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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 $68[illegible]54 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…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.

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 $\zeta_m$. 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.

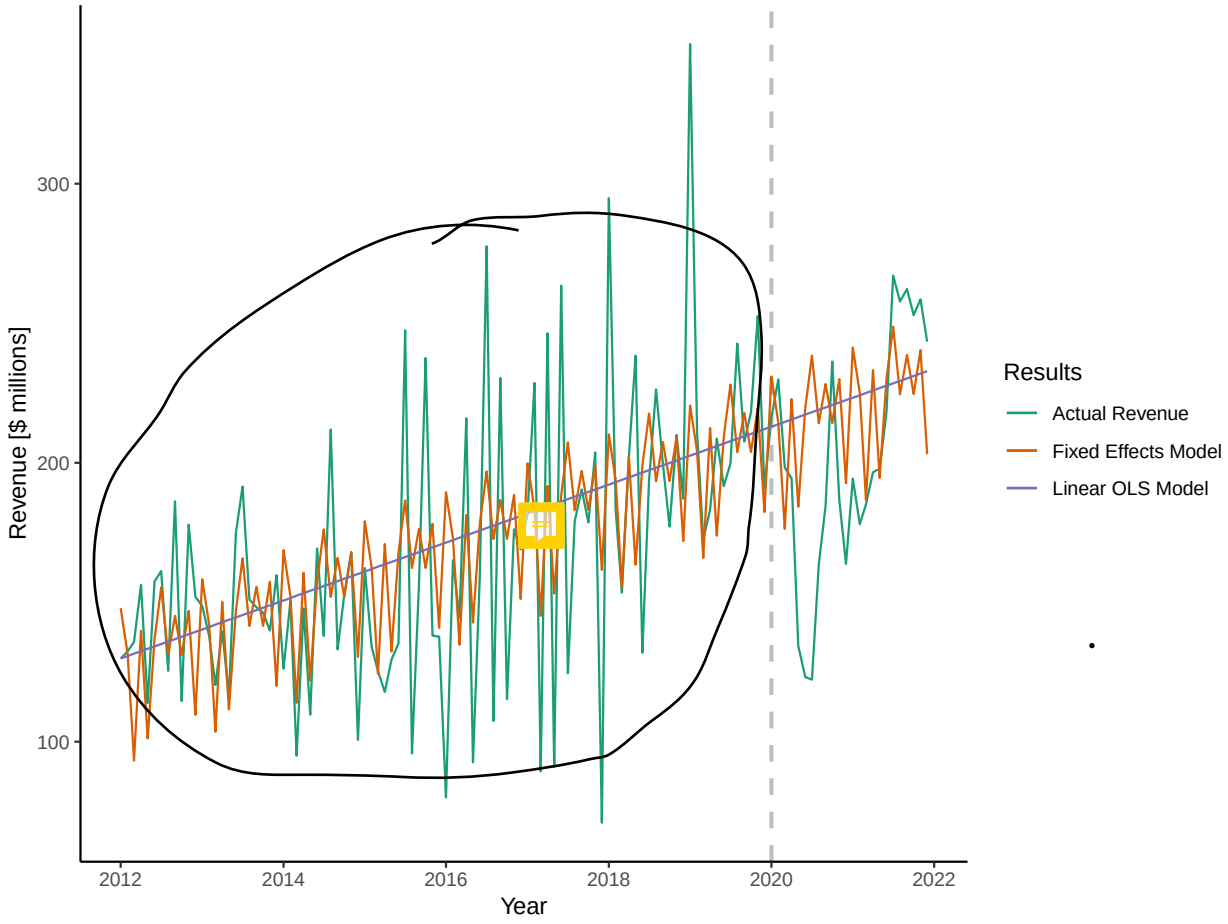
### Recommendations

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.

**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.

**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.