Calendar Effects and Omitted Variables in Employment Time Series

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BUREAU OF LABOR STATISTICS
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Overview

- Very brief explanation of Current Employment Statistics (CES) program
  - Focus on subnational data
- Four vs. Five week calendar effect
- Omitted variables and the problems they bring
- Screening for problems with alternate runs

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Current Employment Statistics

- Large monthly survey (>600,000 establishments)
  - Fed-State cooperative
- Employment, hours, and earnings at National, State, and Area (MSA) level
- Some of the most timely economic indicators
  - Most interest: employment change
- Benchmarked to admin. data

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Current Employment Statistics

- State/MSA-level seasonal adjustment
  - "Two-Step" due to benchmark technique
  - Projected factors
    - Move to concurrent proposed for 2018
  - Publish 2024 SA series (not incl. 3MMA)
- CES reference period: "Pay period including the 12th of the month"
  - Time between reference weeks is variable
    - Noticeable in highly seasonal months
  - User-defined "4/5 Week Effect"

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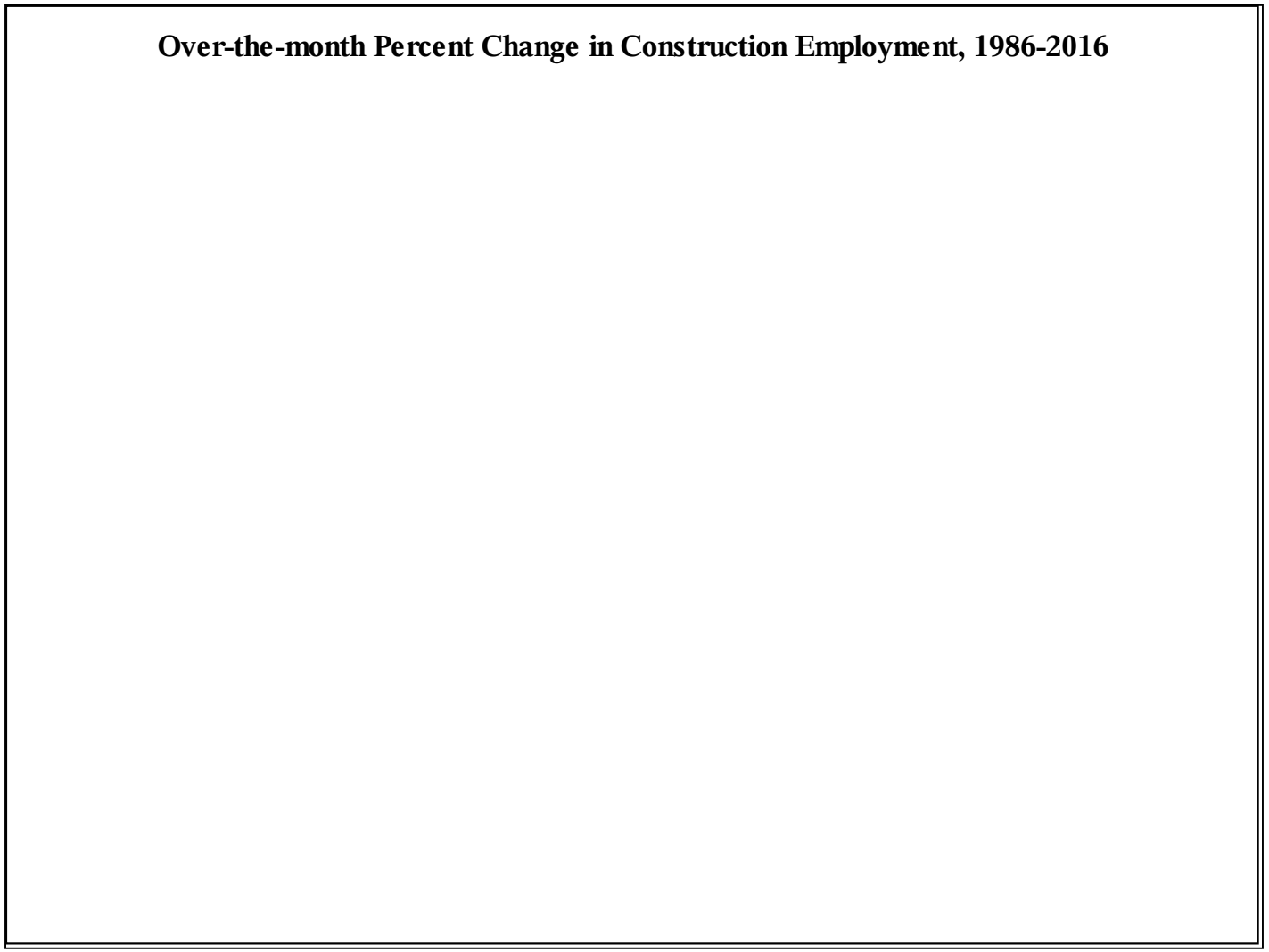
Four-Five Week Effect



Four-Five Week Effect

Date	Weeks	dum1	dum2	dum3	dum4	dum5	dum6	dum7	dum8	dum9	dum10	dum11
JAN2016	4	**1.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FEB2016	5	0.0	**-0.6**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAR2016	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
APR2016	4	0.0	0.0	**1.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAY2016	5	0.0	0.0	0.0	**-0.6**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
JUN2016	4	0.0	0.0	0.0	0.0	**1.0**	0.0	0.0	0.0	0.0	0.0	0.0
JUL2016	5	0.0	0.0	0.0	0.0	0.0	**-0.6**	0.0	0.0	0.0	0.0	0.0
AUG2016	5	0.0	0.0	0.0	0.0	0.0	0.0	**-0.6**	0.0	0.0	0.0	0.0
SEP2016	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.0**	0.0	0.0	0.0
OCT2016	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**-0.6**	0.0	0.0
NOV2016	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**-0.6**	0.0
DEC2016	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.0**

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Four-Five Week Effect

- Important to control for fluctuations in the calendar
- Implemented w/ X-12-ARIMA in May 1996 (Cano et al.)
- Ten-year spans (standard CES input) will have few four (or five) week observation for each month
  - Potential for over-fitting the data

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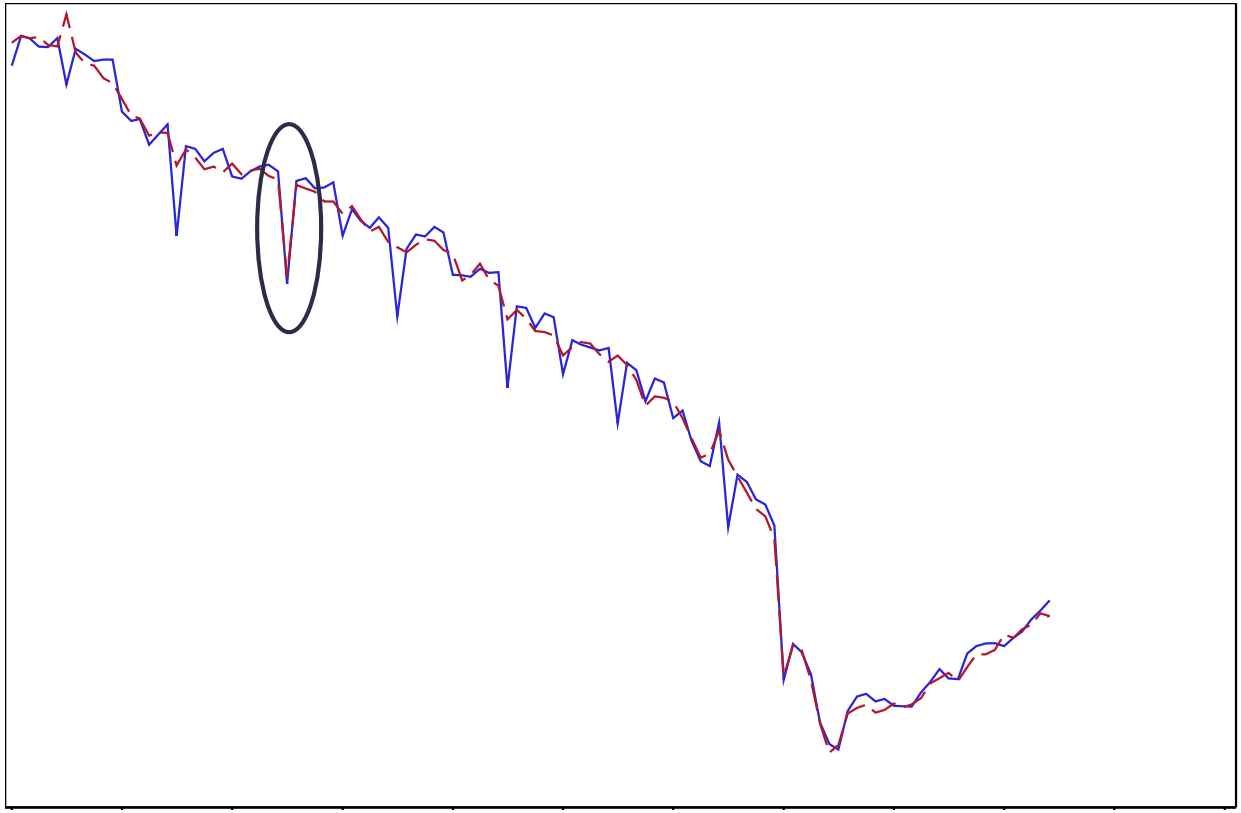
Ex. Michigan Durable Goods (Historical Problem)



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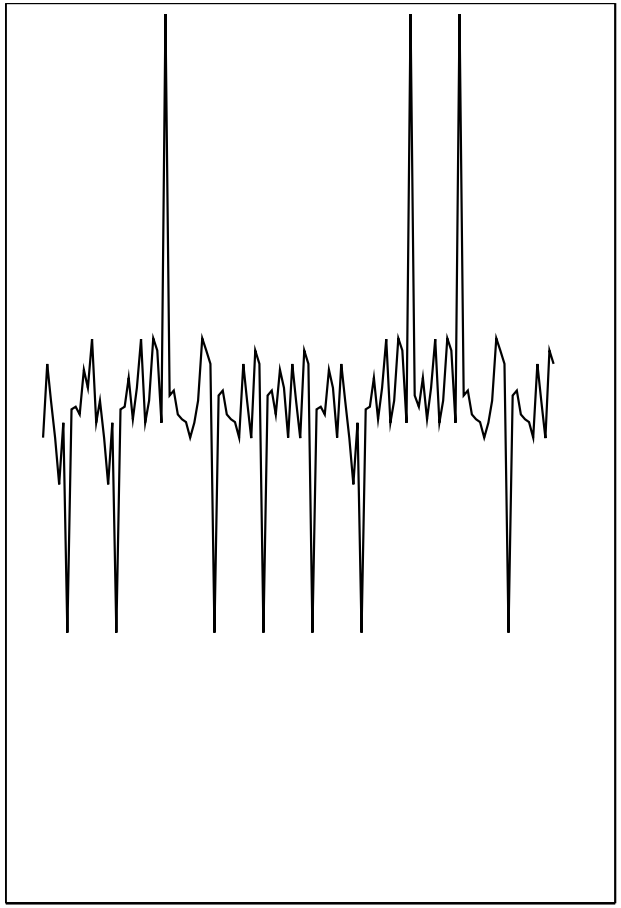

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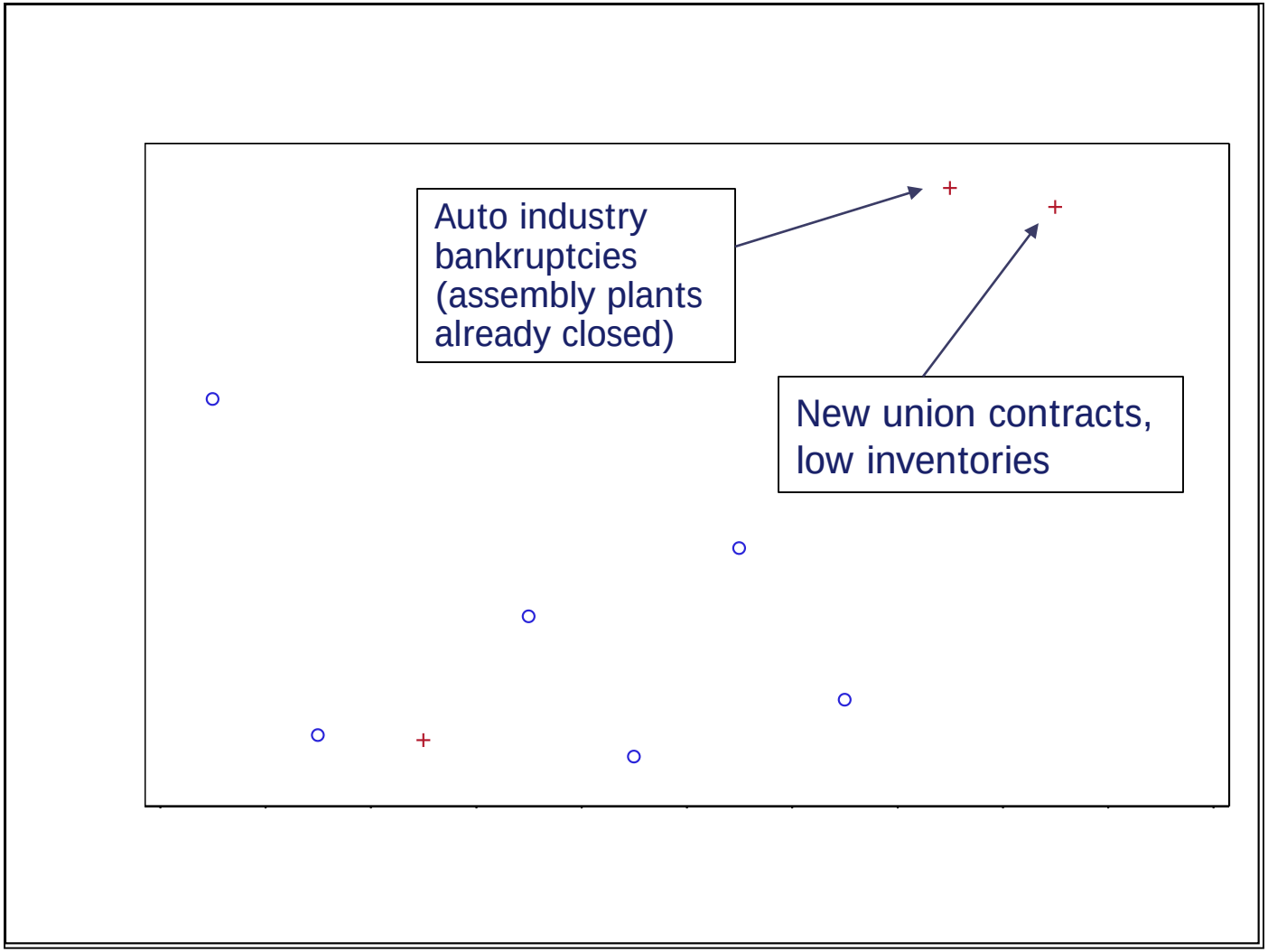

Historical Problems

- Similar issues found in some other series w/ heavy auto-industry concentration
  - Midwest state-level durable goods mfg.
  - Some metro area total nonfarm
- Search for other problem series
  - Decennial Census, hurricanes, etc.
  - Hard to know what's a problem if not SME
- Bad projected factors: mid-year changes

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Omitted Variables

Model 1 ("Short regression"):

$$Y_t = \tilde{\alpha}' M_t + \tilde{\beta}' X_{1,t} + Z_t$$

Model 2 ("Long regression"):

$$Y_t = \alpha' M_t + \beta' X_{1,t} + \gamma' X_{2,t} + Z_t$$

$M_t =$ Month variables

$X_{1,t} =$ Additive outliers, level shifts, interventions, &c.

$X_{2,t} =$ Other outliers and interventions not in Model 1

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Two-Stage Runs

- Potentially biased estimates of α when omitting $\gamma' X_2$
  - If calendar and omitted vars correlated
- Proposal: do two runs
  - First run without $\alpha' M_t$
    - Run auto outlier detection
  - Second run include $\alpha' M_t$
    - Use outliers from first run in regression spec
- Compare out-of-sample forecast
  - At series level and aggregate level

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Overall Results

- Slight improvement in forecasts overall
- Noticeable improvement in known decennial census effect
- When BIG differences: alternate run usually better
- Two-stage modeling doesn't have more outliers in model
  - Perhaps better ones
- A variant where series was prior-adjusted using outliers from first run produced very similar results

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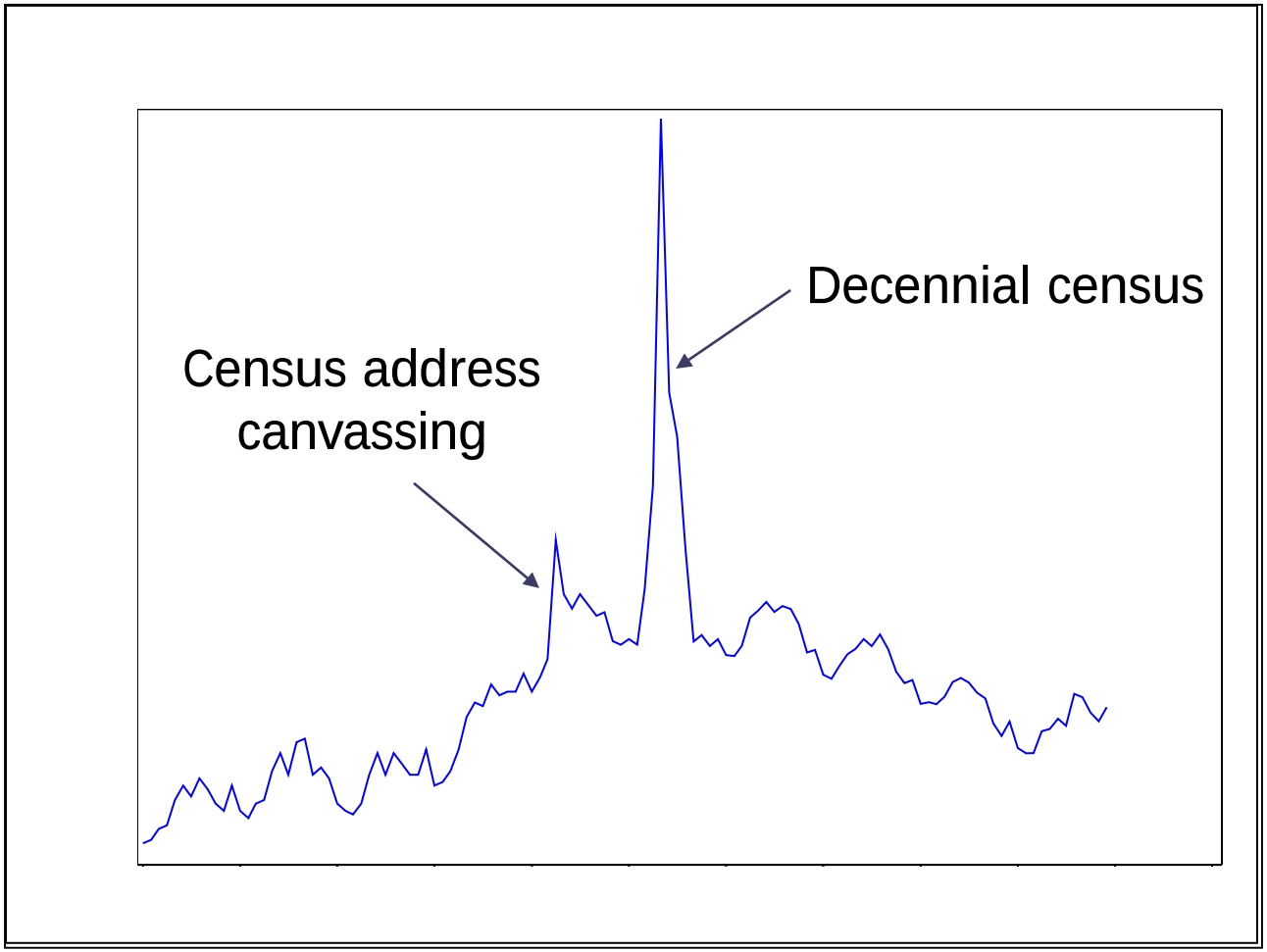
Ex. Nevada, Federal Govt.



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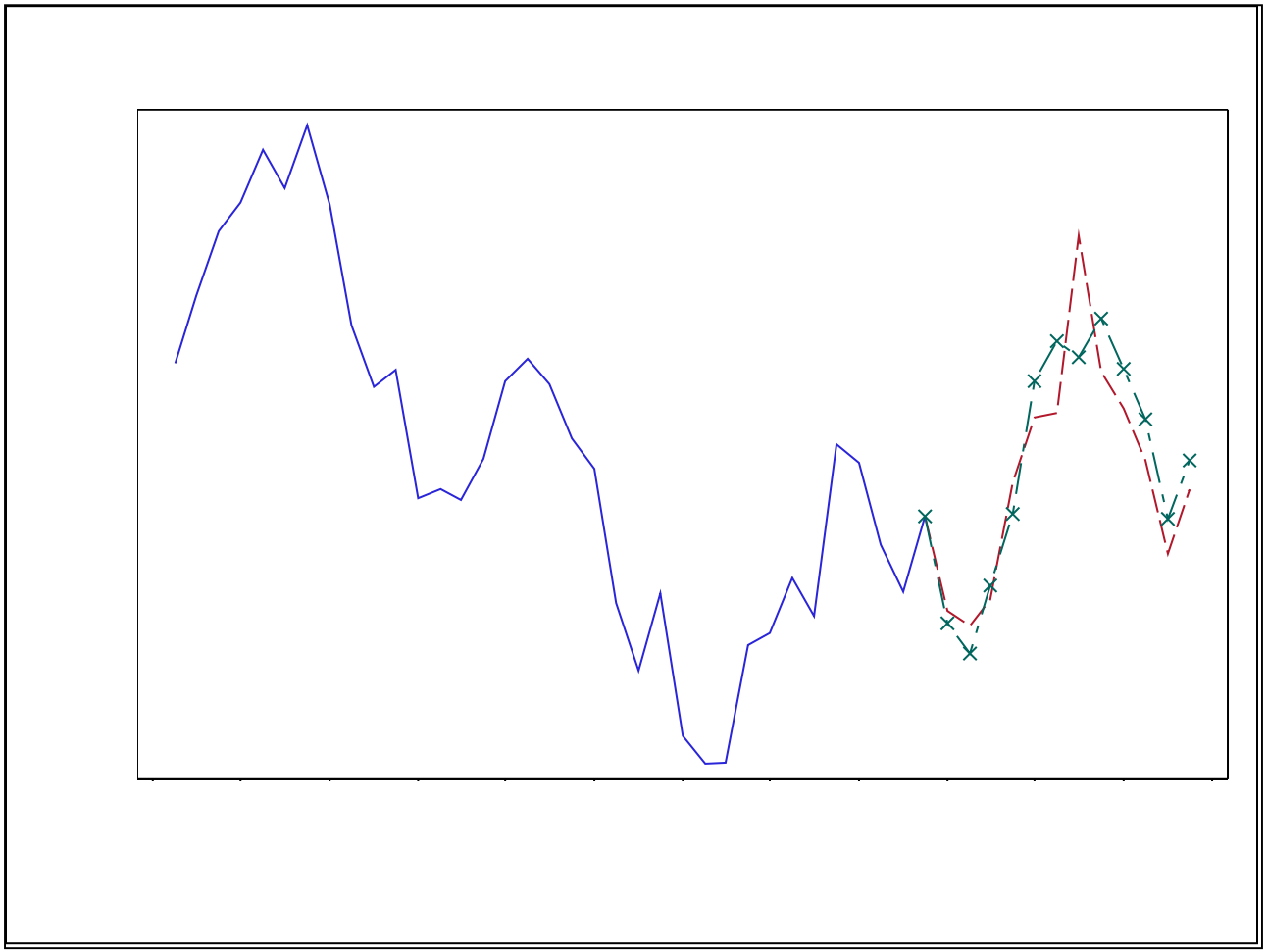

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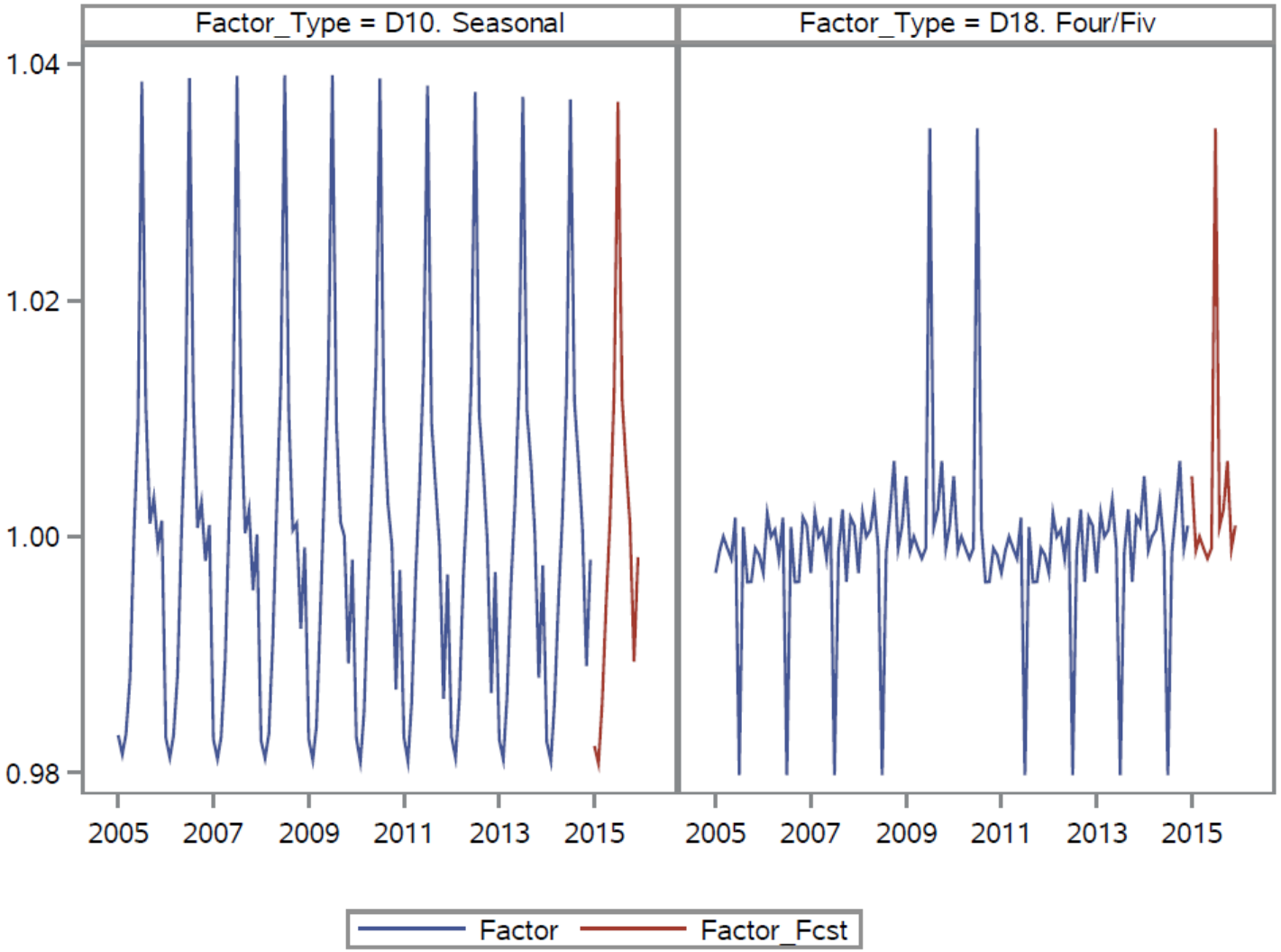

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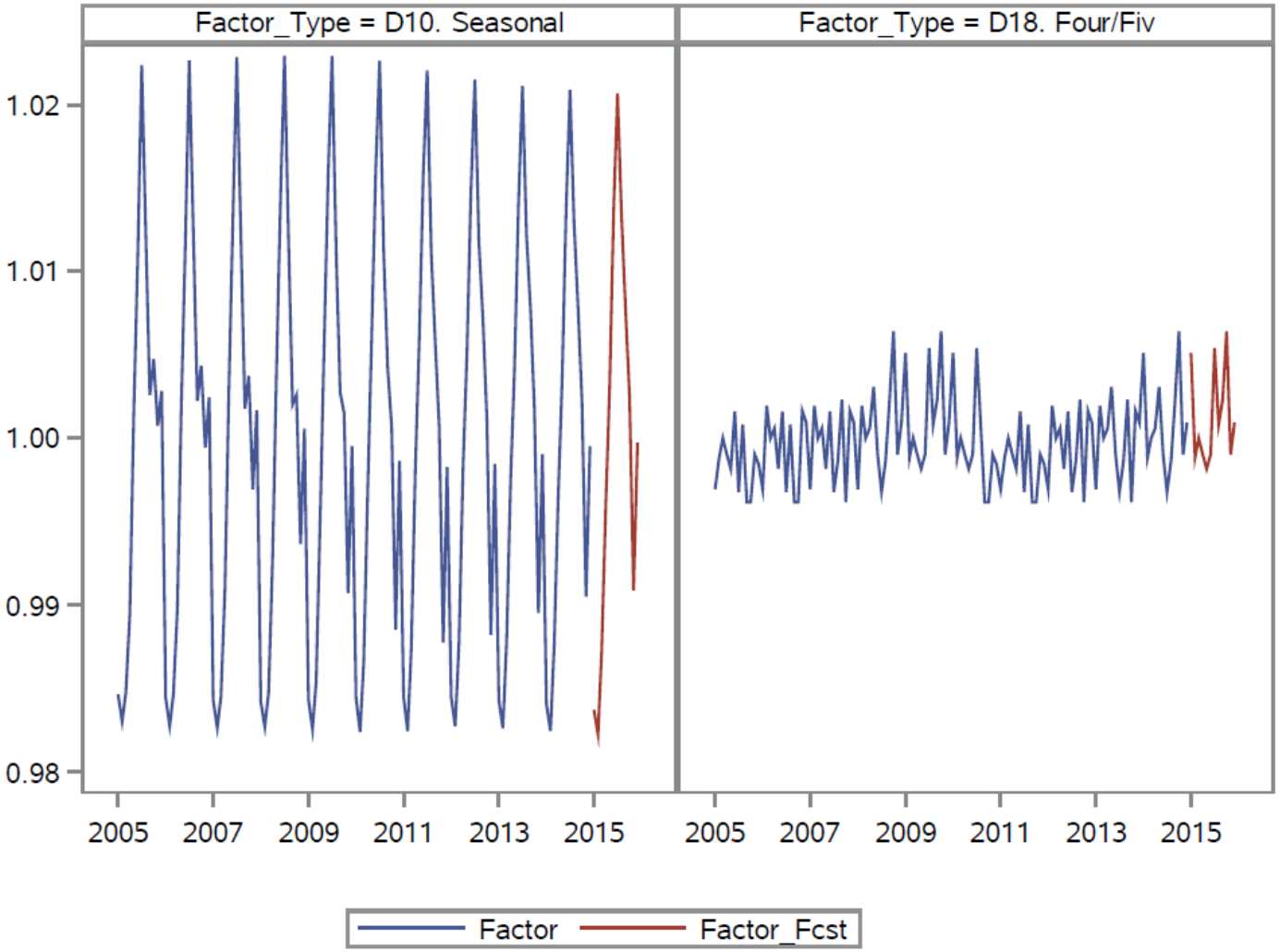

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Standard Run

Variable	Parameter Estimate	Standard Error	t-value
User-defined			
dum1	0.0016	0.00173	0.91
dum2	-0.0007	0.00153	-0.45
dum3	0.0018	0.00186	0.97
dum4	-0.0021	0.00184	-1.14
dum5	0.0033	0.00170	1.91
dum6	0.0118	0.00196	6.01
dum7	0.0004	0.00168	0.26
dum8	0.0021	0.00185	1.14
dum9	0.0029	0.00168	1.71
dum10	0.0010	0.00155	0.65
dum11	0.0004	0.00168	0.22
Automatically Identified Outliers			
AO2009.Apr	0.0414	0.00435	9.52
LS2010.Mar	0.0228	0.00543	4.19
AO2010.Apr	0.0375	0.00554	6.77
TC2010.May	0.1838	0.00693	26.51
LS2010.Jun	-0.0587	0.00599	-9.80
AO2010.Sep	-0.0261	0.00415	-6.28

Two-Stage Run

Variable	Parameter Estimate	Standard Error	t-value
User-defined			
dum1	0.0013	0.00207	0.64
dum2	0.0009	0.00181	0.49
dum3	-0.0008	0.00216	-0.37
dum4	-0.0014	0.00216	-0.63
dum5	0.0018	0.00199	0.90
dum6	0.0021	0.00259	0.80
dum7	0.0002	0.00201	0.08
dum8	0.0017	0.00213	0.82
dum9	0.0019	0.00204	0.96
dum10	0.0017	0.00189	0.88
dum11	-0.0003	0.00203	-0.16
Outliers Identified from Prior Run			
AO2009.Apr	0.0451	0.00518	8.72
LS2010.Apr	0.0417	0.00692	6.02
AO2010.May	0.1296	0.00495	26.17
LS2010.Aug	-0.0548	0.00742	-7.38
TC2010.Sep	-0.0401	0.00636	-6.30

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RMSE Ratios

- RMSER < 1 shows gain

$$RMSER = \frac{RMSE(r_t^B)}{RMSE(r_t^A)}$$

r=over-the-month growth rates
A=standard run
B=two-stage run

RMSE Ratios

	2013	2014	2015
All series	0.97	0.89	0.97
Federal only	0.91	0.84	0.89
Sum-of-States	1.08	0.99	1.06

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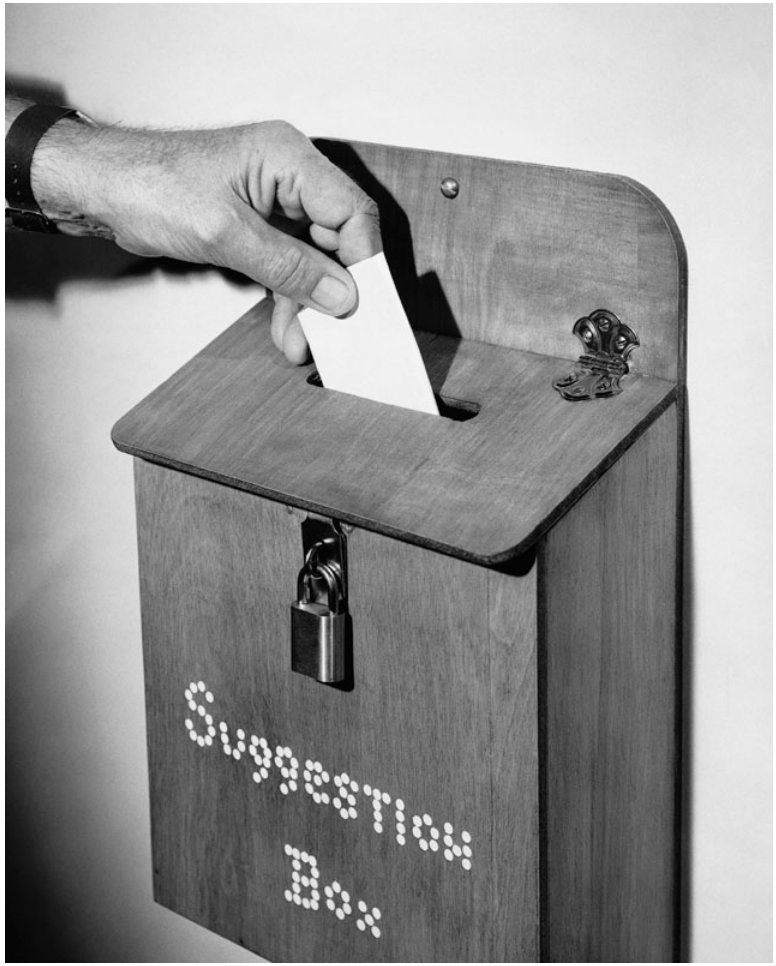
Takeaways

- Be careful when adjusting for calendar effects
  - Correlation of effect and other events causes OVB
- Alternate runs can help to screen for problems
  - Two-stage not a default for production
  - Visual screening may be effective
- Subjective prior adjustments or SME-chosen outliers should be considered

Questions/Comments?



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