How Do Retailers Respond to Sales Tax Holidays?

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Abstract. In my dissertation I will explore how retail stores respond to sales tax holidays. Based on economic theory, I show that retailers should build up inventories preceding sales tax holidays and in most cases increase prices during tax holidays, thereby gaining part of the benefit from the tax reduction at the expense of consumers. Alternatively, stores may decrease prices in response to temporary drop in taxes, an outcome that is possible only under imperfect competition. Using restricted data for the Consumer Price Index, I plan to test (i) whether prices respond and (ii) whether store quality, defined as the presence of items in a store, increases due to sales tax holidays. In addition, I will explore (iii) whether the tax incidence depends on price adjustment costs by exploiting the variation in tax holiday length.
1. Introduction

A sales tax holiday is a short period of time when consumers do not have to pay state and, in most cases, local sales tax for specified items. Since 1997, when New York held a sales tax holiday, 23 states and the District of Columbia have tried it at least once. Given the estimated losses in tax revenue from a two-day tax holiday in Massachusetts of around $23 million, cumulative losses in revenue of local and state governments could total billions of dollars at present.\(^1\) Most policy makers argue that these losses are compensated by benefits to consumers who shop tax-free and retailers who obtain higher revenues. Research shows that consumers indeed spend at least 25% more of usual daily spending on the apparel (Agarwal, Marwell and McGranahan, 2013) and buy from 6 to 17 more computers per 10,000 consumers during sales tax holidays (Cole, 2009a).

Though sales taxes have historically been levied on consumers, economic theory suggests that both market participants may bear the burden of the tax. In my dissertation, I will explore how retail stores respond in prices and quality to sales tax holidays on apparel. In addition, I will test whether adjustment costs influence retailers’ decisions in setting prices by exploiting variation in the length of holidays. Finally, I will compare sales tax holidays and permanent changes in sales tax rates on apparel to see whether there are any dynamic effects involving advertising or the timing of consumer purchases. For my analysis, I will merge confidential micro data collected for the Consumer Price Index (CPI) data by Bureau of Labor Statistics (BLS) with a self-constructed dataset on tax holidays. The uniqueness of the nationally

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\(^1\) This number is taken from “Revenue Impact Analysis” by Massachusetts Department of Revenue
representative CPI data involves a long panel of item presence and prices in given stores at given dates.

2. Literature Review

My research contributes to three strands of economic literature. First, in estimating sales tax incidence, I build upon the papers of Poterba (1996) and Besley and Rosen (1999) by using a broader array of goods, more granular data and a cleaner source of variation in tax schedule. Poterba (1996) studies the effect of state and local taxes on the prices of clothing using city-specific CPI data. He finds that consumers bear the full cost of sales taxes, which is consistent with the assumption of perfectly competitive markets. On the contrary, Besley and Rosen (1999) find that tax incidence is positive using commodity-level data, i.e. a tax increase results in a producer price increase, an outcome that is possible only if competition is imperfect.²

I further contribute to the recently developed literature on tax and subsidy incidence. The closest in methodology to my paper is by Busse et al. (2013) who consider the one-month long federal program “Cash for Clunkers.”³ Unlike manufacture rebates, of which car dealers obtain 20% (Busse, Silva-Risso and Zettelmeyer, 2006), they show that the government rebate goes entirely to the consumers. Samphantharak and Doyle (2008) explore another temporary change in tax policy: suspension of the gasoline tax. They find that consumers enjoy only 70% of the tax cut, while tax reinstatement is fully passed on to them. Hastings and Washington (2010) show that supermarkets respond to Food Stamps benefits with a 3% price increase on products that

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² When the sales tax is not zero, consumers and producers face different prices. When talking about price and incidence, I refer to the producer side of the market.

³ “Cash for Clunkers” is a program that allowed consumers to get a rebate for buying a new car upon trading in the old one.
Food Stamps recipients buy the most. In an important result, Rothstein (2010) shows that employers capture 27% of the EITC by lowering wages. Finally, Weyl and Fabinger (2013)’s result that the incidence of excise taxes on producers is a sufficient statistic for welfare analysis in a general model of imperfect competition serves as a theoretical underpinning of my analysis.

Second, I add to the literature on sales tax holidays, which recently has focused on its effect on consumer expenditures. Using a field experiment framework, Chetty, Looney and Kroft (2009) find that the sales tax is not salient to consumers shopping at supermarkets. In addition, they theoretically show that tax salience decreases the tax incidence on producers.4 Using eBay data, Einav et al. (2014) estimate that a one percentage point increase in a state’s sales tax leads to a 2% increase in online purchases by state residents and to a 3-4% decrease in purchases from state retailers. Agarwal, Marwell and McGranahan (2013) find that sales tax holidays increase daily clothing spending by at least 25% without evidence of intertemporal substitution. Unlike previous researchers, Cole (2009a) finds that intertemporal substitution may account for as much as 90% of the increase in spending on tax-exempt computer items during tax holidays. In addition, Cole (2009b) estimates the lost revenue for states from tax holidays at anywhere from 0.52% to 7.83% of monthly tax collections. Given the substantial purchase response to sales tax holidays, it is reasonable to investigate whether producers in turn alter prices.

Third, I contribute to the literature on optimization with price adjustment costs, which are essentially menu costs here. Numerous macroeconomic papers (see Nakamura and Steinsson, 2013 for review) use menu costs as a foundation for sticky prices in their models.

4 I do not use this result in formulating my hypotheses, it may be worthwhile later to take the salience effect under consideration in discussing results.
Microeconomic research (Levy et al., 1997; Zbaracki et al., 2004) studies the components of menu costs and empirically quantifies them using field analysis. In this project, I will be able to ascertain whether menu costs are empirically relevant by exploiting variation in the duration of sales tax holidays. This allows me to correct for the estimation of tax incidence by addressing the issue of bias due to optimization with frictions emphasized by Chetty (2012). Kleven and Waseem (2013) show empirically that optimization frictions substantially alter the incentives of income taxpayers in Pakistan.

Finally, my paper is distinctive to the literature in one further way. I complement my tax incidence study with an analysis of the effect of tax holidays on retail store quality under imperfect competition. This follows Matsa (2011), who explores how competition between stores increases their quality.

3. Theory and Empirical Hypotheses

In this section, I provide theoretical background for my empirical estimation of tax incidence, which is an important parameter from the theoretical perspective. Weyl and Fabinger (2013) emphasize that tax incidence is (i) a sufficient statistic for complete welfare analysis for monopolistic and perfectly competitive markets and (ii) for computing consumer surplus in a market under any type of competition. Also, as I show in the first and third parts of this section, tax incidence analysis further allows researchers to (iii) identify imperfect competition and (iv) test whether adjustment costs influence prices in the retail industry (in cases where the temporary and permanent variation induced by the tax schedule is observed). In addition to emphasizing the importance of tax incidence, I formulate theoretical predictions to be tested empirically.

Throughout this Section, I follow Chetty, Looney and Kroft (2009) and consider the sales tax as
a unit tax rather than an *ad valorem* tax because analysis for the latter is cumbersome but not conceptually different.\(^5\)

### 3.1 Test for Imperfect Competition

Here, I explain how tax incidence alone yields a test of whether markets are competitive. Kotlikoff and Summers (1987) show that, given the elasticity of demand \(e_D\) and the elasticity of supply \(e_S\), tax incidence on producers under perfect competition is:

\[
\rho = \frac{dp}{dt} = \frac{ep}{e_S-e_D}, \quad e_D < 0, \text{ and } e_S > 0
\]

Formula (1), together with the restrictions on the elasticity signs, implies that the value of tax incidence lies in the \([-1, 0]\) interval. Figure 1 illustrates this result. Weyl and Fabinger (2013) show that tax incidence in general models of imperfect competition is: \(^6\)

\[
\rho = \frac{A}{1+A}, \quad \text{where } A = \frac{\theta}{\epsilon_\theta} + \frac{e_D-\theta}{\epsilon_S} + \frac{\theta}{\epsilon_{ms}}.
\]

Here, \(\theta\) is a conduct parameter from Genesove and Mullin (1998), \(\epsilon_\theta\) is the elasticity of demand with respect to the conduct parameter, \(e_S\) is the elasticity of the inverse marginal cost curve, and \(e_{ms}\) is the elasticity of demand with respect to marginal surplus per firm, where \(ms\) is denoted by: \(^7\)

\[
ms = p \cdot q'(p).
\]

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\(^5\) Anderson, de Palma and Kreider (2001) provide a particular transformation that allows one to treat ad valorem tax as a unit tax.

\(^6\) I use the same notation as Fabinger and Weyl (2013) so that one can consult the paper to clarify the exact definition of variables.

\(^7\) As I state in the empirical section, I cannot estimate the parameters in \(A\) due to data limitations.
$A$, and hence $\rho$, can take any value. This allows me to state my first hypothesis:

**Hypothesis 1. Under the assumption of perfect competition, tax incidence should be in the range $[-1, 0]$.**

One caveat is that failing to reject the hypothesis does not allow one to claim that the market is competitive. However rejecting it unambiguously indicates imperfect competition.

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**Figure 1 – Effect of Unit Tax Under Assumptions of Perfect Competition**

**3.2 Tax Holidays and Retail Store Quality**

Finding positive tax incidence is plausible at least for some goods, given media reports that some retail stores actually decrease prices during sales tax holidays. This would result in rejecting Hypothesis 1, which implies that consumers facing a reduction in both tax rate and

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8 To see this, consider the case when the conduct parameter does not change with quantity and marginal cost is constant. The first two terms in $A$ are zero in this case and the sign and magnitude of the last term is determined by the curvature of the demand curve, which can take almost any value.

9 For instance, the Salvation Army offered additional 10% off on most items during sales tax holidays.
before-tax price would buy higher quantities of the goods during tax holidays. To match this increase in consumption, retailers need to invest in stocks of apparel in advance. At the end of the season, when tax holidays usually occur, some products can be already sold out. So, building up the stocks can benefit consumers shopping before the tax holiday, as they face higher availability of products, or in other words, high quality of retailers.\textsuperscript{10} Following Matsa (2011), I define quality as “whether a [store] reliably has its customers’ preferred products available in stock when they want to make a purchase.” It is unclear if, after holidays, shoppers see a broader array of products. My next hypothesis is:

**Hypothesis 2.** Tax holidays should increase store quality before the policy is implemented. The effect on quality is uncertain during and after the policy.

### 3.3 Optimization with Cost Adjustment

In case I find negative tax incidence, which is consistent with the model of competitive equilibrium, I plan to test whether price adjustment costs are a substantial issue in estimating tax incidence on retail store prices induced by sales tax holidays, which is temporary by its nature.\textsuperscript{11} If the costs for changing prices are high enough in a given store, the managers of the store may decide to keep prices fixed. In addition to physical costs of changing prices, Zbaracki et. al. (2004) suggest that adjustment costs $adjcost_s$ include managerial costs and costs of

\textsuperscript{10} An alternative explanation of increasing quality (or variety) of products is the following. Retailers know that more shoppers visit stores during sales tax holidays. Given that consumers buy apparel relatively seldom, it is in the benefit of stores to present a vast variety of products during sales holidays to persuade consumers to return in the future. I do not observe the variety of products in a given store with the CPI data, but I intend to test this prediction later in my research using scanner data.

\textsuperscript{11} The average duration of a tax holiday is 10 days overall and 3.9 days for apparel.
communicating with customer. I model the trade-off between additional profits from raising the price and adjustment costs as:

\[ t \frac{d\text{profit}}{dt} \cdot Q_{ls} \cdot L_{hol} < 2 \cdot \text{adjcost}_s. \]

(4)

Here, \( Q_{ls} \) represents average daily sales of the product, and \( L_{hol} \) is the duration of the sales tax holiday. The “2” on the left hand side appears because stores have to reinstate the price once the holiday ends. I incorporate Assumption (4) in order to address the issue emphasized by Chetty (2012), who shows that optimization frictions can prevent the researcher from correctly identifying the effect of tax rate change on outcome variables. I plan to use the following hypothesis to test for the relevance of adjustment costs:

**Hypothesis 3. When tax holidays last longer and the change in tax rate is bigger, retail stores should change prices for (i) more goods, (ii) for the goods that are sold in large quantities and (iii) for the goods whose tax incidence is higher.**

4. Empirical Estimation

Now, I describe the variables that I will use and the empirical methodology that I will implement to estimate the incidence of tax holidays on retail store pricing. In addition, I state the crucial assumptions for the validity of my estimation. I consider only apparel (clothing and shoes) items because (i) most tax holidays exempt apparel items, (ii) the CPI data provides enough observations on apparel prices, (iii) Agarwal, Marwell, and McGranahan (2013) find using Consumer Expenditure Survey data that families increase spending only on apparel during tax holiday and (iv) some states vary sales tax rates specifically for apparel. Throughout my

\[ 12 \text{ In reality the manager solves a more complicated problem, I put this equation to emphasize that longer duration and higher tax rate should positively affect changes in prices.} \]
empirical analysis I will try to consider each category of apparel separately to see if my results vary across goods. I define a product as an entry-level item in CPI data. An entry-level item specifies the name of the product but does not specify its characteristics, which can vary across stores. For instance, I do not observe the price of the same blue girls’ dress in all the stores. Instead, I observe prices of dresses that may have different characteristics in different stores.

**4.1 Estimation of Tax Incidence**

To estimate tax incidence of sales tax holidays, I use a basic difference-in-difference specification:

\[ \ln(p_{ict}) = \alpha + \gamma STH_{ct} + \beta_1 \ln(1 + \tau_{ict}) STH_{ct} + \beta_2 \ln(1 + \tau_{ict}) + FE_{mth,yr} + FE_i + Controls_{c,yr} + \epsilon_{ict}, \]  

(5)

where \( p_{ict} \) is a price of item \( i \) at day \( t \) in a store located in county \( c \), and \( \tau_{ict} \) is the sales tax rate in county \( c \) for item \( i \). The tax rate may vary across items in rare cases. For instance, shoes or clothing that cost more than $100 are not tax exempt during sales tax holidays in Alabama. In the rest of the discussion, unless otherwise stated, I do not rely on huge variation in tax rates across items in a given county. Control variables are proxies for the costs of retail store operations at the county level: the unemployment rate, population, average wage, average rent and others. I include item fixed effects \( FE_i \) to control for any constant-over-time characteristic of an item, such as its color or store where it is sold. Month-year fixed effects account for

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13 Chapter17 from BLS explains in detail the specifics of collecting the data for Consumer Price Index

14 By sales tax rate in a municipality I assume the sum of state, city and municipal sales tax rate.

15 I do not expect to observe a big number of items that cost more than $100 in CPI data.
temporary shocks in demand during the school season or price decreases due to seasonal adjustments.

Coefficient $\beta_1$ from specification (5) is of main interest. It shows how a change in the tax rate induced by tax holidays results in a price difference between counties with and without tax holidays. In Table 1, I show that there is substantial variation in tax holiday across states and time. Traditional tax incidence analysis (Poterba, 1996; Besley and Rosen, 1999) for apparel considers coefficient $\beta_2$ as a measure of tax incidence. Hence, it exploits variation in permanent sales tax rates. As we know, the sales tax applies to most goods and, hence, is a tax on overall consumption, which raises concerns about the validity of the resulting estimates due to general equilibrium effects. This concern is not relevant in the case of tax holidays.

**Table 1 – States that have Sales Tax Holidays by Year**

<table>
<thead>
<tr>
<th>Year</th>
<th>States</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>2 (MI, OH)</td>
</tr>
<tr>
<td>1981-1996</td>
<td>None</td>
</tr>
<tr>
<td>1997</td>
<td>1 (NY)</td>
</tr>
<tr>
<td>1998</td>
<td>2 (FL, NY)</td>
</tr>
<tr>
<td>1999</td>
<td>3 (FL, NY, TX)</td>
</tr>
<tr>
<td>2000</td>
<td>7 (CT, FL, IA, NY, PA, SC, TX)</td>
</tr>
<tr>
<td>2001</td>
<td>7+DC (CT, DC, FL, IA, MD, PA, SC, TX)</td>
</tr>
<tr>
<td>2002</td>
<td>8+DC (CT, DC, GA, IA, NC, PA, SC, TX, WV)</td>
</tr>
<tr>
<td>2003</td>
<td>9 (CT, GA, IA, NY, NC, SC, TX, VT, WV)</td>
</tr>
<tr>
<td>2004</td>
<td>12+DC (CT, DC, FL, GA, IA, MA, MO, NY, NC, SC, TX, VT, WV)</td>
</tr>
<tr>
<td>2005</td>
<td>12+DC (CT, DC, FL, GA, IA, LA, MA, MO, NM, NY, NC, SC, TX)</td>
</tr>
<tr>
<td>2006</td>
<td>15+DC (AL, CT, DC, FL, GA, IA, IA, MA, MO, NM, NY, NC, SC, TN, TX, VA)</td>
</tr>
<tr>
<td>2007</td>
<td>15+DC (AL, CT, DC, FL, GA, IA, IA, MA, MO, NM, NC, OK, SC, TN, TX, VA)</td>
</tr>
<tr>
<td>2008</td>
<td>16+DC (AL, CT, DC, GA, IA, LA, MA, MO, NM, NC, OK, SC, TN, TX, VT, VA, WV)</td>
</tr>
<tr>
<td>2009</td>
<td>16 (AL, CT, GA, IA, LA, MS, MO, NM, NC, OK, SC, TN, TX, VT, VA, WV)</td>
</tr>
<tr>
<td>2010</td>
<td>19 (AL, CT, FL, IA, LA, LA, MD, MA, MS, MO, NM, NC, OK, SC, TN, TX, VT, VA, WV)</td>
</tr>
<tr>
<td>2011</td>
<td>17 (AL, AR, CT, FL, IA, LA, MD, MA, MS, MO, NM, NC, OK, SC, TN, TX, VA)</td>
</tr>
<tr>
<td>2012</td>
<td>18 (AL, AR, CT, FL, IA, LA, MA, MD, MS, MO, NM, NC, OK, SC, TN, TX, VA)</td>
</tr>
<tr>
<td>2013</td>
<td>17 (AL, AR, CT, FL, IA, GA, LA, MA, MD, MS, MO, NM, NC, OK, SC, TN, TX, VA)</td>
</tr>
</tbody>
</table>

*Source: Tax Foundation; Federation of Tax Administrators; state websites.*
Now, I would like to discuss the assumptions for the validity of my results. First, in specification (5) I assume that the mode of competition is the same across geographical locations, so that the tax incidence is of the same sign and magnitude (referred to as Assumption (I)). If the assumption does not hold, tax incidence can be of different signs for different counties in the treatment group, pushing coefficient $\beta_1$ closer to zero. To check whether this concern is relevant, I plan to include a dummy on county population size as a proxy for the degree of competition and interact it with the tax rate and sales tax holidays.

Another assumption (referred to as Assumption (II)), which is relevant for external validity, is that there are no changes in demand for apparel due to factors, e.g., advertising, other than a drop in the tax rate. In the latter case, consumers, who otherwise would shop on any other day, would choose to shop during the tax holidays due to lower after-tax prices. Agarwal, Marwell and McGranahan (2013) find no evidence for such intertemporal shifts by consumers, while Cole (2009a) argues that up to 90% of sales can be explained by it, though he focuses on computers. On the other hand, additional advertising during a sales tax holiday, rather than the drop in the tax rate, might induce more people to shop for clothing and shoes during the holiday. I do not have data on the advertisings from retailers, but I find no evidence that big retailers, such as Walmart or Marshall’s, specifically advertise tax holidays on their websites. ¹⁶ Both advertising and dynamic behavior of consumers bias the estimates of tax incidence up. So, I can treat my estimates from specification (5) as an upper bound of the actual tax incidence.

Alternatively, I can check for the presence of bias using permanent sales tax changes, specifically for apparel, instituted in the states of New York and Connecticut. New York State

¹⁶ I believe that it is a good starting point for future research on sales tax holidays
established a “year round tax holiday” for clothing and shoes priced below $110 in 2006. It then repealed it in 2010, reestablished in 2011 for items with price below $55 and returned to $110 in 2012. Connecticut repealed its tax exemption for apparel items priced below $50 in 2011. These policies allow me to use triple-difference estimation, comparing items of different prices, and to rule out the bias associated with short-term issues. Specification (5) is still valid, once I substitute the dummy for sales tax holiday with that of for New York and Connecticut policies. Hence, I expect to observe higher proportion of goods that do not face drop in a tax rate.

4.2 Retail Store Quality

To test whether store quality changes due to sales tax holidays, I follow the empirical methodology introduced by Matsa (2011):

\[ Stockout_{isct} = \alpha + \sum_{j=-N}^{N} \beta_j week_{t-j} 1(STH_{ct}) + \gamma Controls_{isct} + FE_{mth, yr} + FE_{c} + FE_{s} + \epsilon_{isct}, \]  

(6)

The dependent variable is a dummy \( Stockout_{isct} \), which is equal to 1 if an item \( i \) is present in a store \( s \) located in a county \( c \) on a given day \( t \). The main explanatory variable is a sum of composite variables. Each composite variable \( week_{t-j} 1(STH_{ct}) \) is equal to 1 if the observation is \( j \) weeks before the occurrence of a tax holiday. The variable \( N \) represents the number of weeks around tax holidays that I would like to consider. Control variables include characteristics of items and time-varying county characteristics. County and store fixed effects control for

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17 (Un)Happy Hoidays: the True Meaning of Sales Tax "Holiday" Policy, Jannsen (2012)

18 Decision to hold sales tax holidays usually takes place several weeks before the holiday, which may affect the change in inventories. Current specification does account for it and reasonably assumes that tax holidays, once established, occur every year. In my future work, I will check if announcements play a role in shaping the inventories
permanent over time unobserved factors, whereas year-month fixed effects control for temporary shocks or seasonal effects. In terms of coefficients, Hypothesis 2 implies that coefficients $\beta_j$ decrease in the positive domain of the index. Assumption (II) is necessary for the validity of the results obtained using specification (6).

4.3 Price Adjustment Costs

To test for the presence of menu costs, I exploit variation in the duration of tax holidays $L_{hol, st}$ which I interact with the dummy for sales tax holiday. My main dependent variable is a dummy that is equal to one when price changes from the previous observation.

$$Pchange_{imt} = \alpha + \gamma STH_{ct} + \beta_1 \ln(1 + \tau_{ict}) STH_{ct} + \beta_2 \ln(1 + \tau_{ict}) + \beta_3 L_{hol, st} STH_{ct} + FE_{mth, yr} + FE_{i} + Cntrls_{mt} + \epsilon_{imt},$$

Fixed effects $FE_i$ here are at the item level. They control for all possible permanent differences between items (e.g. white t-shirt or black t-shirt) including average quantity sold in a store and tax incidence. Hypothesis 3 implies that coefficients $\beta_1$ and $\beta_3$ are positive. Both assumptions (I) and (II) are necessary for the estimation.

5. Data and Power Analysis

In this paper, I plan to use two datasets. First, I plan to get access to confidential micro data used to construct the Consumer Price Index (CPI) by the BLS, which I will merge with a self-constructed dataset on sales tax holidays. Second, I will use the data from Booth School of Business.¹⁹

¹⁹ I do not provide explanation of how I am going to use the second dataset, as I am not sure I will be able to work with it. Summer Durrant, Alderman librarian, has allocated money for the data, but the Acquisitions Department has yet to approve the deal.
The uniqueness of the nationally representative CPI data involves its long panel of item presence and prices in a given store. Moreover, the CPI data provides the exact date when the price is collected. This is essential, as sales tax holidays last no longer than 10 days. In addition, the collectors pay attention to the characteristics of an item and visit the same store several times. This may allow me to use store and item fixed effects, and control for the cases when a store stops selling a specific item.

However, a potential problem with the CPI data is a lack of observations that may result in low statistical power of my estimation. The BLS collects prices only bimonthly (on business dates) on most CPI items subject to tax holidays. To address this issue, I perform a power analysis test to show that the CPI confidential data should furnish enough observations for precise estimation.\textsuperscript{20} The results of my analysis are presented in Table 2. At the conventional 80\% power level, I am able to estimate any change in producer price that is larger than or equal to 14.5 cents given 136 treatment points. This precision seems pretty reasonable, and, in fact, will be higher in my actual empirical analysis due to several reasons. First, I will control for other variables; this should decrease the variance induced by seasonal changes or geographical differences in prices. Second, I include two additional years in the sample (2012, 2013), which will increase number of treatment observations. Third, I can aggregate apparel data to broader level, which will also lead to a greater number of observations, though possibly may increase the variance.

\textsuperscript{20} Details of the power analysis test can be provided upon request. I limit my analysis solely to apparel, but later intend to consider other goods covered by tax holidays. For the analysis, I use the numbers kindly provided by the BLS staff and from official reports (BLS \textit{Chapter17} for data collected in 2012 and Tax Foundation \textit{review on sales tax holidays}). I thank numerous BLS employees for assisting me in understanding CPI data, specifically Verbrugge R., Velez F., Stewart K.
Table 2 – Statistical power for testing my hypotheses given the CPI data.

<table>
<thead>
<tr>
<th>Number of treatment observations</th>
<th>Statistical power of the test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>80</td>
</tr>
<tr>
<td>136</td>
<td>16.3</td>
</tr>
<tr>
<td>272</td>
<td>10.3</td>
</tr>
</tbody>
</table>

Notes: I show changes in producer prices (in cents) that I will be able to identify precisely given number of (treatment) observations and statistical power of the test. Conventional level of power is equal to 80%.

6. Further research

I plan to create a stylized model that shows that, despite the high expenditure response to tax holiday, consumer welfare may not increase much because of costs associated with crowding: the marginal shopper should be indifferent between going to a store on sales tax holiday when she buys items at lower price, but stays in lines and traffic jams versus going the day before or after the tax holiday when she pays a little bit more, but saves time.

7. References


