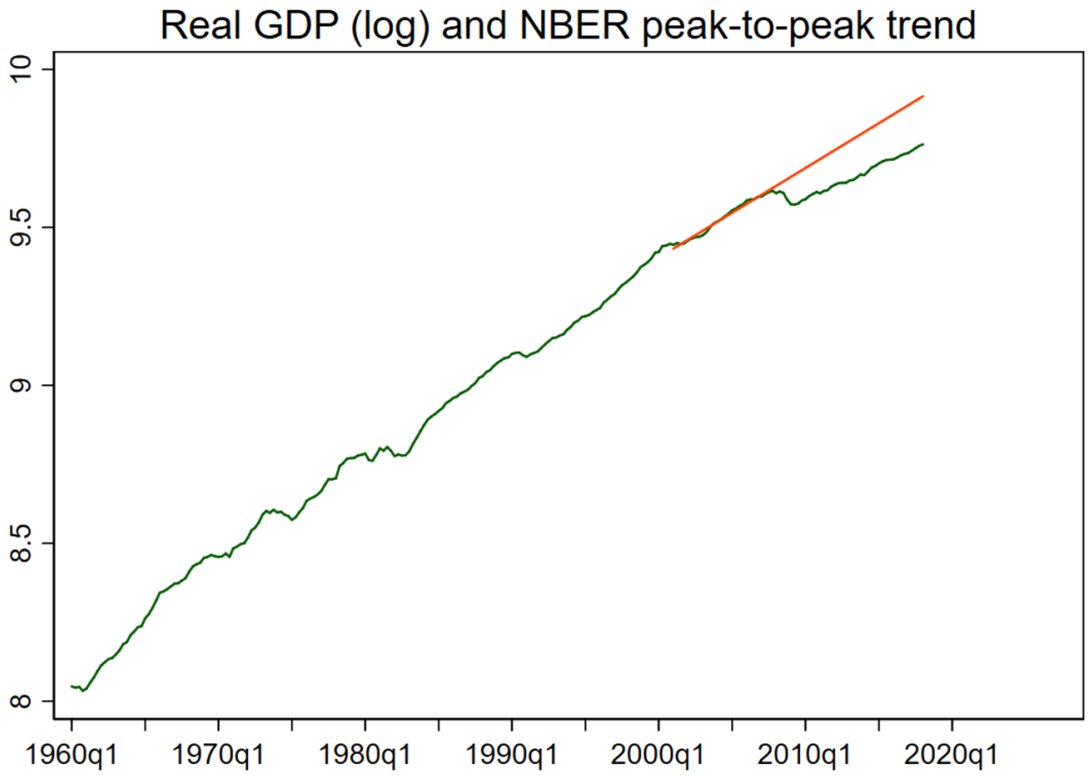
ESRI Annex Seminar on Business Cycle Indicators

Stability of the US Business Cycle?

The Slow Recovery from the Financial-Crisis Recession



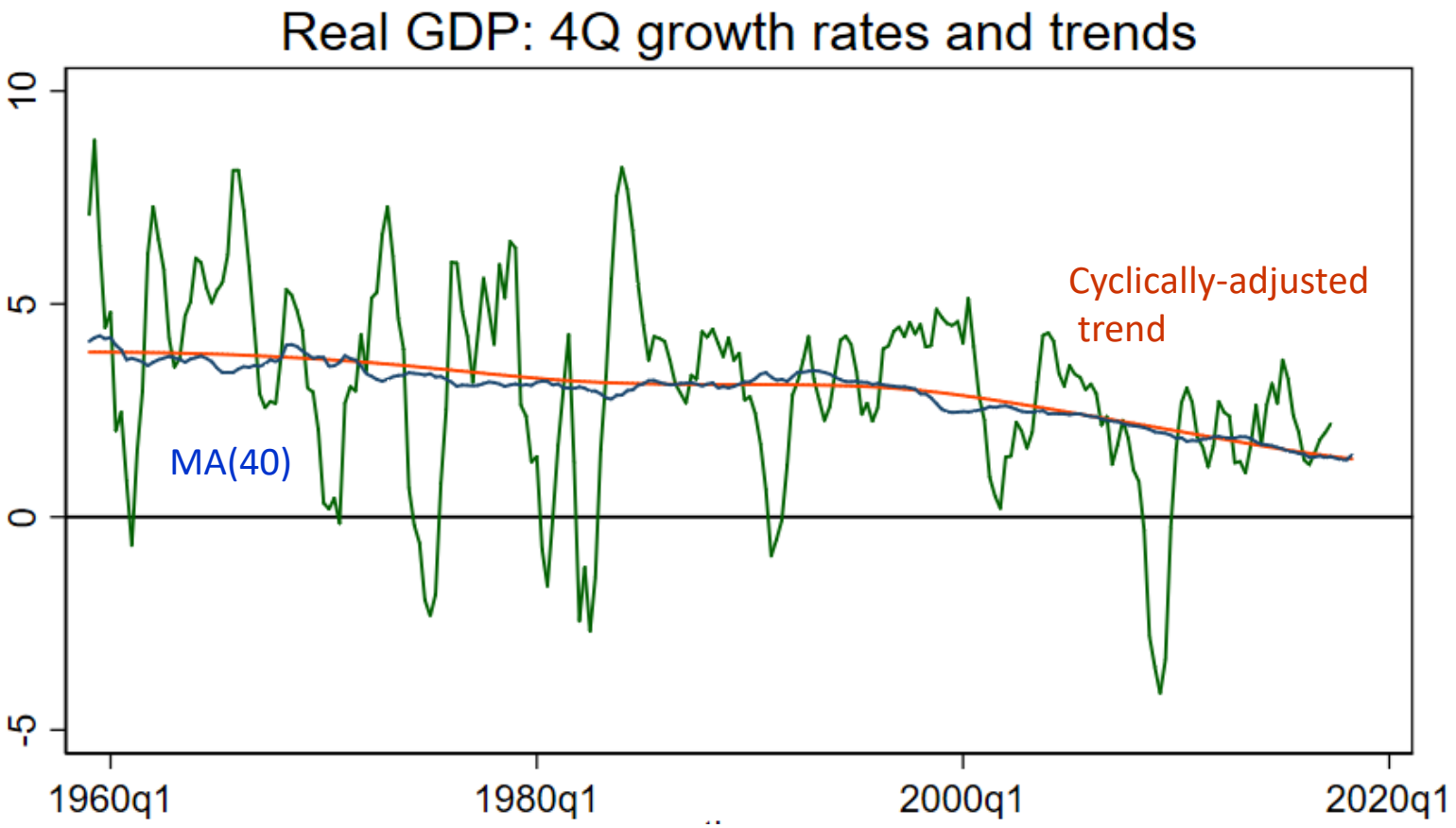
James H. Stock, Harvard University and the NBER

August 1, 2018

The Slow Recovery

1. Background: Long term trends in the U.S. economy
2. Explanations for the slow recovery in output
3. A closer look at the instability hypothesis

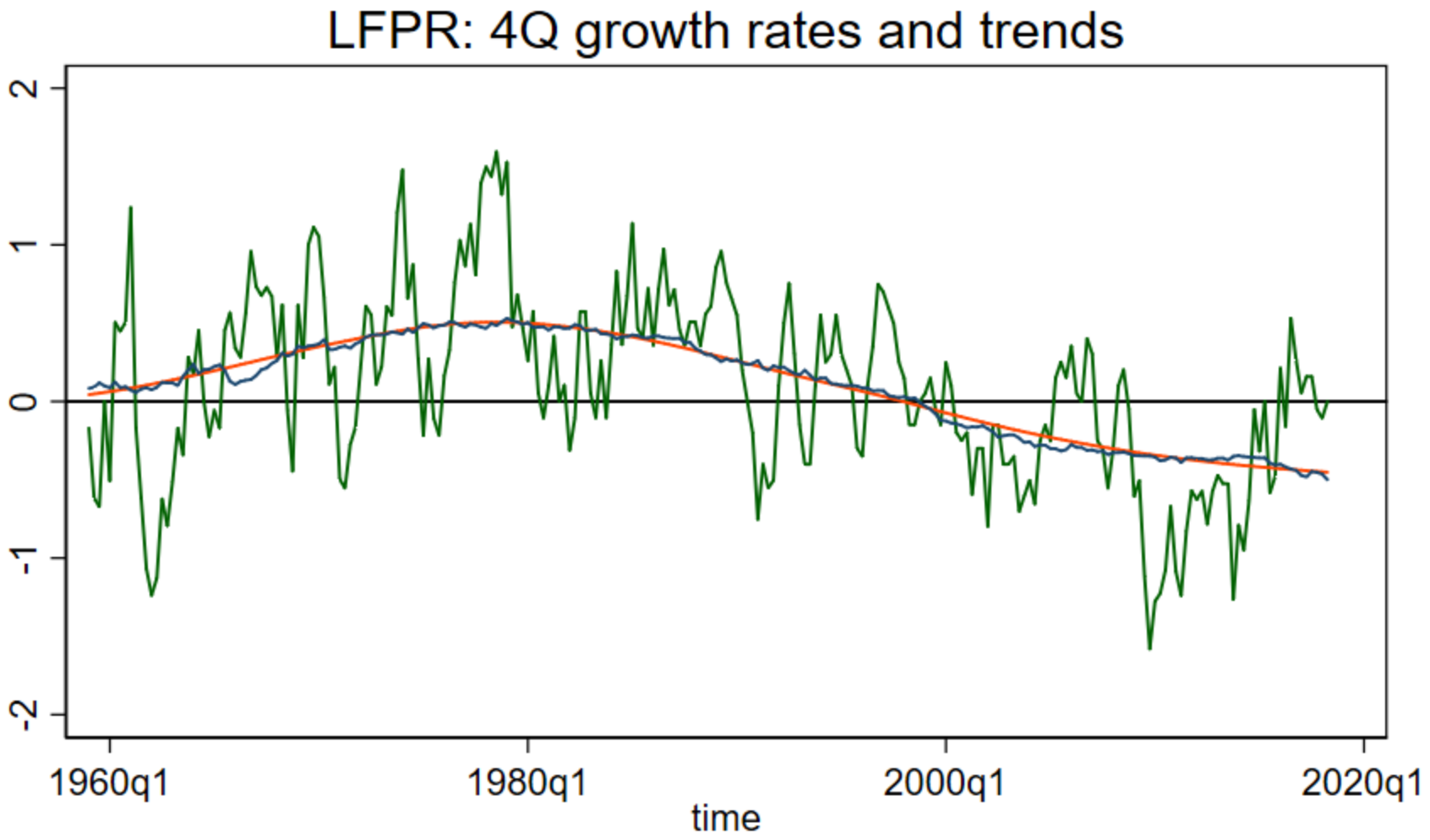
1. Background:
Long term trends in the U.S. Economy



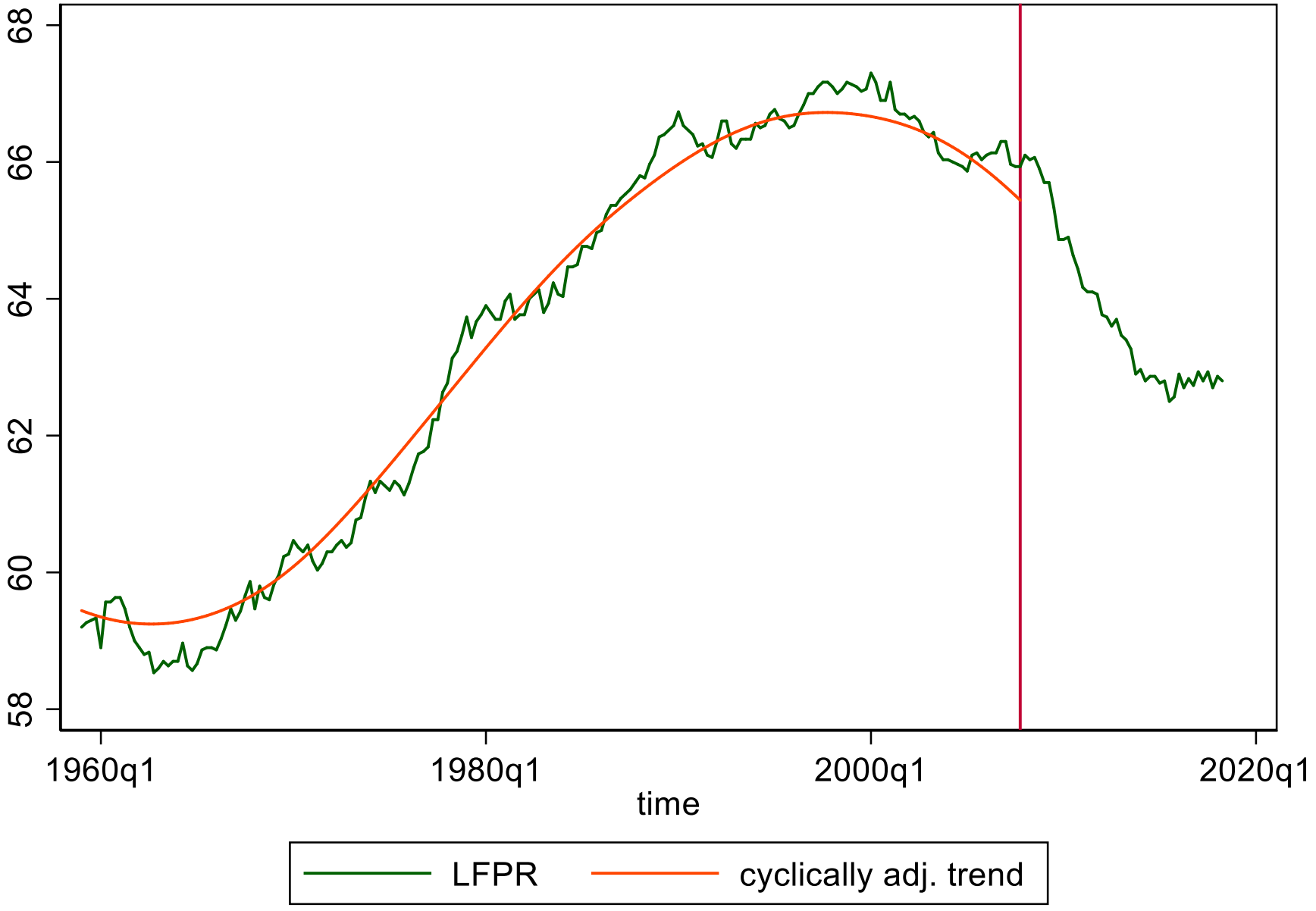
Estimates of trend GDP growth:

	Cyclically Adj.	MA(40)	Biweight
1965	3.8%	3.5%	3.7%
1975	3.5%	3.4%	3.3%
1985	3.1%	3.1%	3.1%
1995	3.1%	3.2%	3.1%
2005	2.5%	2.3%	2.3%
2010	2.0%	1.8%	2.0%

Components of GDP growth: LFPR growth



Labor force participation rate



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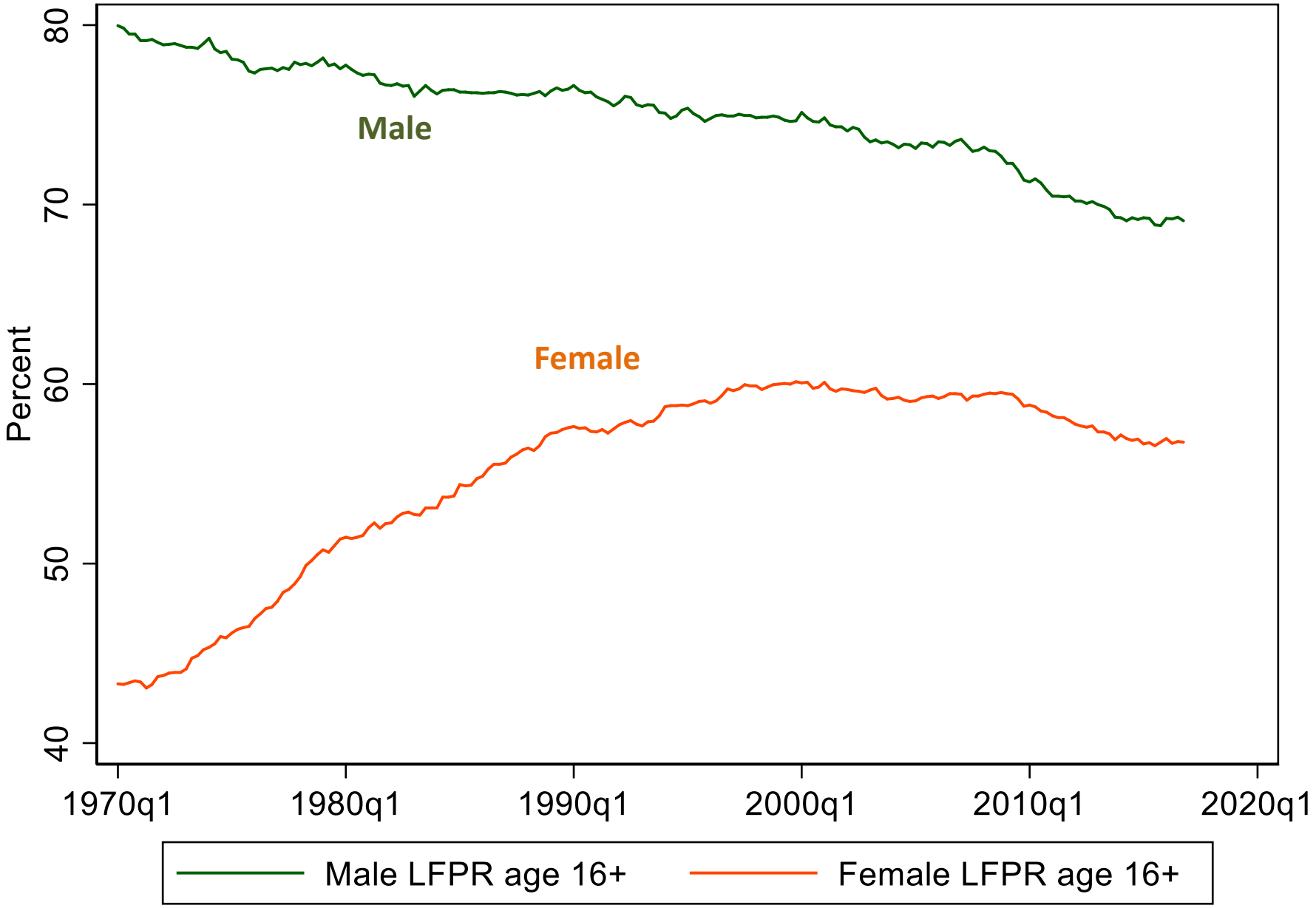
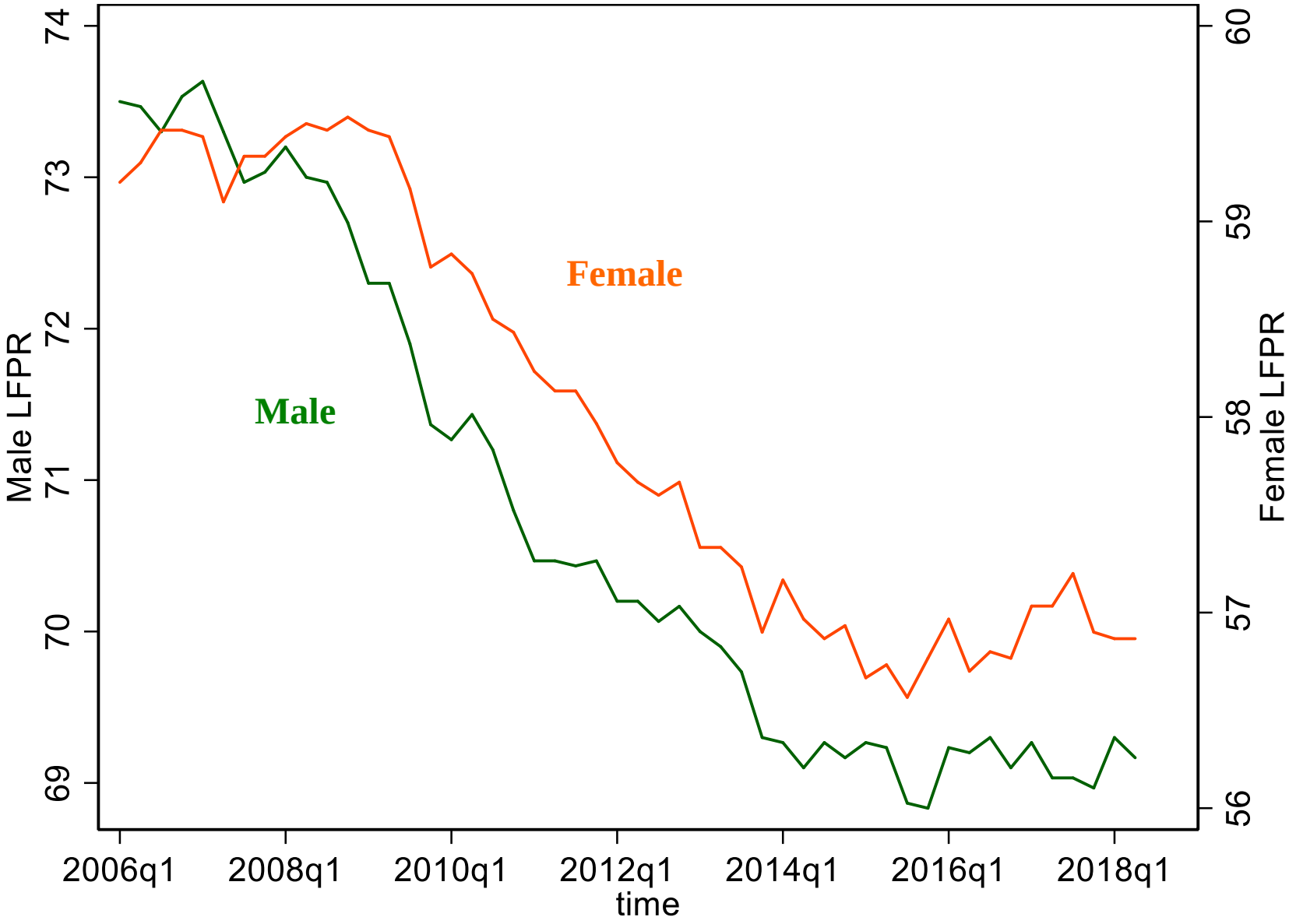
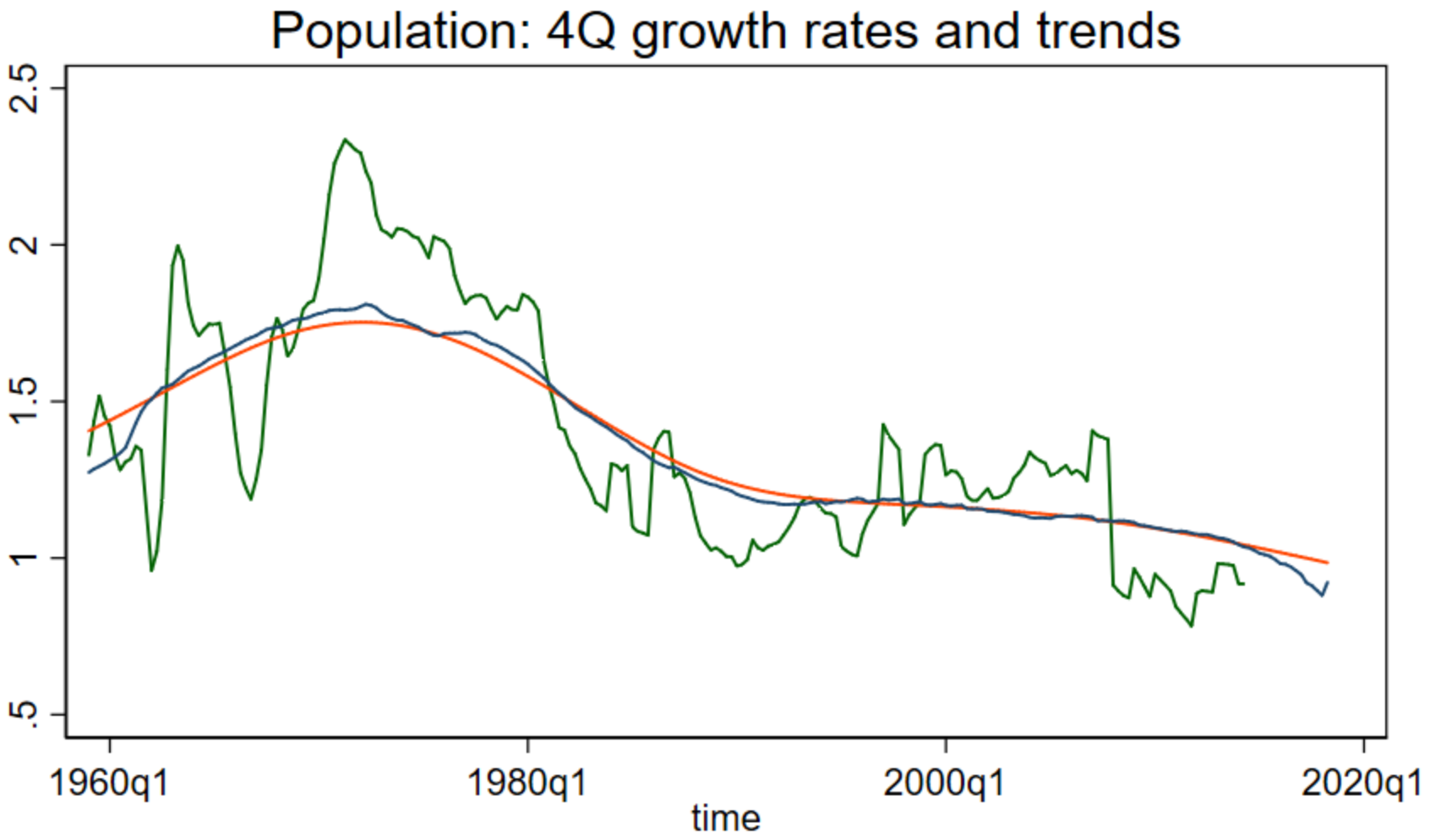


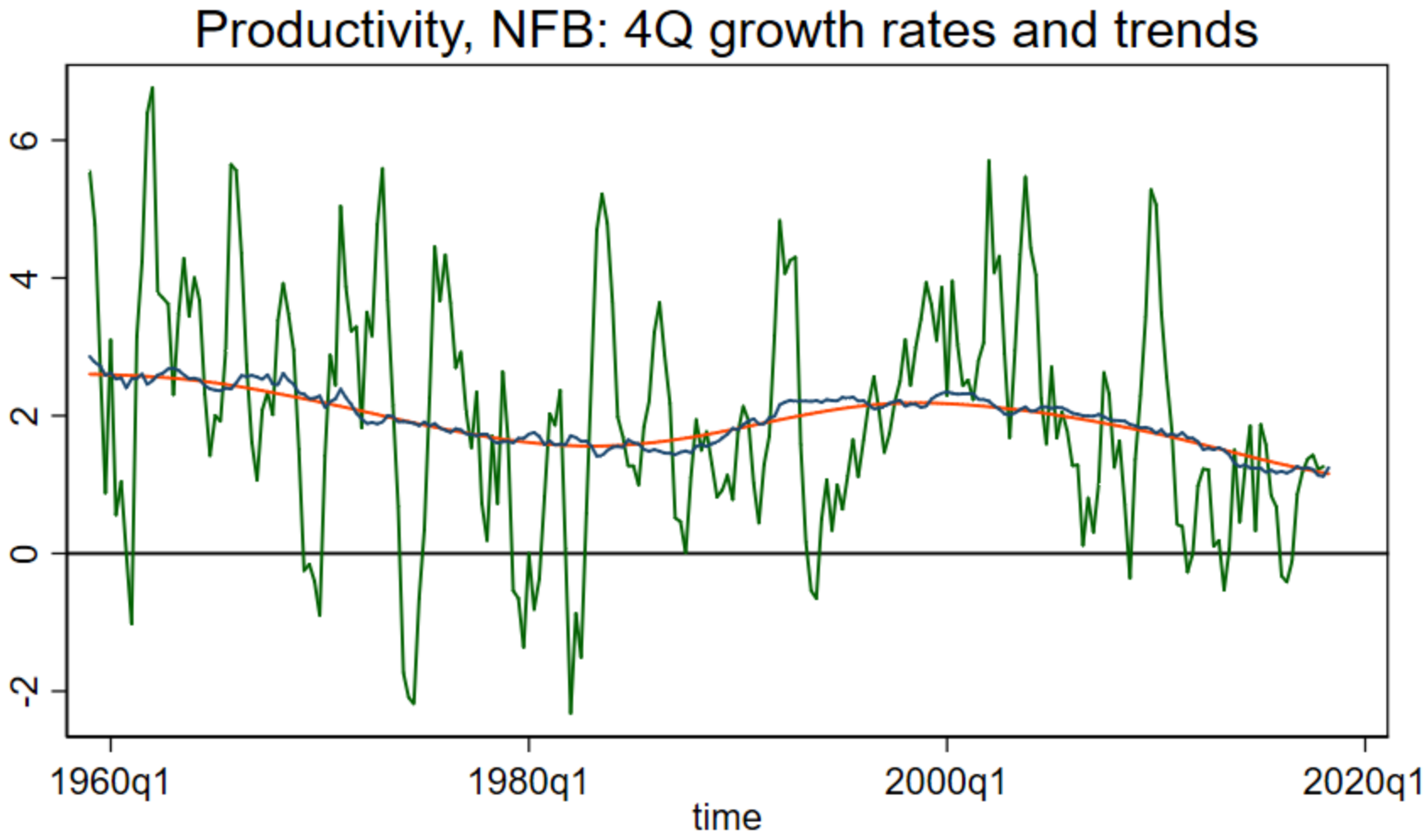
LFPR declines since 2006 are similar in women and men



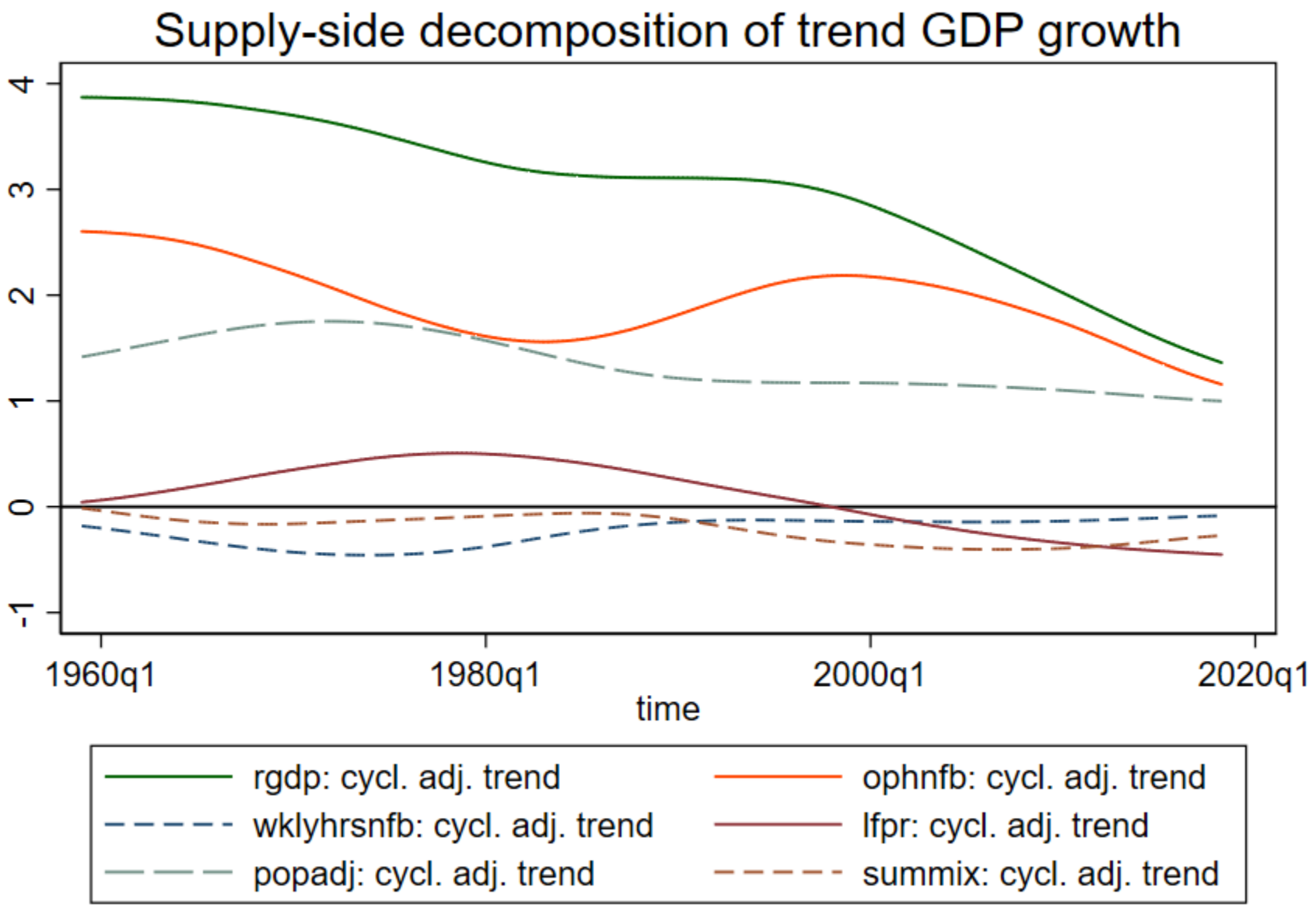
Components of GDP growth: population growth



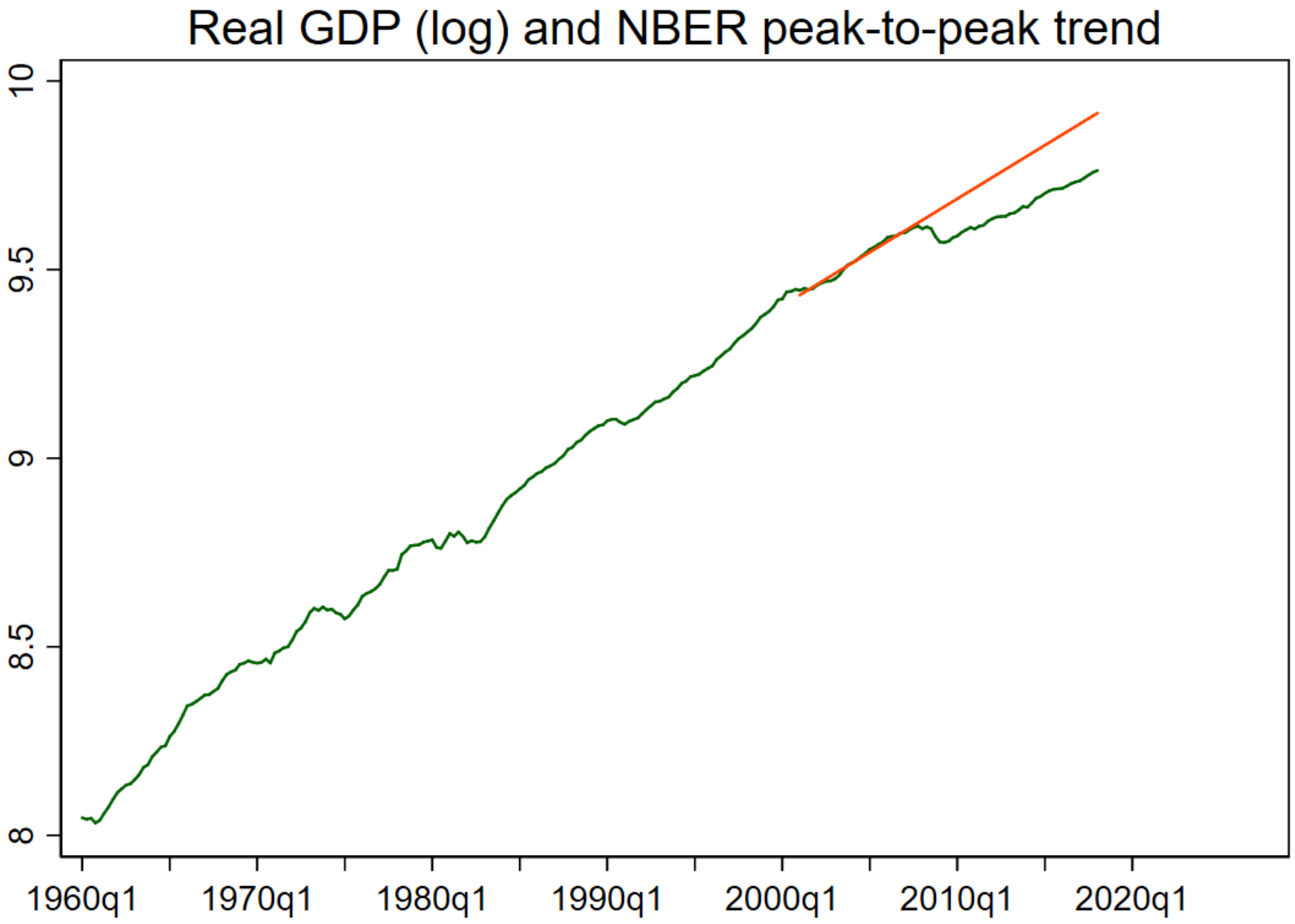
Components of GDP growth: labor productivity, NFB



$$\Delta \ln GDP_t = \Delta \ln Productivity_t + \Delta \ln WklyHrs_t + \Delta \ln EmpRate_t + \Delta \ln LFPR_t + \Delta \ln Pop_t + \Delta \ln Mix_t$$



1(a) The Slow Recovery in Output



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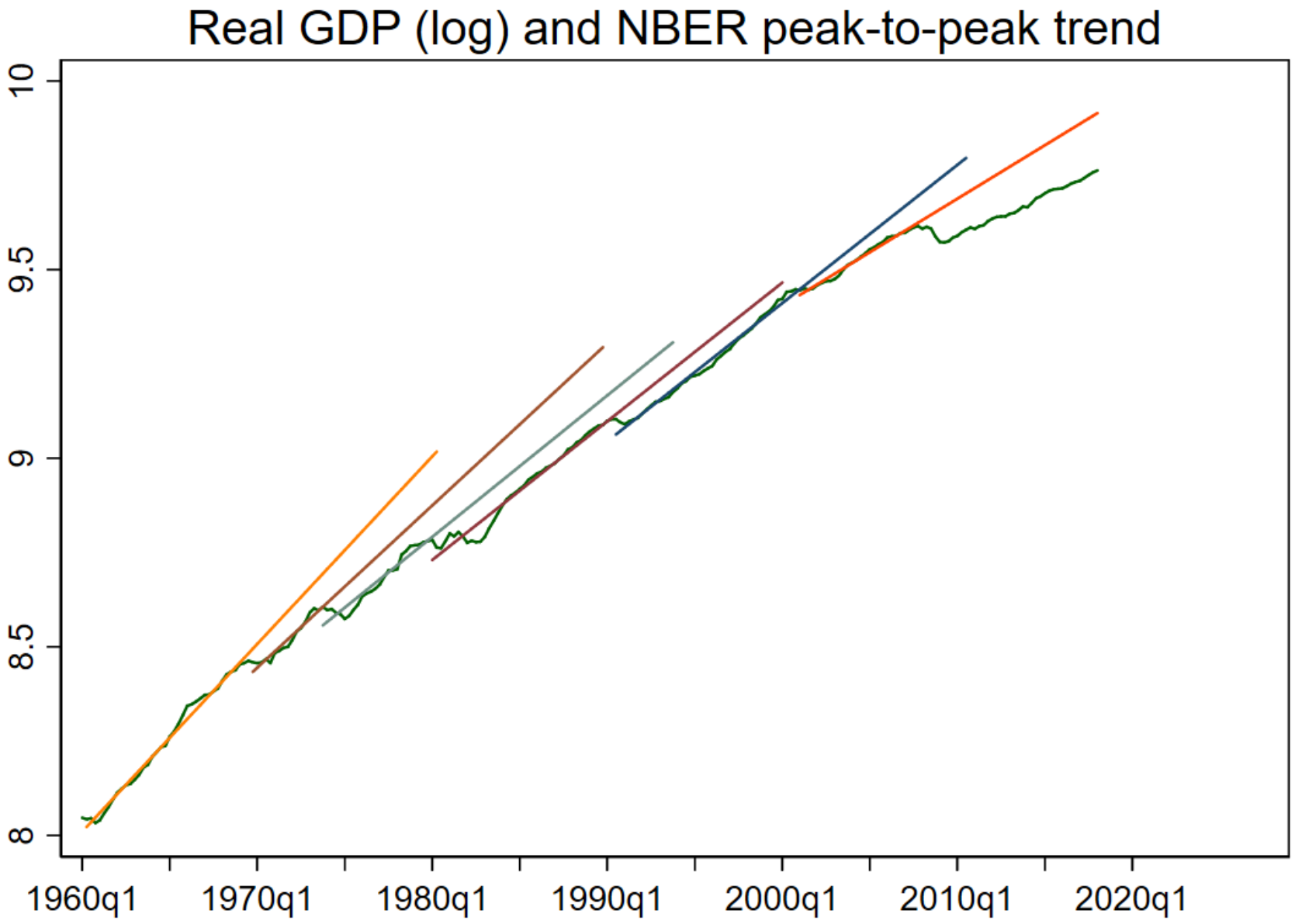
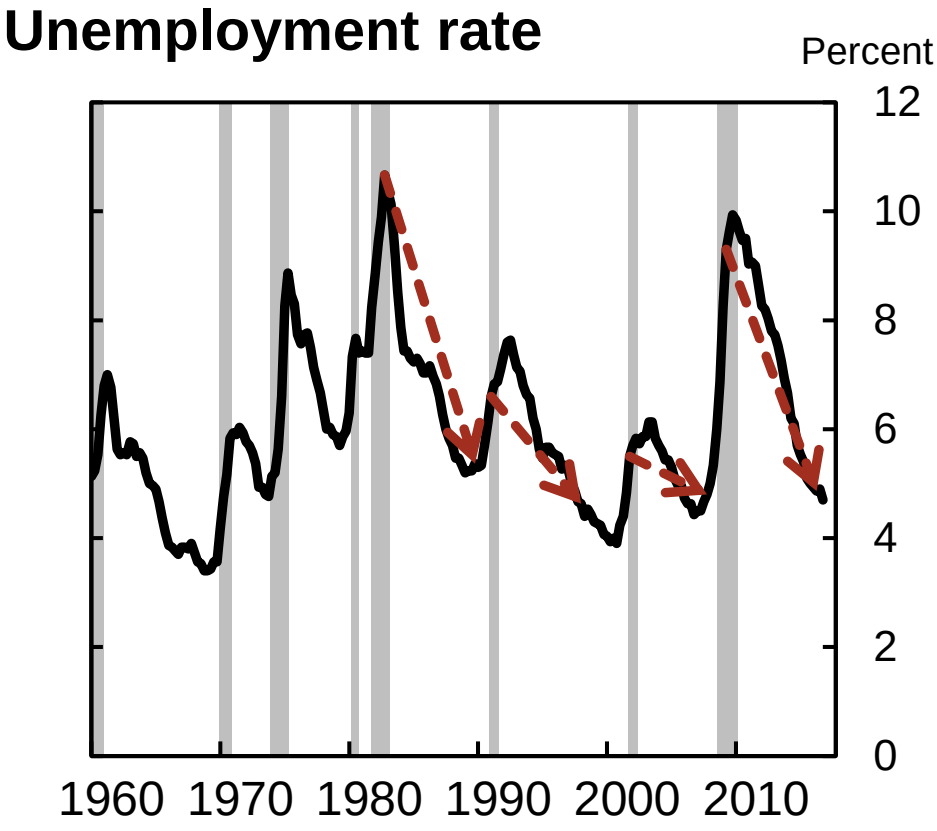
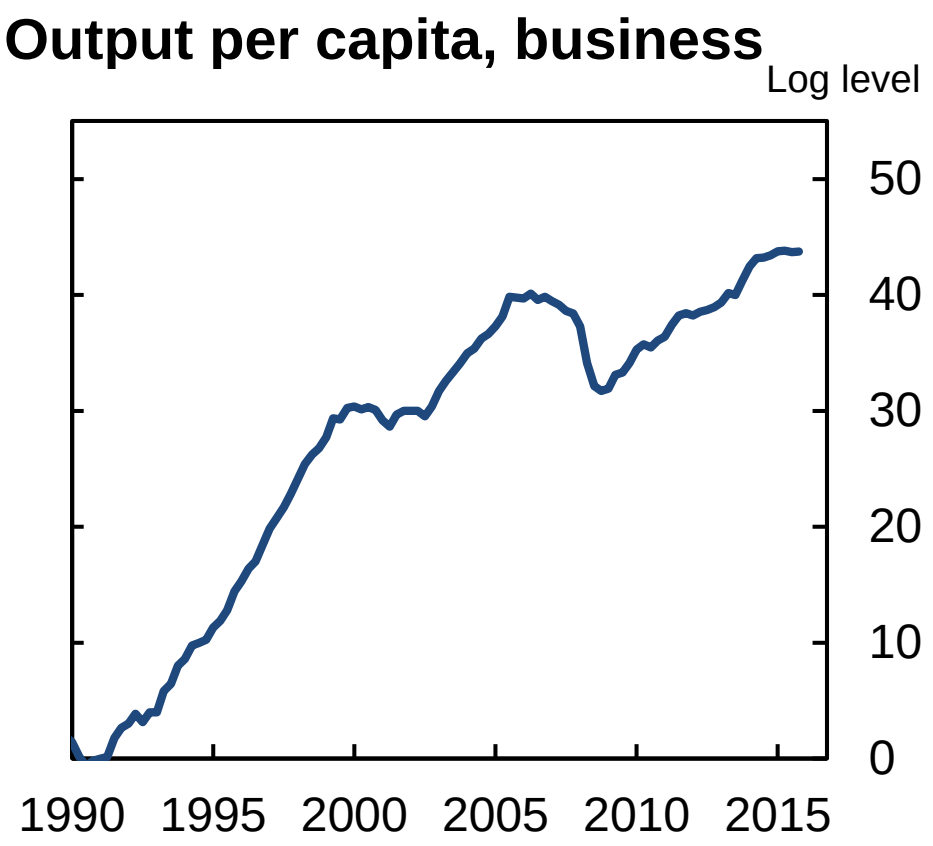


2. The Slow Recovery in Output 2009 - 2017

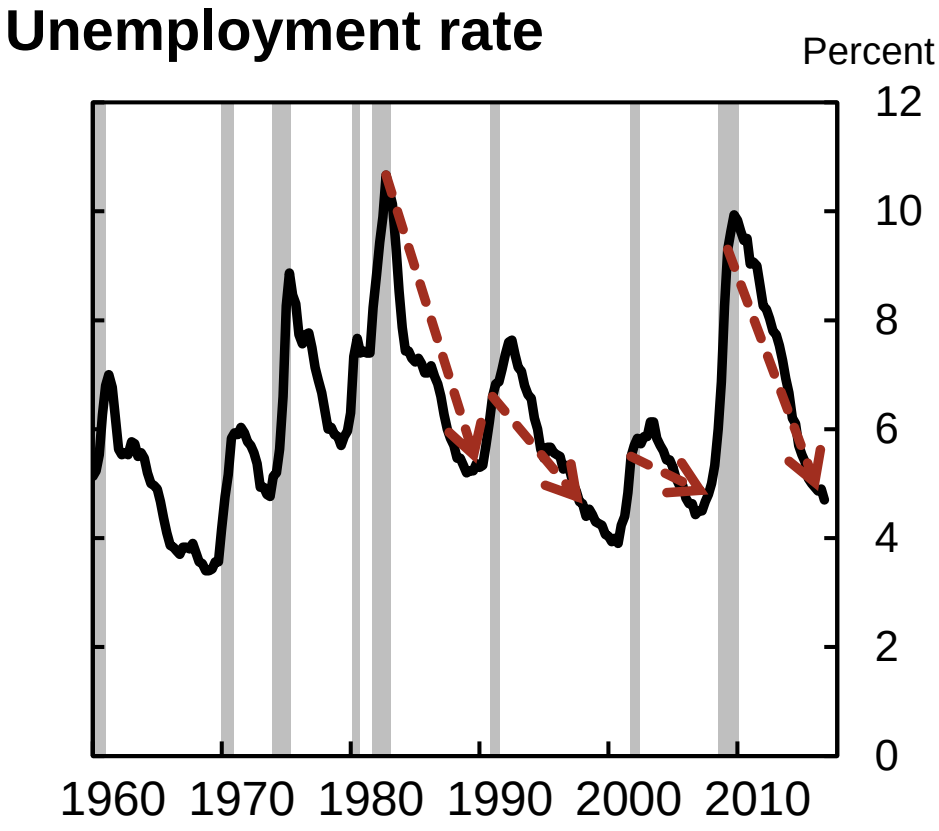
Why has output growth been so slow, given the strong the recovery of the unemployment rate?

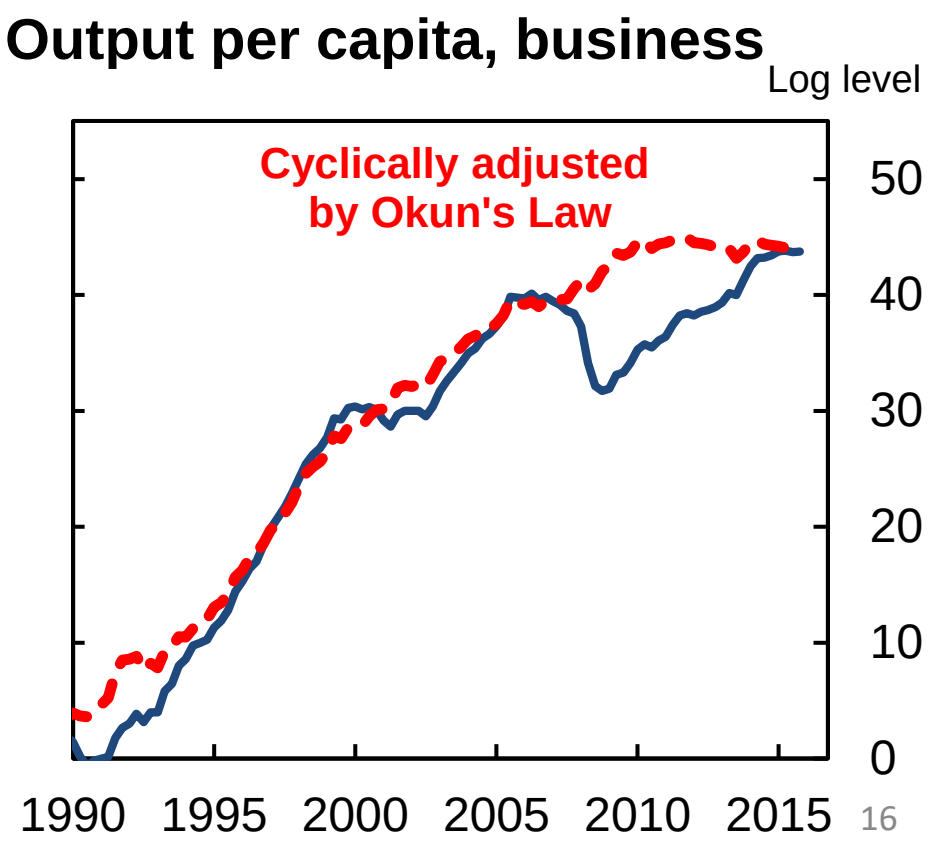




Why has output growth been so slow, given the strong the recovery of the unemployment rate?

FHSW answer: The U.S. had a deep recession superimposed on a sharply slowing trend rate of growth of output





Selected References

Selected references on aspects of the GDP slowdown & slow recovery

Aaronson, S. et. al., *BPEA* (2006) (on LFPR)
Aaronson, S. et. al., *BPEA* (2014) (on LFPR)
Aaronson, D. et. al., Chicago Fed *EP* (2014) (on LFPR)
Ball (2014)
Blanchard, Cerutti, and Summers (2015)
CEA, *Economics Report of the President*, Ch. 2 (2013)
CBO, *Economic Outlook – Update* (August 2014)
Fernald, Hall, Stock, & Watson, *BPEA* (2017)
Gordon, *NBER WP 20423* (2014); *Rise & Fall of American Growth* (2016)
Gourio and Farhi, *BPEA* (2018)
Hall, *NBER Macro Annual* (2014)
Martin, Munyan, Wilson, IMF WP 1145 (2015)
Ohanian, Taylor, and Wright (2012)
Reifschneider, Wascher, and Williams (2015)
Redmond and van Zandweghe (2015)
Stock and Watson, *BPEA* (2012)

Candidate explanations for the slow recovery

1. Weak aggregate demand
   a) Inadequate funds because of impaired financial institutions
   b) Weak consumption growth because of increasing income inequality
   c) Weak consumption growth because of deleveraging and negative wealth (decrease in housing values)
   d) Weak investment growth because of uncertainty
   e) Insufficient fiscal expansion
   f) Insufficient monetary expansion

2. Supply problems
   a) Wrong type of fiscal and/or monetary expansion with unintended consequences (e.g. extension of unemployment benefits)
   b) Weak investment growth because of tax policy (investment flowing to lower-tax countries) and/or regulatory burden
   c) Hysteresis (job skill deterioration)
   d) Weak total factor productivity (TFP) growth

3. Mis-measurement hypothesis

4. Adjustment to long-run demographic trends

Fernald, Hall, Stock, and Watson (2017)

1. Weak aggregate demand
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   c) Hysteresis (job skill deterioration)
   d) Weak total factor productivity (TFP) growth as a result of a negative pre-recession shock
3. Mis-measurement hypothesis

4. Adjustment to long-run demographic trends – decline in LFPR

1(d) FHSW decomposition of the missing output growth

Bus output per capita:

$$\left(\frac{Y_t^{Bus}}{Pop_t}\right)=\left(\frac{Hours_t^{Bus}}{Pop_t}\right)\left(\frac{Y_t^{Bus}}{Hours_t^{Bus}}\right)$$

Decomposition of the growth of business output per capita:

$$\Delta\ln\left(\frac{Y_t^{Bus}}{Pop_t}\right)=\Delta\ln\left(\frac{Hours_t^{Bus}}{Pop_t}\right)+\Delta\ln\left(\frac{Y_t^{Bus}}{Hours_t^{Bus}}\right)$$

where:

$$\Delta\ln\left(\frac{Hours_t^{Bus}}{Pop_t}\right)=\Delta\ln WeeklyHrs+\Delta\ln\left(\frac{Emp_t^{Bus}}{Emp_t^{CPS}}\right)+\Delta\ln\left(1-unrate_t\right)+\Delta\ln LFPR$$

$$\Delta\log\left(\frac{Y_t^{Bus}}{Hours_t^{Bus}}\right)=\frac{\Delta\log TFP_t}{1-\alpha_t}+\left(\frac{\alpha_t}{1-\alpha_t}\right)\Delta\log\left(\frac{K_t}{Y_t^{Bus}}\right)+\Delta\log\left(LQ_t\right)$$

Controlling for cyclical recovery: Okun's Law method

$$y_t = \mu_t + c_t + z_t$$
$$= \mu_t + \beta(L)\Delta U_t + z_t$$

Method 1: Use (generalized) Okun's Law to control for cycle (c_t).

- $\widehat{c_t} = \beta(L)\Delta U_t$ is cyclical adjustment
- Cyclically adjusted "residual" is

$$y_t - \widehat{c_t} = y_t - \hat{\beta}\,(L)\Delta U_t = \widehat{\mu_t} + \widehat{z_t}$$

- Trend = cyclically-adjusted biweight trend, bandwidth = 60 quarters

This method preserves additivity: if *y* = *x* + *z*, then *trend(y) = trend(x) + trend(z), etc.*

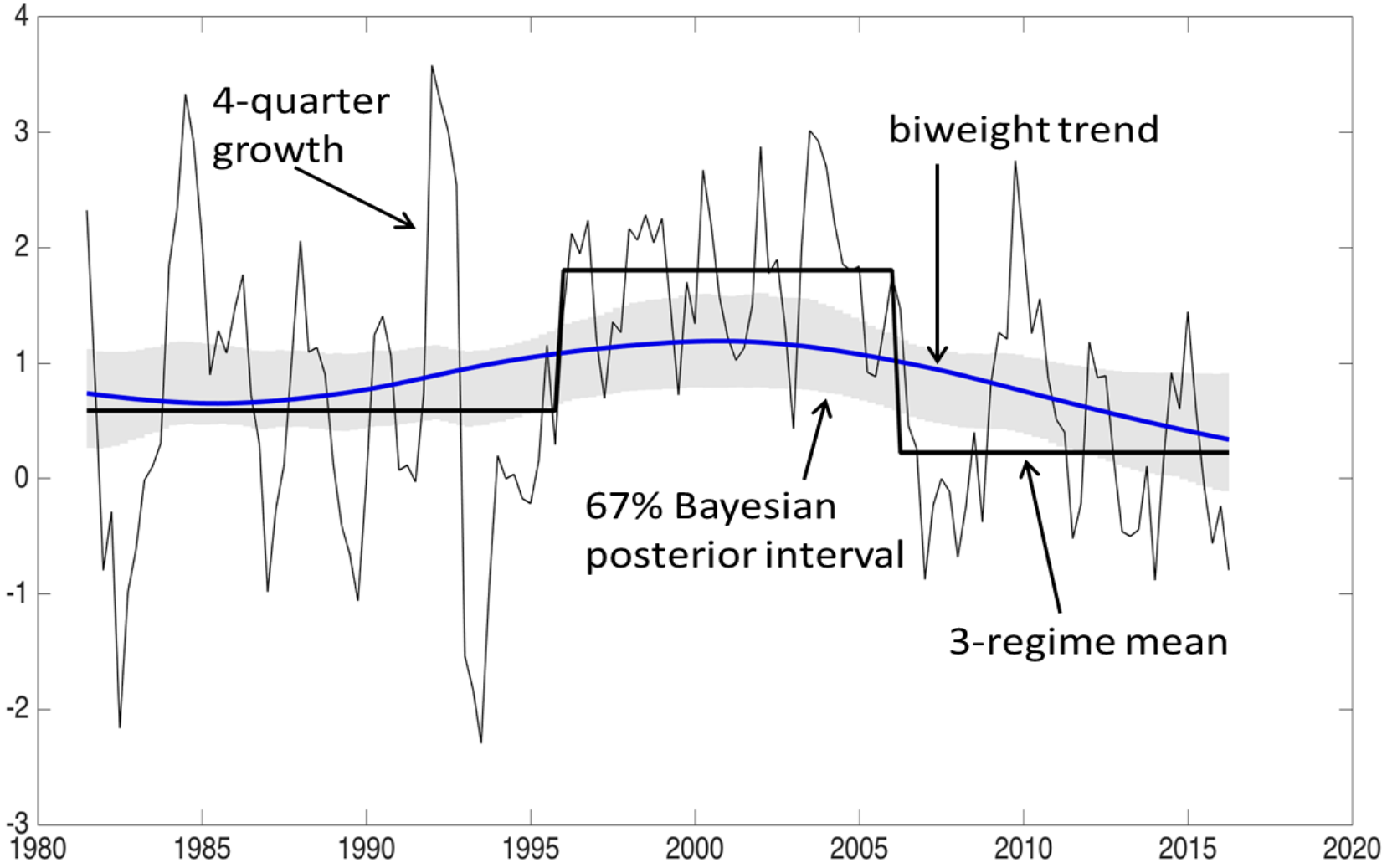
Current v. three previous recoveries: Okun cyclical adjustment

	Historical values (not cyclically adjusted)			**Cyclically adjusted**			
	Three previous recovs.	2009Q2-2016Q2	Annual shortfall (a)-(b)	Three previous recovs.	2009Q2-2016Q2	Cyclic. Adjusted shortfall (d)-(e)	Cumul. shortfall
	(a)	(b)	(c)	(d)	(e)	(f)	(i)
Bus. output per capita	2.9	1.7	1.2	2.1	0.3	**1.8**	**13.5**
Bus. labor hours per capita	0.8	0.6	0.2	-0.1	-0.8	0.7	5.0
Hrs/worker, business	0.1	0.2	-0.2	-0.1	-0.1	0.0	-0.2
Bus. empl / CPS empl	0.1	0.4	-0.3	-0.1	0.0	-0.1	-0.8
CPS employment rate	0.4	0.7	-0.2	0.0	0.0	0.0	0.0
Lab. Force Partic. Rate	0.2	-0.7	0.9	0.2	-0.7	**0.8**	**6.1**
Output/ hour (labor prod.)	2.1	1.1	1.0	2.1	1.0	1.1	8.1
TFP / (1 -α)	1.9	1.4	0.5	1.5	0.5	**1.0**	**7.0**
(Cap/output)×α/(1-α)	-0.3	-0.7	0.4	0.2	0.1	0.1	0.6
Labor quality	0.4	0.3	0.1	0.5	0.4	0.1	0.4

Entries are percent or percentage point differences. Columns (a) to (f) are annualized.

When did the slowdown in TFP growth begin?

Cyclically-Adjusted TFP and Estimated Low-Frequency Mean Growth Rates



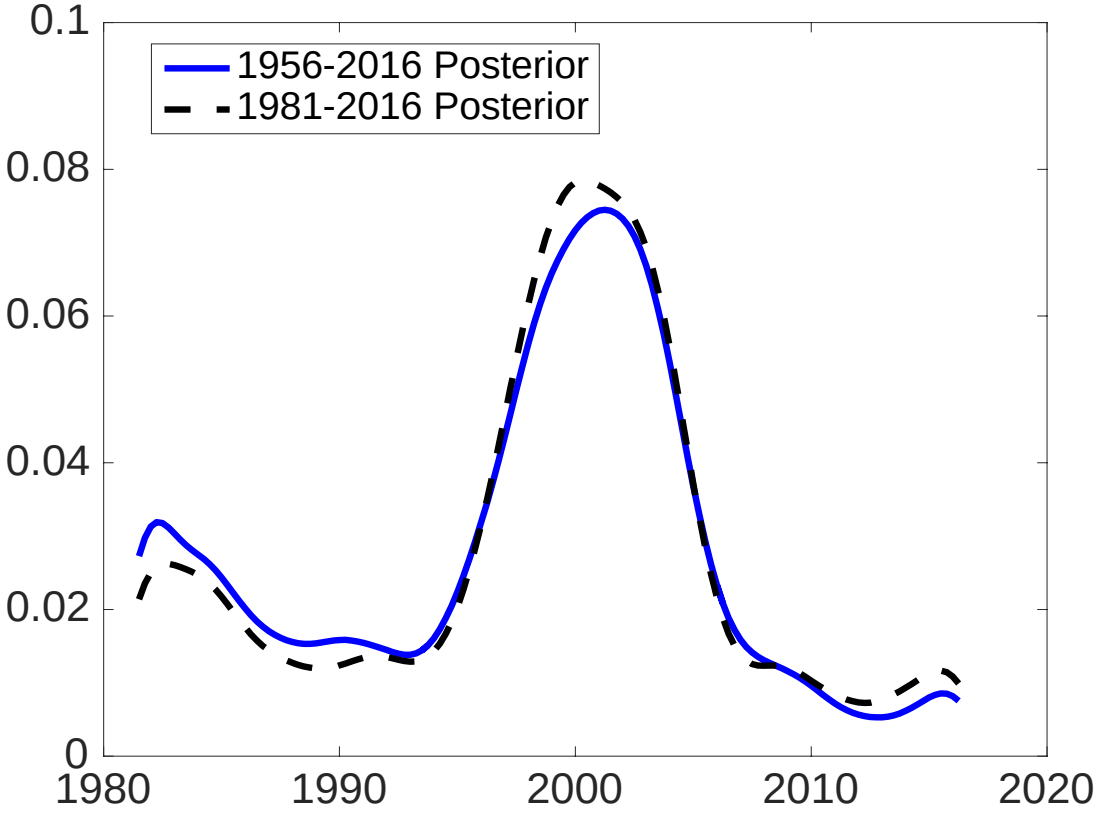
When did the slowdown? Break tests and dates

Cyclically-adjusted TFP

$\hat{\sigma}_{\Delta\mu}$	QLR (sup-Wald) test: 1 break	QLR (sup-Wald) test: 2 breaks	QLR (sup-Wald) test: 3 breaks	Nyblom test
A. 1956-2016				
p-value for H_0: $\mu_t = \mu$	0.01	0.06	0.01	0.02
Estimated break dates	1973Q1	1973Q1 2006Q1	1973Q1 1995Q4 2006Q1	
$\hat{\sigma}_{\Delta\mu}$	0.11			0.11
90% CI for $\sigma_{\Delta\mu}$	(0.03, 0.36)			(0.02, 0.40)
B. 1981-2016				
p-value for H_0: $\mu_t = \mu$	0.38	0.14	0.25	0.35
Estimated break dates	2006Q1	1995Q1 2006Q1	1988Q1 1995Q4 2006Q1	
$\hat{\sigma}_{\Delta\mu}$	0.05			0.05
90% CI for $\sigma_{\Delta\mu}$	(0.0, 0.15)			(0.0, 0.27)

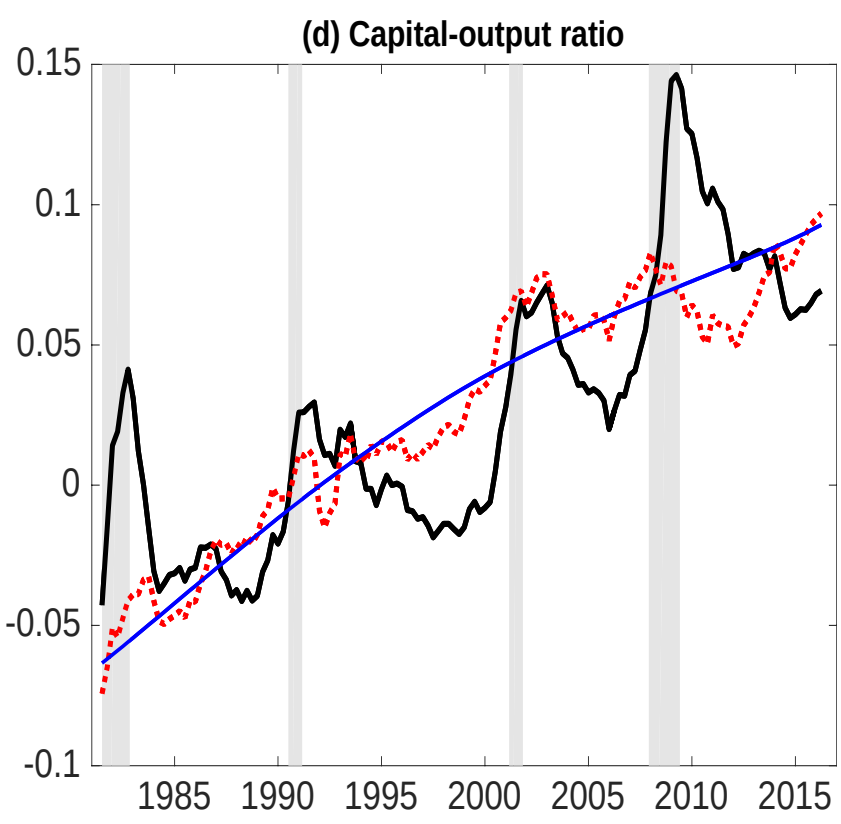
When did the slowdown begin?

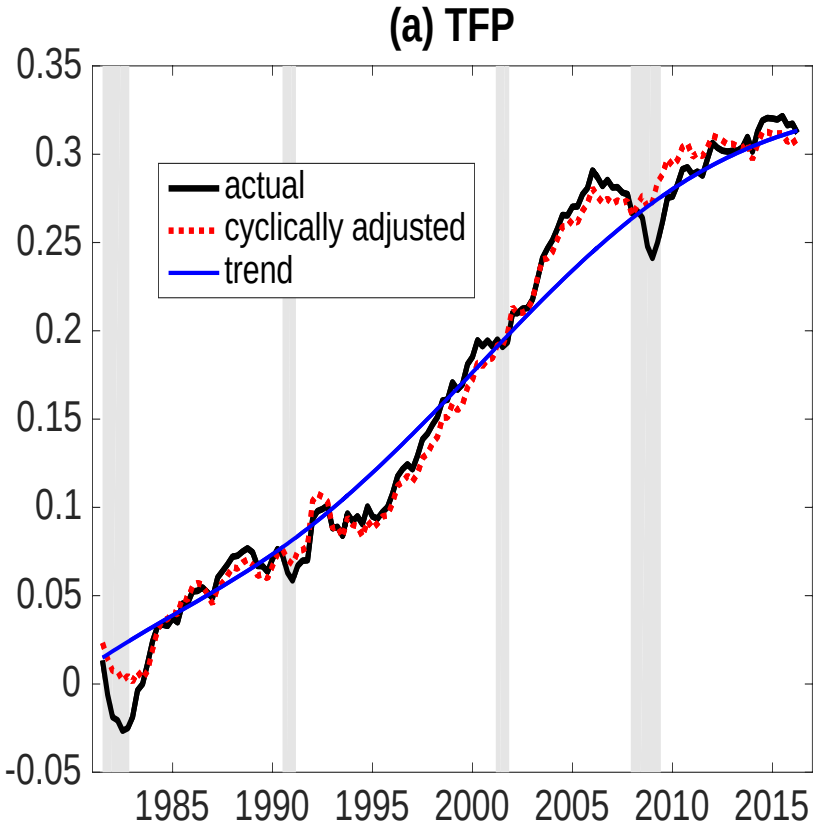
Posterior Density of Date of Maximum Trend Growth in CA TFP, 1981-2016



Notes: The posterior is for the date of the maximum trend cyclically-adjusted TFP growth between 1981 and 2016. Computed using Bayes implementation of the random walk-plus-noise model for productivity growth, with a flat prior on the date of the maximum.

TFP (not capital) explains weak labor productivity growth





Notes: Series are normalized to have same means over period shown. Biweight trend (with bandwidth 60 quarters) is estimated on cyclically adjusted data from 1947-2016.

Non-recession stories for slow TFP growth

- Mismeasurement?
  - No evidence mismeasurement has *worsened* (Byrne et al, 2016, Syverson, 2016)
- Regulation/lack of dynamism?
  - Not post-2008 regulation—timing doesn't work. Besides:
    - Energy regulations increased…so did energy TFP growth.
    - Finance-intensive industries perform better than non-finance-intensive ones
  - Panel regressions show no link between industry TFP growth and changes in industry-specific federal regulations (1988-2014)
- Return to normal after exceptional IT-linked decade?
  - Unusual period was late 1990s/early 2000s
  - Every story at time emphasized transformative role of IT

Timing suggests the recession didn't cause the slowdown in TFP growth

- Intuitive story: Innovation is investment, which falls in recessions
  - Recent examples of this (old) story: Reifschneider, Wascher, and Wilcox (2013), Anzoategui et al (2016), others
- Challenge for U.S.: TFP slowed before recession

- In addition, our TFP estimates are already cyclically adjusted – so for the recession to have played a role, there would need to be something unusual about this recesssion
  - Lack of diffusion of inventions (Comin-Gertler)? But why would this recession be different, conditional on demand and/or unemployment rate?
  - Maybe financial factors? Not by 2016.
  - Mismeasurement? We think not (e.g. Byrne et al (2016)

3. A Closer Look at Stability Over the Expansion

Empirical Framework:
A 248-variable Dynamic Factor Model (DFM)

- 248 quarterly macro variables (*X*)
- Framework: Dynamic factor model (*F*, 4 factors in empirical work)

$$X_t = \Lambda F_t + e_t$$
$$F_t = \Phi(L) F_{t-1} + G\eta_t$$

Questions

- The DFM captures to correlations among the many macro variables
- Have these correlations changed?
- If so, what variables have changed, and how?
- Are these changes idiosyncratic or are they indicative that business cycle dynamics have changed in this recovery?
- These questions (and the analysis) focus on the post-2009 recovery (stages II - IV in Burns-Mitchell (1946) terminology) – the issue isn't whether there were differences during the recession

Selected References

Stability in DFMs: methods

Breitung and Eickmeier (2011)
Han and Inoue (2015)
Stock and Watson (2009, 2012)
Survey: Stock and Watson, *Handbook of Macroeconomics* V.2A (2016)

Empirical DFM applications to the recession and recovery

Cheng, Liao, and Schorfheide, *Review of Economic Studies* (2016)
Fernald, Hall, Stock, and Watson, *BPEA* (2017)
Stock and Watson, *BPEA* (2012)

Hazama (2018) (Japan)

Analytical Methods

$$X_t = \Lambda F_t + e_t$$
$$F_t = \Phi(L) F_{t-1} + G\eta_t$$

1. Break tests
   - Estimate factors 1984q1-2018q1 (principal components)
   - Test for break in factor loadings: 2010q1-2018q1 same as 1984q1-2007q3?

2. RMSE measure of fit of common component
   - RMSE ratio = ratio of residual RMSE of common component, Phase II-IV of previous two expansions (1991-2001, 2002-2007) to residual RMSE of current expansion, using factor loadings estimated 1984-2007
   - >1 indicates deterioration in fit

3. Plots of selected series, common component fit, and common component fit post-2009

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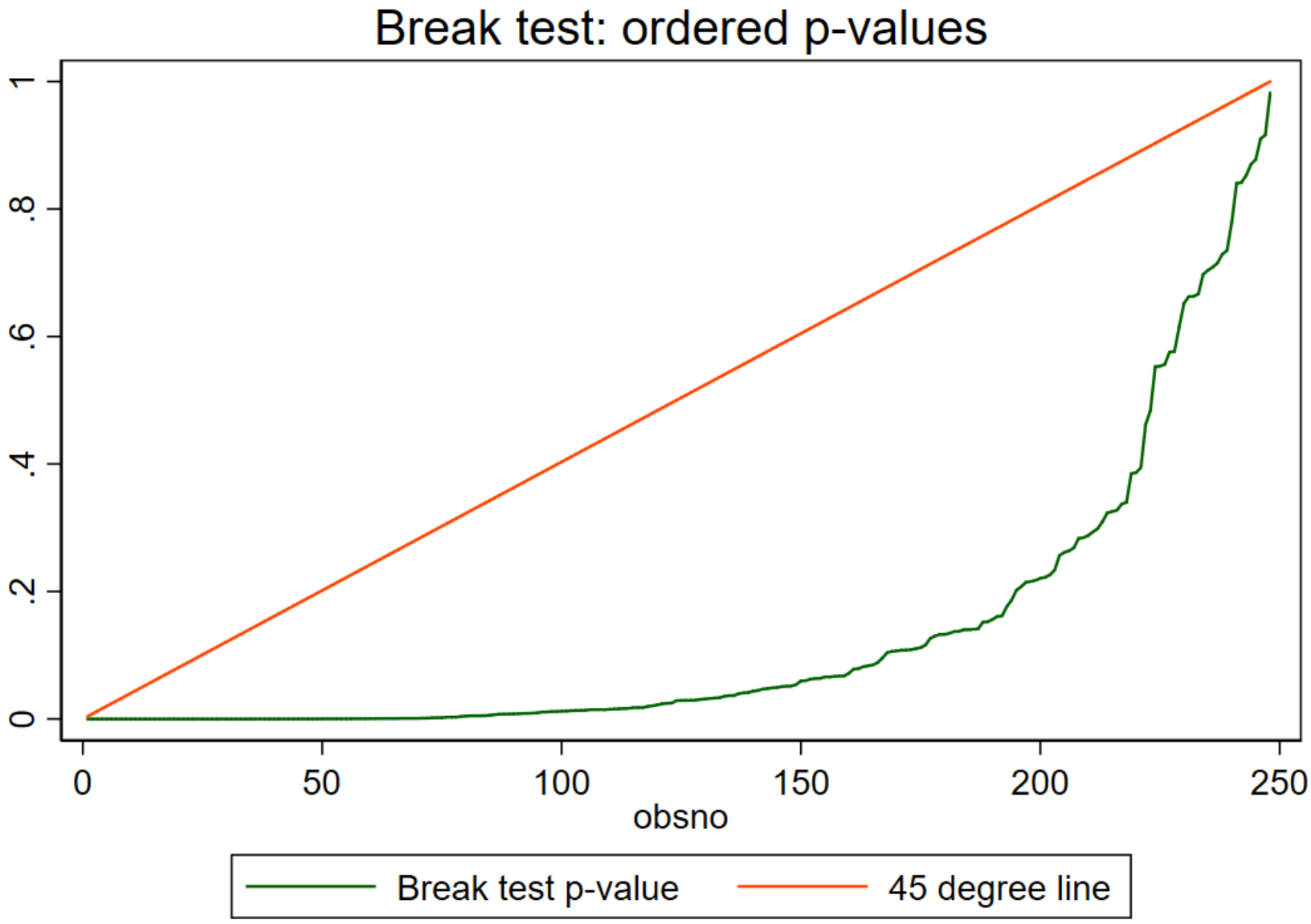
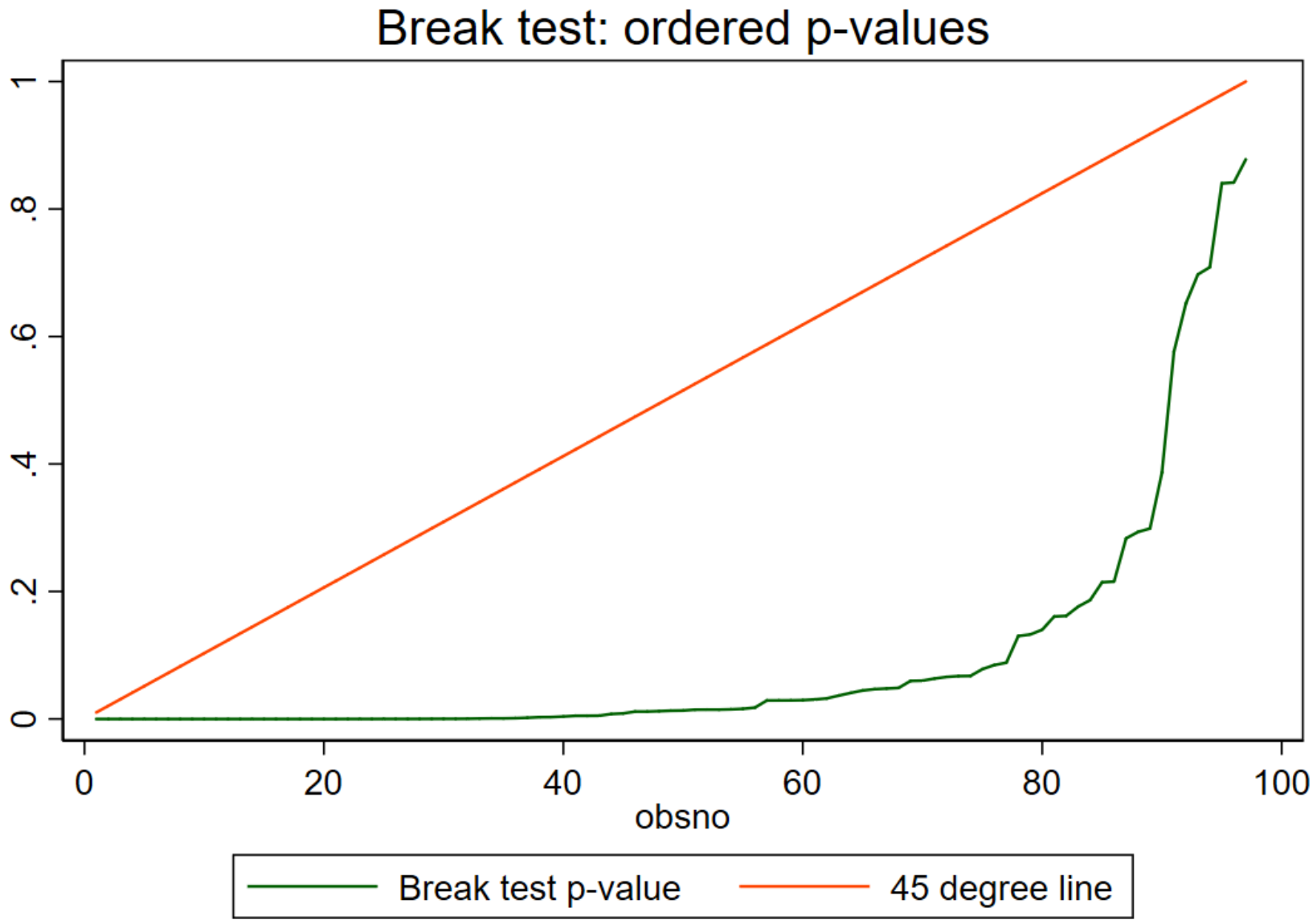
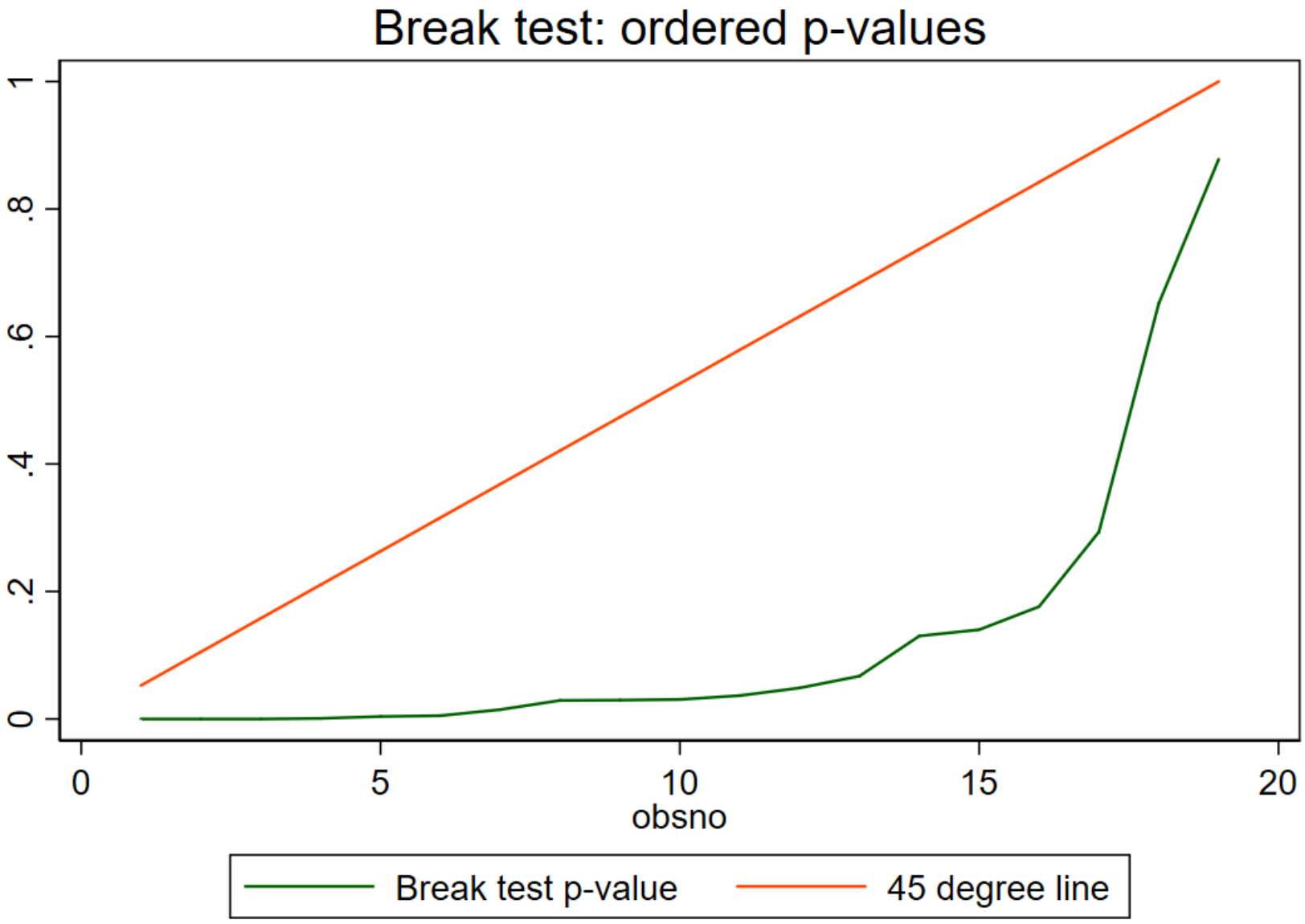
Break Tests: summary, all variables (*n* = 248)



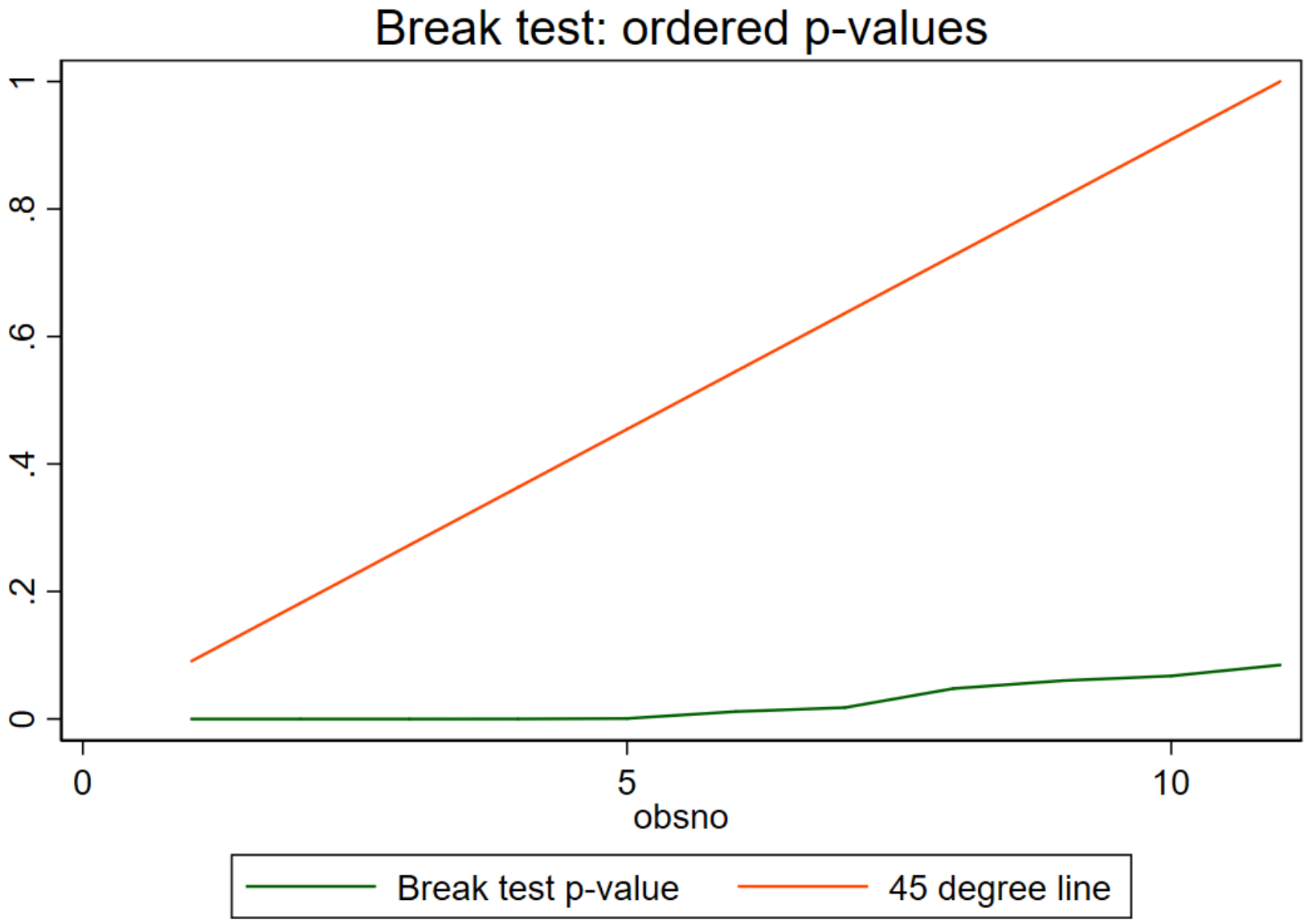
Break Tests: Real activity variables (*n* = 98)



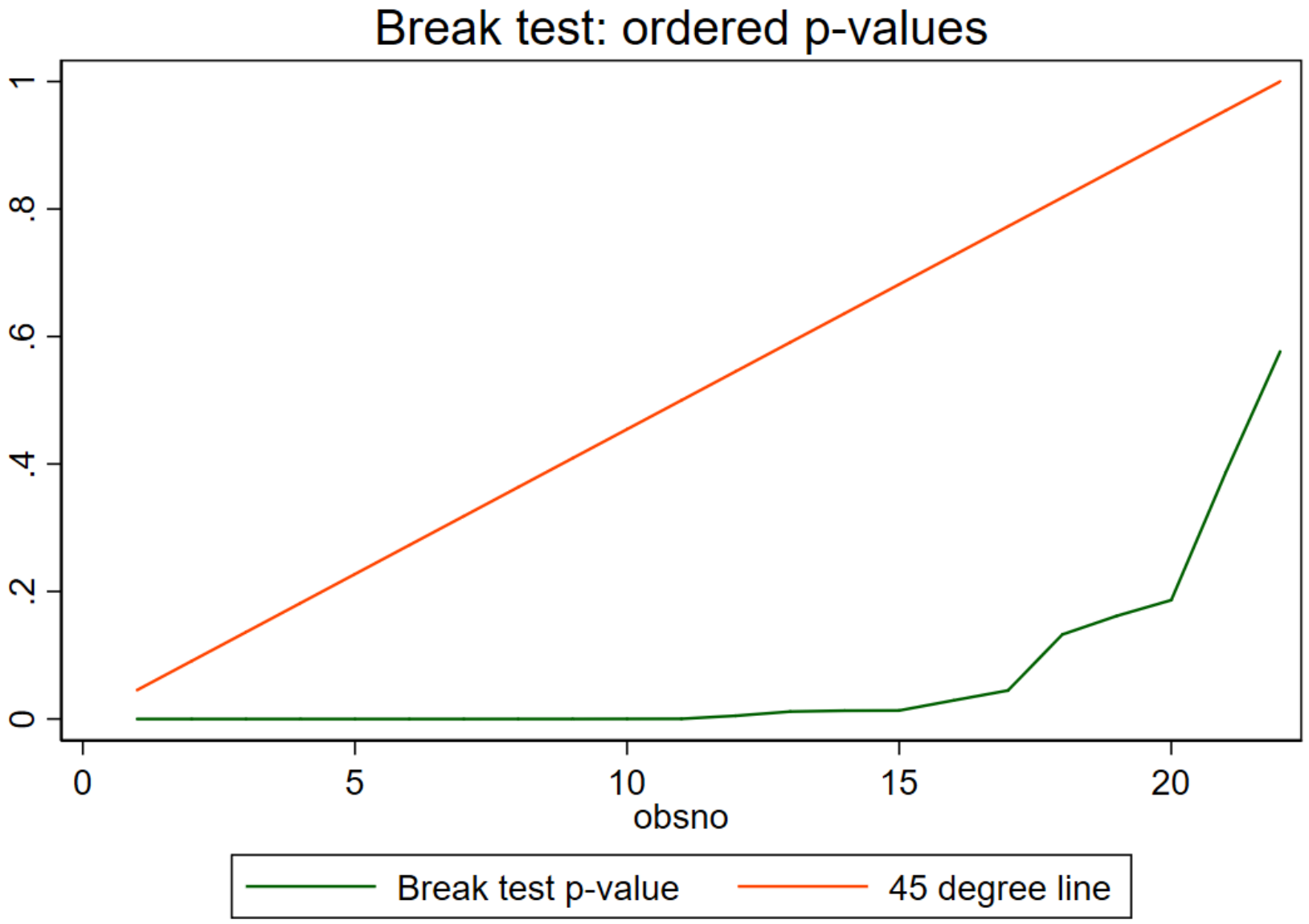
Break Tests: NIPA variables (n = 20)



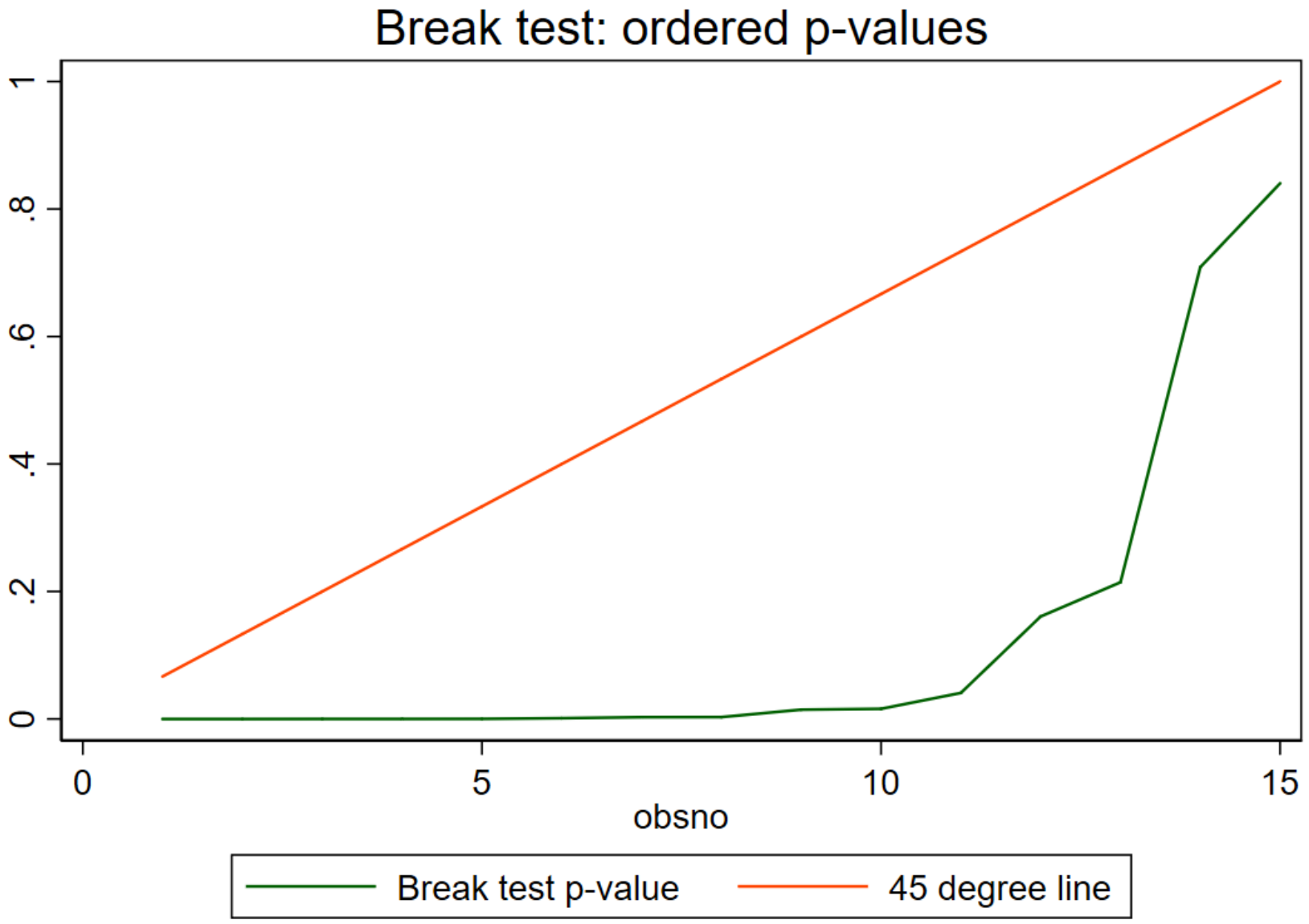
Break Tests: Industrial production (n = 11)



Break Tests: Employment variables (*n* = 22)



Break Tests: Unemployment rates & components (*n* = 15)



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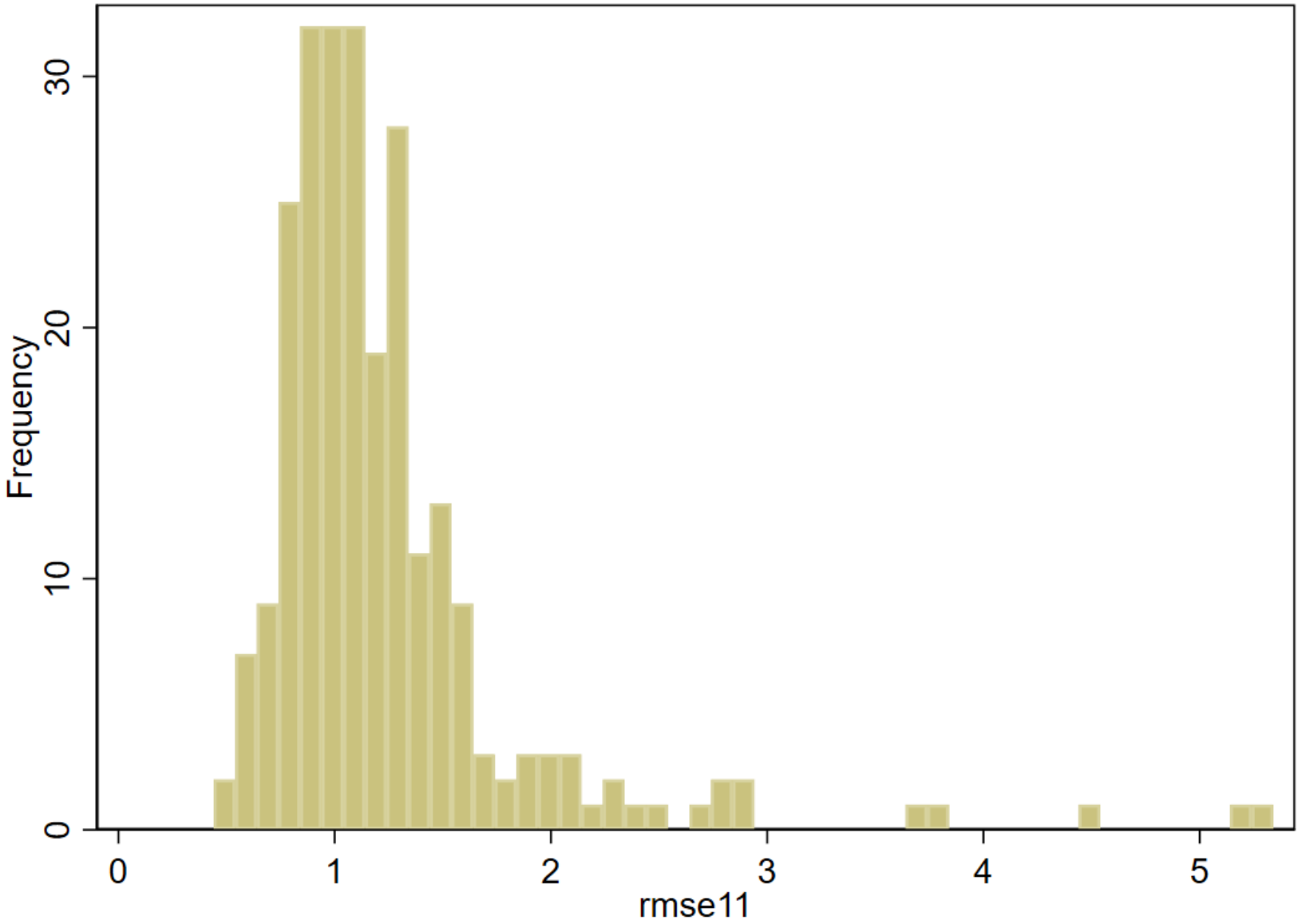
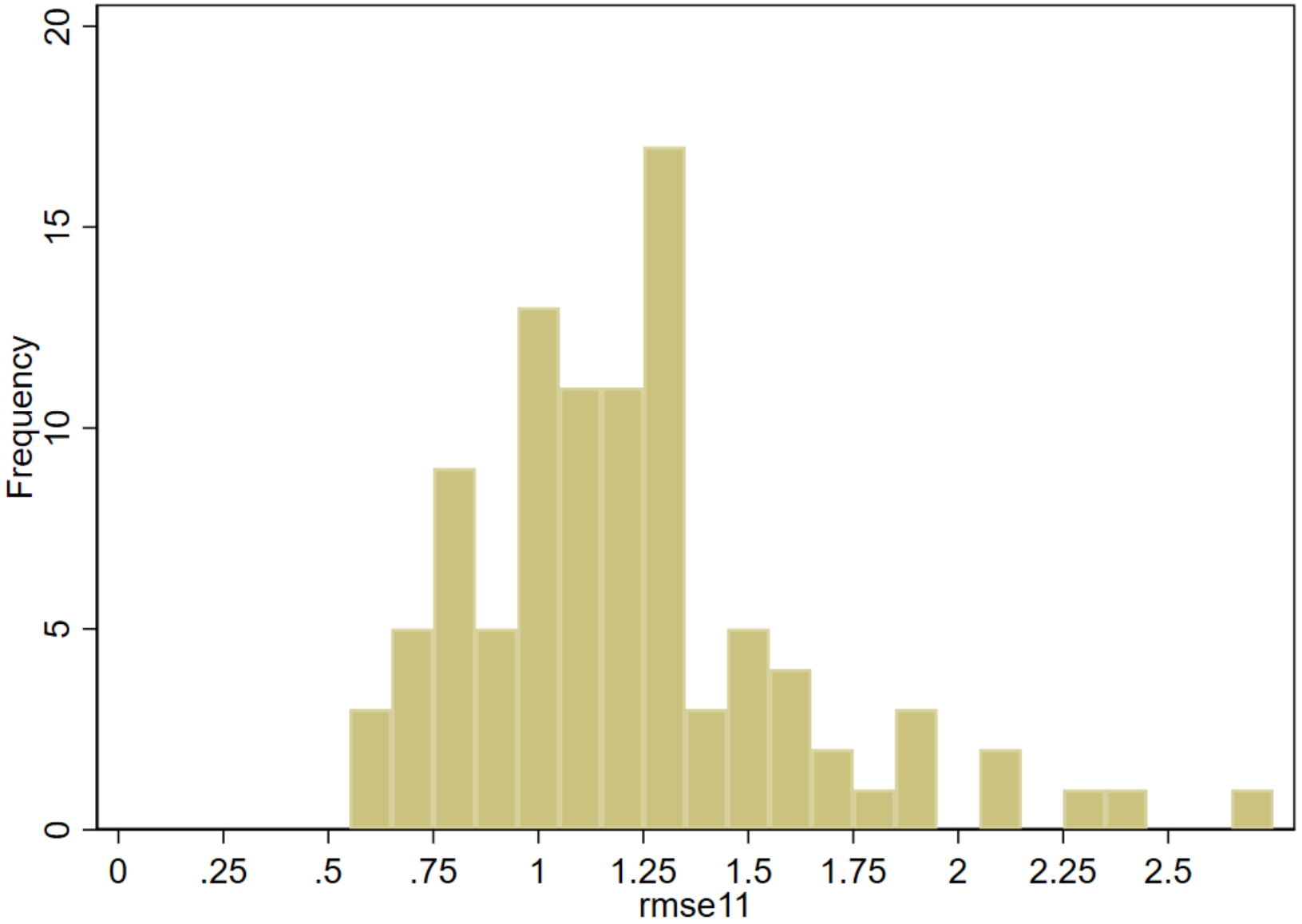
3. Plots of selected series, common component fit, and common component fit post-2009

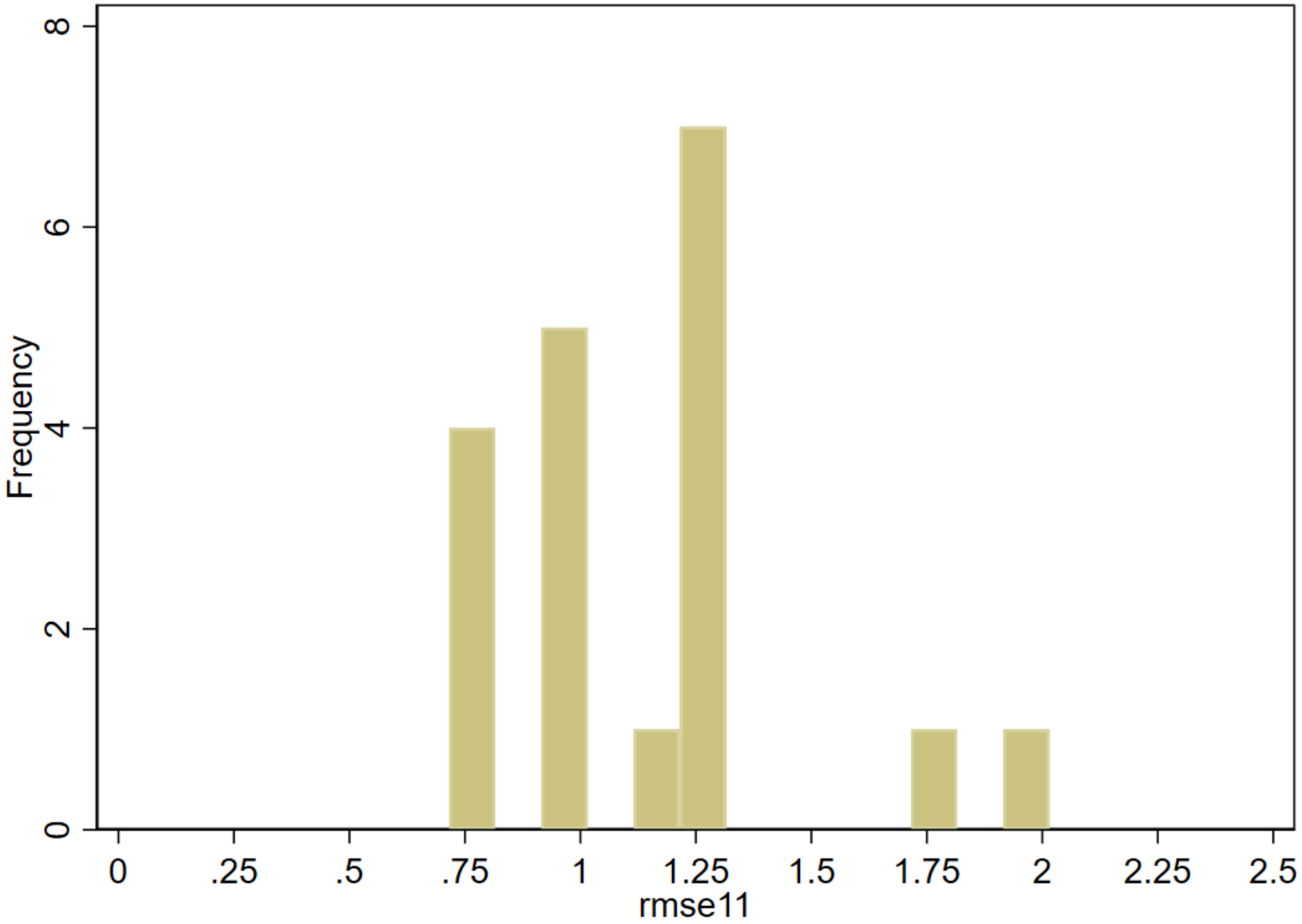
Common component RMSE ratio, post-2009 to previous two recoveries: All variables (*n* = 248)



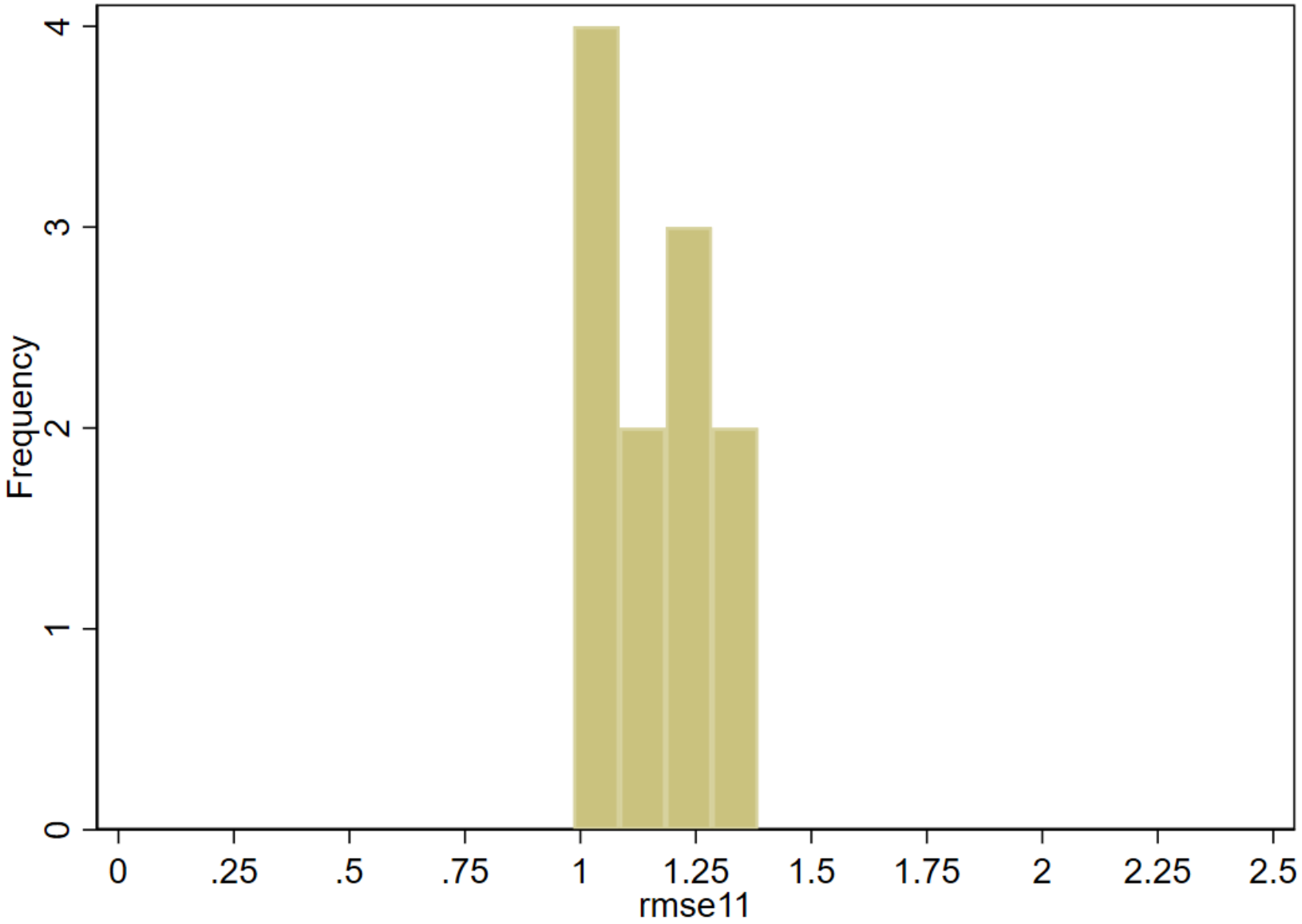
Common component RMSE ratio, post-2009 to previous two recoveries: Real activity variables (*n* = 98)



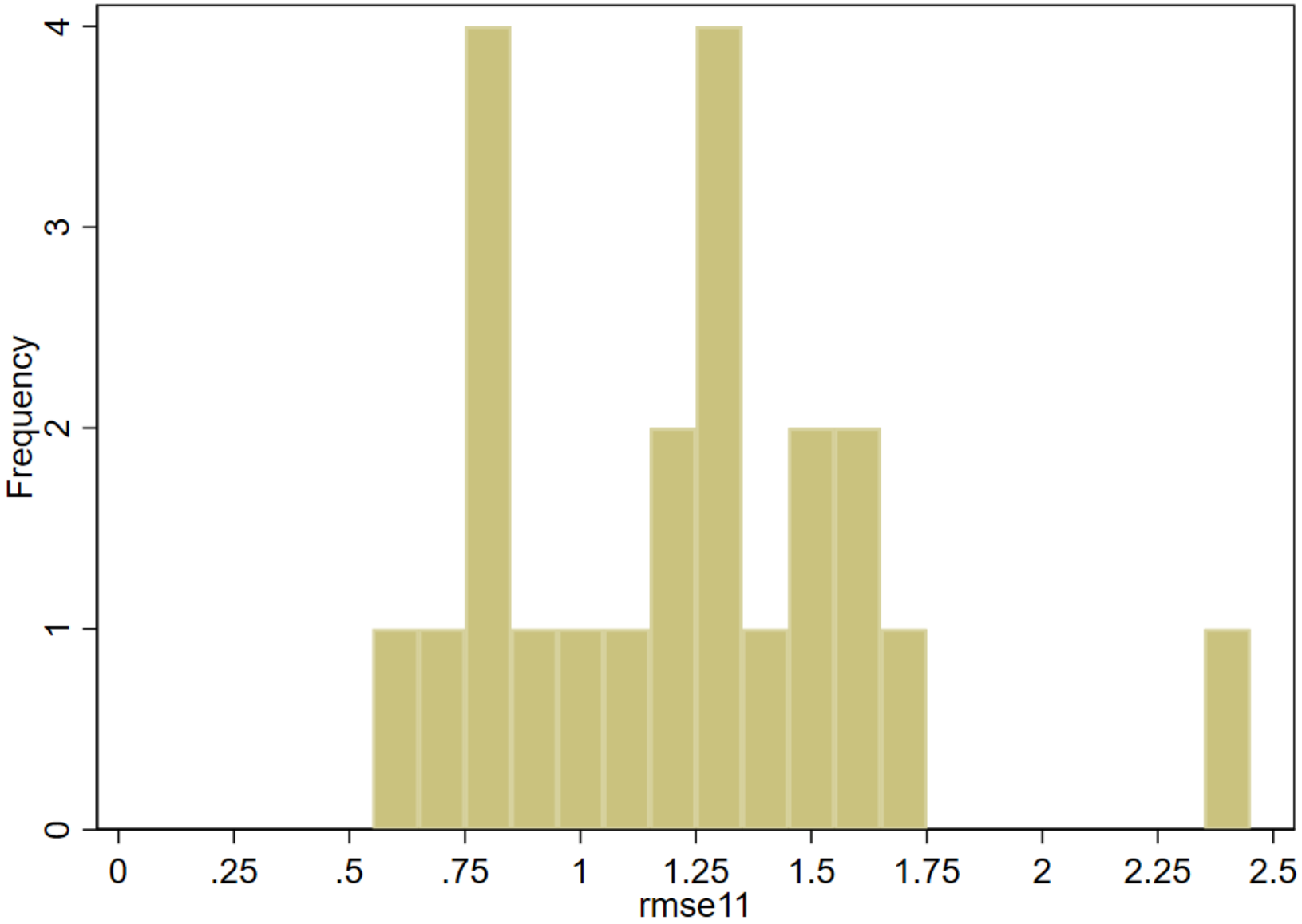
Common component RMSE ratio, post-2009 to previous two recoveries: NIPA variables (*n* = 19)



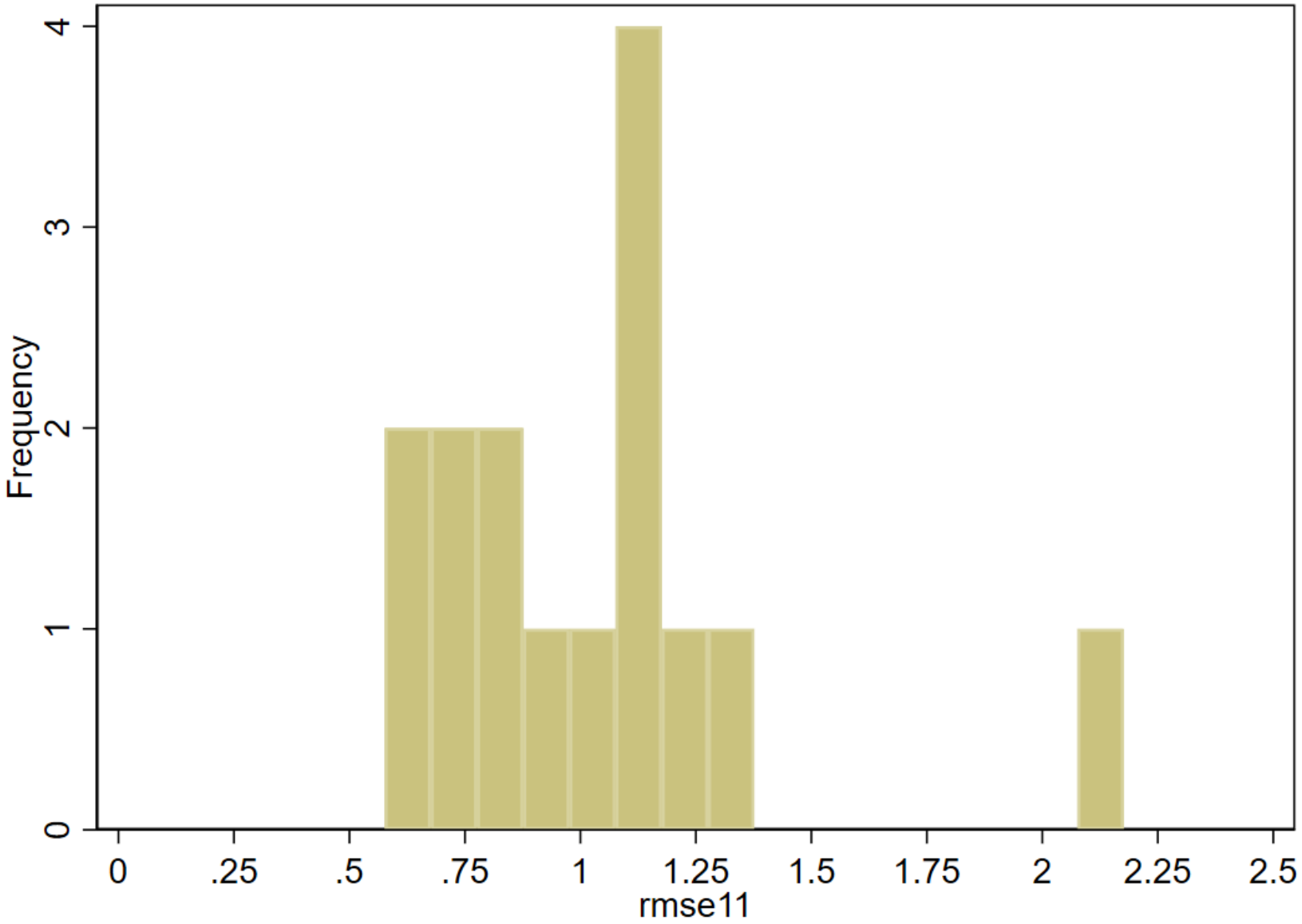
Common component RMSE ratio, post-2009 to previous two recoveries: IP variables (n = 11)



Common component RMSE ratio, post-2009 to previous two recoveries: Employment variables (*n* = 22)



Common component RMSE ratio, post-2009 to previous two recoveries: Unemployment rates & components (*n* = 15)



Analytical Methods

$$X_t = \Lambda F_t + e_t$$
$$F_t = \Phi(L) F_{t-1} + G\eta_t$$

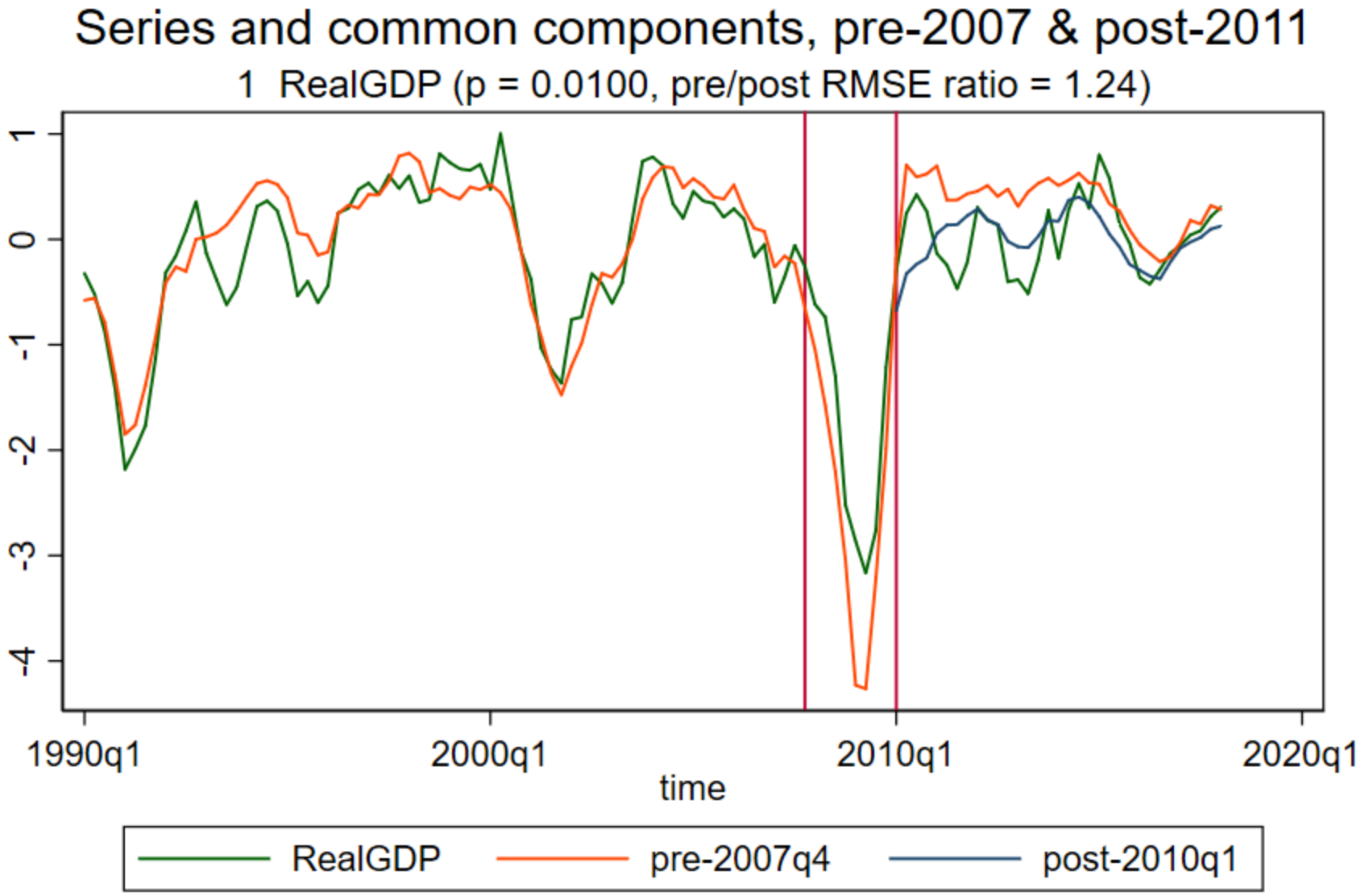
1. Break tests
   - Estimate factors 1984q1-2018q1 (principal components)
   - Test for break in factor loadings: 2010q1-2018q1 same as 1984q1-2007q3?

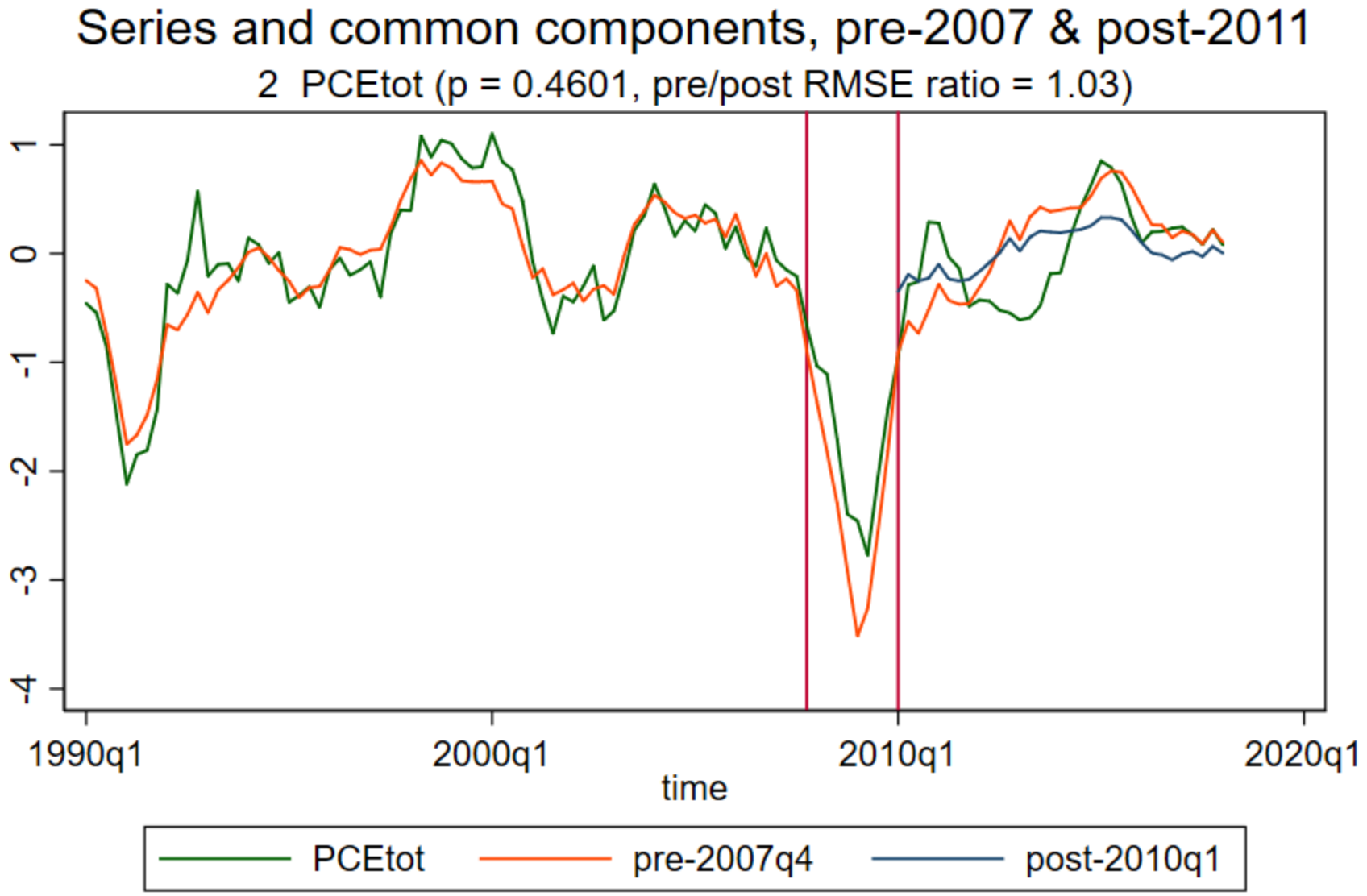
2. RMSE measure of fit of common component
   - RMSE ratio = ratio of residual RMSE of common component, Phase II-IV of previous two expansions (1991-2001, 2002-2007) to residual RMSE of current expansion, using factor loadings estimated 1984-2007
   - >1 indicates deterioration in fit

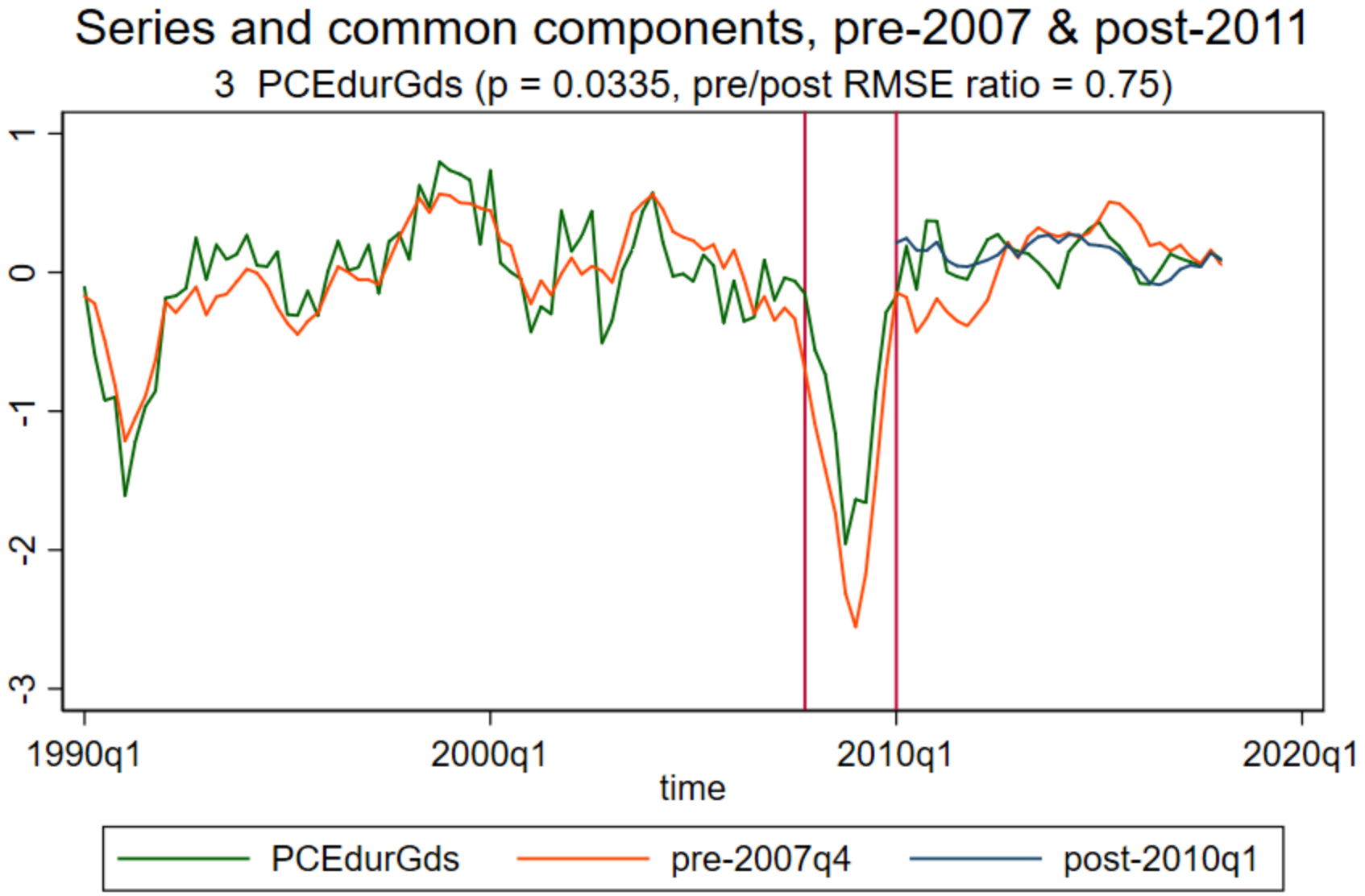
3. Plots of selected series, common component fit, and common component fit post-2009

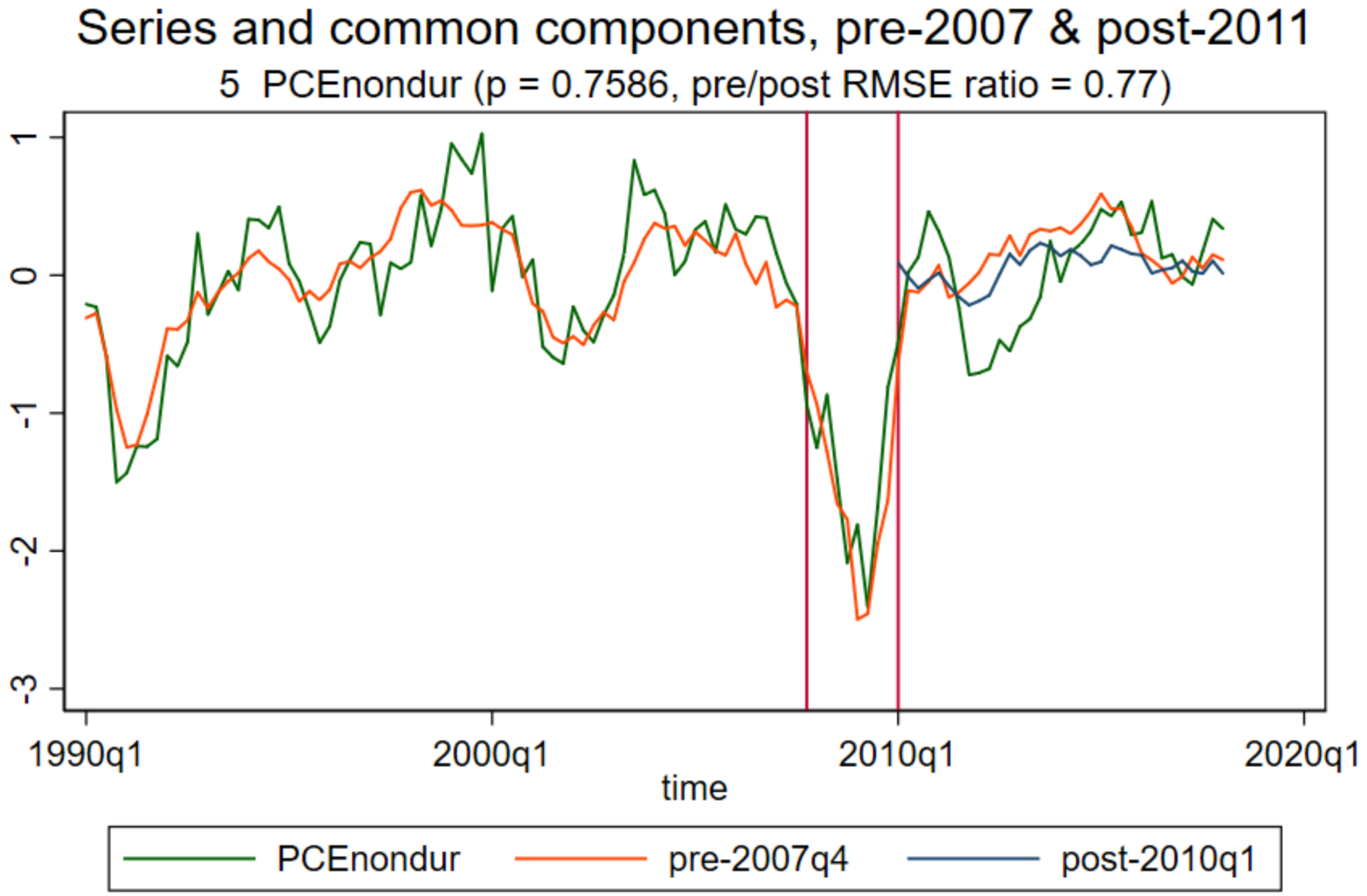
Stability of common components

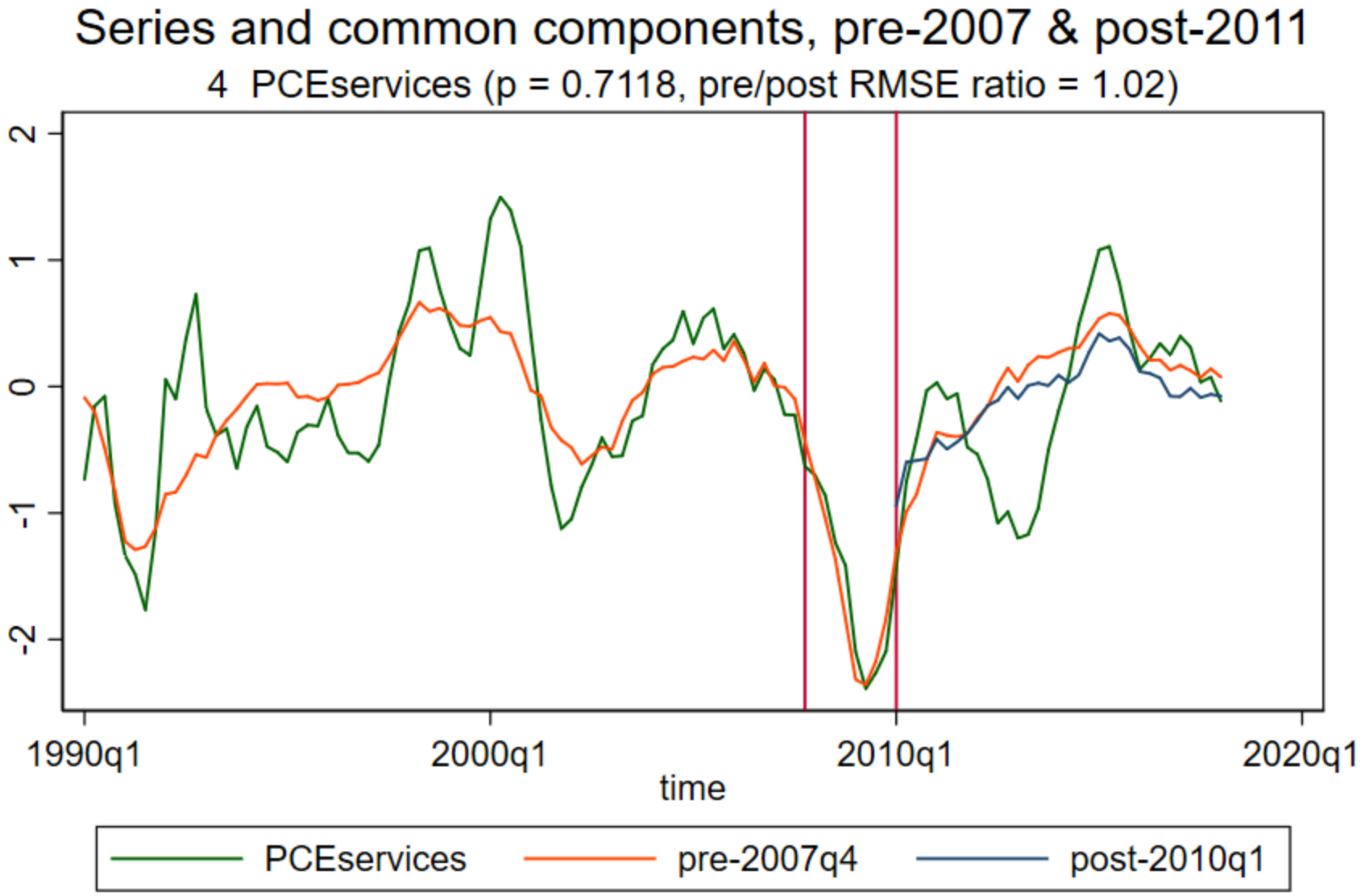
NIPA variables

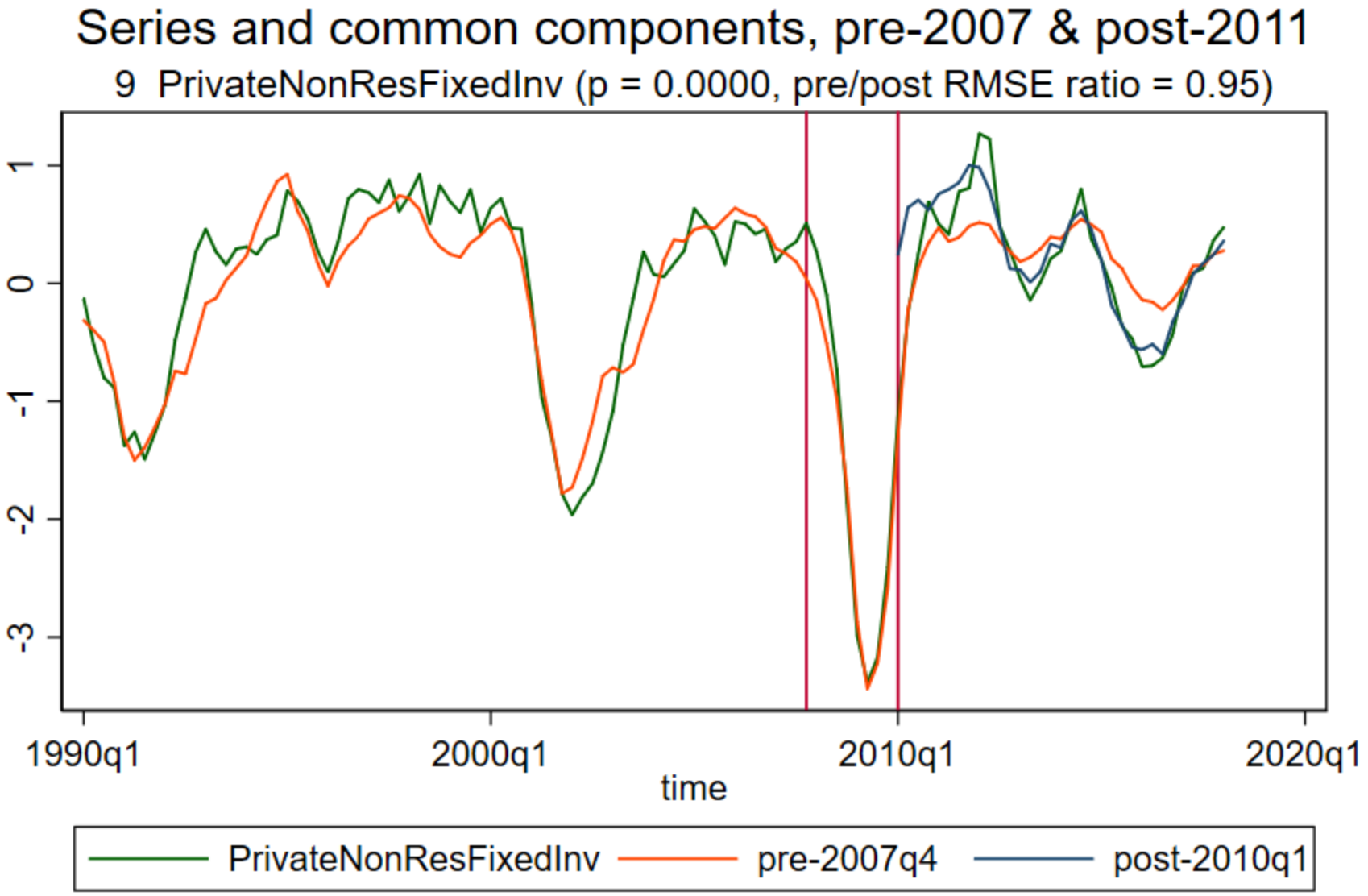

Series and common components, pre-2007 & post-2011
1 RealGDP (p = 0.0100, pre/post RMSE ratio = 1.24)
1
0
-1
-2
-3
-4
1990q1
2000q1
2010q1
2020q1
time
RealGDP
pre-2007q4
post-2010q1
4-quarter moving average.

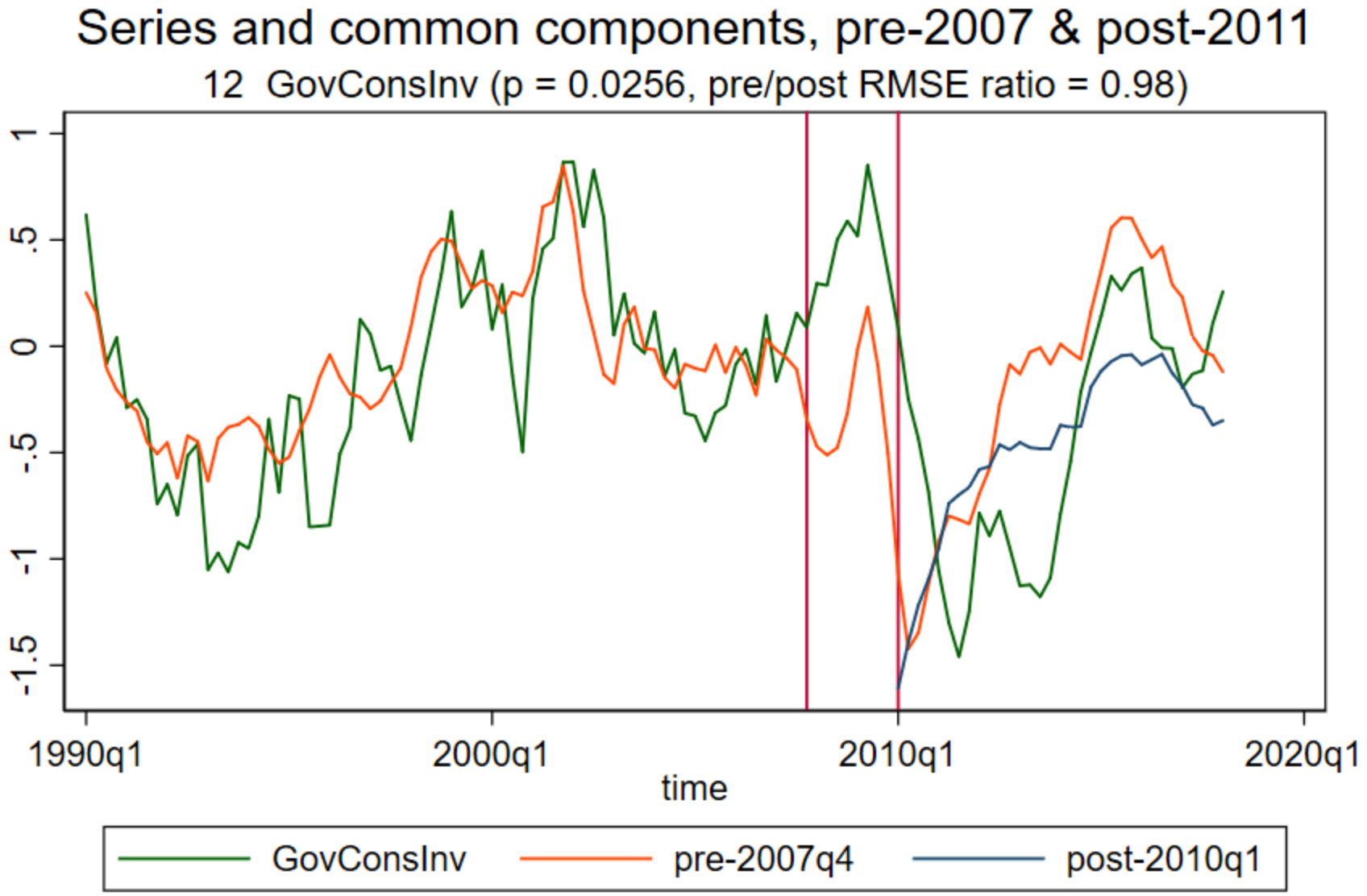

Series and common components, pre-2007 & post-2011
2 PCEtot (p = 0.4601, pre/post RMSE ratio = 1.03)
1
0
-1
-2
-3
-4
1990q1
2000q1
2010q1
2020q1
time
PCEtot
pre-2007q4
post-2010q1
4-quarter moving average.


Series and common components, pre-2007 & post-2011
3 PCEdurGds (p = 0.0335, pre/post RMSE ratio = 0.75)
1
0
-1
-2
-3
1990q1
2000q1
2010q1
2020q1
time
PCEdurGds
pre-2007q4
post-2010q1
4-quarter moving average.


Series and common components, pre-2007 & post-2011
5 PCEnondur (p = 0.7586, pre/post RMSE ratio = 0.77)
1
0
-1
-2
-3
1990q1
2000q1
2010q1
2020q1
time
PCEnondur
pre-2007q4
post-2010q1
4-quarter moving average.

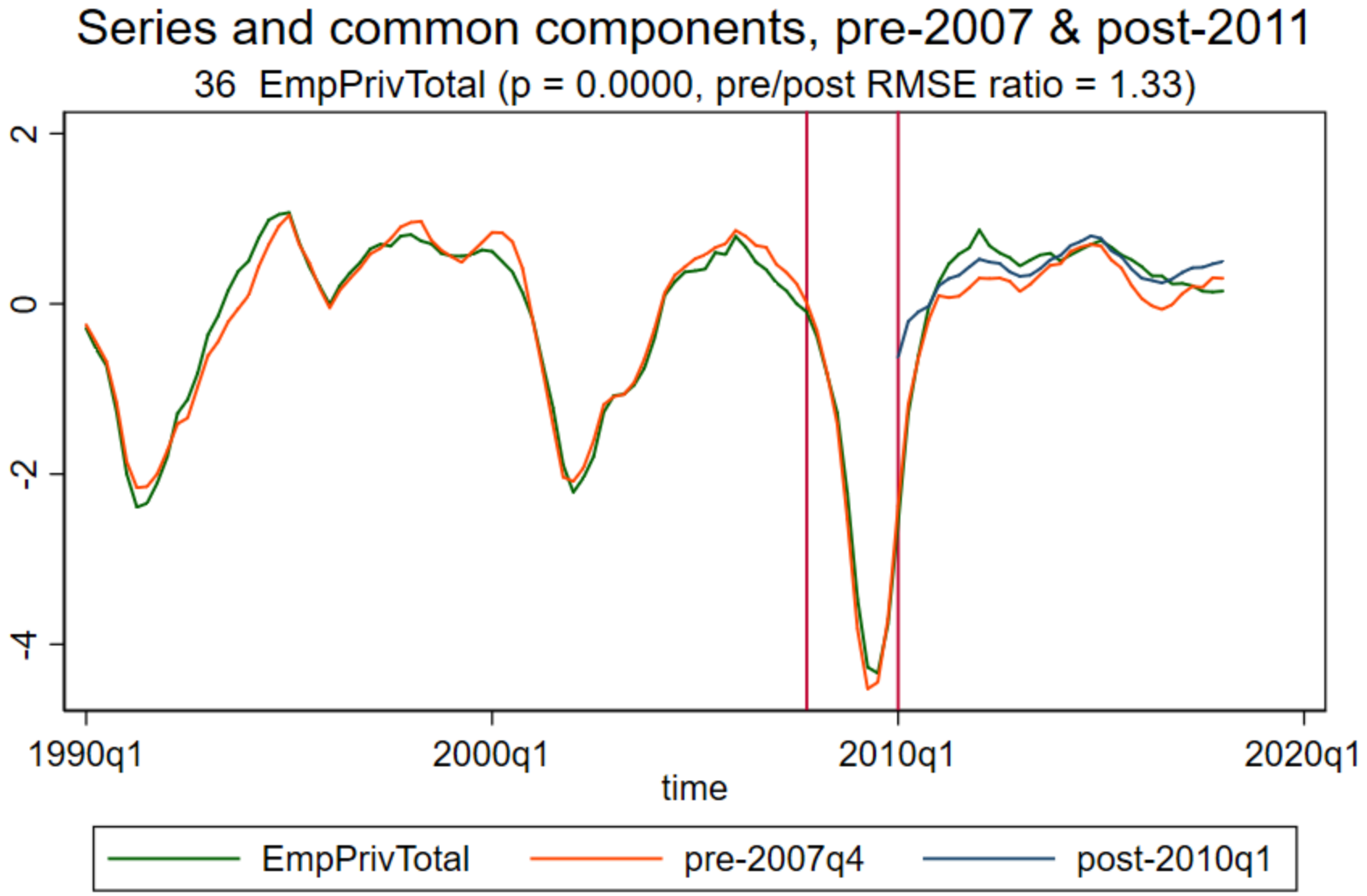

Series and common components, pre-2007 & post-2011
4 PCEservices (p = 0.7118, pre/post RMSE ratio = 1.02)
2
1
0
-1
-2
1990q1
2000q1
2010q1
2020q1
time
PCEservices
pre-2007q4
post-2010q1
4-quarter moving average.

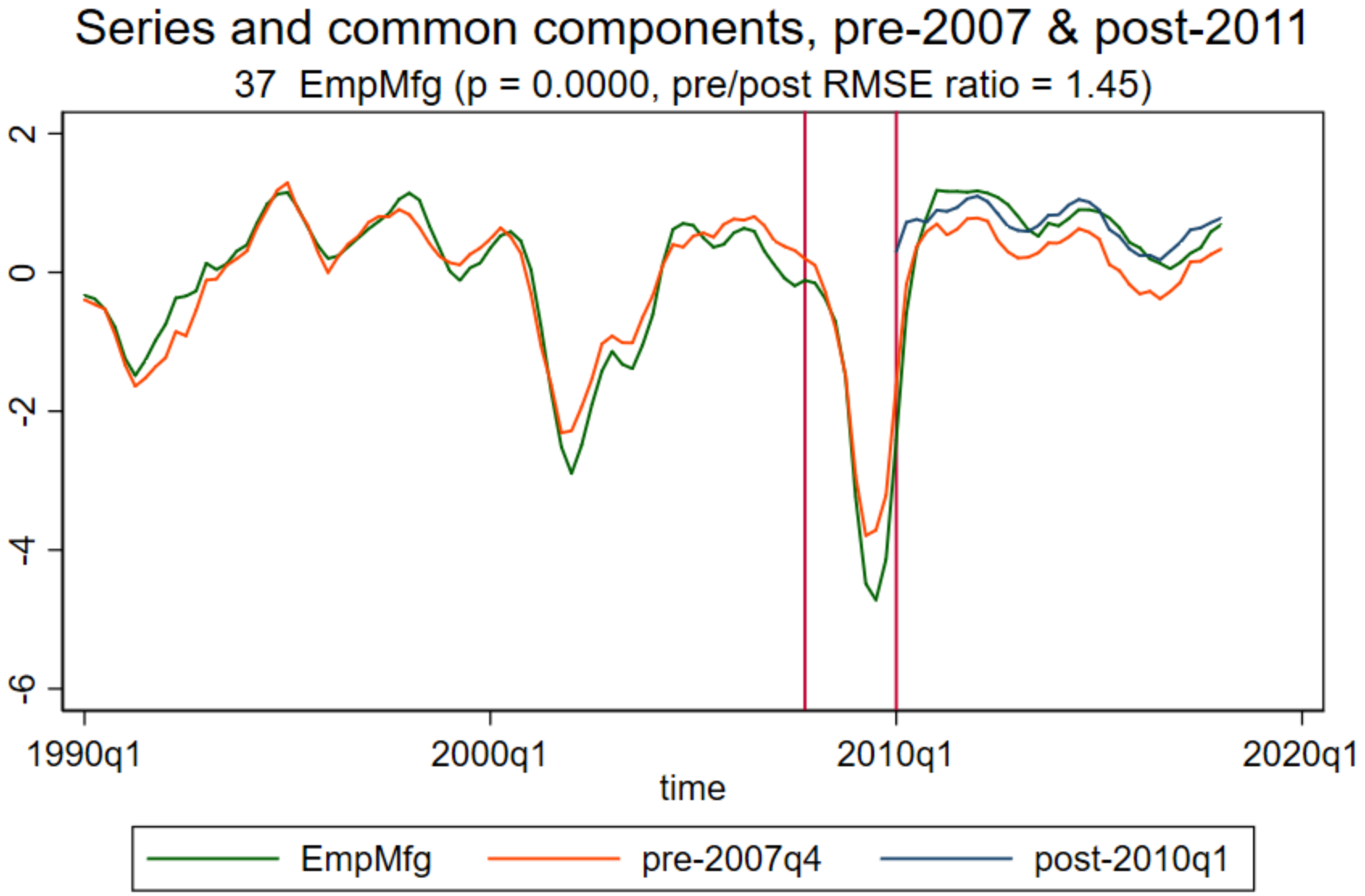

Series and common components, pre-2007 & post-2011
9 PrivateNonResFixedInv (p = 0.0000, pre/post RMSE ratio = 0.95)
1
0
-1
-2
-3
1990q1
2000q1
2010q1
2020q1
time
PrivateNonResFixedInv
pre-2007q4
post-2010q1
4-quarter moving average.

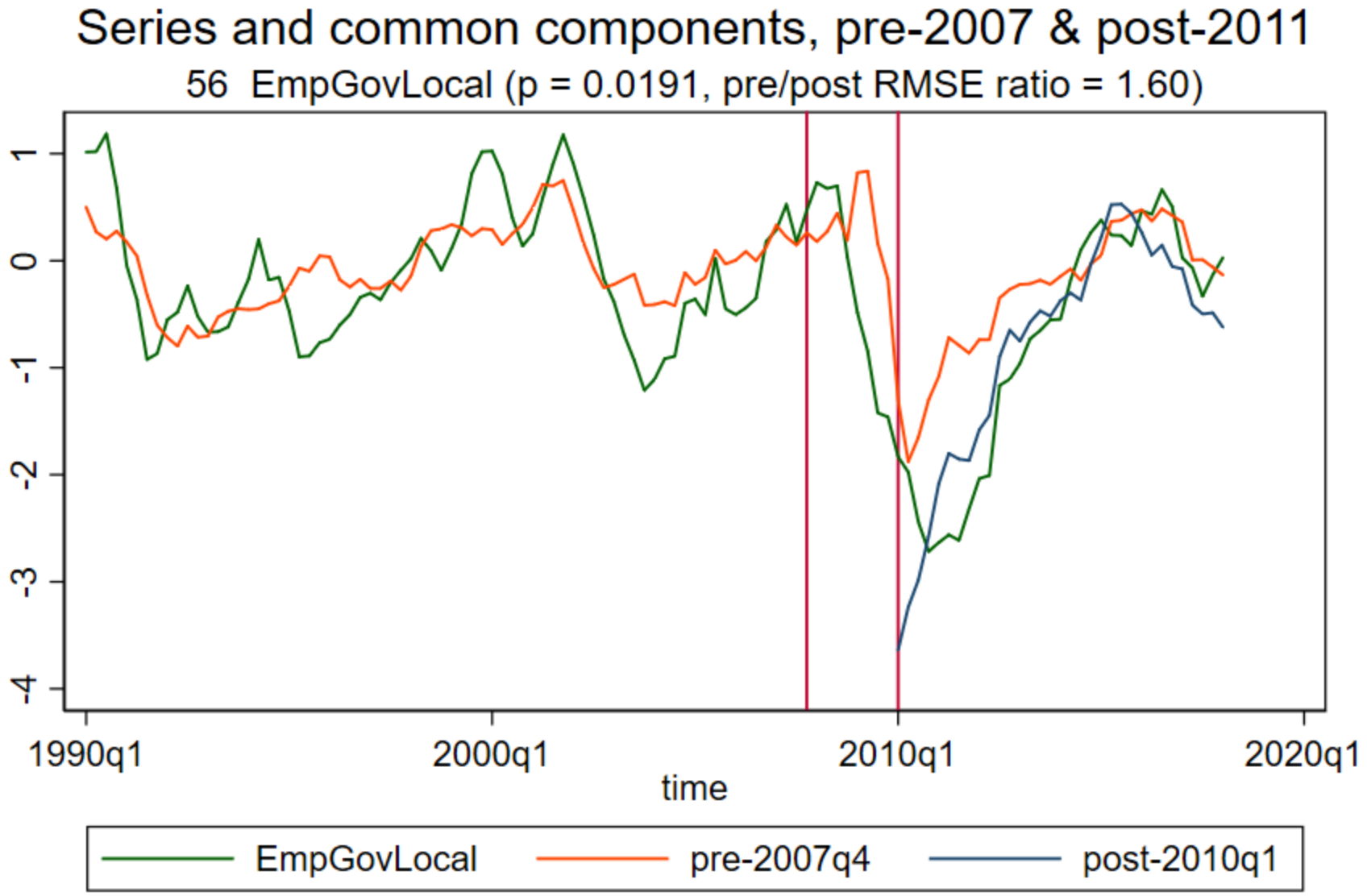

Series and common components, pre-2007 & post-2011
12 GovConsInv (p = 0.0256, pre/post RMSE ratio = 0.98)
1
.5
0
-.5
-1
-1.5
1990q1
2000q1
2010q1
2020q1
time
GovConsInv
pre-2007q4
post-2010q1
4-quarter moving average.

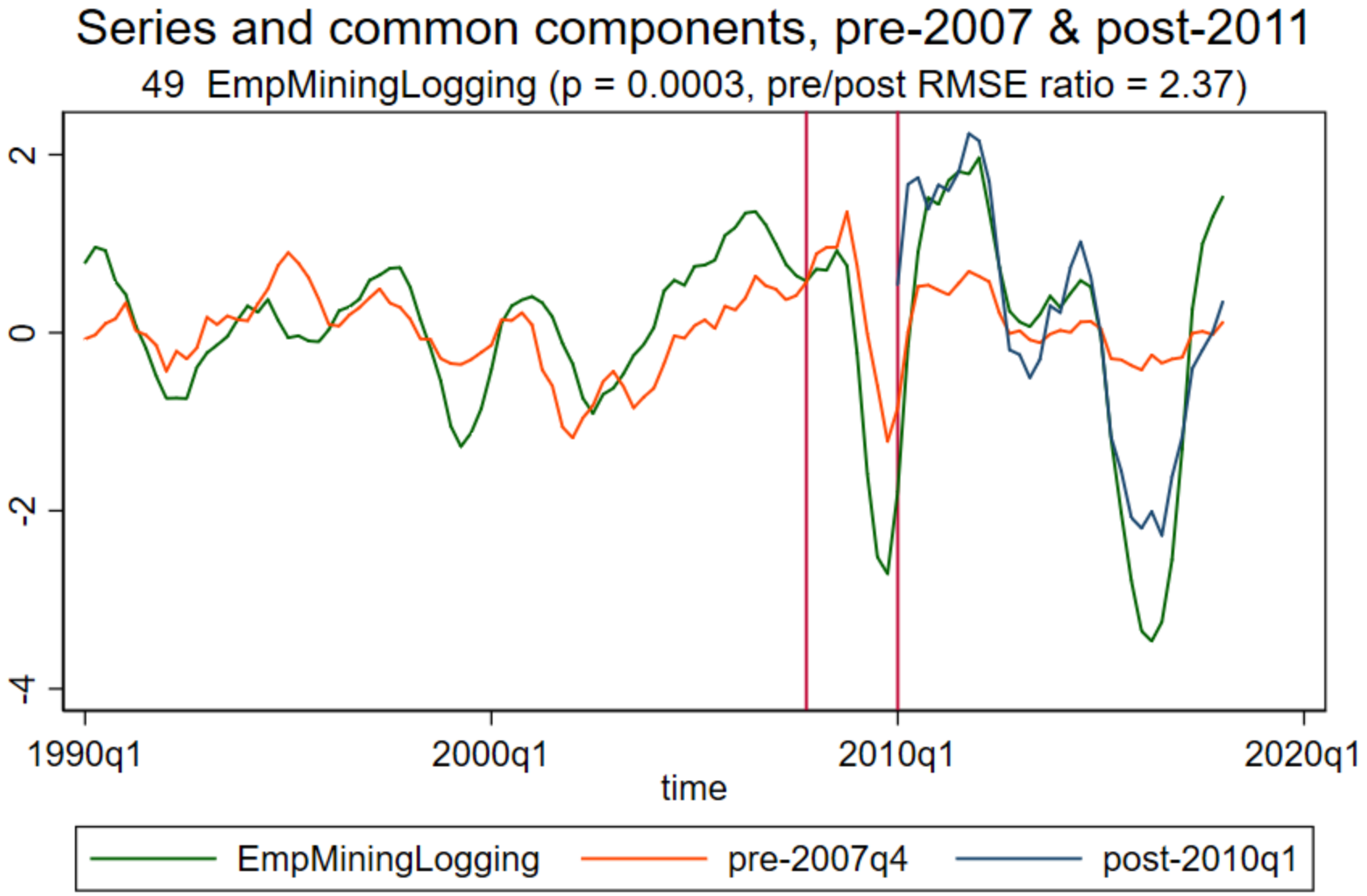
Stability of common components

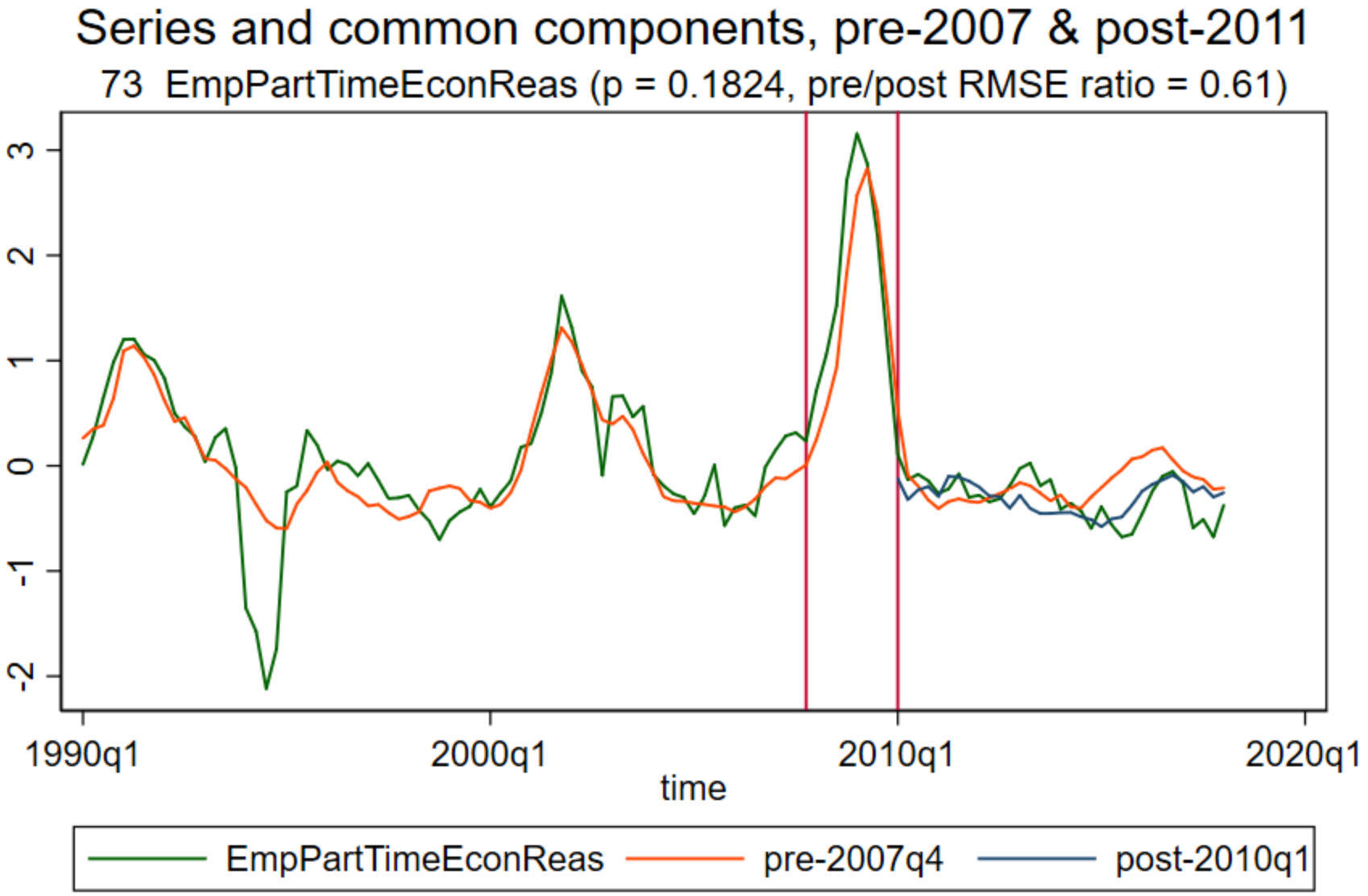
Employment

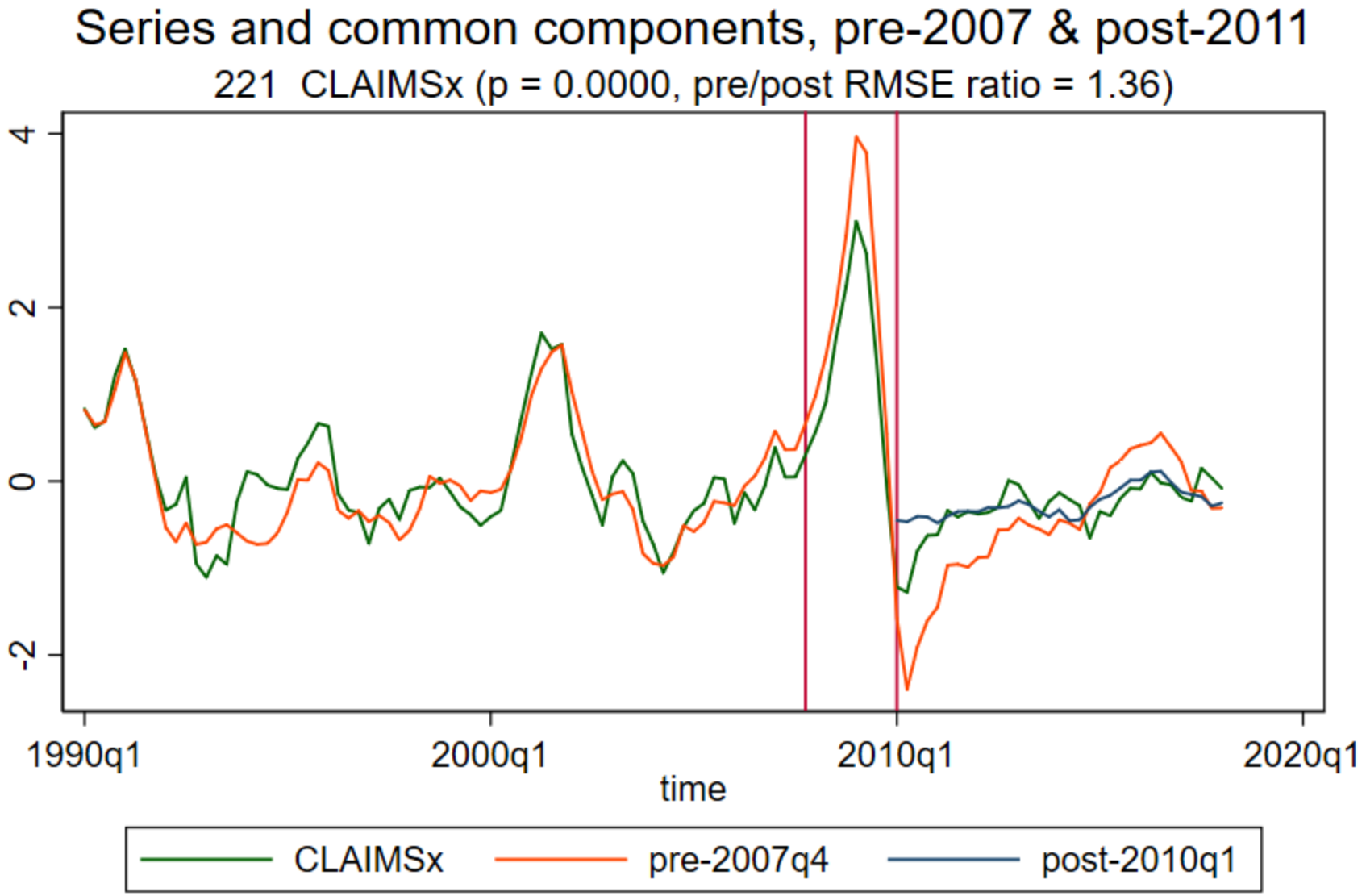

Series and common components, pre-2007 & post-2011
36 EmpPrivTotal (p = 0.0000, pre/post RMSE ratio = 1.33)
2
0
-2
-4
1990q1
2000q1
2010q1
2020q1
time
EmpPrivTotal
pre-2007q4
post-2010q1
4-quarter moving average.


Series and common components, pre-2007 & post-2011
37 EmpMfg (p = 0.0000, pre/post RMSE ratio = 1.45)
2
0
-2
-4
-6
1990q1
2000q1
2010q1
2020q1
time
EmpMfg
pre-2007q4
post-2010q1
4-quarter moving average.


Series and common components, pre-2007 & post-2011
56 EmpGovLocal (p = 0.0191, pre/post RMSE ratio = 1.60)
1
0
-1
-2
-3
-4
1990q1
2000q1
2010q1
2020q1
time
EmpGovLocal
pre-2007q4
post-2010q1
4-quarter moving average.

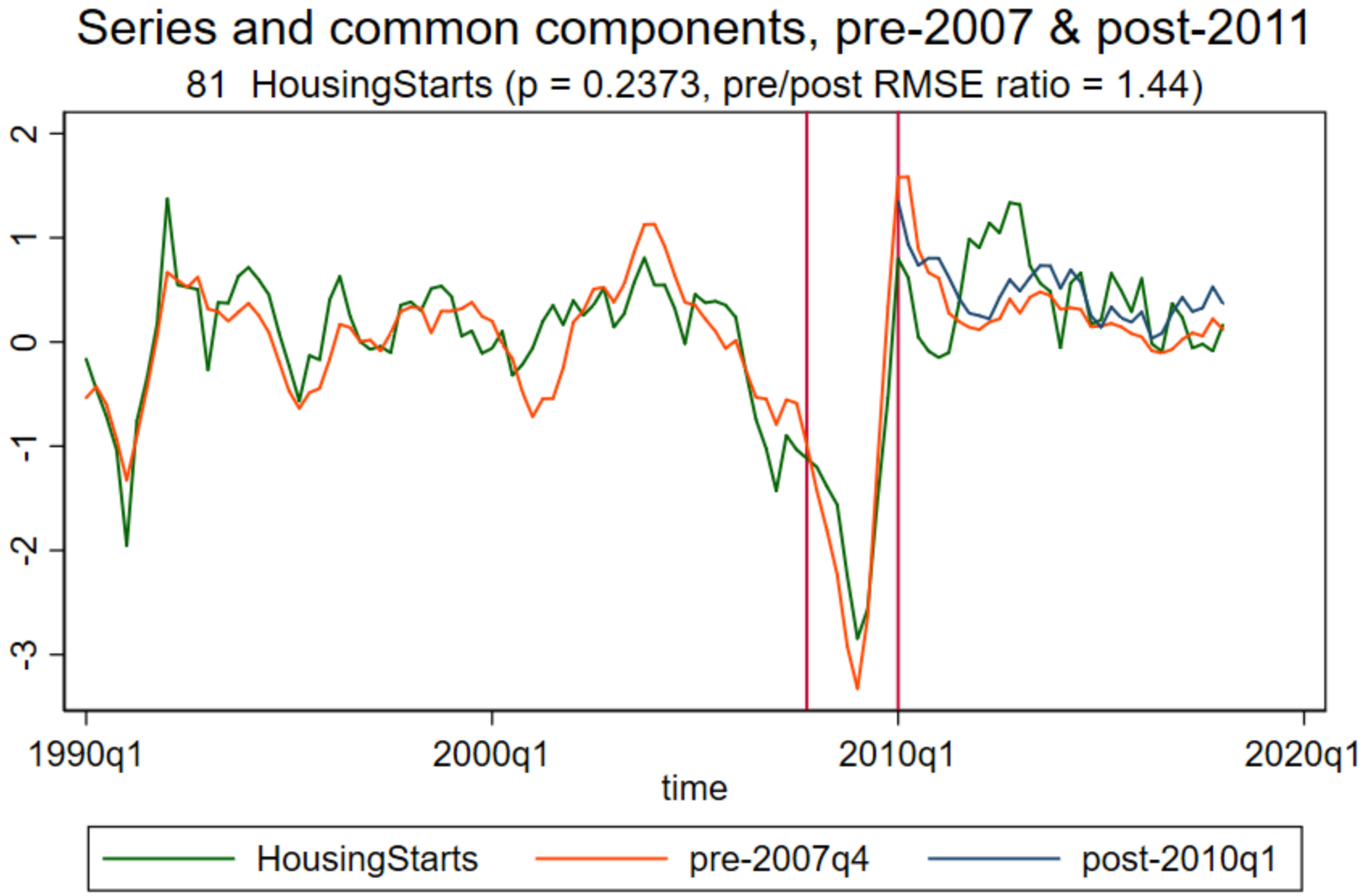

Series and common components, pre-2007 & post-2011
49 EmpMiningLogging (p = 0.0003, pre/post RMSE ratio = 2.37)
2
0
-2
-4
1990q1
2000q1
2010q1
2020q1
time
EmpMiningLogging
pre-2007q4
post-2010q1
4-quarter moving average.

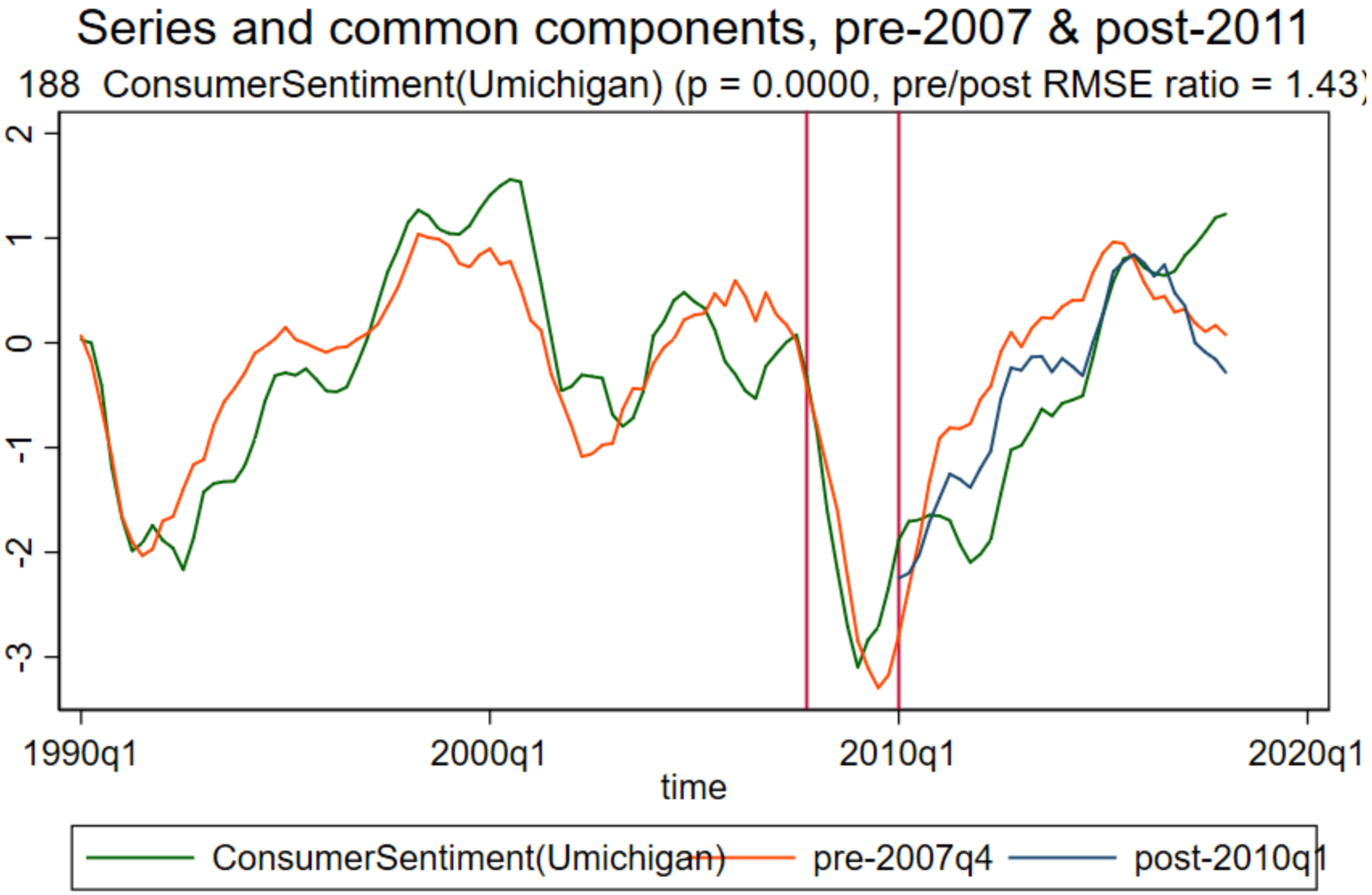

Series and common components, pre-2007 & post-2011
73 EmpPartTimeEconReas (p = 0.1824, pre/post RMSE ratio = 0.61)
3
2
1
0
-1
-2
1990q1
2000q1
2010q1
2020q1
time
EmpPartTimeEconReas
pre-2007q4
post-2010q1
4-quarter moving average.


Series and common components, pre-2007 & post-2011
221 CLAIMSx (p = 0.0000, pre/post RMSE ratio = 1.36)
4
2
0
-2
1990q1
2000q1
2010q1
2020q1
time
CLAIMSx
pre-2007q4
post-2010q1
4-quarter moving average.

Stability of common components

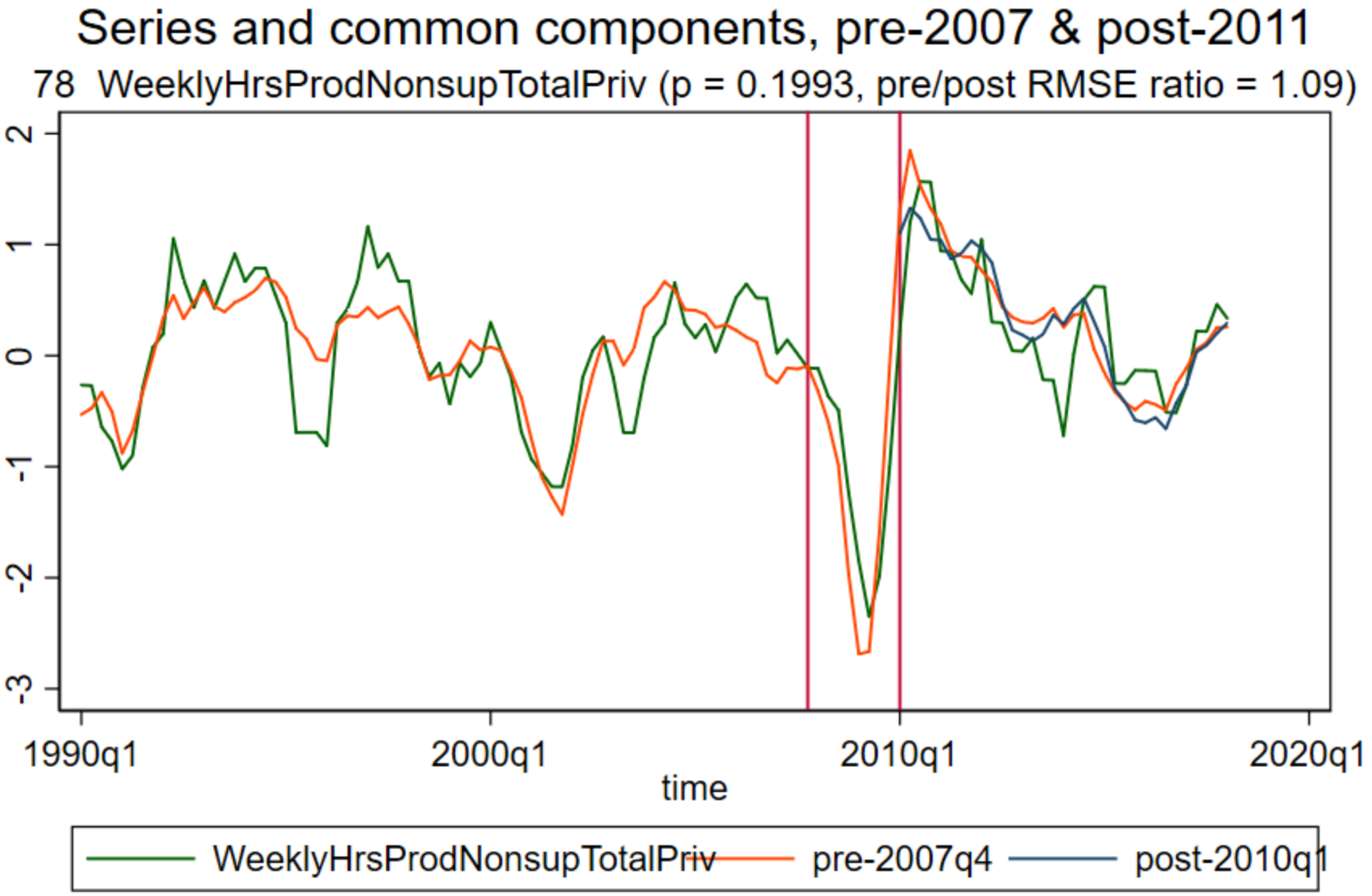
Housing and Consumer Sentiment

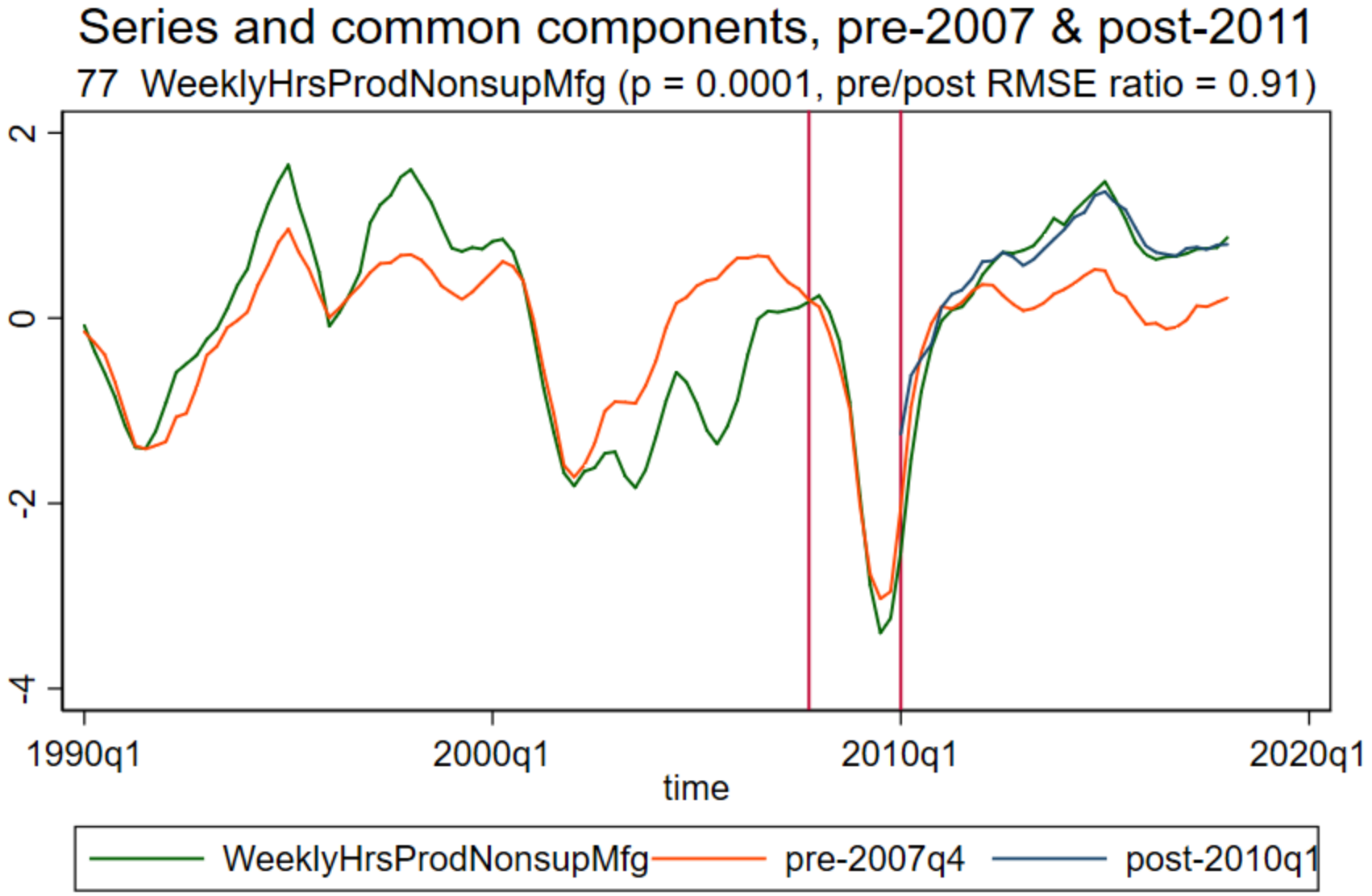

Series and common components, pre-2007 & post-2011
81 HousingStarts (p = 0.2373, pre/post RMSE ratio = 1.44)
2
1
0
-1
-2
-3
1990q1
2000q1
2010q1
2020q1
time
HousingStarts
pre-2007q4
post-2010q1
4-quarter moving average.

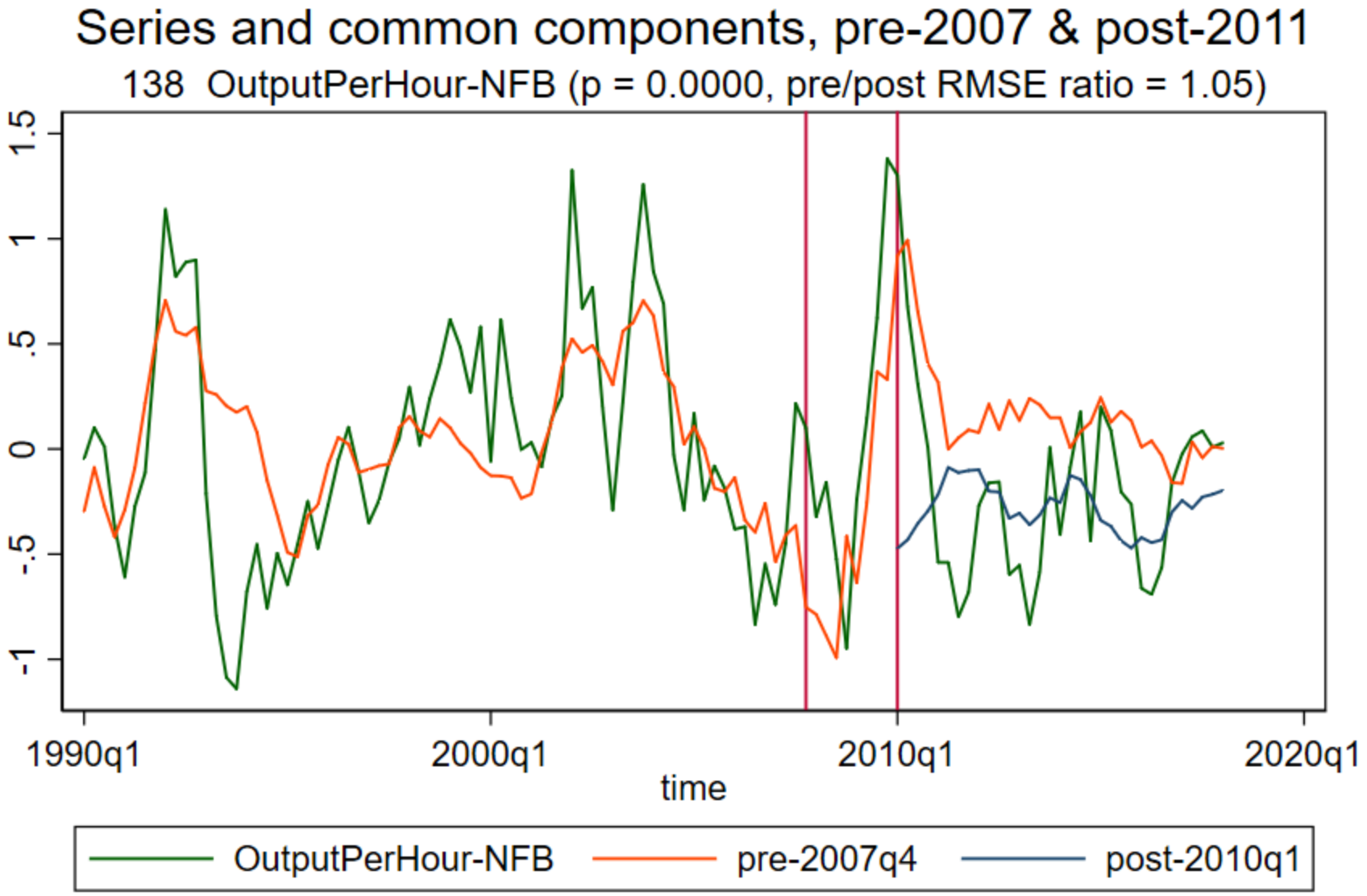

Series and common components, pre-2007 & post-2011
188 ConsumerSentiment(Umichigan) (p = 0.0000, pre/post RMSE ratio = 1.43)
2
1
0
-1
-2
-3
1990q1
2000q1
2010q1
2020q1
time
ConsumerSentiment(Umichigan)
pre-2007q4
post-2010q1
4-quarter moving average.

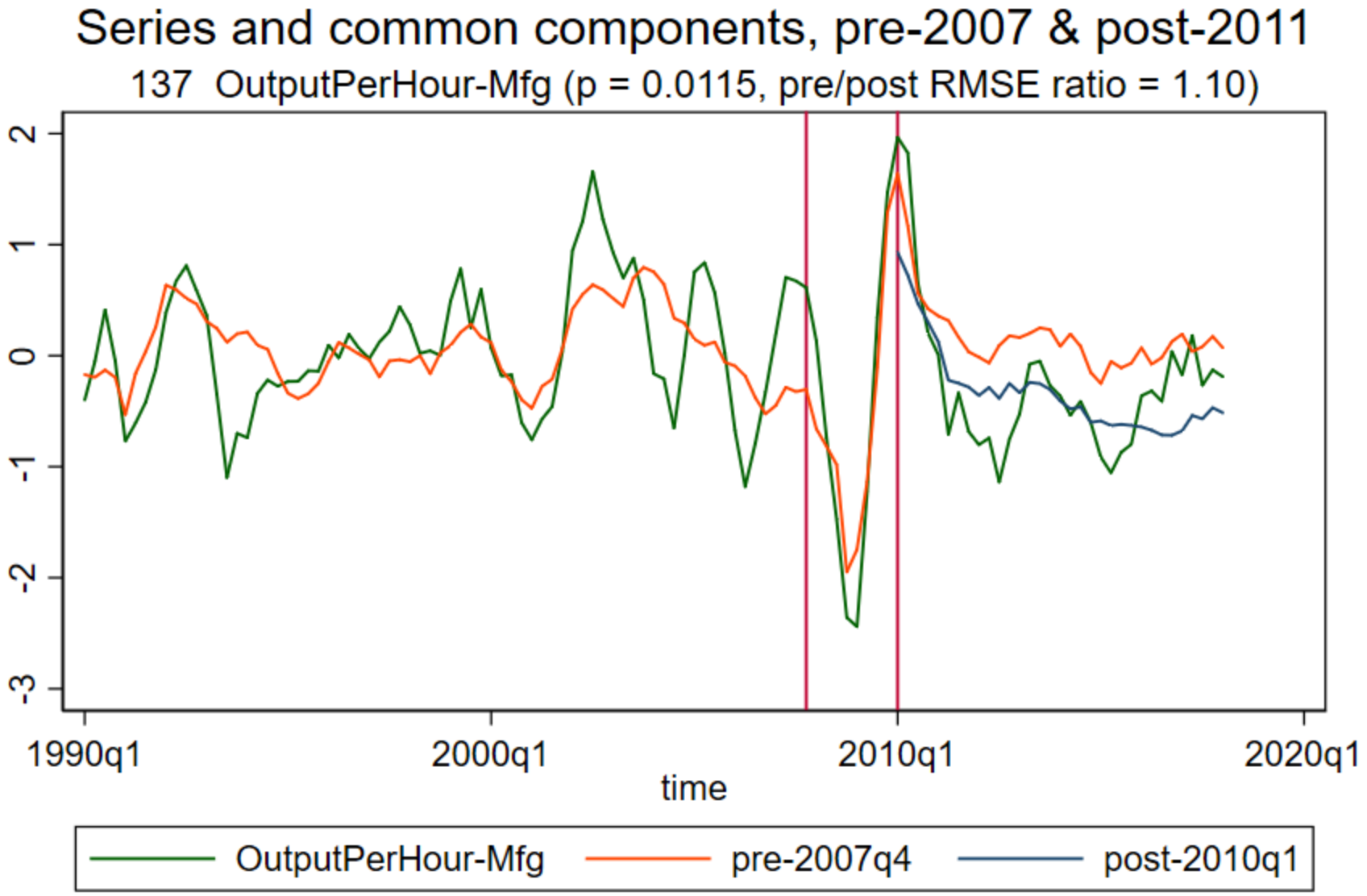
Stability of common components

Hours and Productivity


Series and common components, pre-2007 & post-2011
78 WeeklyHrsProdNonsupTotalPriv (p = 0.1993, pre/post RMSE ratio = 1.09)
2
1
0
-1
-2
-3
1990q1
2000q1
2010q1
2020q1
time
WeeklyHrsProdNonsupTotalPriv
pre-2007q4
post-2010q1
4-quarter moving average.

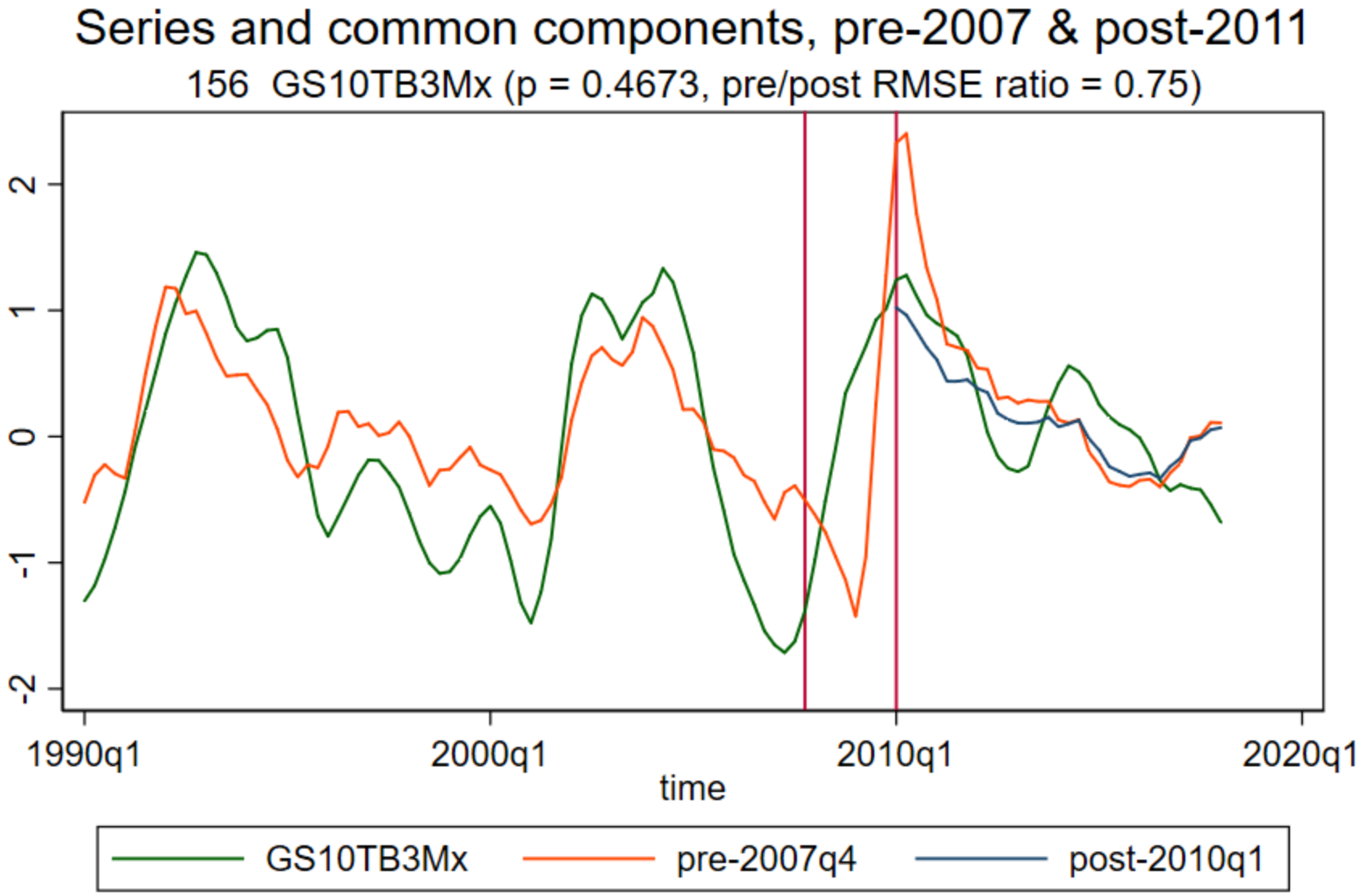

Series and common components, pre-2007 & post-2011
77 WeeklyHrsProdNonsupMfg (p = 0.0001, pre/post RMSE ratio = 0.91)
2
0
-2
-4
1990q1
2000q1
2010q1
2020q1
time
WeeklyHrsProdNonsupMfg
pre-2007q4
post-2010q1
4-quarter moving average.

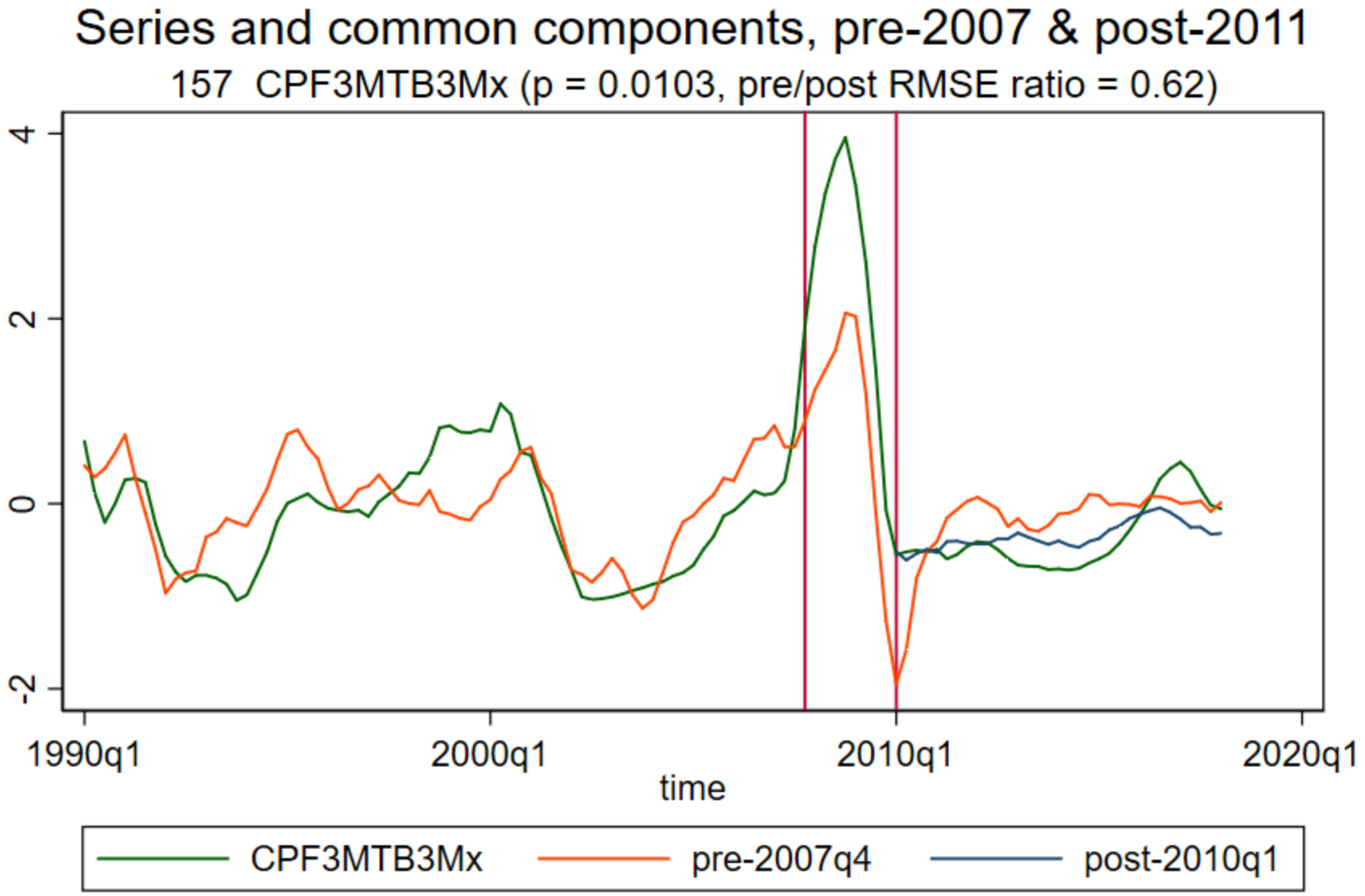

Series and common components, pre-2007 & post-2011
138 OutputPerHour-NFB (p = 0.0000, pre/post RMSE ratio = 1.05)
1.5
1
.5
0
-.5
-1
1990q1
2000q1
2010q1
2020q1
time
OutputPerHour-NFB
pre-2007q4
post-2010q1
4-quarter moving average.

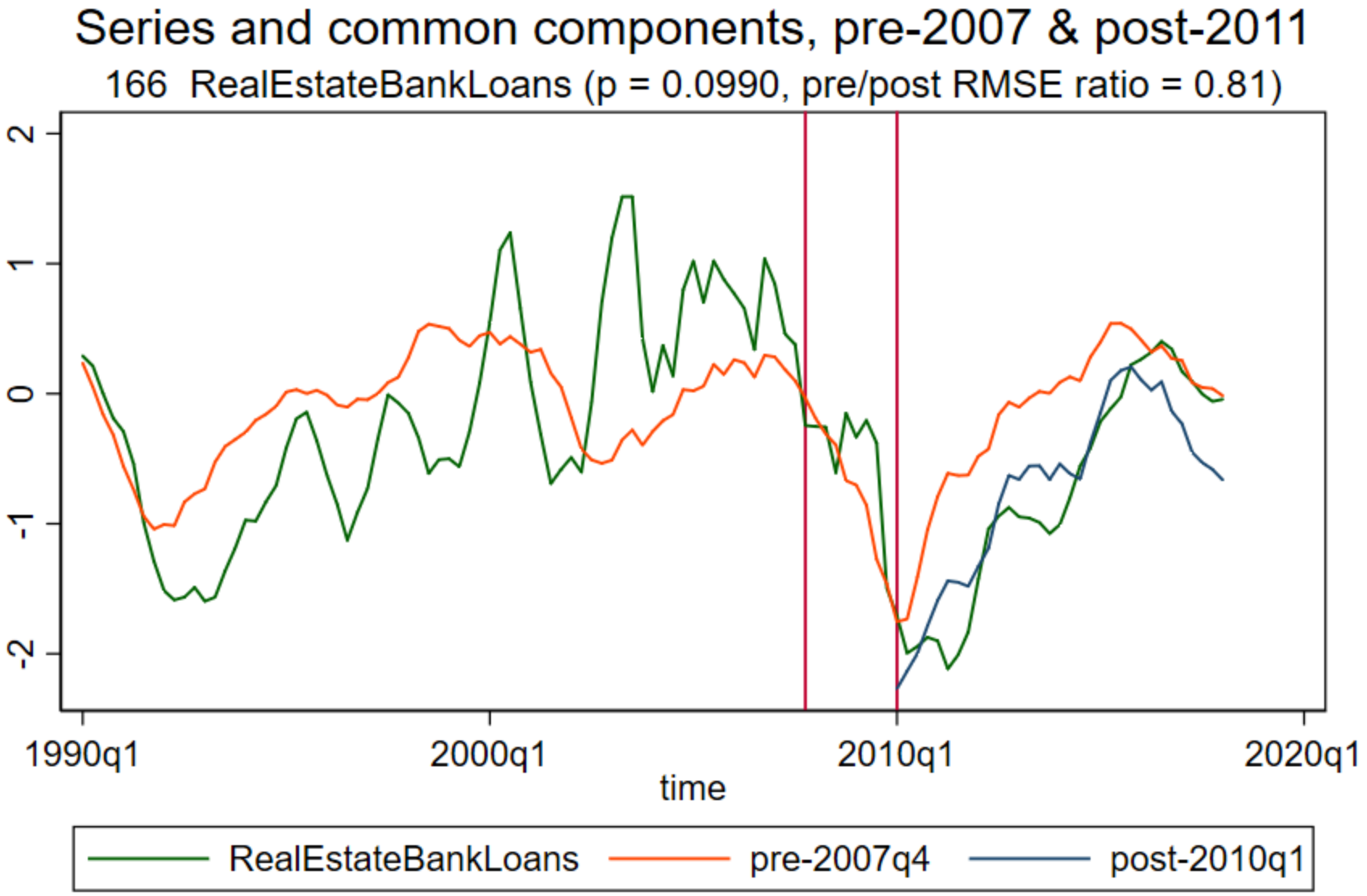

Series and common components, pre-2007 & post-2011
137 OutputPerHour-Mfg (p = 0.0115, pre/post RMSE ratio = 1.10)
2
1
0
-1
-2
-3
1990q1
2000q1
2010q1
2020q1
time
OutputPerHour-Mfg
pre-2007q4
post-2010q1
4-quarter moving average.

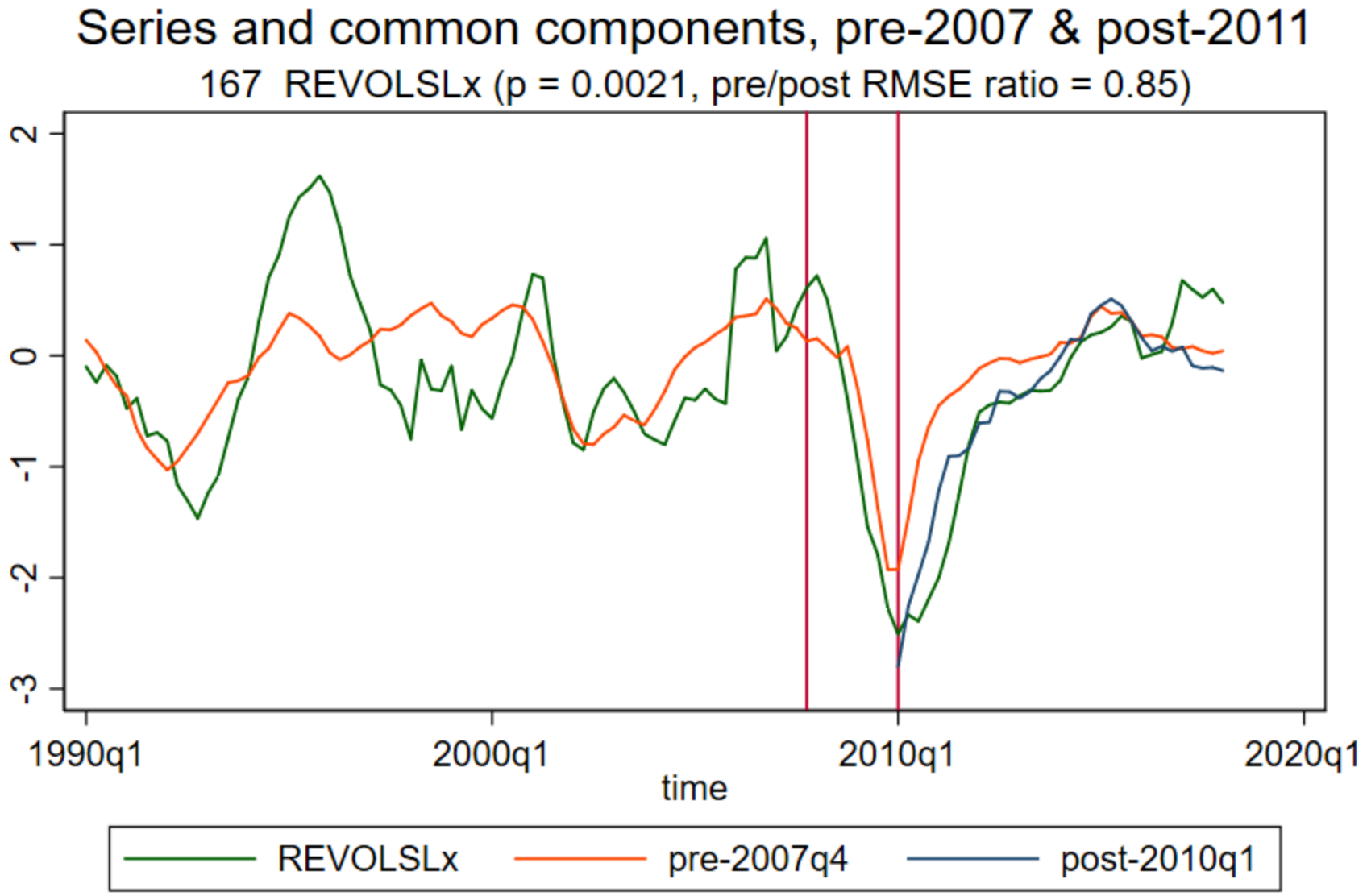
Stability of common components

Financial variables


Series and common components, pre-2007 & post-2011
156 GS10TB3Mx (p = 0.4673, pre/post RMSE ratio = 0.75)
2
1
0
-1
-2
1990q1
2000q1
2010q1
2020q1
time
GS10TB3Mx
pre-2007q4
post-2010q1
4-quarter moving average.

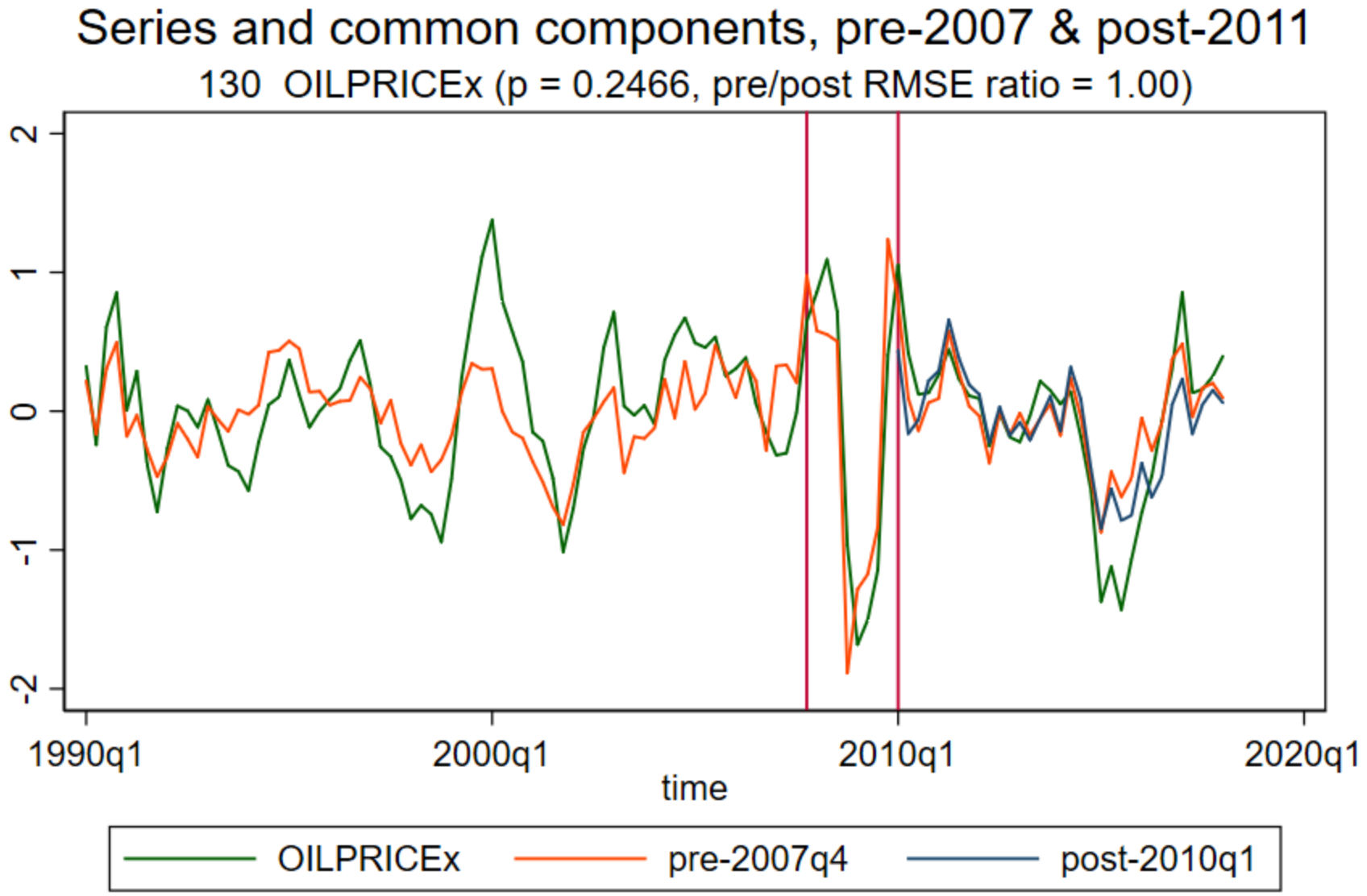

Series and common components, pre-2007 & post-2011
157 CPF3MTB3Mx (p = 0.0103, pre/post RMSE ratio = 0.62)
4
2
0
-2
1990q1
2000q1
2010q1
2020q1
time
CPF3MTB3Mx
pre-2007q4
post-2010q1
4-quarter moving average.


Series and common components, pre-2007 & post-2011
166 RealEstateBankLoans (p = 0.0990, pre/post RMSE ratio = 0.81)
2
1
0
-1
-2
1990q1
2000q1
2010q1
2020q1
time
RealEstateBankLoans
pre-2007q4
post-2010q1
4-quarter moving average.


Series and common components, pre-2007 & post-2011
167 REVOLSLx (p = 0.0021, pre/post RMSE ratio = 0.85)
2
1
0
-1
-2
-3
1990q1
2000q1
2010q1
2020q1
time
REVOLSLx
pre-2007q4
post-2010q1
4-quarter moving average.

Stability of common components

Oil prices


Series and common components, pre-2007 & post-2011
130 OILPRICEx (p = 0.2466, pre/post RMSE ratio = 1.00)
2
1
0
-1
-2
1990q1
2000q1
2010q1
2020q1
time
OILPRICEx
pre-2007q4
post-2010q1
4-quarter moving average.

Stability of Factors

$$X_t = \Lambda F_t + e_t$$
$$F_t = \Phi(L) F_{t-1} + G\eta_t$$

1. Subsample v. full sample estimates of factors
   - Three sets of factors:
     - Full-sample
     - 1984-2007
     - 2008-2018q1
   - Compare:
     - Canonical correlations
     - Common components

2. Tests for stability of factor VAR coefficients
   - Are factor dynamics different in this recovery than in previous recoveries?

Stability of Factors

$$X_t = \Lambda F_t + e_t$$
$$F_t = \Phi(L) F_{t-1} + G\eta_t$$

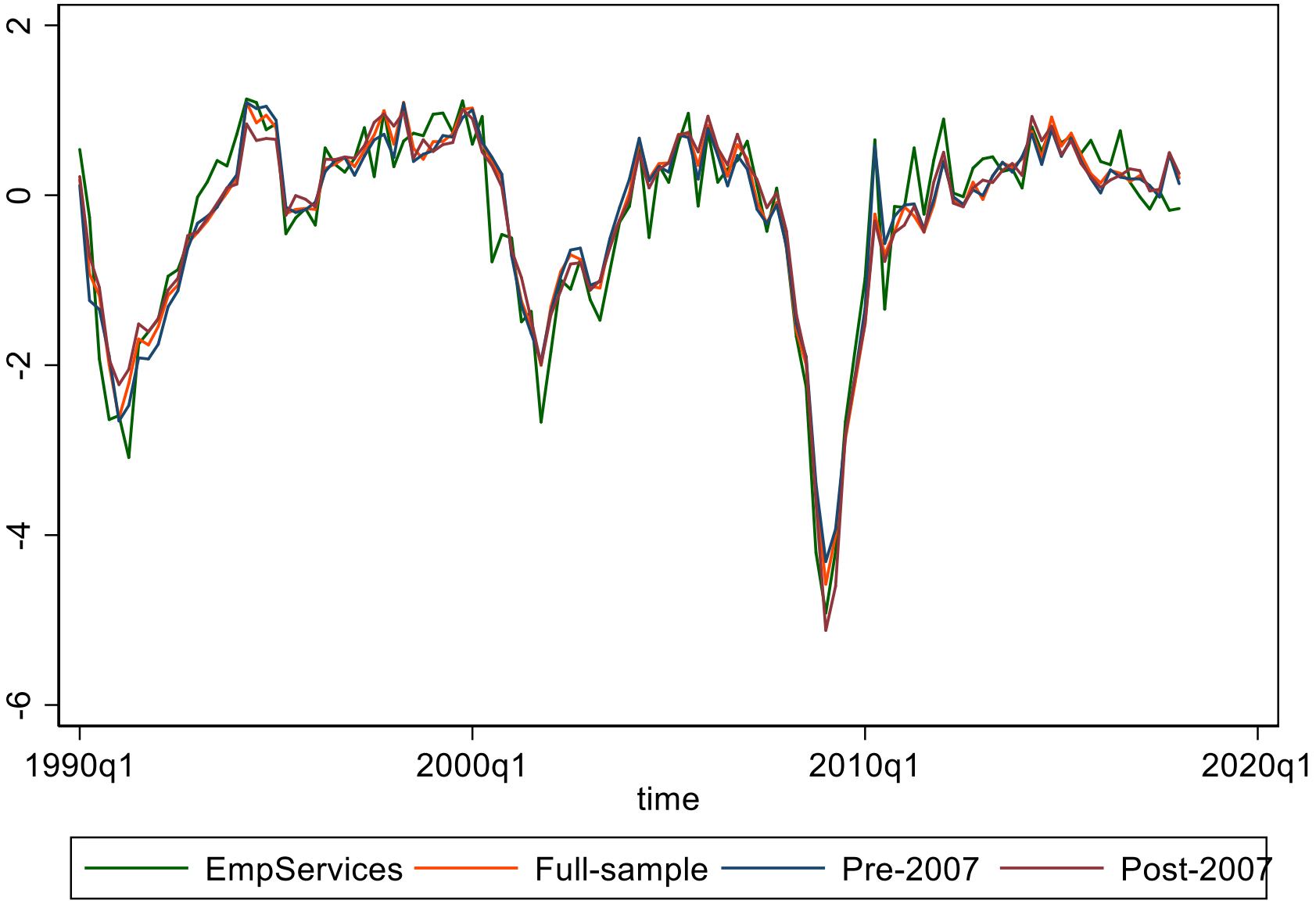
Canonical correlations (first 6 factors)

- Full-sample and sub-sample factors over the post-2007 period:

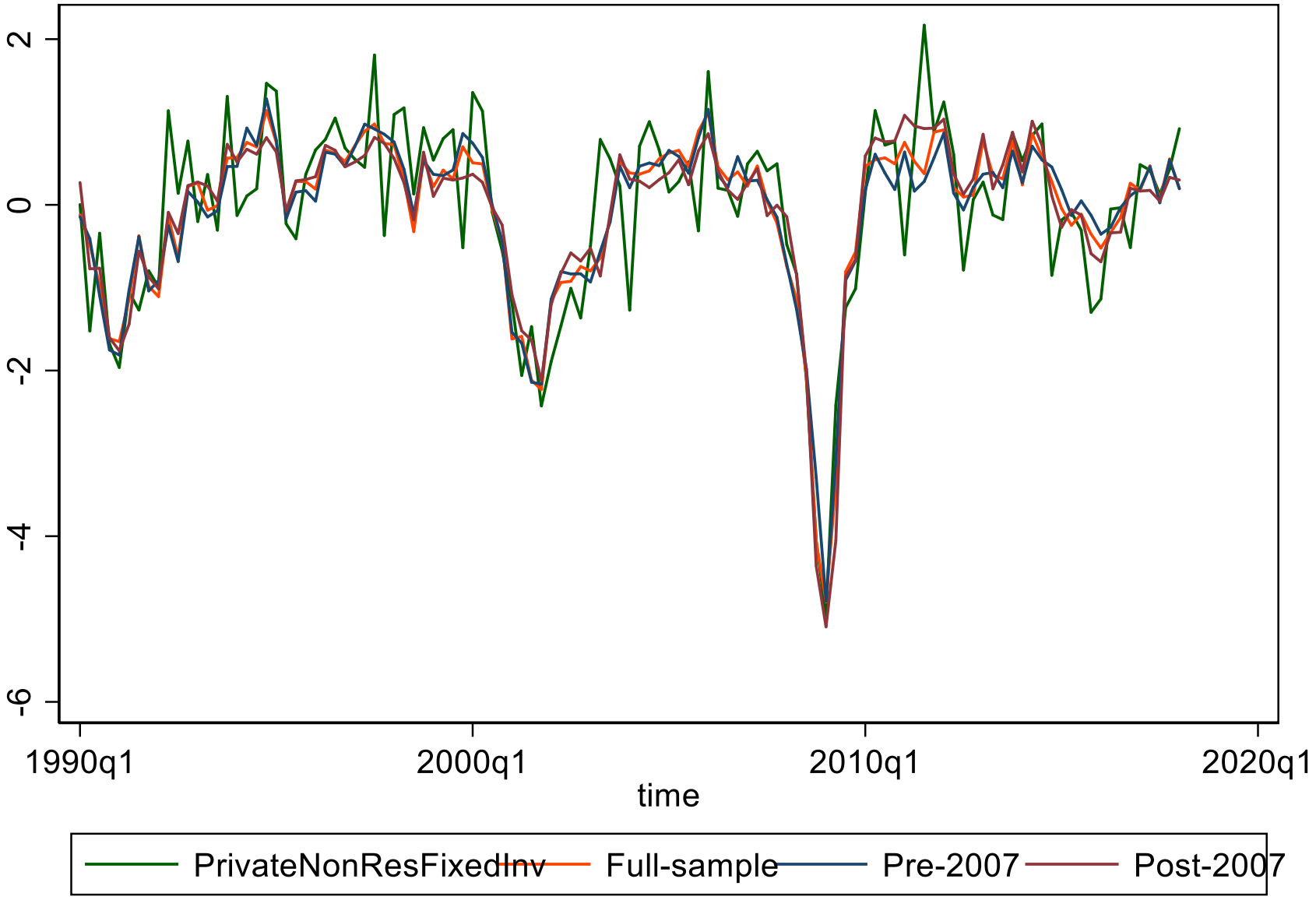
  0.9996 0.9954 0.9872 0.9859 0.9468 0.6053

Plots of selected series and common components…

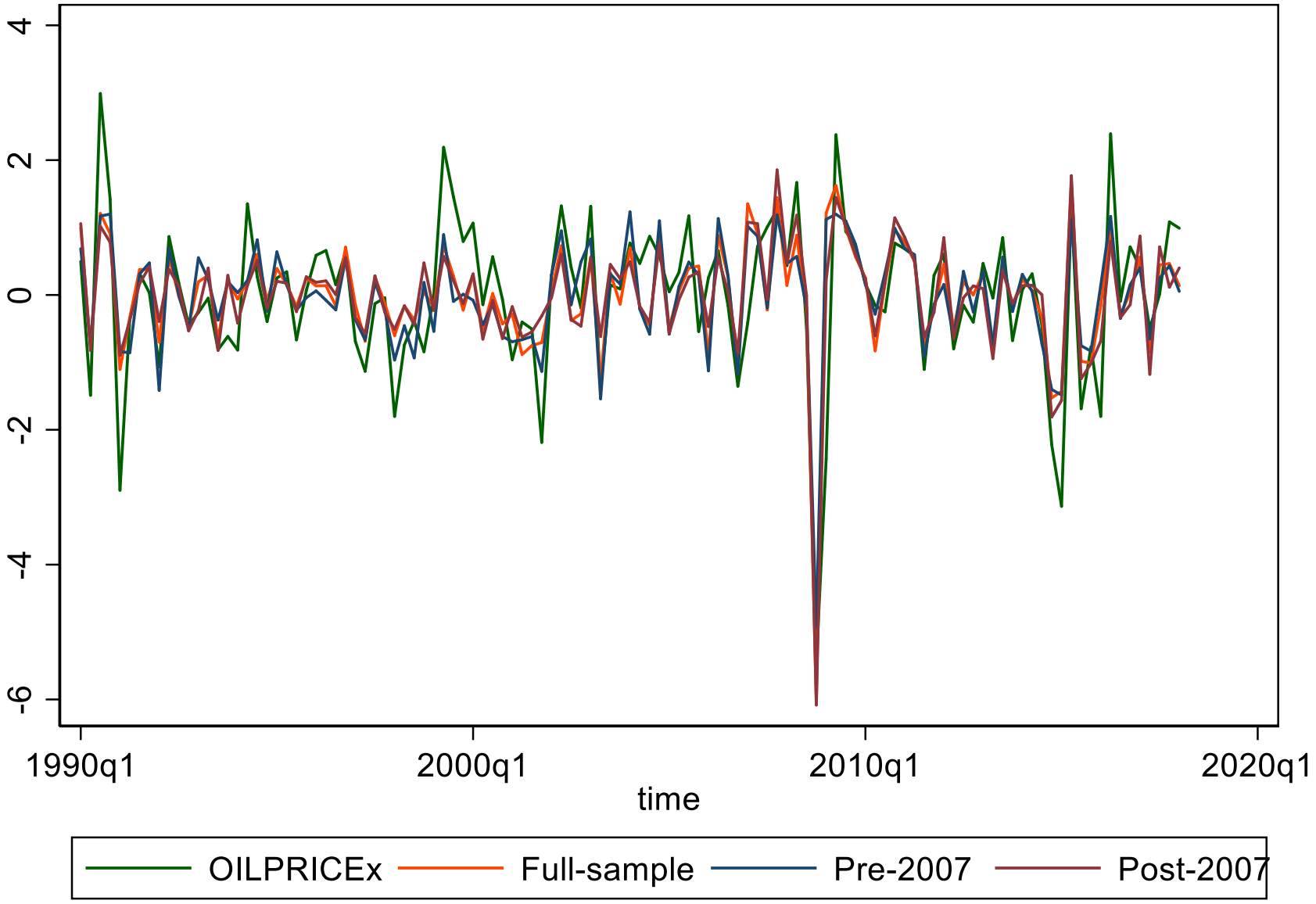
Common components, selected series



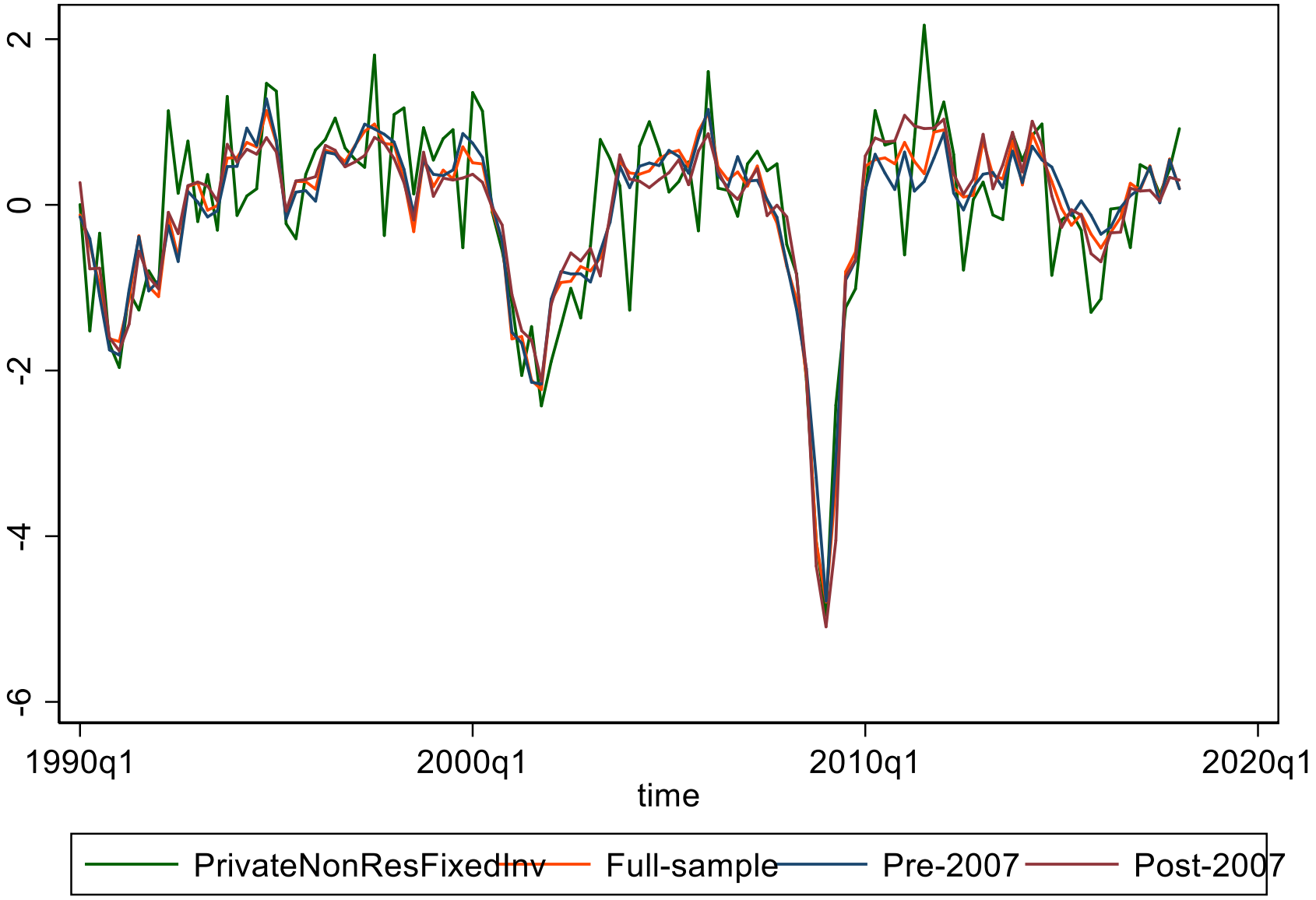
Common components, selected series



Common components, selected series



Common components, selected series



Tests for stability of factor VAR coefficients

$$X_t = \Lambda F_t + e_t$$
$$F_t = \Phi(L) F_{t-1} + G\eta_t$$

- Four factor, *p*-lag VAR
- Test equation-by-equation for coefficient stability, 1984-2007q4 v. 2010q1-2018q1 (drop the recession and phase I recovery)

F-statistics (p-values) testing VAR coefficient stability

Factor (equation) number:

	1	2	3	4
p=2	1.45 (0.169)	1.78 (0.074)	1.08 (0.379)	0.26 (0.984)

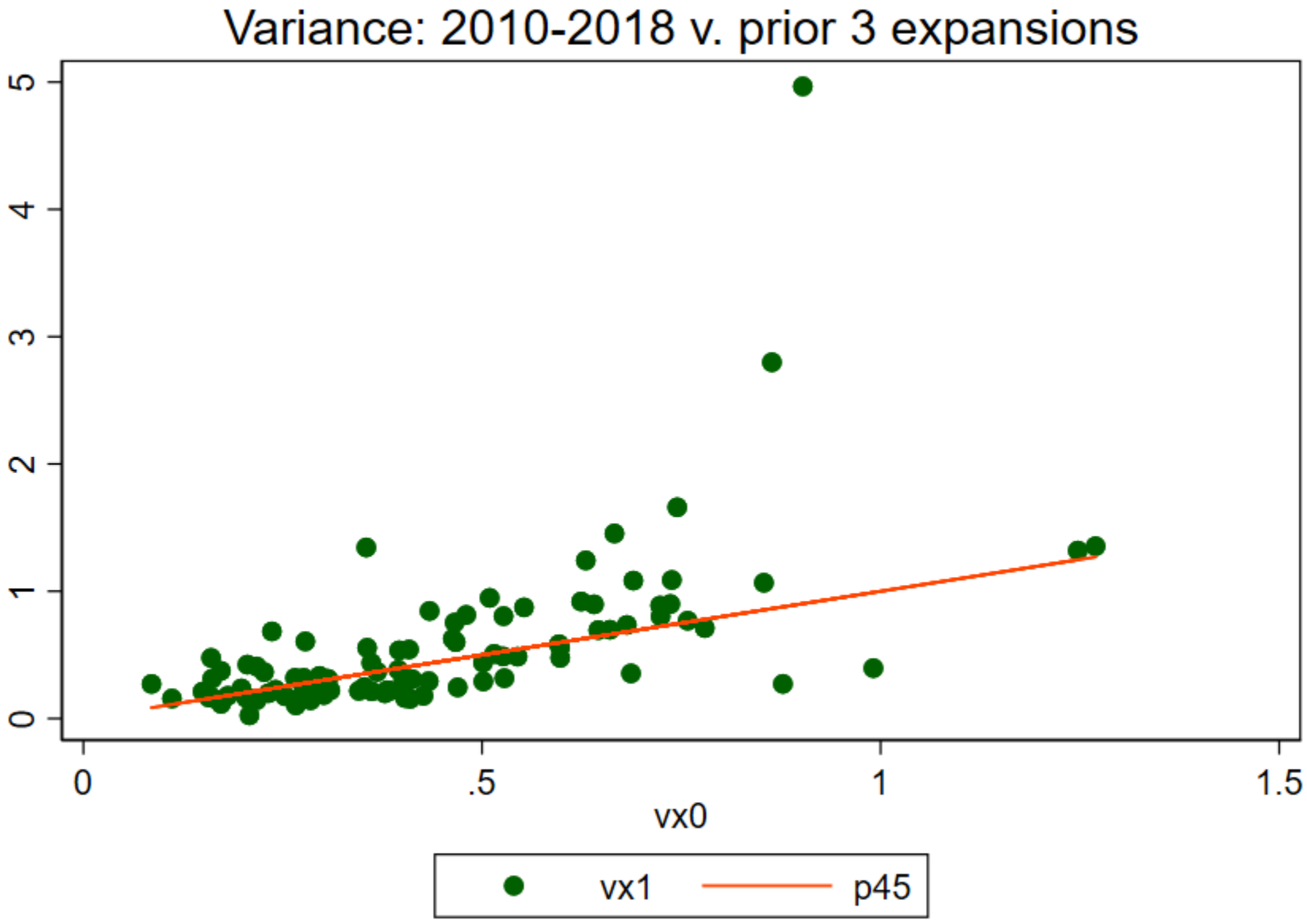
What about the Great Moderation?

How does volatility over this expansion compare to the prior 3 expansions in the Great Moderation?

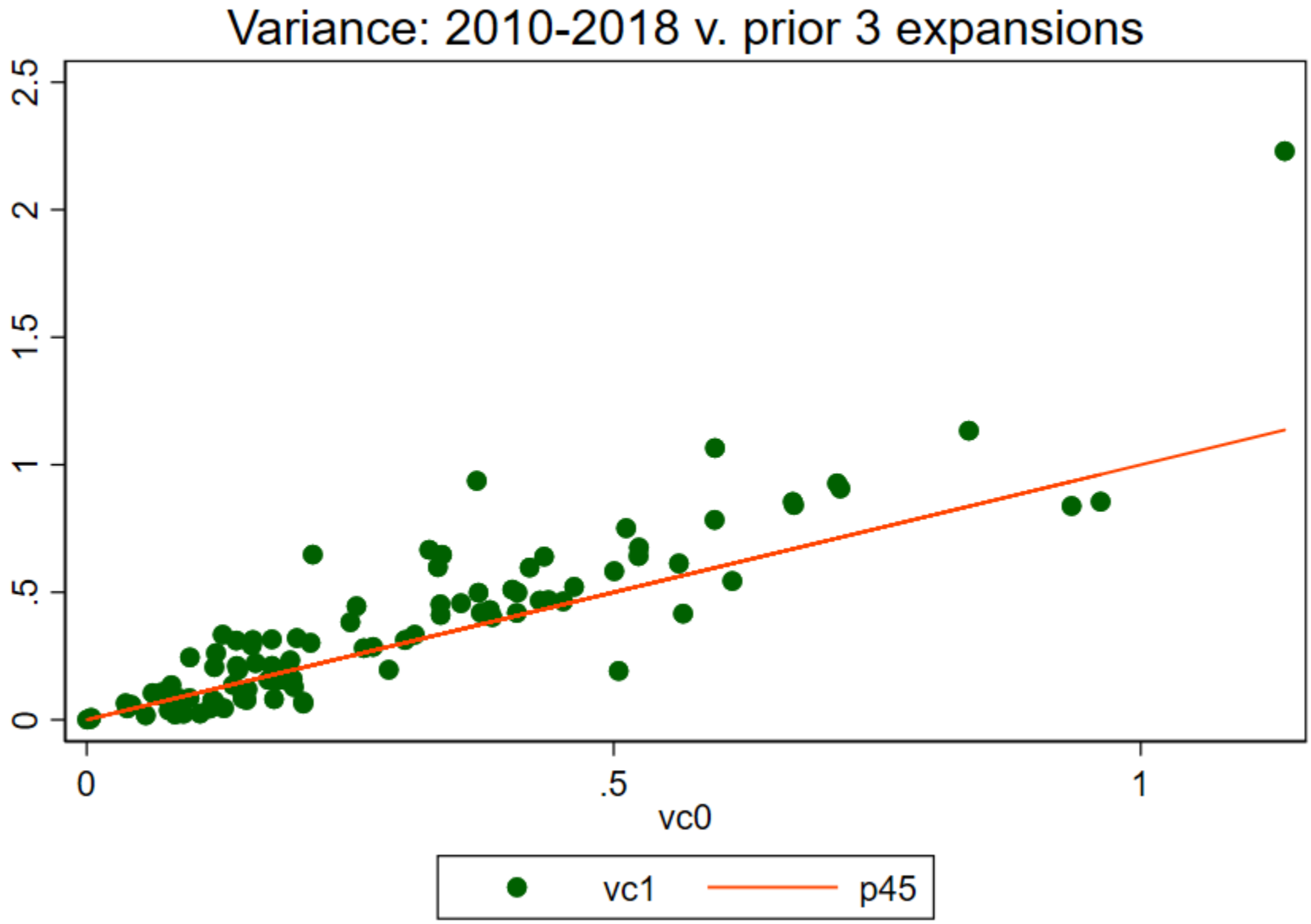
- 1982q4 – 1990q3
- 1991q1 – 2001q1
- 2001q4 – 2007q4

- Shorten to consider stages II-IV (start at trough + 2)
- Questions:
  - Have we returned to the low volatility of the previous three expansions?
  - Are changes in the volatility associated with changes in the common component or idiosyncratic component?

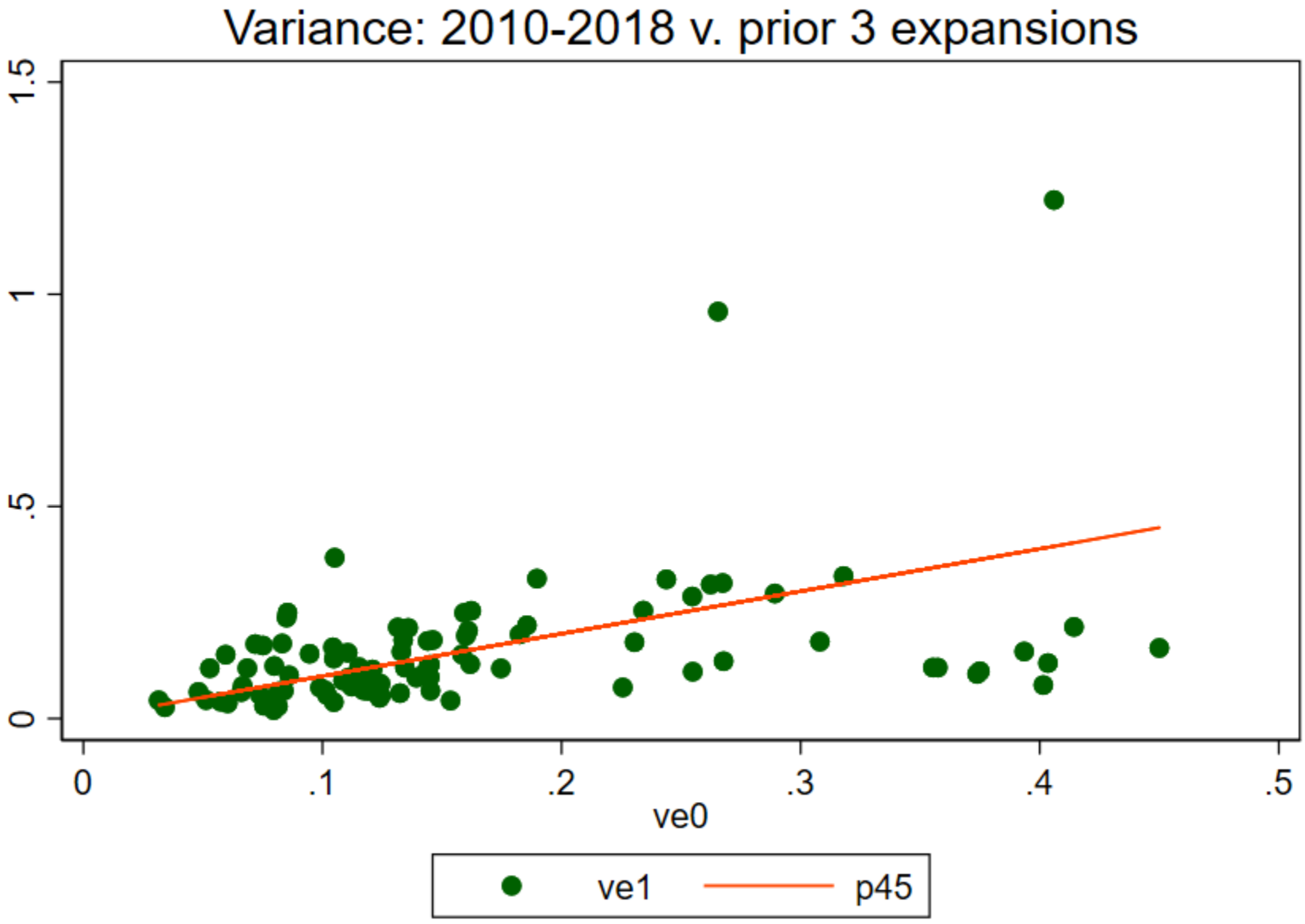
Real activity variables: Series



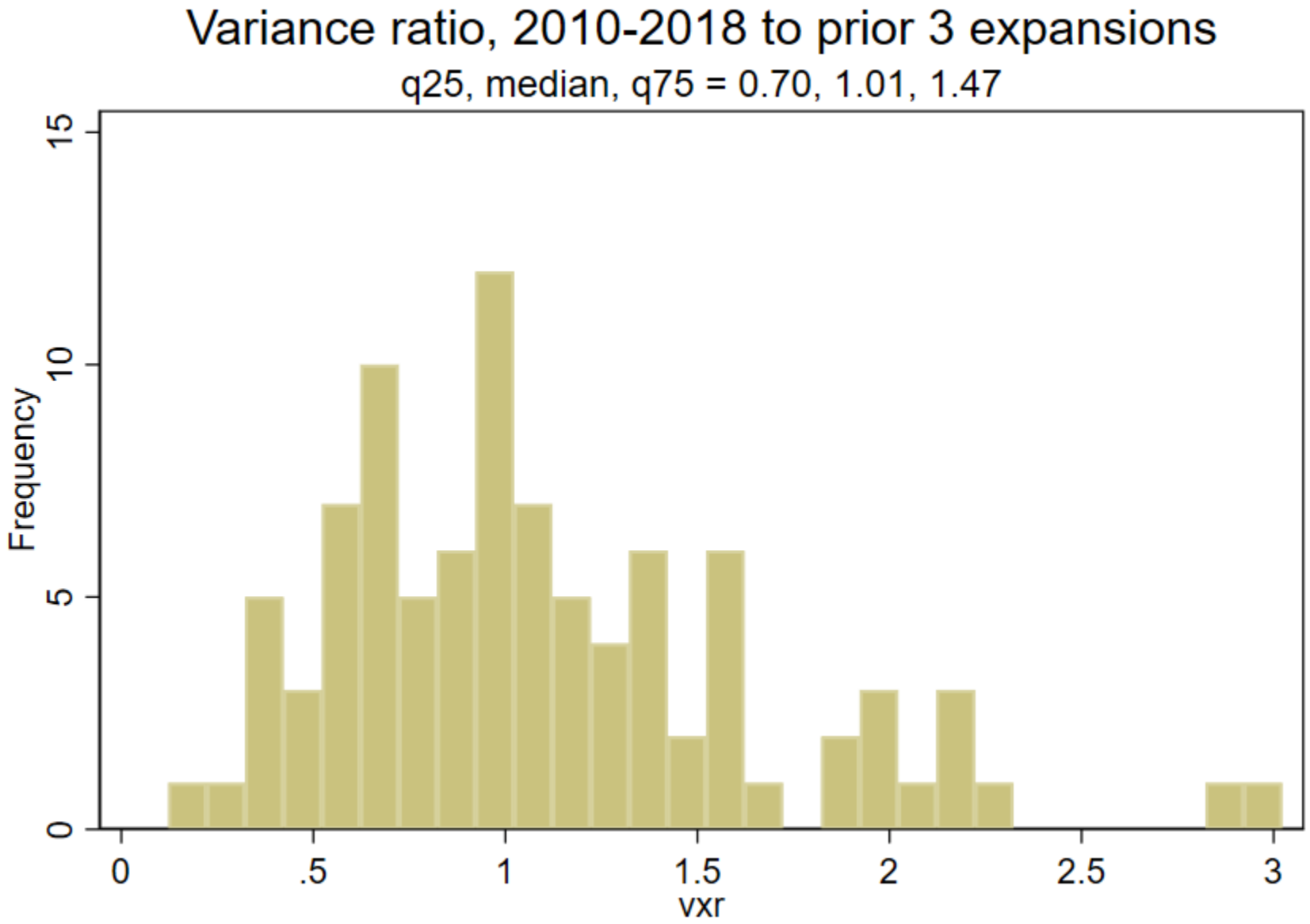
Real activity variables: Common Component



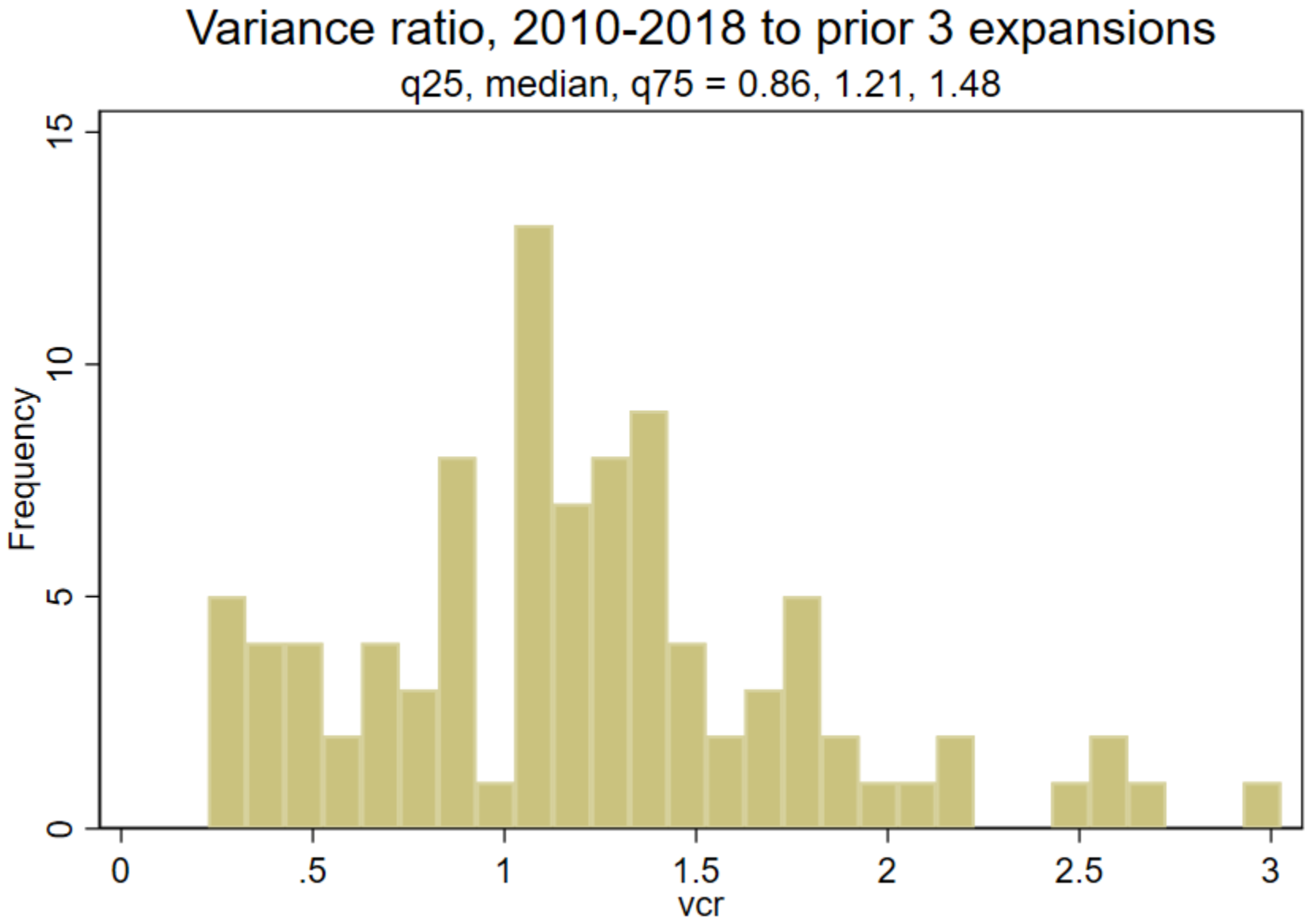
Real activity variables: Idiosyncratic component



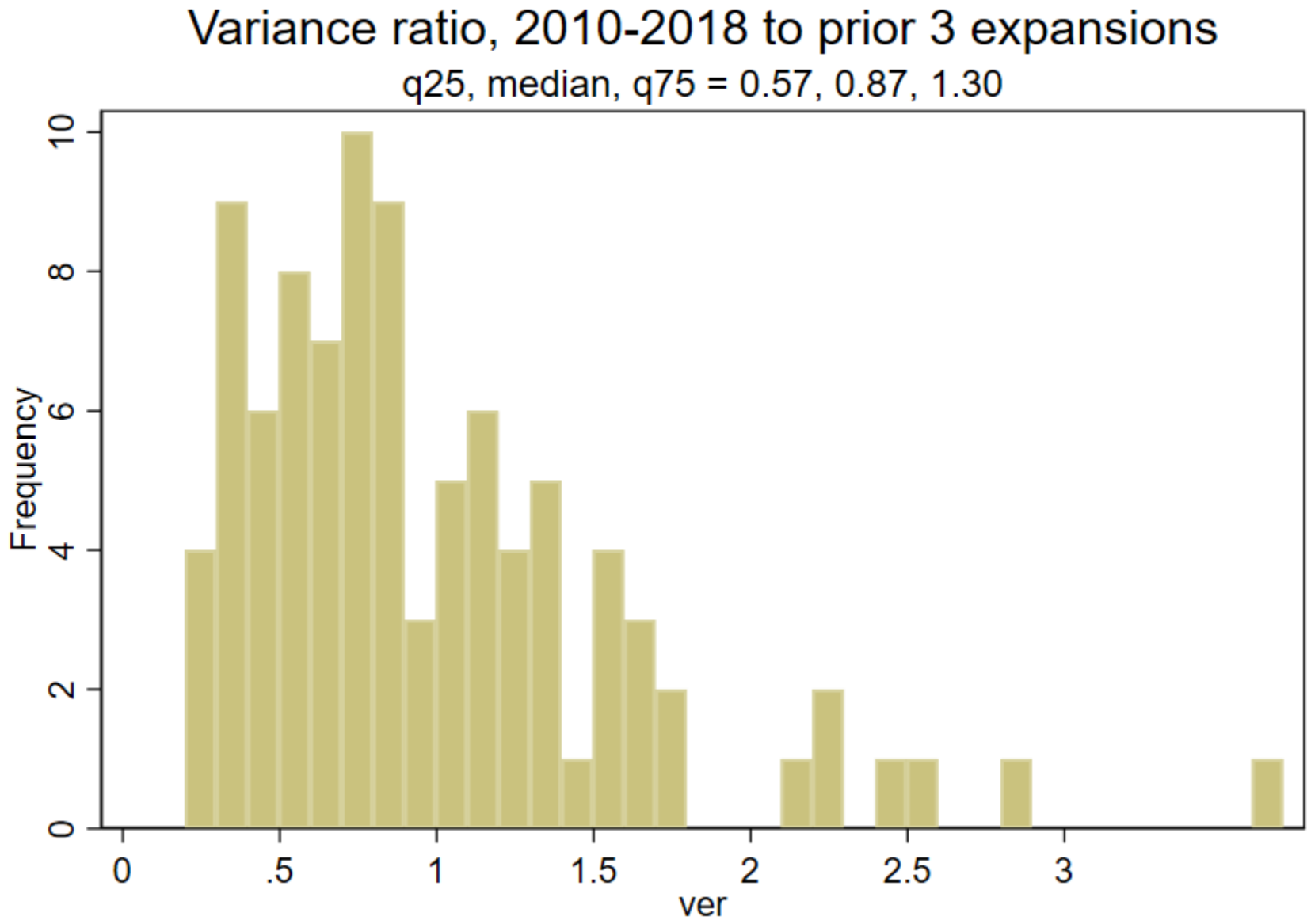
Variance ratio, real activity variables: Series



Variance ratio, real activity variables: Common component



Variance ratio, real activity variables: Common component



Summary of findings

1. Factor dynamics – i.e., overall macro dynamics – appear no different overall in this recovery than in previous two.

2. Widespread evidence of changes in correlations of many series with overall macro factors.

3. However, for most series these changes, while statistically significant, do not represent economically large breakdowns – in fact for most series, the fit of the pre-2007 common component is remarkably good.

4. For series with large departures, they tell important stories about the recovery: the revival of manufacturing, slow productivity growth, and sluggish state & local govt. spending

5. No evidence of widespread, qualitatively important breakdowns