Evaluating County Population Forecast Errors for Florida and Beyond

Stefan Rayer and Ying Wang
Bureau of Economic and Business Research
University of Florida

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Background:

BEBR produces population projections for all counties in Florida each year.

We project county populations with four extrapolation methods:

- Linear
- Exponential
- Share-of-Growth
- Shift-Share

The specific methods and base periods used may change from year to year (e.g., we dropped the constant population method last year).

From these individual methods, we calculate various averages.

The final projection – usually a trimmed average – then gets controlled to a separately produced projection for the state.

Study Motivations / Questions:

How do these methods perform for projecting county populations?

How many years of base data to include? Should the base period be similar in length to the projection horizon? Should it be the same for all methods?

Are trimmed averages preferable to a simple average? How much trimming makes sense?

What about adjustments such as excluding institutional populations?

How to deal with negative projections (or run-away growth)?

How to apply the share-of-growth method when population change for a county has a different sign from state-level growth?

Data and Methods:

Study Period: 1980–2015.

Data: Census counts and intercensal estimates (BEBR and Census Bureau).

Base Periods: 1–25 years.

Projection Horizons: 1–25 years.

Total of 6,810 projections (base period, projection horizon, target year combinations) for each method.

	Horizon																								
Base	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**All**
1	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	550
2	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	525
3	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	500
4	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	475
5	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	450
6	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	425
7	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	400
8	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	375
9	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	350
10	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	325
11	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1		300
12	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1			276
13	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1				253
14	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1					231
15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1						210
16	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1							190
17	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1								171
18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1									153
19	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1										136
20	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1											120
21	14	13	12	11	10	9	8	7	6	5	4	3	2	1												105
22	13	12	11	10	9	8	7	6	5	4	3	2	1													91
23	12	11	10	9	8	7	6	5	4	3	2	1														78
24	11	10	9	8	7	6	5	4	3	2	1															66
25	10	9	8	7	6	5	4	3	2	1																55
All	550	525	500	475	450	425	400	375	350	325	300	276	253	231	210	190	171	153	136	120	105	91	78	66	55	6,810

Data and Methods (continued):

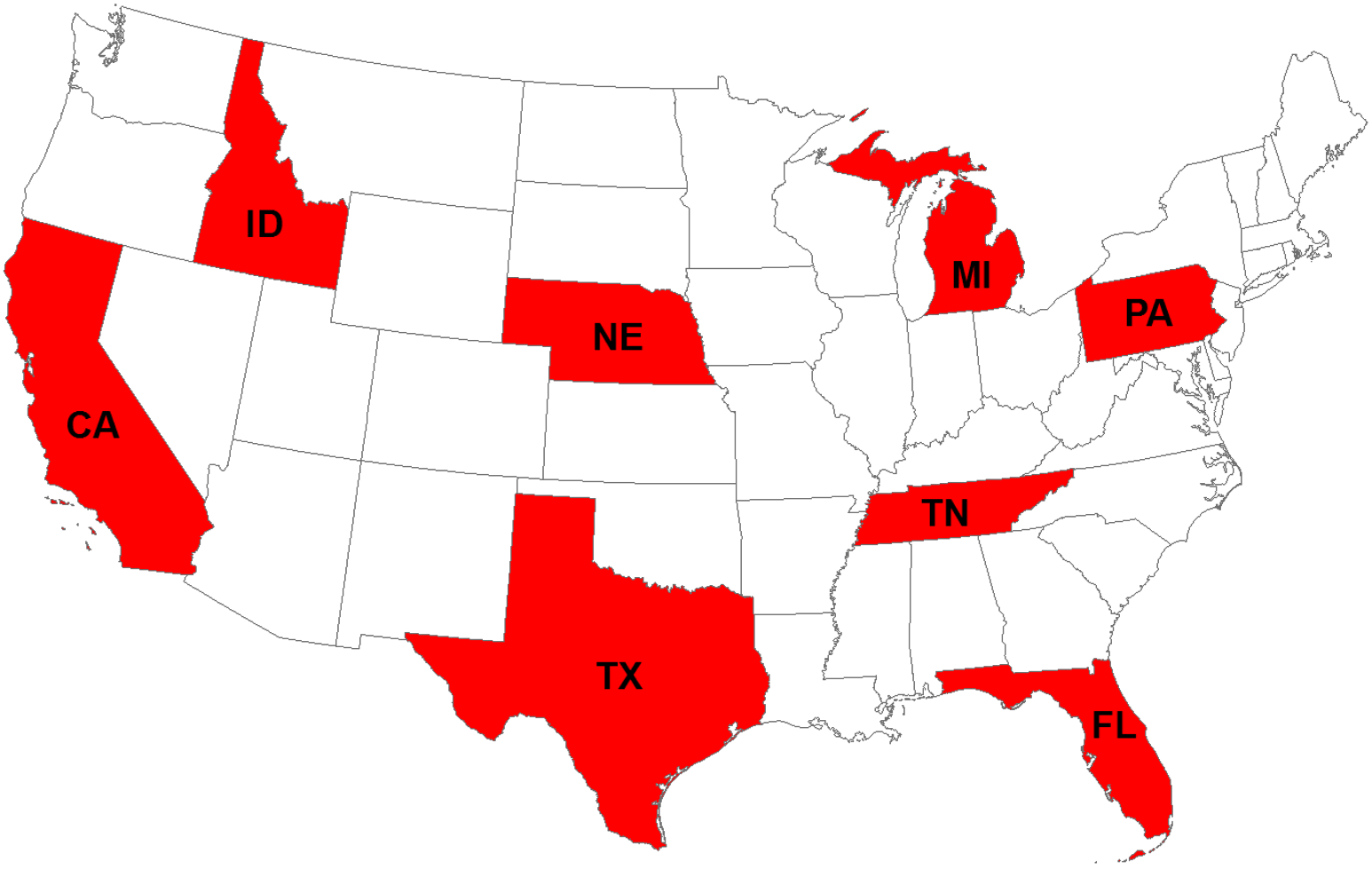
Six trend extrapolation methods, plus various averages:

- Linear
- Exponential
- Share-of-Growth
- Shift-Share
- Constant-Share
- Constant Population
- Overall Average & Trimmed Averages

Error Measures: MAPEs, MALPEs, MedAPEs, and MedALPEs.

Study Area: 67 counties in Florida, plus 694 counties in 7 other states.

Study Area: 761 Counties in 8 States



Data and Methods (continued):

Criteria for selecting these states:

- States cover all geographic regions of the country
- Wide range of county (and state) population sizes
- Wide range of county (and state) population growth rates
- Sufficient number of counties per state to allow for calculation of mean and median error measures
- No significant county boundary changes over study period

Study Area Population Characteristics:

	State Population		Median County Population		Median 1-Year Growth Rate		Number of
State	1980	2015	1980	2015	State	County	Counties
California	23,667,764	39,056,686	110,950	182,039	1.3	1.3	58
Florida	9,746,959	20,179,846	49,287	117,668	2.0	2.3	67
Idaho	944,127	1,649,899	10,602	12,943	1.7	0.8	44
Michigan	9,262,044	9,921,009	36,961	38,105	0.2	0.3	83
Nebraska	1,569,825	1,892,888	7,544	6,313	0.6	-0.3	93
Pennsylvania	11,864,720	12,800,319	83,578	87,096	0.2	0.1	67
Tennessee	4,591,023	6,587,169	24,595	31,489	0.9	0.6	95
Texas	14,225,512	27,346,605	14,641	18,513	1.9	0.6	254
8 States	75,871,974	119,434,421	20,717	27,375	1.4	0.5	761

Building a Suitable Model

Trend extrapolation projection models, while simple in mathematical form, require care in their application.

Each trend method has certain strengths and weaknesses.

Potential problems to look out for include:

- Run-away growth with the exponential method
- Negative projections, especially for longer horizons, for counties with declining populations (mainly with shift-share and linear)
- Applying the share-of-growth method when growth in the smaller area is in the opposite direction of growth in the larger area

Minimum/Maximum Brackets

Projections should not be negative!

A common approach is to set negative projections to zero.

While better than having negative projections, this is not ideal:

- County populations rarely go to zero
- It is a one-sided approach (i.e., it does not address run-away growth)

We developed minimum and maximum projection values, below or above which projected populations could not go.

These were based on actual growth rates experienced over the study period (~ 1st and 99th percentiles), and they vary by horizon length.

Min-Max Factors for Counties and States

	Counties																							
	Projection Horizon																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Max Factor	15.0	12.0	11.0	10.4	10.0	9.8	9.6	9.4	9.2	9.0	8.8	8.6	8.4	8.2	8.0	7.8	7.6	7.4	7.2	7.0	6.8	6.6	6.4	6.2	6.0
Min Factor	-12.0	-9.0	-7.5	-6.5	-6.0	-5.5	-5.0	-4.6	-4.3	-4.0	-3.8	-3.6	-3.4	-3.2	-3.0	-2.9	-2.8	-2.7	-2.6	-2.5	-2.4	-2.3	-2.2	-2.1	-2.0
100	115	125	137	149	161	175	190	205	221	237	253	269	285	301	317	333	347	361	375	387	398	408	417	424	429
100	88	83	79	76	73	71	70	69	67	66	65	64	64	63	63	62	62	61	61	60	60	60	60	60	60
	States																							
	Projection Horizon																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Max Factor	4.0	3.7	3.5	3.3	3.2	3.1	3.1	3.0	2.9	2.9	2.9	2.8	2.8	2.7	2.7	2.7	2.6	2.6	2.5	2.5	2.5	2.4	2.4	2.4	2.4
Min Factor	-1.0	-0.8	-0.7	-0.6	-0.5	-0.4	-0.3	-0.3	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
100	104	107	111	114	117	120	123	127	130	133	136	140	143	146	149	152	155	158	161	164	167	170	173	176	179
100	99	98	98	98	98	98	98	98	98	98	98	98	98	98	99	99	99	99	99	99	99	99	100	100	100

Absolute Errors, Exponential Method: Idaho

	MAPE (Original)					MAPE (Min-Max)					(Min-Max) vs. (Original): MAPE				
	Horizon					Horizon					Horizon				
Base	5	10	15	20	25	5	10	15	20	25	5	10	15	20	25
1	7.8	17.0	28.9	60.2	168.0	7.6	15.6	23.2	33.6	34.7	-0.2	-1.4	-5.7	-26.6	-133.3
2	7.1	15.2	26.1	45.8	89.3	7.0	14.2	22.4	31.5	33.0	-0.2	-1.0	-3.7	-14.3	-56.2
3	7.1	14.4	23.7	36.5	55.7	7.0	13.9	21.8	29.6	31.8	-0.1	-0.5	-1.9	-6.9	-23.9
4	7.0	13.6	22.0	30.3	39.1	7.0	13.5	21.4	27.7	30.8	0.0	-0.1	-0.6	-2.6	-8.3
5	6.9	13.3	21.3	27.4	33.8	6.9	13.3	21.0	26.3	30.0	0.0	0.0	-0.2	-1.1	-3.7
6	6.8	13.0	20.8	25.3	31.3	6.8	13.0	20.7	24.8	29.4	0.0	0.0	-0.1	-0.5	-1.9
7	6.8	12.6	20.1	23.2	29.8	6.8	12.6	20.0	22.9	28.4	0.0	0.0	-0.1	-0.3	-1.4
8	6.7	12.0	18.9	21.5	28.2	6.7	12.0	18.8	21.2	27.2	0.0	0.0	-0.1	-0.2	-1.0
9	6.4	11.2	17.5	20.0	27.1	6.4	11.2	17.5	19.8	26.4	0.0	0.0	0.0	-0.2	-0.7
10	6.0	10.3	16.0	18.3	25.5	6.0	10.3	16.0	18.2	25.1	0.0	0.0	0.0	-0.1	-0.5
	MedAPE (Original)					MedAPE (Min-Max)					(Min-Max) vs. (Original): MedAPE				
	Horizon Length					Horizon					Horizon				
Base	5	10	15	20	25	5	10	15	20	25	5	10	15	20	25
1	5.9	12.7	18.7	27.4	30.8	5.9	12.7	18.6	27.0	29.0	0.0	0.0	-0.1	-0.4	-1.8
2	5.5	11.4	18.3	26.0	29.6	5.5	11.4	18.2	25.6	27.8	0.0	0.0	-0.1	-0.4	-1.8
3	5.7	11.6	18.3	26.2	30.9	5.7	11.6	18.3	25.7	29.2	0.0	0.0	0.0	-0.4	-1.7
4	5.8	11.5	17.9	24.8	29.8	5.8	11.5	17.9	24.7	28.7	0.0	0.0	0.0	-0.1	-1.1
5	5.8	11.5	17.9	23.4	28.9	5.8	11.5	17.9	23.4	28.3	0.0	0.0	0.0	0.0	-0.6
6	5.8	11.7	18.0	22.8	29.2	5.8	11.7	18.0	22.8	28.9	0.0	0.0	0.0	0.0	-0.3
7	5.8	11.3	17.1	21.7	28.1	5.8	11.3	17.1	21.7	28.0	0.0	0.0	0.0	0.0	-0.1
8	5.8	10.4	15.7	19.7	26.6	5.8	10.4	15.7	19.7	26.6	0.0	0.0	0.0	0.0	0.0
9	5.6	9.6	14.5	18.8	25.6	5.6	9.6	14.5	18.8	25.6	0.0	0.0	0.0	0.0	0.0
10	5.1	8.7	12.8	16.8	23.7	5.1	8.7	12.8	16.8	23.7	0.0	0.0	0.0	0.0	0.0

Absolute Errors, Shift-Share Method: Michigan

	MAPE (Original)					MAPE (Min-Max)					(Min-Max) vs. (Original): MAPE				
	Horizon					Horizon					Horizon				
Base	5	10	15	20	25	5	10	15	20	25	5	10	15	20	25
1	3.5	8.0	13.6	17.8	19.4	3.4	7.6	12.6	15.9	17.0	-0.1	-0.4	-1.0	-1.9	-2.4
2	3.1	7.7	13.4	17.1	18.3	3.1	7.3	12.4	15.3	15.7	-0.1	-0.4	-1.1	-1.9	-2.6
3	3.2	7.8	13.3	16.7	17.5	3.1	7.4	12.4	14.8	14.8	0.0	-0.4	-1.0	-1.8	-2.7
4	3.2	7.9	13.2	15.9	16.4	3.2	7.6	12.5	14.6	14.2	0.0	-0.2	-0.7	-1.3	-2.2
5	3.3	7.9	13.0	15.2	15.2	3.3	7.8	12.5	14.2	13.5	0.0	-0.1	-0.5	-0.9	-1.7
6	3.4	8.0	12.7	14.4	14.2	3.4	8.0	12.5	13.8	12.9	0.0	0.0	-0.2	-0.6	-1.2
7	3.5	8.1	12.4	13.5	13.1	3.5	8.1	12.3	13.2	12.4	0.0	0.0	-0.1	-0.3	-0.8
8	3.6	8.1	12.1	12.8	12.3	3.6	8.1	12.1	12.7	11.8	0.0	0.0	0.0	-0.1	-0.4
9	3.6	8.1	11.9	12.2	11.7	3.6	8.1	11.9	12.1	11.5	0.0	0.0	0.0	-0.1	-0.1
10	3.7	8.1	11.6	11.5	11.0	3.7	8.1	11.6	11.4	11.0	0.0	0.0	0.0	-0.1	0.0
	MedAPE (Original)					MedAPE (Min-Max)					(Min-Max) vs. (Original): MedAPE				
	Horizon Length					Horizon					Horizon				
Base	5	10	15	20	25	5	10	15	20	25	5	10	15	20	25
1	2.6	6.3	10.8	14.0	15.3	2.5	5.9	10.0	12.6	13.3	-0.1	-0.4	-0.8	-1.4	-2.0
2	2.4	6.1	10.9	14.0	15.0	2.3	5.7	10.0	12.3	12.2	0.0	-0.4	-0.9	-1.7	-2.8
3	2.5	6.2	10.7	14.0	15.0	2.5	5.9	9.9	12.5	12.2	0.0	-0.3	-0.8	-1.5	-2.8
4	2.5	6.3	10.9	13.5	14.4	2.5	6.1	10.3	12.5	12.0	0.0	-0.2	-0.6	-1.0	-2.4
5	2.6	6.5	10.9	12.5	12.9	2.6	6.4	10.6	11.8	11.4	0.0	-0.1	-0.4	-0.7	-1.4
6	2.7	6.6	10.6	11.6	11.4	2.7	6.6	10.5	11.2	10.6	0.0	0.0	-0.1	-0.4	-0.7
7	2.8	6.6	10.4	10.9	10.9	2.8	6.6	10.4	10.7	10.3	0.0	0.0	0.0	-0.2	-0.6
8	2.9	6.6	10.0	10.0	10.0	2.9	6.6	10.0	9.9	9.7	0.0	0.0	0.0	0.0	-0.4
9	3.0	6.6	10.0	9.1	9.4	3.0	6.6	10.0	9.1	9.6	0.0	0.0	0.0	0.0	0.2
10	3.0	6.5	9.5	8.7	8.2	3.0	6.5	9.5	8.7	8.2	0.0	0.0	0.0	0.0	0.0

Minimum/Maximum Brackets: Results

Applying a lower and an upper bound to the projections improved forecast precision virtually everywhere.

Improvements in precision were more noticeable in the MAPEs than the MedAPEs.

Improvements in precision were more noticeable for longer horizons, and for states with many declining or fast growing counties.

The results for forecast bias were similar, though there were a few instances where bias increased.

Using min-max brackets resulted in more reasonable projections overall.

We plan to use them in the future.

Refining Share-of-Growth: The Plus-Minus Method

The share-of-growth method often produces quite accurate projections.

It projects as follows: Each county's share of state population growth in the future will be the same as its share during the base period.

The share-of-growth method struggles when county population change is in the opposite direction of state growth.

In that scenario, if growth in the state increases, a declining county is projected to lose more population.

This does not make sense. If statewide growth increases, one would expect a declining county to lose less population, or maybe even start growing.

The plus-minus method has been proposed as a fix for such a scenario.

Plus-Minus Method: 25-Year Projection for Idaho

	Estimate		Change	% Ch.	Share				Proj. 2014		Pop. Change 89–14		Estimate	ALPE	
County	1984	1989	84–89	84–89	Original	Sub[i]	Abs(Sub)[ii]	P/M[iii]	Original	P/M	Original	P/M	2014	Original	P/M
…															
Madison	21,857	23,397	1,541	7.05	0.4239	0.4239	0.4239	0.0619	293,422	62,841	270,025	39,444	37,958	673.0	65.6
Minidoka	20,959	19,403	-1,557	-7.43	-0.4283	-0.0024	0.0024	-0.0045	-253,426	16,517	-272,829	-2,886	20,307	-1,348.0	-18.7
…															
Idaho	988,597	992,232	3,635	0.37	1.0000	7.2662	7.3381	1.0000	1,629,301	1,629,301	637,069	637,069	1,629,301		

		Original	P/M
MALPE		-843.1	-15.3
MedALPE		-388.1	-23.9

SUM	7.2662	= SUM of (Sub)
ABSUM	7.3381	= SUM of Abs(Sub)
CNTLCHG	1	
POSFACTOR	0.1461	= (ABSUM + (CNTLCHG - SUM)) ÷ ABSUM
NEGFACTOR	1.8539	= (ABSUM - (CNTLCHG - SUM)) ÷ ABSUM
Factor	175.3	= Projected Statewide Change ÷ Base Period Statewide Change

[i] = If (Share-Original) < 0, (Share-Original ÷ Factor), (Share-Original)

[ii] = Absolute value of (Sub)

[iii] = If (Sub) > 0, (Sub) × POSFACTOR, (Sub) × NEGFACTOR

Plus-Minus Method: 25-Year Projection for Idaho

	Estimate		Change	% Ch.	Share				Proj. 2014		Pop. Change 89–14		Estimate	ALPE	
County	1984	1989	84–89	84–89	Original	Sub[i]	Abs(Sub)[ii]	P/M[iii]	Original	P/M	Original	P/M	2014	Original	P/M
…															
Madison	21,857	23,397	1,541	7.05	0.4239	0.4239	0.4239	0.0619	293,422	62,841	270,025	39,444	37,958	673.0	65.6
Minidoka	20,959	19,403	-1,557	-7.43	-0.4283	-0.0024	0.0024	-0.0045	-253,426	16,517	-272,829	-2,886	20,307	-1,348.0	-18.7
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[i] = If (Share-Original) < 0, (Share-Original ÷ Factor), (Share-Original)

[ii] = Absolute value of (Sub)

[iii] = If (Sub) > 0, (Sub) × POSFACTOR, (Sub) × NEGFACTOR

Plus-Minus Method: 25-Year Projection for Idaho

	Estimate		Change	% Ch.		Share			Proj. 2014		Pop. Change 89–14		Estimate	ALPE	
County	1984	1989	84–89	84–89	Original	Sub[i]	Abs(Sub)[ii]	P/M[iii]	Original	P/M	Original	P/M	2014	Original	P/M
…															
Madison	21,857	23,397	1,541	7.05	0.4239	0.4239	0.4239	0.0619	293,422	62,841	270,025	39,444	37,958	673.0	65.6
Minidoka	20,959	19,403	-1,557	-7.43	-0.4283	-0.0024	0.0024	-0.0045	-253,426	16,517	-272,829	-2,886	20,307	-1,348.0	-18.7
…															
Idaho	988,597	992,232	3,635	0.37	1.0000	7.2662	7.3381	1.0000	1,629,301	1,629,301	637,069	637,069	1,629,301		

		Original	P/M
MALPE		-843.1	-15.3
MedALPE		-388.1	-23.9

SUM	7.2662	= SUM of (Sub)
ABSUM	7.3381	= SUM of Abs(Sub)
CNTLCHG	1	
POSFACTOR	0.1461	= (ABSUM + (CNTLCHG - SUM)) ÷ ABSUM
NEGFACTOR	1.8539	= (ABSUM - (CNTLCHG - SUM)) ÷ ABSUM

Factor	175.3	= Projected Statewide Change ÷ Base Period Statewide Change

[i] = If (Share-Original) < 0, (Share-Original ÷ Factor), (Share-Original)

[ii] = Absolute value of (Sub)

[iii] = If (Sub) > 0, (Sub) × POSFACTOR, (Sub) × NEGFACTOR

Plus-Minus Method: 25-Year Projection for Idaho

	Estimate		Change	% Ch.	Share				Proj. 2014		Pop. Change 89–14		Estimate	ALPE	
County	1984	1989	84–89	84–89	Original	Sub[i]	Abs(Sub)[ii]	P/M[iii]	Original	P/M	Original	P/M	2014	Original	P/M
…															
Madison	21,857	23,397	1,541	7.05	0.4239	0.4239	0.4239	0.0619	293,422	62,841	270,025	39,444	37,958	673.0	65.6
Minidoka	20,959	19,403	-1,557	-7.43	-0.4283	-0.0024	0.0024	-0.0045	-253,426	16,517	-272,829	-2,886	20,307	-1,348.0	-18.7
…															
Idaho	988,597	992,232	3,635	0.37	1.0000	7.2662	7.3381	1.0000	1,629,301	1,629,301	637,069	637,069	1,629,301		

			Original	P/M
SUM	7.2662	= SUM of (Sub)	MALPE	-843.1	-15.3
ABSUM	7.3381	= SUM of Abs(Sub)	MedALPE	-388.1	-23.9
CNTLCHG	1				
POSFACTOR	0.1461	= (ABSUM + (CNTLCHG - SUM)) ÷ ABSUM			
NEGFACTOR	1.8539	= (ABSUM - (CNTLCHG - SUM)) ÷ ABSUM			
Factor	175.3	= Projected Statewide Change ÷ Base Period Statewide Change			

[i] = If (Share-Original) < 0, (Share-Original ÷ Factor), (Share-Original)

[ii] = Absolute value of (Sub)

[iii] = If (Sub) > 0, (Sub) × POSFACTOR, (Sub) × NEGFACTOR

Plus-Minus Method (x2): 25-Year Projection for Idaho

	Estimate		Change	% Ch.	Share				Proj. 2014		Pop. Change 89–14		Estimate	ALPE	
County	1984	1989	84–89	84–89	Original	Sub[i]	Abs(Sub)[ii]	P/M[iii]	Original	P/M	Original	P/M	2014	Original	P/M
…															
Madison	21,857	23,397	1,541	7.05	0.4239	0.4239	0.4239	0.0600	293,422	61,611	270,025	38,214	37,958	673.0	62.3
Minidoka	20,959	19,403	-1,557	-7.43	-0.4283	-0.0012	0.0012	-0.0023	-253,426	17,956	-272,829	-1,446	20,307	-1,348.0	-11.6
…															
Idaho	988,597	992,232	3,635	0.37	1.0000	7.2842	7.3202	1.0000	1,629,301	1,629,301	637,069	637,069	1,629,301		

			Original	P/M
SUM	7.2842	= SUM of (Sub)	MALPE	-843.1	-10.9
ABSUM	7.3202	= SUM of Abs(Sub)	MedALPE	-388.1	-17.3
CNTLCHG	1				
POSFACTOR	0.1415	= (ABSUM + (CNTLCHG - SUM)) ÷ ABSUM			
NEGFACTOR	1.8585	= (ABSUM - (CNTLCHG - SUM)) ÷ ABSUM			
Factor x2	350.6	= (Projected Statewide Change ÷ Base Period Statewide Change) × 2			

[i] = If (Share-Original) < 0, (Share-Original ÷ Factor), (Share-Original)

[ii] = Absolute value of (Sub)

[iii] = If (Sub) > 0, (Sub) × POSFACTOR, (Sub) × NEGFACTOR

Plus-Minus Method: Results

Applying the plus-minus adjustment to the share-of-growth method improved forecast accuracy almost everywhere.

Improvements in accuracy were strongest in states that had many declining counties.

Even in states where the plus-minus adjustment had little impact on overall accuracy (e.g., California and Florida), it improved the projections for individual counties that were declining.

We recommend using the plus-minus adjustment whenever population growth for a county is in the opposite direction of that of the state.

Plus-Minus Method: Issues to Consider

There are many different options for implementing the plus-minus adjustment.

P/M adjustment requires experimentation with what works best.

We tried several different specifications, such as doubling the factor. There were some differences, but applying P/M vs. no P/M had a much bigger impact on forecast accuracy than the particular P/M specification.

P/M needs a different implementation when state growth is negative.

P/M in its current form causes declining counties to decline less, but it does not allow for population growth for these counties.

Next Steps

This presentation just covered the initial aspects of our analysis.

We have started evaluating forecast accuracy by projection technique, by horizon and base period length, by size and growth rate, and for the different states.

The vast amount of data and results are a challenge to process, interpret, and present.

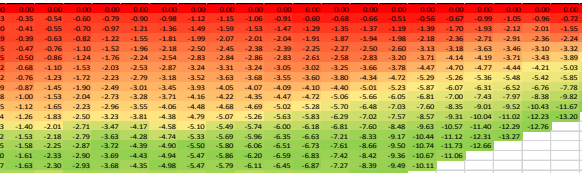
We are still trying to figure out how to condense this plethora of information, and how to present our findings visually.

	Median Absolute Percent Errors (MedAPEs): **Texas - Linear**																							
	Horizon																							
Base	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	1.0	1.8	2.9	4.0	5.2	6.3	7.6	8.8	9.9	10.9	11.8	12.5	13.4	14.2	15.2	16.3	17.4	18.8	19.9	21.1	22.3	23.3	24.6	26.3	27.4
2	0.9	1.7	2.6	3.7	4.6	5.7	6.8	7.9	8.9	9.8	10.6	11.5	12.5	13.6	14.5	15.7	16.9	18.2	19.2	20.1	21.2	22.4	23.9	25.6	26.6
3	0.9	1.7	2.7	3.6	4.6	5.6	6.6	7.6	8.5	9.4	10.2	11.0	11.9	12.9	13.8	15.0	16.2	17.4	18.2	19.1	20.1	21.3	23.1	24.1	24.6
4	1.0	1.8	2.7	3.6	4.5	5.5	6.4	7.2	8.1	8.9	9.7	10.5	11.4	12.3	13.3	14.4	15.4	16.6	17.5	18.4	19.3	21.0	22.4	23.0	22.9
5	1.0	1.8	2.6	3.5	4.4	5.2	6.1	6.8	7.7	8.4	9.3	10.2	11.0	11.9	12.9	13.8	14.8	15.7	16.7	17.4	18.8	20.2	21.3	21.8	21.3
6	1.0	1.8	2.6	3.5	4.3	5.1	5.8	6.5	7.3	8.1	8.9	9.7	10.6	11.6	12.6	13.5	14.2	15.1	15.7	16.9	18.5	19.9	20.7	20.5	20.3
7	1.0	1.8	2.5	3.3	4.1	4.8	5.6	6.3	7.0	7.6	8.4	9.3	10.4	11.1	11.9	12.7	13.6	14.3	15.2	16.3	17.8	19.1	19.6	19.6	18.6
8	1.0	1.7	2.4	3.2	3.9	4.6	5.4	6.0	6.7	7.4	8.1	8.9	9.9	10.6	11.4	12.0	12.7	13.5	14.6	15.7	16.8	17.9	18.8	18.3	17.2
9	1.0	1.7	2.4	3.1	3.7	4.4	5.1	5.8	6.4	7.0	7.7	8.5	9.3	10.1	10.8	11.3	12.2	12.9	13.8	14.8	15.7	16.6	16.8	16.3	14.7
10	0.9	1.6	2.3	3.0	3.6	4.3	4.9	5.5	6.2	6.7	7.5	8.2	8.9	9.4	10.1	10.7	11.4	12.0	12.9	13.6	14.3	14.9	14.8	14.2	13.9
11	0.9	1.6	2.2	2.9	3.5	4.1	4.6	5.2	5.8	6.4	7.1	7.8	8.4	8.9	9.5	9.9	10.4	11.2	11.5	12.1	12.7	12.9	12.9	12.6	
12	0.9	1.5	2.1	2.7	3.3	3.8	4.4	5.0	5.5	6.1	6.7	7.3	7.8	8.3	8.9	9.3	9.8	10.2	10.6	11.0	11.2	11.1	11.4		
13	0.9	1.5	2.0	2.6	3.2	3.6	4.1	4.6	5.3	5.8	6.3	6.8	7.4	8.0	8.4	8.7	8.9	9.2	9.3	9.7	10.0	10.6			
14	0.9	1.4	1.9	2.5	3.0	3.5	4.0	4.5	5.1	5.6	6.1	6.6	7.1	7.5	8.0	8.0	8.2	8.3	8.8	8.8	9.0				
15	0.8	1.4	1.9	2.4	2.9	3.5	3.9	4.4	5.0	5.4	6.0	6.5	6.9	7.4	7.6	7.7	7.9	8.1	8.2	8.4					
16	0.8	1.3	1.9	2.4	2.8	3.4	3.9	4.4	4.9	5.4	5.9	6.3	6.8	7.3	7.7	7.9	8.1	8.1	8.8						
17	0.8	1.3	1.9	2.4	2.9	3.4	3.9	4.4	4.9	5.4	6.0	6.4	7.0	7.3	7.9	8.0	7.9	8.7							
18	0.9	1.3	1.9	2.4	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.7	7.1	7.6	8.0	7.7	7.7								
19	0.9	1.4	1.9	2.5	3.0	3.5	4.0	4.6	5.1	5.7	6.2	6.8	7.3	7.8	8.4	8.1									
20	0.9	1.4	2.0	2.5	3.0	3.5	4.1	4.7	5.2	5.7	6.2	6.8	7.4	7.9	8.3										
21	0.9	1.4	2.0	2.5	3.0	3.6	4.2	4.7	5.2	5.7	6.3	6.9	7.5	7.8											
22	0.9	1.4	2.0	2.5	3.1	3.7	4.2	4.8	5.4	5.8	6.3	6.9	7.5												
23	0.9	1.4	2.0	2.5	3.1	3.7	4.3	4.8	5.3	5.7	6.0	6.4													
24	0.9	1.4	2.0	2.6	3.1	3.7	4.3	4.7	5.2	5.7	6.1														
25	0.9	1.4	2.1	2.6	3.1	3.7	4.3	4.8	5.0	5.4															

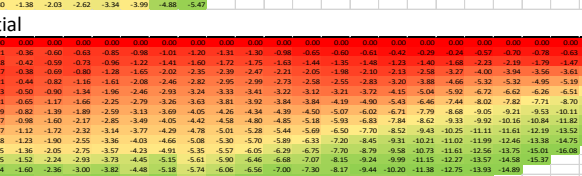
	Median Absolute Percent Errors (MedAPEs) – Deviation from Maximum Error: **Texas - Linear**																							
	Horizon																							
Base	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	-0.1	-0.1	-0.2	-0.3	-0.5	-0.6	-0.8	-0.9	-1.0	-1.1	-1.2	-1.1	-0.9	-0.6	-0.7	-0.7	-0.5	-0.6	-0.7	-1.0	-1.1	-1.0	-0.7	-0.7	-0.9
3	-0.1	-0.1	-0.2	-0.4	-0.6	-0.7	-1.0	-1.2	-1.4	-1.5	-1.6	-1.5	-1.5	-1.3	-1.4	-1.4	-1.2	-1.4	-1.7	-1.9	-2.1	-2.0	-1.6	-2.2	-2.8
4	0.0	-0.1	-0.2	-0.4	-0.6	-0.8	-1.2	-1.5	-1.8	-2.0	-2.1	-2.0	-2.0	-1.9	-1.9	-1.9	-2.0	-2.2	-2.4	-2.7	-2.9	-2.4	-2.2	-3.3	-4.5
5	0.0	0.0	-0.3	-0.5	-0.8	-1.1	-1.5	-2.0	-2.2	-2.5	-2.5	-2.4	-2.4	-2.3	-2.3	-2.5	-2.6	-3.1	-3.2	-3.6	-3.5	-3.1	-3.3	-4.5	-6.2
6	0.0	-0.1	-0.2	-0.5	-0.9	-1.2	-1.8	-2.2	-2.5	-2.8	-2.8	-2.9	-2.8	-2.6	-2.6	-2.8	-3.2	-3.7	-4.1	-4.2	-3.7	-3.4	-3.9	-5.8	-7.1
7	0.0	-0.1	-0.3	-0.7	-1.1	-1.5	-2.0	-2.5	-2.9	-3.2	-3.3	-3.2	-3.0	-3.0	-3.3	-3.7	-3.8	-4.5	-4.7	-4.8	-4.4	-4.2	-5.0	-6.7	-8.8
8	0.0	-0.1	-0.4	-0.8	-1.2	-1.7	-2.2	-2.8	-3.2	-3.5	-3.6	-3.7	-3.5	-3.6	-3.8	-4.3	-4.7	-5.3	-5.3	-5.4	-5.5	-5.4	-5.8	-8.0	-10.2
9	0.0	-0.2	-0.5	-0.9	-1.4	-1.9	-2.5	-3.0	-3.5	-3.9	-4.1	-4.1	-4.1	-4.1	-4.4	-5.0	-5.2	-5.9	-6.1	-6.3	-6.5	-6.8	-7.8	-10.0	-12.7
10	-0.1	-0.2	-0.6	-1.0	-1.5	-2.0	-2.7	-3.3	-3.7	-4.2	-4.2	-4.4	-4.5	-4.7	-5.1	-5.7	-6.0	-6.8	-7.0	-7.4	-8.0	-8.4	-9.8	-12.1	-13.6
11	-0.1	-0.3	-0.7	-1.1	-1.7	-2.2	-3.0	-3.5	-4.1	-4.5	-4.7	-4.7	-5.0	-5.3	-5.7	-6.5	-7.0	-7.6	-8.4	-9.0	-9.5	-10.4	-11.7	-13.6	
12	-0.1	-0.3	-0.7	-1.3	-1.8	-2.5	-3.2	-3.8	-4.4	-4.8	-5.1	-5.3	-5.6	-5.8	-6.3	-7.0	-7.6	-8.6	-9.3	-10.0	-11.0	-12.2	-13.2		
13	-0.1	-0.4	-0.8	-1.4	-2.0	-2.7	-3.5	-4.2	-4.6	-5.1	-5.5	-5.7	-6.0	-6.2	-6.8	-7.6	-8.5	-9.6	-10.6	-11.4	-12.3	-12.8			
14	-0.1	-0.4	-0.9	-1.5	-2.2	-2.8	-3.6	-4.3	-4.7	-5.3	-5.7	-6.0	-6.3	-6.6	-7.2	-8.3	-9.2	-10.4	-11.1	-12.3	-13.3				
15	-0.1	-0.4	-1.0	-1.6	-2.2	-2.9	-3.7	-4.4	-4.9	-5.5	-5.8	-6.1	-6.5	-6.7	-7.6	-8.7	-9.5	-10.7	-11.7	-12.7					
16	-0.1	-0.5	-1.0	-1.6	-2.3	-2.9	-3.7	-4.4	-4.9	-5.5	-5.9	-6.2	-6.6	-6.8	-7.4	-8.4	-9.4	-10.7	-11.1						
17	-0.1	-0.5	-1.0	-1.6	-2.3	-2.9	-3.7	-4.3	-5.0	-5.5	-5.8	-6.1	-6.5	-6.9	-7.3	-8.4	-9.5	-10.1							
18	-0.1	-0.5	-1.0	-1.6	-2.2	-2.9	-3.6	-4.3	-4.9	-5.4	-5.8	-5.9	-6.3	-6.5	-7.2	-8.6	-9.7								
19	-0.1	-0.5	-0.9	-1.5	-2.2	-2.8	-3.6	-4.2	-4.7	-5.2	-5.6	-5.7	-6.2	-6.4	-6.8	-8.2									
20	-0.1	-0.4	-0.9	-1.5	-2.2	-2.8	-3.5	-4.1	-4.6	-5.1	-5.6	-5.7	-6.0	-6.2	-6.8										
21	-0.1	-0.5	-0.9	-1.5	-2.1	-2.7	-3.4	-4.0	-4.6	-5.2	-5.4	-5.7	-6.0	-6.3											
22	-0.1	-0.4	-0.9	-1.5	-2.1	-2.6	-3.3	-4.0	-4.5	-5.1	-5.4	-5.6	-5.9												
23	-0.1	-0.4	-0.9	-1.5	-2.1	-2.6	-3.3	-4.0	-4.6	-5.1	-5.8	-6.2													
24	-0.1	-0.4	-0.8	-1.4	-2.1	-2.6	-3.3	-4.1	-4.7	-5.2	-5.6														
25	-0.1	-0.4	-0.8	-1.4	-2.0	-2.6	-3.3	-4.0	-4.9	-5.5															

Median APEs: Texas (Base Period Deviation)

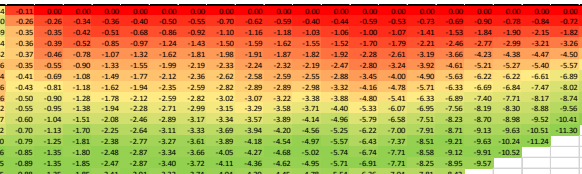
Linear



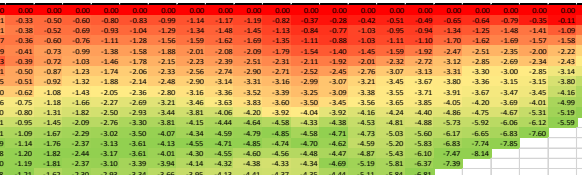
Exponential



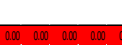
Share-of-Growth



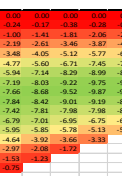
Shift-Share



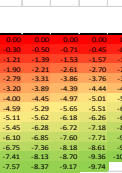
Constant



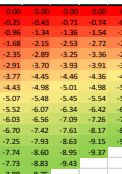
Constant-Share



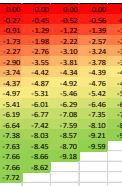
Ave6



Ave4



Ave2



Next steps (continued)

We will have more results at PAA.

Comments and suggestions are greatly appreciated!

Contact:
Stefan Rayer
Bureau of Economic and Business Research
University of Florida
elzer@ufl.edu
352.392.0171 x334