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Local Government Revenue Forecasting



THE CENTER FOR STATE AND LOCAL FINANCE

Local Revenue Forecasting

- Data issues:
 - State and National Data are prevalent compared to County and City data
 - State and National Data may be a poor fit for Local conditions
- County and City economies may be less diversified than States or National
 - This leads to greater volatility of tax revenue
 - Higher likelihood of exogenous shock
 - All of the above can exacerbate creating a helpful forecast



Revenue estimation under duress: A Cautionary Tale

- Covid
- Impact on State Sales Tax and Income tax
- Impact on Local Sales Tax



April 28, 2020

Pandemic-Driven Industry Cutbacks and Closures: Georgia Sales Tax Revenue Impacts

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XXXXXX, Associate Director Peter Bluestone, Senior Research Associate

Presentation to ARC CPLAN



COVID Impact on Employment

Pandemic Job Losses Are Worse Than in Past Recessions

Even excluding directly affected sectors like hotels and restaurants.



Directly affected sectors include air transport; leisure and hospitality; and education • Source: Bureau of Labor Statistics • The New York Times



But Georgia Tax Revenue Impact Modest...

- Income tax collections: -0.4% YOY (Accounting for Change in Filing date)
- July income tax withholding payments: 12% increase YOY



But Georgia Sales Tax Revenue Improves....? <u>https://frc.gsu.edu/georgia-sales-tax-distributions/</u>



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Where did the money come from? CARES Act

- Total CARES Act: \$2 Trillion
- Individuals got cash payments: \$300 million
 - \$1,200 for single earner with less than \$75,000 income
 - \$500 per child
 - Married Family of 4: \$3,400 if income less than \$150,000



Impact of CARES Cash Payments





Where did the money come from? CARES Act

- Extra unemployment payments: \$260 billion
- \$600 extra in unemployment per week from federal Gov.
- Expanded benefits to Gig workers and freelancers!



Impact of CAREs unemployment



Note: End of month balances. The analysis only includes the unemployed who received unemployment insurance benefits through direct deposit. Households with multiple checking accounts are added together. Source: JPMorgan Chase Institute



GA Top-5 Regional Sales Tax Shares and YOY changes Source: Georgia DOR

	share ttl sales tax 2019	YOY change (2019-20)
Atlanta Regional Commission	49%	0.8%
Coastal Regional Commission	8%	3.6%
Northwest Georgia	7%	11.5%
Georgia Mountains	7%	12.4%
Northeast Georgia	5%	9.2%
State Total		4.8%



Modeling Economic Impact of \$1 Billion Shift in Consumer Spending in Georgia Source: IMPLAN

	Gains Online	e sales	Losses Rest/Bars		
–	Emp		_		
Impact Type		output(\$mils)	Emp	output(\$mils)	
Direct Effect	2,699	\$443	-15,044	(\$1,000)	
<u>indirect+induced</u>	<u>2,634</u>	<u>\$422</u>	<u>-5,790</u>	<u>(\$987)</u>	
Total	5,332	\$865	-20,834	(\$1,987)	







- Main cities
- Other cities
- Expressways

TSPLOST Regions

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Economies of the TSPLOST Regions

For 2019 the contributions of the TSPLOST regions are small.

Region	Contribution to GA's economy
Central Savannah (CS)	3.4 percent
River Valley (RV)	2.6 percent
Southern Georgia (SGA)	2.3 percent
Heart of Georgia (HOG)	1.3 percent.

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Revenue from three sales tax generating sectors, 2001- $\hfill _{\rm z}$ 2020



- Manufacturing sector is a larger share of GRP on average than for the state as a whole. For manufacturing, HOG and SGA have higher shares of sector employment (roughly 15 percent) than the state average.
- Roughly half the sales tax collected in the four TSPLOST regions comes from three sectors: retail trade, accommodations and food services, and entertainment services.



Correlations Sales tax with State-level variables

- Moody's Analytics Data: forecasts of Georgia GDP, personal income, and retail sales.
- Sales tax values are sourced from Education Local Option Sales Tax (ELOST) and Special purpose Local Option Sales Tax (SPLOST)

	Georgia (all regions)	Georgia (excl. ATL)	CS	RV	HOG	SGA
Georgia Retail Sales	0.93	0.88	0.89	0.69	0.67	0.75
Georgia Personal Income	0.90	0.86	0.90	0.69	0.66	0.74
Georgia GDP	0.90	0.85	0.88	0.66	0.64	0.72
Population	0.84	0.82	0.86	0.47	0.56	0.71

Table 1. Forecasted values and sales tax correlations for regions and state.



Model Comparison

- Forecast models can be constructively compared by splitting a long time series of observed data into
 - an earlier time period as training and evaluation data and
 - a later time period used to test the models' forecasts.
- Sales tax data is a generic one-percent Local Options Sales Tax that are sourced from SPLOST and ELOST. The missing values were imputed to generate a stable one-percent sales tax collection in every county for every month.
- Data is from 2000Q1 to 2020Q4, where 2016 to 2020 is the forecast period.
- Forecast models considered:
 - Holt-Winters Smoothing
 - ARIMA
 - ARMAX
 - OLS
 - Machine Learning (LASSO, K-Nearest Neighbor, and Random Forests)



Model comparison (contd.)

- H-W Smoothing primarily measures the relationship between lagged revenues to predict subsequent and forecasted revenues. For the TSPLOST regions and Georgia, this model understates the revenues that came in, and it only performed well in the early forecast periods. (RED)
- ARIMA model predictions are shown in the light green lines in the figure; they typically match earlier periods better and represent low but reasonable expectations in the later years. (LIGHT GREEN)
- ARMAX11 is a variant of the ARIMA model family with additional explanatory variables. Here we use an ARMAX model with the same *p*, *d*, *q* parameters as the ARIMA forecast model, also incorporating per capita income. It overstated revenues in the earlier periods for most regions and statewide and predicted the later forecast years much more accurately. Adjustments to this model have been incorporated as more optimistic predictions within recent TSPLOST forecasts. (ORANGE)
 - OLS models the relationship between per capita income and sales tax revenue for the years 2000–2015, controlling for basic time trend effects. This model overstates revenues in all regions compared to other predictions, in all periods except the latest time periods. (LIGHT BLUE)

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(b) DCA Region 7 Central Savannah River Area



Model Comparison – Machine Learning

- Observed (Black)
- Automated ARIMA (Red), LASSO (Blue), KNN (Green), RF (Brown)
- ARIMA model outperformed at least one of the algorithms in three of the four regions.
- However, ML methods provide opportunities to improve. For example, between regions, prediction errors from RF and KNN are systematically lower.



Figure 12. Graphs. Predictions of the proposed models by region.



Example Regional Forecast



Regional Annual TSPLOST Collections Actual and Forecasted for 2019-2032 (millions \$)



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Property Tax Digest example

Gwinnett County Property Tax Digest 2001-24



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Property tax Digest example historical perspective





Local Revenue Forecasting Summary

- Data issues:
 - State and National Data are prevalent compared to County and City data- population might help but no local forecasts
 - State and National Data may be a poor fit for Local conditionseconomies differ in key industry sectors
 - Historical context can be important- Great recession, COVID, data lags
- County and City economies may be less diversified than States or National
 - This leads to greater volatility of tax revenue
 - Higher likelihood of exogenous shock- COVID and 9/11 for areas reliant on hospitality and tourism



Thank you!

Questions?

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