Reliability Statistics for Quarterly Labor Productivity Estimates

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ASSA Meetings
January 4, 2021

Background

- Labor Productivity $= \frac{Output\ (BEA)}{Hours\ Worked\ (BLS)}$
- Hours are estimated by combining data from:
  - CES (W&S employment & PW hours)
  - CPS (self-employed & non-PW)
  - NCS (hours-worked-to-hours-paid ratio)

Sources of Revisions

- Collection of additional data (GDP and CES)
- Benchmarking of CES to QCEW
- Updating of seasonal factors (GDP, CES, CPS)
- Annual revisions to GDP data
- Comprehensive revisions to GDP data

News Releases

- Quarterly news release reports annualized LP growth
  - Preliminary estimate (prelim) – released about 40 days after end of reference quarter
  - First revised estimate (R1) – released about 30 days after prelim
  - Second revised estimate (R2) – released about 60 days after R1
  - Subsequent revised estimates (out of scope for this project) - incorporate all data revisions and methodology changes since R2

Calendar: Releases and Revisions

Month	PFEI Releases	Revision notes
Feb.	**Prelim** for Q4, **R2** for Q3	
March	**R1** for Q4	Incorporates the annual CES benchmark revision through Q4 of the previous year. This affects both current and prior quarter hours.
May	**Prelim** for Q1, **R2** for Q4	
June	**R1** for Q1	
Aug.	**Prelim** for Q2, **R2** for Q1	Both estimates incorporate the annual NIPA/GDP benchmark revision (current and prior quarter output).
Sept.	**R1** for Q2	
Nov.	**Prelim** for Q3, **R2** for Q2	
Dec.	**R1** for Q3	

Current Practice

- The quarterly LP releases provide reliability estimates for the preliminary LP indexes relative to the second revised estimate (R2)
  - No estimate for LP growth rate
  - No estimate for first revised estimate (R1)
- Our goal is to provide more information about how large revisions to LP growth are likely to be

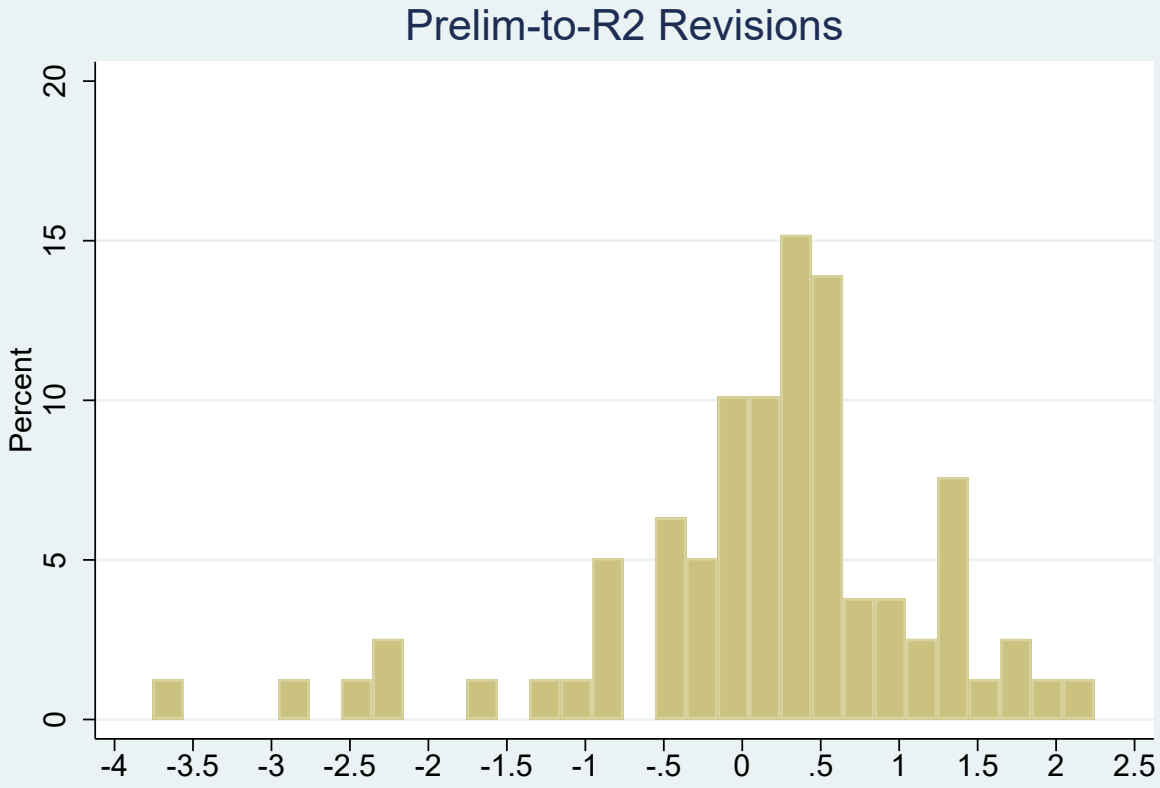
Scope of Project

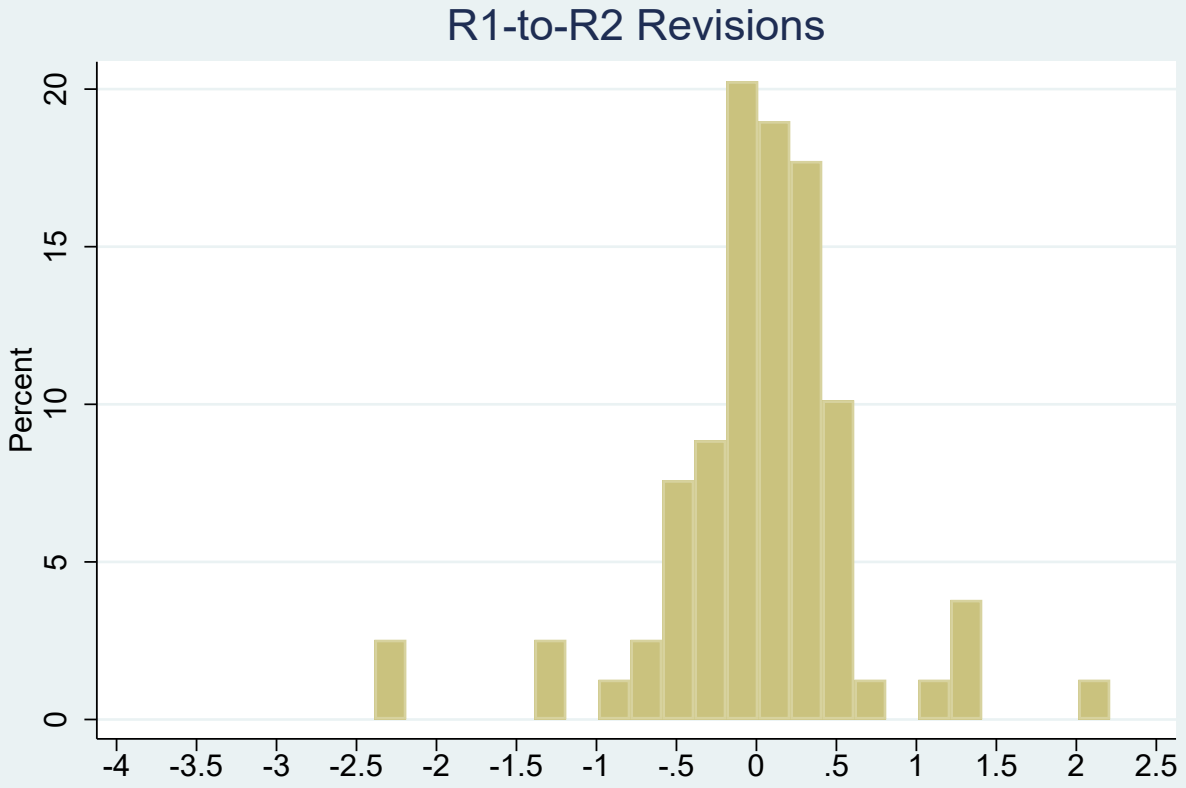
- Estimates of LP growth rates (not the LP index)
- We construct intervals for:
  - Prelim relative to R2
  - R1 relative to R2
- Quarterly data: 2000q1-2019q4 except 2018q4 (79 obs.)

Summary of Revisions

	Prelim-to-R2	R1-to-R2
Mean	0.14	0.04
Median	0.3	0.1
10^{th} Percentile	-1.1	-0.5
90^{th} Percentile	1.3	0.6
Std. Dev.	1.04	0.64
Skewness	-1.17	-0.76
Kurtosis	5.41	7.10
Sign Changes	7	6
Observations	79	79

Distribution of Revisions





Additional Analyses (see paper)

We found:

- No trend in revisions or in the absolute value of the revisions
- The size of the revision is not related to the value of the estimate (prelim or R1)
- The size of the average revision varies across quarters, but the differences are not statistically significant
- There is little difference between recession and non-recession quarters (except for a large negative revision of 3.8 percent in 2008q4)

Revisions to Estimates of LP Growth

- Revisions to output or revisions to hours?
- Revisions to current quarter or prior quarter?
- Decomposing the revisions can shed light on these questions

Decomposition of Revisions

- LP growth can be approximated as:

$$LP\ Growth_{t-1,t} \approx [\ln(Q_t) - \ln(Q_{t-1})] - [\ln(L_t) - \ln(L_{t-1})]$$

- where Q and L are indexes of output and hours
- This gives us a simple additive framework to analyze revisions
- $Revision = LP\ Growth^{R2}_{t-1,t} - LP\ Growth^{P}_{t-1,t}$

Decomposition of Revisions

- Rearranging terms, we have:

$$Revision =$$

$$[\ln(Q_t^{R2}) - \ln(Q_t^P)] \quad \text{Current quarter output}$$

$$-[\ln(Q_{t-1}^{R2}) - \ln(Q_{t-1}^P)] \quad \text{Prior quarter output}$$

$$-[\ln(L_t^{R2}) - \ln(L_t^P)] \quad \text{Current quarter hours}$$

$$+[\ln(L_{t-1}^{R2}) - \ln(L_{t-1}^P)] \quad \text{Prior quarter hours}$$

Decomposition of Prelim-to-R2 Revisions

	Average Revision to:				
	Output		Hours		
	Current Quarter	Previous Quarter	Current Quarter	Previous Quarter	Total
All Quarters	-0.16	-0.27	-0.06	-0.05	0.13
Q1	-1.29	-1.01	-0.15	-0.12	-0.25
Q2	0.25	-0.13	-0.11	0.00	0.49
Q3	0.38	0.02	0.32	0.18	0.22
Q4	0.04	0.04	-0.32	-0.25	0.07

Decomposition of R1-to-R2 Revisions

	Average Revision to:				
	Output		Hours		
	Current Quarter	Previous Quarter	Current Quarter	Previous Quarter	Total
All Quarters	-0.29	-0.30	0.00	0.02	0.03
Q1	-1.26	-1.07	-0.23	-0.16	-0.12
Q2	-0.04	-0.13	-0.05	0.00	0.14
Q3	0.04	0.01	0.29	0.26	-0.01
Q4	0.13	0.00	-0.03	-0.04	0.12

Communicating Revision Magnitudes

- Squared-deviation intervals:
  - Modified standard confidence interval (Fixler, et al)
  - Model (regression)-based intervals
- Percentile-based intervals (Fed IPI):
  - Simple percentiles
  - Nearest percentile
  - Weighted percentiles
- 70-, 80-, and 90-percent intervals

Comparing Performance – Cross Validation

- For each method:
  - Drop the first quarterly observation in the sample, and estimate an interval using the remaining 78 (N – 1) quarters
  - Repeat step (1) for the second quarterly observation and each successive observation

    ➔Interval for each observation
  - Calculate the percent of quarterly R2 estimates that fall within their respective intervals (hit rate)

Intervals for prelim-to-R2 Revisions

Method	90-percent Intervals		80-percent Intervals		70-percent Intervals	
	Interval Width*	Percent in Interval	Interval Width*	Percent in Interval	Interval Width*	Percent in Interval
Modified CI	3.41	89.9	2.66	84.8	2.15	76.0
Model-based	3.54	89.9	2.75	83.5	2.22	76.0
w/Q dummies	3.48	89.9	2.70	81.0	2.18	78.5
Percentile						
Simple	4.09	91.1	2.49	82.3	1.97	70.9
Nearest	3.79	88.6	2.38	81.0	1.75	69.6
Weighted	3.82	88.6	2.40	81.0	1.82	69.6

Intervals for R1-to-R2 Revisions

Method	90-percent intervals		80-percent intervals		70-percent intervals	
	Interval Width*	Percent in Interval	Interval Width*	Percent in Interval	Interval Width*	Percent in Interval
Modified CI	2.11	88.6	1.64	87.3	1.33	86.1
Model-based	2.18	89.9	1.69	87.3	1.37	87.3
w/Q dummies	2.20	88.6	1.71	87.3	1.38	83.5
Percentile						
Simple	2.59	92.4	1.18	81.0	0.90	78.5
Nearest	2.35	88.6	1.00	81.0	0.88	72.2
Weighted	2.37	88.6	1.04	81.0	0.89	72.2

What Should We Report?

- Weighted percentiles based on historical revisions
- 70-, 80-, and 90-percent intervals
- Data from previous 20 years

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