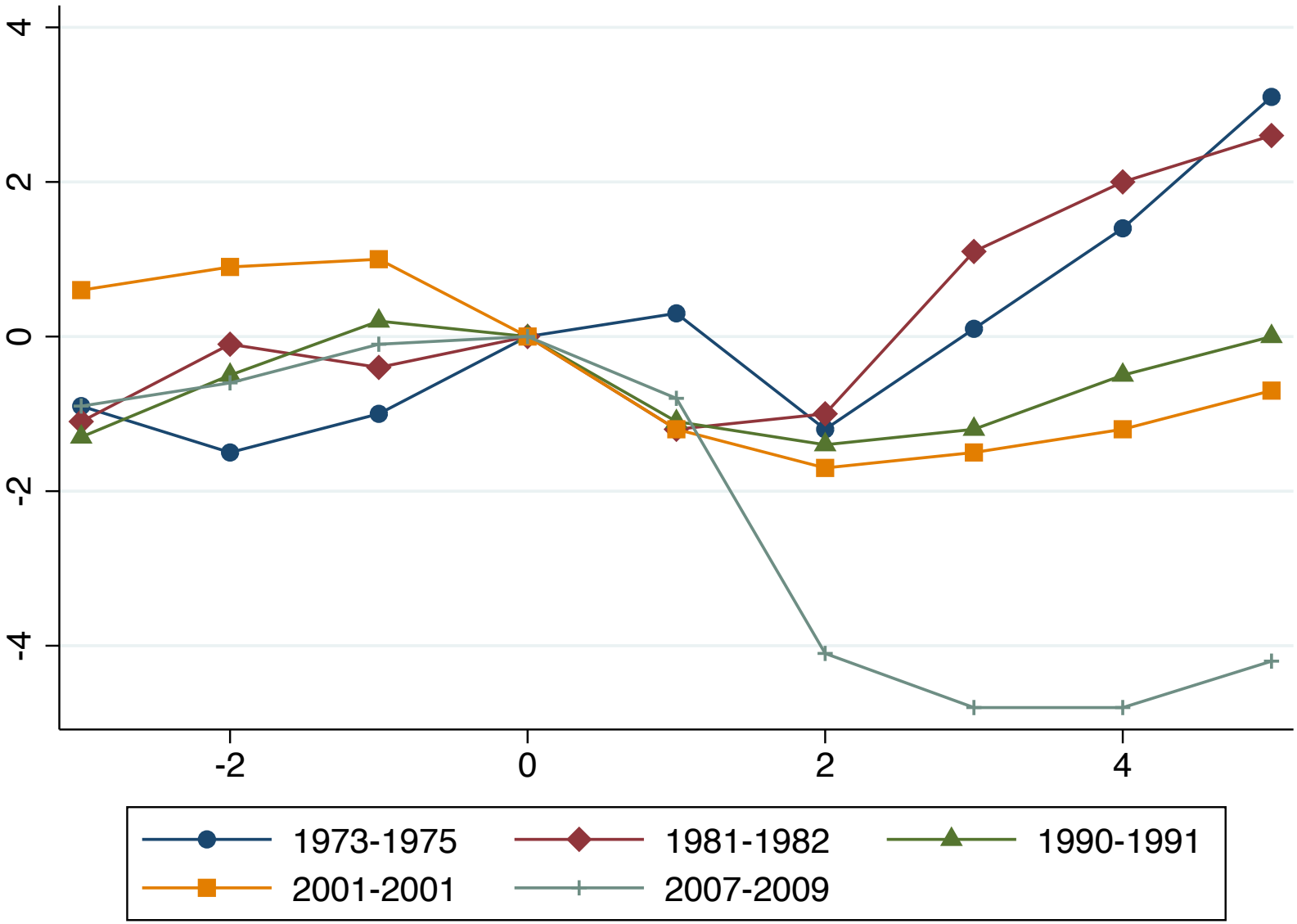
Source: Authors' calculations.

Stock and Watson (2012): Trends

...we estimate that slightly less than half of the difference between the recovery in employment since 2009Q2 and [earlier recoveries] is attributable to cyclical factors.... Instead, most of the slowness...is attributable to a long-term slowdown in trend employment growth. Indeed, that slowdown has been dramatic:...trend annual employment growth slowed from 2.4 percent in 1965 to 0.9 percent in 2005. The explanation ...we find most compelling rests on changes in underlying demographic factors, primarily the plateau in the female labor force participation rate (after a sharp rise during the 1970s through the 1990s) and the aging of the workforce..this slower trend growth in employment translates into slower trend GDP growth... suggests that future recessions will be deeper and longer, and will have slower recoveries, than has been the case historically.

The Trend vs. Cycle and Gender Convergence

Recall: Slow Recoveries, Prime Age



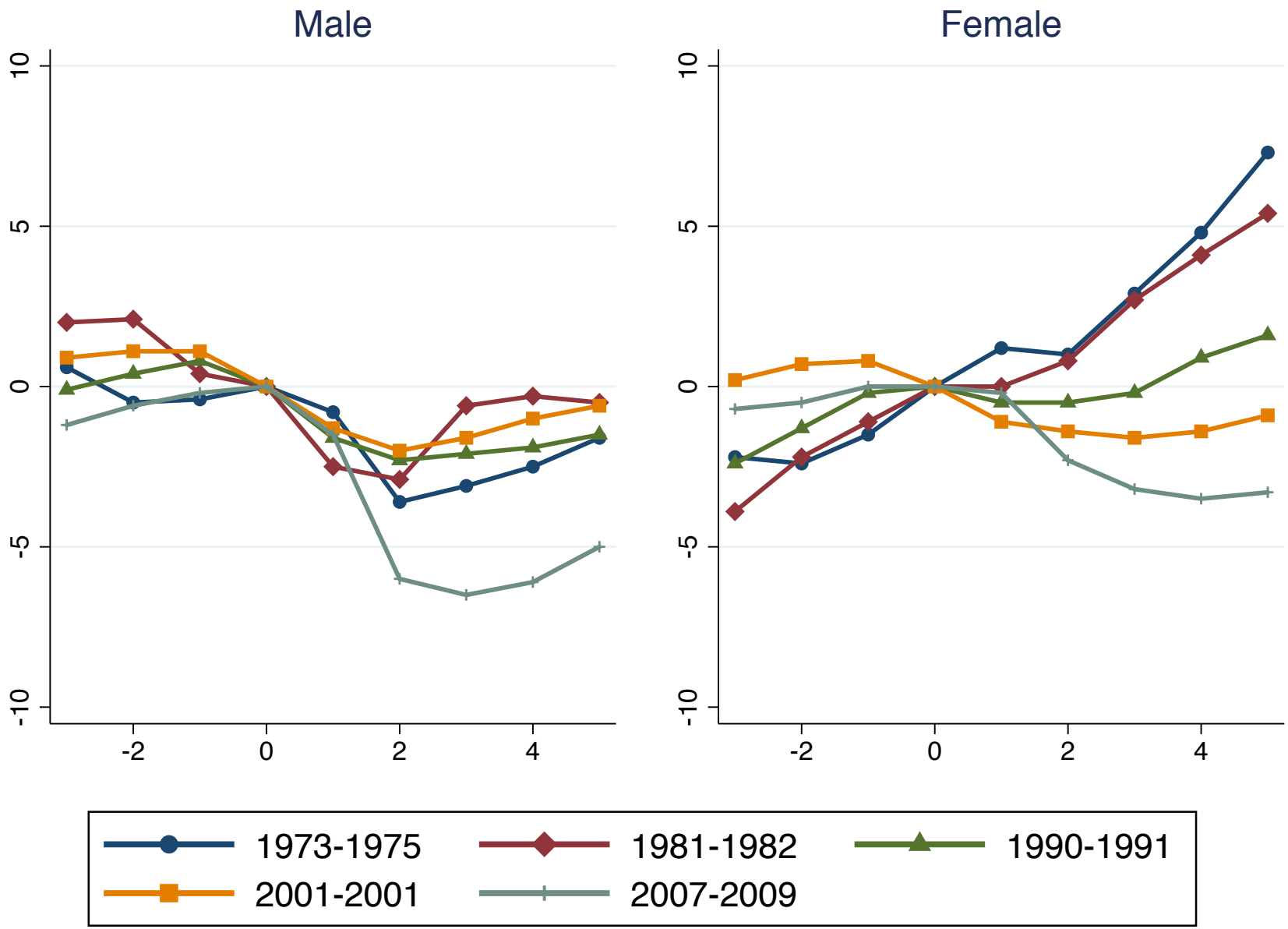
What Slowed Down?

Employment, LFP, Unemployment, Productivity

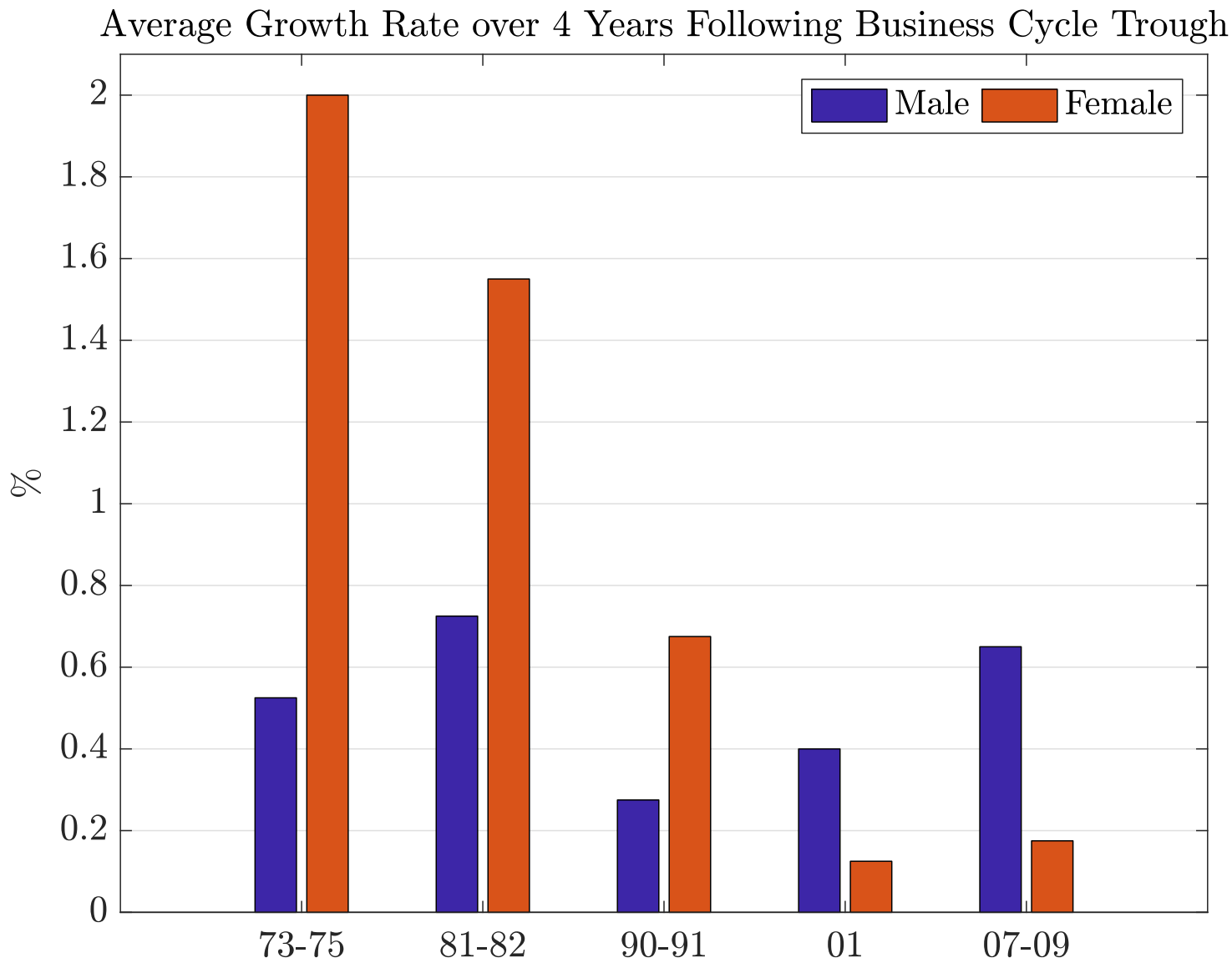
TABLE: Average Growth Rate over 4 Years Following Trough

	Panel A. Prime Age Population				
	73-75	81-82	90-91	01	07-09
Employment Rate	1.32%	1.18%	0.48%	0.28%	0.40%
LFP Rate	0.94%	0.61%	-0.04%	-0.07%	-0.40%
Unemployment Rate	-0.55%	-0.73%	-0.53%	-0.32%	-0.85%
Log Labor Productivity	1.18%	1.73%	1.17%	1.86%	0.77%

Slow Recoveries: Men versus Women



Five Recessions: Prime Age Employment



Table

Slow Recoveries: Men versus Women

Strikingly different patterns for men vs. women:

- For men, recoveries have been slow since (at least) the 1970's
- For women, recoveries were fast and have slowed sharply

20th century saw a "Grand Gender Convergence" (Goldin 06, 14):

- Rate of convergence peaked for employment in 1970s
- Has slowed sharply since, to virtual plateau after 2000

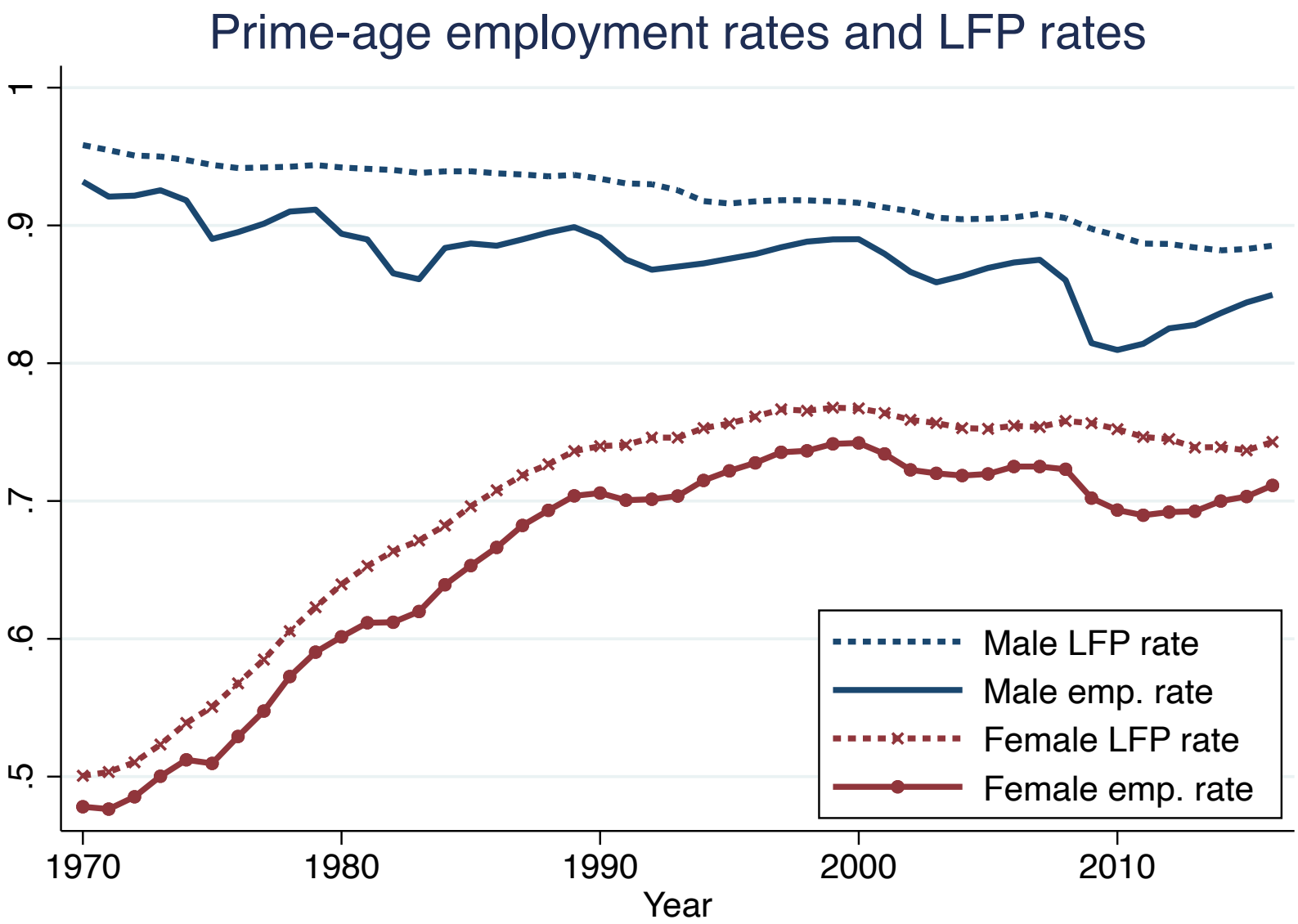
Trend vs. Cycle: Female Convergence

- If you superimpose a recovery on an upward trend, it will look fast
- If you superimpose a recovery on a downward trend, it will look slow

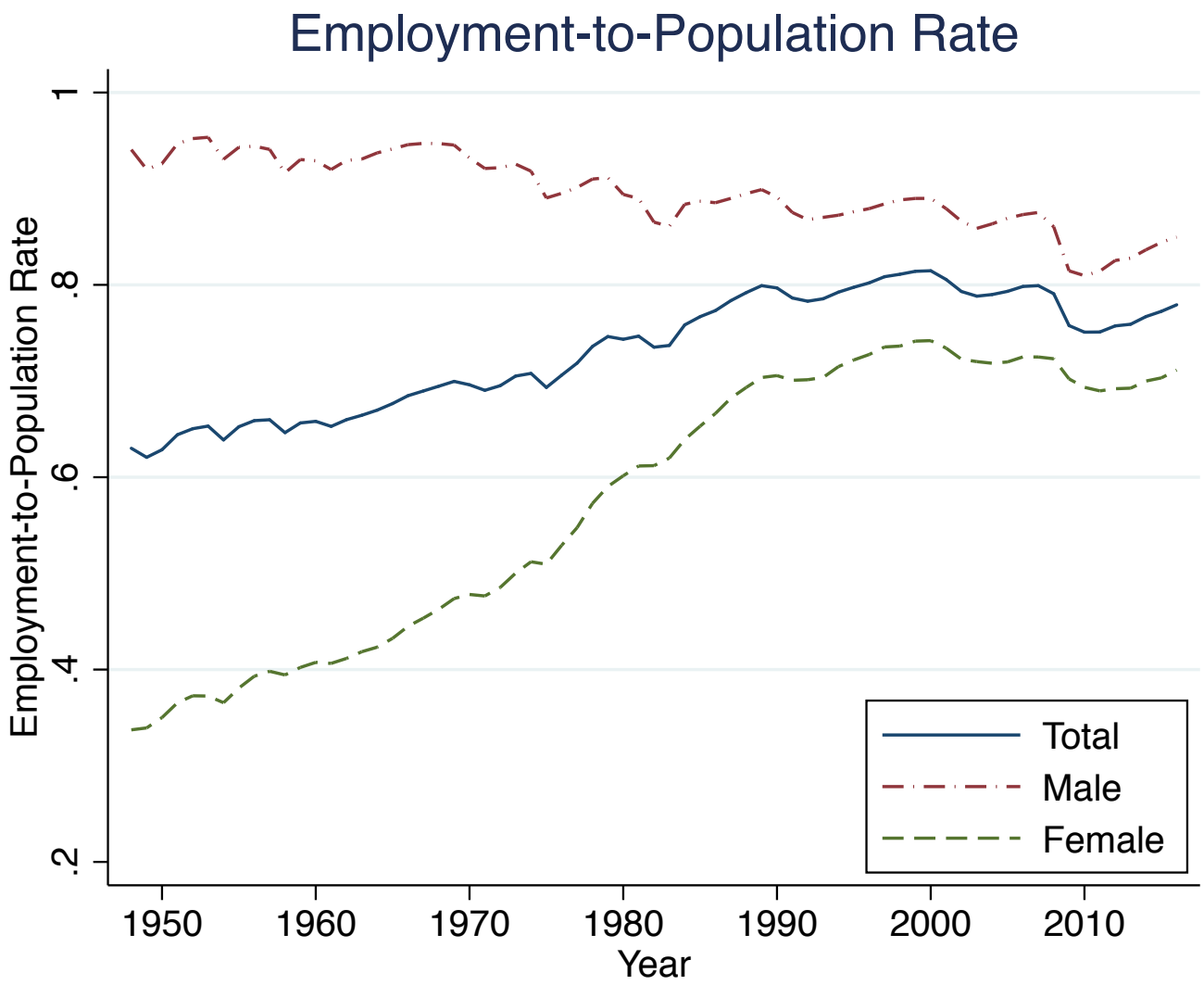
- Rapid rise in female employment in 1970s-80s may have contributed to fast recoveries
- Slower growth of female employment since 1990 may have contributed to slower recoveries

(Juhn-Potter 06, Albanesi 17, Kreuger 17, CEA 17)

Female Employment Converging to Male

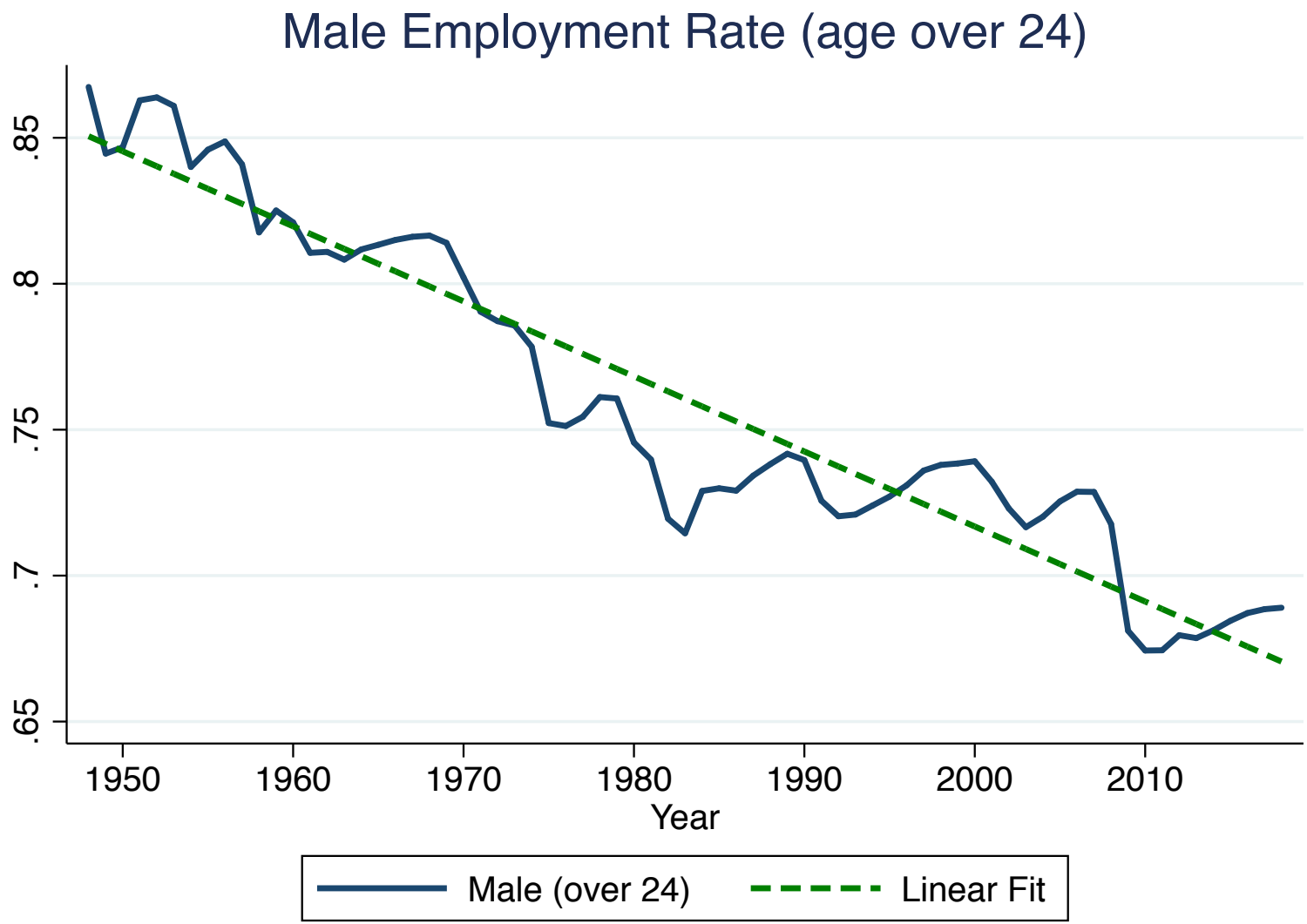


Longer Horizon



Back

Longer Horizon: Age Over 24



Back

Accounting vs. Economics

- Gender Revolution is a big macro shock
- Can't assume that all else is held constant
  - Entry of women may have affected men
  - Accounting exercise assumes zero effect on men
- Magnitude of GE effects crucial in determining whether gender convergence can explain slowing overall recoveries

Crowding Out as a Sufficient Statistic

- Identity:

$$L = \frac{1}{2}L_f + \frac{1}{2}L_m$$

- Effects of a "female-biased shock":

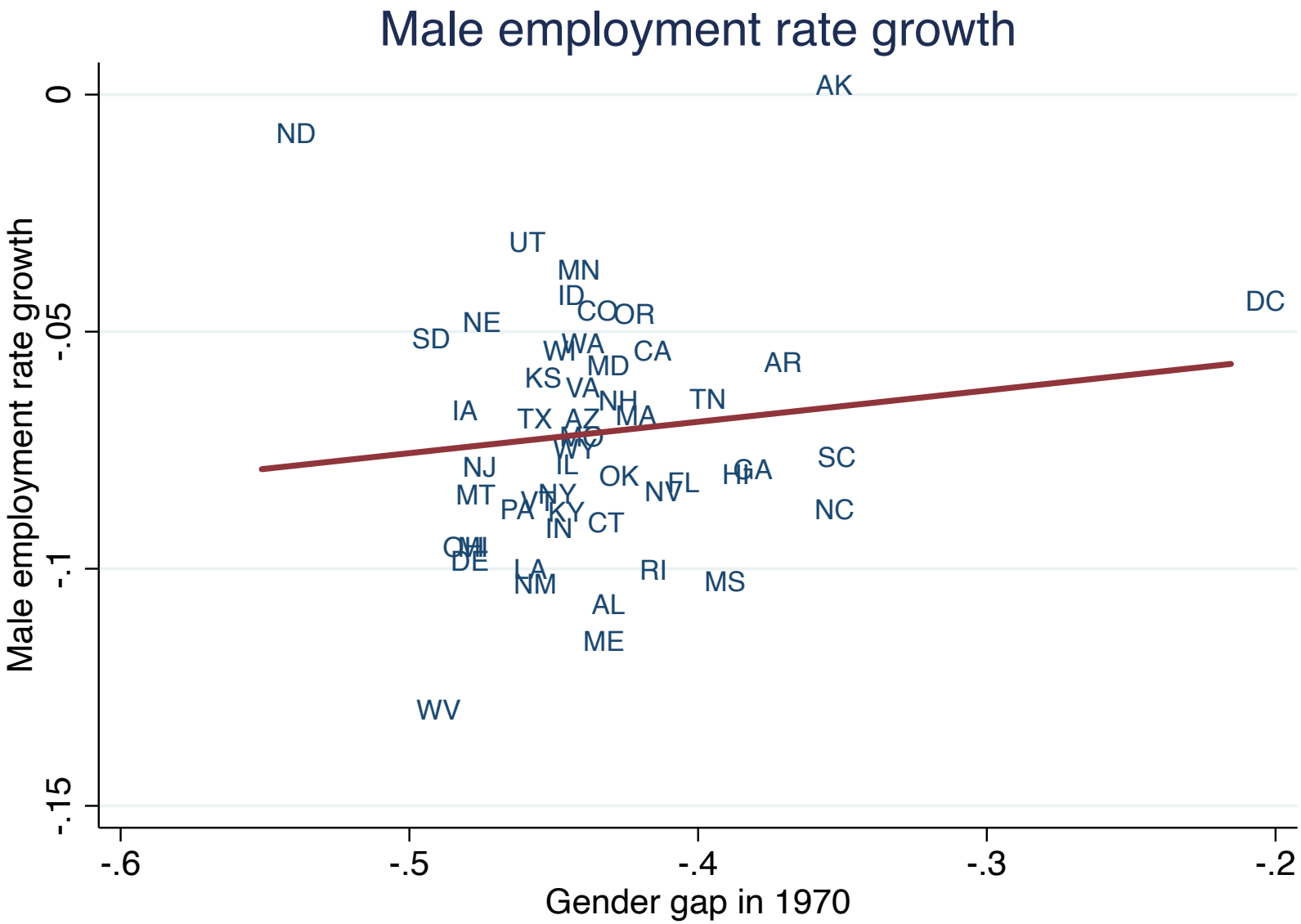
$$\frac{dL}{d\theta} = \frac{1}{2}\frac{dL_f}{d\theta} + \frac{1}{2}\frac{dL_m}{d\theta}$$

$$\frac{dL/d\theta}{dL_f/d\theta} = \underbrace{\frac{1}{2}}_{\text{Accounting}} + \frac{1}{2}\underbrace{\frac{dL_m/d\theta}{dL_f/d\theta}}_{\text{Crowding Out}}$$

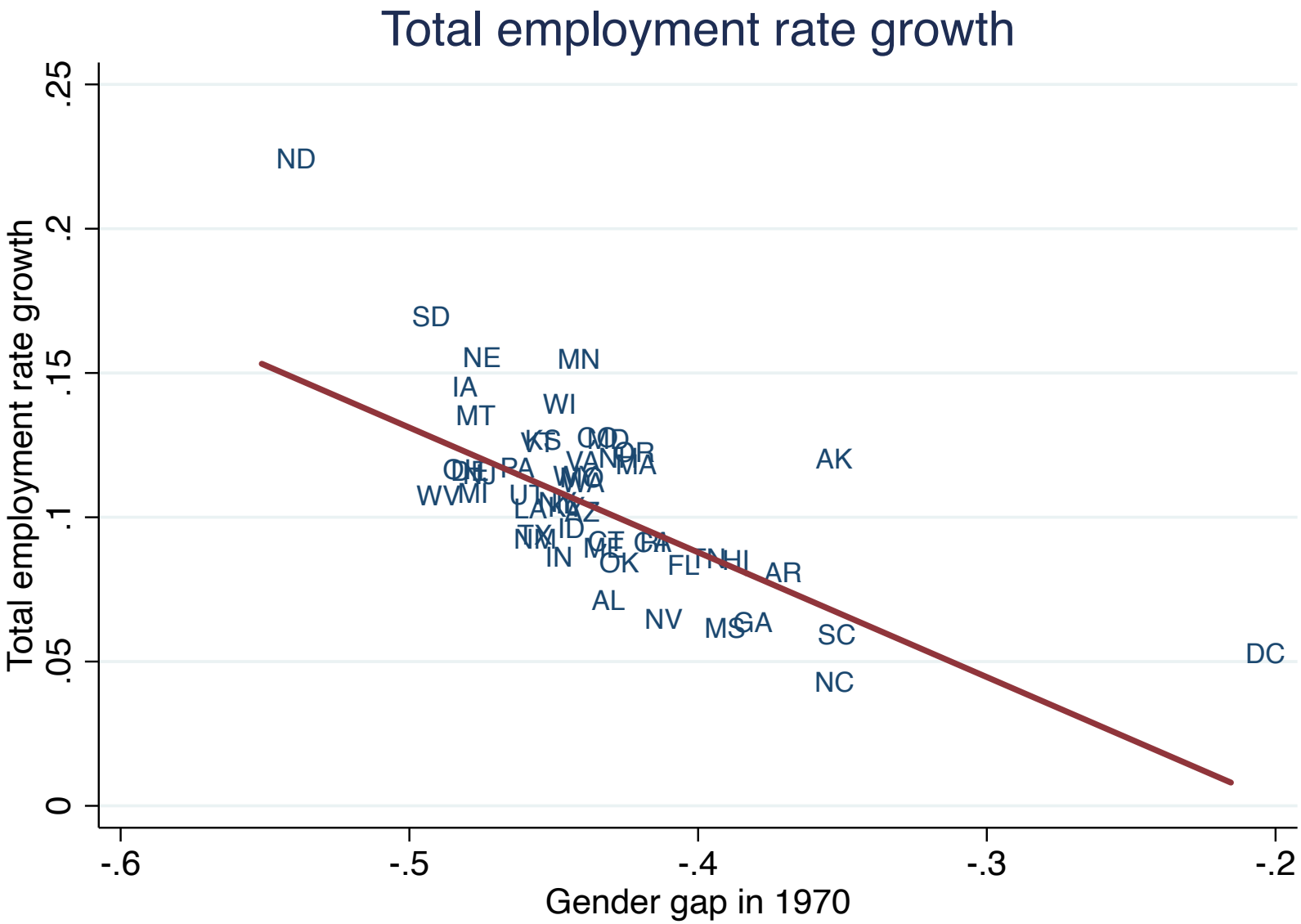
- Effect of Gender Revolution on total employment differs from accounting exercise by crowding out

Cross-State Convergence

No Relationship for Male Employment



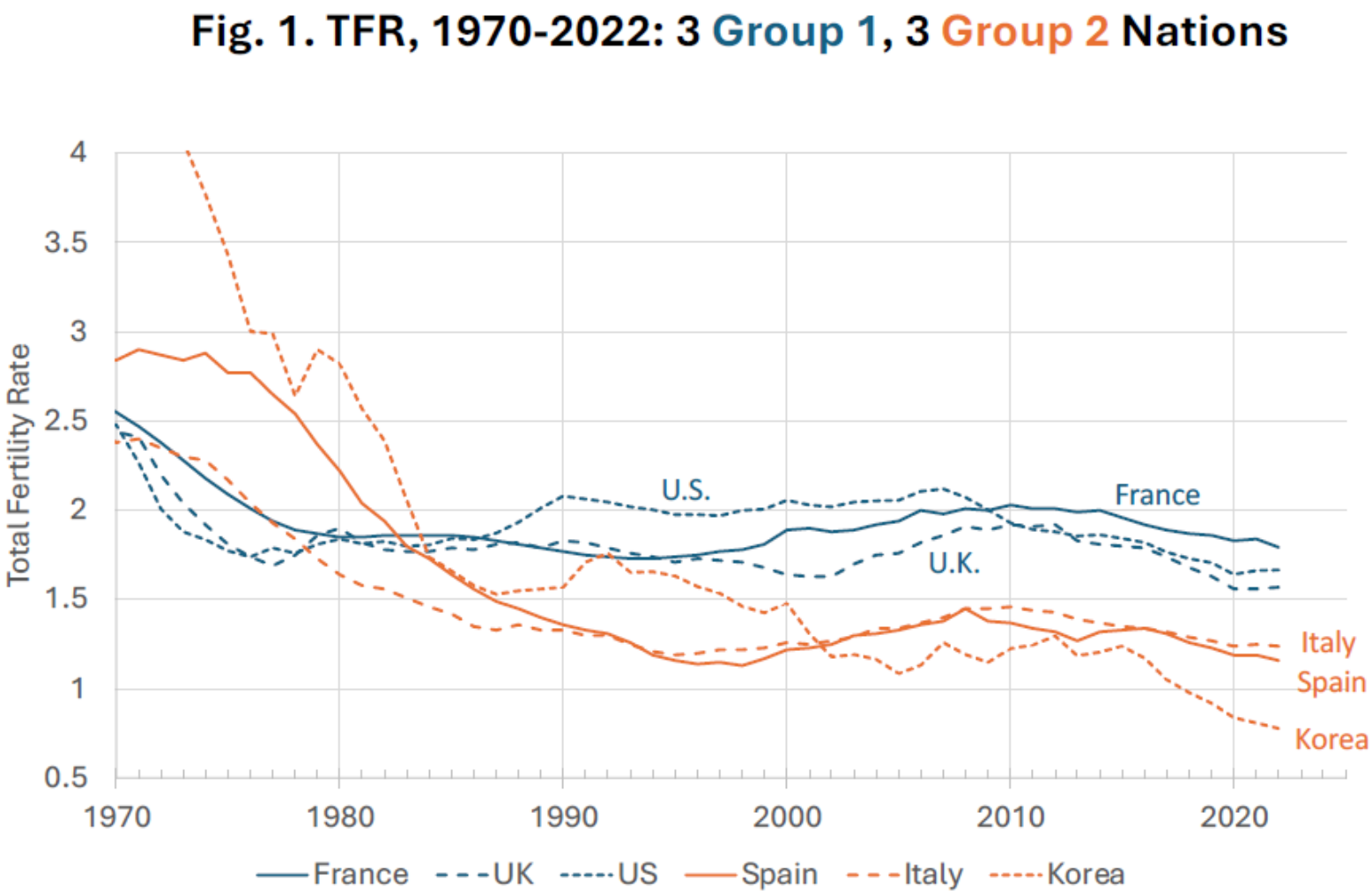
Pass Through to Total Employment



Implications

- Gender revolution led to dramatic growth in female employment in 1970's, followed by substantial slowdown
- Crowding out sufficient statistic for aggregate effects
- Cross-state analysis suggests crowding out is small!
- Nakamura, Fukui and Steinsson (2021)
  - Gender convergence explains 60-75% of slowdown in recoveries
  - Consistent with Stock and Watson (2012) analysis of trends

The Tyranny of Demographics: Fertility



Goldin (2025): Presentation at Jackson Hole Economic Policy Symposium

Measuring Productivity

Measuring Productivity

Cobb-Douglas Production Function:

$$Y = AN^{\alpha}K^{1-\alpha}$$

- Can measure A as Solow residual

$$\log Y - \alpha \log N - (1 - \alpha) \log K$$

- What could go wrong?

Measuring Productivity

Cobb-Douglas Production Function:

$$Y = AN^{\alpha}K^{1-\alpha}$$

- Can measure A as Solow residual

$$\log Y - \alpha \log N - (1 - \alpha) \log K$$

- What could go wrong?
  - Wrong production function (e.g., due to aggregation)
  - Mismeasurement
  - Variable factor utilization
- Which way would the bias go?

Basu, Fernald and Kimball (2006)

Incorporates features of (extensive) previous literature:

- Basu and Fernald (1997) emphasize aggregation issues
- Basu (1996) emphasizes variable factor utilization
- Basu, Fernald and Kimball (2006) puts these together
  - Productivity measure is weighted average across industries

    $\rightarrow$ Looks beyond manufacturing
  - New application: How do productivity shocks affect economy?

Model

- Y = F(AK, EHN, M, Z)
- A is capital utilization, E is effort, H is hours, Z is technology
- Many unobserved margins of adjustment
  - Capital and employment (# workers) both face adjustment costs
  - Firms can freely vary A, E,and H without adjustment cost
  - Can use H to proxy for utilization!

Key Equation

$$(19) \qquad dy_i = c_i + \gamma_i dx_i + \beta dh_i + dz_i.$$

- Can show unobserved factor utilization proportional to hours of work (assumed to be flexible input)
- Can use βdh_i to control for unobserved factor utilization

Identification

- Need variation in inputs uncorrelated with productivity
- Otherwise estimates of productivity will be biased (which way?)
- Use “standard” instruments in this literature
  - Oil prices
  - Growth in government spending
  - Monetary shocks

Basu, Fernald and Kimball (2006)

"Purifying" term in production function:

B. Coefficient on hours per worker

Durables	1.34	Nondurables	2.13
Manufacturing	(0.22)	Manufacturing	(0.38)

Adjustment is substantial!

Solow Residual vs. Output and Hours

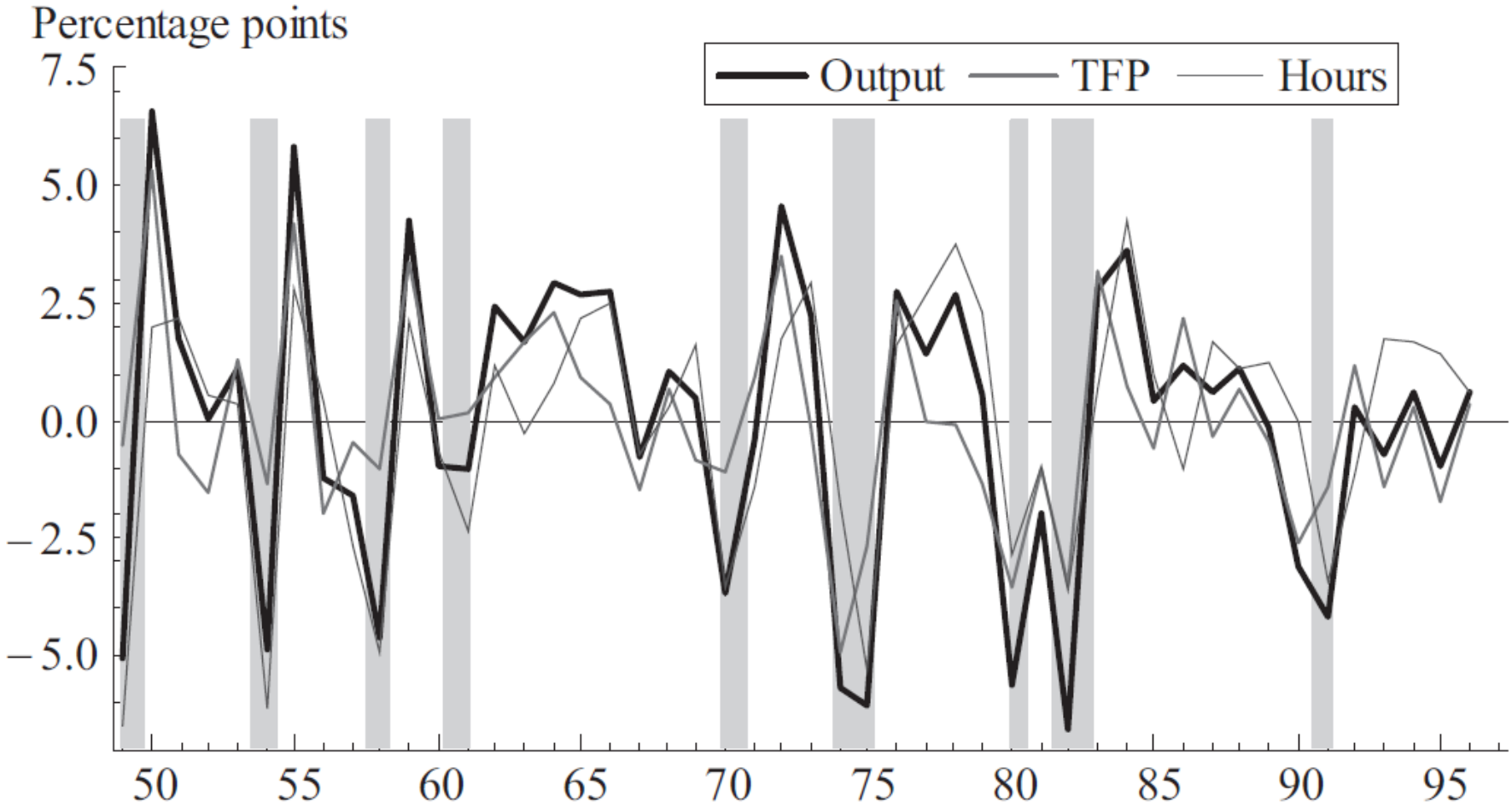
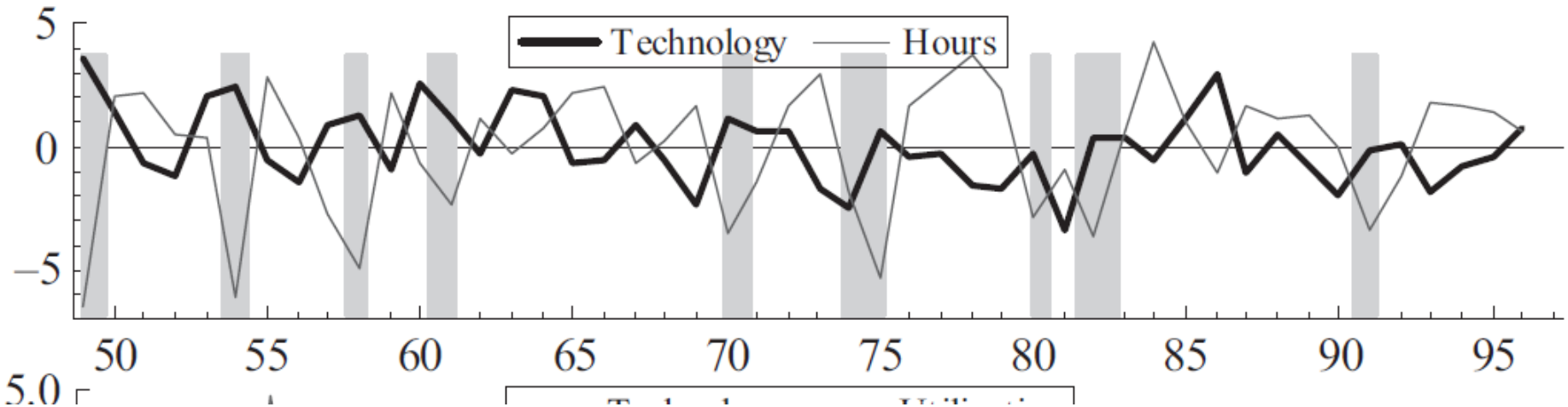


Figure 1. TFP, Output, and Hours
(*Annual percent change*)

"Purified" Technology vs. Hours



Hours covaries negatively with purified tech shocks!

Solow Residual vs. Purified Tech. Shock: Volatility

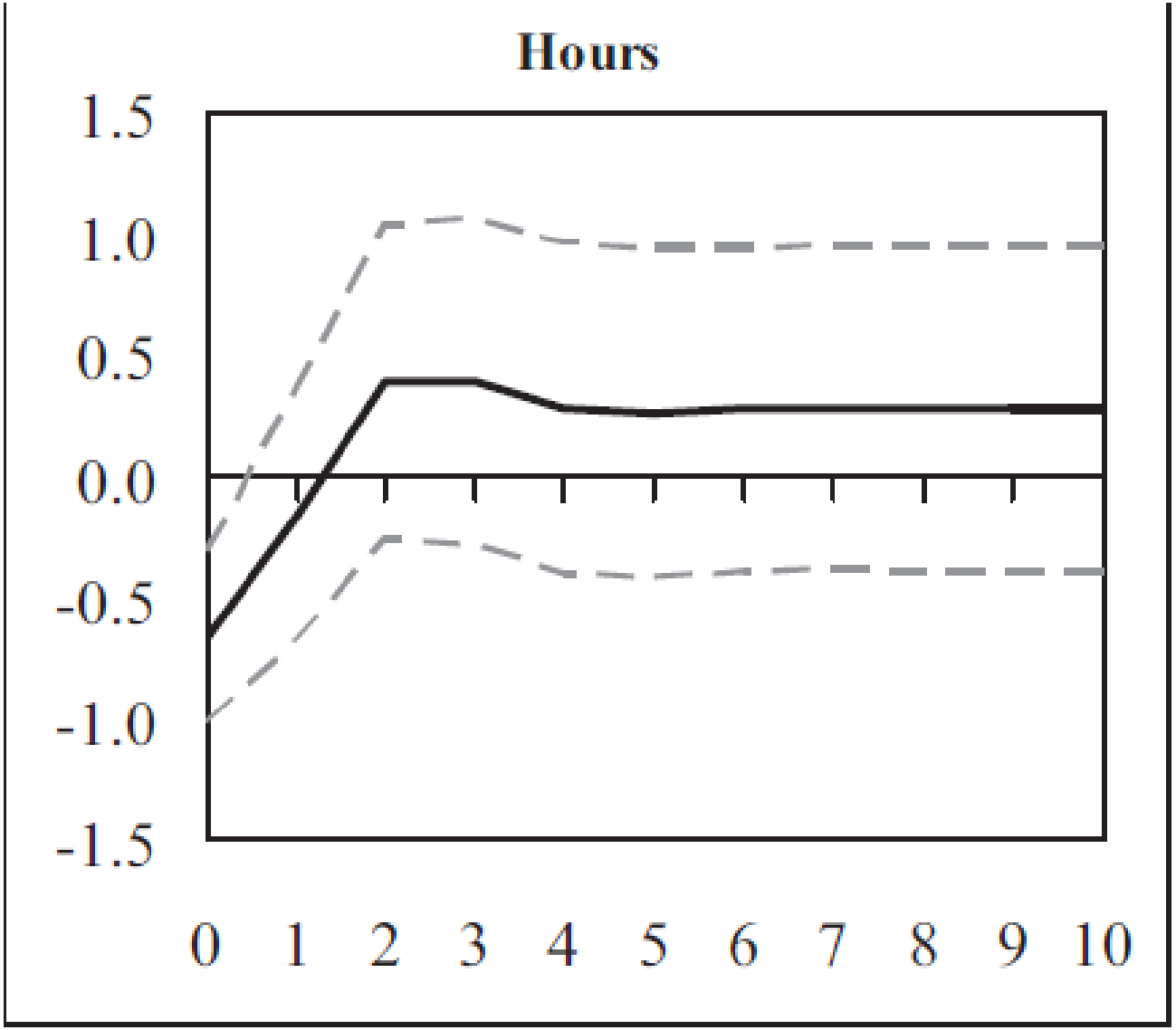
Table 2—Means and Standard Deviations of Productivity
(*Annual percent change*)

		Private economy	Durable manuf.
Solow residual	Mean	0.79	1.75
	Std deviation	2.04	3.59
"Purified" technology	Mean	0.35	1.54
	Std deviation	1.50	4.58

Response to "Purified" Technology

Dependent variable (growth rate, unless otherwise indicated)	dz
(1) Output	0.00
	(0.21)
(2) Hours	−0.60
	(0.14)
(3) Input	−0.44
	(0.09)
(4) Utilization	−0.40
	(0.13)
(5) Employment	−0.52
	(0.11)

Dynamic Response of Hours



Was Marx Right (in the short run?)

What happens to employment in response to a positive technology shock?

- RBC model: It rises!
- Marx: It falls! (He talked about the long-run too)
- Keynesian model: TFP improvements can also be “bad” for employment (In the short-run)
  - What is the logic for this?

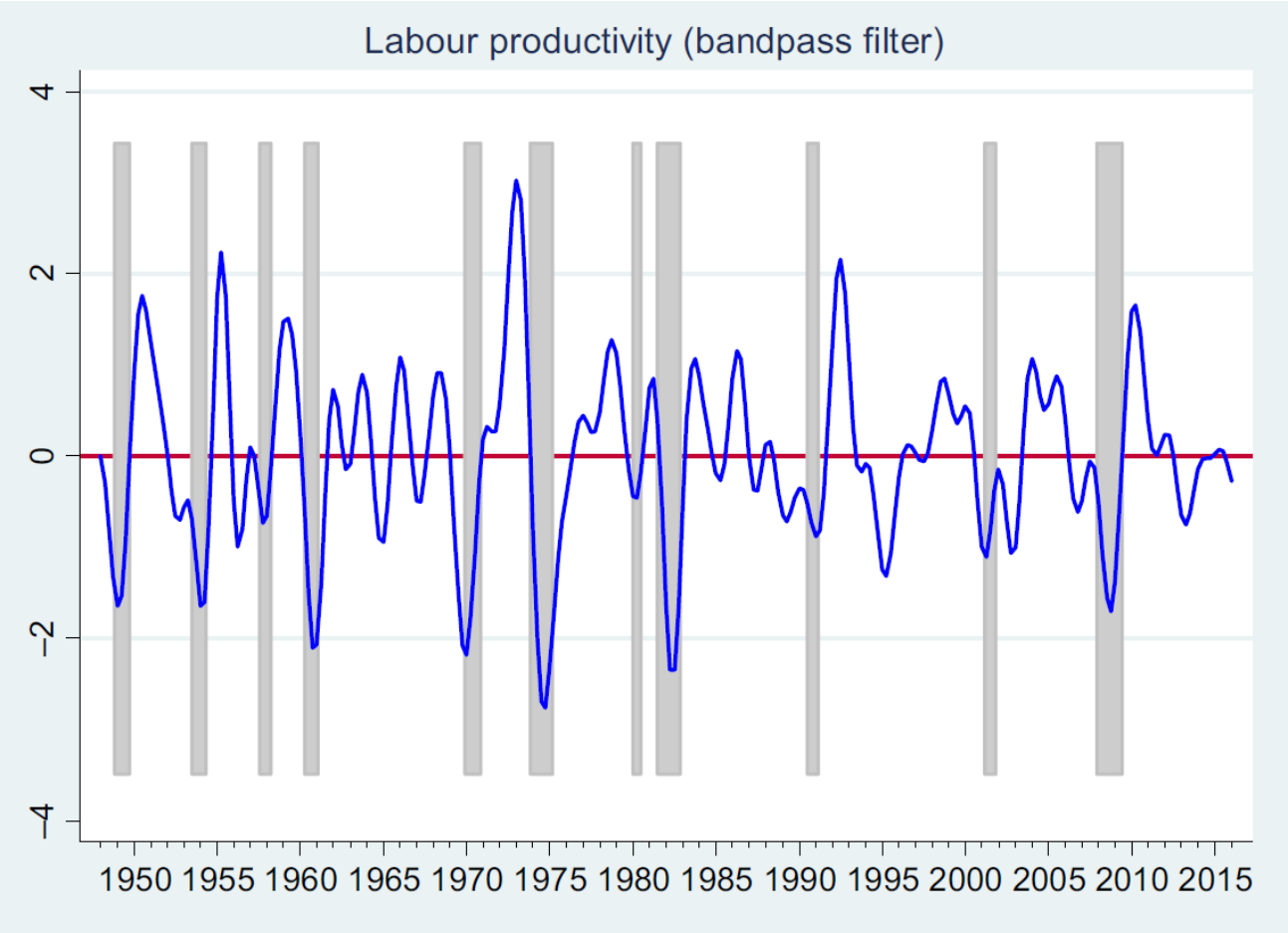
Keynesian Interpretation

- Positive productivity shock does not lead to immediate price fall in sticky price model
- Hence, demand does not increase immediately
- Instead labor, utilization etc. falls
  - Requires sub-optimal monetary policy in simple models

Other explanations:

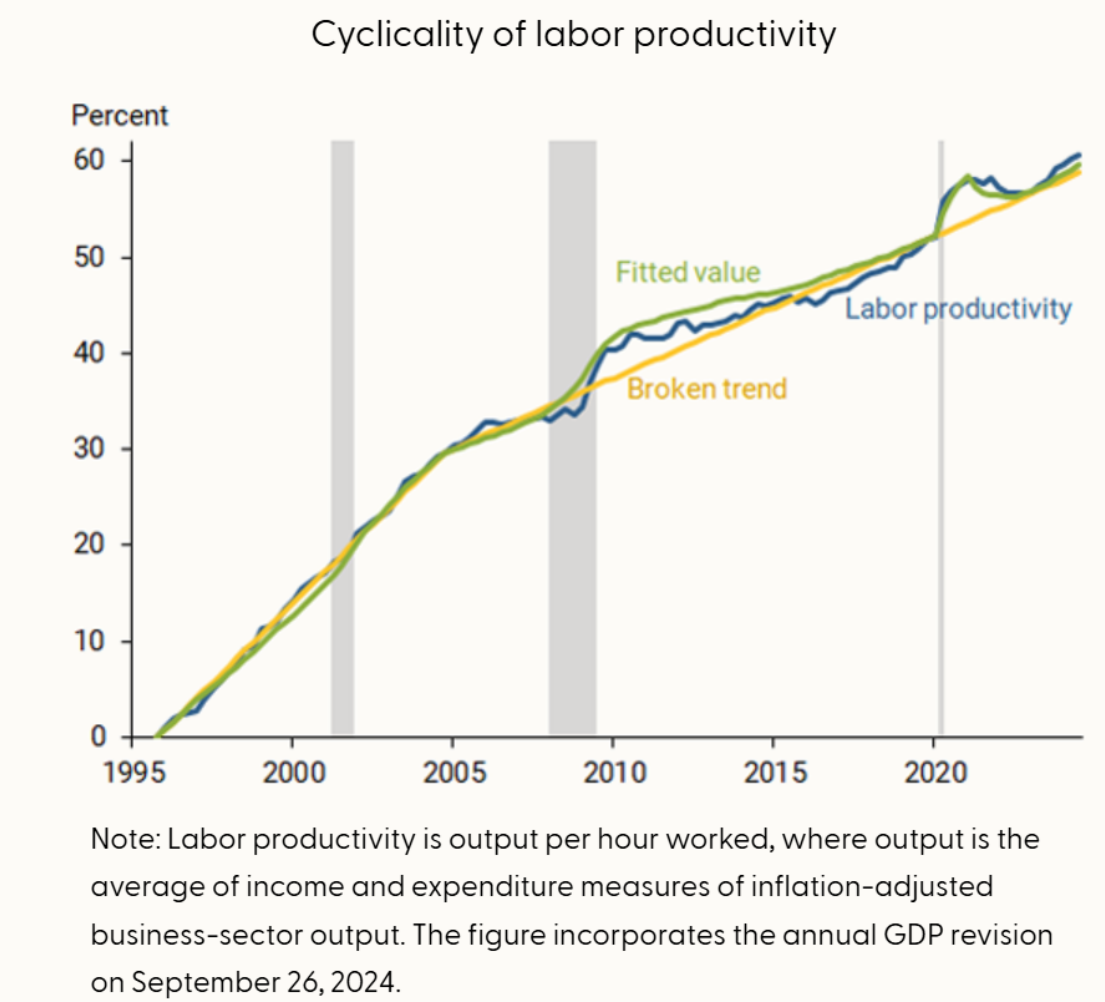
- Argue are less plausible
  - Sectoral shifts: controlling for technological dispersion measure (for productivity shocks / sectoral shifts) makes little difference
  - Firm-level evidence suggests “cleansing” mechanism less likely

The Vanishing Procyclicality of Productivity



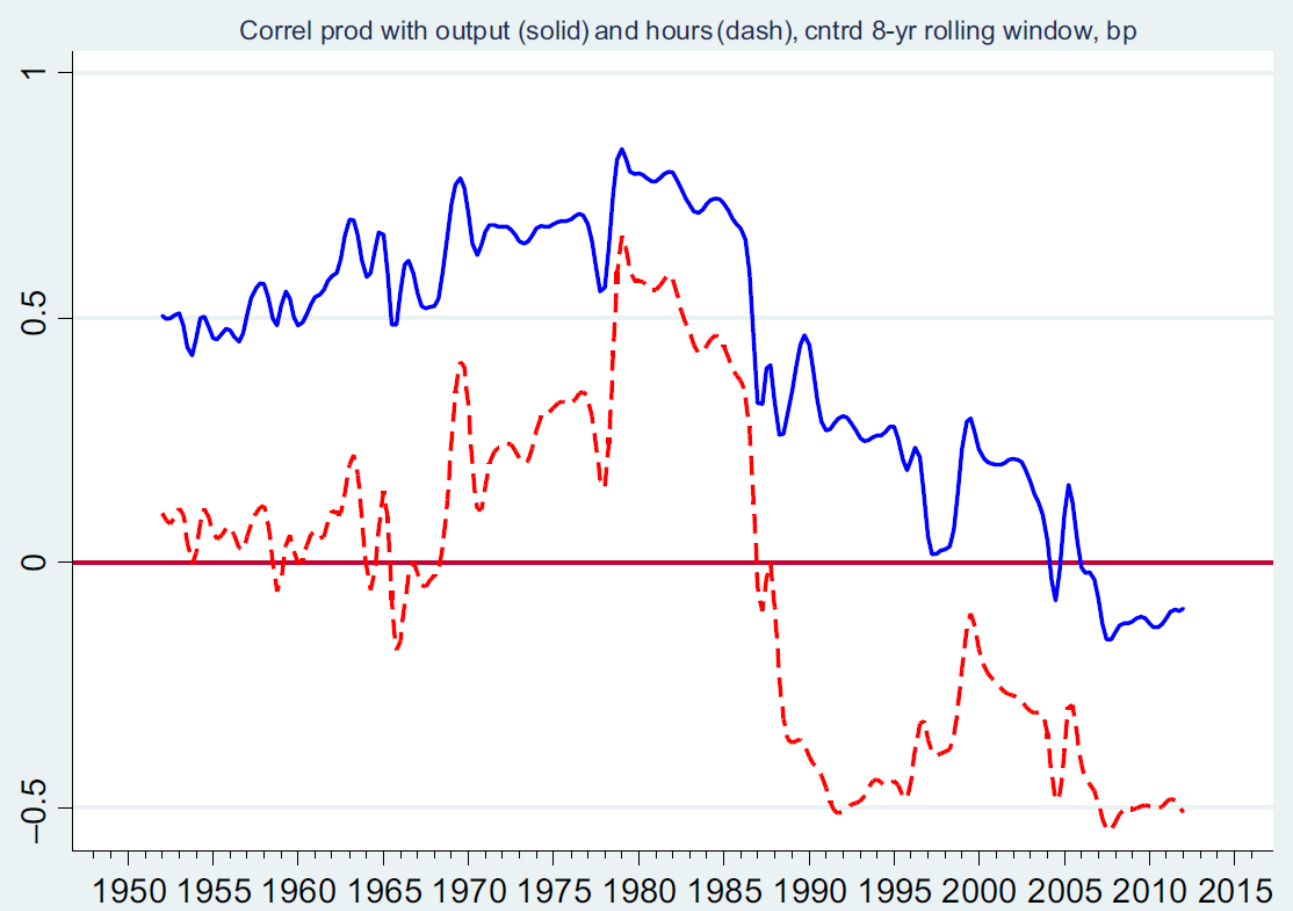
Gali and van Rens (2021)

Time Series of Labor Productivity



FRBSF Economic Letter, Fernald et al. (2024)

The Vanishing Procyclicality of Productivity



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