The Journal of
Regional
Analysis
& Policy

JRAP 46(2): 138-153.

An Analysis of the Economic Impacts of Big-Box Stores on a Community's Retail Sector: Evidence from Maine

Emily A. Freedman, James C. McConnon, Jr., Gary L. Hunt, and Todd M. Gabe
University of Maine – USA

Abstract: This study examines the effects of big-box stores on the change in the number of retail stores operating in a market area. Our econometric results suggest that the presence and growth of big-box retailers has a positive net effect on retail establishment growth in Maine. We found no evidence that big-box stores have any impact on the net change in hardware stores, but did find a positive impact on the net change in the number of restaurants. An additional noteworthy finding of this study is that there appears to be a "saturation point" at which the effect of an additional big-box store becomes negative, a likely result of too much competition in a community's overall retail sector.

1. Introduction

Big-box stores such as Walmart have gained popularity among shoppers in the past decade because of their low prices and wide merchandise availability. New retail development can create a much-needed positive economic boost in communities. However, the growth of big-box retail stores has become a source of controversy in many communities across the country. Grassroots organizations, city planners, environmentalists, and many others argue that the negative economic, social, and environmental impacts of big-box retail far outweigh the benefits to consumers. In particular, much concern has been expressed about the adverse impact these big-box stores have on other smaller retail businesses. As such, policymakers desire credible estimates of the impacts of big-box stores on the local business community.

Small business formation is important to the overall economy and is an indicator of community economic vitality (Deller and McConnon, 2009; Goetz et al., 2010). It is especially important in rural communities that often struggle to maintain a strong retail sector (Irwin and Clark, 2007). Big-box stores have become a source of controversy due to the widely-held notion that Walmarts and other big-box stores have negative effects on the creation and success of local "mom-and-pop" retail stores (Renkow, 2005). However, previous studies have indicated that the presence of a big-box store pulls people in to shop from neighboring communities. Although local businesses that sell the same goods as big-box stores saw reductions in their sales after the introduction of big-box retail, businesses that sold products different from those available in local big-box stores actually saw increases in sales (Stone et al., 1992).

Concerned with the impacts of big-box stores, in 2007 the State of Maine passed the Informed Growth Act, which required towns who have received permit applications for large retail stores to determine whether the store could have "undue adverse impact" on the local economy and community. If shown to do so, the permit for the store could not be approved by the town's planning board. The Act required a study be prepared (paid for by the developers who applied for the permit) by an economic

expert to examine the possible effects of a new large retailer on a "comprehensive economic impact area." The study would examine the effects on local employment, existing retail businesses, wages, and municipal revenue. However, the Informed Growth Act was repealed in 2011 because a majority of legislators felt it was discouraging national companies from building their stores in Maine by adding to the costs of permitting (Bell, 2011).

The majority of current research on the impacts of big-box stores focuses on the negative economic impacts that could result. There is not a great deal of discussion in the relevant research, however, on whether big-box stores may actually be creating "induced demand" in communities. In the case of induced demand, an increase in supply results in more of the good being consumed (Lee et al., 1999). There is the possibility that the research is ignoring the counterfactual — that pushing big-box stores out of town may actually be worse for a local economy. It is possible that big-box stores may supply so many goods and be so convenient that customers may be making shopping trips and purchasing goods that they would otherwise forego due to high opportunity costs. "One-stop shopping" could save shoppers from having to make multiple trips or having to travel greater distances to obtain goods. The savings from purchasing necessary goods at less expensive big-box stores might also provide consumers with more disposable income to spend at other local businesses.

This study examines the impacts of big-box retailers on the vibrancy of Maine's retail sector. Other studies have examined this issue nationally and at the county-level, but few have successfully isolated big-box impacts on the growth of retail businesses at the community-level in a state like Maine. Our empirical specifications are motivated by central place theory considerations (Christaller, 1966; Preston, 1971; Eaton and Lipsey, 2002) and a desire to avoid spurious results and inconsistent estimates under limited data availability for place-based local data.

This study adds to the published research on this topic in a number of significant ways. First, it focuses on the impacts associated with all big-box stores, not just the impacts associated with Walmart. Second, while most of the previous research has examined this issue at the county or regional level, this study assesses the impacts at the community level, where retailing takes place. Third, this work examines the impacts of both the presence and growth of big-box stores on a community's retail sector. Finally, this study evaluates the possible impacts of big-box stores located in adjacent communities on host and non-host communities' retail sectors.

2. Literature review

There have been a number of studies conducted during the past twenty years that have investigated the economic impacts of big-box stores. Many of these studies have focused on Walmart and have attempted to analyze the big-box store's impact on factors such as jobs, wages, poverty levels, and other businesses, mainly at the county level. These studies have found both positive and negative economic impacts associated with the presence of Walmart.

Big-box stores such as Walmart offer low-priced goods by maintaining efficient distribution systems, keeping labor costs low, supply-chain ownership, and achieving economies of scale (Boarnet et al., 2005). Many local chambers of commerce have welcomed big-box stores into communities in great need of economic boosts. Big-box stores strive to dominate every sector in which they do business and to continually expand by driving the competition out of business by offering lower prices and a wider array of products (Pan, 2003). Big-box stores can motivate their competition to also lower their prices, which benefits all customers in the surrounding area.

Perry and Noonan (2001) identified the positive economic aspects of big-box retail development as serving "under-retailed" inner cities, boosting economically depressed communities, and increasing the local tax base and revenues. Stone (1995) found strong initial taxable retail sales growth in communities with new big-box development — 53.6% growth in the first year and a 43.6% increase in sales after the subsequent five years. Artz and McConnon (2001) discovered that the trade area size grew faster in the average Maine Walmart host town than in the average Maine town without a Walmart. In addition, there are broader positive effects associated with the presence of big-box stores such as driving down inflation (Sheppard and White, 2005; Paruchuri et al., 2009).

Hicks (2007) estimated the impact of Walmart on consumer goods, restaurants, and general merchandise sales tax receipts in Maine using monthly retail sales tax data for retail market areas from 1987-2004. Hicks's study estimated a panel regression model and accounted for endogeneity by using a lagged Walmart entrance variable and a measure of market size as instruments. Hicks found that the presence of Walmart increased sales tax receipts in both the consumer goods and general merchandise sectors but had no impact on the restaurant sector. Hicks also

ran a panel vector autoregression model for the consumer goods sector and found that the presence of Walmart increased sales tax receipts in the consumer goods sector.

However, there are negative economic impacts from big-box development as well. Most of the studies previously mentioned also cited reductions in retail sales in towns neighboring big-box host communities, and a potential for the retail sector to become homogenous (Perry and Noonan, 2001). Sheppard and White (2005) defined the impacts resulting from a Walmart in a community as the "Wal-Mart effect" — the "economic effects attributable to the Wal-Mart retail chain," such as lowering local wages and causing smaller retailers to go out of business. In addition, a study by Goetz and Swaminathan (2006) found that counties with higher numbers of incumbent Walmart stores and higher entry rates than other counties had greater increases in family poverty rates during the 1990s.

Perry and Noonan (2001) also found a reduction in the number of non-big-box stores that compete with big-boxes, and therefore a decrease in jobs in those establishments. Many planners also argue that big-box stores are not a socially-optimal option for economic development because they offer low wages, which may actually drive down wages in all area retail because other stores must then lower their own labor costs to compete (Boarnet et al., 2005).

Another study, however, found that Walmart did not have a negative impact on wages and that the net overall employment level had not changed (Hicks, 2008). This analysis is one of only a few big-box development studies that compares retail and labor growth in towns with and without Walmart stores and properly utilizes econometric methods in an attempt to account for "endogenous entrance decisions" (Hicks, 2008). However, Hick's (2008) research found there to be only weak evidence of endogeneity in the entrance decision of Walmart stores in Maryland when utilizing instrumental variable approaches with panel data, the most widely-accepted estimation techniques. Hicks also provides evidence that big-box stores' entrance decisions are likely based on retail market size rather than growth rates.

Sobel and Dean (2008) found that Walmart did not have a statistically significant impact on the actual size of the U.S. small business sector. Ketchum and Hughes (1997) compared wage and employment trends in Walmart and non-Walmart counties and found there to be no evidence that Walmart was responsible for the slowed growth in Maine retail employment. The authors concluded that the change was likely due to other economic factors when they compared retail employment and wage growth to that of other sectors, such as manufacturing.

Sobel and Dean (2008) used the number and growth of Walmart stores per capita (100,000 people) as an explanatory variable in models attempting to explain the growth rates of self-employment, the number of establishments with 1-4 employees (per capita), and the number of establishments with 5-9 employees (per capita). Utilizing ordinary least squares (OLS), spatial autoregression (SAR), and spatial autocorrelation (SAC), the study found that Walmart had no statistically significant impact on any of the three dependent variables using any of the methods. A more recent study by Hicks (2009) also found there to be no statistically significant impact on Iowa firms in three employment ranges (1-4, 5-9, and 10-19 employees).

The research conducted by Sobel and Dean (2008) conceded that the opening of a Walmart did result in the closure of many small businesses in an area but suggests that these businesses are soon replaced by new businesses. Another study found that, within zip codes, the impact from the entrance of a Walmart on small retailers varies depending on their proximity and level of product or service competition with the big-box retailer (Paruchuri et al., 2009). The study also found immediate drops in entry rates in the study zip codes upon the entry of a Walmart, followed by an eventual recovery in most retail categories after a period of time. In adjacent communities some categories, such as home furnishings, dropped, quickly recovered, and actually increased in subsequent years (Paruchuri et al., 2009).

An unambiguous, empirical gauge of a big-box store's impacts on community-level retail markets has yet to emerge. Most of the studies to date have focused on county-level business and/or job impacts associated with the presence of Walmart. However, this study fills a gap in the literature by focusing on community-level retail sector impacts associated with both the presence and growth of all big-box stores in host communities.

3. Maine's retail landscape - descriptive statistics

The descriptive statistics for "host" and "non-host" communities included in the sample are located in Table 1. As is evident from these statistics, communities with big-box retail in Maine are economic service centers with a significant retail market structure and higher average population than those communities without big-box retailers. While Maine experienced an overall decline in the number of all retailers in both host and non-host towns between 2000 and 2009, host communities experienced large, positive percentage changes in their consumer, general merchandise, and building supply sales (the sales categories in which most big-box retailers operate) over the time period. Non-host communities saw comparatively slower or negative rates of growth in their sector sales.

Table 1. Descriptive statistics for "host" communities and "non-host" communities.

HOST COMMUNITIES	2000	2009	2010	Percent Change
Total Number of Big-Box Stores	37	51		37.8%
Average Number of Retail Establishments	104.6	103.3		-1.2%
Average Consumer Sales (in thousands of current dollars)	$245,951		$293,243	19.2%
Average Building Supply Sales (in thousands of current dollars)	$31,090		$40,781	31.2%
Average General Merchandise Sales (in thousands of current dollars)	$70,353		$86,317	22.7%
Average Population	14,965		15,390	2.8%
NON-HOST COMMUNITIES	**2000**	**2009**	**2010**	**Percent Change**
Total Number of Big-Box Stores	0	0	0	
Average Number of Retail Establishments	11.0	10.1		-8.2%
Average Consumer Sales (in thousands of current dollars)	$16,835		$18,711	11.1%
Average Building Supply Sales (in thousands of current dollars)	$2,512		$2,361	-6.0%
Average General Merchandise Sales (in thousands of current dollars)	$2,036		$1,885	-7.4%
Average Population	2,411		2,515	4.3%

Figure 1 depicts the 2000 to 2009 yearly count of total establishments in the 334 Maine study communities, broken down by host and non-host towns. The contributions towards all retail totals are approximately equivalent across host and non-host communities, and the growth of all retail establishment totals in the state has been relatively stable over the time period.

Figure 2 shows the average contribution of big-box towns to the total establishments per year. Interestingly, when the graph is adjusted to account for the fact that there were only 28 host towns and 306 non-host towns in the sample, it is clearly evident that the majority of all retail in the State of Maine is housed within these big-box communities.

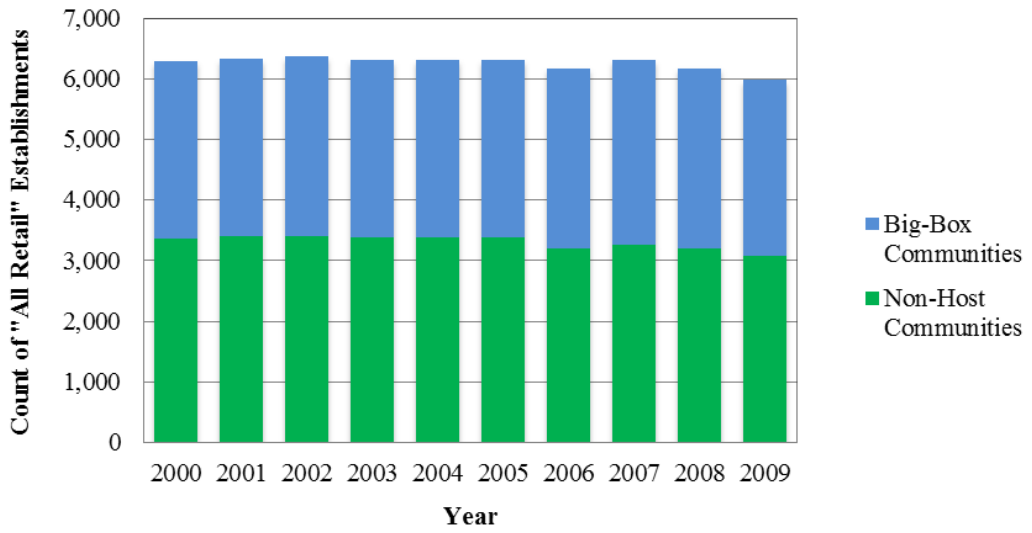

Figure 1. Yearly count of total retail establishments in 334 Maine study communities, 2000-2009.
Note: 2000-2009 totals are from NAICS "44" category data for "host" communities (i.e., the municipality had at least one big-box store between 2000 and 2009) and "non-host" communities (i.e., the municipality never had a big-box store between 2000 and 2009.)

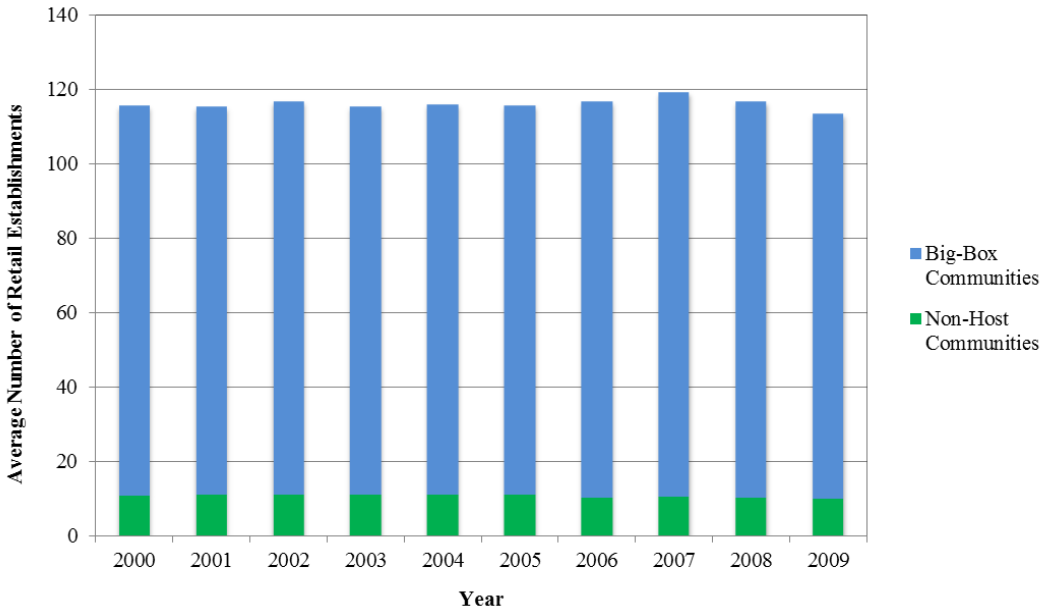

Figure 2. Contribution of big-box and non-host communities to the total number of Maine retail establishments, 2000-2009.
Note: Yearly count of total establishments in 334 Maine study communities; adjusted by the number of big-box (28) and non-host (306) towns.

4. Data

This study employs a database constructed from Maine Revenue Service retail sales data from 2000 to 2010, U.S. Census population data from 2000 to 2010, and U.S. Census County Business Patterns establishment data by North American Industry Classification System (NAICS) totals for 2000 to 2009.[1]

US Census Zip Code County Business Patterns provides information on the count of establishments

[1]Attempts were made to include an accurate record of the counts of establishments from 1994-2009 in this analysis. While Hicks (2009) found no significant sample bias from including data both pre- and post-reclassification from Standard Industrial Classification (SIC) to NAICS codes, this study found the bridge between the classifications of the focus retail categories was questionable, so the analysis was restricted to 2000-2009.

(in this case, those in the retail sector) by employment size. The retail establishments of interest in this analysis were "all retail", or the count of all retail establishments present in a community, and big-box retailers. Direct competitors to big-box retail, such as hardware and grocery stores, include stores who have achieved some economies of scale, not just small "mom and pop" businesses. So, it is more appropriate to examine the impacts of big-box retail on all retail businesses, not just on the smallest businesses, as was done in most previous studies.

The majority of the prior literature has focused on the economic impacts of a Walmart store, likely because Walmart is the most well known big-box retailer. For the purposes of this study, a "big-box store" was defined as a retail establishment with greater than 100 employees falling under the NAICS categories "home center", "discount department store", "department store", and "warehouse store." Using this classification system it is possible to capture all of the large "big-box" retailers present in the state that might have an impact on Maine's retail sector, such as Walmart, Target, Lowe's, Home Depot, Best Buy, Sam's Club, Marden's, K-Mart, and PetSmart.

Adequate data were available for a total of 334 Maine communities.[2] This study was able to identify 28 communities in Maine that hosted one or more big-box retailers between 2000 and 2009. The summary statistics for the data of interest for the 334 Maine communities used in regressions are located in Table 2. A detailed description and source of all data used in this study is included as Table A1 in the Appendix.

Table 2. Summary statistics of variables appearing in the models.

Variable Name	Mean	Maximum	Minimum	Std. Dev.
$RETAILEST_{2000}$	18.820	340	0	37.112
$\Delta RETAILEST_{2000-2009}$	-0.9341	23	-36	4.9077
POP_{2000}	3463.1	64249	79	5607.5
$\Delta POP_{2000-2010}$	130.91	2240	-1132	396.42
$BIGBOX_{2000}$	0.1108	6	0	0.5559
$\Delta BIGBOX_{2000-2009}$	0.0419	3	-1	0.2869
$BIGSM_{2000}$	0.1587	4	0	0.5273
$\Delta BIGSM_{2000-2009}$	0.0120	1	-2	0.2189
$ESAEL_{2000}$	1.3713	7	0	2.0105
$\Delta ESAEL_{2000-2009}$	0.3952	3	-1	0.8557
$BBESADIST_{2000}$	3.0749	7	0	2.2695
$\Delta BBESADIST_{2000-2009}$	1.0509	3	-1	1.2617

5. Methods and analysis

This study uses a variety of model specifications to determine whether the presence and change in the number of big-box stores helps or hurts the growth of "all retail" establishments in communities in Maine. Other studies have examined the issue nationally and in other states, but a study has not yet successfully isolated big-box impacts on the growth of Maine's retail sector. We observe 334 Maine towns (cross-sectional units) over the period 2000 to 2009/2010.

We are therefore able to model the change (first difference) in retail establishments over this time interval for a set of 334 fixed cross-sectional units. Model specifications focus on key initial conditions in each town; therefore, traditional fixed cross-sectional effects are not identified. However, we do specify

[2] This sample accounts for approximately 90% of the state's total 2009 population.

special fixed effects for "twin cities" (Bangor/Brewer and Lewiston/Auburn) based on the historical development patterns in these twins that strongly influenced which city specialized in retail. The effects are specified as unity for Brewer and Lewiston (not as specialized in retail) and zero for Bangor and Auburn.[3]

5.1. Preliminary model specification

Preliminary model estimates attempt to identify the impact of the presence and growth of big-box establishments over the period of 2000 to 2009 on the growth of retail establishments. This study formulates a total of nine econometric models, the first of which are three preliminary base models that examine the impact of population, the presence of big-box retailers, and the growth in the number of big-boxes on a community's retail sector. The remaining six models add different variables in order to test model stability, the impacts from the presence and growth in the number of big supermarkets present in a community, and the impacts from big-box retail located in neighboring communities. All models in this study were estimated using the Ordinary Least Squares (OLS) method in the EViews statistical software program. For all models, the null hypothesis of homoskedasticity was rejected at a p-value of less than 0.0001, and the alternative of heteroskedasticity was accepted. The variance-covariance matrix is therefore estimated with the White heteroskedasticity-consistent robust estimator.

In order to evaluate the impacts of regressors on the vibrancy of Maine's retail sector, the change in "all retail" establishments, defined as $\Delta RETAILEST$, is the dependent variable in all nine model specifications. This variable, $\Delta RETAILEST$, is the change in the number of all retail establishments (NAICS category "44--"), in every employment category (1-1,000 employees) over the period of 2000 to 2009. This dependent variable is classified in such a way as to capture the effects of explanatory variables on the retail sector as a whole, not just on narrow employment categories addressed in previous studies.

As indicated in Model 1, in order to control for other factors that might be driving growth or decline of retail businesses in an area, POP was included as an explanatory variable to capture the impact of the initial town population in year 2000 (selected as the base year because it is a Census year) on the change in all retail establishments. In order to control for other factors that might be driving growth or decline of retail in an area, ΔPOP was included as an explanatory variable to capture the impact of a change in town population (2000 to the decennial Census year 2010) on the change in number of retail establishments (the dependent variable). The error term, ε, is heteroskedastic, as indicated above, but otherwise it is assumed to have the standard Gauss-Markovian properties.

Model 1:

$$\Delta RETAILEST_{2000\text{-}2009} = \beta_0 + \beta_1 POP_{2000} + \beta_2 \Delta POP_{2000\text{-}2010} + \varepsilon \quad (1)$$

In Model 2, $BIGBOX$ is an explanatory variable that accounts for the initial count of big-box stores (i.e., general merchandise or building supply establishments with >100 employees) in year 2000. $\Delta BIGBOX$ is an explanatory variable that accounts for the change in the number of big-box stores over the time period 2000 to 2009.

Model 2:

$$\Delta RETAILEST_{2000\text{-}2009} = \beta_0 + \beta_1 POP_{2000} + \beta_2 \Delta POP_{2000\text{-}2010} + \beta_3 BIGBOX_{2000} + \beta_4 \Delta BIGBOX_{2000\text{-}2009} + \varepsilon \quad (2)$$

In Model 3, an interaction term, $BIGBOX^*\Delta BIGBOX$, is also included to determine whether marginal effects change with differing numbers of big-box stores and changes in big-boxes in Maine's diverse communities.

Model 3:

$$\Delta RETAILEST_{2000\text{-}2009} = \beta_0 + \beta_1 POP_{2000} + \beta_2 \Delta POP_{2000\text{-}2010} + \beta_3 BIGBOX_{2000} + \beta_4 \Delta BIGBOX_{2000\text{-}2009} + \beta_5 BIGBOX_{2000} * \Delta BIGBOX_{2000\text{-}2009} + \varepsilon \quad (3)$$

5.2. Revised model specification

After the three "base models" were specified, additional models were formulated and estimated to determine the robustness of the $BIGBOX$ and $\Delta BIGBOX$ variables, to investigate whether the presence of a big supermarket has a statistically significant impact on the overall number of retail establishments, and to estimate impacts from big-boxes located in neighboring communities.

Model 4 contains the variable $BIGSM$, which is the count of big-box supermarkets in the year 2000. An additional 22 communities in the study sample

[3] An additional fixed effect is set equal to unity for the eight observations considered to be individual island communities (i.e., Beals, Cranberry, Deer, Swan's, Isle au Haut, Islesboro, North Haven, and Vinalhaven). Seven are only accessible by ferry, and Beals and Deer have minor road access. These island effects have extremely large p-values and do not impact the results reported in this paper.

hosted a big-box grocery store with greater than 100 employees (such as a Shaw's or Hannaford Brothers) during the period of 2000 to 2009, but hosted no other large retailers. Recognizing that these types of communities had different retail markets than those host communities with other big-box retailers, the *BIGSM* variable was included to attempt to capture any impacts on retailers that might have been missed by not accounting for the presence of large supermarkets in a community independent of any other big-box retail.

Model 4:

$$\Delta RETAILEST_{2000\text{-}2009} = \beta_0 + \beta_1 POP_{2000} + \beta_2 \Delta POP_{2000\text{-}2010} + \beta_3 BIGBOX_{2000} + \beta_4 \Delta BIGBOX_{2000\text{-}2009} + \beta_5 BIGBOX_{2000} * \Delta BIGBOX_{2000\text{-}2009} + \beta_6 BIGSM_{2000} + \varepsilon \quad (4)$$

Model 5 adds an additional explanatory variable, $\Delta BIGSM$, to account for the change in the number of big-box supermarkets from 2000 to 2009 in communities that have big supermarkets, but no other big-box retail.

Model 5:

$$\Delta RETAILEST_{2000\text{-}2009} = \beta_0 + \beta_1 POP_{2000} + \beta_2 \Delta POP_{2000\text{-}2010} + \beta_3 BIGBOX_{2000} + \beta_4 \Delta BIGBOX_{2000\text{-}2009} + \beta_5 BIGBOX_{2000} * \Delta BIGBOX_{2000\text{-}2009} + \beta_6 BIGSM_{2000} + \beta_7 \Delta BIGSM_{2000\text{-}2009} + \varepsilon \quad (5)$$

This research also recognizes that communities in Maine do not operate in isolation. Therefore, it is necessary to consider the impacts of big-box stores in both host and surrounding communities. In Model 6, *BBEL* is an explanatory variable that accounts for the year 2000 count of big-box stores elsewhere in the county in which the subject town is located but not including the town itself. $\Delta BBEL$ is an explanatory variable that accounts for the change in the count of big-box stores elsewhere in the county in which the subject town is located over the period 2000 to 2009.

Model 6:

$$\Delta RETAILEST_{2000\text{-}2009} = \beta_0 + \beta_1 POP_{2000} + \beta_2 \Delta POP_{2000\text{-}2010} + \beta_3 BIGBOX_{2000} + \beta_4 \Delta BIGBOX_{2000\text{-}2009} + \beta_5 BIGBOX_{2000} * \Delta BIGBOX_{2000\text{-}2009} + \beta_6 BBEL_{2000} + \beta_7 \Delta BBEL_{2000\text{-}2009} + \varepsilon \quad (6)$$

While Basker (2005), Sobel and Dean (2008), and Hicks (2009) adopted a zip-code and county-level approach, this study employs zip-codes and Economic Summary Areas (ESAs) and ESA districts for a more precise definition of a retail market. County-level analysis is far noisier, especially in Maine, where counties can be very large and encompass multiple retail service centers. Many municipalities in Maine also consider their closest service center to be one outside of the political boundaries of their county. Economic Summary Areas are defined by Maine Revenue Services as groupings of towns and cities which participate in the same retail market. ESAs have narrower spatial boundaries than counties (there are 43 ESAs in the state, compared to 16 counties) and provide more detailed information on the retail markets in which towns participate. Studies using a county-wide perspective are likely to have missed community-level impacts, since most shopping occurs at the municipal level. By adopting a municipal, ESA, and ESA district-level approach, this study captures the impacts of a big-box store on day-to-day local shopping in a town or ESA and on bigger, less frequent shopping trips to the district-level.

Model 7 estimates the impacts of big-box retailers on the ESA level. The 334 towns analyzed in this study belonged to 40 Economic Summary Areas[4] and 8 ESA districts. *ESAEL* is an explanatory variable included to account for the year 2000 count of big-box retailers in the ESA to which the subject town belongs (not including the big-box stores within that town). $\Delta ESAEL$ is the change in the number of big-box retailers elsewhere in the ESA during the time period 2000-2009.

Model 7:

$$\Delta RETAILEST_{2000\text{-}2009} = \beta_0 + \beta_1 POP_{2000} + \beta_2 \Delta POP_{2000\text{-}2010} + \beta_3 BIGBOX_{2000} + \beta_4 \Delta BIGBOX_{2000\text{-}2009} + \beta_5 BIGBOX_{2000} * \Delta BIGBOX_{2000\text{-}2009} + \beta_6 ESAEL_{2000} + \beta_7 \Delta ESAEL_{2000\text{-}2009} + \varepsilon \quad (7)$$

Model 8 analyzes the effect a change in the number of big-box retailers elsewhere in the ESA district has on all retail establishments. *BBESADIST* is the 2000 count of retailers in the ESA district, but not in the ESA to which the cross-sectional unit belongs. $\Delta BBESADIST$ is the change in the number of big-box retailers in the ESA district over the study period.

Model 8:

$$\Delta RETAILEST_{2000\text{-}2009} = \beta_0 + \beta_1 POP_{2000} + \beta_2 \Delta POP_{2000\text{-}2010} + \beta_3 BIGBOX_{2000} + \beta_4 \Delta BIGBOX_{2000\text{-}2009} + \beta_5 BIGBOX_{2000} * \Delta BIGBOX_{2000\text{-}2009} + \beta_6 BBESADIST_{2000} + \beta_7 \Delta BBESADIST_{2000\text{-}2009} + \varepsilon \quad (8)$$

[4] The Maine State Planning Office and Maine Revenue Services define Bangor Suburban ESA, Lewiston-Auburn Suburban ESA, and Portland Suburban ESA separately from Bangor ESA, Lewiston-Auburn ESA, and Portland ESA. For the purposes of this study, the urban center and suburban ESAs were combined into one market area ESA each.

Model 9 includes both the ESA and ESA district variables (i.e., *ESAEL* and *BBESADIST*) to determine if results were affected by running the variables simultaneously.

Model 9:

$$\Delta RETAILEST_{2000\text{-}2009} = \beta_0 + \beta_1 POP_{2000} + \beta_2 \Delta POP_{2000\text{-}2010} + \beta_3 BIGBOX_{2000} + \beta_4 \Delta BIGBOX_{2000\text{-}2009} + \beta_5 BIGBOX_{2000} * \Delta BIGBOX_{2000\text{-}2009} + \beta_6 ESAEL_{2000} + \beta_7 \Delta ESAEL_{2000\text{-}2009} + \beta_8 BBESADIST_{2000} + \beta_9 \Delta BBESADIST_{2000\text{-}2009} + \varepsilon \quad (9)$$

6. Results

The OLS-White estimation results of all nine models are reported in Table 3, where asterisks denote statistical significance at alpha level 0.10 (*), 0.05 (**), and 0.01 (***). A tenth model was also estimated that added *BBEL* and *ΔBBEL* to Model 9; however, a test for the joint significance of all of the *BBEL*, *ESAEL*, and *BBESADIST* variables yielded a p-value of 0.77. In addition, in Models 6-9 a test for the joint significance of *BIGSM* and *ΔBIGSM* yielded p-values in the range of 0.38 to 0.44. Consequently, we conclude that there are no statistically significant local effects of large supermarkets or non-local spatial spillover effects of non-supermarket big-box stores in our town data. Estimates of the "twin city" fixed effect in each model are highly significant (p-values less than 0.0000) and carry the correct negative sign. Model 3 is our preferred model.

Table 3. Regression results: effect of big-box stores on the retail sector in Maine.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
C	-0.7832*** (0.00001)	-0.6422** (0.2944)	-0.7321*** (0.2883)	-0.7871*** (0.2653)	-0.7572* (0.2884)	-0.5954* (0.3523)	-0.7033** (0.3055)	-0.7765 (0.4543)	-0.6873 (0.5239)
POP_{2000}	-0.00014 (0.0001)	-0.0003*** (0.0001)	-0.0003*** (0.0001)	-0.0002** (0.0001)	-0.0003*** (0.0001)	-0.0003*** (0.0001)	-0.0003*** (0.0001)	-0.0003*** (0.0001)	-0.0003*** (0.0001)
$\Delta POP_{2000-2010}$	0.0035*** (0.0013)	0.0034*** (0.0012)	0.0040*** (0.0012)	0.0040*** (0.0012)	0.0040*** (0.0012)	0.0041*** (0.0013)	0.0040*** (0.0012)	0.0039*** (0.0012)	0.0039*** (0.0012)
$BIGBOX_{2000}$		2.1945* (1.2707)	2.2883*** (0.8684)	3.1453*** (1.0162)	3.1738*** (1.0108)	2.2238*** (0.8929)	2.3007*** (0.8661)	2.3145*** (0.8806)	2.3149*** (0.8829)
$\Delta BIGBOX_{2000-2009}$		4.6314*** (1.8621)	7.8196*** (1.8952)	8.3228*** (1.9618)	8.2749*** (1.9676)	7.7944*** (1.8715)	7.7156*** (1.8930)	7.8466*** (1.8938)	7.7405*** (1.8992)
$BIGBOX_{2000} * \Delta BIGBOX_{2000-2009}$			-3.7886** (1.5985)	-3.6633** (1.5871)	-3.6330** (1.5758)	-3.7773** (1.6021)	-3.7503*** (1.5856)	-3.7797** (1.6035)	-3.7463** (1.5911)
$BIGSM_{2000}$				-1.6594 (1.3513)	-1.4250 (1.4473)				
$\Delta BIGSM_{2000-2009}$					0.9788 (2.0589)				
$BBEL_{2000}$						-0.0348 (0.1204)			
$\Delta BBEL_{2000-2009}$						-0.0755 (0.1930)			
$ESAEL_{2000}$							0.0868 (0.1381)		0.0764 (0.1479)
$\Delta ESAEL_{2000-2009}$							-0.4105 (0.2980)		-0.3950 (0.3019)
$BBESADIST_{2000}$								-0.0362 (0.0989)	-0.0436 (0.1044)
$\Delta BBESADIST_{2000-09}$								0.1618 (0.1567)	0.1320 (0.1658)
R^2	0.1922	0.3050	0.3538	0.3615	0.3629	0.3550	0.3584	0.3559	0.3600

Note: Asterisks denote two-sided p-value significant at α=0.10*, 0.05**, 0.01***. White heteroskedasticity-consistent robust standard errors reported in parentheses. Twin city fixed effects are specified in each model and are significant below the 0.0000 level and always correctly signed.

All of the models estimated suggest that, on average, communities with higher initial populations in the year 2000 saw a slight decrease in the growth of their retail sector as a whole.[5] Results also indicated that population growth over the study period had a strongly positive and statistically significant impact on the change in the number of all retail establishments. With the addition of new explanatory variables, these base results remained relatively consistent in magnitude and significance.

The *BIGBOX* and $\Delta BIGBOX$ variables were consistently and repeatedly estimated to have a positive, statistically significant impact on the change in the number of all retail establishments across all of our models. These results are consistent with the findings of Hicks and Wilburn (2001), who found that the entrance of Walmart resulted in a modest increase in the number of retail establishments in West Virginia. They are also consistent with the findings of Sobel and Dean (2008), who examined the impact of Walmart on all businesses, not just retail businesses, and found no evidence that Walmart had an adverse impact on the overall size of the small business sector across the U.S.

In all nine models, the sign and relative magnitude of the coefficients associated with the *BIGBOX* and $\Delta BIGBOX$ variables remained relatively unchanged despite the addition of new regressors. The interaction variable $BIGBOX*\Delta BIGBOX$ had a strong, statistically significant negative impact on the growth of retail establishments.

Using the estimated coefficients of Model 3, the marginal effect of a change in the number of big-box retailers on the growth of all retail establishments was estimated (below) using the estimates from our preferred Model 3.

$$\frac{\partial \Delta RETAILEST}{\partial \Delta BIGBOX} = 7.8196 - 3.7886 BIGBOX \qquad (10)$$

These results indicate that the marginal effect of an additional big-box store diminishes as the number of existing incumbent stores increases. This would imply that a small community without any initial big-box retail, such as Mexico, Maine (2000 population of 2,959), would experience a large, positive effect of eight (8) new retailers from the addition of one (1) new big-box retailer. However, a city like Bangor (with population 31,473 and 6 big-box stores in year 2000) would experience a decrease of fifteen (15) new retailers as the result of the addition of one more big-box store. As is evident in Table 4, there exists a point (though not necessarily two stores, given that this is an average, state-wide example) where the addition of more and more big-box retailers results in a negative "crowding out" effect on retailing in the area.

Table 4. An example of the estimated marginal effect of adding one additional big-box retailer on the change in total establishments in a Maine community.

Count of incumbent big-box retailers in 2000	Estimated marginal effect
0	7.8
1	4.0
2	0.2
3	-3.6
4	-7.4
5	-11.2
6	-15.0
7	-18.8

As was previously mentioned, Models 4 through 9 included additional variables to test the robustness and sensitivity of the base models (1 through 3.) Variables were added to the base model specifications in order to test whether big-box supermarkets had a different effect on local retail than general merchandise or building supply big-boxes. Neither the variable *BIGSM*, which is the initial count of big-box supermarkets in a municipality (*BIGSM*), nor the change in big supermarkets ($\Delta BIGSM$), was found to have a strong negative statistically significant effect on the growth of all retailers. However, the change in the count of big supermarkets over the study period was found not to have a statistically significant effect.

Variables were also included as an attempt to capture the impacts of big-box retail growth on adjacent communities. While Paruchuri et al. (2009) found negative impacts on new business entry in adjacent zip-codes from Walmart stores, this study's approaches to estimating effects on adjacent communities did not find any statistically significant impacts

[5] Attempts were made in this analysis to estimate impacts on small businesses (i.e., 1-4, 5-9, and 1-99 employees) but it proved difficult to correctly interpret findings when small retailers could either be "falling out" of their employment category (closing) or "growing up" in classification. Therefore, the "all retail" models provided the most robust estimates of the net effects occurring in Maine's retail sector.

from the presence or growth of big-box retail. County-level estimates did not indicate that the presence or growth of big-box retail elsewhere in a county had a statistically significant effect on retail growth. Likewise, Economic Summary Area (ESA) and ESA district-level estimation again found there to be no statistically significant effects on "all retail" growth.

6.1. Sectoral effects

In addition to estimating models with the change in total retail establishments as the dependent variable, we also estimated models with changes in hardware stores and restaurants as the dependent variable.[6] We selected these two sectors to analyze because they have been cited in the literature as businesses likely impacted by big-box stores, especially by Walmart stores (Stone et al., 1992; Artz and McConnon, 2001; Hicks, 2007; Barnes et al., 1996).

Table 5 presents selected estimates of these sectoral models. The results indicate that for hardware retail establishments there is no statistical evidence that big-box stores had any impact — either positive or negative. This finding is consistent with Hicks (2007), who did not find any evidence that Walmart had any impact on the size of the building material sector in Iowa towns. However, these results differ from Stone (1995) and Artz and McConnon (2001), who found that Walmart stores negatively impacted the hardware store sectors in Iowa and Maine, respectively. The difference in findings is most likely due to methodological differences and time periods studied.

Table 5. Regression results: effect of big-box stores on retail activity in hardware and restaurant sectors in Maine.

Sector	Hardware			Restaurant		
Explanatory Variables	**Model 1H**	**Model 2H**	**Model 3H**	**Model 1R**	**Model 2R**	**Model 3R**
C	-0.1251*** (0.0426)	-0.1278*** (0.0386)	-0.1227*** (0.0398)	-0.2823** (0.1392)	-0.2740** (0.1193)	-0.2535** (0.1193)
POP_{2000}	0.000022 (0.000015)	0.000026* (0.000015)	0.000027* (0.000015)	0.000195*** (0.000037)	0.00017*** (0.000037)	0.00017*** (0.000036)
$\Delta POP_{2000-2010}$	0.0001 (0.00016)	0.0001 (0.00015)	0.000072 (0.000158)	-0.000888 (0.000614)	-0.000913 (0.000605)	-0.00104* (0.00062)
$BIGBOX_{2000}$		-0.0523 (0.1880)	-0.0576 (0.1877)		0.2307 (0.4215)	0.2094 (0.3782)
$\Delta BIGBOX_{2000-2009}$		-0.1811 (0.3081)	-0.3611 (0.3114)		1.2094* (0.6895)	0.4827 (0.8865)
$BIGBOX_{2000} * \Delta BIGBOX_{2000-2009}$			0.2140 (0.1622)			0.8635 (0.6514)
R^2	0.0700	0.0785	0.0885	0.2134	0.2349	0.2452

Note: Asterisks denote two-sided p-value significant at α=0.10*, 0.05**, and 0.01***. Dependent variable is change in hardware (H) and restaurant (R) retail establishments, respectively. White heteroskedasticity-consistent robust standard errors reported in parentheses. Twin city fixed effects are specified in each model and always correctly signed and are statistically significant in Model 1R (0.05 level) and Model 3R (0.10 level).

There is no evidence that big-box stores adversely affect restaurant establishments, and in Model 2R (see Table 5) there is some evidence for a positive impact, suggesting that restaurant establishments and big-box stores may be complements, as Hicks (2007) and Stone et al. (1992) also found. These results are not sensitive to the specification of other explanatory variables reported in Table 5, the results of which are not presented to reduce unnecessary details.

[6] Dependent variable represented the change in the count of all hardware establishments (NAICS category 44130) or all restaurant establishments (NAICS category 722110) in town from 2000 to 2009.

6.2. Potential endogeneity

Concern for the potential endogeneity of the big-box explanatory variable, *change in big-box stores*, led us to develop instrumental variables estimates.[7] Four instruments were employed: two "Bartik" instruments, distance of a town from Interstate 95, and U.S. highway access for a town (yes = 1, no = 0). The "Bartik" instruments were computed by summing the products of the share of town workforces in a set of industries and the corresponding national employment growth rates for these industries (Bartik, 1991). We used data from the American Community Survey to estimate the town workforce shares, and since these data distinguish males and females, we computed the "Bartik" instruments for females and for males. With the four total "outside" instruments, we satisfy the order and rank conditions for the use of IV estimation. The remaining instruments are "inside" ones: constant term, population, change in population, and big-box.

As is well known, the use of IV estimation requires a strong storyline for how the instruments work in addition to the instruments passing empirical relevance and exogeneity tests. The "Bartik" instruments assume that the share of national employment growth that is expected for a town is essentially exogenously determined by national employment growth trends. The distance in meters of a town from access to Interstate 95 and the presence of access to U.S. highways (yes = 1, no = 0) have a storyline that is related to preexisting access of towns to major roads and the importance of major access roads to the spatial business structure of big-boxes such as Walmart. Clearly, there is no reverse causation running from Walmart's location decision-making to I-95 and major U.S. highway access given the timing of the development of the latter relative to the former. However, the access variables may not just influence the dependent variables through their influence on big-box store locations. Therefore, we found all four instrumental variables to have some, although not perfect, value as instruments.

Relevance tests were conducted using the F-statistic for the overall fit of the first-stage IV estimates. The rule stated by Stock and Watson (2003, p. 350 and Appendix pp. 104 and 370-372) is that the first-stage F-statistic should have a value of at least 10. Values below 10 indicate weak instruments which undermine the value of IV estimation. When we regress the change in big-box stores (2000-2009) on the four "outside" instruments discussed above and the "inside instruments" the first-stage F-statistic value is substantially less than 10 in all cases. Using all of the inside and outside instruments and a constant term, the overall F = 2.3. Using just the constant term and the outside instruments, the overall F = 2.29. Clearly, by the Stock and Watson rule, IV estimation is at best uninformative and at worst misleading, given our data and models. Attempts to actually estimate the models with IV generated weak results, extremely unreliable parameter estimates, and in some cases more variation than exists in the data. Of course, considering the exogeneity of the instruments given the results for their relevance is unproductive.

7. Summary and conclusions

The robust estimates of big-box retail's impacts on all retail establishments in 334 Maine communities indicate that both the initial presence and growth of big-box retail can have a positive net effect on Maine's retail sector. The results also consistently indicate that population growth had a strong influence on the size of a community's retail sector, and on average larger communities experienced slower rates of retail growth as a result of population change than smaller municipalities. Unlike most other studies that have relied on aggregated data beyond the town-level, our results were derived from town-level data, where retail sector transactions actually take place.

While the primary focus of this study was on assessing big-box retail's impact on the overall retail sector, we also investigated big-box retail's impact on the restaurant and hardware store sectors. This study found no evidence that big-box stores had any impact on the net change in hardware stores during the study period. However, we did find some evidence of a positive impact between the growth of big-box stores and the net change in restaurants across Maine communities.

The structure of our model and the robustness of our results strongly suggest that endogeneity is likely not a problem, although formal tests with our four instruments is not possible. While appropriate caution must still be exercised given the potential for endogeneity in the change in big-box stores (2000-2009), we have taken care to structure our models to mitigate endogeneity flowing from the change in the big-box

[7] The *level* of big-box stores in the year 2000, versus its change from 2000 to 2009, is considered predetermined in our modeling. Given the timing this seems reasonable, and this treatment permits a relatively strong test of instrument relevance to be conducted, as discussed below.

stores variable. Our specification of the initial number of big-boxes along with initial population and population growth serves to capture underlying town growth trends that big-box location may endogenously respond to (Basker, 2005). Moreover, if our estimates were seriously biased, then there should be substantial differences between the estimates on population and change in population in Model 1 (the model without the big-box variables specified) and other models with the big-box variables specified. This would be the case since big-box planning/entry depends on population and population growth expectations (forecasts) which are themselves substantially correlated with observed population and trends, *ex post*, if big-box planning is on average correct.

Given the results of this study, a policy-neutral approach to big-box stores appears to be the appropriate practice to big-box development regulation, rather than a "one size fits all" approach. The objectives of every municipality vary, and whether or not to approve big-box retail development should be given careful consideration based on the hierarchy of needs of the community. The estimates provided in this study indicate that big-box retailers provide a positive net effect on the growth of the retail sector in Maine.

The results of this study indicate that additional factors should be taken into account when considering whether big-box retailers would benefit a community. It is important to know whether a big-box store has previously existed in the community and how many big-box retailers already exist, because the impacts on retail from a new big-box store vary depending on the number of initial incumbents. The estimates in this study indicate that communities without a big-box store could gain from the introduction, but communities with a high number of incumbents could actually see reductions in the growth of all retail in that community. Additional considerations (which were beyond the scope of this paper) might be the potential displacement of jobs, how the big-box store will affect municipal tax revenues, and whether any negative impacts resulting from the big-box development could be mitigated at low cost.

Economic impacts cannot be the sole criteria for evaluating a potential big-box development, nor can strictly environmental or aesthetic impacts. Therefore, only a thorough and objective assessment of big-box store economic, livability, and environmental quality impacts based on reliable, municipal-level data can help decision-makers determine if big-box retail is "good" or "bad" for a specific community.

Acknowledgements

We thank anonymous referees for suggesting the "Bartik" instruments. We thank our colleague, Professor Kate Beard-Tisdale, Director of the National Center for Geographic Information and Analysis and Professor of Spatial Informatics at the University of Maine, for computing the "distance to I-95" variable for each town using GIS. The usual disclaimer applies.

References

Artz, G., and J.C. McConnon, Jr. 2001. The impact of Wal-Mart on host towns and surrounding communities in Maine. Paper presented at the Northeast Agricultural and Resource Economics Association Conference, Bar Harbor, Maine (June).

Artz, G., and K. Stone. 2001. The impact of big-box building materials stores on host towns and surrounding counties in a Midwestern state. Paper presented at American Agriculture Economics Association Conference, Chicago, Illinois (August).

Barnes, N.G., A. Connell, L. Hermenegildo, and L. Mattson. 1996. Regional differences in the economic impact of Wal-Mart. *Business Horizons* 39(4): 21-26.

Bartik, T. J. 1991. *Who Benefits from State and Local Economic Development Policies?* Kalamazoo, MI: W.E. Upjohn Institute for Employment Research Press.

Basker, E. 2005. Job creation or destruction? Labor market effects of Wal-Mart expansion. *The Review of Economics and Statistics* 87(1): 174-183.

Basker, E. 2005. Selling a cheaper mousetrap: wal-mart's effect on retail prices. *Journal of Urban Economics* 58(2): 203-229.

Bell, T. 2011. "House votes to repeal Informed Growth Act." *The Portland Press Herald*, May 3. www.pressherald.com/2011/05/03/maine-house-repeal-informed-growth-act-big-box/.

Boarnet, M., R. Crane, D. Chatman, and M. Manville. 2005. Emerging planning challenges in retail. *Journal of the American Planning Association* 71(4): 433-449.

Christaller, W. 1966. *Central Places in Southern Germany. Translated by C.W. Baskin.* Englewood Cliffs, NJ: Prentice Hall.

Deller, S.C., and J. C. McConnon. 2009. Microenterprises and economic growth: A panel study of the US States: 1977-1997. *Applied Economics Letters* 16(13): 1307-1312.

Eaton, C. B., and R.G. Lipsey. 1982. An economic theory of central places. *The Economic Journal* 92(365): 56-72.

Freedman, E.A. 2012. Econometric analyses of two determinants of regional retail establishment growth and sales activity – cruise tourism and big-box stores. School of Economics M.S. Thesis Paper No. 1763, University of Maine.

Goetz, S.J., M. Partridge, S.C. Deller, and D. Fleming. 2010. Evaluating U.S. rural entrepreneurship policy. *Journal of Regional Analysis and Policy* 40: 20-33.

Goetz, S.J., and H. Swaminathan. 2006. Wal-Mart and county-wide poverty. *Social Science Quarterly* 87(2): 211-26.

Hicks, M. 2007. *The Local Economic Impact of Wal-Mart*. New York, NY: Cambria Press.

Hicks, M. 2008. Estimating Wal-mart's impacts in Maryland: A test of identification strategies and endogeneity tests. *Eastern Economic Journal* 34(1): 56-73.

Hicks, M. 2009. Wal-Mart and small business: Boon or bane? *The Review of Regional Studies* 39(1): 73-83.

Hicks, M., and K. Wilburn. 2001. The regional impact of Wal-Mart entrance: A panel study of the retail trade sector in West Virginia. *Review of Regional Studies* 31(3): 305-313.

Irwin, E., and P. Clark. 2007. Mitigating impacts of big-box retail on local communities. *Journal of Regional Analysis and Policy* 37(1): 53-55.

Ketchum, B.A. and Hughes, J.W. 1997. Walmart and Maine: The effect on employment and wages. *Maine Business Indicators*, 42(2): 6-8.

Lee, B.D., L. Klein, and G. Camus. 1999. Induced traffic and induced demand. *Transportation Research Record* 1659: 68-75.

Maine Revenue Services. 2011. *Maine Taxable Retail Sales 2000-2010.* www.maine.gov/spo/economics/retail/.

Maine State Planning Office. 2009. *Definitions of Economic Statistical Areas*. www.maine.gov/spo/economics/retail/defs_ESA.pdf.

Pan, P. G. 2003. *Legislative Reference Bureau Report No. 4: Big-Box Retailing.* Honolulu, Hawaii. www.hawaii.gov/lrb.

Paruchuri, S., J. Baum, & D. Potere. 2009. The Wal-Mart effect: Wave of destruction or creative destruction? *Economic Geography* 85(2): 209-236.

Perry, T., and J. Noonan. 2001. *Big-Box Retail Development. Managing Maryland's Growth: Models and Guidelines.* Maryland Department of Planning. Baltimore, MD.

Preston, R.E. 1971. The structure of central place systems. *Economic Geography* 47(2): 136-155.

Renkow, M. 2005. Wal-Mart and the local economy. North Carolina Cooperative Extension Service Fact Sheet, North Carolina State University.

Sheppard, L., and M. White. 2005. Flatspace: Exurbanism and infrastructural landscape. *Lateral Office* 9:126–37. Accessed September 12, 2015. www.lateraloffice.com/#30-60-90-FLATSPACE-2005.

Sobel, R., and A. Dean. 2008. Has Wal-Mart buried mom and pop? The impact of Wal-Mart on self-employment and small establishments in the United States. *Economic Inquiry* 46(4): 676-695.

Stock, J. H., and M.W. Watson. 2003. *Introduction to Econometrics*. Third Edition. Boston, MA: Addison-Wesley.

Stone, K. S., Deller, S., and J. C. McConnon. 1992. The new retail environment in Maine. Department of Resource Economics and Policy Staff Paper 3(1): 1-4. University of Maine.

Stone, K. 1995. The impact of Wal-Mart stores on Iowa communities: 1983-1993. *Economic Development Review* 13(2): 60-69.

U.S. Census Bureau. 2011. *American Community Survey, Civilian Employed Population 16 Years and Over, 2005-2009.* Washington, DC.

U.S. Department of Commerce. 2011. *Zip Code County Business Patterns, 2000-2009.* Washington, DC.

Appendix.

Table A1. Description and source of all variables appearing in the models.

Variable Name	Description and Source
$\Delta RETAILEST_{2000-2009}$	Dependent variable composed of the change in the count of all retail establishments (NAICS category 44--) in town from the year 2000 to year 2009. Source: US Department of Commerce, ZIP Code County Business Patterns.
C	Constant term
POP_{2000}	The population of town in the year 2000. Source: 2000 US Census Bureau.
$\Delta POP_{2000-2010}$	The change in population of town over the time period of 2000 to 2010. Source: 2000 and 2010 US Census Bureau.
$BIGBOX_{2000}$	The count of big-box retailers (establishments in NAICS categories 444110, 452111, 452112, and 452910 that fall into the employment categories 100-249, 250-499, 500-999, or 1,000 or more employees) in town in the year 2000. Source: US Department of Commerce, ZIP Code County Business Patterns.
$\Delta BIGBOX_{2000-2009}$	The change in the count of big-box retailers (establishments in NAICS categories 444110, 452111, 452112, and 452910 that fall into the employment categories 100-249, 250-499, 500-999, or 1,000 or more employees) in town from the year 2000 to year 2009. Source: US Department of Commerce, ZIP Code County Business Patterns.
$BIGBOX_{2000} * \Delta BIGBOX_{2000-2009}$	The count of big-box retailers (establishments in NAICS categories 444110, 452111, 452112, and 452910 that fall into the employment categories 100-249, 250-499, 500-999, or 1,000 or more employees) in town in the year 2000 interacted with the change in the count of big-box retailers over the time period 2000 to 2009. Source: US Department of Commerce, ZIP Code County Business Patterns.
$BIGSM_{2000}$	The count of big-box supermarkets (establishments in NAICS category 445110 that fell into the employment categories 100-249, 250-499, 500-999, or 1,000 or more employees) in town in the year 2000. Source: US Department of Commerce, ZIP Code County Business Patterns.
$\Delta BIGSM_{2000-2009}$	The change in the count of big-box supermarkets (establishments in NAICS category 445110 that fell into the employment categories 100-249, 250-499, 500-999, or 1,000 or more employees) in town from the year 2000 to year 2009. Source: US Department of Commerce, ZIP Code County Business Patterns.

Table A1. Description and source of all variables appearing in the models (continued).

Variable Name	Description and Source
$BBEL_{2000}$	The count of big-box retailers (establishments in NAICS categories 444110, 452111, 452112, and 452910 that fall into the employment categories 100-249, 250-499, 500-999, or 1,000 or more employees) elsewhere in the county in which town belongs in the year 2000. Source: US Department of Commerce, ZIP Code County Business Patterns.
$\Delta BBEL_{2000-2009}$	The change in the count of big-box retailers (establishments in NAICS categories 444110, 452111, 452112, and 452910 that fall into the employment categories 100-249, 250-499, 500-999, or 1,000 or more employees) elsewhere in the county in which town belongs from 2000 to 2009. Source: US Department of Commerce, ZIP Code County Business Patterns.
$ESAEL_{2000}$	The count of big-box retailers (establishments in NAICS categories 444110, 452111, 452112, and 452910 that fall into the employment categories 100-249, 250-499, 500-999, or 1,000 or more employees) elsewhere in the ESA in which town belongs in the year 2000. Source: US Department of Commerce, ZIP Code County Business Patterns; Maine State Planning Office (SPO) "Definitions of Economic Summary Areas (ESA) and Districts"
$\Delta ESAEL_{2000-2009}$	The change in the count of big-box retailers (establishments in NAICS categories 444110, 452111, 452112, and 452910 that fall into the employment categories 100-249, 250-499, 500-999, or 1,000 or more employees) elsewhere in the ESA in which town belongs in the year 2000. Source: US Department of Commerce, ZIP Code County Business Patterns; Maine SPO "Definitions of Economic Summary Areas (ESA) and Districts"
$BBESADIST_{2000}$	The count of big-box retailers (establishments in NAICS categories 444110, 452111, 452112, and 452910 that fall into the employment categories 100-249, 250-499, 500-999, or 1,000 or more employees) elsewhere in the ESA district in which town belongs in the year 2000. Source: US Department of Commerce, ZIP Code County Business Patterns; Maine SPO "Definitions of Economic Summary Areas (ESA) and Districts"
$\Delta BBESADIST_{2000-2009}$	The change in the count of big-box retailers (establishments in NAICS categories 444110, 452111, 452112, and 452910 that fall into the employment categories 100-249, 250-499, 500-999, or 1,000 or more employees) elsewhere in the ESA district in which town belongs from year 2000 to 2009. Source: US Department of Commerce, ZIP Code County Business Patterns; Maine SPO "Definitions of Economic Summary Areas (ESA) and Districts"