INDIANA
UNIVERSITY

TO: ANN BINGMAN, CPA, CFE, MBA, CONTROLLER AND EXEC. DIR. OF THE BOND BANK
             C/O CITY OF CARMEL DEPARTMENT OF THE CONTROLLER

FROM: JACOB ALDER, INDIANA UNIVERSITY REVENUE ANALYST

DATE: FEBRUARY 9, 2021

RE: CARMEL, INDIANA FOOD & BEVERAGE TAX REVENUE SHORTFALL

This memorandum reports a statistically robust estimate of the revenue collections shortfall that the City of Carmel experienced in 2020 and 2021 as a result of COVID-19. In specific, I examine the economic shock on the Food and Beverage industry by forecasting the tax revenues from 2012 to 2019. To ensure an accurate forecast, I used three distinct models and report the results in Table 1. I provide a graphical representation of the linear estimation models in Figure 1.

The purpose of this estimation is to develop a reasonable projection of Carmel's lost revenue and enable the City to recuperate funds. I estimate that the City of Carmel lost between $390k and $680k during 2020 and 2021 that it would have otherwise collected from its tax on food and beverage.[1] I am more confident about the lower bound of the estimate.

Fortunately for Carmel, as part of the American Rescue Plan Act (ARPA), the U.S. treasury authorized $65.1 billion in direct funding available to counties, including Hamilton. I recommend the City apply for these funds to assist affected businesses and citizens.

METHOD 1

My first estimation builds on the revenue loss calculation method authorized by the National Association of Counties (NACo). In partnership with the Government Finance Officers Association (GFOA), NACo, developed a revenue loss spreadsheet calculator that uses a formula to help calculate revenue loss. I downloaded the workbook and changed the applicable tax inputs and filled in the cell for Alcoholic Beverage Tax. I used 2019 as a base year, in which Carmel collected $2,628,136 from the food and beverage tax. In 2020, I input the tax collected: $2,153,220. Using this method, I calculated that Carmel lost approximately $682,554 taxes in 2020-2021. I report the full range of inputs in Table 1.

METHOD 2

My second method uses a linear time trend, where trend is a simple count variable for each month, starting at $t = 1\ldots N$, and y_{it} is the tax revenue. I estimated this model with the 2012 – 2019 data only in order to eliminate the estimation being affected by the 2020 and 2021 revenue

---

[1] I obtained these estimate by subtracting the actual collections, $4,865,535 from my forecasted collections, reported in Table 2.

Carmel, IN Food & Beverage Tax Revenue Shortfall

Indiana Revenue Theory LLC

collections. After I obtained estimates for the coefficients, I predicted the monthly revenue collections for 2020 and 2021 and display the estimates in Table 2. Below, I report the model.

$$y_{it} = \alpha + \beta \ trend + \varepsilon_{it}$$

The *i* and *t* are indexes for individual month and year. Using this method, I calculated a decrease in 2020-2021 revenue of $491,585.

METHOD 3

In my third method, I used another linear time trend model, but included a fixed effect for the variation in months, denoted by ζ_m. Though the *trend* coefficient on this model and the simple model were identical ($865), I determined that the fixed effect model is more accurate because it has a smaller variation in the estimates because it allows for month over month variation. As with the previous method, I extrapolated the 2020 and 2021 months, and display the City of Carmel's estimated revenue collections in Table 2. Below, I report the model.

$$y_{it} = \alpha + \beta \ trend + \zeta_m + \varepsilon_{it},$$

As in the previous model, the *i* and *t* are indexes for individual month and year. Using this method, I calculated a decrease in 2020-2021 revenue of $391,356. As noted in the introduction, I conclude that this model is likely more statistically accurate than the linear model. Furthermore, since the GFOA calculator is a "black-box" method that only relies on revenue collected from the previous year, I am inclined to select the fixed effects model as more robust. Additionally, the GFOA calculator's estimate is nearly two times as high as the linear estimation methods.

RECOMMENDATIONS

I recommend that the City of Carmel evaluate the lost revenue and apply for ARPA relief package to recuperate funds. According to my estimations, Carmel lost a lower bound of $390k to $680k between 2020 and 2021. I chose the conservative estimate, $390k, as my recommendation, but the City can review whether the number should be higher or lower, within the reasonable bounds my estimations have set.

CONCLUSION

Linear estimation has limitations; however, with appropriate assumptions, the approach can create a robust prediction of what *would have happened*. In the case of COVID-19, the City of Carmel can reasonably assume that, without the pandemic, revenue collection from the food and beverage tax would have continued in a similar pattern to previous years and months.

Indiana Revenue Theory LLC

FIGURE 1. Graphical representation of actual revenue collection and predictive models
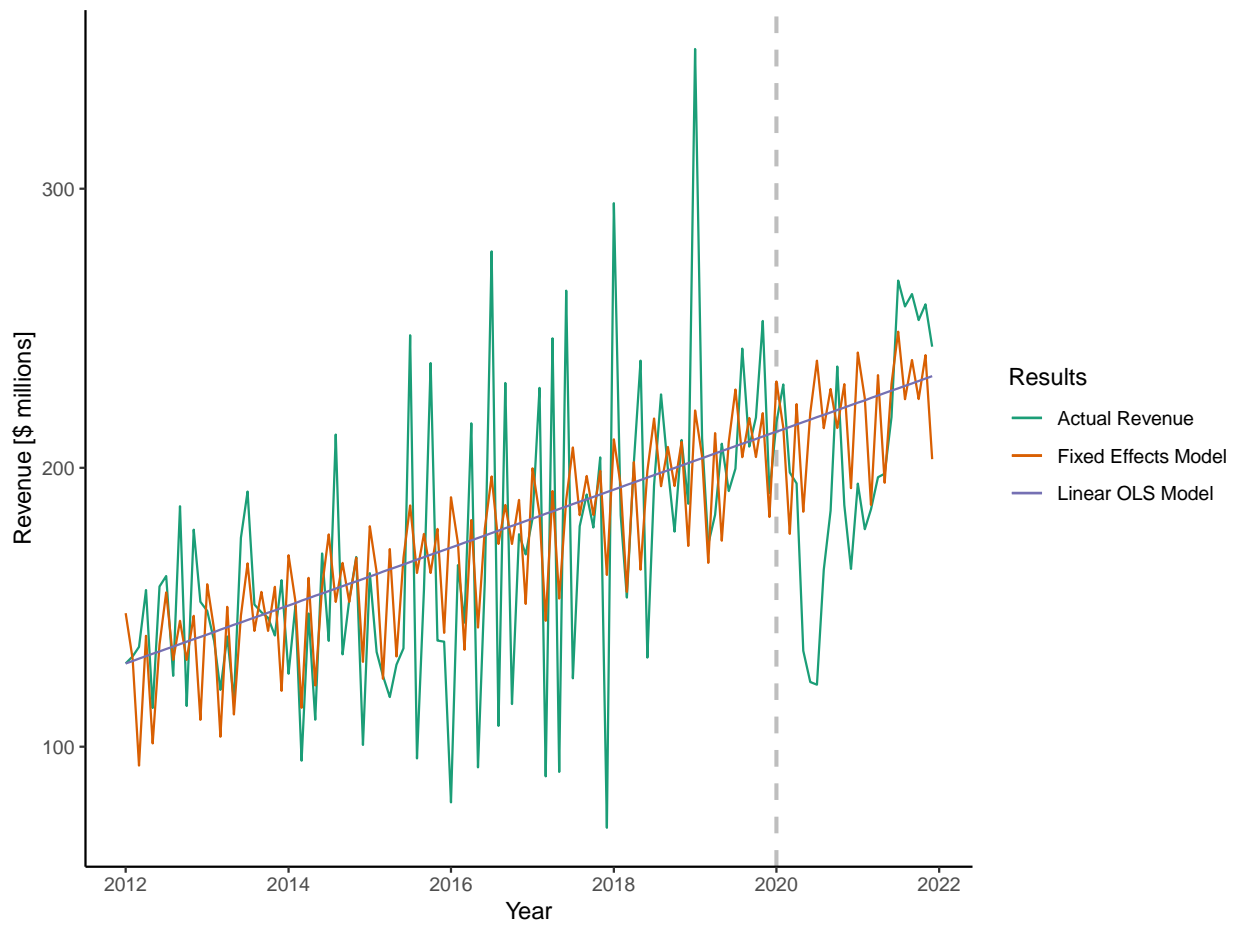
Note: The green line shows actual revenue collected in the City of Carmel. The orange line is the fixed effects model, which allows for individual month variation. The straight purple line is the result of a linear trend model.

Carmel, IN Food & Beverage Tax Revenue Shortfall

Indiana Revenue Theory LLC

TABLE 1. Estimation results of GFOA Calculator, Linear Model, and Fixed Effects Model

GFOA Calculator	Model Inputs	Linear		Fixed Effects	
Fiscal Year End	June	Trend	865.115	Trend	865.115
			-158.07		-158.07
Base Year Revenue Period	6/30/19	(Intercept)	129340	(Intercept)	147015.004
			-16518.918		-16518.918
Fiscal or Calendar Year	Calendar			February	-17336.055
					-21292.61
Calculation Date	12/31/20			March	-56378.744
					-21294.37
Number of Months	18			April	-10728.94
					-21297.303
Base Year Revenue	$2,628,137			May	-50146.965
					-21301.409
Growth Rate	5.2%			June	-15613.555
					-21306.687
Counterfactual Revenue	$2,835,774			July	2285.08
					-21313.135
Actual Revenue	$2,153,220			August	-22815.006
					-21320.754
Revenue Reduction	$ 682,554			September	-9649.608
					-21329.542
Revenue Reduction %	-24.1%			October	-24515.867
					-21339.497
				November	-9579.633
					-21350.617
				December	-47735.215
					-21362.902
		Num.Obs.	96	Num.Obs.	96
		R2	-1152.52	R2	-1152.52
		Std.Errors	IID	Std.Errors	IID
		FE: Month	X		

Note: The left column shows uses the GFOA calculator to forecast "Revenue Reduction" the City of Carmel would have otherwise obtained from the Food and Beverage tax. The Linear model line is the straight line method and only has an estimate for Trend. The Fixed Effects model, right, allows for individual month variation, and has an estimate for each month except January (which is accounted for in the intercept term).

TABLE 2. Tabular representation of actual revenue collection and predictive models

FY	Month	Actual Revenue [$]	Linear Model [$]	Fixed Effects [$]
2020	January	216,188	213,256	230,931
2020	February	229,856	214,121	214,460
2020	March	198,270	214,986	176,283
2020	April	194,373	215,852	222,798
2020	May	134,370	216,717	184,245
2020	June	123,166	217,582	219,643
2020	July	122,273	218,447	238,407
2020	August	163,426	219,312	214,172
2020	September	184,663	220,177	228,202
2020	October	236,282	221,042	214,201
2020	November	186,632	221,907	230,003
2020	December	163,722	222,772	192,712
2020 Subtotal		**2,153,220**	**2,616,172**	**2,566,057**
2021	January	194,331	223,638	241,313
2021	February	177,980	224,503	224,842
2021	March	185,119	225,368	186,664
2021	April	196,627	226,233	233,179
2021	May	197,887	227,098	194,626
2021	June	218,127	227,963	230,025
2021	July	267,109	228,828	248,788
2021	August	257,801	229,693	224,553
2021	September	262,260	230,558	238,584
2021	October	252,896	231,424	224,583
2021	November	258,568	232,289	240,384
2021	December	243,410	233,154	203,094
2021 Subtotal		**2,712,114**	**2,740,748**	**2,690,634**
Grand Total		**4,865,335**	**5,356,920**	**5,256,691**
Difference from Actual Revenue			(491,585)	(391,356)

Note: This table shows the extrapolation of 2012-2019 linear estimation models to predict the amount of revenue from the food and beverage tax the City of Carmel would have collected if the 2020 and 2021 years had followed the previous years' trends. The difference from Actual Revenue (bottom row) is displayed as a negative number because this is the counterfactual of what the City of Carmel *would have collected* but did not.

Indiana Revenue Theory LLC