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FRC Report No. 228
March 2011

Georgia State University | ANDREW YOUNG SCHOOL OF POLICY STUDIES

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Acknowledgments

The author would like to thank David Sjoquist and Carolyn Bourdeaux of the Fiscal Research Center, and Shiferaw Gurmu of the Department of Economics for their helpful comments. Any errors or omissions are the responsibility of the author.

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Executive Summary

Sales tax holidays (STHs) have become common occurrences in many states over the last decade, with 22 states plus the District of Columbia holding STHs since 2000 (Cole 2008; Federation of Tax Administrators). Most STHs are held in early to mid-August to exempt from taxation items that families typically buy during the back-to-school shopping season. Several states have also held sales tax holidays covering such things as ENERGY STAR® rated appliances and emergency supplies. Georgia's first STH came in 2002, exempting clothing, school supplies, computers, and related items from state and local sales taxes for two days in March and two days in August. From 2003 through 2009, the STH for these items was held once per year for four days during the back-to-school season. In October 2005, Georgia added a STH for household appliances and other items carrying the ENERGY STAR label. Neither the back-to-school STH nor the ENERGY STAR STH was renewed for 2010 due to budget concerns.

The common arguments in support of STHs are that they lower the final price of targeted retail goods such as school supplies and clothing during back-to-school shopping, benefiting lower income families; that they encourage purchase of goods such as computers or energy efficient appliances to help achieve other goals of policy makers; that they stimulate the state economy through add-on sales of non-exempt goods; or that they enable retailers to reduce prices to compete with shops in neighboring states or online (Marwell and McGranahan 2010; Robyn, Cohen, and Henchman 2009).

Though the economic literature is somewhat limited, it does provide some evidence against these arguments for STHs. Among the findings are that households tend to shift consumption in time to take advantage of a STH rather than increasing consumption overall, that higher income households are more likely than lower income ones to shift consumption in time, and that retailers do not fully pass along the tax savings from STHs to consumers, absorbing a significant portion into profits instead (Harper et al. 2003; Marwell and McGranahan 2010). There is some evidence that STHs can induce consumers who would not otherwise buy a computer to purchase lower priced desktop models (Cole 2009a), but there is no credible

empirical evidence to date that STHs provide a material boost to a state's economy or tax revenues either through add-on sales of non-exempt items or by making the state's retailers more competitive with those of neighboring states.

While the economic benefits of STHs are unclear, the revenue effects are not. Using Georgia Department of Revenue reports of monthly sales tax collections from the state's retailers over the period from June 1986 through August 2010, we estimate the state revenue effect of Georgia's back-to-school STHs on state sales tax revenues. Controlling for personal income, home values (as a proxy for household wealth), statutory sales tax rates, and seasonal and dynamic effects, the data show that Georgia's back-to-school STHs reduced state revenues by 8.0 to 10.6 percent of otherwise expected monthly sales tax revenues or $36 to $50 million annually. Local governments, on average, would experience similar percentage losses.

Overall, the evidence to date on sales tax holidays does not support the arguments of their proponents. Consumer benefits from a STH depend on how much of the tax savings is passed along by retailers rather than being retained by them as added profits; and what benefits consumers realize are not targeted toward lower income families. The benefits are realized by retailers and by those households best able to shift consumption to the STH period—i.e. higher income households. There is some support for the notion that targeted STHs help promote computer ownership, but the evidence to date with regard to STHs boosting sales of non-exempt items or attracting significant cross-border shoppers suggests they do not. On the other hand, the cost of these uncertain benefits in terms of lost state revenues is substantial.

The report proceeds first with a brief history of sales tax holidays in the U.S., then an overview of sales taxes and STHs in Georgia. Section III reviews the economic literature and Section IV presents a summary of the empirical analysis of the Georgia data, with details provided in an appendix. Section V concludes and suggests some avenues for further analysis of Georgia's experience with sales tax holidays.

I. A Brief History of Sales Tax Holidays

Though Ohio and Michigan acted earlier, holding tax holidays for automobile purchases in 1980, New York launched STHs toward their recent popularity. In 1997, New York exempted up to $500 per transaction of clothing and footwear for seven days in January and for seven more in September. New York was joined in August 1998 by Florida and then in August 1999 by Texas, with seven- and three-day STHs, respectively, covering clothing and footwear. Four more states added STHs in 2000 and by 2010, 19 states were holding STHs. In total, 21 other states plus the District of Columbia have followed New York's lead by holding STHs (Cole 2008; Federation of Tax Administrators).

Motivations for holding STHs and the items covered have varied somewhat over time and across jurisdictions. New York initially enacted a STH because, as then-Mayor Rudy Giuliani of New York City said, New York retailers "were losing business to New Jersey and surrounding states, where clothing is not taxed." Massachusetts passed a weekend-long exemption on most tangible personal property in 2004, with a generous limit of $2,500 per item, to try to keep consumers from shopping in neighboring, sales tax-free New Hampshire. Oklahoma Governor Charles B. Henry made the same cross-border competition argument for his state's first STH in 2007 (Cole 2008).

Florida and Texas, initiating STHs during the strong late-1990s economy, did so in part as a means of offering general tax relief at a time of budget surpluses. South Carolina's first STH, in 2000, was proposed specifically to provide relief to families with children during the back-to-school season, while Iowa's Governor Tom Vilsack, in the same year, offered the same justification along with increasing competitiveness of border county retailers (Smith 2000). Several states initiated STHs to encourage consumer spending toward other policy goals. Pennsylvania's STH, also initiated in 2000, exempted personal computers with the goal of increasing the state's below average computer ownership rate (Strawley 2000); Florida, Louisiana, and Virginia have held STHs in several years that exempted hurricane preparedness supplies; and several states have held STHs exempting purchases of new, energy-efficient appliances (Cole 2008).

While the number of jurisdictions holding STHs has generally grown from year-to-year, not all have stuck with their STHs. New York held its last STH in January 2006, shortly after which the state decided to exempt clothing, footwear, and certain related items (up to $110 per item or pair) from the state sales tax year-round. More recently, Florida and Maryland cancelled their STHs after 2007 and 2006, respectively, as revenues declined, while Massachusetts skipped its 2009 STH and instead raised the sales tax rate by 1.25 percentage points (Waisanen and Haggerty 2010), but all three resumed holding STHs in 2010. The District of Columbia passed a STH for 2009, but then cancelled it shortly before the scheduled date due to growing budget shortfalls and did not hold a STH in 2010. Finally, to help close its budget gap after holding STHs from 2002 through 2009, Georgia did not pass a STH in 2010 (for FY2011).

II. Sales Taxes and Holidays in Georgia

Presently, Georgia imposes a 4 percent general sales and use tax at the state level. The state sales tax rate was last changed in 1989, increasing from 3 percent, and the exemption for food for home consumption was phased in over two years beginning October 1996. Other than the five states that do not have a state sales tax, only Colorado has a lower state sales tax rate than Georgia.[1] Georgia's rate is one percentage point below the (unweighted) average of all states and 1.68 percentage points below the median. Local sales taxes in Georgia range from 2 percent in eight counties to 3 percent in the other 151, with an additional 1 percent in the City of Atlanta.

Food for home consumption is exempt from the state sales tax in Georgia, but is subject to local taxes. Of the 45 states with state sales taxes, seven charge the full tax rate on food, while seven others charge a reduced rate and the remainder exempt food. Including Georgia, six states with a reduced rate or state exemption on food provide no local exemption (Federation of Tax Administrators).

The state's first STH came in 2002, exempting the following items for two days in March and two in August:

- clothing and footwear priced at $100 or less per item;
- computers and accessories for non-business use up to $1,500; and
- certain school supplies and children's books priced at $20 or less per item.

Beginning in 2003, the STH for these items was changed to once per year, for four days at the end of July or in early August. The limits remained the same and the exemptions applied to local sales taxes as well. In 2005 through 2009, generally in October,[2] Georgia held STHs for household appliances and other items carrying the EPA's ENERGY STAR label, and priced at $1,500 or less per item. These items were also exempt from local sales taxes in 2006 through 2009 and for 2008 and 2009, items carrying the EPA's WaterSense® label were covered as well (Cole 2008;

[1] States with no state sales tax as of January 1, 2010 are Alaska, Delaware, Montana, New Hampshire, and Oregon.

[2] The 2006 STH for ENERGY STAR labeled items was held in August along with the back-to-school STH.

Robyn, Cohen, and Henchman 2009). Neither the back-to-school (August) nor the ENERGY STAR (October) STH was renewed for 2010 (FY2011).

III. Review of Sales Tax Holiday Research

The economic literature on STHs is still limited, in part because the widespread adoption of them is a fairly recent phenomenon, but there have been a few notable empirical papers that look into the effects of STHs on consumption patterns and prices (Cole 2009a; Harper et al. 2003; Marwell and McGranahan 2010), and the fiscal impact of STHs (Cole 2009b). In addition, Mogab and Pisani (2007) conducted a survey-based study of shoppers' responses to a 2004 Texas STH.

Again, the primary arguments in favor of STHs are roughly the following:

1. STHs on clothing and school supplies lower the financial stresses on lower income families with children, who need to spend on these things during the back-to-school shopping period.

2. STHs promote consumption that is believed to be socially beneficial and thus politically favored, such as for children's and educational books to promote reading, for computers to promote computer literacy among children and adults, and for energy or water efficient appliances and fixtures to promote conservation.

3. STHs boost the state economy and tax revenues by increasing sales of both exempt and non-exempt goods during the holiday, the latter as add-on or impulse purchases while shopping for exempt goods.

4. STHs boost the state economy (particularly in border counties) and tax revenues by encouraging residents of neighboring states to cross the border to shop during the holidays.

There are several reasons to be skeptical of the benefits of STHs. First, consumers saving money during a STH depends on whether retailers pass through the tax savings to consumers, or retain some or all of the benefit by holding pretax prices higher than they otherwise would have been. Second, targeting benefits to lower-income families depends on their ability to adjust the timing of their spending to take advantage of the STH. Third, promotion of spending on particular goods and boosting consumption in general both presume the consumer response is not merely a matter of timing of spending. If the response is primarily timing, then taxpayers are subsidizing those able to shift their spending to the dates of the STH, with little or no effect on overall consumption or on sales of the targeted, socially beneficial goods.

Theory suggests that the burden of a sales tax is shared between consumer and producer depending on the relative elasticities of demand and supply, with the

consumer's share of the burden falling as the elasticity of demand rises relative to that of supply. If the consumer bears the entire burden, then the tax is said to be *fully-shifted* and the pretax price of the good would not change in response to a tax change. Some empirical studies into the price effects of sales tax rate changes (e.g. Poterba 1996, and Besley and Rosen 1999) suggest that sales taxes on some consumer goods may be fully-shifted to the consumer, implying that, in this case of a STH, the consumer may receive all of the benefit. It is not clear, however, that the tax shifting responses to tax increases and decreases is necessarily symmetric–for example, firms may under-shift tax cuts in the short-run, but fully-shift increases, due to asymmetries in short-run supply (Carbonnier 2005). In addition, the tax cut in the case of a STH is also anticipated and temporary, further complicating the expected effect on the consumer's tax-inclusive price. A STH is likely to boost demand for exempted goods during the holiday (but not necessarily over the longer-term) as consumers shift purchases to the holiday period from days or weeks surrounding the STH, allowing retailers (or producers) to hold net-of-tax prices higher and retain more of the benefit of the tax cut.

Nevertheless, the consumer would ordinarily benefit from a reduction in a sales tax even if the tax-inclusive price does not drop by the full amount of the tax reduction. The extent to which consumers save money or retailers boost profits during a STH is ultimately an empirical question, which the first two papers cited above attempt to answer. Harper et al. (2003) collected retail clothing price data on like items from retailers operating in both Pensacola, Florida, and nearby Mobile, Alabama, around the 2001 STH in Florida. The authors find that before-tax prices actually rose in both cities during the Florida holiday, though by a smaller amount and by less than the amount of the tax savings in Pensacola. They estimate that about 80 percent of the tax relief in in this instance was realized by consumers while 20 percent was claimed by retailers.

Cole (2009a) uses sales transaction data on desktop and laptop computers (over 30 thousand transactions) over a 30 week period in 2007, including STH periods in nine states, and finds weak evidence that retailers *over-shift* the tax savings to consumers in the case of lower priced desktop computers, but that before-tax prices of laptops and higher-priced desktops do not change. He suggests that retailers may

be reducing pre-tax prices on cheaper models during the STH to capture sales to consumers who would not have bought a computer in the absence of a STH, but that time-shifting of purchases likely accounts for the majority of added unit sales during computer STHs.

The possibility that a STH is more likely to induce a timing response (deferring or accelerating already planned purchases to fall during the STH) than an increase in consumption of exempted goods over a longer period is one of the questions Marwell and McGranahan (2010) address using daily household consumption data from the diary portion of the Consumer Expenditure Survey. This possibility also raises a question of whether STHs actually benefit lower-income households, as is often the stated intent, or primarily those households that are in a better position to shift the timing of their spending to take advantage of the STH. Marwell and McGranahan found evidence that purchases of clothing, shoes, and school supplies are significantly depressed in the period three weeks before a STH on those goods, though the effects in periods closer to the STH were unclear.

Marwell and McGranahan also found that the households showing statistically significant increases in purchases of exempt goods were those with higher incomes and those consisting of a married couple with young (age 17 or less) children. Low-income and single parent households show no statistically significant response in consumption to a STH. As a means of targeting tax relief to families with greatest need, these results suggest STHs are, at best, imprecise. Finally, the authors also addressed the question of how STHs affect sales of non-exempt goods, finding, contrary to an argument of STH proponents, that STHs "are more likely to reduce than increase consumption of non-exempt items."

As for boosting economic activity and competing for cross-border sales, a report from New York state tax officials concluded that the state's inaugural clothing STH in January 1997 failed to increase overall clothing sales for the quarter, suggesting the STH failed on both counts (New York State Department of Taxation and Finance 1997). The report also included results of a survey of retailers, 61 percent of which operated in New York City or counties bordering other states. The survey found that 41 percent said they gained no sales from non-residents as a result

of the STH, 31 percent said they did not know, and 14 percent said less than 5 percent of STH sales came from non-residents.

Mogab and Pisani (2007) addressed similar questions using a survey of 710 shoppers during a STH in Texas in August 2004. The authors found, among other things, that shoppers were more likely to say the STH was important to their decision to shop the higher was the size of their planned purchases, and that shoppers from moderate-income households were more likely than either high- or low-income shoppers to say the STH was important to them. They also found, perhaps counter to intuition, that the importance shoppers placed on the STH was inversely related to their professed price sensitivity. The authors suggest that price sensitive shoppers may view the potential savings from comparison shopping as greater than the likely savings from the temporary tax exemption.

Finally, while Cole (2008) and other sources report estimates of the revenue losses from various states' STHs, the bases for these estimates are generally unclear and there is little in the economic literature in the way of systematic empirical analysis of the fiscal impact of STHs. One such analysis was conducted by Cole (2009b), who collected monthly sales tax data to construct a panel of 13 states plus the District of Columbia, over varying periods of time from six to 40 years. Cole found that the occurrence of a STH in a given month reduces sales tax collections in that month by about 4.2 percent (statistically significant at the 5 percent level), controlling for the sales tax rate, state population, real income, and unemployment rates. Adding controls for the duration of the holiday indicated that more STH days has no significant effect—that the existence of a STH, and not its duration, is what matters. This, he says, is consistent with the notion that consumers are shifting purchases to the STH days to take advantage of the tax break. He also finds no evidence of shifting from months before or after the month in which the holiday falls.

IV. Empirical Analysis of Georgia's Sales Tax Holidays

At this time, the data available for the study of Georgia's experience with STHs are fairly limited. The state Department of Revenue reports monthly sales tax collections,[3] but no information as to the base—the amounts of taxable and exempt retail sales, or other details reported on sales tax returns from businesses. The monthly collections time series, however, can be used to estimate the fiscal impact of STHs, controlling for income and wealth, changes in tax rates, and seasonality of retail sales.

The dependent variable in the regressions is the natural log of monthly sales tax collections, while control variables include measures of personal income and household wealth (home values),[4] the state general sales tax rate and the rate applicable to food sales. To address econometric issues, a one-month lag of collections was also included in some models and models were also run with collections data seasonally adjusted based on seasonal patterns over the roughly 15 years of available data prior to the state's first STH in 2002. Regressions were also run with collections, income and the wealth measure in both nominal dollar and inflation-adjusted terms. A detailed discussion of the control variables, econometric issues, and methodology, as well as more detail as to the results, is presented in a technical appendix to this report.

The variable of interest is the indicator for the occurrence of a STH–a variable equal to the number of STH days in a given month or, alternately, equal to one if any part of a STH falls within the month and zero otherwise. Regression results for the STH indicator variables were consistent across all specifications and generally statistically significant, and suggest that Georgia's typical four-day back-to-school STH costs the state about 8.0 to 10.6 percent of its otherwise expected monthly sales tax revenues. Over the five year period 2005-2009, all of which included a back-to-school STH, average sales tax collections for the month of August, in which most of

[3] Note that sales tax collections in a given month represent payments of estimated taxes due on sales in the prior month plus final payments of balances due on sales two months prior, so they do not precisely capture revenue accruals for a single month.

[4] Specifically the 24-month moving average of Georgia personal income, calculated from Bureau of Economic Analysis data, and, as a proxy for wealth, the Conventional Mortgage Home Price Index published by Freddie Mac.

the STH days fell during this period, were about $419 million. Grossing this amount up by 8.0 to 10.6 percent, the results suggest a revenue loss from this STH of about $36.4 to $49.7 million each year. Effects on local sales tax revenues would be similar, though slightly smaller given the typical 2.8 percent local tax rate versus 4 percent on the state level.

V. Conclusions

Overall, the evidence to date on sales tax holidays does not support the arguments of their proponents. Consumer benefits from a STH depend on how much of the tax savings is passed along by retailers rather than being retained by them as added profits; and what benefits consumers realize are not targeted toward lower income families. The benefits are realized by retailers and by those households best able to shift consumption to the STH period–i.e. higher income households.

There is some support, with Cole's (2009a) finding that computer retailers appear to reduce prices on cheaper desktop models to attract new buyers during the STH, for the notion that STHs help promote computer ownership. However, the evidence to date with regard to STHs boosting sales of non-exempt items suggests they do not. Finally, New York tax officials reported that the state's inaugural STH did not increase overall sales of exempt items, but rather shifted sales from nearby weeks, providing little support for material cross-border sales gains.

With little evidence supporting the STH proponents' case, we turn to estimating the cost of Georgia's back-to-school STH. Using monthly state sales tax collections from June 1986 through August 2010 and controls for personal income, home values, and tax rates, econometric analysis suggests that revenue losses to the state from a four-day STH are most likely in the area of $36 to $50 million annually.

These estimates are substantially larger than earlier estimates made by the Fiscal Research Center (FRC) during the 2010 legislative session. The FRC estimated then that the combined revenue impact of renewing the back-to-school (August) and ENERGY STAR (October) STHs for calendar 2010 (FY2011) was about $13 million on the state level and $9.8 million locally.

Further analysis of Georgia's experience with sales tax holidays may help answer questions about proponents claimed benefits of STHs, but will require additional data from sales tax returns. In particular, sales tax returns include data as to the tax base that would enable the analysis of exempt and non-exempt retail sales to gauge effects on economic activity and timing behavior. Detailed data by county would enable the analysis of cross-border effects, and detail as to estimated and final payments would more precisely associate collections with the month in which the taxable sales occurred, allowing for more precise estimates of revenue effects.

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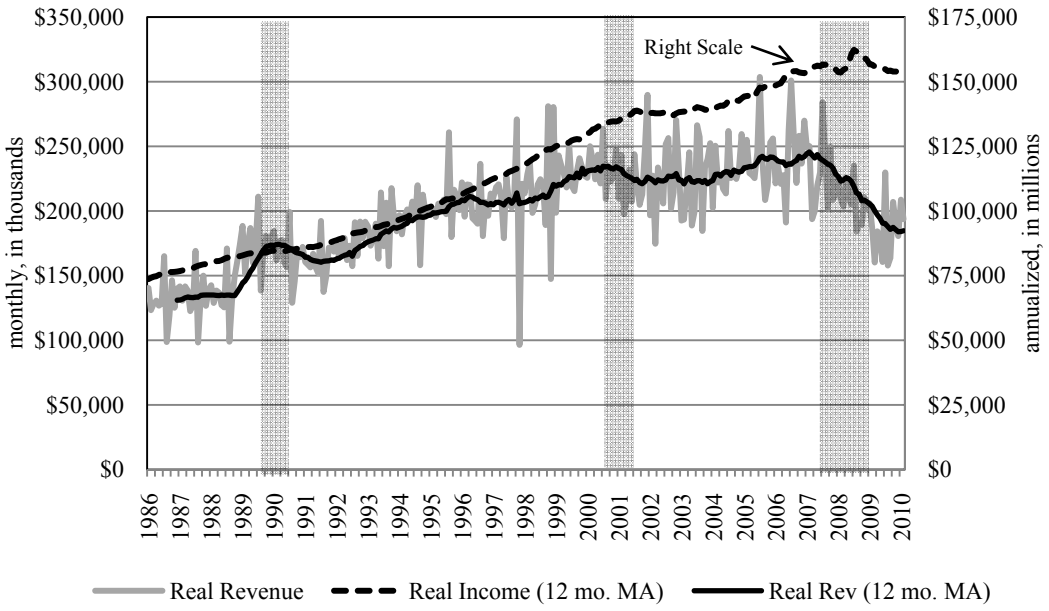
Appendix

Data and Methods

Figure 1 presents real monthly collections of state sales tax revenues from June 1986 through August 2010, deflated using the Consumer Price Index, with the 12-month moving average overlaid. The 12-month moving average of Georgia real personal income is also shown (right scale)[5] and recession periods are shaded. The effects of the 1989 tax rate increase and the recessions are apparent from the figure, but clearly the revenue effects of the most recent, longer recession are much more severe than changes in real income might suggest. This divergence is consistent with the reported recent rise in household savings rates. The earlier divergence between revenues and income from 1996 to about 1999 is apparently attributable to the phase-out of the sales tax on food.

FIGURE 1. REAL SALES TAX COLLECTIONS AND PERSONAL INCOME
(1982-84 Dollars)



[5] Real personal income data are calculated from quarterly, seasonally adjusted, annualized data from the Bureau of Economic Analysis (http://www.bea.gov/regional/sqpi), deflated using the CPI. Monthly data are interpolated assuming equal income in all months of a quarter and the monthly data are then used to calculate moving averages.

For the analysis that follows, the dependent variable is the natural log of monthly state sales tax collections, with regressions run using both nominal and real dollars. The income variable used is the 24-month moving average to approximate *permanent* income, which according to Friedman's permanent income hypothesis should be more closely related to consumption spending, and thus sales tax revenues, than shorter-term income measures. The income variables are also converted to natural logs for the regressions and real or nominal income is used depending on the collections variable.

To control for a wealth effect on consumption spending, a plausible explanation for the divergence between income and consumption noted above, the Conventional Mortgage Home Price Index (CMHPI) for Georgia, published monthly by Freddie Mac, is also included in log form. Other control variables include the general sales tax rate and the sales tax rate applicable to food.

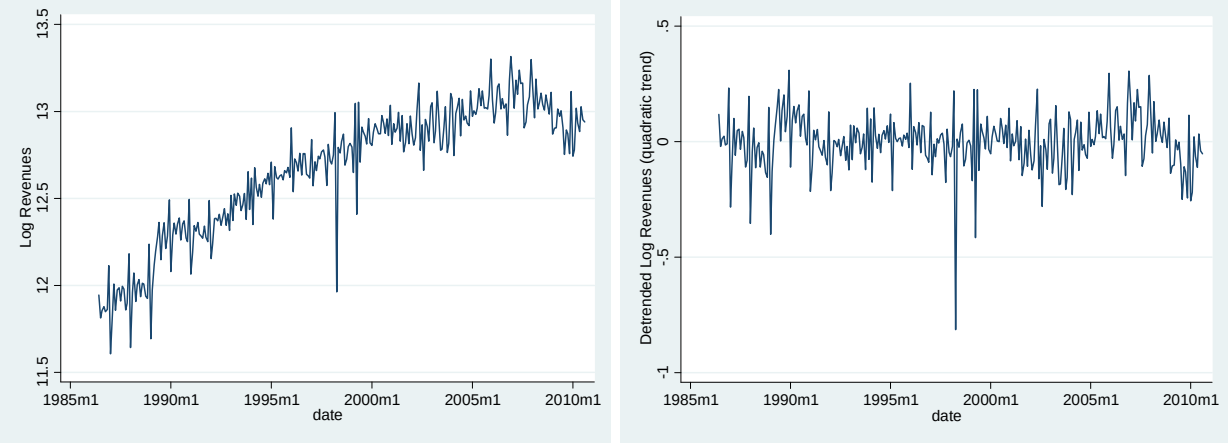
The variable of most interest is the indicator for the occurrence of a STH in a given month. Georgia's STHs have generally fallen in August and lasted four days, but in the first year Georgia held a STH, it held two-day holidays in March and August, and in many years one or more days of the back-to-school holidays have fallen in July. For this reason, the STH indicator variable is the number of days of STH falling within the given month. Also, because the scope of the energy and water efficiency STHs is so much narrower, a separate indicator was tested for these holidays. However, coefficient estimates on this variable were not significant and inclusion detracted somewhat from model precision, so results including it are omitted.

An econometric issue that often arises in the analysis of aggregate economic variables such as the variables used here is non-stationarity. In this case, the log revenue variables are apparently non-stationary, clearly trending over time, but can be made stationary by detrending–that is, the variables are "trend stationary."[6] Figure

[6] Non-stationary variables in linear time series regressions can lead to invalid inferences. Augmented Dickey-Fuller unit root tests found evidence of non-stationarity in the nominal and real log revenue series when a trend term was not included, while inclusion of a linear trend term resulted in rejection of the unit root hypothesis. The time trend also need not be linear; it may be exponential, quadratic, or follow some higher order polynomial function that best describes the trending series (see Wooldridge 2002, p. 344-353 for further discussion). In this case, a quadratic time trend appears to best fit the data.

2 shows the nominal log revenues series compared to the detrended variable. Also, sales tax collections and personal income tend to trend together as the population grows, and nominal collections, income, and home values, of course, rise together with the general price level. Co-trending dependent and independent variables can lead to finding spurious correlations when used together in a regression, so to avoid these problems, these variables are detrended before inclusion in the regressions.[7]

FIGURE 2. LOG REVENUES AND QUADRATIC DETRENDED LOG REVENUES

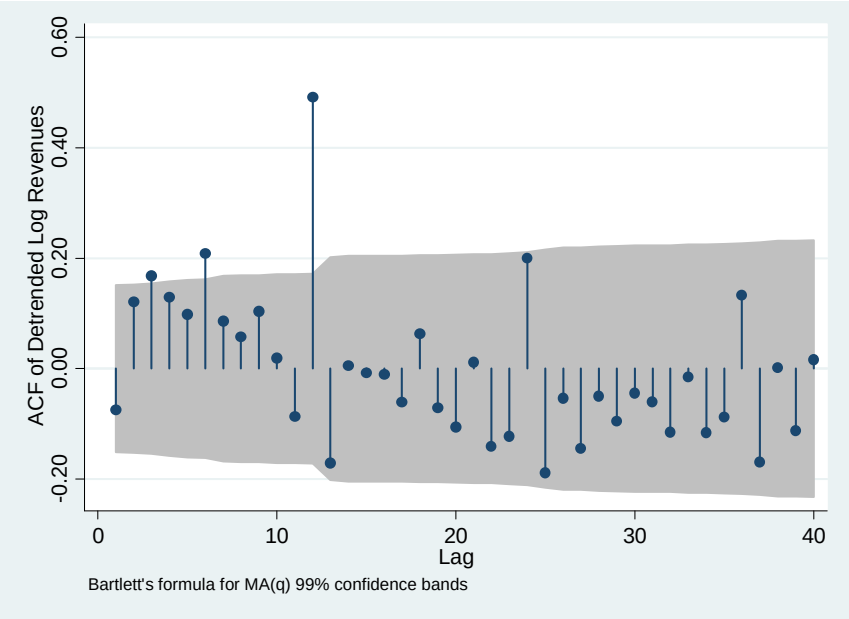


Sales tax revenues are also seasonal, following the seasonal patterns of retail sales, as can be seen more clearly from Figure 3, a correlogram of the detrended log revenues variable (correlations between the detrended variable and lags thereof), which shows a large positive correlation with the 12-month lagged value. The simplest method to address this seasonality is to include dummy variables for 11 months in the regressions. However, this approach assumes that the monthly seasonal pattern is constant over the entire 24 years of data, while our empirical question is about how STHs affect the pattern of monthly revenues in the years in which they were held. For this reason, rather than using dummy variables, the sales tax collections data is seasonally adjusted using monthly factors derived from the roughly 15 years of data prior to the state's first STH in 2002.[8]

[7] The variables are regressed on a time index and its square, t and t^2, with the residuals saved as the detrended versions of each.

[8] I first regress the detrended log revenues variable, for periods prior to 2002, on monthly dummy variables. The seasonally adjusted variable is equal to the residual for each period–that is, actual less predicted revenues, over the full sample period (see Wooldridge 2002, p. 353-354).

FIGURE 3. AUTOCORRELATIONS OF DE-TRENDED LOG REVENUES



The seasonally adjusted data are used in the regressions where indicated, but while the adjustment dampens the seasonal variation, it does not eliminate the seasonal autocorrelation in regression residuals. The regression coefficient estimates, however, are consistent (that is, unbiased) in the presence of autocorrelation; the consequence is that the variance of coefficient estimates is biased downward, potentially overstating the statistical significance of the estimates. For this reason, all OLS regression results, whether or not run on seasonally adjusted data, include Newey-West standard error estimates, correcting for possible autocorrelation of residuals up to 12 lags.

There is also reason to suspect correlation of a shorter-term nature, with sales tax collections in a given month possibly depending on the prior month's collections. Though not apparent from Figure 3, some regressions showed evidence of first order autocorrelation, an AR(1) process, in the residuals. A negative AR(1) process in sales tax collections might be expected if short-term factors such as unseasonably bad weather keep shoppers at home, deferring some spending to the following month. Alternatively, positive economic shocks might have effects that boost sales tax collections for several months, resulting in a positive AR(1) process. I model this possible short-term dependence directly by including a one month lag of the dependent variable in some regressions.

Results

Tables 1 and 2 present the regression results with tax collections, income, and home prices in nominal and real terms, respectively. Tax collections for all models in Tables 1 and 2 are detrended as discussed above. The first column of each table gives results of a simple model with no lagged dependent variable while the second adds the one-month lagged collections. Using nominal variables and the column one model, a Durbin-Watson test suggests negative autocorrelation,[9] while adding the lagged dependent variable in column two does not substantively change the estimates for any other variable and further tests find no evidence of an AR(1) process when the lag is included. However, there remains evidence of a seasonal autoregressive process (positive autocorrelation of residuals with their 12^{th} lag); while this does not bias the coefficient estimates, it can bias the coefficient standard error estimates, requiring the use of Newey-West standard error estimates as noted previously. In addition to estimating corrected the standard errors, the last two columns of each table also use seasonally adjusted tax collections in specifications that are otherwise the same as columns two and three.

Finally, columns three and five substitute a binary STH dummy variable for the number of STH days in the month, the indicator equaling one if any STH days fall within a given month. Cole (2009b) found that marginal, one-day changes in the duration of the STH do not significantly change the fiscal impact. If this is so, then one could not necessarily assume that the effect of a four day STH would be four times the per day marginal effect estimated by the first two models. However, the column three estimates, which say that a STH of any duration should be expected to reduce monthly collections by about 8 percent in Table 1 or 8.6 percent in Table 2 (both statistically significant at the 5 percent level), is roughly four times the -2.0 and -2.2 percent per STH day effect estimated in the column two models.

[9] The Durbin-Watson statistic, d, is 2.316 and $4 - d = 1.684$, while the 5 percent upper and lower critical values are 1.843 and 1.773, respectively, suggesting negative autocorrelation. Durbin's h-test also finds evidence of first order autocorrelation in the Table 1, column one model.

TABLE 1. REGRESSION RESULTS: NOMINAL REVENUES

Dependent Variable: Natural Log of Nominal Sales Tax Collections

Variables	1	2	3	4	5
Lagged Dep. Variable (1-month lag)		-0.1647** (0.082)	-0.1684** (0.080)	-0.0649 (0.085)	-0.0691 (0.084)
Personal Income, log (24-month MA)	-0.0500 (0.549)	-0.0505 (0.634)	-0.0584 (0.619)	-0.0972 (0.580)	-0.1003 (0.563)
CMHPI, log (12-month MA)	0.7660*** (0.223)	0.9104*** (0.255)	0.9164*** (0.246)	0.8482*** (0.236)	0.8524*** (0.226)
Gen'l Sales Tax Rate	0.0780** (0.034)	0.0974** (0.038)	0.0982** (0.038)	0.0890** (0.035)	0.0899** (0.035)
Food Sales Tax Rate	0.0102* (0.005)	0.0122* (0.007)	0.0115* (0.006)	0.0104* (0.006)	0.0097 (0.006)
STH Days	-0.0192 (0.012)	-0.0203* (0.012)		-0.0264** (0.013)	
STH Dummy			-0.0807** (0.034)		-0.0980*** (0.037)
Constant	-0.3180** (0.134)	-0.3973** (0.154)	-0.3980** (0.154)	-0.3585** (0.142)	-0.3594** (0.142)
Detrended:	Y	Y	Y	Y	Y
Seasonally Adjusted:	N	N	N	Y	Y
Obs	289	288	288	288	288
F-statistic (p-value)	0.0025	0.0012	0.0001	0.0017	0.0002
R-squared	0.0763	0.1060	0.1154	0.1041	0.1178

Newey-West standard errors are in parentheses.
*** indicates significance at the 1% level, **5%, and *10%.

Focusing on the seasonally adjusted revenue models in the last two columns of both tables, the estimated effects of a STH are somewhat larger at -2.6 percent per day in the nominal revenue model and -2.9 percent per day in the real revenue model, both significant at the 5 percent level. With the STH dummy variable in place of STH days, the column five estimated effects in the two tables are -9.8 percent and -10.6 percent, both significant at the 1 percent level.

TABLE 2. REGRESSIONS RESULTS: REAL REVENUES

Dependent Variable: Natural Log of Real Monthly Sales Tax Collections

Variables	1	2	3	4	5
Lagged Dep. Variable (1-month lag)		-0.1714** (0.079)	-0.1754** (0.078)	-0.1298* (0.075)	-0.1360* (0.073)
Personal Income, log (24-month MA)	-0.2460 (0.518)	-0.3142 (0.587)	-0.3383 (0.570)	-0.3317 (0.556)	-0.3532 (0.537)
CMHPI, log (12-month MA)	0.7909*** (0.212)	0.9477*** (0.240)	0.9543*** (0.228)	0.9272*** (0.221)	0.9332*** (0.208)
Gen'l Sales Tax Rate	0.0634 (0.041)	0.0802* (0.048)	0.0802* (0.048)	0.0768* (0.046)	0.0770* (0.046)
Food Sales Tax Rate	0.0072 (0.007)	0.0087 (0.008)	0.0079 (0.008)	0.0076 (0.008)	0.0067 (0.008)
STH Days	-0.0207* (0.012)	-0.0223* (0.012)		-0.0291** (0.014)	
STH Dummy			-0.0859** (0.034)		-0.1060*** (0.036)
Constant	-0.2558 (0.169)	-0.3240* (0.194)	-0.3212* (0.194)	-0.3046 (0.186)	-0.3021 (0.186)
Detrended:	Y	Y	Y	Y	Y
Seasonally Adjusted:	N	N	N	Y	Y
Obs	289	288	288	288	288
F-statistic (p-value)	0.0021	0.0005	0.0000	0.0001	0.0000
R-squared	0.0703	0.1017	0.1118	0.1094	0.1248

Newey-West standard errors are in parentheses.
*** indicates significance at the 1% level, **5%, and *10%.

Taken together, these results suggest that Georgia's typical four-day back-to-school STH costs the state about 8.0 to 10.6 percent of its otherwise expected monthly sales tax revenues. Over the five year period 2005-2009, all of which included a back-to-school STH, average sales tax collections for the month of August (the month in which the majority of STH days fell over this period) were about $419 million. Grossing this amount up by 8.0 to 10.6 percent, the results suggest a revenue loss from this STH of about $36.4 to $49.7 million each year.

Other Findings and Robustness Checks

Given the limited data availability, particularly without information as to exempt and non-exempt gross sales, it is not possible to directly test proponents' claims about STHs boosting overall or non-exempt sales. However, a decline in

revenues for a STH period at least implies that gains from add-on non-exempt sales do not make up for revenue lost on STH-eligible sales.

As for time-shifting of purchases to take advantage of a STH, the best one can do with only monthly collections data is to test whether collections in adjacent periods are lower than otherwise expected. As noted above, previous research has found some evidence of shifting of school supply, clothing, and computer purchases from nearby weeks to the STH period (Cole 2009a; Marwell and McGranahan 2010). Marwell and McGranahan found the strongest evidence for shifting from three weeks prior to the holiday, but little evidence of shifting from post-holiday weeks. Because Georgia's STH has generally been held in the first week of August, it is possible that shifting from July might show up in the data, though shifting from later nearby weeks would occur within the same month. When the STH falls in part or fully in late July, it is doubtful that shifting from June would be significant. To test for an effect of time-shifting on revenues, a dummy variable was included for July periods followed by an August STH. The results showed no statistically significant effect.

To test whether the results hold up to different treatments of seasonality and time trends, two general alternative approaches were used. First, regressions were run using the log revenue data without detrending, but with a time index and its square included as regressors along with monthly dummy variables. Results were substantially the same, with coefficient estimates on STH days of about -0.028 in both nominal and real revenue models. The second approach was to model the seasonal autoregressive process directly as a SAR(12) model in Stata[10] using the detrended revenue data. Coefficient estimates on the STH days and STH dummy variables were not statistically different from those in the models above, though only those on the STH dummy variable were statistically significant. Estimates on the STH dummy variable were -0.069 and significant at the 5 percent level.

[10] A SAR(12) (or seasonally autoregressive with monthly data) model in Stata utilizes the 'ARIMA' command with its 'SARIMA' option to include one 12-period lag of the dependent variable and estimate the model by maximum likelihood. Models were run with both an AR(1) and SAR(12) process (one 1-period and one 12-period lag) and with the SAR(12) process alone.

About the Author

Robert Buschman is a Senior Research Associate in the Fiscal Research Center and a candidate for PhD in Economics at the Andrew Young School of Policy Studies. His research interests include corporate and personal taxation, public expenditures, macroeconomic policy, history of economic thought and economic history. Prior to joining the Andrew Young School, Bob worked for several years in corporate banking and corporate financial management. Bob holds a BA in Economics from Duke University, an MBA in Finance from the Goizueta Business School at Emory University, and an MA in Economics from Georgia State University.

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Sales Tax Holidays and Revenue Effects in Georgia

Publisher(s): Fiscal Research Center of the Andrew Young School of Policy Studies

Author(s): Robert Buschman

Date Published: 2011-03-22

Subject(s): Government Reform