



The COVID-19 state sales tax windfall

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Abstract

Policymakers were surprised to find increases in sales tax revenues in 2020 due to expectations that they would drop 8–20%. We investigate this puzzle and provide novel insights into consumption taxes based on this experience. Using a case study from the State of Utah, we document that shifts in the structure of consumption played a significant role in the robustness of sales tax revenue. Two factors stand out in our results. The first factor is the structure of the tax base for sales taxes in the USA. This tax base covers only a subset of personal consumption, excluding, for example, many services. During the pandemic, when services were restricted or shut down, this caused a shift in spending toward goods that are more likely to be in the sales tax base. The second factor is the boom in e-commerce during the pandemic, which boosted sales tax collections. This was catalyzed by recent legal changes that made the collection of sales taxes in e-commerce easier. Interestingly, this e-commerce boost also shifted the point of sale and related sales tax revenues away from urban areas toward suburban areas. Our case study of the pandemic's effect on sales taxes in the USA generally, and Utah's experience specifically, provides lessons for consumption taxes, such as the VAT more broadly, and lessons on the role of consumption taxes for tax revenue volatility.

Keywords Sales tax · Online shopping · e-Commerce · COVID-19 · Tax revenue

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1 Introduction

The COVID-19 pandemic greatly impacted taxes on goods and services, such as the value-added tax (VAT) and retail sales tax (RST). In the USA, state and local governments expected the economic disruptions of the pandemic to cause massive budget gaps due to declines in state tax revenues based on their experiences in the past two recessions (Auerbach et al., 2020; Dadayan, 2020; Seegert, 2020).

US state tax prediction models forecasted tax revenue shortfalls between 8% and 20% or roughly between \$130 billion and \$875 billion nationwide, see White et al. (2020); Bartik (2020).¹ These expected shortfalls led to expected cuts in services from trash collection to education with knock-on effects on local economies as state and local governments employ 20.2 million people.²

Such forecasts seemed reasonable at the time because sales tax revenue typically decreases in recessions as households and firms contract their spending in response to economic uncertainty and income declines. Durable good consumption makes up a disproportionate fraction of sales tax revenue and is very responsive to recessions. As expected, sales tax revenues experienced a decline in the second quarter of 2020 at the beginning of the pandemic.³ Given these past experiences in recessions, local US state governments feared the worst.

US state sales tax revenues did not fall. Moreover, this phenomenon seems to be more general than US states. Almost a third (11 of 38) of OECD countries experienced increased revenues from taxes on goods and services (mostly VAT) in 2020. Within the USA, 75% (or 35 of 46) of states with either state or local sales taxes experienced an increase in sales tax revenues year over year in 2020.⁴

¹ Other estimates are similarly large and fall between these estimates. See, for example, Auerbach et al. (2020), Chernick et al. (2020), Clemens and Veuger (2020), Dadayan (2020), Bivens and Walker (2020), McNichol et al. (2020), Veuger and Clemens (2020), and Whitaker (2020). Of particular note is Dadayan (2020), who estimates a loss of \$200 billion using forecasts by states, and Auerbach et al. (2020), who uses a bottom-up approach and estimates a loss of \$156 billion in 2020 and \$165 billion in 2021.

² We use the number employed in February of 2020, [bls.gov/news.release/archives/empst_03062020.pdf](https://www.bls.gov/news.release/archives/empst_03062020.pdf).

³ Specifically, in the second through fourth quarters of 2020, state sales tax revenues were only 2.7 percent lower than in 2019 (Dadayan and Rueben, 2021). However, we note that in 2020, twelve states changed their sales tax, resulting in a decrease for five states and an increase for the other seven. For example, Tennessee required more firms to remit sales and use tax by lowering the nexus threshold from \$500,000 to \$100,000, increasing sales tax revenue. Utah did not make any major changes to its sales tax in 2020; a few local governments made incremental sales tax rate changes tax.utah.gov/salestax/rate/20q2combined.pdf.

⁴ Delaware, Montana, New Hampshire, and Oregon do not have a statewide or local sales tax. Alaska does not have a statewide tax but allows lower jurisdictions to levy sales taxes.

Does this state sales taxes forecast error reflects a one-time mistake, or does it indicate a more fundamental gap in our understanding of the economics of sales taxes? To address this question, we focus on the US State of Utah, which experienced an increase in taxable sales of 8.4% year over year in 2020, above its average over ten years of 6.1%.⁵

Focusing on Utah has several advantages. We have access to the internal Utah state sales tax forecast model, which allows us to analyze the tax predictions directly. Based on this model, we show that the sales tax prediction error is partly driven by better-than-expected economic conditions. However, Utah state's internal prediction model would still have underestimated the growth in taxable sales, even if economic conditions had been forecasted perfectly. One, therefore, has to turn to deeper potential issues with our understanding of the economics of sales taxes. This is where the State of Utah offers unique advantages in terms of data. One advantage is that Utah provides detailed quarterly administrative data on industry and point-of-sale locations, which is not available to the US federal government. Another advantage of focusing on one state allowed us to use consumer survey evidence from 400–500 Utah residents surveyed every month.⁶ The survey data on consumption allow us to consider consumption changes of taxable and nontaxable items, which is not possible with tax administrative data at the state or national level.

Conceptually, our analysis focuses on changes in the tax base because Utah did not change its sales taxes during the pandemic.⁷ We also have data on taxable sales, a direct measure of tax base separate from tax rates. Our framework shows that tax revenues may differ because of differences in economic conditions or the structure of the tax base. This tax base structure includes all legal definitions of taxable and tax-exempt consumption and consumption behavior, following Seegert (2015). Based on this framework, we provide evidence of the impact of economic conditions and tax base structure on sales taxes during the COVID-19 pandemic.

First, we consider the impact of economic conditions. For example, expansionary fiscal policy may have bolstered tax revenues. Between March 2020 and March 2021, the federal government enacted a series of pandemic-related fiscal stimulus bills totaling over \$5 trillion, or nearly 25% of US GDP Dean (2022). Notably, the early pandemic CARES Act in the USA spent \$2.31.7 trillion (around 11% of GDP), providing tax rebates to individuals (\$293 billion), expanding unemployment benefits (\$268 billion) and the food safety net (\$25 billion), as well as loans to businesses (\$510 billion to corporations and \$349 billion in forgivable Small Business Administration loans), and subsidies to hospitals,

⁵ These numbers are the calendar year taxable sales reported by the State of Utah in their annual sales tab <https://tax.utah.gov/econstats/sales>.

⁶ The sample is recruited based on addresses by sending participants a hard copy letter. In addition, we provide a \$10 gift card incentive for participation in an online survey. We sample from the universe of addresses in Utah weighted to account for nonresponse rates in previous surveys in Utah. The weighting provides a final sample that is representative of Utah (Samore et al., 2020; Yang et al., 2023) and has been shown to have minimal nonresponse sample selection (Gaulin et al., 2020).

⁷ Of course, tax revenues may also change if tax rates change. Our empirical analysis focuses on a context without state tax rate changes to isolate the changes due to changes in the tax base.

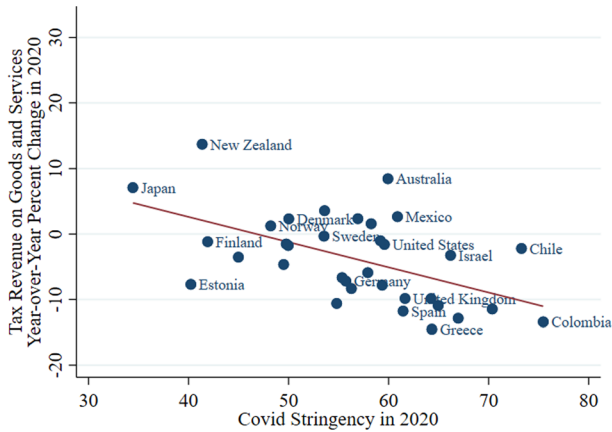


Fig. 1 Year-over-Year change in revenues on goods and services and COVID strictness. *Note* Fig. 1 reports year-over-year percent change in tax revenues on goods and services reported by the Organization for Economic Co-operation and Development (OECD) as it relates to Covid Stringency from The Oxford Coronavirus Government Response Tracker, accessed at Mathieu et al. (2020). The stringency index is calculated using school, public transportation, and workplace closures, cancellation of public events, restrictions on public gatherings, stay-at-home requirements, public information campaigns, and restrictions on internal and international travel. A higher index corresponds to a stricter response

state and local governments, and international assistance (\$100 billion, \$150 billion, and \$49.9 billion, respectively). With both CARES Act and other pandemic fiscal stimulus, households not only spent these funds but also paid down debt and saved a sizable portion of funds, enabling future spending.

Second, we consider the impact of the structure of the tax base. Specifically, tax revenues may have been more resilient than expected because of changes in the spending behavior of purchasers. The actual tax base on which revenues are collected combines government rules, such as the general rules of taxability and exemptions from those general rules, and consumer and firm economic behavior. Changes in behavior, paired with different tax bases, may have bolstered tax revenues. The sales tax imposed by states in the USA differs from a value-added tax and a pure consumption tax Mikesell (1996). Goods make up a larger portion of the sales tax base than services. As goods have become a smaller portion of overall consumption, the sales tax base shrinks relative to the economy, although it still generally grows nationally. Merriman and Skidmore (1997) find that sales tax coverage dropped from 60% of personal income to 40% between 1975 and 1994.

Third, we consider differences in COVID restrictions that may also affect tax revenues. For example, we find in a cross-sectional analysis in 2020 of OECD countries that a one standard deviation increase in COVID stringency led to a 4% decrease in tax revenues on goods and services year over year. Figure 1 provides a scatter graph relating year-over-year change in tax revenue on goods and services and COVID stringency in 2020. We find a strong negative relationship. Notably, Japan and New Zealand had two of the least stringent COVID policies in 2020 and experienced

7.09% and 13.73% increases in tax revenues on goods and services. Our analysis focuses on changes in consumption—many of which had to do with COVID policies. In the analysis, we control for differences in reported COVID cases, deaths, and restrictions to focus on other candidate explanations.

All three candidate explanations are important for understanding tax revenues in Utah during the pandemic. The importance of changes in household spending toward disproportionately taxable items is surprising and has implications for the design of consumption taxes broadly. At a national level, spending on goods increased substantially while spending on services decreased in 2020. These sharp changes contrast a larger trend over the last decade, where spending on goods as a fraction of personal consumption has decreased. We then drill down on the industry and specific consumption categories using our administrative data from Utah and our survey evidence. These data show us that spending on taxable items increased in 2020 while spending on items not in the sales tax base decreased. Using the latest available data, we find a level shift due to the pandemic, and spending remains higher into 2022 for items in the sales tax base.

Utah's detailed administrative tax data also allow us to examine the interaction between changing spending behavior, point-of-sale, and e-commerce. A large literature has considered the implications for consumption taxes due to e-commerce (Agrawal and Fox, 2017; Agrawal and Shybalkina, 2023). Our evidence complements this literature. We find that the pandemic likely accelerated the shift of point-of-sale from brick-and-mortar to e-commerce. Specifically, in Utah, taxable sales in e-commerce went from roughly half a billion dollars to one and a half billion dollars between 2019 and 2022, a three times change. This increase in taxable sales is due to the interaction between increased cooperation of online retailers like Amazon, the US Supreme Court's *South Dakota v. Wayfair* decision and laws enacted or changed in its aftermath, and a general shift in consumption to e-commerce during the pandemic. Finally, we also find a dramatic early pandemic shift in point-of-sale from urban to suburban areas. One explanation for this shift in point of sale is that suburban consumers increased their e-commerce consumption at the expense of shopping in urban areas. Another explanation is that service sector shutdowns or capacity limitations, such as occurred with major entertainment, restaurant, travel, and university venues located in urban areas, along with the rapid shift to teleworking from home rather than commuting to urban commercial centers, influenced the location of consumer purchases.

The shifts in consumption and their implications for tax revenues we document have important implications for policymakers. First, our results suggest that revenues from goods and services taxes depend not only on the overall level of household and firm spending but also on the composition. This suggests that forecasting models should take into account potential shifts in consumer and firm spending patterns. Second, how much shifting spending impacts goods and services tax bases depends on the breadth of the base. If the tax base covers all consumption, then spending shifts in spending will not affect consumption's large share of sales tax revenues. Narrow tax bases, however, have the potential to be more affected by these shifts. Third, the effect of the interaction between consumer and firm behavior and sales tax base breadth can have stabilizing or destabilizing effects. During

the pandemic, the narrower tax base of retail sales in Utah and a shift in consumer spending toward goods actually stabilized tax revenues. However, to some extent, the pandemic led to something of a forced shift away from services, which were subject to closure or other significant limitations. So, whether this general spending trend can be expected for future recessions has important implications for the stability of a state's tax portfolio (Seegert, 2015).

2 Background

In this section, we provide some general background on the sales tax base for US states, some specific rules for a given US state, Utah, and end with some rules about e-commerce and the sales tax base.

2.1 Sales tax base

The sales tax is a broad consumption tax imposed by 45 states and the District of Columbia in the USA, and local sales taxes are collected in 38 states. The theoretical underpinning of the sales tax is to tax the final consumer. In practice, the sales tax covers most sales of goods, selected services, and some business inputs. In practice, there are also exemptions—notably, grocery store food is often not taxed or taxed at a lower rate. The sales tax remains an important source of revenues for state and local governments, comprising roughly 24% percent of total state and local government tax revenues.

We focus on Utah's sales tax because it functions similar to other states' taxes and the State of Utah provides detailed administrative data on sales tax collections. For example, the state reports sales tax collections by industry (NAICS codes) and jurisdiction by quarter.

The Utah sales tax base can be decomposed into taxable retail trade, taxable services, taxable business investment, and all other taxable sales. Taxable retail trade is 53% of the total, followed by taxable services at 26%, and business investment at 17%. All other taxable sales are 4%. Taxable retail trade includes all sales of goods in retail stores and online retailers (more on this in Sect. 2.3). Taxable services include hotels, utilities, food services, and admissions to entertainment. Taxable business investments include construction materials and durable goods in the wholesale trade that does not include goods for resale.⁸

The sales tax broadly taxes personal consumption but does not include all consumption. In Utah, nearly 90% of goods consumption and 24% of services consumption are in the sales tax base. Personal consumption consists roughly of 60% services and 40% goods. Together, this suggests that the sales tax base encompasses 50% ($.9 \cdot .4 + .24 \cdot .6 = .5$) of personal consumption.

⁸ These data come from Utah State Tax Commission: tax.utah.gov/econstats/sales.

Even if total consumption remained unchanged, a shift in consumption from services to goods could have a dramatic shift in sales tax revenues because of the differential coverage of these items in the sales tax base. This became apparent during the pandemic when services were restricted or shut down, and the federal government provided resources to people to bolster their total consumption.

2.2 Utah sales tax rules

In Utah, the state and certain local governments (counties, cities, and towns) impose sales and use taxes. Local governments can only impose taxes as authorized by the Utah Legislature, so each sales and use tax imposed derives authority from statute, which sets parameters such as the tax base, tax rate parameters, and revenue uses. The rate imposed on any particular taxable sale sums the applicable state rate and any applicable local tax rates in the geographic area to which that sale sources under state law. The Utah State Tax Commission collects all sales and use taxes, and then distributes revenues to the applicable entity.

Sourcing rules do not impact the distribution of collected state sales and use taxes but do impact local allocations. Each transaction must source to a geographic location. Sourcing is generally destination-based, with the definition of destination varying depending on sale circumstances. Figure 8 in Appendix summarizes general sourcing rules based on the type of taxable sale.

The State of Utah imposes three sales and use tax rates, including on general taxable sales (4.85% rate), residential fuel (2.00% rate), and unprepared food (1.75% rate). State sales and use tax revenues go into (a) the state General Fund for allocation to any legitimate state purpose as determined by the Legislature and (b) various earmarked accounts, allocated primarily for infrastructure like roads and water, and health care.

Utah allows municipalities and counties to enact sales taxes of 1.00% and 0.25%, respectively. In practice, all municipalities and counties have enacted these rates. The statutory tax base for these rates corresponds to the state base. A statutory formula allocates these two rates based 50% on population and 50% based on the point of sale using sourcing rules summarized in Fig. 8 in Appendix (subject to certain minimum allocations). Notably, as remote sales increasingly displace some physical store retail purchases, buyer-based sourcing aligns more closely with a population-based distribution because most consumers ship goods sold remotely to their homes.

Local governments (counties, cities, and towns) may also choose to implement additional sales taxes. The revenues from these taxes are all point of sale. These include additional taxes for transportation, rural hospitals, resort communities, recreation, culture, zoo, arts, and parks. The tax base differs for these taxes; for example, grocery store food is not included. The tax rate for these additional sales taxes varies from 0% additional taxes to 3.00% in Park City, which is a popular ski resort. These general sales tax rates exclude additional hotel, restaurant, or car rental sales taxes that local governments below the state level can also impose.

The total sales tax paid by a consumer in Utah combines the state sales tax, the statewide local taxes, and the other local optional taxes. For example, consider the

Table 1 Example of different tax rates across Utah

	Food	Shirt purchased in			
	in Utah	Salt Lake City	Moab	St. George	Cedar City
	(1)	(2)	(3)	(4)	(5)
State rate	1.75%	4.85%	4.85%	4.85%	4.85%
Statewide local municipal	1.00%	1.00%	1.00%	1.00%	1.00%
Statewide local county	0.25%	0.25%	0.25%	0.25%	0.25%
Optional local transportation rates	n/a	1.05%	0.55%	0.55%	n/a
Optional other local rates	n/a	0.60%	2.20%	0.10%	0.10%
TOTAL	3.00%	7.75%	8.85%	6.75%	6.20%

This table reports an example of buying unprepared food purchased anywhere in Utah and a shirt in different jurisdictions. The unprepared food is not subject to the non-statewide local options taxes and therefore is the same across Utah. The shirt is subject to different tax rates because local jurisdictions have different tax rates

tax paid on a purchase of a T-shirt throughout the state summarized in Table 1. A shirt bought in Salt Lake City (the capital of Utah), would be subject to a 7.75% sales tax. This tax includes the 4.85% state rate, the 1.00% statewide local tax, the 0.25% statewide county tax, and a 1.05% and 0.60% other local optional taxes (including a tax earmarked for the zoo, arts, and parks). In contrast, that same shirt bought in Cedar City is subject to a tax of 6.25%. The difference is in the other local sales tax, which is only 0.10% in Cedar City compared to 2.75% in Salt Lake City.

2.3 E-commerce and the sales tax base

One major sales and use tax issue in recent decades is remote sales. Although states have imposed use taxes for many decades (Utah first imposed a use tax in 1937), the acceleration of online remote sales amplified use tax collection difficulties. Consumers increasingly making purchases online rather than in brick-and-mortar stores in recent decades created challenges for states because even though use taxes remained legally due, use tax collection for household purchases, in particular, remained very minimal, and the amount of legally taxable sales displaced increasing amounts of existing taxable sales. However, the remote sales landscape dramatically changed in the past several years.

Utah offers an interesting case study in increasing remote sales and use tax collections in the past several years. Utah traditionally collected meaningful use tax amounts from businesses for major purchases since these entities tend to have tax experts aware of the use tax liability and, given the smaller number, are easier to audit, partly because they tend to deduct taxable items on income tax returns. In addition to previous business use tax collections, state individual income tax forms included a specific line for the use tax. Still, the state only collected a small revenue amount via this method (\$1.3 million as of 2015).

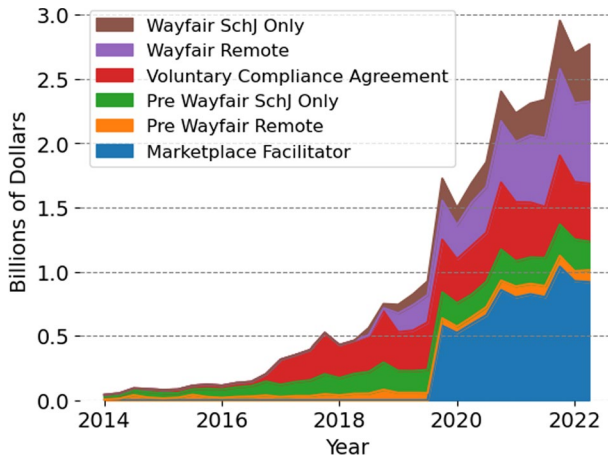


Fig. 2 Remote taxable sales. *Note* Fig. 2 graphs remote sales by categories. The order of the legend corresponds to the order in the graph, e.g., Wayfair Sch J Only is the top in the legend and the top area in the graph. 'Pre-Wayfair' indicates an account that commenced after July 1, 2013, but before August 1, 2018. 'Wayfair' indicates an account that commenced and first filed after August 1, 2018. 'Remote' indicates an account with a non-nexus/remote seller flag that does not have a UT outlet. 'Sch J Only' indicates an account that only files Sch J (sales from a nonfixed place of business) that does not have a UT outlet. 'VCA' indicates an account that entered into a Voluntary Compliance Agreement since July 1, 2013

Remote sales collections began to increase slowly from 2013 to 2017. However, this began to change significantly in 2017, as in the years prior, states increasingly pushed on the remote sales problem created in the modern world by previous court cases such as *Quill v. North Dakota* and *National Bellas Hess v. Illinois*. As shown in Fig. 2, moderate collection increases in remote sales began occurring from 2013 to 2016, as some businesses began collecting and remitting sales and use taxes.

In late 2016, Amazon decided to begin collecting and remitting on Amazon's own sales in Utah in 2017 under a voluntary compliance agreement. This likely occurred in part because Amazon intended to create physical nexus the following year and because the voluntary compliance agreement meant Utah would not endeavor to collect sales and use back taxes.

In June 2018, the US Supreme Court ruled in favor of states collecting tax on remote sales in *South Dakota v. Wayfair*, with certain conditions. Utah already had on the books a law stating that if either Congress or the US Supreme Court acted to authorize remote sales and use tax collection and remittance, that requirement would automatically take effect the following quarter.

In July 2018, the Utah Legislature met in a special session to enact S.B. 2001 Online Sales Tax Amendments, which conformed state statute to the Wayfair case's parameters. This bill took effect on January 1, 2019. As Fig. 2 shows, while the state recorded taxable sales related to the Wayfair case in the final two quarters of 2018, the Wayfair increases largely showed up in the first quarter of 2019 after the special session bill took effect.

Some online sellers argued they were marketplaces, not retailers, and therefore did not have to collect and remit sales taxes. In response, in its general session in early 2019, the Utah Legislature enacted S.B. 168 Sales and Use Tax Revisions, which clarified that the marketplace facilitators had to collect and remit sales and use taxes. This bill took effect October 1, 2019.

As shown in Fig. 2, total remote taxable sales filings increased from nearly zero in late 2013 to nearly \$1.75 billion in taxable sales in 2019 Q4. Notably, this does not necessarily represent an increase in overall taxable sales because many remote sales simply displaced sales that previously occurred within other brick-and-mortar categories of the collected tax base. Moreover, this tax was always due, even if not collected. However, our prior is that sizable portions of this did represent a net increase to state sales tax revenue, even though our confidence interval for this guess is very wide.

Utah's timing turned out to be fortuitous for the state, as the COVID-19 pandemic hit in 2020 Q1, the quarter following the final piece of remote collections coming into place. As Fig. 2 shows, sales and use tax collections follow cycles, with the 4th quarter consistently representing the largest collections quarter of the year, presumably due to holiday shopping. Remote sales increased dramatically during the pandemic. For example, 2020 Q4 remote taxable sales exceed 2019 Q4 by nearly 40%, and 2021 Q1 exceeded 2020 Q1 by nearly 50%. While these remarkable growth rates moderated some in subsequent quarters, through 2022 Q2 they remained at or above 20% year-over growth. In short, the collected tax base on remote sales grew dramatically during the pandemic. We note that enforcing sales tax online after these rule changes increased the share of sales on which sales tax could be collected. It also could have caused less e-commerce due to the tax now being enforced

3 Data

We combine three sources of data to investigate changes in consumption and taxable sales. Specifically, we rely on detailed administrative data from the State of Utah, a purpose-built survey of households, and national consumption data from the Bureau of Economic Analysis. The main advantage of the administrative data from the State of Utah is that we have data by city, sector, and quarter. The survey provides additional insights into the mechanisms behind the patterns we observe in the administrative data, and the national data provide some external validity.

The administrative data from the State of Utah are a panel of 66 locations (cities, counties, and towns) and 38 industries over 92 quarters from the first quarter of 1998 to the fourth quarter of 2020. An observation, therefore, is an industry location quarter and the data contain 197,936 observations. Industries are three-digit NAICS codes, for example, "Utilities," "Retail-food and beverage stores," and "Arts, Entertainment, and Recreation." Not all locations have all industries.

The household survey is part of the Utah Economic Survey and was run from 2021 to 2022 by three of the authors (Maclean Gaulin, Nathan Seegert, and Mu-Jeung Yang) with financial support from the State of Utah. This survey consisted of 400–500 Utah residents every other month, following the Michigan Survey of Consumers, which samples 500 people in the USA. Addresses are randomly selected from the universe of addresses in Utah, weighted for nonresponse bias, based on previous survey work in Utah (Seegert et al., 2020; Yang et al., 2023; Samore et al., 2020; Gaulin et al., 2020). The survey sends out 6,000 to 12,000 letters, with an expected response rate of 3% to 7%. Note that this response rate is low by design—we over-sample addresses with low response rates to create a representative sample of Utah. Households receive a \$10 Amazon gift card for participation in the survey. The final sample is representative of Utah across observable characteristics (Samore et al., 2020; Yang et al., 2023) and has been shown to have minimal nonresponse sample selection (Gaulin et al., 2020). For additional details on this survey see Seegert et al. (2020) and www.econ-update.com.

4 Framework

We provide a simple framework for considering changes in tax revenues. In particular, we follow the framework in Seegert (2018) and begin with an accounting identity that combines the tax rate t and a vector of economic conditions x to produce tax revenues. Specifically, tax revenue in each period t is equal to the tax rate τ_t times the actual collected (not theoretical or legal) tax base $b_t(t, x)$,

$$\text{Revenues}_t = \tau_t \cdot b_t(\tau_t, x_t). \quad (1)$$

The tax base decreases in the tax rate, $\partial b_t(\tau_t, x_t)/\partial \tau_t < 0$. For example, Merriman and Skidmore (1997) find that their sales tax coverage index decreases 80.5% of the time when a state increases their sales tax rate and increases 75% of the time when a state decreases their sales tax rate. It is common to model the tax base as a linear combination of the tax rate and economic conditions in logs,

$$\log(b_t(\tau_t, x_t)) = \beta_{0,t} + \beta_{1,t} \log(\tau_t) + \beta_{2,t} \log(x_t) + \varepsilon_t. \quad (2)$$

With this modeling choice, we can write the log of tax revenues as

$$\log(\text{Revenues}_t) = \beta_{0,t} + (1 + \beta_{1,t}) \log(\tau_t) + \beta_{2,t} \log(x_t) + \varepsilon_t. \quad (3)$$

Any observed change in tax revenues can, therefore, be separated into either a change in tax rates (captured by τ_t), economic conditions (captured by x_t), or the tax base structure (captured by changes in coefficients $\beta_{0,t}$, $\beta_{1,t}$, and $\beta_{2,t}$). Specifically, we can write the change in the log of tax revenues between periods 1 and 2 as,

$$\begin{aligned} \Delta \log(\text{Revenues})_{2,1} &= \beta_{0,2} + (1 + \beta_{1,2}) \log(\tau_2) + \beta_{2,2} \log(x_2) + \varepsilon_2 \\ &\quad - \beta_{0,1} - (1 + \beta_{1,1}) \log(\tau_1) - \beta_{2,1} \log(x_1) - \varepsilon_1, \end{aligned} \quad (4)$$

where $\beta_{0,t}$ denotes the constant in period t and $\beta_{1,t}$ and $\beta_{2,t}$ denote the slope coefficients in period t . By adding and subtracting $\beta_{1,2} \log(\tau_1)$ and $\beta_{2,2} \log(x_1)$ and rearranging, we can write this difference as,

$$\begin{aligned} \Delta \log(\text{Revenues})_{2,1} &= \underbrace{\beta_{1,2}(\log(\tau_2) - \log(\tau_1))}_{\text{Change in tax rates}} \\ &+ \underbrace{\beta_{2,2}(\log(x_2) - \log(x_1))}_{\text{Change in economic conditions}} \\ &+ \underbrace{\beta_{0,2} - \beta_{0,1} + (\beta_{1,2} - \beta_{1,1})\log(\tau_1) + (\beta_{2,2} - \beta_{2,1})\log(x_1)}_{\text{Change in tax base structure}} \\ &+ \underbrace{E[\varepsilon_2 - \varepsilon_1]}_{=0} \end{aligned} \tag{5}$$

In our setting, we compare sales tax revenue in Utah in 2019 and 2020, where there were no state sales tax rate changes with only a few minor local changes. Therefore, any difference in observed tax revenues is due to either a change in economic conditions or tax base structure. We consider these two factors in turn.

5 Changes in economic conditions

We estimate counterfactual sales tax revenue by combining a forecast model and the actual economic conditions to quantify the effect of economic conditions on the year-over-year sales tax revenue changes observed. For Utah, we have access to the internal revenue forecasting models. We follow the State of Utah’s process for forecasting sales tax revenue, which relies on forecasting sales tax revenues as a function of economic indicators, such as migration, unemployment, GDP, and wages. The State of Utah’s forecast for the following year is a combination of the coefficients estimated on these economic indicators (based on previous years) and a consensus forecast of these economic indicators developed by the State of Utah. We similarly estimate the coefficients for our estimate, but instead of using the consensus forecast of economic indicators for 2020, we use the realized values. The resulting estimates, therefore, provide the state forecast model’s predictions without the uncertainty of the actual economic conditions.

Formally, the forecast model can be written as a combination of I covariates indexed by i ,

$$\log(\text{Sales Tax Revenue}_t) = \sum_i^I \beta_i \log(X_{i,t}) + \varepsilon_t. \tag{6}$$

The 2020 forecasted sales tax revenues is then given by $\log(\text{Sales Tax Revenue}_{2020}^{\text{forecast}}) = \sum_i^I \beta_i \log(X_{i,2020}^{\text{forecast}})$, where the

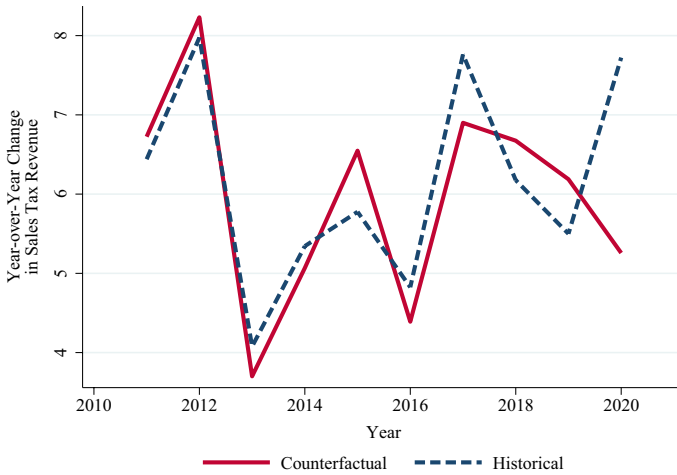


Fig. 3 Year-over-year change in Utah sales tax revenue. *Note* Fig. 3 reports year-over-year percent change in sales tax revenue historical (dash blue) and counterfactual changes given the forecast model and actual economic conditions (solid red). This figure uses yearly data from the first quarter of 2010 to the last quarter of 2020 (Color figure online)

estimated coefficients $\hat{\beta}_i$ come from Eq. (6) and the independent variables are forecasted economic variables $\log(X_{i,2020}^{\text{forecast}})$. Our sales tax revenue estimate differs from this forecast because it uses the actual economic indicators instead of forecast indicators. Specifically, our counterfactual estimate is given by $\log(\text{Sales Tax Revenue}_{2020}^{\text{counterfactual}}) = \sum_i^J \hat{\beta}_i \log(X_{i,2020}^{\text{actual}})$, where we use the same estimated model as the forecast model, given by $\hat{\beta}_i$, but use the actual economic indicators that occurred in 2020 $X_{i,2020}^{\text{actual}}$.

We show in Fig. 3 that the counterfactual estimate matches the actual sales tax revenue collected until 2020, where it diverges. Specifically, given the economic conditions in 2020, the counterfactual model predicts sales tax revenue would have grown by only 5.2% compared to the 7.7% actual increase.⁹ The difference is, therefore, due to a structural break from relationships in predictor values $X_{i,2020}^{\text{actual}}$ and sales taxes. Said differently, some of the resilience of the sales tax revenue collections in 2020 is due to a change in the relationship between sales tax revenues and economic indicators.

⁹ This analysis uses the quarterly data by jurisdiction, which differs slightly from the annual total sales tax numbers.

6 Changes in tax base structure

Changes in tax base structure capture all of the ways the tax base changed other than through changes in observable characteristics. For example, we first consider changes in spending behavior between durable and nondurable goods. Consider the case where aggregate consumption remained constant, but the share of durable and nondurable goods changed such that more (or less) of an individual’s expenditures are taxed. This change would not show up in changes in observable characteristics $x_{i,t}$ (unless durable and nondurable expenditures were in $x_{i,t}$) but would show up by a change in coefficient β in how it maps aggregate consumption into tax revenue. Therefore, to quantify these other tax base changes, we consider how spending (1) changed across taxable and nontaxable items, (2) changed between durable and nondurable goods, (3) changed across industries, and (4) changed across geographies.

6.1 Consumers increased spending in taxable items

Households in Utah responded to our survey by indicating that their consumption patterns changed in 2020 in a way that increased the sales tax base. Said differently, households shifted their spending to goods that are taxable, such as electronics, and away from spending that is not taxable, such as services or travel outside of the state.

In Panel A of Fig. 4, we report these changes in spending. We asked households how much they spent in 2019 and 2020 and reported their spending in 2020 relative to spending in 2019. The blue line at 100 indicates the same amount of spending in 2020 as in 2019, and a value of 110 indicates 10% more spending in 2020 than in 2019. The bars in red on top indicate goods included in the sales tax base, such as home improvement material, e-commerce, and household durables. The bars in gray on the bottom indicate goods outside of the sales tax base, such as education and special events.

The largest gains in expenditures are those in the sales tax base. For example, home improvement material, e-commerce, and electronics increased in spending

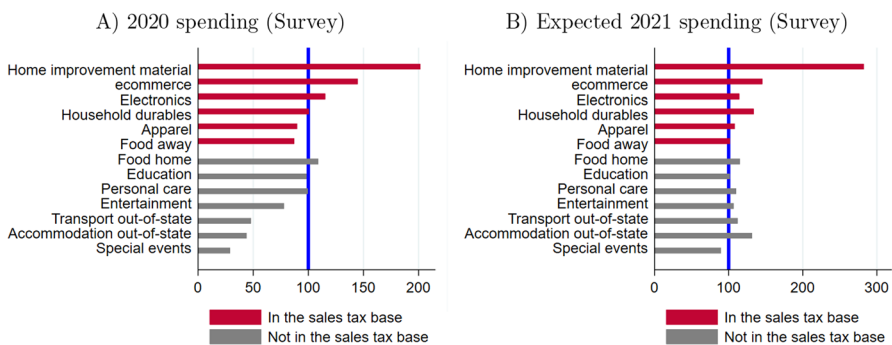


Fig. 4 Spending changes. *Note* Fig. 4 reports survey evidence on spending in the sales tax base (red bar) and not in the sales tax base (gray bar) in 2020 relative to 2019 (Panel A) and 2021 relative to 2019 (Panel B) (Color figure online)

in 2020 relative to 2019, with percentages of 200%, 145%, and 110% relative to the 100% baseline in 2019. Food at home also saw an increase in spending; however, food is only partially in the sales tax revenues in Utah as it is taxed at a lower rate. In general, some of the largest decreases in expenditures are those not in the sales tax base, while some are in the base. For example, special events and out-of-state accommodation and transport have index levels below 50. In Panel B of Fig. 4, we report expected spending in 2021 relative to 2019 and find people's expectations suggest those patterns would not fully reverse. Together this evidence suggests a large shift in consumer behavior, resulting in a change in the tax base. The subsection below provides detailed data that complement this survey evidence and show similar shifts in consumer behavior.

6.2 Consumers increased spending on durable goods

We use data from the US Bureau of Economic Analysis to complement the detailed data from Utah. Specifically, the US Bureau of Economic Analysis provides data on the personal consumption expenditures by goods (typically included in the sales tax base) and services (typically excluded from the sales tax base). The data are also subdivided by durable and nondurable good consumption. These national data provide some external validity to the findings from the detailed data from Utah.

We show in Panel A of Fig. 5 that in 2020 the proportion of total expenditure on goods increased dramatically, and the proportion of total expenditure on services decreased markedly. We show in Panel B of Fig. 5 that both durable (solid red line) and nondurable (dashed blue line) expenditures increased as a share of total household consumption in 2020. Durable good expenditures have remained steady as a share of the total since 2010 and, after an initial dip in 2020, experienced a substantial and sustained increase. Nondurable good expenditures have generally decreased as a share of the total since 2010. However, the amount that the nondurable good expenditures share decreased over

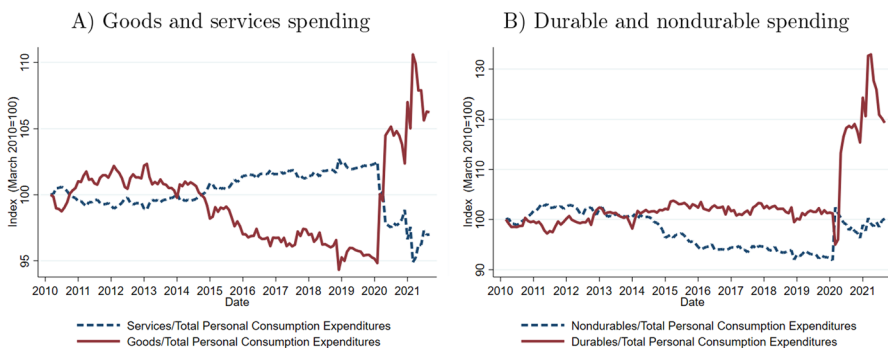


Fig. 5 US spending changes. *Note* Fig. 5 uses data from the US Bureau of Economic Analysis on personal consumption expenditure

the last ten years was wholly reversed in 2020 and remained at this higher level through 2021. This evidence is consistent with the detailed data from our survey. Specifically, these data suggest a substantial broadening of the sales tax base.

We also highlight in Panel B of Fig. 5 that the shift from services to goods has remained persistent after the initial change in early 2020. The change in spending also reverses a general trend toward more services and away from goods, as seen from 2010 to 2020.

6.3 Consumers increased spending in e-commerce, agriculture, wholesale, and construction

We also see changes in consumption behavior using detailed administrative tax data from Utah. The advantage of these data is that it provides the universe of taxable sales by city, sector, and quarter. The disadvantage is that it only includes taxable goods and services so it misses some household consumption. Table 2 reports the differences in taxable sales in 2020 by sector. We control for sector j fixed effects, quarter t fixed effects, and city i fixed effects to focus on changes in spending in 2020 by sector holding fixed level differences in spending across time, location, and sector. We report the specification,

$$\begin{aligned} \% \Delta \text{Taxable Sales}_{i,j,t} = & \beta_0 + \sum_{j=1}^J \beta_{1,j} \text{Sector}_j \times \mathbb{1}(\text{year} = 2020)_t \\ & + \sum_{t=1}^T \beta_{2,t} \text{Quarter}_t + \sum_{i=1}^I \beta_{3,i} \text{City}_i + \sum_{j=1}^J \beta_{3,j} \text{Sector}_j. \end{aligned} \tag{7}$$

Table 2 Taxable sales by sector during the pandemic

	E-commerce	Agriculture	Wholesale	Construction	Retail	Services	Special events
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Pandemic	49.162*** (17.003)	39.720** (14.911)	5.677* (2.978)	5.676** (2.066)	-0.787 (0.908)	-3.382** (1.437)	-64.697*** (16.582)
Constant	30.524*** (6.108)	11.639** (5.272)	4.456*** (1.053)	3.924*** (0.730)	5.713*** (0.321)	4.818*** (0.508)	8.402 (5.428)
Adj. R-Square	0.197	0.164	0.078	0.174	-0.008	0.128	0.345
Observations	31	32	32	32	32	32	28

NOTE. This table reports estimates of year-over-year percent change in taxable sales by industries. An observation is a quarter from quarter 1, 2013, to quarter 1, 2022. Each column denotes the industrial sector the data are restricted to; e-commerce, agriculture, wholesale, construction, retail, services, and special events. The specification we report $\beta_1, Y_t = \beta_0 + \beta_1 \mathbb{1}(\text{Year} \geq 2020)_t + \varepsilon_t$. The coefficients from this specification are similar to a specification where all industries are interacted with the indicator variable for being in or post-2020, which includes quarter-fixed and industry-fixed effects, reported in Table 4. We denote statistical significance by * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The coefficients of interest are $\beta_{1,j}$, which are the interaction between an indicator variable for the pandemic year 2020 and sector j .

We show in Table 2 that there were large changes in spending across sectors in 2020 relative to previous years. For example, retail food stores experienced a decline, while sporting goods, hobby, and music retail increased. Construction and building materials saw strong growth. These estimates reinforce the survey evidence and show substantial changes in spending behavior (Fig. 6).

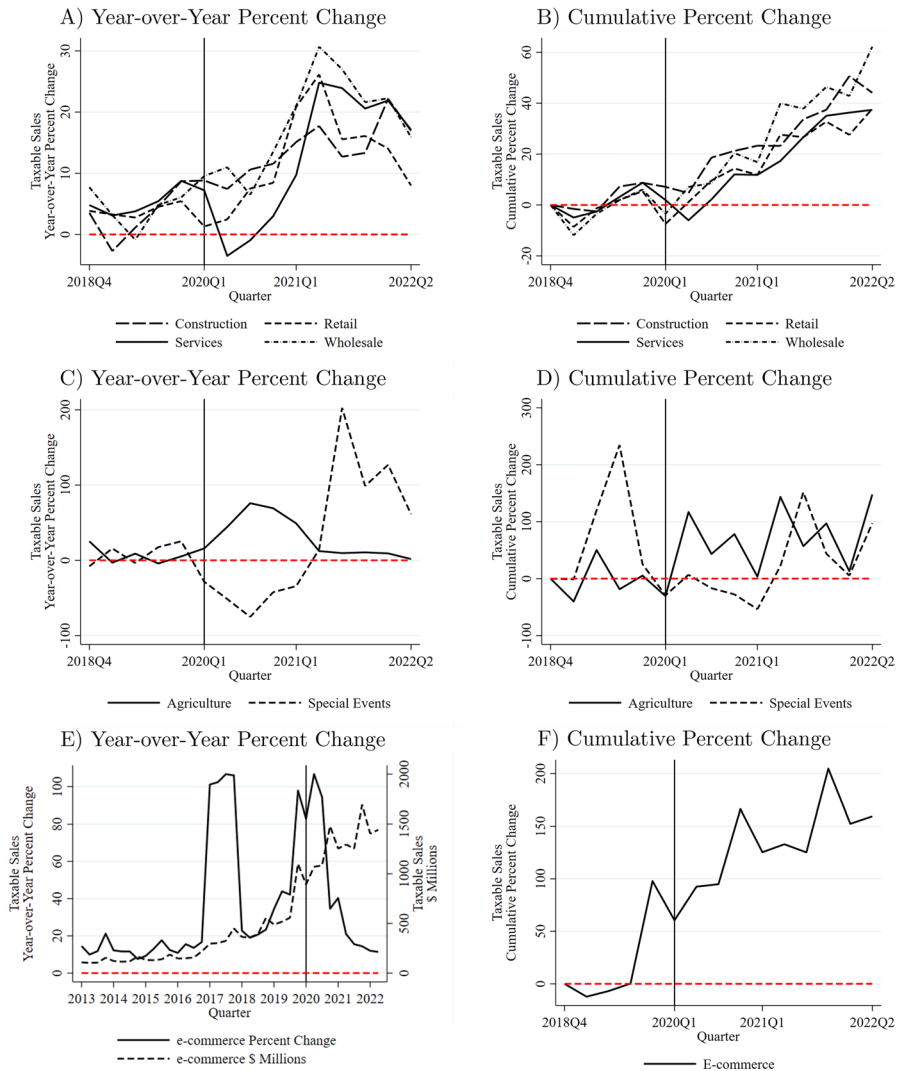


Fig. 6 Industry Taxable Sales. *Note* Panels **A** and **B** show the year-over-year percent change and cumulative percent change for construction, retail, services, and wholesale industries. Similarly, Panels **C** and **D** show the year-over-year percent change and cumulative percent change for agriculture and special events industries. Finally, Panels **E** and **F** show the year-over-year percent change and cumulative percent change for e-commerce

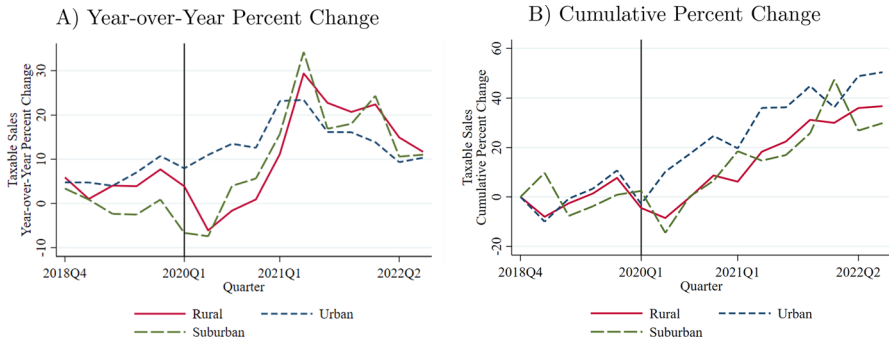


Fig. 7 Rural, Suburban, and Urban Sales Taxable Sales. *Note* In Panel **A**, we report the year-over-year percent change in taxable sales by rural (solid red line), suburban (long dashed green line), and urban (dashed blue line) areas. In Panel **B**, we report the cumulative change since the fourth quarter of 2018. We designate the Wasatch Front employment centers of Salt Lake City, Provo, and Ogden as urban, other jurisdictions on the Wasatch Front and Washington County as suburban, e.g., Sandy and St. George, and all other jurisdictions as rural, e.g., Moab. See the text for the full list of suburban jurisdictions. This figure uses quarterly data from the fourth quarter of 2018 to the second quarter of 2022

6.4 Consumers shifted point of sale from urban and rural to suburban areas

We also find that consumers shifted their consumer behavior in where they shop. The geography of where they shop can have several implications for tax revenue and economic development at large. Different locations have different sales tax rates. A shift from one location to another, therefore, can change the total amount of sales tax revenue collected. In Utah, some urban areas (e.g., Salt Lake City) have higher sales tax rates than suburban or rural areas. Local jurisdictions also plan different types of development based on potential tax revenues. In Utah, property taxes are relatively low. As a result, local governments have favored retail and commercial development to gain tax revenues from sales taxes. Finally, remote sales are treated as a sale at the location where the goods are sent, for example, to a residential address, see Appendix Figure 8.

Our detailed data allow us to define urban, suburban, and rural based on jurisdictions where the sale is made. We designate the Wasatch Front employment centers of Salt Lake City, Provo, and Ogden as urban, other jurisdictions on the Wasatch Front and Washington County as suburban, e.g., Sandy and St. George, and all other jurisdictions as rural, e.g., Moab.¹⁰

¹⁰ The full list of jurisdictions designated as suburban include, Alpine city, American Fork city, Bluffdale city, Bountiful city, Cedar City city, Cedar Hills city, Centerville city, Clearfield city, Clinton city, Cottonwood Heights city, Draper city, Eagle Mountain city, Elk Ridge city, Farmington city, Fruit Heights city, Genola town, Herriman city, Highland city, Holladay city, Hooper city, Hurricane city, Ivins city, Kaysville city, Kearns metro township, Layton city, Lehi city, Lindon city, Logan city, Magna metro township, Mapleton city, Midvale city, Millcreek city, Murray city, North Ogden city, North Salt Lake city, Orem city, Payson city, Pleasant Grove city, Pleasant View city, Providence city, Riverdale city, Riverton city, Roy city, Salem city, Sandy city, Santa Clara city, Santaquin city, Saratoga Springs city, South Jordan city, South Ogden city, South Salt Lake city, South Weber city, Spanish Fork city, Springville city, St. George city, Sunset city, Syracuse city, Taylorsville city, Tooele city, Vineyard town, Washington city, Washington Terrace city, West Bountiful city, West Jordan city, West Point city, West Valley City, White City metro township, and Woods Cross city.

We find that in the early pandemic, consumers shifted sales from urban and rural areas to suburban areas. In Fig. 7, we graph the cumulative percent change in sales tax base from 2016 Q1 to 2022 Q4 in Panel A and the year-over-year percent change in Panel B. We depict sales tax base growth in rural areas (solid red line), urban areas (dashed blue line), and suburban areas (long dashed green line). The vertical line at 2020 Q1 denotes the beginning of the COVID-19 pandemic in the USA. Before the pandemic, the growth in urban and suburban areas moves roughly together. Starting in Q1 of 2020, sales tax base diverges, with sales tax base in suburban areas growing faster than in urban areas. Note that across all areas, sales tax growth increased year over year. We provide estimates of these changes in Table 3.

7 Implications for the VAT

There is extensive literature on the value-added tax, covering myriad topics (Bird and Gendron, 2007). An important stream of this literature considers changes in consumer behavior in response to changes in the value-added tax, either a temporary cut

Table 3 Sales tax revenue by geography during the pandemic

	(1)	(2)	(3)	(4)	(5)	(6)
Suburban × Pandemic	0.103*** (0.021)	0.103*** (0.031)	0.103*** (0.031)	0.095*** (0.030)	0.095*** (0.031)	0.095*** (0.028)
Rural × Pandemic	0.063*** (0.022)	0.057 (0.035)	0.057 (0.035)	0.062* (0.034)	0.056 (0.035)	0.065** (0.031)
Suburban	0.024*** (0.008)	0.024*** (0.008)	0.024*** (0.008)			
Rural	0.017** (0.008)	0.004 (0.015)	0.005 (0.015)			
Cubic time trend		✓				
Quintic time trend			✓		✓	
Quarter fixed effects						✓
Location fixed effects				✓	✓	✓
Controls COVID cases and unemployment	✓	✓	✓	✓	✓	✓
Adj. R-Square	0.007	0.010	0.011	0.022	0.025	0.031
Observations	87,053	87,053	87,053	87,053	87,053	87,053

This table reports changes in year-over-year tax revenue before and after the pandemic by urban, rural, and suburban areas (where urban is the left-out group).

$$\begin{aligned} \text{Year-over-Year Sales Tax Revenue}_{i,t} = & \beta_0 + \beta_1 \mathbb{1}(\text{Suburban})_i \times \mathbb{1}(\text{Pandemic})_t + \beta_2 \mathbb{1}(\text{Rural})_i \times \mathbb{1}(\text{Pandemic})_t \\ & + \beta_3 \mathbb{1}(\text{Suburban})_i + \beta_4 \mathbb{1}(\text{Rural})_i + \beta_5 \mathbb{1}(\text{Pandemic})_t \\ & + g(\lambda_t) + \sum_i \delta_i \lambda_i + X_{i,t} \beta + \varepsilon_{i,t}. \end{aligned}$$

All specifications control for unemployment and COVID-19 cases at the county level. Time and location controls are indicated at the bottom of the table. We focus on quarters from the first quarter of 2013 to the second quarter of 2022 (latest available data). Standard errors are clustered at the location level. We denote statistical significance by * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(Bachmann et al., 2021), a tax rate change (Cashin and Unayama, 2016, 2021), or an adoption (Hammour and Mckeown, 2022). Another stream of this literature considers how prices change in response to changes in the value-added tax (Benzarti et al., 2020). Benzarti et al. (2020) find that prices react to VAT changes asymmetrically: prices rise more with VAT increases than they decline for an equal VAT decrease. Insights from this literature inform our understanding of the efficiency and incidence of the value-added tax. Generally, economists have found the value-added tax to be an efficient tax, but of course, how it is implemented matters (Keen, 2009). This finding has led to the widespread adoption of value-added taxes, although because implementation details matter, not all countries have had a positive experience (Keen and Lockwood, 2010). Ballard et al. (1987) find that overall the value-added tax is regressive but, again, implementation details matter and different features can make it less so. Montag et al. (2020) find incomplete pass-through of the VAT to consumers for a temporary VAT reduction in Germany in response to COVID-19 and that the pass-through differed across fuel types.

We provide the dual to this literature by providing evidence of how changes in consumer behavior change consumption taxes—albeit using sales tax in the USA as our setting. First, we demonstrate that forecast models can be sensitive to changes in consumer behavior. This fragility provides an impetus for governments to collect and monitor data in real time about spending behavior. In the USA, the lack of these data led states to contract spending in expectation of large decreases in sales tax revenues when, in fact, revenues increased substantially.

Second, our findings suggest stability of the VAT may depend critically on how broad its base is. This finding mirrors the previous literature in that implementation factors matter. As an illustrative example, consider the corner cases. At one extreme, if all consumption was in the tax base, then consumer changes across consumption types would not affect sales tax revenue collections. Only the level of total consumption would matter in this case. At the other extreme, if only half of aggregate consumption is in the tax base, then consumer behavior has the potential to substantially change sales tax revenue collections even if aggregate consumption does not change. This example highlights a different justification for broader sales tax bases: stability of tax revenues.

Third, our findings suggest that consumer behavior can change the geography of sales tax collections. In our setting, we found one initial response to the pandemic was a shift of taxable sales from rural and urban areas to suburban areas. Other shocks, whether booms or recessions, may have similar catalyst effects on changing geographies. In our setting in the USA, changes in geography had significant implications for local government's budgets. This experience suggests governments should monitor geographic shifts in spending and set up systems that adequately allow for sharing revenues to facilitate understanding (and possibly even predicting) shifts in geography.

8 Implications for tax revenue volatility

An important factor of many tax systems is their ability to provide stable revenues. This stability is particularly important in smaller countries and subnational governments in larger countries, such as US States. US states experienced devastating budget crises due to the recessions in 2001 and 2008 and their tax portfolios that exposed them to this risk (Seegert, 2015). In 2020, states feared the worst, given these past experiences. In contrast, tax revenues increased. States are now fiercely debating to what extent the increased revenues are one-time temporary influxes or ongoing. The answer has implications for whether governments can increase spending on ongoing programs like K-12 education or should provide one-time tax cuts.

Previous literature on tax revenue volatility has focused on changes in revenues from a given source relative to changes in income and understanding how different revenue sources aggregate into a tax portfolio with a given level of risk (Dye and McGuire, 1991; Seegert, 2018). Dye and McGuire (1991) show that whether income or consumption taxes are more volatile depends on how these taxes are implemented. Seegert (2015) builds on these findings and shows that progressive income taxes, exempting food from the sales tax, and other features change the volatility of a given revenue source. Chernick et al. (2014) highlight that states that depended more on capital gains in their income tax base experienced greater tax revenue volatility in the recession in 2008. Seegert (2018) considers the tax system as a whole, focusing on the covariance of different revenue sources and showing that states can build tax portfolios that are more or less exposed to economic shocks. Over the last few decades, the states have expanded their reliance on income tax primarily at the expense of selective sales taxes.

The results from this paper highlight risk exposure depends on underlying individual behavior. At first pass, consumption taxes may seem more stable than income taxes because individuals smooth their consumption relative to income. What this paper highlights is that it is not sufficient to consider aggregate volatility of consumption in consumption taxes. Specifically, shifts in spending across types (e.g., goods versus services or household consumption versus taxable business purchases), geography (e.g., rural, suburban, and urban), and modes (e.g., brick-and-mortar versus online) can lead to changes in volatility.

9 Conclusion

Tax revenues ebb and flow with economic conditions. Sometimes, however, seismic shifts change the relationship between tax revenues and economic conditions. Previous literature has shown that changes in the tax portfolio of states changed the volatility of tax revenues in the 2000s (Seegert, 2020). In this paper, we explore whether the COVID-19 pandemic similarly changed this relationship. Using administrative data paired with household surveys, we find the answer is yes. Specifically, spending patterns discontinuously changed in 2020 in a way that dramatically changed the sales tax base. We show this change has differential effects for rural,

suburban, and urban areas, with implications for how states distribute revenues to local governments.

The changes we observed in 2020 mark a dramatic change in the evolution of the sales tax base. It is yet to be seen whether these changes are permanent or transitory. For example, households report that the increase in e-commerce in 2020 will not decrease in 2021. In addition, households reported that they expect to spend more on household durables in 2021, continuing the trend from 2020. Since household durables (e.g., dishwashers) are in the sales tax base, we continue to see an increase in sales tax revenues. Sales tax collections in Utah and many other states continued to be strong through 2022.

Finally, the shifts in spending have important implications for distributing revenues to rural, suburban, and urban areas. In many states, sales tax revenues are distributed to local governments based, at least in part, on the point of sale. Households shifted consumption dramatically from brick-and-mortar stores in urban areas to e-commerce sent to their homes. This shift means that suburban and rural areas will receive more revenues as a share of the total and the urban regions less over time as e-commerce grows as a share of the sales tax base. Future work should look at the impacts of this shift in revenues and changes in local governments' incentives to promote retail stores versus housing.

Appendix

See Tables 4 and 5 and Fig. 8.

Table 4 Sales tax revenue by sector during the pandemic

	(1)
E-commerce	40.699** (16.043)
Agriculture	35.714*** (13.045)
Construction	.0108 (1.796)
Retail	-6.435*** (2.214)
Services	-9.050*** (2.516)
Special events	-67.030*** (8.684)
Constant	3.362*** (0.917)
Industry fixed-effects	✓
Quarter fixed-effects	✓
Adj. R-Square	0.486
Observations	66,088

This table reports estimates of year-over-year percent change in taxable sales by industries. An observation is a quarter t , location i , and industry j from quarter 1, 2013, to quarter 1 2022. Industries are combined into seven aggregate industries; e-commerce, agriculture, wholesale, construction, retail, services, and special events. The specification includes quarter and industry fixed effects,

$$Y_{i,j,t} = \beta_0 + \sum_{j=1}^7 \beta_j \mathbb{1}(\text{Year} \geq 2020)_t \times \text{Industry}_j + \sum_t \lambda_t + \sum_{j=1}^7 \lambda_j + \varepsilon_{i,j,t}.$$

The coefficients from this specification correspond to the columns in Table 2. Wholesale is the left out industry. Standard errors are clustered at the quarter level. We denote statistical significance by $*p < 0.10$, $**p < 0.05$, $***p < 0.01$

Table 5 Rural sales tax revenue during the pandemic with wayfair

	(1)	(2)	(3)	(4)	(5)	(6)
Suburban × pandemic	0.104*** (0.021)	0.104*** (0.030)	0.104*** (0.031)	0.096*** (0.030)	0.096*** (0.030)	0.096*** (0.028)
Rural × pandemic	0.061*** (0.022)	0.057 (0.035)	0.057 (0.035)	0.061* (0.034)	0.055 (0.035)	0.065** (0.031)
Suburban × wayfair	0.035 (0.044)	0.036 (0.035)	0.036 (0.035)	0.028 (0.036)	0.028 (0.035)	0.028 (0.036)
Rural × wayfair	-0.032 (0.046)	-0.023 (0.040)	-0.024 (0.040)	-0.032 (0.041)	-0.023 (0.040)	-0.026 (0.041)
Suburban	0.023*** (0.008)	0.023*** (0.008)	0.023*** (0.008)			
Rural	0.018** (0.008)	0.005 (0.015)	0.006 (0.015)			
Adj. R-Square	0.008	0.011	0.011	0.022	0.025	0.032
Observations	87,053	87,053	87,053	87,053	87,053	87,053
Cubic time trend		✓				
Quintic time trend			✓		✓	
Quarter fixed effects						✓
Location fixed effects				✓	✓	✓
Controls COVID cases and unemployment	✓	✓	✓	✓	✓	✓
Adj. R-Square	0.010	0.015	0.016	0.038	0.045	0.060
Observations	168,552	168,552	168,552	168,552	168,552	168,552

This table reports estimates with the addition of an interaction between Wayfair and rural and suburban (urban is the left out category) and Wayfair in levels. We define Wayfair as being in the fourth quarter of 2019, when the regulations in Utah took effect. The dependent variable is the year-over-year percent change. All specifications control for unemployment and COVID-19 cases at the county level. We focus on quarters from the first quarter of 2013 to the second quarter of 2022 (latest available data). Standard errors are clustered at the location level. We denote statistical significance by * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Transaction Type:	Source To:	Exceptions:
Retail sale of tangible personal property in Utah (including vending machine operators and sellers who sell from mobile inventory)*	Seller's fixed place of business (whether or not the goods or services delivered) Location where inventory warehoused for vending machine operators and sellers who sell from mobile inventory	Sales at special events (fairs, swap meets, races, etc.) sourced to the event location.
Retail sale of taxable services in Utah when seller also sells tangible personal property	Seller's fixed place of business OR customer's location (seller's preference)	If the seller sells tangible personal property on the same invoice as the service, the transaction must be sourced to the seller's fixed place of business. Sales at special events (fairs, swap meets, etc.) sourced to the event location.
Retail sale of taxable services in Utah when seller does not sell any tangible personal property*	Customer's location	
Retail sale of tangible personal property (including manufactured/mobile/modular homes, motor vehicles, aircrafts and watercrafts) or taxable services from outside Utah*	Buyer's location (the place the buyer receives the service or property)	
Retail sale of admissions	Location of activity or event (regardless of ticket purchase location)	
Lease or rental of tangible personal property* (other than motor vehicles, semi-trailers, trailers 10,000 pounds or less, and aircraft)	Location the customer receives the goods or services for down payment and first payment Location of the item for subsequent payments	If no recurring payments: source to the location the customer receives the goods or services or source to the customer's location if shipped from outside the state to a Utah customer.
Lease or rental of motor vehicles, semitrailers, trailers 10,000 pounds or less, and aircraft	Customer's location (address) for all payments, including down and first payments	If there are no recurring payments, source to the seller's fixed place of business.

Source: Utah State Tax Commission, Publication 25

Fig. 8 Utah general sales tax sourcing rules

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Declarations

Conflict of interest The authors have nothing to declare and no competing interests, financial or non-financial interests.

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