# Telework and Local Tax Performance

by

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**Abstract**

This paper studies the effect of fully remote and hybrid work-from-home (WFH) on sales and property tax revenues. We obtain detailed administrative data concerning sales tax returns from the state of Tennessee that allows us to study the effects by type of good, type of vendor, and type of local jurisdiction (small versus large). Conducting a difference-in-difference that compares high telework potential counties with low telework potential counties, we find tax base declines due to telework. The effects are largest for non-food sales, smaller value items, general merchandise stores, and vendors located in more populated jurisdictions. The declines in the sales tax base are consistent with a shift in consumption toward services that are generally not taxed. Using aggregate property tax assessment by type (industrial / residential / agricultural), we find that WFH has small effects on property tax revenues, albeit with some subtle differences by large / small jurisdictions and property type.

**Keywords:** sales tax, property tax, telework, work-from home
**JEL:** H24, H25, H71, J21, R51

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## 1. Introduction

Policymakers and researchers have discussed many dimensions of the rapid expansion of fully remote or hybrid work from home (WFH) that has taken place during and since the COVID-19 pandemic,[2] such as its effect on worker productivity,[3] the ability of firms to hire workers across expanded geographic areas, changes in commuting patterns due to increased suburbanization, and the effects on interstate migration. We focus on one potentially major concern resulting from WFH: how these changing labor market dynamics impact state and local taxation. WFH shifts employment out of central cities, potentially resulting in fiscal losses from declining property tax bases, reduced income tax revenues, and changes in where and how people buy goods and pay sales taxes. In addition, WFH may encourage substitution away from taxable tangible physical goods toward services that are more complementary to WFH and oftentimes not subject to state sales taxation. The issue is of considerable policy concern because the shifting distribution of revenues from one jurisdiction to another and changes in the total amount of revenues, in the absence of any policy changes, potentially can significantly impact the ability of local governments to deliver key local public services, such as education, police and fire protection.

Changing WFH patterns not only impact where personal income taxes are remitted, and the effective income tax rates confronted by workers at separate locations, but can alter the geographic distribution and levels of almost all state and local taxes. While much of the related tax literature in public economics has focused on which jurisdictions should tax income and how taxes influence the mobility patterns of teleworkers,[4] our emphasis is on other taxing instruments that are especially important for *local* (and state) governments. For example, the

[2] See Aksoy, et al. (2022), Barrero, Bloom and Davis (2021 and 2023), Dingle and Neiman (2020), and Zarate (2024).
[3] See Nicholas Bloom (2024) for comprehensive discussion of the productivity effects.
[4] See Agrawal and Stark (2022) and Agrawal and Brueckner (2025) for detailed discussions of implications for state and local personal income taxes. They point out that these depend on the extent of WFH behavior, the distance from former workplaces to home, and the institutional structures of state and local income taxes at both places. The institutional features often differ across the U.S and can themselves elicit WFH behavioral responses. Yet, Akran et al (2025) show that assuming most income taxes are residence-based, there is an increase in migration toward low-tax states.

distribution of sales taxes can change when teleworkers eat at home, have food delivered, or eat in restaurants near their residence instead of the downtown restaurants near their place of work. These actions potentially not only shift which jurisdiction receives the sales tax revenue, but in the case of switches from restaurant meals to food-at-home, whether the transaction is taxed at all. Property taxes offer another example of changes to the level and distribution of tax revenues across jurisdictions. Less need for commercial and office space can reduce property taxes in central cities, while greater demand for housing to allow work at home may offset this to some extent, though often in a different more suburban taxing jurisdiction.

Just prior to the pandemic, personal income taxes were the second largest source of revenue for U.S. state and local governments (23.9 percent of taxes) in 2019 but this means about three-fourths of tax revenues come from the other sources, which also may be affected by WFH.[5] A broad set of non-personal income, state and local taxes raised more than $1.4 trillion during fiscal year 2019. Focusing only on income taxes because telework directly affects the labor market ignores the important channels through which WFH can impact other important revenue sources. Further, income taxes comprise only 4.9 percent of local tax revenues and are only imposed in 12 states, meaning WFH induced changes in local income taxes can only have a modest effect in most states. This paper focuses on identifying how greater WFH alters the distribution of sales and property tax revenues, highlighting the heterogeneity across sectors resulting from nuanced substitution patterns across different types of consumption and properties. Property taxes were 30.9 percent of state and local tax revenues in 2019, general sales taxes were 23.4 percent (local governments in 36 states impose local sales taxes), selective sales taxes were 11.1 percent and corporate income taxes were 3.6 percent.

Of course, the idea that WFH can affect non-income tax revenues is not new. Given the interest in real estate markets and property prices, a literature in urban economics studies a phenomenon nicknamed the "urban doom loop" resulting from the spiral in commercial real

[5] Source: 2019 State & Local Government Finance Historical Datasets and Tables and authors' calculations.

estate prices after WFH (Gupta, Mittal, Van Nieuwerburgh, forthcoming). The basic idea is that WFH causes businesses to demand less central-city office space, which causes commercial prices to fall in the city. In turn, declining prices lower urban property tax revenues, which result in cuts to city services. Lower public services result in out migration from the city, which further lowers property tax revenue, resulting in a doom loop for cities. Chernick and Reschovsky (2025), on the other hand, argue that the doom loop is unlikely to occur in many large cities since the property tax revenue shock in the 135 cities they study is insufficient to offset agglomeration benefits in large cities. Still, they recognize that some cities, and particularly ones that are already experiencing fiscal challenges, may be at risk.

While the literature has studied the effect of WFH on house prices, the empirical evidence on revenues is limited and generally fails to investigate institutional differences in the way property is taxed. Due to assessment rules, changes in prices are not sufficient to determine the extent of property tax revenue changes. Further, this literature ignores how telework changes consumption patterns, and thus sales tax revenues, and focuses on large center cities without considering distributional effects across places. Suburbs and smaller places may be affected/benefitted by outmigration from cities or changes in where people buy goods. Changes in where tax revenues are collected can potentially affect the ability to deliver public services and certainly alter historical revenue patterns.

We study the effect of telework on local tax bases and revenues using a difference-in-differences design. To isolate the effect of telework, we use the index of Dingel and Neiman (2020), which classifies occupations as teleworkable or not based on their pre-pandemic job characteristics. We then use variation in the occupation mix in each commuting zone to construct the index of teleworkable potential---the share of teleworkable jobs in the commuting zone. Comparing counties with high telework potential with those with low telework potential, both before and after the pandemic yields our difference-in-differences design. We first show that high potential telework counties experienced a larger increase in WFH than those with low potential. We then study this effect on tax bases and revenues.

As state governments often only release aggregated data by county, we obtain administrative data from the Tennessee Department of Revenue that allows us to explore the precise channels by which taxes are affected. With respect to the property tax, we obtain tax assessments by type of property (commercial/residential/agricultural) and by jurisdiction (county/city). For our analysis of sales taxes, we use vendor tax returns to obtain information at the sector level (NAICS 4-digit codes), product level (food versus non-food), and jurisdiction (county/city). The administrative data also contain information on taxable sales, exemptions, large item purchases, and a rich variety of information not publicly released in any state. Obviously studying one state raises concerns of external validity, but the rich data we have access to could not feasibly be constructed for multiple states and allow us to pin down the precise mechanisms by which WFH affects local public finances.

We find a persistent change in the distribution of sales taxes, though the effect differs widely across types of vendors, commodities, and space. In high teleworkable counties, the total sales tax base shrinks by about 10% relative to less teleworkable counties. This effect is more pronounced for non-food sales than for food at home sales. In addition, we find no decline in the purchases of large-ticket items (value greater than $1600). There is also substantial heterogeneity across vendor types. Retail and general merchandise mimic the overall negative effects, while sectors like accommodation and food services (restaurants) only see declines in the early pandemic years, with purchases reverting to trend two years later. Electronic commerce, although imperfectly measures, shows a decline while computer system design companies see an increase. Finally, separating the effects by large and small towns, we find the results are driven by declines in larger cities. Smaller towns and cities see increases, though these results are noisy. All in all, we conclude that telework appears to have altered the place of purchases, shifting it from employment centers to smaller and more residential centers. At the same time, the overall negative effects indicate a shift in consumption away from taxable physical goods toward generally untaxable services that are likely more complementary to WFH.

Turning to the property tax, we find no significant differences in the tax assessments in highly teleworkable places relative to less teleworkable places. To explore why, we disaggregate assessments by the type of property, again finding null results. When turning to jurisdiction size, we find some declines in commercial property assessments in large cities, that are accompanied by slight increases in residential and agricultural property values in smaller towns. However, these effects only arise by 2024, perhaps due to lags in assessment adjustments. The lack of a clear fiscal doom loop is consistent with Chernick and Reschovsky (2025), though the large cities in Tennessee (Nashville, Memphis, Knoxville, Chattanooga) may be under less fiscal stress than other superstar cities (New York, Chicago, etc.).

**2. Relationship Between Taxes and WFH**

Working from home but within the same taxing jurisdiction does not alter tax revenues in the narrowly defined case where everything is the *same* except the location of where the individual works from. But, WFH changes more than the location of work, as households and businesses change what they buy and where they buy it. Likely behavioral changes associated with WFH may alter the size of a jurisdiction's tax bases with institutional features such as tax exemptions for food-at-home, but not for restaurant meals, affecting both taxability and the size of tax bases. The jurisdictions where a taxable activity occurs may also change, as might happen if individuals no longer travel to the city from the suburbs. As seen in the discussion below, the expected effects of WFH likely depend on the specific items purchased, which requires precise decomposition of revenues into their individual components to quantify. We first discuss revenue effects within a single jurisdiction and then the cross jurisdictional implications.

Behavioral responses associated with WFH decisions, and the institutional structures of the tax system determine the effects on sales and property taxes, even within a given jurisdiction. WFH entails less use of commercial and industrial property and presumably lower associated property tax payments, at least in the longer term after firm demand for property declines, leases expire and are not renewed, market prices adjust to the new equilibrium and property is

reappraised. On the other hand, more housing demanded to provide workspace (Mondragon and Wieland, 2022; Stanton and Tiwari, 2021; Gamber, Graham and Yadav, 2023; Brueckner 2024) can increase property tax revenues, again, after full market adjustment and property reappraisal occur.

In many states, property classifications may influence the degree to which gained revenues from residential properties offset lost revenues from commercial properties. In Tennessee, for example, residential property is taxed at 25 percent of full value, while commercial and industrial property is taxed at 40 percent. Thus, the total property tax base declines by 37.5 percent from simply substituting the same appraised commercial/industrial value for housing value. The effects on revenues will also depend on if there are different rates for both categories. The total effect on property tax revenues also depends on the net effect of increased demand for housing and decreased demand for commercial/industrial property combined with the relative values of the two types of property. Reappraisal usually occurs in cycles, which differ across states; reappraisal is generally every four years in Tennessee. The net effects of these market and institutional forces mean the property tax responds to new market values with substantial lags, given the timelines for reappraisal cycles and need for property markets to adapt, so a significant window may be necessary to quantify the effects. We only have four years of post-pandemic data, which challenges our ability to find large effects, despite the dramatic changes in commercial and residential market values that may have occurred.[6]

Likewise, changes in purchasing decisions affect sales taxes, and the specific effects can depend on the institutional structure. For example, unprepared food consumed at home is exempt from sales tax in most states, but restaurant food is taxable at the general sales tax or higher rate (with rates up to 10 percent or more), meaning transitions to eating at home reduce sales tax

[6] Indeed, the prior literature indicates that it takes about three years for an increase in market values to show up in property tax revenues, and that the elasticity is significantly below one (Chernick et al., 2021; Doerner and Ihlanfeldt, 2011; Lutz, 2008). A further complication is that decreases in market values are much less likely to show up as changes in assessed values. The elasticity is even smaller than for when market values fall (Alm et al., 2011; Doerner and Ihlanfeldt, 2011; Lutz et al., 2011). This highlights the importance of studying assessed values to make inference about property taxes, since they may differ substantially from market values.

liabilities significantly even if the same expenditures are made.[7] Other purchasing decisions by either the firms or workers can also influence taxability. As an example, simple changes such as decisions to purchase more casual clothes might influence total tax liabilities. It is also possible that office purchases by businesses are exempt when the same purchase by employees for work at home is taxable. At the same time, WFH has spurred a boost in weekday leisure activities. For example, Finan and Bloom (2023) show an over 150 percent increase in golf trips during the week. More generally, this could increase gym subscriptions or other leisure services, and the extent to which this translates into sales tax revenue depends on whether those services are taxable in the state.[8] However, in most states including Tennessee, many of these types of services will not be subject to sales taxes.

WFH also potentially alters the distribution of tax revenues across jurisdictions and could raise or lower total property and/or sales taxes in some jurisdictions at the expense of others.[9] Tax revenues redistribute across jurisdictions if increasing WFH alters the jurisdiction in which taxable activity occurs. Full-time or hybrid WFH may result in individuals moving further away from the city center and engaging in less cross-border commuting, thereby shifting revenues from urban to suburban or even rural places. These channels can affect both the property and sales tax bases. Total tax revenues may rise or fall depending on the tax rates in the two jurisdictions and the other institutional features that were discussed for within jurisdiction WFH.

[7] At least 36 states exempt food for consumption at home and four states have favored rates. Tennessee taxes food at home at a reduced 4 percent rather than the general 7 percent rate. Food in Tennessee is also subject to the relevant local sales tax rate. See chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://taxadmin.org/wp-content/uploads/resources/tax_rates/sales.pdf

[8] States differ significantly as to inclusion of services in their sales tax base. Some expansions of the base to services has taken place over recent decades in some state. For example, Kentucky expanded the base to 30 new services in 2023, such as recreation, photography, and rental space. Tennessee did not expand the base to any new services during our panel.

[9] Presumably, workers seek to maximize some version of total utility and not minimize total taxes paid when making WFH decisions. Efficient WFH decisions consider out of pocket and implicit time commuting costs and other factors, which allows for the possibility that state and local taxes increase even as overall wellbeing rises.

WFH may also encourage digitalization of economic activity and remote purchasing. Individuals who WFH may be more likely to buy goods online rather than in bricks-and-mortar stores. This affects tax revenues in two ways. First, in many states e-commerce taxes are sourced to the destination locality, meaning that a switch from a bricks-and-mortar purchase shifts the taxable location from the county with the retail center to the county where the individual lives (Agrawal and Shybalkina, 2023). Second, tax avoidance associated with online transactions may be easier if the vendor does not have an economic nexus in the state, meaning that revenue may decline.[10] At the same time, if WFH encourages a more service-oriented consumption economy revolving around digital services like Netflix, social media, digital home security, etc., then WFH may cause a decline in traditional physical e-commerce.

**3. Data and Institutional Details**

We use highly detailed sales and property tax data from Tennessee to investigate the relationship between increased WFH and the levels and distribution of property and sales tax revenues for all local governments in the state. Monthly state and local sales tax data from January 2017 through 2024 for the universe of registered sales taxpayers[11] and annual property tax data for 2017 through 2024 are employed to analyze how rapid increases in WFH affected tax revenues. The sales tax data are disaggregated across various industries and products by NAICS codes, allowing detailed analysis of the revenue effects, and the property tax data are disaggregated into several categories as well.

Tennessee's distribution of state and local tax collections differs from the national averages in two important ways that enhance our ability to focus on non-income taxes. First, Tennessee is

[10] The switch to economic nexus increases tax revenues, yet some non-compliance remains due to smaller vendors, difficulty in identifying taxable vendors, and so forth (Fox, Hargaden Luna 2022). Illinois recently passed legislation allowing tax amnesty for non-compliance with sales tax due on remote sales for the period 2021-2026 (Tax Notes, June 11, 2025), suggesting an expectation that some vendors have failed to properly collect tax.

[11] In some cases, at highly disaggregated NAICS classification, up to 7.8 percent of vendors and 5.1% percent of state net taxable sales, including food, were redacted in the sales tax analysis because of limited sample sizes in some NAICS codes and some smaller local governments. Less redaction occurs in analyses with greater aggregation, and there is no redaction when looking at county level total aggregates.

one of nine states with no state personal income tax and does not permit local income taxes. Thus, we can isolate the effects on non-income taxes without considering intrastate responses to personal income taxes.[12] Second, Tennessee relies more on sales taxes at both the state and local levels than national norms, which is not surprising given the lack of income taxes. But the state also relies on property taxes somewhat less than the national average. Property taxes generated 70.2 percent of total local taxes in the country, versus 65.0 percent in the state. Local governments in Tennessee offset lower property taxes by raising 22.1 percent from sales taxes versus 14.1 percent across the nation. Tennessee's local sales tax share is higher than average, but much below local governments in states such as Louisiana (51.5 percent) and New Mexico (42.3 percent). Combined sales and property taxes raise 87 percent of local tax revenues in Tennessee allowing us to paint a clear picture of the effect of WFH on local public finances in the state.

The Tennessee Department of Revenue collects and distributes sales tax revenues for the 450 counties and cities that are recipients of local sales tax revenues,[13] permitting detailed analysis of geographic and institutional effects.[14] Each vendor is required to file a sales and use tax return with the state of Tennessee. Given each vendor is classified under a particular NAICS code and (possibly multiple) taxing jurisdiction, this allows the Department of Revenue to aggregate any items reported on the sales form by NAICS codes and taxing jurisdiction. This unique ability to aggregate the data at the NAICS by county level is not possible using publicly available data in the state of Tennessee or most any other state. The unique administrative data thus allow investigation of nuanced behavioral responses in where and what people and

[12] Of course, WFH responses to personal income taxes may arise as migrants into or out of Tennessee consider other states' personal income taxes in their location decisions. Inbound migration to Tennessee rose from 192 thousand annually from 2016-2019, prior to the rapid expansion in WFH, to 217 thousand annually from 2021-2023, potentially suggesting some increase in working from Tennessee to avoid other state and local income taxes. https://www.census.gov/data/tables/time-series/demo/geographic-mobility/state-to-state-migration.html

[13] We do not examine effects on the modest distribution of state sales tax collections to cities.

[14] Sales taxes in most counties are attributed to the city or county (outside a city) where the transaction occurs, as unique tax bases, though at least one-half of the sales tax revenues must go to local schools in the entire county, regardless of where collected. However, about 40 cities have sales tax rates that exceed the county rate, and the city retains all this differential revenue.

businesses purchase across products and industries in places where more WFH occurs relative to places where work remains more in business offices.

In-state vendors must file a comprehensive sales tax return that distinguishes gross sales from exempt sales and taxable sales. We have access to all of the line items on this return, which also distinguishes between food and non-food purchases since they are taxed at different rates as well as large item purchases since they are subject to reduced local tax rates. Thus, in addition to being able to aggregate the data by type of vendor (NAICS code) we can aggregate by the type of commodity. An example of a tax return, along with the corresponding information it contains, is shown in Figure A1.

In Tennessee's tax revenue accounting system, TR3, a single taxpayer account can have many locations, each of which is associated with situs locations and NAICS industry codes. Filing for multiple sales tax locations may be from the same physical location and may or may not have different NAICS codes, but the returns indicate the location of sale. Vendors may be organized for sales tax purposes in multiple ways. Some large vendors with multiple (even hundreds of locations) file a single monthly return that is itemized for many individual locations. Other vendors that are commonly thought of as a single entity may have multiple sales tax accounts, for example one account for online sales and another for sales from their bricks and mortar locations. These result in multiple returns that each might contain sales from many locations. Nonetheless, these returns are aggregated by jurisdiction/NAICS code in the data that we use.

In the data, remote sellers (from out-of-state vendors without physical presence in Tennessee) are isolated from sales by vendors with physical presence, permitting us to distinguish between taxes remitted by these categories. Tennessee, like all other sales taxing states, adopted new sales tax statutes for remote vendors after the *South Dakota v. Wayfair*[15] decision. Out-of-state vendors began self-identifying as remote firms through the compliance process in December

[15] South Dakota v. Wayfair, Inc.,138 S. Ct. 2080, 201 L. Ed. 2d 403, 2018

2017 and requirements for remote vendors to collect sales taxes began in July 2019, though some began to voluntarily comply prior to this date.[16]

Tennessee levies the local sales tax on instate sales at the point of sale and not at the residence or location of the purchaser, even if delivered to another jurisdiction in the state. Of course, these are in the same jurisdiction unless cross-border shopping occurs. Out-of-state sales delivered into Tennessee, on the other hand, are situsedat the destination, rather than the point of sale. Remote firms can remit local sales tax revenue to the state at a fixed rate for formula distribution, which most firms did immediately after being required to remit taxes. By November 2019, over 80 percent of revenue was situsedto the destination jurisdiction and by April 2020 over 90 percent was sourced to the destination Out of state sales tax revenue has risen rapidly, from $1,415 million in calendar 2019 to $3,334 million in calendar 2024 and represents over 25 percent of the state sales tax base in 2024. In some cases, website sales by many vendors that supply online orders and also have bricks-and-mortar locations, may be situsedto a physical fulfilment center or as an out of state sale, depending on how the seller books the sale. Marketplace sales are always destination sourced to the buyer, regardless of the vendor.

In interpreting our results, it is important to keep in mind that the sales tax base is narrowly defined, with many aspects of consumption omitted. In 2024, the total state sales tax base comprised about 36.2% of total state GDP. The sale of tangible personal property (including food at a reduced 4% rate) and specifically enumerated services is subject to sales tax unless a statutory exemption applies. Tennessee taxes 76 of 176 services in the FTA 2017 survey,[17] 14th highest among the states, yet still omitting many important services. Specifically enumerated taxable services include lodging services and rooms, cleaning tangible personal property and animal bathing, and repair or installation of tangible personal property or computer software.

[16] The collection threshold for vendors was reduced from $500,000 to $100,000 in past 12 months' sales during 2020.
[17] See https://taxadmin.org/state-taxation-of-services-by-category-2017/

In addition, the tax form first collects the gross sales of a business and then subtracts off various exemptions from tax, allowing us to study some non-taxable physical products. Exemptions are generally based on one of three criteria: 1. the type of entity making the purchase (e.g., non-profit and educational entities and government entities), 2. the type of product being sold (e.g., gasoline, textbooks, and newspapers), or 3. the specific use of the product (e.g., vehicles, vessels, trailers, and aircraft removed from Tennessee within three days of the purchase and Concrete purchased to construct an electric generating plant). Sales for resale are also exempt from sales tax.

Property tax data are only available annually, though they include the same years as our sales tax series. Property tax base, revenue, and rates are available for at least 414 city and county areas though we initially focus on county aggregate tax bases. Counties can impose property taxes on their entire area and cities (always smaller than counties though occasionally crossing county lines) can impose property taxes on the area within their borders, so the city and county tax bases are often overlapping. The property tax base is separated by residential; commercial, and industrial; utilities; and tangible personal property. Thus, we can examine how several types of property respond to WFH and examine whether the distinct categories of base move in different directions.

## 4. Empirical Design

### *4.1 Measuring Telework Potential*

We exploit data from Dingel and Neiman (2020) to isolate the effects of WFH on local tax revenues/bases. These authors construct an indicator for each occupation that equals 1 if the occupation is easily susceptible to teleworking and 0 if not based on the occupation's 2019 characteristics. The occupation indicators are then aggregated at the NAICS level to construct a measure of how susceptible each industry is to WFH. As our interest comes in exploring the effect of WFH on local sales and property taxes, we introduce a spatial component to the index

following Brueckner, Kahn and Lin (2023). When doing this, we can either weight by employment or the wage bill by NAICS code from the County Business Patterns - we focus on the former in our analysis. In other words, we obtain a measure of the share of employment in each commuting zone (or county) that can be done from home for each industry and aggregate across industries to obtain a commuting zone (county) total. Specifically, WFH potential (WFHPOT) in commuting zone $c$ (or county in some robustness checks) is given by

$$WFHPOT_{c(j)} = \sum_i \; s_{ic(j)} \, WFH_i \qquad (1)$$

where $WFH_i$ is the WFH potential of NAICS sector $i$ and $s_{ic(j)}$ is the employment (wage) share of industry $i$ by employer in in commuting zone $c$ containing county $j$.[18] This provides variation in WFH across Tennessee commuting zones, but could easily be calculated with county-specific measures by replacing the $c$ index with simply a $j$ index.

The WFHPOT variable is based on the place of physical employment and not residence for the workers. Given this, we believe it is best to focus on aggregation at the level of the commuting zone, so that all counties in the same commuting zone have the same WFH potential. This is because a given county $j$ is affected by telework if workers in that county have *access* to jobs that are teleworkable in the entire labor market $c$. It should be noted that these metrics are likely correlated with urbanicity and jurisdiction size of the commuting zones, placing a minor caveat on our ability to identify causal effects.

The WFHPOT can vary from 0 to 1. We find considerable heterogeneity among the counties and commuting zones. For example, using 3-digit NAICS codes to construct the index,[19] WFHPOT varies from a high of 0.4325 in Williamson County to 0.1732 in Lake County. Thus, between 17.3

[18] We use 2020 data on commuting zones from Fowler (2024).

[19] The analysis provided below is calculated separately using 2- and 3-digit NAICS code weights and remote employment potential data. Census data necessary to measure $s_{jc}$ are not available for cells with fewer than 4 firms, which is more likely to occur with 3-digit rather than 2-digit data, although 3 digit data more accurately measure the count potential.

percent and 43.3 percent of jobs have the potential to be remote, depending on the county of employment. The relative findings are generally consistent with a priori expectations. Williamson County, a suburb of Nashville, has the highest household income ($128,610) and the highest education in Tennessee. Lake County, a rural county located in far northwest Tennessee, has the lowest household income in the state ($32,554).

Less heterogeneity exists when WFHPOT is aggregated to the commuting zone level (see Appendix Table A1), but it still varies from 0.384 (Nashville area) to 0.220 (east Tennessee, including the primarily tourist oriented area of Gatlinburg/Pigeon Forge). Commuting zones for the four largest cities in Tennessee, Chattanooga, Knoxville, Memphis, and Nashville, all have WFHPOT in the top 6 of 18 zones. Remote work potential when weighted by the wage bill rather than employment has a wider range of outcomes, evidencing that higher wage jobs are more likely to have remote potential, and we will show various robustness checks to different measures of aggregation.

*4.2 Difference-in-Differences Design*

The empirical design exploits a difference-in-difference estimator. Focusing here on the finer sales tax regressions, we estimate regressions of the form:

$$\ln(R_{ijt}) = \beta WFHPOT_c \times POST_t + \gamma_j + \gamma_t + \varepsilon_{ijt} \quad (2)$$

where $\gamma_j$ are county fixed effects, $\gamma_t$ are time fixed effects, $\ln(R_{ijt})$ is the log of revenue or various tax base measures in NAICS code $i$ of county $j$ in commuting zone $c$ and time (year) $t$, and $POST_t$ equals one for years including 2020 and after. Obviously, this indicator $POST_t$ can be replaced with year dummies, facilitating an event study design. While our measure of WFH potential is continuous, the recent literature suggests that using a continuous treatment variable requires a much stronger parallel trend assumption than the standard difference-in-differences design (Callaway, Goodman-Bacon and Sant'Anna 2024). In particular, it requires

that the "path of outcomes for lower-dose units must reflect how higher dose units' outcomes would have changed had they instead experienced the lower dose" and the presence of no pre-trends does not provide evidence in support of this stronger assumption.

Given this assumption may be strong and pre-trends do not provide a test of it, we follow the advice in Callaway, Goodman-Bacon, and Sant'Anna (2024) and aggregate across treatment doses by dichotomizing the continuous variable into high and low dose treatments.[20] We then implement a standard binary difference-in-differences design that compares high dose treatment commuting zones with low dose commuting zones. High-dose (treatment) counties have a value of $WFHPOT$ that is in the 75$^{th}$ percentile or higher, while low-dose (comparison) counties have a value that is in the 25$^{th}$ percentile or below. As the low-dose counties are partially treated by telework (e.g., they are not never treated units), our effects represent a lower bound on the causal effect of telework. Medium-dose counties are excluded from the regression, though comparing them to low-dose counties yields smaller results than in our baseline.

The main analyses use treatments where all counties in the same commuting zone have the same dosage, as telework may be driven by common labor market rather than county level characteristics but with county level revenues. We also estimate relationships using treatment dosage at the county level, though we expect these effects to be attenuated because treatment is determined by whether one's job (labor market) can be worked from home and not whether one lives in a county with many jobs that can be worked from home (as many individuals work for firms across county borders).

In some specifications, rather than letting $j$ index counties, we let it index the situs jurisdiction. In Tennessee, cities can levy their own taxes, and some of the revenues can accrue to special districts. We aggregate all sales tax collected in special districts into the appropriate city. We then run regressions exploiting city level variation in sales and revenues. When doing this,

[20] For a recent empirical example following this recommendation, see Brainerd and Malkova (2025).

areas that are outside of formal cities are included as a "county remainder". Note that cities include large urban areas but also smaller areas that are often considered towns in other states. There may be a significant population in the remainder of the county.

A similar regression equation is used for the property tax, with the $i$ now indexing residential, commercial and industrial, farming, public utilities and tangible personal property sectors. The time lags in market adjustment and assessment are long, making it more challenging to identify revenue effects for the property tax than for the sales tax. Counties reappraise every four years but on different schedules, introducing heterogeneity across counties in the data.

One challenge of using monthly local revenue data, especially disaggregated at the sector level, is that the data can be noisy due to seasonal demand factors. One approach to mitigate these fluctuations is to follow Agrawal and Shybalkina (2023) and replace the dependent variable with the year-over-year growth rate, but this approach still poses challenges especially at the sectoral level. Given our design does not require a high-frequency approach, we instead prefer to aggregate the data at the annual frequency and to use those data rather than the monthly data series. We show results using higher frequency data in robustness checks. In addition, to mitigate these concerns, the regressions are weighted by county employment (in 2019). This also helps us interpret the coefficients as capturing the revenue effects for the county that the average individual lives in, rather than the average county in the sample.

We identify two challenges facing our empirical analysis. First, we focus on a single state, which lowers the extent of variation in WFH potential across places and stacks the deck against finding statistically significant effects. However, this limitation is offset by the rich Tennessee data that allow us to look at detailed revenue across sectors and subsectors. To our knowledge, this type of rich data is not publicly available in most states. As a result, we believe the Tennessee case study provides important implications that shed light on the optimal design of the taxability of various types of products. Further, wide cross-state tax structure differences significantly complicate multi-state analysis of detailed sales and property tax data.

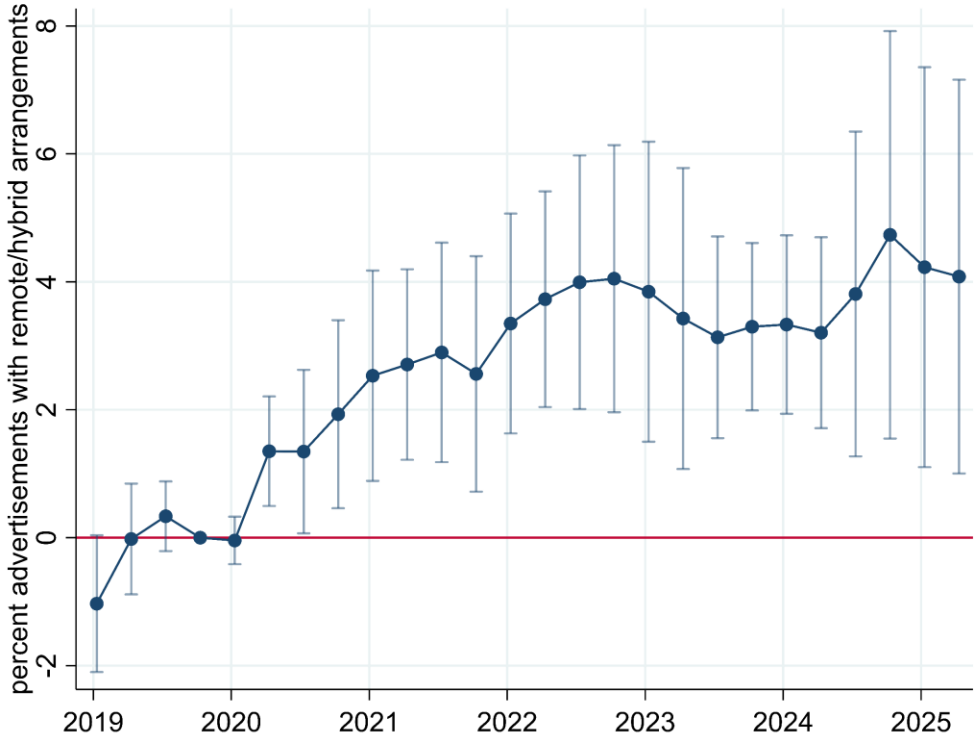
A second empirical concern relates to the measure of WFH potential. WFH is correlated with particular types of sectors and occupations that are more predominant in larger urban areas; this latter correlation is visible by the counties that are high telework potential in Table A1. These larger urban areas may differ in other important ways that could affect tax revenues. For example, urban areas saw larger declines in the sales tax base than rural areas during the pandemic or may have been differentially exposed to other health related shocks (Agrawal and Fox, 2020, and Agrawal and Shybalkina, 2023). Further, the expansion of WFH occurred during the pandemic, which also had revenue implications that may have differed across places. To address these issues, we focus on an event study specification that studies the effects from 2017 to 2024. This allows us to study where the effects in highly teleworkable counties were different in the pandemic years of 2020 and 2021 versus those that occurred later, with the idea that any confounding effects of the pandemic have died down, but WFH persists.

*4.3. First Stage*

To validate our empirical design, we first show that our measure of WFH potential is correlated with telework takeup. To do this, for each county in Tennessee, we obtain data from the American Community Survey (ACS). The ACS asks individuals how they usually commuted to work last week, selecting the method of transportation used for most of the distance. While individuals can select standard methods, such as car or walking, they also have the option to say that they worked from home. Given the wording of the question, it is not clear if this picks up all hybrid and fully remote workers or not. It also has the limitation that the ACS county estimates are five-year averages, meaning that the variable is slow moving to adjust to the dramatic annual shift occurring after the pandemic. Nonetheless, it provides a useful proxy to validate that work from home potential, determined based on pre-pandemic characteristics, is correlated with actual telework takeup. We then estimate (2) using this Census WFH question as the outcome variable. Appendix Figure A2 shows an increase in the telework by residents of treated counties relative to comparison counties.

To address the data limitations of the ACS telework question, we then use data on job postings from Hansen et al (2023). These authors provide monthly data on the percentage of new online job advertisements in the USA that explicitly offer remote or hybrid work arrangements. These data are released at the county level. Data are tracked starting in 2019, so shorter pre-trends are available. And because the jobs are employment based, the location is attributed to the county where the employer and not the worker is located. As a result of this, the data are better situated to capture the effects of telework potential on the labor market. The data show a four percentage point increase in telework related job postings in high potential counties relative to low potential counties (Figure 1).

**Figure 1: Telework Takeup**




This figure shows an event study where the outcome variable is percent of job postings that allow for hybrid or fully remote work. Treated counties are in a commuting zone with high telework potential, while comparison counties are in a commuting zone with low telework potential. Standard errors are clustered at the county level with 95 percent confidence intervals shown.

## 5. Sales Tax Results

*5.1 Tax Bases*

We begin with an analysis of the sales tax, where we study both state sales taxes raised in each county and local sales taxes collected in each jurisdiction, as they could offer different insights due to different treatments of products such as food in the state and local tax base. For our main analysis, we focus on telework treatment defined at the commuting zone level, with county level telework potential relegated to an appendix.

Given we have access to every line on the firms' sales tax return plus details about exemptions from a separate schedule, we decompose WFH effects across various line items on the form and across NAICS codes for several types of commodities. We generally discuss state sales tax base unless otherwise noted, because of the broader state tax base in Tennessee and better ability to disaggregate by type of sales. The broader base provides external validity to other states considering a broad tax base. Focusing on the base rather than the tax revenues also allows us to interpret the results in a way that is not dependent on the relative tax rates for food and non-food products.

As discussed previously, the sales tax is imposed on each taxable transaction though it is remitted through aggregate monthly returns. The tax is at destination for many remote sales and some taxable business purchases (and particularly for larger businesses) but is levied at the point of sale for many consumer purchases. Thus, we are analyzing the extent of changes in the jurisdictions where these transactions occur and the extent to which remote transactions grow as greater WFH takes place. Overall, the results are consistent with economic expectations though not every year of the event studies is always statistically significant.

It is important to observe that only partial treatment effects can be identified. As high telework counties are compared to low telework counties, and because inevitably some individuals in low telework counties likely WFH, the measured results are a lower bound of a full treatment

response if the comparison group were not entirely untreated. Further our results are for a single state that does not permit the variation in telework that would be found if larger cities and other states---such as the tech heavy areas of California---could be included in the analysis, so any measured effect need to be taken in the context of the observed telework potential in Tennessee.

To summarize, we find a significant reduction in total taxable sales in high telework counties relative to low telework counties in 2020 and 2021 when both WFH treatment and COVID are taking place and a smaller and often marginally insignificant effect in 2022-2024. These effects differ widely by type of good and by type of vendor, meaning the overall revenue effect is the combination of very different responses across sectors. General merchandise stores experience large losses in higher telework places and food for consumption at home undergoes more modest declines. Tourism related activities, such as accommodations, entertainment, and even restaurants, show no persistent effect from rising telework. Similarly, products for which people might shop more broadly, such as higher priced products and electronics have no persistent response. Interestingly, e-commerce (inclusive of out-of-state purchases) evidences a negative effect in higher telework counties suggesting that e-commerce and telework may be substitutes, likely because telework is more complementary to digital services that largely remain untaxed. Below are more detailed discussions of the findings.

*5.2 State and Local Sales Tax Revenues*

With respect to sales taxes, we begin by examining the relationship between WFHPOT at the commuting zone level and the total taxable base (including food and non-food) raised in each county.[21] We first proceed using information filed on Tennessee tax returns from in-state vendors. In-state vendors file different returns than out of state vendors that contain comprehensive data for which we have a rich set of information. Of course, focusing on this

[21] Sales tax returns generally report sales and use tax obligations with a one-month lag.

misses any e-commerce or mail order sales that are shipped into the state. But, it is the relevant metric for *locally* occurring taxable activities.

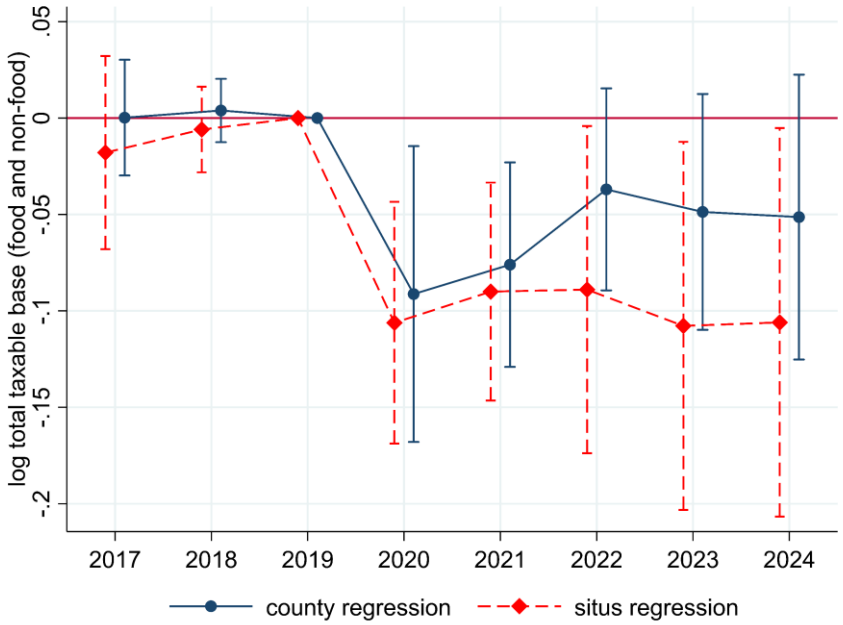
Focusing on the total base, rather than revenue, allows us to talk about what would happen in a state with a broad base that potentially taxed both food and non-food items at the same rate. No evidence of pre-trends exists in the event studies, with no significant relationship prior to 2020 (Figure 2 panel a). Places with higher remote worker potential are found to lose about 10 percent of state sales tax base in 2020.[22] The results hold up using treatments at both the county and commuting zone level and are very similar whether potential is weighted by employment or wages.[23] Effects are largest in 2020 when both COVID and greater WFH likely affected shopping patterns. The extent of sales tax decline became smaller over the next two years but remains negative at about 5 percent of revenues through 2024, evidence that high work from home had a persistent negative effect on sales tax bases for at least four years in high telework counties. The coefficients are marginally insignificant at the 5 percent level from 2022-2024 when looking at county level results.

In the red series of figure2a, rather than exploiting sales at the county level, we study the situs level. Each county contains multiple cities as well as a portion of area not within city limits. While these data provide a richer variation, they also are more likely to have additional redactions due to the small number of firms in very small jurisdictions. While we will later conduct heterogeneity analysis across place, it is important to note that using the city level variation produces point estimates that are nearly identical to the county level in 2020 but remain about 10 percent of tax base in the longer-term. However, the standard errors now indicate each year is statistically significant (maintaining the same level of clustering at the county level in both the red and blue series), suggesting that aggregation to the county reduces the number of jurisdictions in a way that increases confidence intervals.

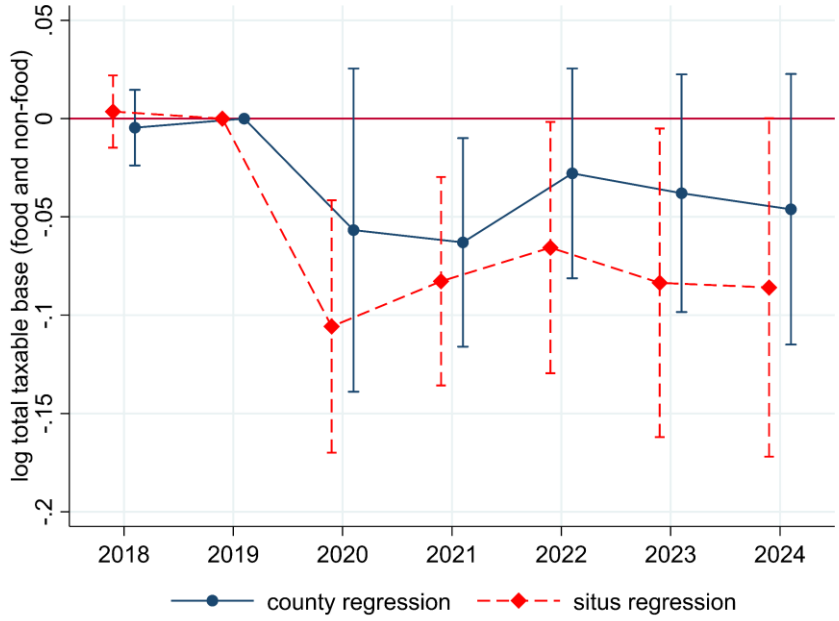
[22] Figure a illustrates the results with 3-digit weighting in WFHPOT but they are very similar when weighted and estimated using 2-digit NAICS codes. This is included as one of our robustness checks in Appendix Figure A4.
[23] Quarterly dummy variables were also estimated, but the annual estimates are preferred since the former evidence considerable seasonality and are noisier. (See Appendix Figure A3.)

**Figure 2: Sales Tax: Total Taxable Base (Food + Non-food)**

*Panel a: Excluding Out of State Vendors*




*Panel b: Including Out of State Vendors*

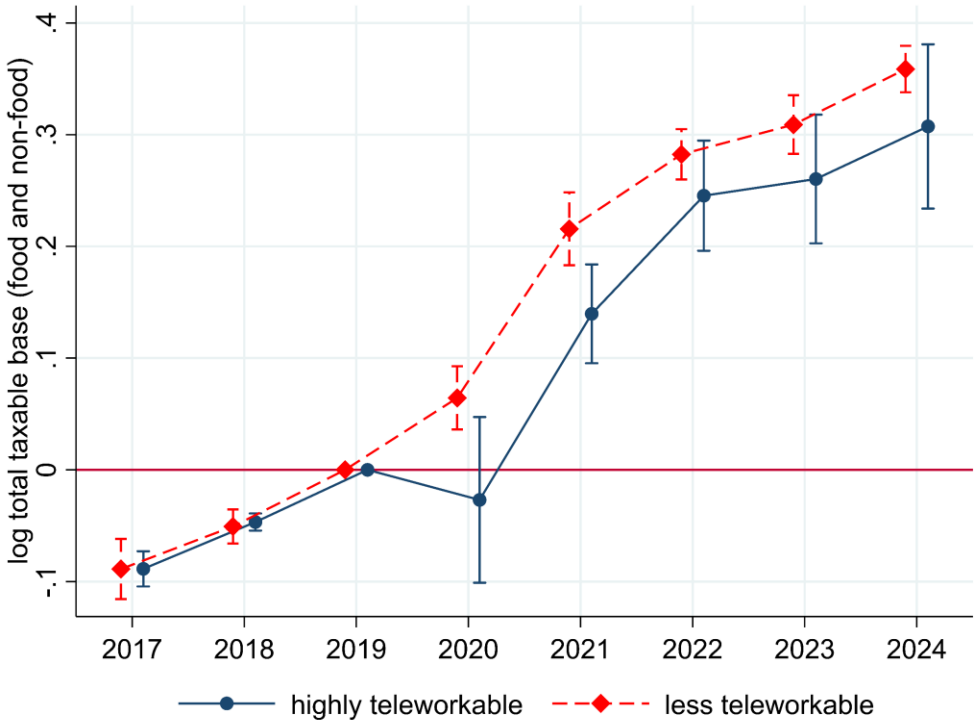



This figure shows an event study where the outcome variable is the log of the total potential taxable base including food and non-food purchases in the taxing jurisdiction (county in blue and situs/city in red). Panel a excludes out of state vendors, while panel b includes them. While some data are available for out of state vendors, it is limited and panel b therefore excludes food (approximately 1% of out of state sales in 2019). Treated jurisdictions are in a commuting zone with high telework potential, while comparison jurisdictions are in a commuting zone with low telework potential. Standard errors are clustered at the county level with 95 percent confidence intervals shown.

Of course, there are many reasons why sales from in-state vendors may have fallen, including telework inducing a shift toward non-taxable services. Another issue is that telework may spur additional ecommerce and when products are shipped into the state those sales are not reported with the same level of detail on Tennessee tax returns. For state sales tax purposes those sales are reported as an "out of state situs" and then appropriately distributed to the counties. Remote vendors file a separate schedule for local sales tax that contains less information (less variables than we will use in our subsequent analysis). Additionally, these data do not contain out of state food sales at the county level. However, out of state food sales are known at the state level and they were less than 1 percent of out of state sales in 2019 and less than 2 percent by the end of our sample. Furthermore, because Tennessee did not start sourcing out-of-state sales to the destination county until 2018, we have one less year of data on these sales. Figure 2b shows the results after *adding* these out-of-state sales to our in-state sales of each county. The results indicate similar, albeit sometimes slightly smaller declines, suggesting the entire decline is not just a result of a shift to out of state e-commerce. This is expected given that out-of-state sales are 25.5 percent of total taxable sales statewide in 2024. All subsequent results, except for those related to e-commerce will focus only on information filed on Tennessee vendor returns, as those returns permit the most disaggregated analysis.

As robustness checks, Figure A3 shows the results are robust to aggregating at the quarterly level. Figure A4 shows the results are robust to a variety of alternative specifications including economic covariates and not weighting the regression (Panel a). In addition, we show the results are robust to defining telework potential at the county $j$ level rather than at the commuting zone $c$ level. Furthermore, rather than weighting by employment shares, weighting by the area's share of the total wage bill has negligible effects (Panel b). Finally, the dose regressions may be sensitive to the thresholds used. Thus, we follow recommendations to also display comparison of medium dose counties (between the $25^{th}$ and $75^{th}$ percentile) to low dose counties. As expected the effects decrease but remain significant. We also show results splitting at the median WFH potential value (Panel c).

**Figure 3: Separated Trends by the Treatment and Comparison Group**



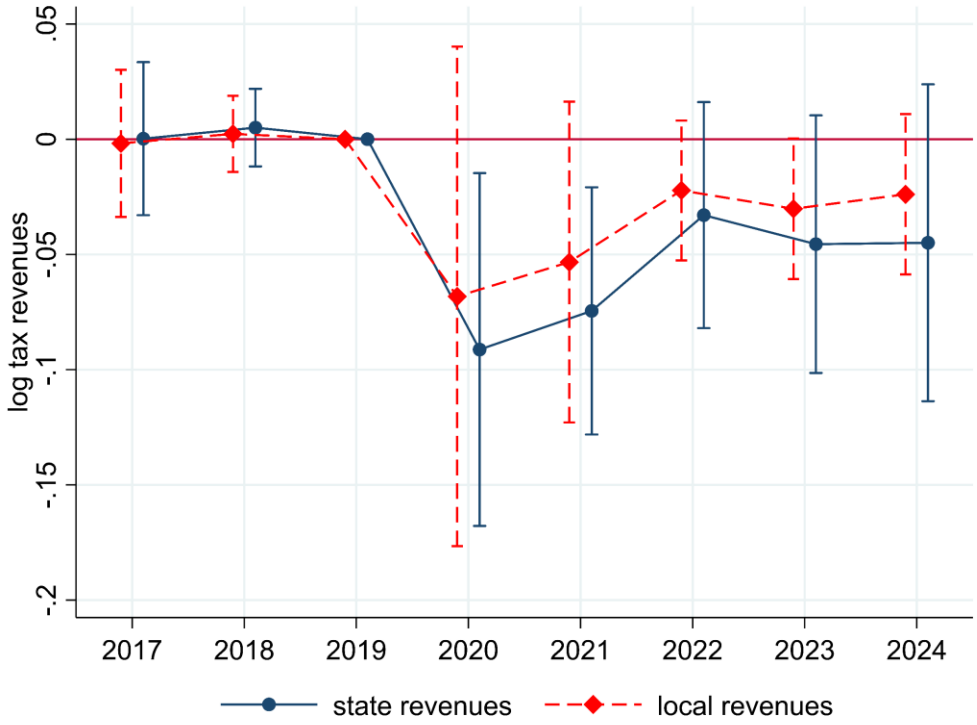

This figure shows an event study where we plot event dummies separately for the treatment and the comparison group. The difference between the two lines is then the effects in Figure 2. The outcome variable is the log of the total potential taxable base including food and non-food purchases in the county. Treated counties are in a commuting zone with high telework potential, while comparison counties are in a commuting zone with low telework potential. Standard errors are clustered at the county level with 95 percent confidence intervals shown.

To further illustrate our results, we divided counties into those with less and with more telework potential. We then regress the outcome variable on event dummy indicators separately for the treated and comparison groups to verify the decline is due to the treatment group seeing a decline in its taxable base and not something occurring in the comparison group. Counties with less WFHPOT did not experience a decline in sales tax revenues in 2020 and indeed saw an acceleration in 2021 (see Figure 3).[24] High WFHPOT counties, on the other hand, saw a revenue decrease in 2020 and never recovered with sales tax revenues still lower in 2024 relative to lower telework counties. The findings are consistent with workers shifting some of their

[24] Increased online purchases may also explain some of the pattern in low WFHPOT counties (see Agrawal and Shybalkina, 2023).

purchases from high telework counties where they formerly worked physically to the places where they live but also with a shift in consumption from taxable goods to non-taxable services.

**Figure 4: State versus Local Tax Revenues**




This figure shows an event study where the outcome variable is the log of state tax revenues and the log of local tax revenues in the county. We control for the local sales tax rate to address any possible changes in the tax rate that may affect taxable sales. Treated counties are in a commuting zone with high telework potential, while comparison counties are in a commuting zone with low telework potential. Standard errors are clustered at the county level with 95 percent confidence intervals shown.

Finally, do state revenues raised in a county follow a different pattern from the county's own local revenues? Local sales tax revenue regressions may differ because of heterogeneity in the local tax rates and differences across the state and local sales tax bases that can affect revenue performance.[25] The state defines both the state and local tax bases and limits the maximum local sales tax base for any single item (referred to as the single article cap). Any price in excess

[25] Local governments can impose a rate up to 2.75 percent. County rates apply to all jurisdictions within the county, though cities can impose a higher rate than the county as long as the combined rate does not exceed 2.75 percent. Revenues are distributed based on situs of sales or destination for remote sales, but at least one-half of the revenues must go to schools. Most school districts are at the county level.

of the ceiling only increases the state tax base. Coefficients and patterns for county bases are very similar to the state base, except the initial reaction is somewhat smaller (see Figure 4) although not statistically different.[26] We find no evidence that counties changed their tax rates in response to the revenue changes, which is unsurprising. First, about one-half of the counties are already at the maximum permissible rate (2.75 percent) and about 40 cities in the lower rate counties already impose the maximum rate. So, there is limited upward rate flexibility. Second, a vote of the population is necessary to raise the rate, and this likely would take time to implement.

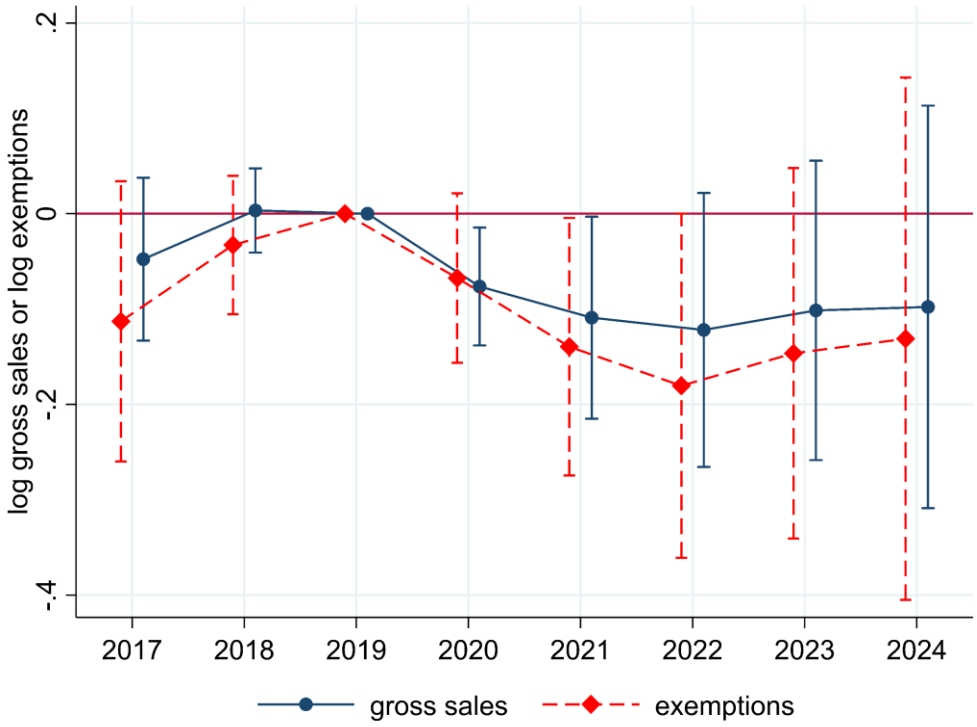
*5.3 Disaggregated Responses*

We decompose the tax return data into several broad sub-components to better understand the underlying revenue performance. The state sales taxable base is gross sales minus exemptions plus use taxes, so we estimate regressions separately for gross sales and exemptions. Gross sales generally comprise all sales by taxpaying vendors. The most important exemptions are for sales shipped with an out-of-state destination; sales for resale; sales to non-taxable buyers including the federal government, Tennessee governments, and not-for-profits; industrial and agricultural equipment; and food paid for with SNAP benefits.[27] [28] Both gross sales and exemptions showed declines of 10 percent or more, which expanded through 2022, two years longer than the initial shock to the tax base (Figure 5). Also, comparing Figure 5 to Figure 2, the estimated maximum coefficient is nearly twice as large for exemptions than for the taxable base and is slightly larger for gross sales than it was for the taxable base. Again, the latter years are

[26] Results were similar when regressions were estimated for all sales taxing jurisdictions in Tennessee, including cities. WFHPOT was at the county level for these regressions.
[27] Technically, food sales are treated as an exemption and then taxed at a preferred rate.
[28] State sales tax revenues during a month may differ from gross sales times the tax rate because a small number of differential rates are imposed (such as food for consumption at home), exemptions reduce the taxable base, payment of past due taxes is remitted, and use taxes are paid. Use taxes include tax on purchases by the sales taxpayer from an out-of-state vendor where sales tax has not already been collected, purchases for resale where the items were changed to a taxable purpose (such as cleaning products used by the business), and taxable tangible personal property that was created for use in Tennessee. Use tax regressions were insignificant, which is consistent with the use tax being paid at the physical location of the business and not changed by different WFH behavior. We do not analyze consumer use taxes.

not statistically significant, particularly as the standard errors grew. The offsetting effects of these two major components explain the tax revenue performance. Simply, exemptions fell enough to offset much of the effect on gross sales.

**Figure 5: Gross Sales versus Exemptions**




This figure shows an event study where the outcome variable is either the log of gross sales or the log of total exemptions in the county. We control for the local sales tax rate to address any possible changes in the tax rate that may affect the base. Treated counties are in a commuting zone with high telework potential, while comparison counties are in a commuting zone with low telework potential. Standard errors are clustered at the county level with 95 percent confidence intervals shown.

### 5.3.1 Effects by Commodity

We next examine three components of the disaggregated tax base: food for consumption at home, non-food sales, and large ticket items. These three categories can be studied because of particular institutional features of the tax system in Tennessee. Food at home is disaggregated on state tax forms because it is taxed at a different rate than all other sales. Further, large ticket items have special tax rules discussed below, facilitating study of larger products. This analysis

can be viewed as studying the differential effects of sales by commodity type. In the next section, we will then study sales by taxpayers in various NAICS code, which are sales by vendor. The data in food at home, larger ticket items and various NAICS codes may overlap as vendors in a given NAICS code may sell all of these types of items.

We next plot event studies for the sales of food at home and the sales of all non-grocery taxable purchases (Figure 6). The event study for food consumed at home showed only about half as large of a reduction in sales in high telework places during 2020 as that for aggregate taxable sales shown in Figure 2. The effect of non-grocery sales is similar to that of Figure 2. Intuitively, this is because grocery sales are only 12.4 percent of the total taxable sales.

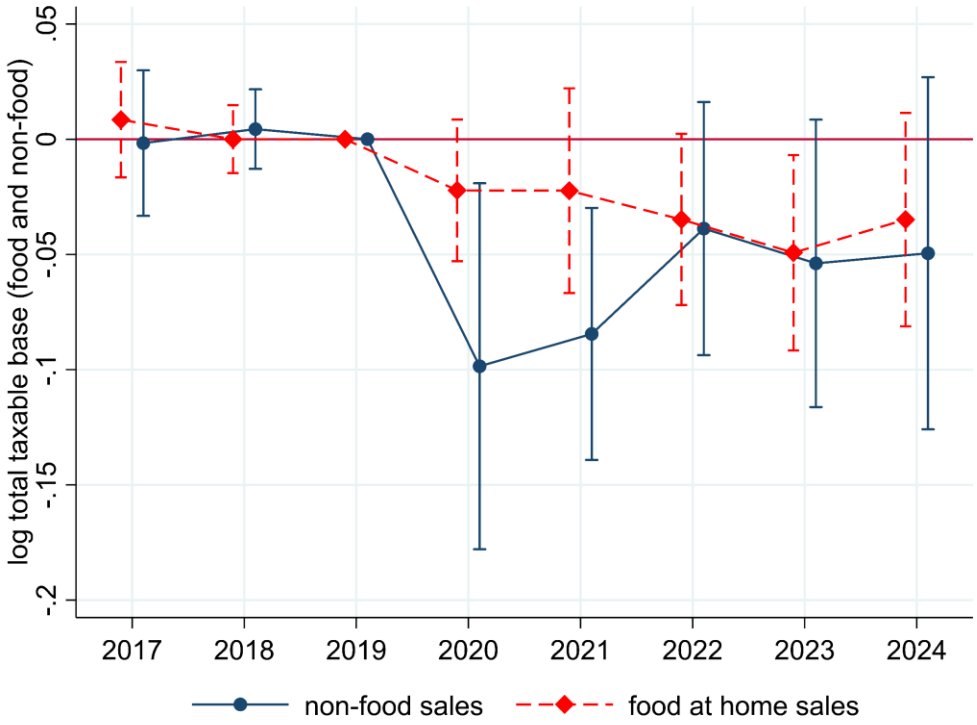
Though the effect on grocery food purchases is smaller, the coefficient for food at home declined through 2023 and is statistically significant in 2023, while that for all sales experienced a large decrease in 2020 followed by lesser decreases in subsequent years. The declines in total sales tax revenue and food tax revenues are much closer for the latter years as food sales at retailers also declined about 5 percent at the end of the panel. The result is consistent with people generally shopping more for food at home and less at restaurants during COVID but changing their pattern for food shopping similar to the average over time.

However, as we will show below, the behavior of food at Food and Beverage Stores (NAICS 445) differs dramatically from General Merchandise Stores (NAICS 452). Both undergo large decreases in 2020, but Food and Beverage Stores have zero or positive coefficients in later years, while food at General Merchandise stores illustrate the average decline. Food Service and Drinking Places (NAICS 722), where most sales are taxable at the general rate, had a significant decline in 2020 and 2021 and smaller insignificant declines in subsequent years. Also, Tennessee enacted several food tax holidays during the panel[29], which could reduce tax

[29] The retail sale of food and drink by restaurants and limited-service restaurants was exempted from sales tax from August 7th through August 9th, 2020 (Public Chapter 759 (2020)). The retail sale of food, food ingredients, and prepared food products was exempted from sales tax from July 30th through August 5th, 2021 (Public Chapter 456 (2021)). The retail sale of food and food ingredients was exempted from sales tax from August 1st through August

revenues during those years, though time fixed effects should account for this and these holidays may have similar effects in treated and comparison counties.

**Figure 6: Food Versus Non-Food Sales**




This figure shows an event study where the outcome variable is either the log of food and non-food taxable sales in the county. We control for the local sales tax rate to address any possible changes in the tax rate that may affect the base. Treated counties are in a commuting zone with high telework potential, while comparison counties are in a commuting zone with low telework potential. Standard errors are clustered at the county level with 95 percent confidence intervals shown.

The fact that food sales do not decline in Food and Beverage Stores is consistent with food being a relatively inelastic product---grocery store purchases might be expected to be relatively constant over time except for substitution with restaurant meals. However, the fact that food purchases decline in general merchandise stores or gas stations is consistent with trip bundling. Baker, Johnson, and Kueng (2021) show that in the presence of shopping trip fixed costs, individuals often trip bundle to purchase a variety of goods at once. As sales and number of

31st, 2022 (Public Chapter 1131 (2022)). The retail sale of food and food ingredients was exempted from sales tax from August 1st through October 31st, 2023 (Public Chapter 377 (2023)).

trips for non-food purchases at general merchandise stores fall or gasoline purchases fall due to less commuting, trip bundling implies sales of food purchases also fall there.

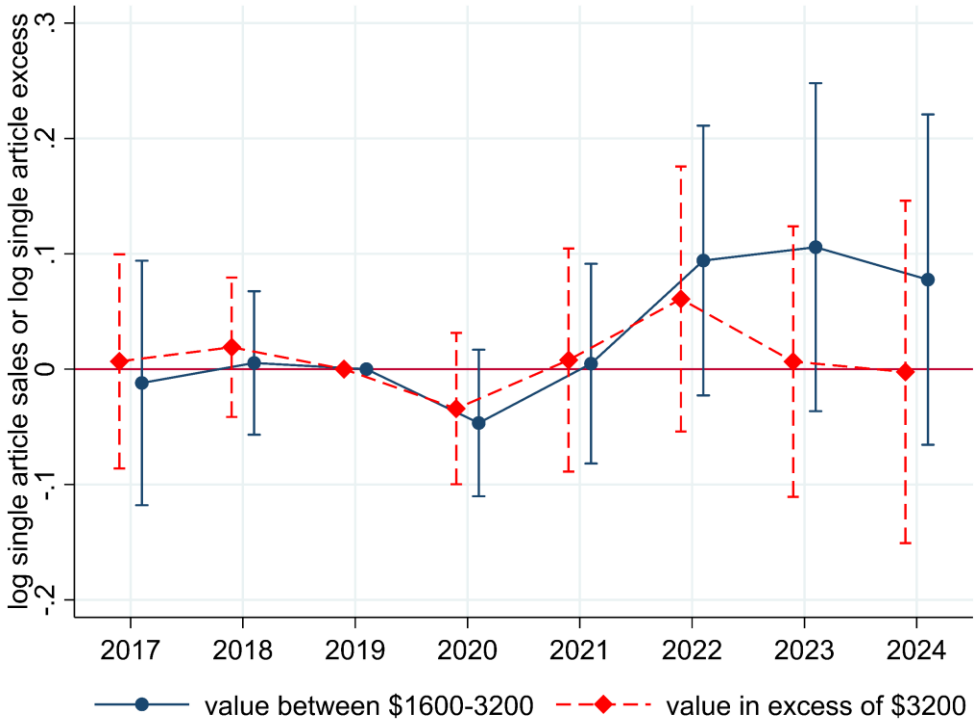
Next, we use a unique institutional feature of the TN sales tax to study large item purchases where the state caps the value that localities can tax. Tennessee's local option cap has multiple steps. The first $1600 of any single item is taxed at the local tax rate. The next $1600 is taxed at fixed rate of 2.75 percent (the revenues accrue to the state) and any amount above $3200 is not subject to local tax. The regular state tax rate (7 percent) is imposed on the entire price. The tax return allows us to use this detail to analyze how bigger ticket item sales are affected by WFH. Specifically, the tax return includes the value of sales in excess of the $1600 cap and therefore not subject to local tax and instead reveals total tax collections from the second tier that are subject to the fixed 2.75 percent tax. Assuming that most large item purchases are more than $3200, data for the tax revenues between $1600 and $3200 (the second tier) are essentially a quantity measure for items with prices above $3200 since the tax on each of these items is (.0275*($3200-$1600)). However, the data for quantity is measured imprecisely to the extent there are items priced in the second tier ($3200>P>$1600).

A 5 percent decline in the quantity proxy occurs in 2020 followed by no effect in 2021 (see Figure 7), suggesting the number of large ticket item sales (single article sales) declined only during the first year of COVID. The number of big purchases rises in each subsequent year, though the coefficients are insignificant. The result is consistent with two possible explanations. First, inflation caused more items to be priced in this range and inflation was stronger in teleworkable counties or second, more large ticket items sales occurred in higher teleworking places over time.

A 5 percent decline in the quantity proxy---single article sales---occurs in 2020 followed by no effect in 2021 (see Figure 7), suggesting the number of large ticket item sales declined only during the first year of COVID. The number of big purchases rises in each subsequent year, though the coefficients are insignificant. The result is consistent with two possible explanations.

First, inflation caused more items to be priced in this range and inflation was stronger in teleworkable counties or second, more large ticket items sales occurred in higher teleworking places over time.

**Figure 7: Single Article Tax on Large Item Purchases**




This figure shows an event study where the outcome variable is either the log of single article sales or single article excess in the county. We control for the local sales tax rate to address any possible changes in the tax rate that may affect the base. Treated counties are in a commuting zone with high telework potential, while comparison counties are in a commuting zone with low telework potential. Standard errors are clustered at the county level with 95 percent confidence intervals shown.

The aggregated excess over $1600 (P-$1600)---single article excess---provides a value measure for higher priced goods and is also tracked by the state. The event study finds a slight decline in aggregate big-ticket sales with COVID in 2020 and no effect in the other years - evidence that the decline in total sales (Figure 2) is concentrated in lower price items and food. The results are consistent with people shopping across a wider geography (both in places where they live and formerly worked) for higher price items without a change as they commute to work less frequently.

*5.3.2.* Effects by Vendor Type

Analysis by type of vendor is possible because the tax return data contain the NAICS code for each remitting firm. The results are somewhat noisier with further disaggregation, and measurement error becomes more problematic due to smaller counties having more suppressed cells, but interesting conclusions emerge. Select event studies by NAICS codes are shown in Figure 8 though we talk about others without illustration and instead display coefficients by industries in a single Appendix Table A3, which shows results from a simple DiD model with a treat by post coefficient.

Although Appendix Table A3 only shows average post-pandemic effects, inspecting the event study graphs for each industry indicates that several industries evidence larger negative coefficients than our baseline results, particularly in 2020 and 2021 , but these are balanced out by zero or positive effects in other industries when aggregated. For example, Figure 8 Panel a shows that retailers see a significant 5 percent decline in 2020-21 in high telework places, though a smaller coefficient than the total tax base. Approximately the same reduction occurs for retailers in 2022-2024. The smaller decline in retail, given its large share of the taxable base, indicates that other sectors saw larger declines.

Teleworkable counties saw large declines in Food and Accommodation Services, covering hotels, food prepared in restaurants (NAICS 72), and arts and entertainment (NAICS 71), during the pandemic, but the effects revert to pre-Covid patterns in the final three years. Figure 8 Panel b shows these results for NAICS 72. Two possible explanations include: first, WFH was most significant in the pandemic years and thus created the largest effect; second, the pandemic may have affected teleworkable counties differently in other unobservable ways than less teleworkable counties.

We then disaggregate to 3-digit or 4-digit retail industries in Table A3. General Merchandise Stores decline in 2020, but the effect grows to more than 20 percent in high telework places

over the next several years, though there is some evidence indicating that pre-trends are not perfectly parallel. The industry includes 17.6 percent of total retail and 9.5 percent of all taxable sales (see Table A2 for relative shares of the base for select industries). Miscellaneous Retailers show a similar and persistent pattern, though a little smaller. Gasoline stations, which sell food and miscellaneous other taxable products (gasoline is not subject to the sales tax), are 2.1 percent of taxable sales and exhibit a similar pattern.

Electronic and Appliance Stores (EAS) and Motor Vehicles have an initial decline during Covid but no persistent effect. Furniture and Home Furnishings Stores (FHFS) also have a large initial decline, but the effect is not significant in the latter years given the bigger standard errors. Both EAS and FHFS have a larger coefficient in the first 1-2 years of response than do total revenues. The overall pattern suggests that shopping at these vendors was highly affected during COVID but otherwise occurs across broader geographic areas and is not altered by WFH, consistent with the discussion of higher price items above.

Computer Systems Design, which is not a retail industry and represents 0.9 percent of taxable sales, shows the reverse effect with a substantial increase in high telework places (Figure 8 Panel d). These are likely business services, and potentially goods, with attribution of the revenues to the place of business, which could be at either the buyer's or seller's location depending on the particular transaction. Alternatively, consumers could purchase taxable hardware at the providers' location while obtaining any non-taxable services. Lawn and Garden Stores see no effect, but there is evidence of a decrease in sales at Home Centers in higher telework places, except during 2023. Construction shows declining revenues across the panel, with a 5 percent decline that is significant by 2024.[30] The result is consistent with research finding higher demand for housing in places where teleworkers reside, assuming that individuals are moving further out of the highly teleworkable commuting areas.

[30] Construction materials are taxable but not construction services.

Alcohol Stores and Food Service and Drinking Places have similar patterns to each other and to the two-digit categories where they fall and in the broader groupings discussed above (Arts, Entertainment, and Recreation; Accommodations and Food Service)– large decreases in 2020-21 and no persistent effect of the telework treatment afterwards. Combined, these categories are about 11 percent of taxable sales. The lack of a sustained effect from telework suggests tourism sales are particularly important in these categories, and tourists frequent the same places even after telework expands. Also, employees in these industries are much less likely to have a WFH option.

Non-store Retailers and Electronic Shopping and Mail-Order Houses are likely to include much of remote sales. Sales at Non-store Retailers (1.0 percent of taxable sales) are unaffected by the extent of telework. We focus on Electronic Shopping and Mail-Order Houses (NAICS 4541), combined with data on out-of-state sales sourced at destination, as our best measure of e-commerce. Studying e-commerce is challenging because some e-commerce sales may be allocated to electronic shopping firms, but sales by general retailers like Walmart may be allocated to another NAICS category. In addition, as discussed previously, sales by out-of-state vendors are tracked separately. Interestingly, on average out-of-state sales were about 14.9 percent of total sales in 2019 but rise to 25.5 percent by 2024. Instead, NAICS 4541 is about 2.7 percent of taxable sales.[31] This suggests that many online purchases from instate vendors may indeed be appearing under other NAICS classifications.

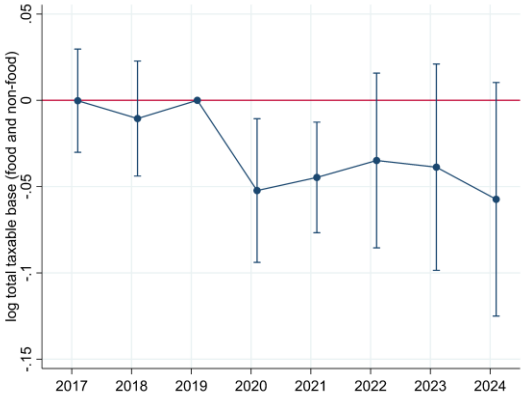
Ignoring any e-commerce not allocated either to NAICS 4541 or out of state vendors, Figure 8 panel c shows a comparable relative decrease in out-of-state e-commerce sales as well as out-of-state sales plus those sales in NAICS 4541. In other words, despite e-commerce increasing in the aggregate throughout the pandemic, e-commerce has risen at a slower rate in high telework potential places than in low-telework potential places. This is consistent with the result in Agrawal and Shybalikina (2023) who show that the e-commerce boom was largest in smaller

[31] Electronic Shopping rose dramatically during the panel, from 1.9 percent of tax base in 2017 to 6.8 percent in 2024. Of course, the Wayfair decision explains the rapid early growth.

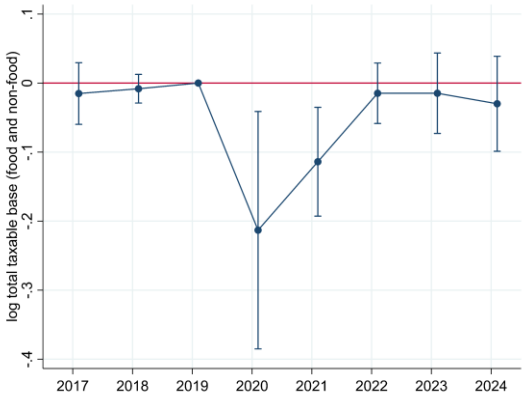
localities than larger localities. The result may evidence the relationship between WFH and consumer purchases but may also account for changes in online purchases of taxable intermediate products by businesses, where revenues are attributed to the place of work in larger, urban counties. Again, remote sales by other firms, such as General Merchandise Stores, are usually included with other sales by the firms and are included in their NAICS code.

**Figure 8: Select NAICS Category Event Studies**

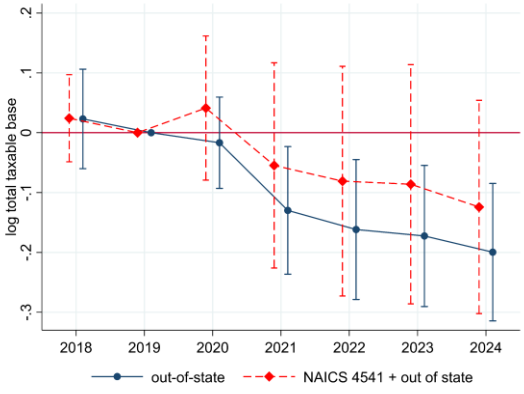
*Panel a: Retail (NAICS 44-45)*



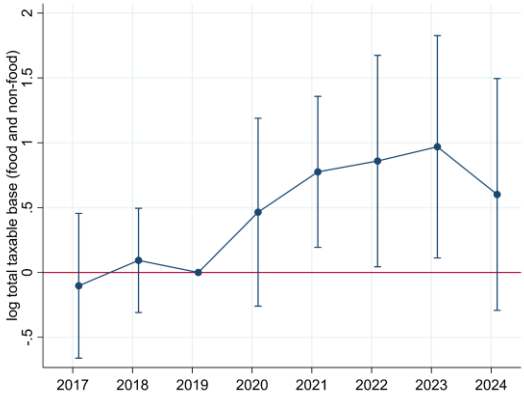

*Panel b: Accommodation and Food Service (NAICS 72)*




*Panel c: Electronic Shopping and Mail-Order Houses (NAICS 4541)*




*Panel d: Computer Systems Design and Related Services (NAICS 5415)*




This figure shows an event study where the outcome variable is either the log of food and non-food taxable sales in the county for various NAICS codes. Panel a and b are at the two-digit level, while panel c and d are at the four-digit level. In panel c the blue series plots out-of-state sales (regardless of NAICS) while the red series plots that plus instate sales from NAICS 4451. Out of state sales do not include food purchases. Treated counties are in a commuting zone with high telework potential, while comparison counties are in a commuting zone with low telework potential. Standard errors are clustered at the county level with 95 percent confidence intervals shown.

To summarize, Table A3 in the Appendix shows the coefficients from a simple DiD model with a treat by post coefficient. To implement this simple design, we replace the event dummies with a treat by post interaction and a treat by pre interaction, where 2019 is omitted from both. Thus, the treat by post coefficient is a measure of the causal effect while the treat by pre-coefficient tests for pre-trends, with it ideally being zero to validate the design. While simple, these regressions miss the dynamics discussed in the prior discussion. The treat by post variable indicates a causal decrease in General Merchandise, Miscellaneous Store Retailers, Gasoline Stations, and Food Service and Drinking Places and a causal increase at Electronic Shopping and Mail-Order Houses.

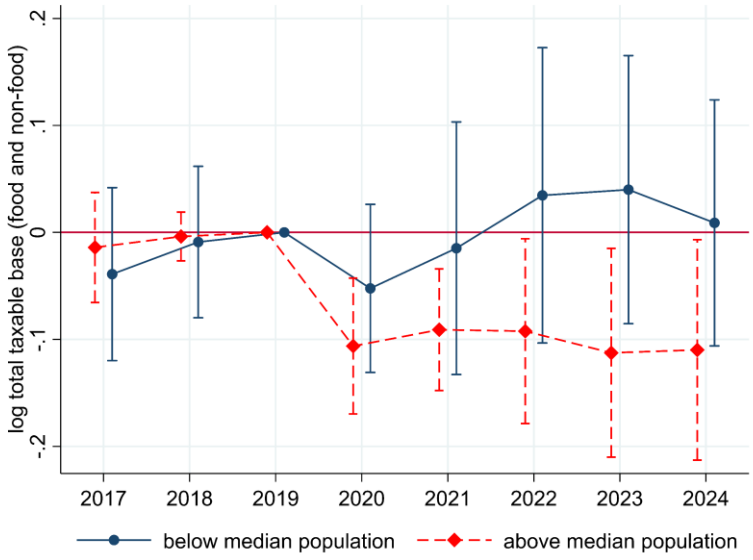
*5.4. Effects by Jurisdiction Size*

Technological change has the potential to redistribute revenue from large to small jurisdictions by shifting the location of purchase from central cities toward smaller hometowns. As a result, telework may cause sales tax revenue to be more closely linked to the county of residence where an individual lives and receives most of the public services from which they benefit. Given our sales tax data contains the point of sale for the vendor, we study whether telework helps redistribute revenues in this manner. Here our focus is on in-state vendors, rather than out-of-state purchases.

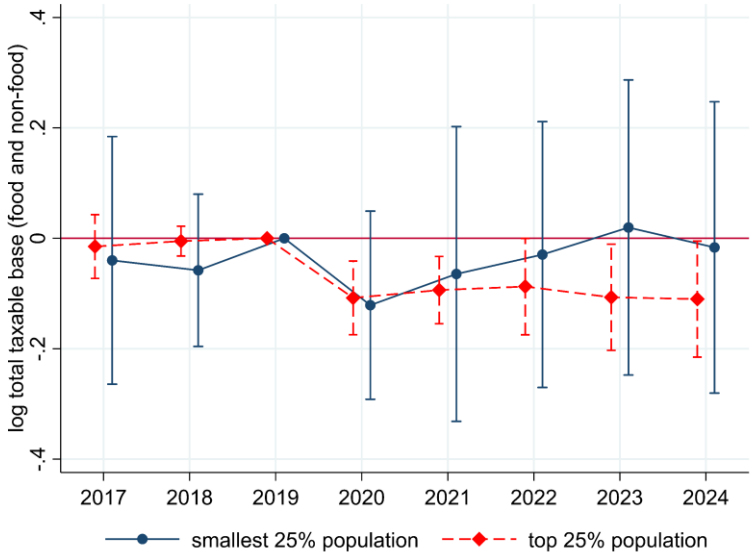
To do this, we use the city and balance of county data to examine whether WFH potential redistributed sales tax revenue from larger to smaller jurisdictions by examining above median (3000 people) versus below median population size places (Figure 9, panel a) and 75$^{th}$ percentile versus 25$^{th}$ percentile places based on population (Figure 9, Panel b). In Tennessee the median defined “city” is quite small, so this might better be descripted as municipalities rather than cities. When conducting this analysis, we maintain the DiD analysis. For example, in Panel a, to estimate the effect of large cities we compare cities above the median in teleworkable counties to cities above the median in low telework potential counties. Small jurisdictions are then compared to each other between the high and low telework potential counties.

**Figure 9: Small Versus Large Jurisdictions---Sales Tax**

*Panel a: Above Versus Below Median Size*




*Panel b: Largest 25% Versus Smallest 25%*




This figure shows an event study where the outcome variable is the log of the total potential taxable base including food and non-food purchases in the taxing jurisdiction. We split the sample based on jurisdiction size and run separate regressions for large and small jurisdictions while maintaining the DiD framework such that treated large [small] jurisdictions are compared to comparison large [small] jurisdictions. Panel a splits jurisdictions at the median population, while panel b focuses on the bottom/top 25% based on size. Treated jurisdictions are in a commuting zone with high telework potential, while comparison jurisdictions are in a commuting zone with low telework potential. Standard errors are clustered at the county level with 95 percent confidence intervals shown.

Larger places exhibited a significant, persistent reduction, equal to about 10 percent of sales, using both measures of population size as revenues show no significant change in smaller places. The decline in one set of areas without offsetting growth in others evidences continuation of the aggregate long-standing decline in sales tax bases because of continued shifts to non-taxable services (such as health care) and away from taxable goods and policy changes to reduce bases.[32]

Appendix Figure A5 explores this heterogeneity even further by studying the effects in the "central city" of the commuting zone compared to all other places. The central city is defined as the largest jurisdiction in the commuting zone. Central cities see even larger declines.

## 6. Property Tax Results

We now turn to studying the effects of WFH on various property tax bases. While the prior literature has shown that central city real estate prices have fallen along with residential price increases in more suburban jurisdictions, knowing these prices are not sufficient to know what happens to property tax revenues for several reasons. First, reassessments may not result in instantaneous changes in assessed values and even if they do, assessed values on commercial and residential property may be capped at different limits of market value. Second, declines in market values are often met by changes in assessments that are much smaller (Alm et al., 2011; Doerner and Ihlanfeldt, 2011; Lutz et al., 2011).

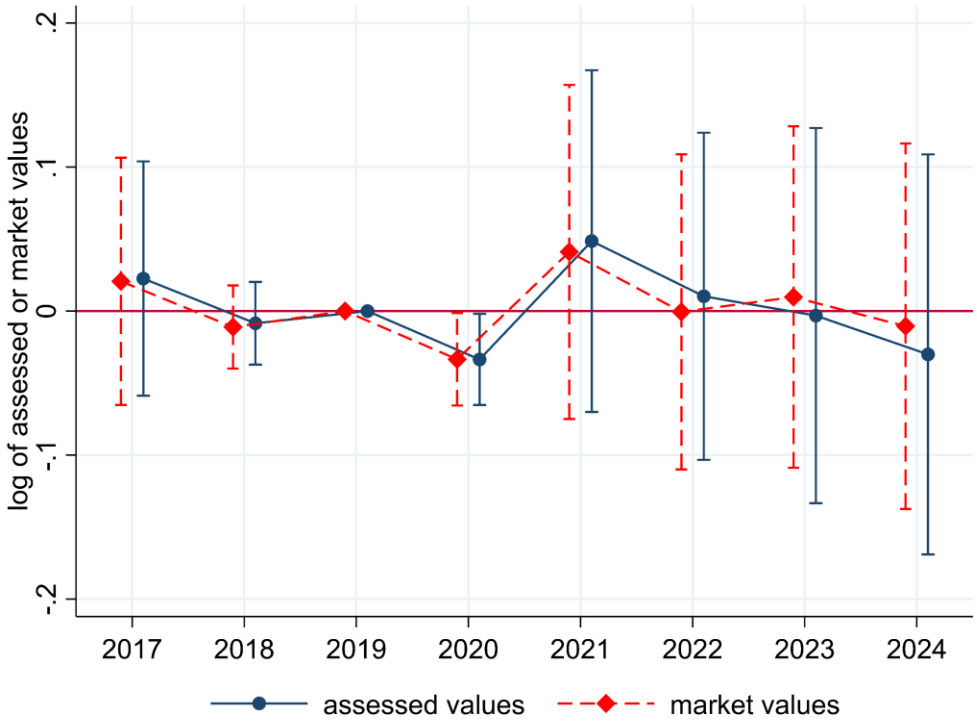
### *6.1. Local Property Tax Bases*

In Tennessee, local assessors value residential, commercial and industrial, and farm property, while the state often assesses public utility property. All categories are subject to local property tax. The property tax base is slow to adjust because properties are reassessed every four years on a staggered basis across counties. Otherwise, changes in jurisdiction property values

[32] See Fox (1998) for an early discussion of the base decline.

generally represent new construction rather than value changes. In addition, in Tennessee some properties are given a PILOT, and thus are not included in the property tax base, though we have data separately on these properties. After appraisal, property is assessed at 25 (residential), 40 (commercial and industrial and tangible personal property), or 55 (public utility) percent of full value, depending on the type of property. Assessment ratios are constitutional and apply in all jurisdictions. Properties in cities may be subject to both county and city level property taxes.

**Figure 10: Property Tax: Total Assessed Values**




This figure shows an event study where the outcome variable is the log of total assessed value of properties in the county in blue and market value (converted from assessed values) in red. Treated counties are in a commuting zone with high telework potential, while comparison counties are in a commuting zone with low telework potential. Standard errors are clustered at the county level with 95 percent confidence intervals shown.

We first study the total assessed values of all properties in counties. Figure 10 shows a null effect of the switch from in-person work to WFH on assessed property values. This null effect occurs both in the short- and long-term. Similarly, we find no effects on public utility or PILOT properties. We also analyze appraised values, which have not been adjusted for assessment

ratios. Results for appraised values, before differential assessment ratios are applied, also indicate no effect. This suggests that the different weights on property (as given by the assessment ratios) do not explain the lack of a measured aggregate effect.

One possible reason for this null effect is that commercial properties fell as demand for office space declined, while residential properties increased as demand for more housing increases due to telework. We investigate this phenomenon by separately analyzing commercial, residential, and farm tax bases (Appendix Figure A6). Of course, this is possible because the different assessment ratios require separation of the tax base data into these categories. We find no heterogeneous effects across types of tax base --- all three bases show no meaningful increases, though farm properties rise slightly in teleworkable counties (Appendix Figure A6).

As an alternative explanation, counties may be too large to capture the nuances of fiscal doom loops, as commercial properties may fall predominantly in city centers and residential properties may rise in more suburban places in the same county. We will explore this heterogeneity next.

*6.2 Effects by Jurisdiction Size*

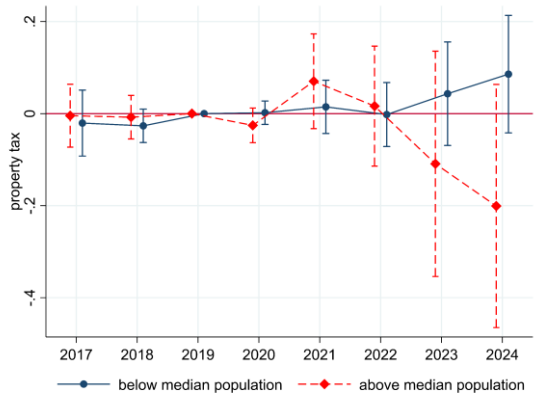
As discussed with the sales tax, the prior literature has shown that technological change can advantage small jurisdictions at the expense of larger jurisdictions. This might explain some of the reason why we find null effects of telework on the overall property tax base of the county. If telework drives down property values in central cities but raises them in more suburban or rural jurisdictions, no aggregate effect at the county level might be found. Thus, we split the sample by portions of the county that are above and below the median population in the property-tax sample.[33] Focusing on aggregate assessed values in each city (residential plus industrial plus

[33] In general we focus on defined cities, which might better be referred to as towns. However, in the property tax regressions movement may be to non-city (e.g., unincorporated) areas of the county. So, we treat that remainder as one of the jurisdictions in the sample despite those jurisdictions not having the ability to levy property taxes and instead only subject to the county property tax.

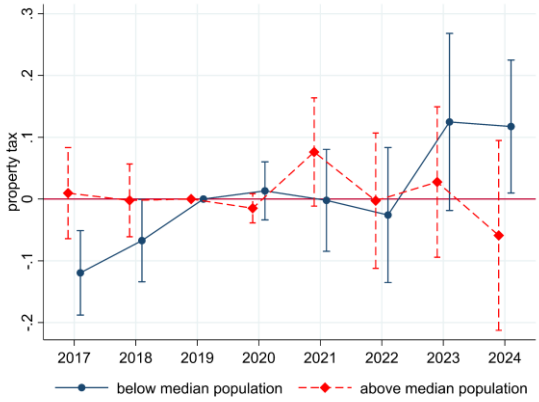
agricultural) we again find no heterogenous effects by large or small jurisdictions. But because the doom loop story is driven by the initial decline in commercial values in the city and then residential flight to the suburbs, we then disaggregate the assessments across all cities and in Tennessee. Areas in counties outside of cities are aggregated in a separate category within each county.

**Figure 11: Small Versus Large Jurisdictions---Property Tax**

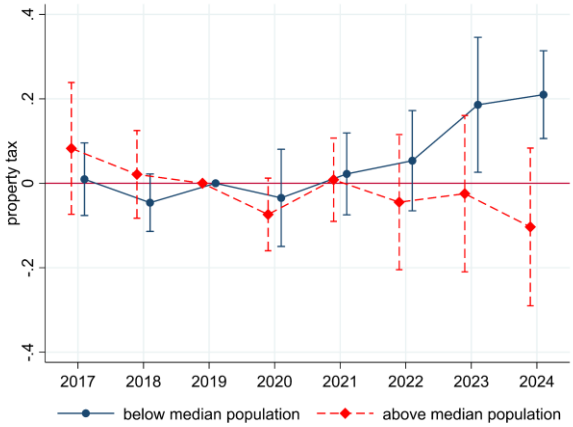
*Panel a: Industrial/Commercial*




*Panel b: Residential*




*Panel c: Farm/Agricultural*




This figure shows an event study where the outcome variable is the log of the various property tax bases in the taxing jurisdiction. We split the sample based on jurisdiction size and run separate regressions for large and small jurisdictions while maintaining the DiD framework such that treated large [small] jurisdictions are compared to comparison large [small] jurisdictions. All panels split jurisdictions based on the median population size. Treated jurisdictions are in a commuting zone with high telework potential, while comparison jurisdictions are in a commuting zone with low telework potential. Standard errors are clustered at the county level with 95 percent confidence intervals shown.

Figure 11 shows different effects when jurisdictions are split into small and large and when we break apart assessments by type of property. Keeping in mind that reassessment is staggered in Tennessee, we should only expect to see noticeable effects by the end of the sample. Larger places see 20 percent declines in commercial/industrial assessed values by 2024, as small places see some growth. Similarly, larger places experience declines in residential property values (though imprecisely measured) as smaller places see them rise. This suggests some movement of people (and possibly businesses) from larger to smaller jurisdictions. Interestingly, there is an increase in the value of farm or agricultural properties. Farm properties include true agriculture but also contain smaller plots that higher income households use to primarily live on, with limited agricultural use on the side. The increase might be driven by households moving to more rural areas and buying farms for residential purposes.

## 7. Conclusion

Telework can raise or lower total state and local tax revenues depending on institutional features of the taxes, rates in different jurisdictions, and macroeconomic effects and can alter the jurisdictional distribution of revenues. We find that jurisdictions from which telework now occurs lose sales tax revenues as the propensity for telework rises. Simply, the places where teleworkers reside and now work gain tax revenues as the physical location of the businesses lose revenues. Revenue losses are heavily concentrated in above median population size places. On net, the decline revenues appear to decline relatively over the panel. These effects differ widely across types of vendors and commodities. Taxes associated with higher-ticket price items and tourism are less likely to be affected, while those associated with general merchandise stores are more likely to fall. Growing remote sales, including those situsued to the location of physical businesses, on the other hand, may increase with telework. We find no evidence that aggregate property tax revenues fall in high telework counties, though we find evidence (sometimes insignificant) that larger sub-county places lose property value as smaller places gain depending on the type of property.

The sales tax losses by themselves are not likely to create significant fiscal stress for most jurisdictions but property tax losses can also occur at the sub-county level. Property tax revenue losses associated with the doom loop (see Chernick, and Reschovsky, 2025, and Gupta, Mittal, and Van Nieuwerburgh, forthcoming) are found in other research, at least in center cities, adding to the financial stress. Further, expected reductions in personal income tax revenues where workers no longer commute exacerbate the problem (see Agrawal and Stark, 2022). Again, center cities are most likely to lose income tax revenues, though the effects are larger at the state than the local level. The combined redistribution of these three taxes, which collect on average more than three-fourths of state and local taxes, can harm revenues in urban centers and increase revenues in suburban and outlying areas. These effects exacerbate the revenue redistribution that occurred following the Wayfair case (see Agrawal and Fox, 2021, and Agrawal and Shybalkina, 2023) that moved revenues from center cities and retail centers to suburban and rural areas. The compounding effects of these technology-related revenue transitions (see Fox and Zodrow, 2025) increase the fiscal pressure on traditional centers of employment and trade.

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## Figure A1: Sales Tax Return

1. Gross sales.....(1) _____
2. Cost of personal property purchased on a resale certificate but used.....(2) _____
3. Cost of out-of-state purchases and property imported into Tennessee for use.....(3) _____
4. Fair market value of tangible personal property fabricated, produced, compounded, or severed from the earth for use in Tennessee.....(4) _____
5. Total sales and purchases (add Lines 1-4).....(5) _____
6. Exempt transactions from Schedule A Line 11.....(6) _____
7. State net taxable total (subtract Line 6 from Line 5).....(7) _____
8. State sales and use tax (multiply Line 7 by 7%).....(8) _____
9. State food tax (multiply Schedule A, Line1 by 4%).....(9) _____
10. Local sales and use tax from Schedule B, Line 8.....(10) _____
11. Tax collected in excess of state and local levies.....(11) _____
12. State tax on transactions subject to single article and reduced rates from Schedule C Line 9.....(12) _____
13. Local tax on transactions subject to the special tax rate from Schedule C Line 15.....(13) _____

This figure shows a tax return for sales taxes in the state of Tennessee.

**Table A1**
**Commuting Zones**

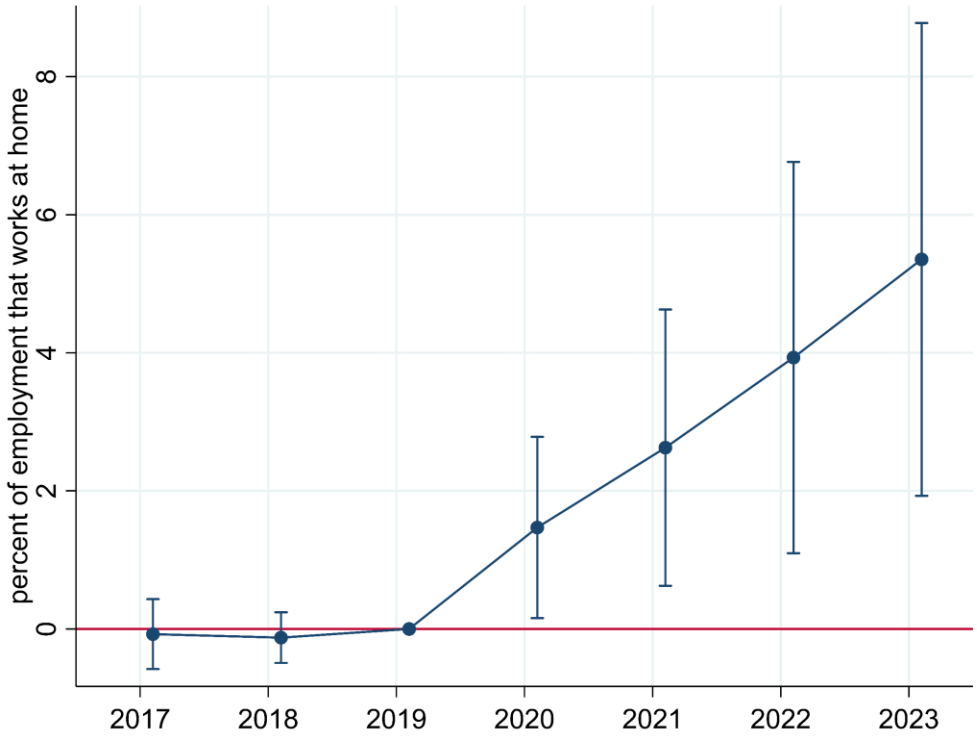
| Commuting Zone* | Counties | WFHPOT |
|---|---|---|
| 10 | Lincoln | 0.342 |
| 51 | Shelby, Tipton, Fayette (Memphis) | 0.326 |
| 118 | Bledsoe, Bradley, Hamilton, Marion, McMinn, Meigs, Polk, Rhea, Sequatchie (Chattanooga) | 0.307 |
| 159 | Obion, Weakley | 0.307 |
| 224 | Claiborne, Hancock | 0.277 |
| 232 | Houston, Montgomery, Stewart (Clarksville) | 0.252 |
| 395 | Johnson | 0.250 |
| 486 | Anderson, Blount, Campbell, Knox, Loudon, Monroe, Morgan, Roane, Scott, Union Knoxville) | 0.311 |
| 487 | Bedford, Cannon, Coffee, Franklin, Grundy, Marshall, Moore, Rutherford | 0.282 |
| 488 | Benton, Carroll, Henry | 0.272 |
| 489 | Carter, Greene, Hawkins, Sullivan, Unicoi, Washington (Kingsport, Johnson City) | 0.266 |
| 490 | Cheatham, Davidson, Dickson, Hickman, Humphreys, Macon, Robertson, Smith, Sumner, Trousdale, Wilson, Williamson (Nashville) | 0.384 |
| 491 | Chester, Crockett, Decatur, Gibson, Hardeman, Haywood, Hardin, Henderson, Madison, McNairy (Jackson) | 0.254 |
| 492 | Clay, Dekalb, Jackson, Overton, Pickett, Putnam, Van Buren, Warren, White | 0.250 |
| 493 | Cocke, Grainger, Hamblen, Jefferson, Sevier | 0.220 |
| 494 | Cumberland, Fentress | 0.253 |
| 495 | Dyer, Lake, Lauderdale | 0.239 |
| 496 | Giles, Lawrence, Lewis, Maury, Perry, Wayne | 0.250 |

* WFHPOT based on employment weights

**Table A2**

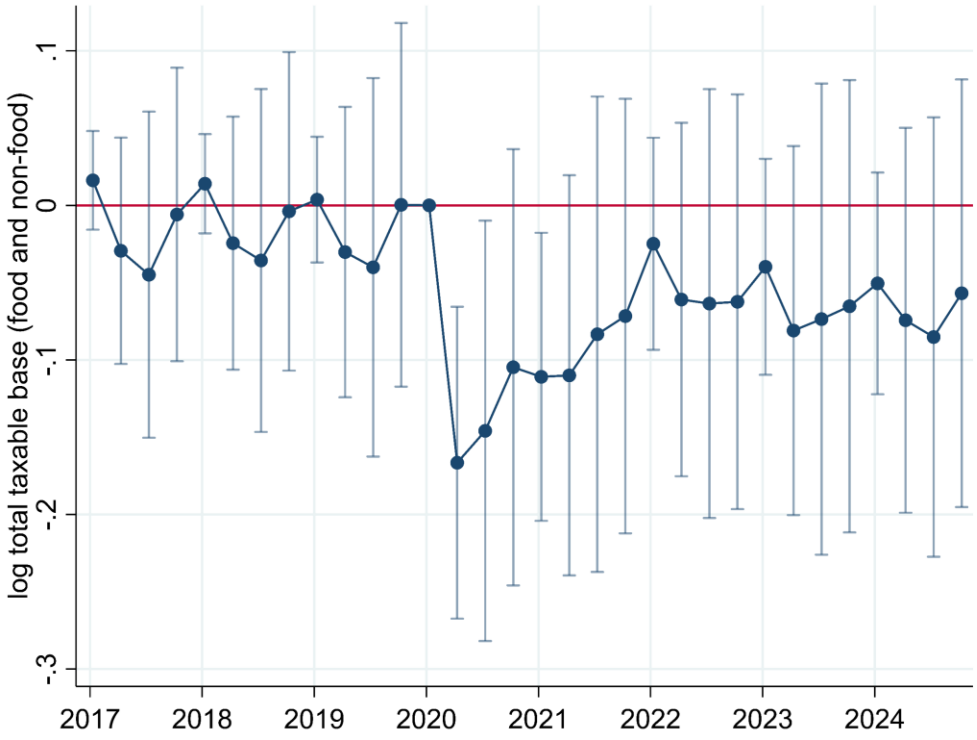
| **Share of Total Sales: Selected Industries** | |
|---|---|
| **NAICS Code and Name** | **2019** |
| 42: Wholesaling | 0.064 |
| 44411: Home Centers | 0.034 |
| 444: Building Material Stories | 0.061 |
| 445: Food and Beverage Stories | 0.107 |
| 447: Gasoline Stations | 0.021 |
| 448: Clothing and Clothing Accessories | 0.031 |
| 452: General Merchandise Stores | 0.095 |
| 453: Miscellaneous Store Retailers | 0.025 |
| 4541: Electronic Shopping and Mail-Order Houses | 0.027 |
| 51: Information | 0.023 |
| 53: Rental and Leasing Services | 0.034 |
| 71: Arts Entertainment and Recreation | 0.009 |
| 722: Food Service and Drinking Places | 0.109 |
| 8111: Automotive Repair and Maintenance | 0.028 |

**Figure A2: Telework Takeup with Census Data**




This figure shows an event study where the outcome variable is percent of individuals who report working at home in the ACS. Five year ACS estimates are based on averages of the prior five years of data, so the outcome variable is slow to adjust. Treated counties are in a commuting zone with high telework potential, while comparison counties are in a commuting zone with low telework potential. Standard errors are clustered at the county level with 95 percent confidence intervals shown.

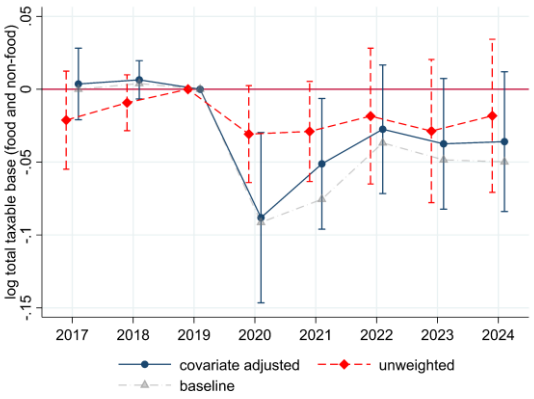
**Figure A3: Quarterly Data**




This figure shows an event study where the outcome variable is the log of the total potential taxable base including food and non-food purchases in the county. The only difference from the baseline figure in the main text is that this figure uses quarterly data. Treated counties are in a commuting zone with high telework potential, while comparison counties are in a commuting zone with low telework potential. Standard errors are clustered at the county level with 95 percent confidence intervals shown.

## Figure A4: Robustness Checks

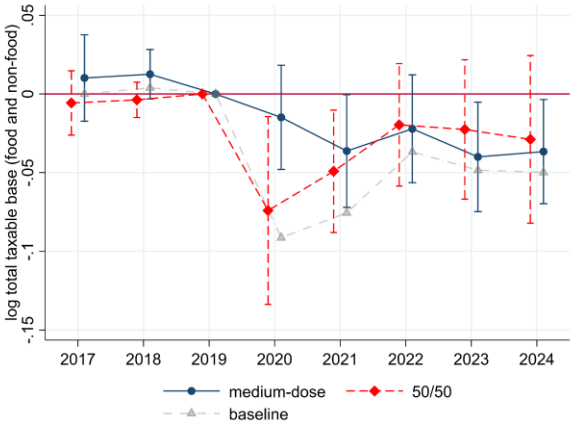
*Panel a: Specifications*




*Panel b: Treatment Definition*




*Panel c: Treatment Thresholds*




This figure shows robustness checks to our baseline specification, which are shown on the graph in gray triangles. Panel a adds covariates for jurisdiction size, unemployment, and tax rates. In addition, results are shown for unweighted regressions. Panel b calculates the definition of teleworkable at the county level (keeping employment weights) but also calculates it at the commuting zone level with weights based on the wage bill. Panel c changes the threshold for being a high dose region by comparing medium to low dose regions and comparing counties in the top 50% to those in the bottom 50%. Standard errors are clustered at the county level with 95 percent confidence intervals shown.

**Table A3: Results by NAICS Subcategories**

*Panel a*

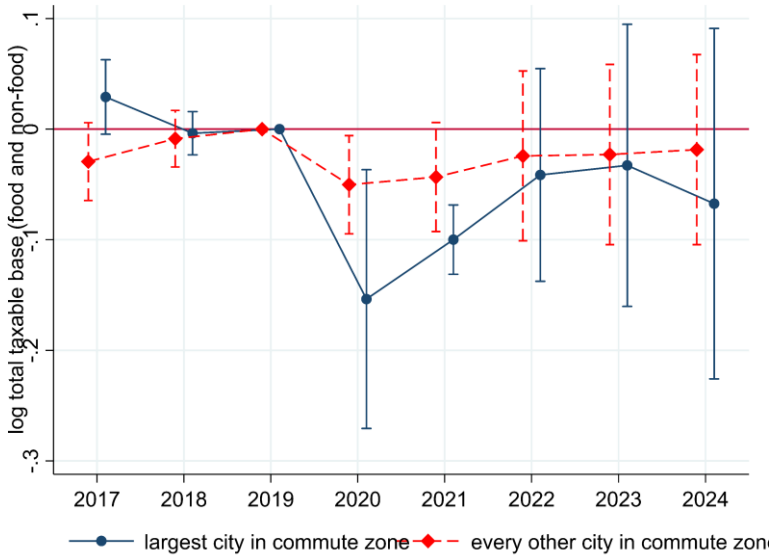
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| NAICS | 452 | 453 | 447 | 443 | 441 | 442 | 5415 | 4442 | 44411 | 2361 |
| preXtreat | 0.0183 | -0.0317 | 0.000309 | -0.0641 | -0.0460 | 0.0645 | -0.00331 | -0.265* | -0.0164 | 1.184 |
| | (0.111) | (0.0351) | (0.0283) | (0.0820) | (0.0602) | (0.0586) | (0.156) | (0.144) | (0.0389) | (0.955) |
| postXtreat | -0.197*** | -0.123*** | -0.122** | -0.0570 | 0.0377 | -0.137 | 0.743** | 0.0987 | -0.0739* | -1.067 |
| | (0.0705) | (0.0435) | (0.0531) | (0.0792) | (0.0467) | (0.0823) | (0.322) | (0.183) | (0.0417) | (0.662) |

*Panel b*

| | (11) | (12) | -13 | (14) |
|---|---|---|---|---|
| NAICS | 422 | 4453 | 454 | 4541 |
| preXtreat | -0.0144 | 0.0759 | -0.0130 | -0.382** |
| | (0.0137) | (0.0802) | (0.0845) | (0.171) |
| postXtreat | -0.0583** | -0.0568 | -0.145 | 0.597 |
| | (0.0244) | (0.0665) | (0.138) | (0.450) |

This table shows the results of a simple DiD regression that focuses on various subcategories given by the NAICS code at the top of the column. The categories are: 452: General Merchandise Stores, 453: Miscellaneous Store Retailers, 447: Gasoline Stations, 443: Electronic and Appliance Stores, 441: Motor Vehicle and parts, 442: Furniture and Home furnishings, 5415: Computer Systems Design and Related Services, 4442: Lawn and Garden Stores, 44411: Home Centers, 2361: Residential Construction, 722: Food Service and Drinking Places, 4453: Wine and Liquor Stores, 454: Nonstore retailers, and 4541: Electronic Shopping and Mail-Order Houses. To conduct the regression, the event dummies are replaced by simple treat by post indicators where post is 1 for every year after 2019. We also include a treat by pre indicator where pre takes on a value of 1 prior to 2019. This provides a pretrends test whereby interaction terms are relative to the omitted year, 2019. Standard errors are clustered at the county level with standard levels of significance.

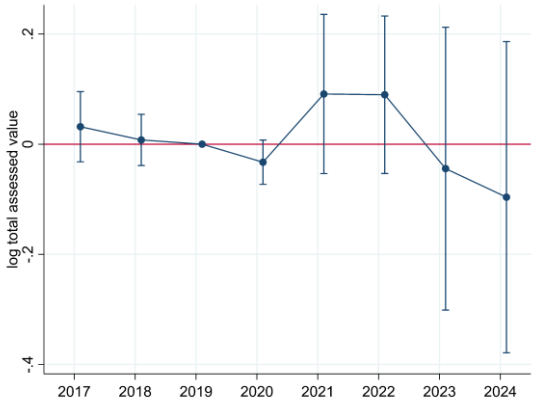
## Figure A5: Principal Cities versus Everyone Else



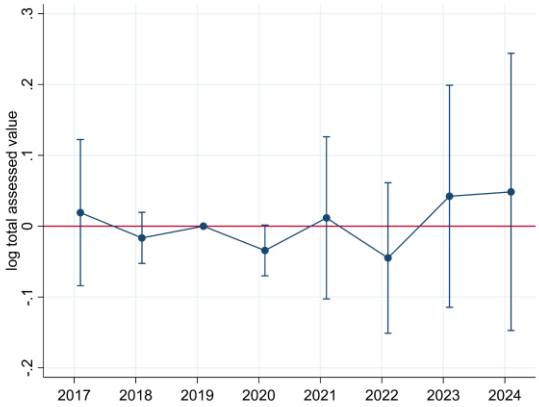

This figure shows an event study where the outcome variable is the log of the total potential taxable base including food and non-food purchases in the taxing jurisdiction. We split the sample based on jurisdiction size separating the sample into the largest (population) city in the commuting zone and every other city in the commuting zone. County remainders are dropped from the analysis. We then run separate regressions for large and small jurisdictions, but maintain the DiD framework such that treated large [small] jurisdictions are compared to comparison large [small] jurisdictions. Treated jurisdictions are in a commuting zone with high telework potential, while comparison jurisdictions are in a commuting zone with low telework potential. Standard errors are clustered at the county level with 95 percent confidence intervals shown.

**Figure A6: Property Tax Assessed Value by Base Type**

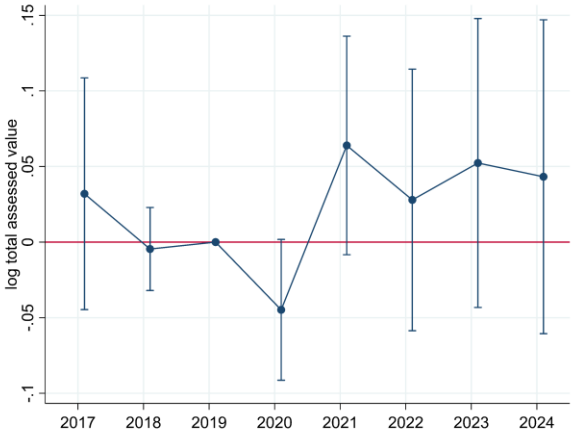
*Panel a: Commercial/Industrial*




*Panel b: Residential*




*Panel c: Farm/Agricultural*




This figure shows the effects on three sub-components of the property tax base: industrial properties, residential properties, and farm properties. . Treated counties are in a commuting zone with high telework potential, while comparison counties are in a commuting zone with low telework potential. Standard errors are clustered at the county level with 95 percent confidence intervals shown.