University of Illinois System

Institute of Government and Public Affairs
Task Force on the Impact of the COVID-19 Pandemic

Data Indicate COVID-19 Impact on State Revenue Not as Severe as Feared

Economic and Fiscal Health Impact Group

January 26, 2021

At the request of President Tim Killeen, IGPA has assembled more than four dozen interdisciplinary faculty experts from all three U of I System universities to assess COVID-19's effects on the state. Assessments focus on three impact groups: Economic and Fiscal Health, Community and Family Resilience, and the Health Care Workforce. Each group is collaborating on a series of modeling activities, data analyses, and syntheses of impact. This report is the fourth from the Economic and Fiscal Health Impact Group.

Faculty Lead

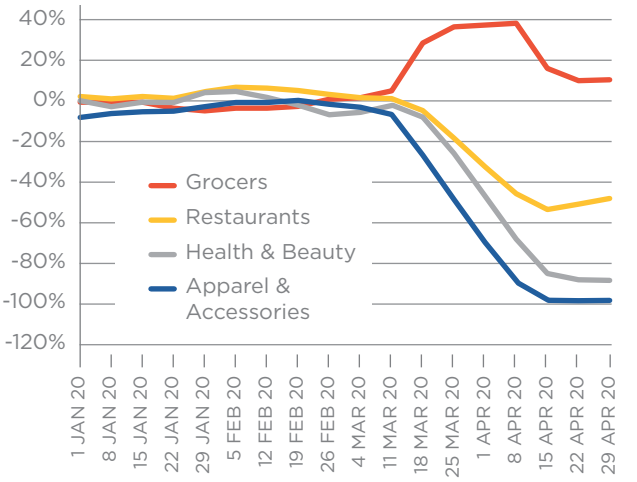
Kenneth A. Kriz, Affiliate, Institute of Government and Public Affairs, University of Illinois System; University Distinguished Professor of Public Administration and Director, Institute for Illinois Public Finance, University of Illinois Springfield

EXECUTIVE SUMMARY

The year 2020 proved to be one of the most volatile and destructive years in history. Not since the Spanish flu pandemic of 1918–1919 has the world seen the level of negative health, economic, and financial consequences witnessed last year. Although only one of many important consequences, state and local government finances suffered heavily under the weight of people self-isolating to avoid becoming ill, and from efforts to mitigate the spread of the virus imposed by state governments.

Illinois became one of the first states to enact a shelter-in-place order in late March.[1] Even before that, high-frequency economic indicators suggested that people were starting to restrict activities to only those essential for sustaining life. Figure 1 shows the year-over-year changes for in-store credit card purchases at grocery stores, restaurants, and two categories of retail sales during the pre-pandemic and early pandemic period. A value of 0% indicates that retail sales in that category were the same as the year before. Therefore, the fall of between 50% and 60% in restaurant sales at the peak of the shutdown, the week of April 15, 2020, means that charges at restaurants fell to a level of

Figure 1: Year-over-year change in credit card receipts, State of Illinois, January 1 - April 29, 2020



Source: Earnest Research.

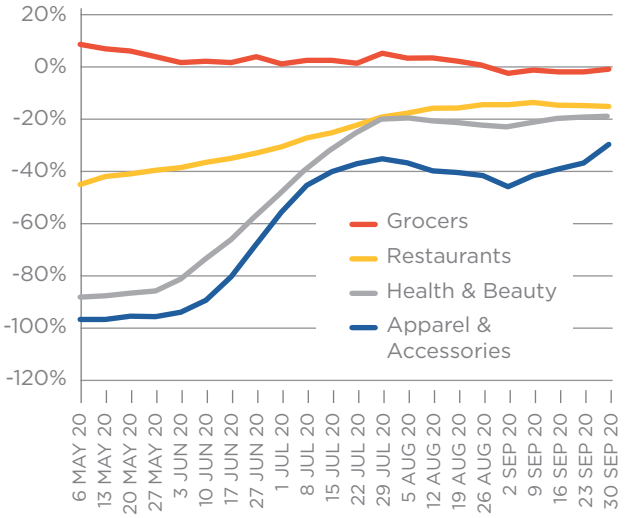
only half of what they were in the same week in 2019. For reference, the average share of spending by households on food in 2019 was 13% of total household spending, with groceries accounting for just over half of that amount. Spending on apparel and services accounted for 3% of total spending, and personal care spending accounted for 1.2%.[2]

Starting in mid-March, sales at grocery stores rose dramatically as people stocked up for an extended period at home. Sales at restaurants and retail activities started to fall during this time. After the stay-at-home order was issued, sales at these locations plummeted. In April, as it became clear that the state would extend the stay-at-home order, concerns began to mount that the state and its local governments would see revenue fall dramatically as spending increased for social services and healthcare.

In early April, a report from the Economic and Fiscal Heatlh Impact Group releasing this report projected that revenue from the "Big Three" state revenue sources—individual and corporate income taxes and sales taxes—could fall as much as $4.8 billion in 2020 and by a similar amount in 2021.[3] Many other sources projected similar revenue declines, including the Illinois General Assembly's Commission on Government Forecasting and Accountability.[4]

However, during May and June, an interesting thing started to happen. People began to adapt their behavior to their changing circumstances. Once retail establishments and restaurants began curbside pickup services, sales started to rise. The federal stimulus program pumped billions of dollars into the Illinois economy through stimulus checks and Paycheck Protection Program loans and credits, and acted as a catalyst for increased spending.[5] Figure 2 shows the credit card spending for the period at the end of the first wave of COVID-19 until the fall of 2020. The recovery is clear in the spending data. For example, by the end of the second quarter, spending on apparel and accessories rose from a low of a nearly 100% annual fall in expenditures to between 25% and 30% below 2019 levels. And restaurants bounced back to only 15% to 20% below 2019's spending rate.

Figure 2: Year-over-year change in credit card receipts, State of Illinois, May 6 - September 30, 2020



Source: Earnest Research.

Rebounding receipts caused us to wonder whether the revenue impacts of COVID-19 were as dire as predicted at the start of the pandemic. As described below, this report presents a statistical analysis of the impact of COVID-19 on state revenue sources.

We find that Illinois' net revenue loss is much lower than what many projected at the beginning of the COVID-19 pandemic. The state did lose a sizable amount of revenue during the early months, but much of that loss was recovered.

DATA AND METHODS

This analysis uses data from the Office of the Illinois Comptroller on tax receipts for all major revenue sources with annual receipts greater than $100 million. The comptroller compiles receipts monthly, and the publicly available data goes back to fiscal year 2002. Data from July 2014 through November 2020 were used to build the model. This report limits its analysis to receipts into the state's General Funds.[6] The reason for this limitation is that the state's balanced budget requirement applies only to those funds, and therefore the state will feel any real budgetary impact in these funds. For the major revenue sources, much of the money goes into the General Funds. For example, in 2020 about 85% of individual income tax revenue, 49% of corporate income tax revenue, and 52% of sales tax revenue went into the General Funds, as Table 1 shows. The revenue sources analyzed here together account for more than 94% of General Funds revenue, with the Big Three sources accounting for just over 60% of General Funds revenue. The tax sources are adjusted for rate changes to produce consistent data over time.

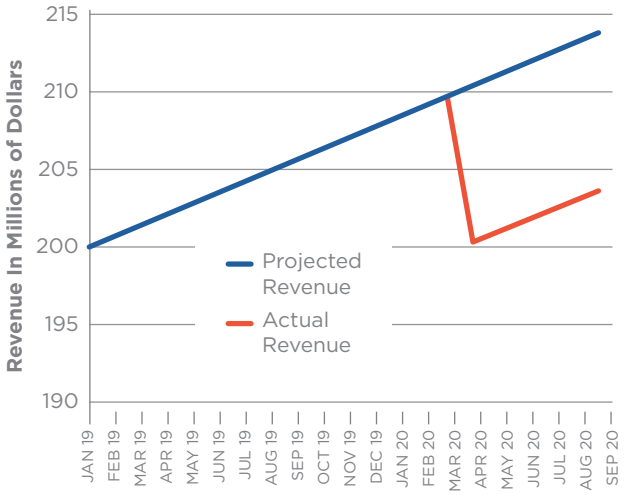
This report uses a method called an event study to measure the impact of COVID-19. Researchers in areas such as business finance and public policy have used event studies to measure the impact of a time-specific event (for example, the release of bad news on corporate earnings or a natural event on some policy variable). The method consists of creating a "counterfactual" for what would have happened if the time-specific event had not happened, then comparing the actual outcome with the counterfactual prediction to determine the amount caused by the event. Figure 3 shows the logic of an event study. In this simplified, hypothetical example, we track revenue over time up to the point when an event happens (April 2020). As the trend in this example is known with certainty, we can project it forward in time to produce the counterfactual (the blue line). The

Table 1: Revenue structure, State of Illinois, FY 2020

Revenue Type	General Funds		Other Funds		Percent of Revenue in General Funds
	Revenue	Share of Total Revenue	Revenue	Share of Total Revenue	
Individual Income Taxes	$18,471,109,270	46.0%	$3,188,216,778	2.2%	85.28%
Sales Taxes	$8,255,204,460	20.6%	$7,505,571,020	5.3%	52.38%
Corporate Income Taxes	$2,080,629,717	5.2%	$2,168,923,248	1.5%	48.96%
Federal Sources	$3,529,274,498	8.8%	$21,893,087,828	15.4%	13.88%
Statutory Transfers*	$3,294,000,000	8.2%	$324,000,000	0.2%	91.04%
Public Utility Taxes	$830,500,891	2.1%	$755,705,142	0.5%	52.36%
Insurance Taxes, Fees, & Licenses	$361,439,505	0.9%	$120,796,816	0.1%	74.95%
Inheritance Taxes	$283,246,933	0.7%	$18,520,351	0.0%	93.86%
Licenses, Fees, & Registrations	$162,001,548	0.4%	$2,495,187,064	1.7%	6.10%
Cigarette Taxes	$266,565,210	0.7%	$583,998,150	0.4%	31.34%
All Other Sources	$2,580,154,905	6.4%	$103,547,647,172	72.6%	2.43%
Total Revenue	$40,114,126,937		$142,601,653,569		

*Note: * indicates Statutory Transfers are net (Transfers In - Transfers Out).*
Source: Illinois Office of Comptroller, Revenue by Revenue Source.

Figure 3: Event study methodology



Source: Author.

actual amount (orange line) falls dramatically at the time of the event and then continues at the same trend. The difference between the counterfactual and the actual is the amount of the effect.

RESULTS

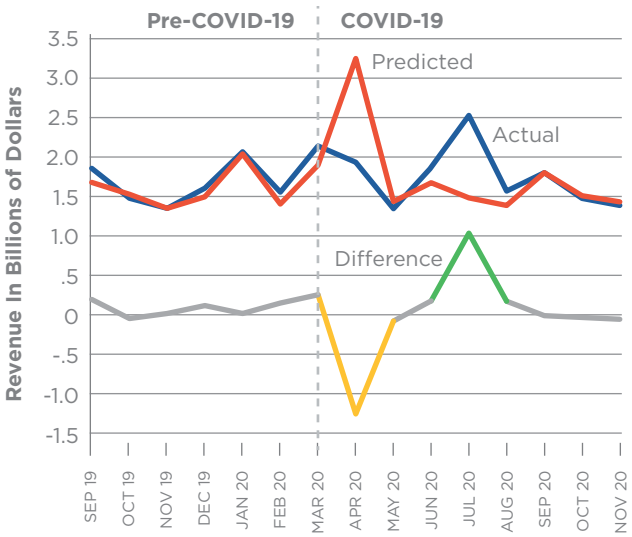
An example of the statistical results is provided in the Technical Appendix. The illustration in Figure 4 shows the deviations of the actual amount of individual income taxes from the forecast developed with our time-series model, starting in September 2019. To the left of the dashed gray line showing the virus outbreak and implementation of the mitigation efforts, the model fits the data well. Then in April 2020, revenue falls dramatically compared to the forecast. This was partially due to the direct effects of COVID-19, and partially due to the delayed tax-filing deadline put into place as one of the federal economic recovery plans. But by May, revenue had recovered to its expected level, and in June it was above the counterfactual. Once the delayed filing date passed in July, revenue was significantly above the model's forecast, returning in August to near the forecasted level. By September, revenue was running slightly below the model's pre-COVID-19 forecast and has stayed close to the forecasted value since then.

This story is congruent with credit card spending data. There was a steep fall in spending in most categories in April and May, then a recovery toward pre-COVID-19 levels. Spending has not recovered completely, but it is near what it likely would have been in the absence of COVID-19.

This analysis was repeated for all major revenue sources. Table 2 (page 5) shows the results of the analysis. During the stay-at-home period, the state incurred $1.4 billion in lost individual income tax revenue due to COVID-19, with more than $600 million in losses from other revenue. During the recovery period, the state recovered 90% of the individual income tax revenue loss. Therefore, the net effect for major revenue sources in the General Revenue Fund is a net loss of $868 million due to COVID-19 up to November 2020. Looking at the Big Three revenue sources, the net COVID-19-related loss in individual income taxes was just less than 1% of the total General Funds receipts for that source, much less than forecast. Sales tax losses were also less than expected, at 3.4% of total General Funds sales tax receipts. The corporate income tax is one source where revenue losses were of a size forecast in early 2020. The $345 million loss in that revenue source is more than 16% of total General Funds corporate income tax receipts.

The total loss is far less than what the Economic and Fiscal Health Impact Group estimated earlier in the year. Some of this is due to using a different data source. The data used in the earlier report covered the Big Three revenue sources but in all funds. The last row of Table 2 shows the estimate for COVID-19 related losses in the Big Three sources of $800 million. To make this amount comparable to an "all funds" revenue estimate, one

Figure 4: Model results, individual income tax receipts ($)



Source: Illinois Office of Comptroller, Revenue by Fund, *and author's calculations.*

must take the estimated losses for each revenue source and apply the percentage of revenue in fiscal year 2020 that went to other funds from those sources. This is shown in Table 3. Using this method, total revenue loss in the Big Three sources across all funds totaled $1.44 billion. Though this is larger than the loss in General Funds alone, it is still below the Economic and Fiscal Health Impact Group's most conservative estimates in the spring.

This is good news from a budgetary perspective. While most forecasters were expecting revenue losses of 15-20% from an extended recession, Illinoisans can meet the small net loss of revenue (accounting for less than 2% of total General Revenue Fund receipts) with relief. In recent weeks, both the Commission on Government Forecasting and Accountability[7] and the Governor's Office of Management and Budget[8] have released updated forecasts that tacitly acknowledge COVID-19-related losses were small, and fiscal year 2021 revenue has been revised upward.

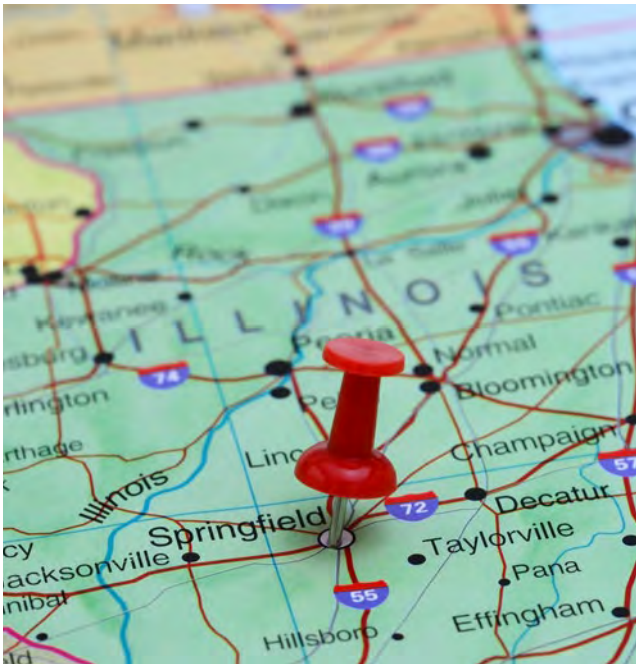


Table 2: Estimated change in revenue due to COVID-19 in the General Revenue Fund, various periods

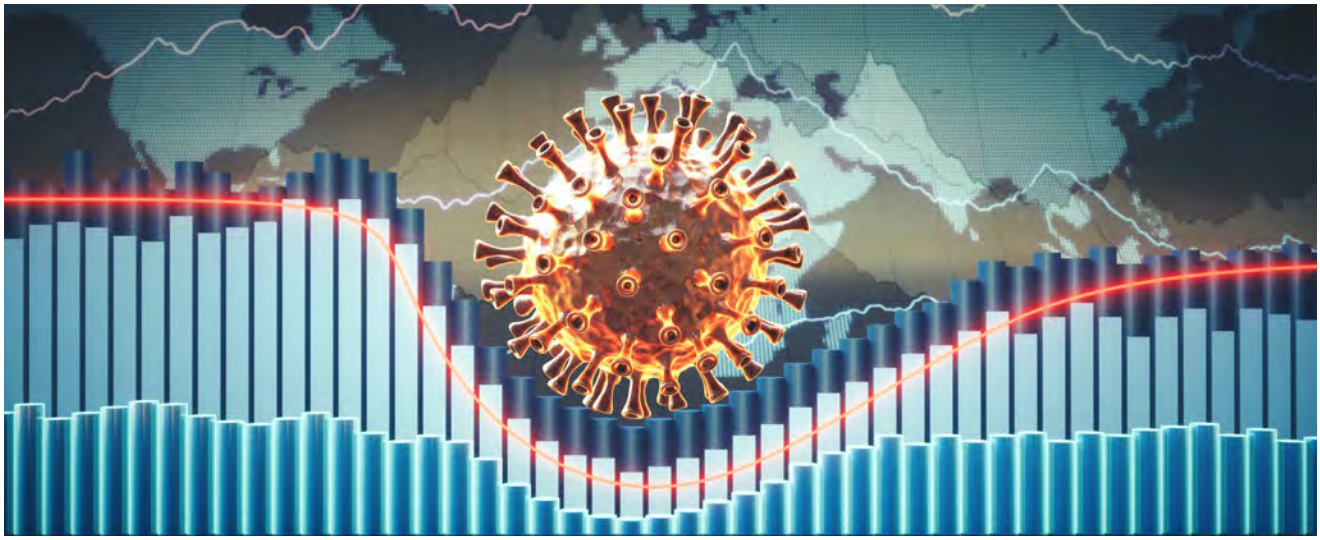
Revenue Source/Period	Lockdown (April - May 2020)	Post-Lockdown (June - November 2020)	Total Effect
Individual Income Taxes	($1,417,314,000)	$1,245,474,000	($171,840,000)
Sales Taxes	(283,736,000)	0	(283,736,000)
Corporate Income Taxes	(345,116,000)	0	(345,116,000)
Federal Sources	0	0	0
Statutory Transfers	0	0	0
Public Utility Taxes	0	0	0
Insurance Taxes Fees & Licenses	0	45,794,460	45,794,460
Inheritance Taxes	0	0	0
Licenses Fees & Registrations	(17,955,840)	(39,609,060)	(57,564,900)
Cigarette Taxes	(20,346,000)	(35,677,620)	(56,023,620)
Total	($2,084,467,840)	$1,215,981,780	($868,486,060)
Big Three Sources	($2,046,166,000)	$1,245,474,000	($800,692,000)

Source: Author's calculations. Original source data from Illinois Office of Comptroller, Revenue by Fund.

Table 3: Estimated change in revenue, various revenue sources, all funds

Fund	Individual Income Taxes	Sales Taxes	Corporate Income Taxes	Total Effect
General Funds	($171,840,000)	($283,736,000)	($345,116,000)	($800,692,000)
Other Funds	(29,660,545)	(257,970,679)	(359,761,331)	(647,392,555)
Total COVID-19 Losses	($201,500,545)	($541,706,679)	($704,877,331)	($1,448,084,555)

Source: Author's calculations. Original source data from Illinois Office of Comptroller, Revenue by Fund, *and Illinois Office of Comptroller,* Revenue by Revenue Source.



LOOKING AHEAD

Going forward, tremendous uncertainties remain. While baseline economic forecasts are optimistic, with relatively strong growth in the fourth quarter of 2020 and a return to long-term trend growth rates (around 2-2.5%) in 2021, most forecasts acknowledge more than a fair amount of uncertainty due to potential COVID-19 spikes, vaccine rollout timelines, and political risk at the state and, more importantly, federal level.[9] Despite the good news on the revenue effects of COVID-19, the state faces other budget challenges. Some of those challenges existed prior to COVID-19 (a large structural deficit and bill backlog) and some have happened recently but are not directly attributable to COVID-19 (voters' rejection of the proposed graduated income tax constitutional amendment).

One other benefit of the type of analysis conducted here is that it supplies a baseline for examining risks of COVID-19-related shutdowns. Had shutdowns persisted, this model suggests that revenue losses could have easily grown to a level predicted in the Economic and Fiscal Health Impact Group's earlier report or even surpassed them. Little is certain until COVID-19 is in the rear-view mirror. But Illinois' response in 2020 suggests that the economy and our public finances are at least somewhat resilient, given appropriate countercyclical policy responses.

Looking at the Big Three revenue sources, the net COVID-19-related loss in the individual income tax was just less than 1% of the total General Funds receipts for that source, much less than forecast. Sales tax losses were also less than expected, at 3.4% of total General Funds sales tax receipts. The corporate income tax is one source where revenue losses were of a size forecast in early 2020. The $345 million loss in that revenue source is more than 16% of total General Funds corporate income tax receipts.

One factor that likely affected the lower-than-expected revenue losses is the unequal distribution of the effects of the coronavirus. As discussed in a recent article in *The New York Times*,[10] the labor market effects of the virus and mitigation measures fell more heavily on low-income households. High-income households have maintained their income levels or even seen them rise. And stimulus programs have buffered low-income household finances. Therefore, aggregate incomes and consumption have continued to grow, leading to stable or increased state revenue.

This pattern suggests that a key element of resiliency is a recognition that our revenue systems are based on an individual's income and consumption; therefore macroeconomic policy must support income and consumption to ensure a robust revenue system. There are many ways that this can be accomplished, from targeted programs such as extended unemployment benefits and small business loan programs to help businesses withstand the worst of virus-related shutdowns, to broader support programs such as Economic Impact Relief payments (stimulus checks).

TECHNICAL APPENDIX

We created the interrupted time-series model by first creating an ARIMA time-series model on each of the revenue sources indicated in Table 1.

$$\left(1 - \sum_{i=1}^{p'-d} \phi_i L^i\right)(1-L)^d X_t = (1 + \sum_{i=1}^{q} \theta_i L^i)\varepsilon_t$$

We followed the Box-Jenkins methodology for model building,[11] as detailed in Mills.[12] The noise model follows the form where ***X*** is the observed variable (individual revenue source), ***p*** is the autoregressive order (***ϕ***'s indicate the autoregressive terms), ***d*** is the level of differencing required to induce stationarity, ***q*** is the moving average order (***θ***'s being the moving average terms), ***L*** is the lag operator, and ***ε*** is an iid error term. The shorthand notation for these models is ARIMA(p,d,q). For some of the revenue series, there is a seasonal component—autoregressive and moving—average terms that occur periodically over time. We use a multiplicative seasonal model for those series, adding L^{12} and d^{12} terms to the equation (1). The shorthand for this type of model is ARIMA(p,d,q) $(P,D,Q)_m$ where the capitalized terms are the seasonal autoregressive, differencing, and moving average terms and *m* is the number of periods in each season. Following the Box-Jenkins methodology, models are developed iteratively, with residual checking and AIC/MAPE minimization evaluation techniques. Table A1 shows the noise model structure for each of the revenue sources. For all models, we use monthly data, so *m*=12.

After the noise model was developed, we used a set of two pulse variables to model the COVID-19 event. A pulse variable takes the value of 1 for each period that an event occurs and 0 for all other periods. For the purposes of this model, the term Lockdown is used to indicate limitations on the economy. For example, one could effect a Lockdown in an economic sense without a stay-at-home order by simply mandating a closing of non-essential businesses. So citizens would be free to go out but couldn't engage in economic activities.

The first pulse variable (Lockdown) has a value of 1 for the months April and May and 0 for other periods. The second pulse variable (post-Lockdown) has a value of 1 for June through November, and 0 for all other periods. We then estimated the models using the AS197 algorithm for maximum likelihood estimation in the statistical software gretl.[13] We present the results below for the Big Three revenue sources. Table A2 shows the output from the intervention model run on the Individual Income Taxes variable, Table A3 for Sales Taxes (page 8), and Table A4 for Corporate Income Taxes (page 8).[14]

The effects of COVID-19 were calculated by multiplying the binary event variables by the

Table A1: ARIMA noise models for revenue sources

Revenue Source	ARIMA Noise Model
Individual Income Taxes	(0,0,0)(1,0,0)
Sales Taxes	(1,0,0)(1,0,0)
Corporate Income Taxes	(0,0,[3])(1,0,0)
Federal Sources	(0,0,0)(1,0,0)*
Statutory Transfers	(0,0,0)(1,0,0)
Public Utility Taxes	(1,0,0)(2,1,0)
Insurance Taxes Fees & Licenses	(1,0,0)(1,0,0)
Inheritance Taxes	([5],0,0)(0,0,0)
Licenses Fees & Registrations	([1,2,10],0,0)(1,0,0)
Cigarette Taxes	([3,8],0,0)(0,0,0)

*Notes: Bracketed terms mean that individual lag AR or MA terms were included. For example, an AR(3) means three AR terms, at lags 1, 2, and 3, were included in the model. An AR([3]) indicates only one AR term, at lag 3, was included. * - For Federal Sources, an outlier in November 2017 was identified and controlled using an indicator variable.*

Source: Author's calculations. Original source data are from the Illinois Office of Comptroller, Revenue by Fund.

Table A2: Results of interrupted time-series model, dependent variable is Individual Income Tax revenue

Variable	Coefficient	Standard Error	z-statistic
Constant	1,546,190,000	122,644,000	12.61***
Seasonal AR1	0.84	0.05	15.35***
Lockdown	-708,657,000	200,979,000	-3.53***
Post-Lockdown	207,579,000	114,266,000	1.82*
Adjusted R^2	0.65		

Notes: p <0.1, ** p<.05, *** p<0.01*

Source: Author's calculations. Original source data are from the Illinois Office of Comptroller, Revenue by Fund.

coefficients. For example, for Individual Income Taxes, there are two 1's (April and May) for the Lockdown variable. Therefore, the effects in the Lockdown period are found by multiplying the Lockdown coefficient (-$708,657,000) by 2 to yield an estimated Lockdown period effect of -$1,417,314,000. For the post-Lockdown period, there are six 1's (June through November), and the calculation proceeds as above.

The interrupted time-series model is strong against most internal validity concerns. One valid concern that could be raised about the model is that there could have been other things happening during the period of the Lockdown that may have affected revenue. And that is almost certainly true here, many things were changing. But many of the most important factors that might affect revenue were driven by the virus itself, things like increasing unemployment, and reduced income and output. We ran a robustness check by entering the closing value of the S&P 500 Total Return Index, a broad measure of

stock market returns, as a control variable. This should capture perceived risks that might not be captured by real economic variables. The results of the analysis were qualitatively similar to our base models.

Table A3: Results of interrupted time-series model; dependent variable is Sales Tax revenue

Variable	Coefficient	Standard Error	z-statistic
Constant	681,749,000	19,999,200	38.09***
Seasonal AR1	0.73	0.07	10.01***
AR1	0.29	0.11	2.65***
Lockdown	-141,868,000	36,132,800	-3.93***
Post-Lockdown	6,590,830	24,814,100	0.27
Adjusted R^2	0.64		

*Notes: * p <0.1, ** p<.05, *** p<0.01*

Source: Author's calculations. Original source data are from the Illinois Office of Comptroller, Revenue by Fund.

Table A4: Results of interrupted time-series model; dependent variable is Corporate Income Tax revenue

Variable	Coefficient	Standard Error	z-statistic
Constant	188,260,000	52,111,500	3.61***
AR3	0.32	0.11	2.97***
Seasonal AR1	0.83	0.06	15.00***
Lockdown	-172,558,000	58,273,100	-2.96***
Post-Lockdown	42,075,100	40,651,800	1.04
Adjusted R^2	0.71		

*Notes: * p <0.1, ** p<.05, *** p<0.01*

Source: Author's calculations. Original source data are from the Illinois Office of Comptroller, Revenue by Fund.

We are honored to have the opportunity to harness our collective research and experience to serve our neighbors and the residents of Illinois during a time of great need.

Respectfully submitted,

Geoffrey Hewings
IGPA Scholar Emeritus;
Director Emeritus
Regional Economics
Applications Laboratory
University of Illinois at
Urbana-Champaign

Kenneth Kriz
IGPA Affiliate;
University Distinguished
Professor of Public Administration;
Director, Institute for Illinois
Public Finance
University of Illinois
at Springfield

David Merriman
IGPA Senior Scholar;
James J. Stukel Presidential
Professor of
Public Administration
University of Illinois
at Chicago

Beverly Bunch
Professor of Public
Admiistration
University of Illinois
at Springfield

Patricia Byrnes
Associate Professor
of Economics
University of Illinois
at Springfield

Francis Choi
PhD Student
Public Administration
Univeristy of Illinois
at Chicago

Larry DeBrock
Dean Emeritus;
Professor of Finance
and Economics
Gies College
of Business
University of Illinois at
Urbana-Champaign

Michael Disher
PhD Student
Economics
University of Illiois
at Chicago

Joshua Drucker
Associate Professor
of Urban Planning
and Policy
University of Illinois
at Chicago

Matt Finkin
Maybelle Swanlund
Endowed Chair,
Center for
Advanced Study;
Professor of Law
University of Illinois at
Urbana-Champaign

Don Fullerton
IGPA Senior Scholar;
Gutgsell Professor
of Finance
University of Illinois at
Urbana-Champaign

Brian Gaines
IGPA Senior Scholar;
Professor of
Political Science
University of
Illinois at
Urbana-Champaign

J. Fred Giertz
IGPA Scholar
Emeritus;
Professor Emeritus
of Economics
University of
Illinois at
Urbana-Champaign

Joseph Hoereth
Director, Institute
for Policy
and Civic
Engagement
University of Illinois
at Chicago

Faye Jones
Director
Albert E. Jenner
Law Library; Clinical
Professor of Law
University of
Illinois at
Urbana-Champaign

Amanda Kass
Associate Director
Government Finance
Research Center
University of Illinois
at Chicago

Arwi Kriz
Visiting Research
Fellow
Institute for Illinois
Public Finance
University of Illinois
at Springfield

Christopher Z. Mooney
IGPA Senior Scholar;
W. Russell Arrington
Professor of
State Politics
University of Illinois
at Chicago

Michael Pagano
Dean, College of
Urban Planning and
Public Affairs
Director, Government
Finance Research
Center
University of Illinois
at Chicago

Lisa Powell
Director
Division of
Health Policy
and Administration
University of Illinois
at Chicago

Tara Powell
Assistant Professor
School of
Social Work
University of
Illinois at
Urbana-Champaign

Elizabeth T. Powers
IGPA Senior Scholar
Associate Professor
of Economics
University of
Illinois at
Urbana-Champaign

Kent Redfield
IGPA Scholar
Emeritus;
Professor Emeritus
of Political Science
University of Illinois
at Springfield

Julian Reif
IGPA Senior Scholar;
Assistant Professor
of Finance
University of
Illinois at
Urbana-Champaign

Moira Zellner
Associate Professor
Urban Planning
and Policy Director,
Urban Data
Visualization Lab
University of Illinois
at Chicago

Robin Fretwell Wilson
Director
Institute of
Government and
Public Affairs
University of Illinois
System

ENDNOTES

[1] Office of the Illinois Governor, "Executive Order 2020-10," March 20, 2020, accessed Jan. 7, 2021, https://perma.cc/26QT-R9GT.

[2] U. S. Bureau of Labor Statistics, "Consumer Expenditure Survey," https://perma.cc/GB22-U2Q2.

[3] Kass, Amanda, Kenneth A. Kriz and David Merriman, "What Policymakers Should Know About the Fiscal Impact of COVID-19 on Illinois," Institute of Government and Public Affairs, University of Illinois System, April 9, 2020, https://perma.cc/HN62-GKWL.

[4] Klenke, Clayton and Jim Muschinske, "Revised Fiscal Year 2021 Revenue Estimate and FY 2020 Revenue Update," p. 23, Commission on Government Forecasting and Accountability, May 2020, accessed Jan. 7, 2021, https://perma.cc/S24S-HRRZ.

[5] An analysis by the Peter G. Peterson Foundation showed that 83% of low-income households and 55%–56% of high-income households used the stimulus payments primarily for household expenses. See Peter G. Peterson Foundation, "How Did Americans Spend Their Stimulus Checks and How Did It Affect the Economy?" accessed Dec. 23, 2020, https://perma.cc/3DYH-XRNB.

[6] There are six funds that are considered part of the General Funds under the State Budget Law, 15 ILCS 20/50: General Revenue, Common School, Education Assistance, Road, Motor Fuel Tax and Agricultural Premium.

[7] Klenke, Clayton and Jim Muschinske, "Updated Economic and FY 2021 Revenue Outlook," p. 40, Commission on Government Forecasting and Accountability, November 2020, accessed Jan. 7, 2021, https://perma.cc/4SPE-6BV8.

[8] Governor's Office of Management and Budget, "Illinois Economic and Fiscal Policy Report," p. 17, Nov. 13, 2020, accessed Jan. 7, 2021, https://perma.cc/9UGG-ST3J.

[9] The state of the housing market presents another risk. Requests for mortgage forbearance increased dramatically in 2020, creating concern about what will happen in 2021 when laws mandating forbearance expire.

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[13] See http://gretl.sourceforge.net for description of this resource.

[14] Full results of all models available from the faculty lead.

Audience: IGPA COVID-19 Impact Group Reports are intended to be useful to policymakers and stakeholders, including but not limited to University of Illinois System leaders, state legislators, Gov. J.B. Pritzker's office, state agencies, news media, nonprofit organizations, educators, volunteer organizations, and faith leaders.

Editors' Note: Any opinions expressed herein are those of the author and not necessarily those of the Institute of Government and Public Affairs or the University of Illinois System.

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Pg. 2 - Closed #1214354294 by RichLegg

Pg. 5 - Map #532055281 by dk_photos

Pg. 6 - Infographic #1219125996 by matejmo

Pg. 8 - Headlines #1222047290 by JJ Gouin