

Territorial Government Revenue Vulnerability Index (TGRVI)

*Measuring Financial Impacts to Territorial Governments During the COVID-19
Pandemic*

Decision and Infrastructure Sciences Division

About Argonne National Laboratory

Argonne is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC under contract DE-AC02-06CH11357. The Laboratory's main facility is outside Chicago, at 9700 South Cass Avenue, Argonne, Illinois 60439. For information about Argonne and its pioneering science and technology programs, see www.anl.gov.

DOCUMENT AVAILABILITY

Online Access: U.S. Department of Energy (DOE) reports produced after 1991 and a growing number of pre-1991 documents are available free at OSTI.GOV (<http://www.osti.gov/>), a service of the US Dept. of Energy's Office of Scientific and Technical Information.

Reports not in digital format may be purchased by the public from the National Technical Information Service (NTIS):

U.S. Department of Commerce
National Technical Information Service
5301 Shawnee Rd
Alexandria, VA 22312
www.ntis.gov
Phone: (800) 553-NTIS (6847) or (703) 605-6000
Fax: (703) 605-6900
Email: orders@ntis.gov

Reports not in digital format are available to DOE and DOE contractors from the Office of Scientific and Technical Information (OSTI):

U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062
www.osti.gov
Phone: (865) 576-8401
Fax: (865) 576-5728
Email: reports@osti.gov

Disclaimer

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor UChicago Argonne, LLC, nor any of their employees or officers, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of document authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof, Argonne National Laboratory, or UChicago Argonne, LLC.

Territorial Government Revenue Vulnerability Index (TGRVI)

Measuring Financial Impacts to Territorial Governments During the COVID-19 Pandemic

Prepared by
Braeton Smith PhD^a, Matthew Riddle PhD^b, Melissa Braybrooks^c, Amanda Savitt PhD^a, and
Iain Hyde^a

^a Decision and Infrastructure Sciences Division, Argonne National Laboratory

^b Energy Systems Division, Argonne National Laboratory

^c Office of Insular Affairs, U.S. Department of the Interior

September 2021

Territorial Government Revenue Vulnerability Index

Executive Summary

What is the Territorial Government Revenue Vulnerability Index (TGRVI)?

Disruptive events such as a pandemic can have lasting impacts on national and local economies, as has been made clear by the economic downturn caused by COVID-19. Reduced economic activity also impacts state, local, tribal, and territorial government budgets, which limits their ability to respond to the needs of community members.

Argonne National Laboratory (Argonne), in coordination with the U.S. Department of Interior (DOI) Office of Insular Affairs (OIA) developed the Territorial Government Revenue Vulnerability Index (TGRVI) to help estimate the revenue vulnerability of territorial governments due to the impacts of COVID-19 and other economic downturns. This index focuses on estimated losses in fees, taxes, and other sources of revenue resulting from the shutdown of non-essential businesses, protective actions, and resulting job losses.

What Does the TGRVI Measure?

The TGRVI measures the vulnerability of territorial government revenues by estimating monthly changes relative to January 2020 (baseline). Revenues included in the index include: taxes on products and sales, transportation and housing revenues, individual income taxes, severance taxes and royalties, and property taxes. This revenue data is aggregated to produce the index. Compared to data for state and local government revenue vulnerability indices (SGRVI and LGRVI, respectively), the TGRVI has some limitations, including less uniform and detailed baseline data, and less data availability to differentiate revenue impacts over time for a given revenue source between different territories.

Why Is the TGRVI Important?

This index provides up-to-date estimates of which territorial governments are likely to be experiencing the greatest revenue losses, which can in turn help identify territorial governments most in need of outside support. As part of a suite of other data, the TGRVI can also be used to provide a more complete picture of the socioeconomic impacts of the pandemic.

How Can I Use the TGRVI?

The TGRVI may be used as a first step in identifying territorial government financial vulnerabilities by indicating which governments rely on revenue streams that are likely to have been most heavily impacted by the pandemic. The territorial scores produced by the TGRVI reflect the estimated impacts on revenues collected by each territory relative to January 2020. A government with a TGRVI score of 96% for a given month, for example, is expected to collect 96% as much revenue from economic activity that occurred in that month as it collected from January 2020 activity. When interpreting index scores for the TGRVI, lower scores reflect higher revenue vulnerability, and higher scores reflect lower revenue vulnerability.

This index provides important context for understanding the combined and relative impacts of the vulnerability of various revenue sources on territorial economies. There are several limitations, however, that should be considered when using this index. First and foremost, as noted above, the TGRVI is an estimate of revenue impacts based on proxies, rather than on government revenue reporting. Data for territorial government revenue can be limited as compared to U.S. counties and states. The index does not account for differences between territorial governments in policy and behavioral responses, timing of revenue collection, fund balances or debt levels, or changes in government expenditures. It is also important to keep in mind that the TGRVI is designed to measure impacts relative to January 2020, rather than to what economic activity would have been in the absence of COVID-19. In other words, if economic activity would have increased after January 2020 in the absence of COVID-19, the index may underestimate the impacts of the pandemic.

You can use the [TGRVI story map](#) to view the latest results. You can also [download the data](#) to view all results since January 2020.

Introduction

Disruptive events, including pandemics and other disasters, can have lasting impacts on national and local economies. This has been made clear by the economic downturn caused by COVID-19. Reduced economic activity also impacts state, local, tribal and territorial government budgets, which can limit their ability to respond to the needs of community members. An up-to-date estimate of which communities are likely to be experiencing the greatest revenue losses could help identify governments in the most need of assistance.

This whitepaper introduces Argonne National Laboratory's (Argonne) Territorial Government Revenue Vulnerability Index (TGRVI). The goal of this index is to identify territories where government revenues are relatively more vulnerable to the economic impacts of a national-level event such as the COVID-19 pandemic. They focus on estimated losses in revenues from many sources, including taxes and fees, as a result of policies designed to mitigate the effects of COVID-19.

The TGRVI can be used as a first step in identifying government financial vulnerabilities by identifying which territory-level governments rely on revenue streams that are likely to have been most heavily impacted by the pandemic. This index is not intended to provide exact information on actual revenue impacts in each territory, which may vary from these estimates. Detailed accounting of actual revenue losses can be obtained directly from specific territorial governments, or from publicly available audit reports as they become available. Additional information on economic impacts and population vulnerability in each territory can also be used in conjunction with this index to provide a more complete picture of the socioeconomic impacts of the pandemic.

Methodology

The TGRVI is calculated for each month relative to a pre-event baseline, in this case January 2020. Changes in monthly revenue from the base period to the current period are estimated using different methods as appropriate to the varying types of revenue. The total expected change in revenues for each territory is estimated by aggregating the expected changes in revenues for different revenue sources.

Baseline Revenues Estimates

Revenue shares are derived using data from audit reports from the Federal Audit Clearinghouse, supplemented by additional sources when audit reports are unavailable or do not contain sufficient detail. In some cases, more detailed and more recent breakdowns are available from supplementary data sources, but we choose to use the same level of aggregation as is available from the audit reports of other territories, to facilitate comparisons between index values in different territories. U.S. Virgin Islands (USVI) audit data is supplemented by detailed tax breakdowns from the Government of the Virgin Islands' open finance website. American Samoa audit data is supplemented by quarterly reports provided by the American Samoa Department of Treasury. Data for Puerto Rico is not based on audit data, which is not as easily available. Instead, tax revenues are taken from a Department of Finance report on general fund revenues, and non-tax revenues such as charges and grants are assumed to be the same share of total revenue as USVI. Baseline data is from 2018 for USVI and the Northern Mariana Islands, and from 2019 for Puerto Rico, Guam, and American Samoa.

Revenues Included

The revenues covered in the index include fees such as for utility services and transportation, taxes such as income, excise, sales, and gross receipts taxes, and federal government grants. For each revenue stream, we identify it as low risk, moderate risk, elevated risk, high risk, very high risk or extreme risk. Monthly estimates for key revenue sources are derived by tying the revenue rate to a monthly publicly available data source; for example, retail sales data are used to estimate impacts on sales taxes and unemployment, and wage data are used to estimate impacts on income taxes. When these data sources are unavailable, the selected trajectory over time is modeled to match the average trajectory of other revenue sources with the same risk rating. The methodology for determining the risk rating is described below in the Revenue Estimates Based on Risk Ratings section of this white paper.

Appendix B provides the full list of government revenues analyzed, the risk ratings of each, and whether monthly revenues are tied to a data source.

Sales and Excise Taxes Tied to Spending and Import Data

There are several types of sales taxes that each territorial government may collect. Reliance on sales tax, and different types of sales tax collected can vary greatly between the governments modeled.

General sales taxes are only collected in Puerto Rico and are tied to seasonally adjusted U.S. Census retail sales data for U.S. total retail sales including restaurants but not groceries. General excise taxes are tied to seasonally adjusted total U.S. imports of goods bases on U.S. Census foreign trade data.

All other sales and excise taxes listed below are tied to seasonally adjusted U.S. spending data as specified in the chart below. An adjustment is made for motor fuels sales taxes to divide by the consumer price index for motor fuels, since motor fuels taxes are generally levied on a per gallon basis.

All other sales taxes listed below are tied to seasonally adjusted U.S. spending data as specified in the chart below. An adjustment is made for motor fuels sales taxes to divide by the consumer price index for motor fuels, since motor fuels taxes are generally on a per gallon basis. The chart below identifies the type of sales tax, a short description, and the data source used to model impacts on that type of sales tax. Seasonally adjusted spending data is used.

Sales Tax Type	Description of Data Used	Data Source
General Sales	Sum of all retail sales, partially including groceries (see text for details)	Census Retail Sales (RS) data
General Excise	Total U.S. imports of goods	Census Foreign Trade data
Liquid Fuels	Gasoline and other motor fuel spending divided by motor fuel price	Bureau of Economic Analysis (BEA) Personal Consumption Expenditure (PCE) data, Consumer Price Index (CPI) data
Gaming	Pari Mutuel Net Receipts	PCE data
Vehicles	Household Utilities Data	PCE data
Alcoholic Beverage Sales	Off-premises consumption data	PCE data

Tobacco Product Sales	Tobacco sales data	PCE data
Hotel Occupancy	Lottery spending data	RS data

The expected change of revenues ($\% \Delta R$) in territory t for a sales tax of type i in month m is calculated as the percentage change from the base month to month m in total sales of products p covered by sales tax i .

For all sales and excise taxes, U.S. averages are used.

$$\% \Delta R_{t,r_sales_i,m} = \frac{\sum_{p \in P(r_sales_i)} S_{US,p,m}}{\sum_{p \in P(r_sales_i)} S_{US,p,\widehat{base}}} - 1$$

Where S represents sales using either retail sales or personal consumption expenditure data or calculated as described above.

Gross Receipts Taxes

Gross receipts taxes are assumed to follow seasonally adjusted U.S. total personal income, not including transfer receipts such as government benefit, using BEA data on personal income and its disposition.

Transportation and Housing Revenues

Revenues from airport fees are tied to ridership data from the Bureau of Transportation Statistics. Air ridership numbers are reported later than other data sources Argonne used. To fill in the last month of data, we assume that the impacts of the pandemic were reduced relative to the previous month by the same amount as transit ridership, also from the Bureau of Transportation Statistics.

Federal Grants

There is assumed to be no impact on federal aid due to COVID-19. Federal aid may in fact have increased, but we assume that any increases in federal aid are intended to cover increased expenditures, which are not captured separately, and that the net impact is 0.

Individual Income Taxes

Percent changes in revenue, $\% \Delta R$, for income taxes are estimated by first calculating US national average percent change in seasonally adjusted employment by industry i from the base month to the current month m .

$$\% \Delta Emp_{US,i,m} = \frac{Emp_{US,i,m} - Emp_{US,i,\widehat{base}}}{Emp_{US,i,\widehat{base}}}$$

These are multiplied by estimated total wages (W) by industry in each territory, which is estimated by multiplying employment by industry in each territory by average wages by industry in the U.S., calculated as total wages (W) divided by total employment (E), and aggregated for all industries in the state or county. U.S. total wages and employment are taken from the 2019 Quarterly (QCEW), as is employment by industry data for Puerto Rico and the U.S. Virgin Islands. Employment by industry estimates for the Pacific territories rely on data from the 2018 County Business Patterns from the Census. The percent change in income tax revenues are assumed to follow the estimated percent change in wages for each territory.

$$\% \Delta R_{t,r_income,m} = \frac{\sum_i (W_{t,i,base} \cdot (1 + \% \Delta Emp_{US,i,m}))}{\sum_i W_{t,i,base}} - 1$$

$$W_{t,i,base} = E_{t,i,base} \cdot \frac{W_{US,i,base}}{E_{US,i,base}}$$

Property Taxes

Property taxes are assigned a moderate risk rating by S&P. We follow a July 2020 report by the New York state comptroller, “Under Pressure: Local Government Revenue Challenges During the COVID-19 Pandemic,” in assuming that the cumulative impact on property taxes in 2020 is 2%. The impacts from each month are assumed to follow the same pattern over time as the average of all other revenues.

Revenue Estimates Based on Risk Ratings

For revenue sources that are not tied to a specific data source, we estimate revenue impacts over time by comparing them to other revenue sources with the same risk rating. When possible, risk ratings for each revenue source are taken from Standard and Poor’s (S&P) or the Tax Foundation. Revenue sources which were not rated by other sources were assigned a risk rating by evaluating the detailed descriptions of revenue sources in each category and determining which other revenue sources they were most similar to. The ratings assigned to each revenue source are summarized in Appendix B.

Estimated change in revenues from the baseline January 2020 revenues for each risk rating are updated monthly and are documented in the supporting file RevenueStreams.xlsx. These are calculated using a simple average of the monthly impacts for the revenue streams with the same risk rating that are tied to a data source. Revenue sources that are used for the State Government Revenue Vulnerability Index (SGRVI) and Local Government Revenue Vulnerability Index (LGRVI) and documented in the associated white paper are included when calculating averages for each risk rating.

Creating the Aggregate Territorial Government Revenue Vulnerability Index (TGRVI)

Estimated lost revenues LR for each type of revenue r in each territory t are calculated to be the baseline 2019 revenues times the % change in revenues for that type of revenue source and state.

$$LR_{t,r,m} = R_{t,r,base} \cdot \% \Delta R_{t,r,m}$$

The monthly index measures estimated lost revenues from taxes in each month relative to January 2020.

$$Index_{t,m} = \frac{\sum_r LR_{t,r,m}}{\sum_r R_{t,r,base}}$$

The cumulative index measures estimated lost revenues from taxes from January 2020 through current period as a percentage of the cumulative number of months M of revenues at January 2020 rates (e.g. the September index measures estimated lost revenues as a percentage of nine months of revenues). Values less than one indicate an expected loss of revenues relative to the base month, with lower values indicating greater losses. Values greater than one indicate an expected increase in revenues.

$$Index_{t,cum} = \frac{\sum_{m \in \{1, \dots, M\}} \frac{\sum_r LR_{t,r,m}}{M}}{\sum_r R_{t,r,base}}$$

Data Sources:

Index Data	Data Source	Frequency
Revenues for USVI ($R_{USVI,t,base}$)	Management's Discussion and Analysis, Financial Statements (with Independent Auditor's Report thereon), and Required Supplementary Information, Government of the U.S. Virgin Islands https://facdissem.census.gov/ Government of the United States Virgin Islands Open Finance, https://usvi.finance.socrata.com#!/dashboard	Annual, 2018
Revenues for Guam ($R_{Guam,t,base}$)	Basic Financial Statements, Additional Information, and Independent Auditors' Report, Government of Guam https://facdissem.census.gov/	Annual, 2019
Revenues for American Samoa ($R_{AS,t,base}$)	Basic Financial Statements with Auditor's Report, Territory of American Samoa https://facdissem.census.gov/ General Fund Expenditure Report, American Samoa Government (not publically available)	Annual, 2019
Revenues for CNMI ($R_{CNMI,t,base}$)	Basic Financial Statements, Additional Information and Independent Auditors' Report, Commonwealth of the Northern Mariana Islands https://facdissem.census.gov/	Annual, 2018
Revenues for Puerto Rico ($R_{PR,t,base}$)	Gobierno de Puerto Rico, General Fund Net Revenue July-June http://www.hacienda.gobierno.pr/sites/default/files/recaudos_ingles_2_agosto.pdf	Annual, 2019
Total annual wages by industry ($AW_{US,i,base}$)	Bureau of Labor Statistics (BLS), Quarterly Census of Employment and Wages (QCEW) https://www.bls.gov/cew/	Annual, 2019
Current Employment by Industry, US Total ($Emp_{US,i,m}$)	BLS, Current Employment Statistics (CES): Employment and Earnings Table B-1a: Employees on nonfarm payrolls by industry sector and selected industry detail, seasonally adjusted https://www.bls.gov/ces/	Monthly, Jan 2020-current
Personal Consumption Expenditure ($S_{US,p,m}$)	BEA, Personal Consumption Expenditures (PCE) https://apps.bea.gov/iTable/iTable.cfm?ReqID=19&step=2#reqid=19&step=2&isuri=1&1921=underlying	Monthly, Jan 2020-current
Retail Sales ($S_{US,p,m}$)	Census, Retail Sales (RS) https://www.census.gov/retail/index.html	Monthly, Jan 2020-current
Personal Income	BEA, Personal Income and its Disposition https://apps.bea.gov/iTable/index_nipa.cfm	Monthly, Jan 2020-current

U.S. Imports	Census, U.S. International Trade in Goods and Services https://www.census.gov/foreign-trade	Monthly, Jan 2020-current
U.S. Consumer Price Index, Motor Fuels	Bureau of Labor Statistics (BLS) https://www.bls.gov/cpi/data.htm	Monthly, Jan 2020-current
U.S. Air Traffic	BTS https://data.bts.gov/Research-and-Statistics/Monthly-Transportation-Statistics/crem-w557	Monthly, Jan 2020-current

Additional Notes and Limitations

- This analysis focuses on the risk to government finances due to the riskiness of the sources of tax revenues and whether the territory’s underlying regional economy is composed of industries that are more immediately exposed to coronavirus-related employment declines. It does not account for differences between territories in policy and behavioral responses to the coronavirus pandemic.
- The use of U.S. national average trajectories to estimate revenue streams may lead to a failure to account for some differences between the territories and states.
- The index does not account for the timing of revenue collection. It should be interpreted as the expected effect on annual finances based on economic impacts that have occurred up to a given point in time, not the effect on revenues collected up to that point.
- The index does not include fund balances or debt levels.
- The index does not account for changes in government expenditures or tax policy since the onset of the COVID-19 pandemic.
- Impacts are relative to January 2020, and not relative to a projected baseline level. If economic activity would have increased in the absence of COVID-19, the index may underestimate the impacts of COVID-19.
- Income taxes are assumed to track wages and unemployment and do not account for changes in capital gains tax collections that may be driven by stock market performance and housing prices rather than wages.
- Alcoholic beverage taxes are assumed to follow liquor store sales. Any alcohol taxes that may exist that also cover sales in restaurants and bars are not accounted for.
- The revenue data is not standardized between territories, and different levels of aggregation may lead to differences in calculated values between territories.
- For Puerto Rico, only tax revenue data was available. As such, non-tax revenues for Puerto Rico are estimated based on proportions in the Virgin Islands.

Acknowledgments

This whitepaper has been created by UChicago Argonne, LLC, Operator of Argonne National Laboratory (“Argonne”). Argonne, a U.S. Department of Energy Office of Science laboratory, is operated under Contract No. DE-AC02-06CH11357. The U.S. Government retains for itself, and others acting on its behalf, a paid-up nonexclusive, irrevocable worldwide license in said article to reproduce, prepare derivative works, distribute copies to the public, and perform publicly and display publicly, by or on behalf of the Government. The Department of Energy will provide public access to these results of federally sponsored research in accordance with the DOE Public Access Plan. This work was supported by the Federal Emergency Management Agency (FEMA).

Appendix A – Data Dictionary for TGRVI

This appendix details the fields or columns found in the companion data table for the TGRVI and provides a plain language description.

Column Name	Description
Main Index: estimated cumulative impact on revenues based on reduced economic activity through January 2021	The main Territorial Government Revenue Vulnerability Index (TGRVI), which estimates cumulative loss of revenue based on economic activity through January 2021 relative to what revenues would have been if activity had stayed at January 2020 levels
Estimated impact on revenues based on reduced economic activity in <month>	The estimated percent loss of revenues due to economic activity in each month from February 2020 through the current month, compared to January 2020 levels
Individual Income Tax as % of total, 2018/19	The percentage of 2018 or 2019 revenues that came from individual income taxes
Corporate Income Taxes as % of total, 2018/19	The percentage of 2018 or 2019 revenues that came from corporate income taxes
Gross Receipts Taxes as % of total, 2018/19	The percentage of 2018 or 2019 revenues that came from gross receipts taxes
General Sales and Excise Taxes as % of total, 2018/19	The percentage of 2018 or 2019 revenues that came from general sales and general excise taxes
Property Taxes as % of total, 2018/19	The percentage of 2018 or 2019 revenues that came from property taxes
Alcohol, Tobacco Taxes as % of total, 2018/19	The percentage of 2018 or 2019 revenues that came from taxes on alcohol and tobacco products
Hospitality/Gaming/Gas Taxes as % of total, 2018/19	The percentage of 2018 or 2019 revenues that came from hospitality, gaming and gas taxes
Other Excise Taxes as % of total, 2018/19	The percentage of 2018 or 2019 revenues that came from excise taxes on vehicles and other specific products
Federal Aid as % of total, 2018/19	The percentage of 2018 or 2019 revenues that came from federal capital and operating grants
Transportation Charges as % of total, 2018/19	The percentage of 2018 or 2019 revenues that came from airport, transportation and communication charges
Other Charges and Fees as % of total, 2018/19	The percentage of 2018 or 2019 revenues that came from charges and fees for utilities, general government, public safety, health, education, recreation, environmental protection, public housing and other

Appendix B – Revenue Sources and Risk Ratings

This appendix details the revenue sources analyzed, the risk ratings for each, and the sources of data for monthly updates to risk calculations, if such data exist.

Revenue Source	Risk Classification	Source Data for Revenue Estimate
Individual Income Tax	elevated risk	unemployment and wage data
Corporate Income Tax	very high risk	
Gross Receipts Taxes	elevated risk	personal income not counting transfers
Other Excise Taxes	elevated risk	US imports
Sales and Use Tax	elevated risk	total retail sales
Property Taxes	moderate risk	
Tobacco Taxes	low risk	tobacco sales
Alcoholic Beverage Taxes	low risk	alcoholic beverage sales
Liquid Fuels Taxes	high risk	gasoline station retail sales
Hotel Occupancy	very high risk	hotel spending
Limited Gaming	very high risk	pari-mutuel net receipts
Vehicle Excise Tax	high risk	vehicle sales
Other Taxes	elevated risk	
Federal Operating Grants and Contributions	no effect	
Federal Capital Grants and Contributions	no effect	
Charges: General Government	moderate risk	
Charges: Public Safety / Protection of Life and Property	moderate risk	
Charges: Health / Public Health	moderate risk	
Charges: Public Housing and Welfare	elevated risk	
Charges: Education / Public Education	moderate risk	
Charges: Transportation and Communication / Transportation	very high risk	
Charges: Culture and Recreation	elevated risk	
Charges: Environmental Protection / Lands and Natural Resources	moderate risk	
Charges: Other	moderate risk	
Section 30 Federal Tax Collections	elevated risk	unemployment and wage data
Fines and Fees	moderate risk	
Airport Charges	extreme risk	air ridership
Utility Charges	elevated risk	
Other Component-Unit / Business-Type Activity Charges	elevated risk	





U.S. DEPARTMENT OF
ENERGY

Argonne National Laboratory is a U.S. Department of Energy
laboratory managed by UChicago Argonne, LLC

National Preparedness Analytics Center
Decision and Infrastructure Sciences Division

Argonne National Laboratory
9700 South Cass Avenue, Bldg. 203
Argonne, IL 60439

www.anl.gov