Use of State Coincident Indexes

Federal Tax Administrators
Revenue Estimating and Tax Research Conference

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** The views expressed today are my own and not necessarily those of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.*

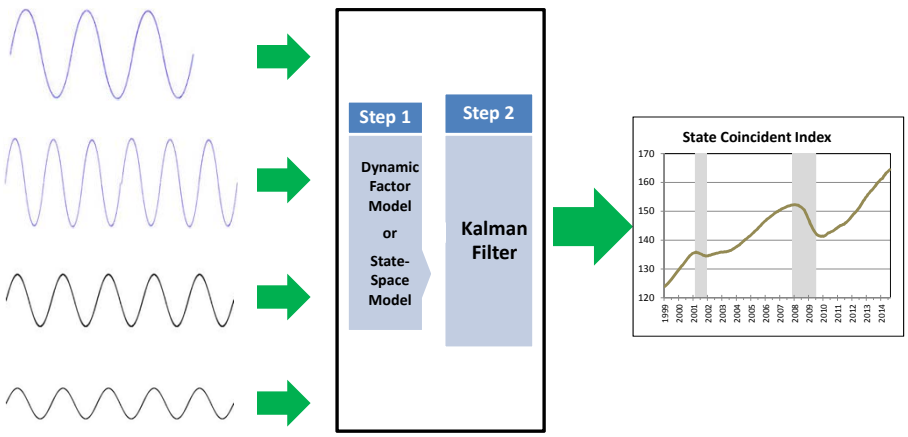
Plan for today

- Provide a brief overview of our state coincident index methodology
- Preview an article that identifies state business cycles using the historical coincident index estimates
- Consider the U.S. and state business cycles using real-time estimates of the coincident indexes; most important for forecasting
- Weave a discussion of challenges and caveats throughout
- End with a mention of our research agenda

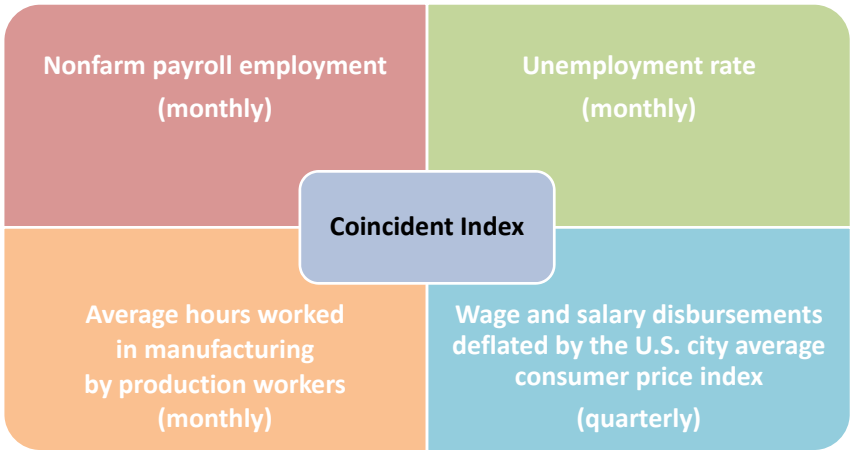
An overview of our state coincident index methodology (and U.S.)

- A dynamic single-factor model, à la Stock & Watson, is used with a Kalman filter/smoother to handle mixed frequency data
- Seasonally adjusted estimates of four monthly and quarterly data series are standardized to have a mean of zero and a standard deviation of one
- Key References:
  - Crone, Theodore M., and Alan Clayton-Matthews. "Consistent Economic Indexes for the 50 States," Review of Economics and Statistics, 87 (2005), pp. 593-603.
  - Stock, James H., and Mark W. Watson. "New Indexes of Coincident and Leading Economic Indicators," *NBER Macroeconomics Annual* (1989), pp. 351-94.

Our model extracts a signal from noisy data and produces a single measure representing the state's overall economy

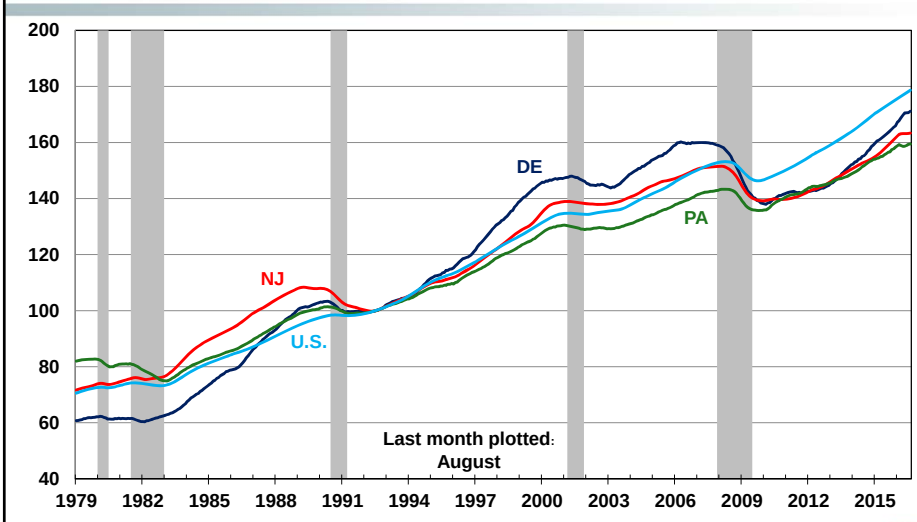


The coincident index is designed to represent the comovement of four state-level economic statistics



Philadelphia Fed Coincident Indexes

Index: July 1992 = 100, SA



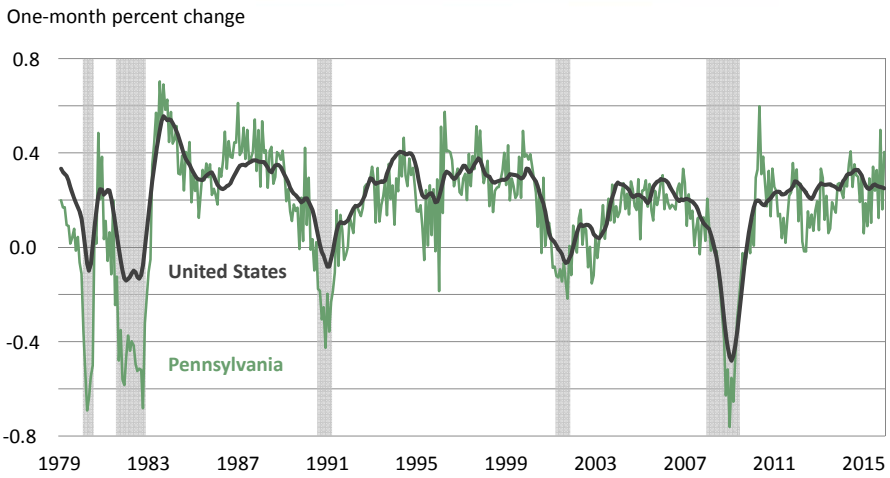
Note: Components include the unemployment rate, payroll employment, average hours worked in manufacturing, and real wages and salaries.

Historical identification of state business cycles: A preview

- Article is forthcoming in the Q4 edition of *Economic Insights* from the Federal Reserve Bank of Philadelphia
- Analysis is based on June 2016 vintage of coincident indexes, but considers data only through December 2015 due to the typical extent of annual data revisions
- National recessions identified with the coincident index align well with NBER designations; state recessions fit intuition
- Fewer energy states are recently (currently?) in recession compared to the number of energy/farm states in recession in the mid-1980s.

Our national index aligns well with NBER recessions

Pennsylvania's as well, but state indexes are inherently more volatile



Sources: Federal Reserve Bank of Philadelphia and National Bureau of Economic Research

State	CT	FL	IL	NH	PA	US
Abs. Ave.	0.29	0.36	0.29	0.35	0.25	0.24
Jan-79						
Feb-79	0.39	0.57	0.06	0.54	0.20	0.33
Mar-79	0.40	0.59	0.18	0.61	0.17	0.32
Apr-79	0.41	0.60	0.39	0.55	0.17	0.31
May-79	0.42	0.62	0.04	0.39	0.09	0.30
Jun-79	0.41	0.47	0.14	0.37	0.09	0.28
Jul-79	0.41	0.65	(0.04)	0.19	0.02	0.25
Aug-79	0.39	0.50	(0.13)	0.32	0.04	0.23
Sep-79	0.37	0.68	(0.42)	0.36	0.08	0.21
Oct-79	0.35	0.68	(0.18)	0.44	(0.01)	0.19
Nov-79	0.33	0.69	(0.42)	0.54	0.04	0.17
Dec-79	0.29	0.70	(0.18)	0.41	(0.06)	0.15
Jan-80	0.24	0.57	(0.30)	0.33	(0.11)	0.12
Feb-80	0.18	0.61	(0.55)	0.30	(0.36)	0.06
Mar-80	0.12	0.30	(0.53)	0.15	(0.52)	(0.00)
Apr-80	0.07	0.32	(0.85)	(0.16)	(0.69)	(0.07)
May-80	0.04	0.31	(0.55)	(0.22)	(0.64)	(0.10)
Jun-80	0.03	0.47	(0.67)	(0.02)	(0.55)	(0.07)
Jul-80	0.05	0.30	(0.59)	0.09	(0.50)	0.00
Aug-80	0.09	0.60	(0.25)	0.35	0.11	0.09
Sep-80	0.13	0.56	(0.30)	0.45	0.02	0.16
Oct-80	0.17	0.56	(0.25)	0.60	0.48	0.22
Nov-80	0.20	0.55	(0.28)	0.51	0.20	0.25
Dec-80	0.21	0.54	(0.10)	0.55	0.38	0.24
Jan-81	0.22	0.52	(0.18)	0.32	0.03	0.22
Feb-81	0.21	0.51	0.04	0.37	0.11	0.23
Mar-81	0.19	0.48	(0.12)	0.40	(0.06)	0.24
Apr-81	0.18	0.46	(0.06)	0.40	0.06	0.24
May-81	0.16	0.43	0.01	0.43	(0.11)	0.21
Jun-81	0.13	0.41	(0.04)	0.44	0.20	0.16
Jul-81	0.11	0.23	(0.22)	0.33	(0.25)	0.11
Aug-81	0.07	0.23	(0.15)	0.31	(0.12)	0.04
Sep-81	0.04	0.08	(0.23)	0.15	(0.48)	(0.00)
Oct-81	0.00	0.07	(0.43)	0.12	(0.35)	(0.05)
Nov-81	(0.02)	0.05	(0.26)	0.04	(0.56)	(0.10)
Dec-81	(0.04)	0.04	(0.50)	(0.09)	(0.58)	(0.13)
Jan-82	(0.05)	0.03	(0.46)	(0.04)	(0.47)	(0.14)
Feb-82	(0.05)	0.02	(0.62)	(0.18)	(0.37)	(0.13)
Mar-82	(0.04)	(0.00)	(0.58)	(0.07)	(0.44)	(0.13)
Apr-82	(0.03)	0.13	(0.60)	(0.01)	(0.40)	(0.11)
May-82	(0.01)	0.11	(0.59)	0.11	(0.42)	(0.10)
Jun-82	0.01	0.13	(0.63)	0.23	(0.50)	(0.11)
Jul-82	0.04	0.16	(0.48)	0.26	(0.53)	(0.13)
Aug-82	0.06	0.04	(0.47)	0.20	(0.51)	(0.13)
Sep-82	0.08	0.09	(0.49)	0.13	(0.52)	(0.12)
Oct-82	0.12	0.12	(0.34)	0.04	(0.68)	(0.07)
Nov-82	0.18	0.16	(0.35)	0.11	(0.32)	(0.01)
Dec-82	0.25	0.18	(0.18)	0.29	(0.22)	0.07
Jan-83	0.33	0.31	(0.05)	0.46	(0.11)	0.14
Feb-83	0.42	0.61	0.12	0.67	(0.09)	0.21
Mar-83	0.52	0.61	0.24	0.83	0.35	0.28
Apr-83	0.60	0.64	0.43	1.05	0.44	0.34
May-83	0.68	0.78	0.43	1.12	0.57	0.40
Jun-83	0.74	0.93	0.61	1.01	0.44	0.45

Determining state peaks and troughs

Five examples drawn from the double-dip recessions are representative.

Criteria:

1. A state business cycle peak is determined as the last month in which the index has a positive monthly change prior to a period of at least four months in which the sum of the monthly changes is negative and its absolute value equals or exceeds the simple variance in that state's coincident index.
2. A state business cycle trough is determined as the last month of a qualifying recession (and one with a negative monthly change) prior to a period of at least four months in which the sum of the monthly changes is positive and its absolute value equals or exceeds the simple variance.
3. A period with offsetting monthly changes (a net change of zero for two or more months) at the start of a qualifying recession is treated as part of the prior expansion. Likewise, a period of two or more months of no net change at the end of a qualifying recession is treated as part of the subsequent expansion.

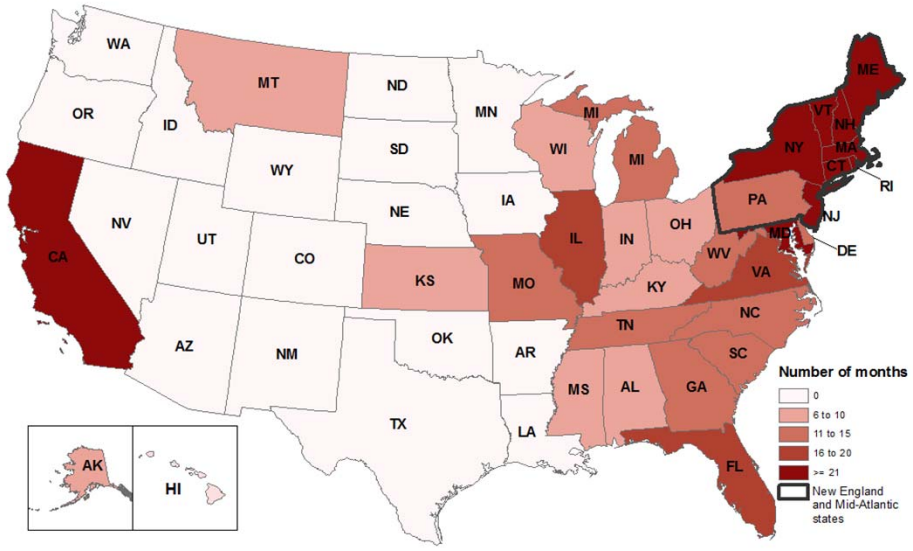
Examples:

- Pennsylvania followed the nation into and out of both recessions — one of 36 states to do so.
- Florida avoided both recessions. Although its growth rate was well below its norm, the state economy continued to expand.
- Connecticut also avoided both recessions. It did experience a seven-month decline (shaded yellow) during the second U.S. recession that was too shallow to qualify as a recession.
- Illinois experienced one long recession. While the U.S. enjoyed a brief intervening expansion, Illinois was one of two states that declined throughout. Three other states escaped that fate by virtue of a bare minimum four-month expansion.
- New Hampshire avoided the first recession because of an insufficient duration, although it had a sufficiently deep decline (shaded yellow). Eight other states avoided the first recession with little or no decline, but not the second, while Alaska experienced the first and avoided the second.

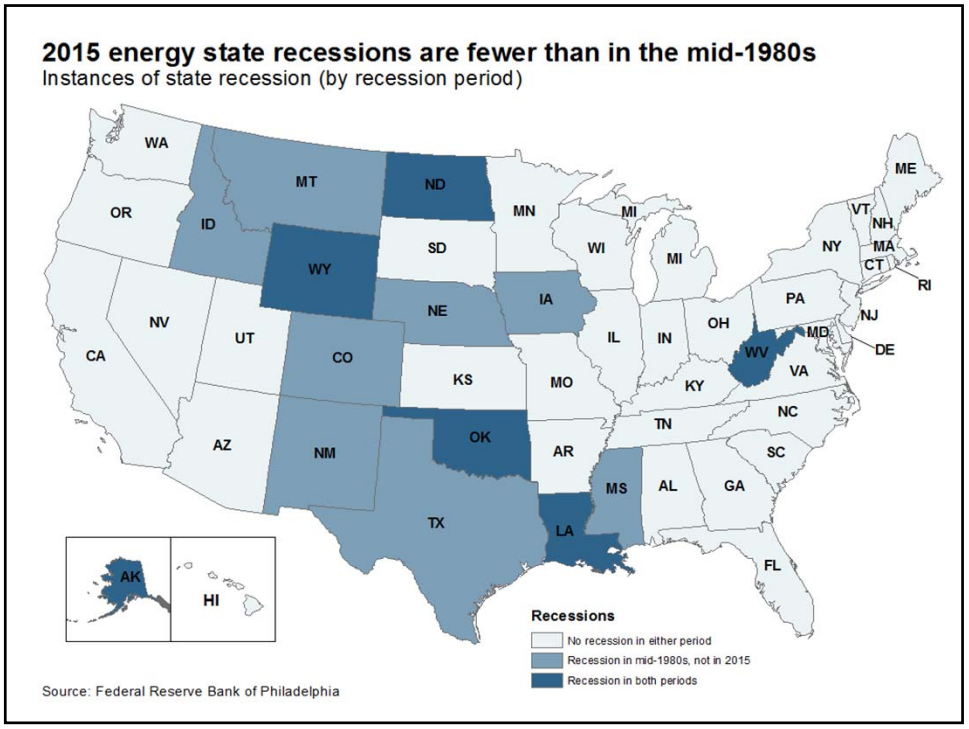
Sources: Federal Reserve Bank of Philadelphia and National Bureau of Economic Research

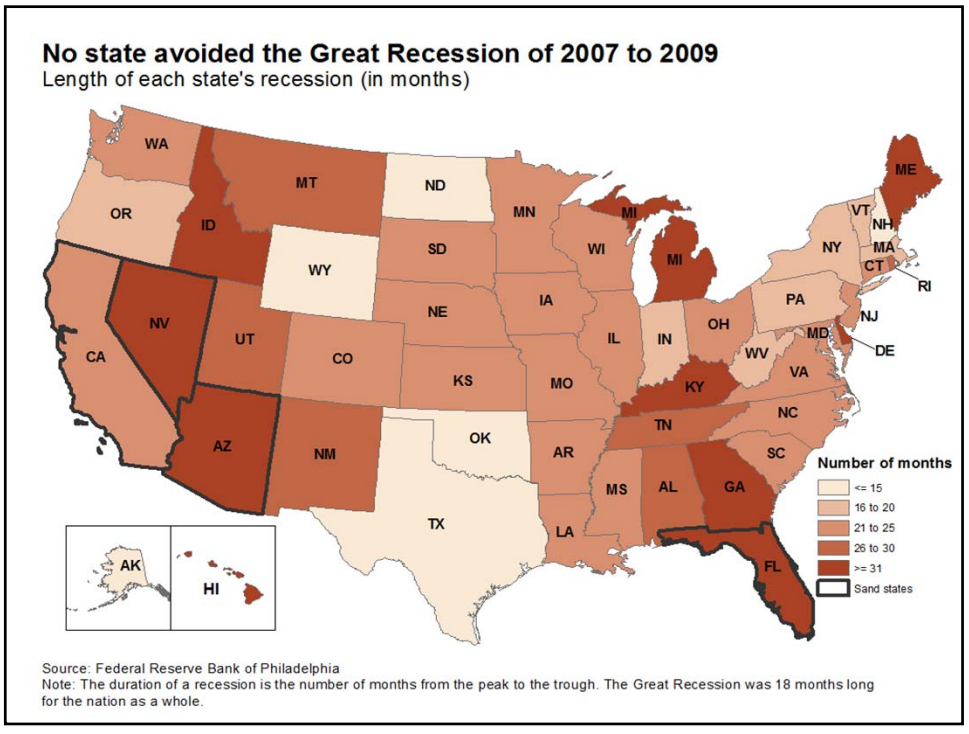
Nineteen states avoided the bi-coastal recession of 1990-1991

Length of each state's recession (in months)



Source: Federal Reserve Bank of Philadelphia
Note: The duration of a recession is the number of months from the peak to the trough. The 1990-1991 recession was 8 months long for the nation as a whole.


2015 energy state recessions are fewer than in the mid-1980s
Instances of state recession (by recession period)
WA
OR
CA
ID
NV
MT
WY
UT
AZ
CO
NM
ND
SD
NE
KS
OK
TX
MN
IA
MO
AR
LA
WI
IL
MS
MI
IN
KY
TN
AL
OH
WV
GA
FL
SC
NC
VA
PA
NY
MD
DE
NJ
CT
RI
MA
VT
NH
ME
AK
HI
Recessions
No recession in either period
Recession in mid-1980s, not in 2015
Recession in both periods
Source: Federal Reserve Bank of Philadelphia

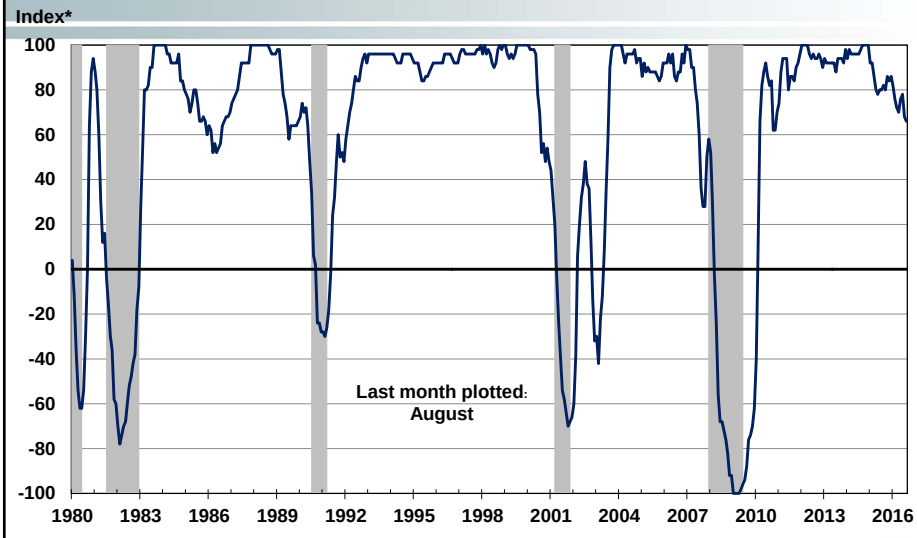

No state avoided the Great Recession of 2007 to 2009
Length of each state's recession (in months)
WA
OR
CA
ID
NV
MT
WY
UT
AZ
CO
NM
ND
SD
NE
KS
OK
TX
MN
IA
MO
AR
LA
WI
IL
MS
MI
IN
KY
TN
AL
OH
WV
GA
FL
SC
NC
VA
PA
NY
MD
DE
NJ
CT
RI
MA
VT
NH
ME
AK
HI
Number of months
<= 15
16 to 20
21 to 25
26 to 30
>= 31
Sand states
Source: Federal Reserve Bank of Philadelphia
Note: The duration of a recession is the number of months from the peak to the trough. The Great Recession was 18 months long for the nation as a whole.

Real-time analysis and other problems: In brief

- Identifying state business cycles in hind-sight is easier than in real-time, or examining the coincident index "tail"
- A heavy reliance on employment data misses signals from sectors, like finance, that are important to some states
- The impacts of retrending (and not revariancing) affect the interpretation of the indexes – DO NOT RANK states

Philadelphia Fed Coincident Indexes

3-Month Diffusion Index



Source: Federal Reserve Bank of Philadelphia
* Index represents percentage of respondents reporting more than a 0.5% increase minus percentage reporting less than a 0.5% decrease.

Data revisions can be significant at turning points

One-month diffusion index viewed in real-time across multiple vintages

		Vintages																																					
		2007		2008												2009												2010											
	Date	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Date										
2007	Nov	64	50	72	62	50	50	56	60	58	54	58	70	56	52	50	52	52	52	52	58	56	60	56	70	62	56	54	58	Nov	2007										
	Dec	NBER Peak	-6	66	56	56	52	54	60	56	38	48	46	60	48	32	28	28	34	32	26	32	32	34	36	48	42	50	58	Dec										
2008	Jan	Employment Peak		60	58	52	50	46	50	50	48	50	40	44	46	14	16	14	18	20	22	22	24	22	28	22	36	36	38	Jan										
	Feb	Largest Revisions		60	38	40	36	36	40	26	26	22	18	14	-16	-14	-16	-22	-14	-14	-10	-8	-14	-16	-8	-10	16	20	Feb										
	Mar			-6	-20	-36	-34	-30	-42	-40	-42	-46	-52	-46	-32	-42	-44	-42	-38	-42	-40	-44	-40	-38	-40	-24	-22	Mar										
	Apr				20	-2	-8	-6	-10	-16	-22	-28	-34	-66	-52	-38	-50	-44	-50	-48	-52	-52	-52	-46	-48	-38	-34	Apr										
	May					-66	-68	-66	-72	-70	-76	-76	-78	-50	-36	-38	-32	-38	-32	-34	-38	-44	-46	-46	-40	-66	-62	May										
	Jun						-28	-10	-20	-28	-20	-42	-52	-76	-64	-62	-62	-52	-54	-56	-58	-64	-66	-62	-66	-72	-72	Jun										
	Jul							-50	-44	-38	-44	-56	-66	-64	-52	-54	-52	-48	-38	-50	-46	-54	-58	-60	-62	-72	-70	Jul										
	Aug								-38	-38	-42	-56	-66	-66	-46	-48	-52	-44	-42	-36	-42	-52	-54	-54	-60	-76	-68	Aug										
	Sep									-26	-30	-44	-62	-86	-68	-66	-70	-62	-62	-62	-60	-72	-72	-72	-74	-84	-84	Sep										
	Oct										-36	-46	-84	-74	-62	-62	-64	-62	-62	-58	-58	-54	-66	-62	-66	-86	-88	Oct										
	Nov											-58	-82	-92	-86	-88	-88	-84	-82	-86	-84	-86	-82	-86	-88	-90	-92	Nov										
	Dec												-100	-94	-92	-94	-94	-88	-92	-94	-94	-96	-96	-92	-96	-96	-98	Dec										
2009	Jan													Benchmark Revision		-96	-98	-98	-98	-94	-96	-96	-96	-98	-98	-98	-94	-100	-100	Jan										
	Feb															-100	-100	-100	-100	-100	-100	-100	-100	-100	-98	-100	-100	-100	-100	Feb										
	Mar																-98	-98	-94	-92	-92	-90	-94	-96	-94	-94	-100	-100	Mar										
	Apr																	-84	-84	-84	-82	-82	-84	-84	-84	-82	-96	-96	Apr										
	May																		-92	-96	-96	-96	-96	-96	-96	-96	-96	-94	May										
	Jun																			NBER Trough	-86	-82	-78	-88	-90	-88	-88	-96	-96	Jun										
	Jul																					-56	-70	-70	-74	-80	-80	-88	-84	Jul										
	Aug																						-50	-68	-72	-68	-74	-86	-88	Aug										
	Sep																							-60	-46	-46	-52	-62	-74	Sep										
	Oct																								-24	-24	-34	-44	-46	Oct										
	Nov																									20	-22	-34	-36	Nov										
	Dec																										-74	-38	-30	Dec										
2010	Jan																											Benchmark Revision		-8	4	Jan	2010						
	Feb																											Employment Trough		-2	Feb									

Source: Federal Reserve Bank of Philadelphia

As the year progressed, the coincident index became negative in February 2008 for more and more states

Vintage	States in recession, and stayed in (as of January 2009)	States in and out of recession
2008: February	Nevada, Pennsylvania & Rhode Island	Alaska, Idaho, Louisiana, Mississippi, New Mexico & West Virginia
2008: May	Arizona, Florida, Indiana, Kentucky, Maine & Michigan	Louisiana & Mississippi
2008: December	Connecticut, Delaware, Hawaii, Illinois, Minnesota, Montana & Washington	Louisiana, Mississippi, New Mexico, & New Jersey
2009: January	Alabama, Arkansas, Georgia, Maryland, New Hampshire, Ohio, Oregon, South Carolina, Tennessee, Utah, Vermont & Wisconsin	Idaho

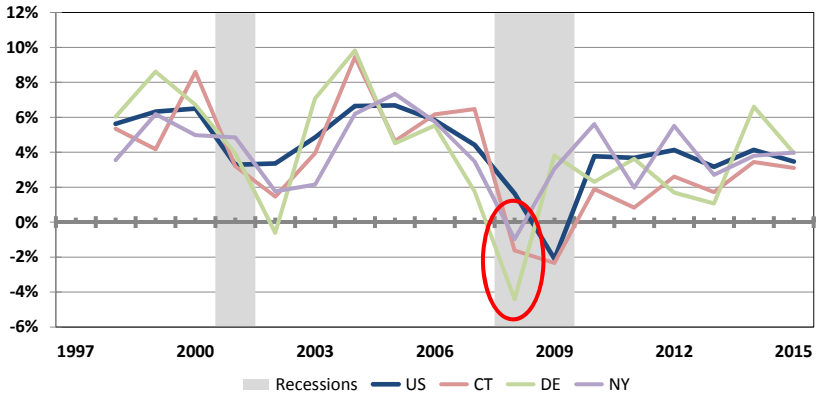
Source: Federal Reserve Bank of Philadelphia

Example of three states with large finance sectors
(average share of nominal GDP – 1997 through 2015)

US	CT	DE	NY
Finance 20%	Finance 29%	Finance 41%	Finance 30%
Manuf. 13%	Manuf. 14%	Prof. 11%	Prof. 12%

Source: Bureau of Economic Analysis

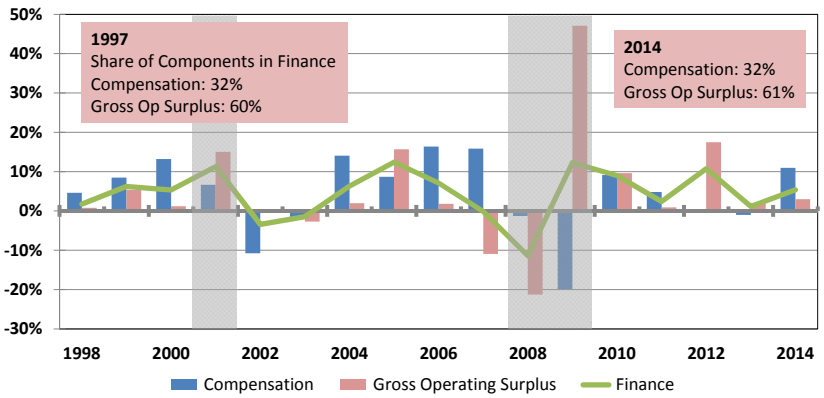
GDP in these states turned negative earlier than the nation
(annual change in nominal GDP – 1997 through 2015)



Source: Bureau of Economic Analysis

Profits are twice payrolls in New York's financial sector

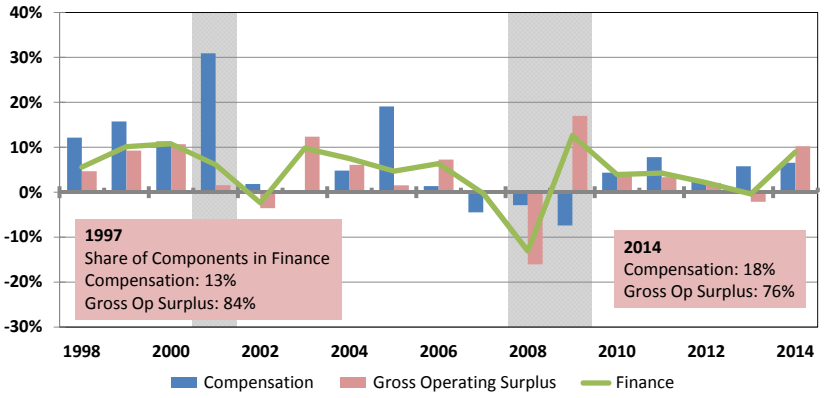
(annual change in nominal GDP for finance and its components – 1997 through 2015)



Source: Bureau of Economic Analysis

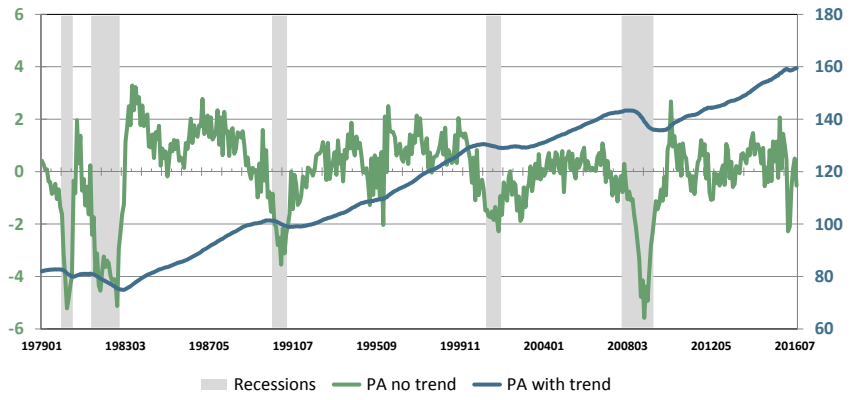
Profits more than five times payrolls in Delaware finance

(annual change in nominal GDP for finance and its components – 1997 through 2015)



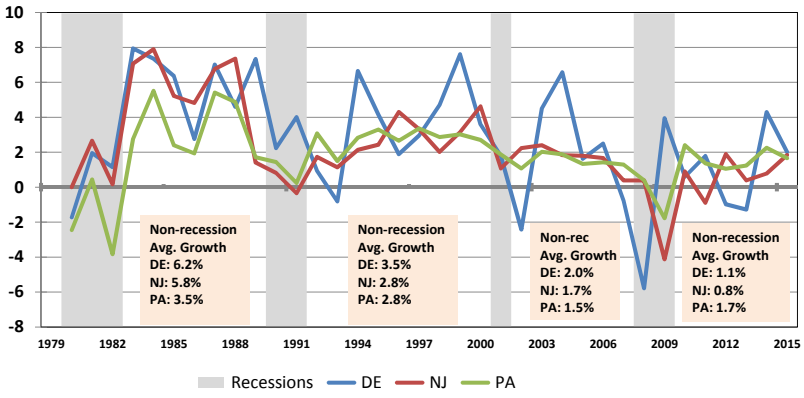
Source: Bureau of Economic Analysis

Coincident index results for Pennsylvania before and after retrending to match the state's long-run GDP growth rate



Source: Federal Reserve Bank of Philadelphia

Average growth rates of real GDP have fallen in successive business cycle expansions for these Mid-Atlantic states



Source: Bureau of Economic Analysis

Our research agenda:

- Complete a rewrite of C++ code to EViews for greater accessibility and greater ease for testing alternatives
- Add variables to better capture economic trends driven from farm, energy, and finance sectors
- Improve our process of retrending the indexes and incorporate a method of revariancing them to improve comparability of indexes
- Shorten the "tail" in which estimates are subject to the greatest potential for data revisions by using early benchmarks of employment data and by identifying other fresh data

Final remarks

- Our state coincident indexes have value for identifying historical state business cycles, as an immediate indicator of state GDP, and as a signal of a U.S. recession in near real-time
- However, the immediate, real-time indexes for states can be improved by:
  - capturing more state-specific factors,
  - better retrending and re-variancing, and
  - shortening the "tail" in which large data revisions are anticipated
- We are working on these improvements; however, a magic bullet for estimating economic growth within the "tail" remains elusive

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