Spatial Analysis and Implications of Cross-County Food and Retail Sectors in Virginia

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Selected Paper prepared for presentation at the Southern Agricultural Economics Association's 2015 Annual Meeting, Atlanta, Georgia, January 31-February 3, 2015

Background

In the past decade, retail trade underwent a tremendous transformation leading to retail market concentration and a shift from small retail stores to big box retailers and, to online shopping. The retail spending patterns were greatly influenced by the change in consumers' perspectives for a one-stop shopping experience at big box retailers. The ease and convenience of internet shopping led to a bigger leap, and a second paradigm shift in retail sales. The next frontier in retail sales is a shift away from internet shopping on the computer to a dynamic shopping experience on mobile phones and tablets, based on interests, preferences and geographical location of the consumer. The challenge for retailers is to increase their market shares by targeting customers on these new and emerging avenues. This study focuses on understanding and explaining consumer trends and the underlying causes of the transformation in the retail sector across 134 counties and cities in Virginia, a state with a $383 billion economy comparable in size to Saudi Arabia. The study examines retail trade and the underlying spatial patterns in Virginia over the past twenty years and evaluate the roles of critical factors in retail trade transformation across the state. A good understanding of the trade flow is crucial to policy makers in the counties and cities and, to economic planners and potential investors, within and outside the state.

Model

A two-step approach was used in the data analysis. First, retail concentration in Virginia was analyzed by calculating retail pull factors, market share, trade area capture and growth in the retail sector over the last decade. Based on the previous analysis, commuting patterns of retail

customers across the state were calculated and presented. Second, a spatial regression model is used to examine the strength of retail sector in these counties and cities and in Virginia as a whole.

In order to assess the performance of the retail trade sector in a county relative to the state of Virginia, retail trade pull factors were calculated. Pull factors estimate the number of customers and retail sales that a county attracts from neighboring counties. Retail pull factors were calculated based on:

$$Pull\ factor = \left(\left(\frac{County\ Retail\ sales}{County\ Adjusted\ Population} \right) / \left(\frac{State\ Retail\ Sales}{State\ Adjusted\ Population} \right) \right) \quad (1)$$

The trade area capture was calculated as:

$$Trade\ area\ capture = (Pull\ factor * Adjusted\ Population) \quad (2)$$

Market share is the percentage of retail trade area captured by a county with respect to the state. In other words, market share is the percent of total customer base in Virginia captured by the county's retail trade. This was calculated as:

$$Market\ share = \frac{County\ trade\ area\ capture}{State\ trade\ area\ capture} = \frac{County\ adjusted\ population * Pull\ factor}{State\ adjusted\ population * Pull\ factor} \quad (3)$$

A retail pull factor greater than 1 indicates that retail customers are spending more than the State average or a gain in retail customers from surrounding counties. A retail pull factor of 1 indicates that retail customers are spending the same as the State average and neither gaining nor losing retail customers. A retail pull factor less than 1 indicates that retail customers are spending less than the State average and are losing customers to surrounding counties.

The buying power index is a measure of the capability of the retail customers living in that county to buy retail goods. The higher the index, the greater the ability to buy retail goods and

support retail activity in the region. The buying power index is calculated by the following equation:

$$BPI = \frac{(2*Population\%)+(3*Retail\ Sales\%)+(5*Per\ capita\ income\%)}{10} \quad (4)$$

where *Population %* is the county population as a percentage of the state's population. *Retail Sales %* is the retail sales in the county as a percentage of the state's total retail sales, while *Per capita income %* represents the per capita income in the county as a percentage of the Virginia State's per capita income.

Results and discussion of findings

Results show that forty-three (43) counties in the State had a pull factor greater than 1, two (2) had exactly equal to 1 and eighty-nine (89) counties exhibited less than 1 pull factor.

Figure 1 shows the estimated retail pull factors of counties and cities in Virginia. Norton (2.47), Fairfax (2.11) and Colonial Heights (2.08) were the top three counties gaining retail customers. The estimates indicate that residents in these counties were spending more than twice as much on retail goods and services than the state average. Bedford (1.00) and James City (1.00) neither gained nor lost any retail customers or spent the same amount on retail goods and services as the State average. Redford (0.46), King and Queen (0.53) and Westmoreland (0.56) were the bottom three counties losing retail customers or the residents were spending less than the State average on retail goods and services.

Figure 1. Retail Trade Pull Factors

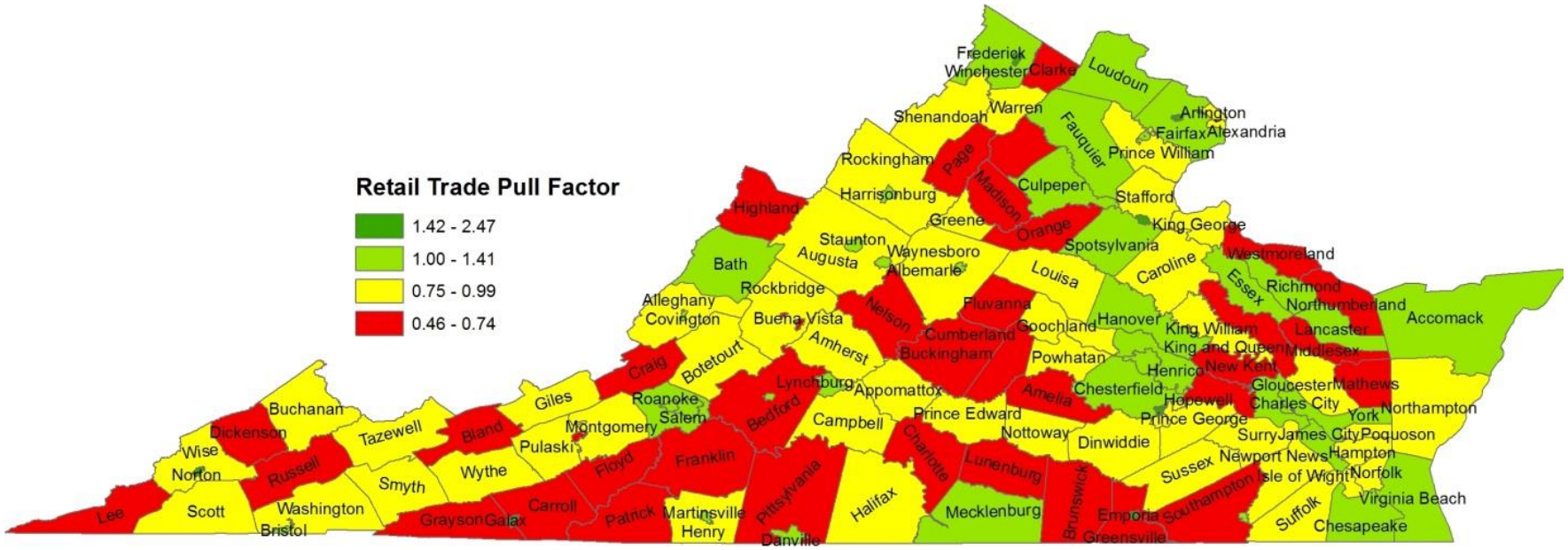


Figure 2. Retail Commuter's Surplus or Leakage

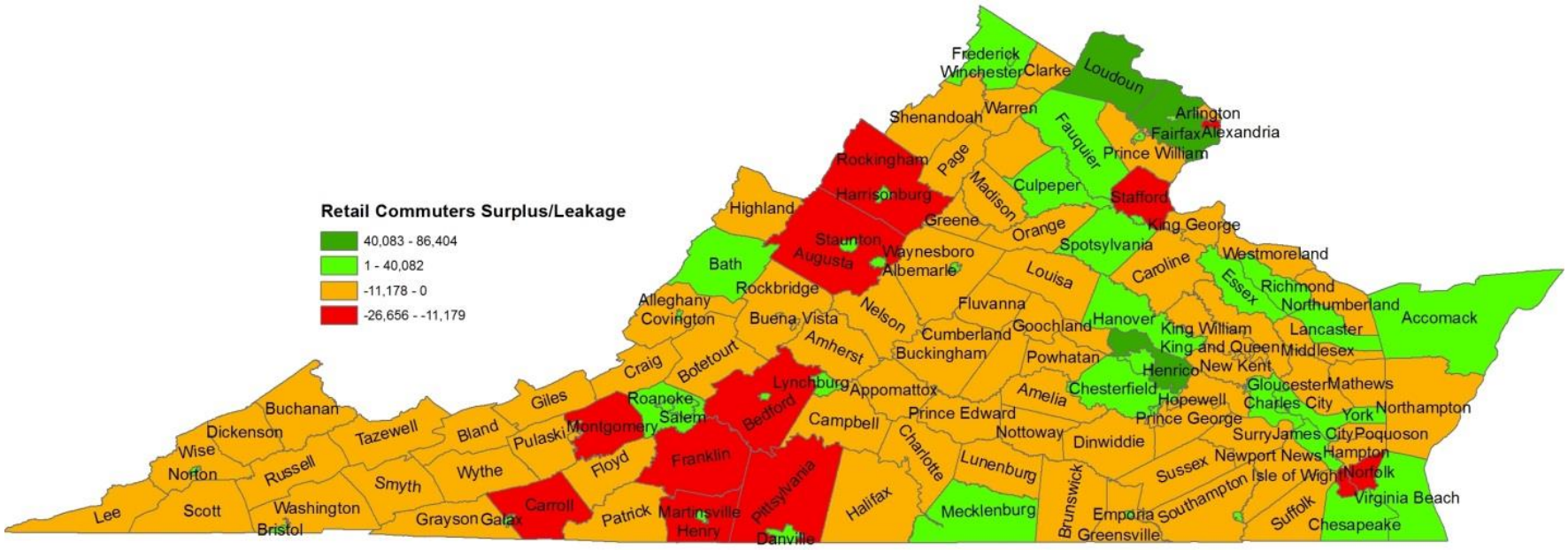


Figure 2 illustrates the net retail commuters that are either gained or lost by a county. The retail commuters are calculated by deducting the trade area capture from the adjusted population. If the number is positive, it is a surplus and if it is a negative number, it is a leakage from the County. It is assumed that all the retail customers shop for goods and services in the State of Virginia and there is no leakage to any surrounding states. Based on the analysis, the major gains of retail customers are in Loudon (86.404), Henrico (69,423) and Fairfax (65,526), while the most leakage of retail customer are from Norfolk (26,656), Pittsylvania (24,603) and Bedford (23,485).

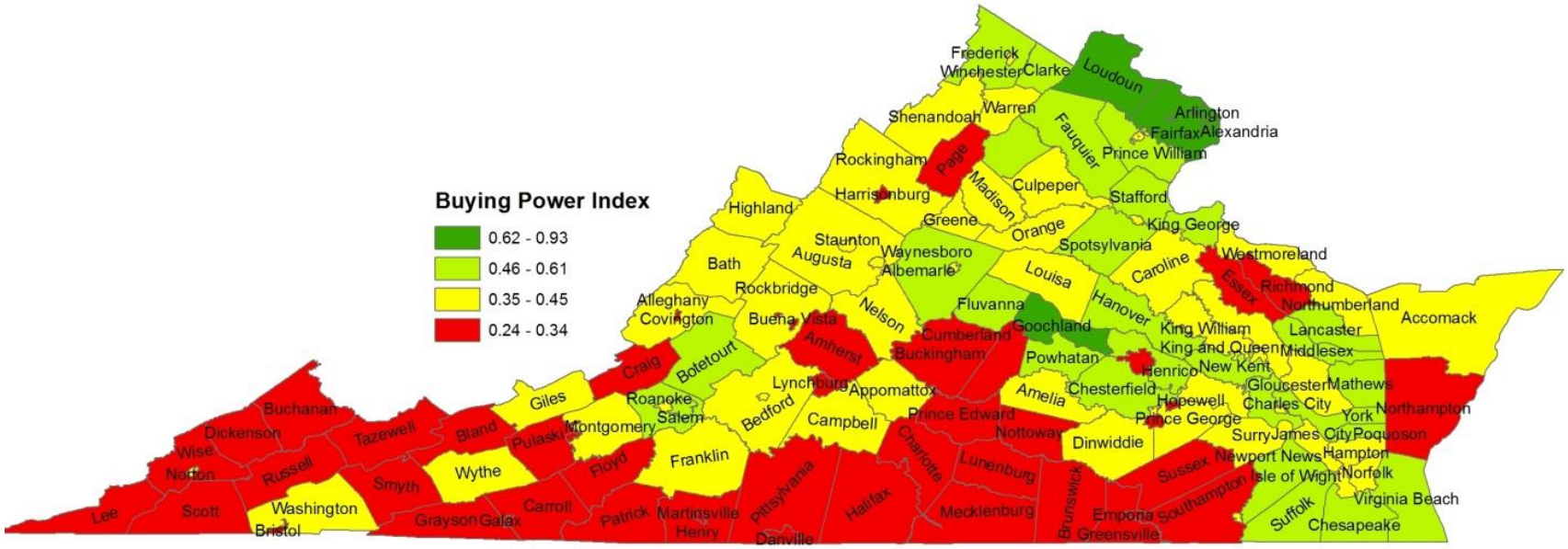
Figure 3 below illustrates the buying power index of the retail customers in the State. The buying power index is a measure of the capability of the retail customers living in that county to buy retail goods. The higher the index, the greater the ability to buy retail goods and support retail activity in the region.

The buying power index is calculated by the following equation:

Where Population % is the percentage of county population to that of the State of Virginia
Retail Sales % is the percentage of retail sales in the county to that of the State of Virginia
Per capita income % is the percentage of per capita income in the county to that of the State of Virginia

Arlington (0.93), Falls Church (0.87) and Alexandria (0.83) have the highest buying power, while Radford (0.24), Lexington (0.24) and Greensville (0.25) have the lowest buying power among all the counties in Virginia.

Figure 3. Buying Power Index



Market Share Analysis

The market share analysis compares retail activity in the region to the total retail activity of the State of Virginia. Since 2000, while 43 counties and cities gained market share, 14 counties and cities neither gained nor lost their market share and 78 counties lost their market share. Between 2000 and 2012, Northern Virginia (2.45%) and Greater Fredericksburg (0.94%) region gained the most market share, while Hampton Road (-1.47%), Southern Virginia (-0.51%) and Virginia's e-region (-0.40%) lost the most market share. The three most important regions for retail activity in the State are Northern Virginia, Hampton Roads and Greater Richmond.

Northern Virginia region has an average market share of 30.78% in the State. Fairfax, Loudoun and Prince William counties have played a pivotal role in attracting retail customers to this region. Since 2000, while Fairfax County's market share has declined (-0.93%), that of Loudoun (2.38%) and Prince William (1.16%) have gained in market share in the region.

Hampton Roads region has an average market share of 21.45% in the State. Virginia Beach, Chesapeake, and Newport News have played a pivotal role in attracting retail customers to the region. Since 2000, while Suffolk (0.21%) and York (0.18%) gained the most market share, Norfolk (-0.71%) and Hampton (-0.39%) lost the most market share in the region.

Greater Richmond region has an average market share of 9.57% in the State. Henrico, Richmond and Hanover have played a pivotal role in attracting retail customers to the region. Since 2000, while Hanover (0.23%) and Goochland (0.06%) gained the most market share, Richmond (-0.36%) and Henrico (-0.06%) lost the most market share in the region.

The Central region has an average market share of 3.68% in the State. Albemarle and Charlottesville have played a pivotal role in attracting retail customers to the region. Since 2000,

while Louisa (0.08%) and Culpeper (0.07%) gained the most market share, Charlottesville (-0.11%) and Bedford (-0.05%) lost the most market share in the region.

The Eastern shore has an average market share of 0.56% in the State. Accomack played a pivotal role in attracting retail customers to the region. Since 2000, while Accomack (0.02%) gained the most market share, Northampton (-0.04%) lost the most market share in the region.

The Greater Fredericksburg region has an average market share of 4.08% in the State. Spotsylvania and Stafford played a pivotal role in attracting retail customers to the region and gained 0.42% and 0.38% market share in the region. Between 2000 and 2012, the Greater Fredericksburg is the only region with all the counties and cities gaining market share.

The New River Valley region has an average market share of 1.69% in the State. Montgomery and Pulaski played a pivotal role in attracting retail customers to the region. Since 2000, while Montgomery (0.02%) and Floyd (0.01%) gained a small market share, Pulaski (-0.07%), Radford (-0.02% and Giles (-0.02%) lost market share in the region.

The Northern Shenandoah Valley region has an average market share of 2.03% in the State. Frederick and Winchester played a pivotal role in attracting retail customers to the region. Since 2000, Frederick (0.29%) and Warren (0.06%) gained a small market share, Winchester (-0.10%) lost a small market share in the region.

The Region 2000 has an average market share of 2.63% in the State. Lynchburg and Bedford played a pivotal role in attracting retail customers to the region. Since 2000, Bedford (0.09%) gained a small market share but Lynchburg (-0.18%) and Campbell (-0.02%) lost a small market share in the region.

The River Country has an average market share of 0.90% in the State. King William and Lancaster played a pivotal role in attracting retail customers to the region. Since 2000, King

William (0.02%) gained market share while Westmoreland (-0.04%) and Essex (-0.02%) lost a small market share in the region.

Roanoke valley has an average market share of 3.79% in the State. Roanoke and Franklin played a pivotal role in attracting retail customers to the region. Since 2000, Roanoke (0.07%) and Alleghany (0.02%) gained a smaller market share while city of Roanoke (-0.36%) and Covington (-0.02%) lost a small market share in the region.

Shenandoah valley has an average market share of 3.93% in the State. Rockingham, Harrisburg and Augusta played a pivotal role in attracting retail customers to the region. Since 2000, Rockingham (0.02%) and Shenandoah (0.01%) gained a small market share, Staunton (-0.08%), Harrison (-0.02%), Page (-0.02%) and Bath (-0.02%) lost a small market share in the region.

Southern Virginia has an average market share of 2.59% in the State. Danville and Pittsylvania played a pivotal role in attracting retail customers to the region. Since 2000, all the cities lost market share in the region, including Tazewell (-0.09%), Russell (-0.08%) and Wise (-0.08%).

Virginia's Gateway region has an average market share of 5.84% in the State. Chesterfield and Colonial heights played a pivotal role in attracting retail customers to the region. Since 2000, while Prince George (0.04%), Chesterfield (0.03%) and Dinwiddie (0.03%) gained market share, Petersburg (-0.09%) and Hopewell (-0.06%) lost market share in the region. Counties and cities lost market share in the region, including Danville (-0.19%) and Pittsylvania (-0.19%).

Virginia's Corridor has an average market share of 2.15% in the State. Washington and Wythe played a pivotal role in attracting retail customers to the region. Since 2000, all the

Table 1. County Retail Market Share and Change from 2000-2012

County	Average Market Share	Δ 2000-2012	Region	County	Average Market Share	Δ 2000-2012	Region
Albemarle	1.17%	0.01%	Central	Floyd	0.11%	0.01%	New River Valley
Culpeper	0.56%	0.07%	Central	Giles	0.18%	-0.02%	New River Valley
Fluvanna	0.17%	0.04%	Central	Montgomery	0.94%	0.02%	New River Valley
Greene	0.16%	0.05%	Central	Pulaski	0.37%	-0.07%	New River Valley
Louisa	0.28%	0.08%	Central	Radford	0.10%	-0.02%	New River Valley
Madison	0.12%	-0.01%	Central	Clarke	0.13%	0.01%	Northern Shenandoah Valley
Nelson	0.14%	-0.01%	Central	Frederick	0.89%	0.29%	Northern Shenandoah Valley
Orange	0.29%	0.03%	Central	Warren	0.38%	0.06%	Northern Shenandoah Valley
Bedford	0.08%	-0.05%	Central	Winchester	0.64%	-0.10%	Northern Shenandoah Valley
Charlottesville	0.71%	-0.11%	Central	Arlington	2.55%	-0.04%	Northern Virginia
Accomack	0.41%	0.02%	Eastern shore	Fairfax	14.93%	-0.93%	Northern Virginia
Northampton	0.15%	-0.04%	Eastern shore	Fauquier	0.80%	0.16%	Northern Virginia
Caroline	0.24%	0.05%	Greater Fredericksburg	Loudoun	4.18%	2.38%	Northern Virginia
King George	0.19%	0.06%	Greater Fredericksburg	Prince William	4.78%	1.16%	Northern Virginia
Spotsylvania	1.57%	0.42%	Greater Fredericksburg	Rappahannock	0.07%	-0.01%	Northern Virginia
Stafford	1.42%	0.38%	Greater Fredericksburg	Alexandria	1.71%	-0.21%	Northern Virginia
Fredericksburg	0.67%	0.03%	Greater Fredericksburg	Fairfax	0.71%	-0.11%	Northern Virginia
Charles City	0.06%	0.00%	Greater Richmond	Falls Church	0.27%	0.00%	Northern Virginia
Goochland	0.19%	0.06%	Greater Richmond	Manassas	0.62%	0.05%	Northern Virginia
Hanover	1.49%	0.23%	Greater Richmond	Manassas Park	0.17%	0.00%	Northern Virginia
Henrico	4.74%	-0.06%	Greater Richmond	Amherst	0.32%	-0.02%	Region 2000
New Kent	0.15%	0.03%	Greater Richmond	Appomattox	0.14%	0.00%	Region 2000
Powhatan	0.23%	0.05%	Greater Richmond	Bedford	0.54%	0.09%	Region 2000
Richmond	0.11%	-0.05%	Greater Richmond	Campbell	0.53%	-0.02%	Region 2000
Richmond	2.60%	-0.36%	Greater Richmond	Lynchburg	1.10%	-0.18%	Region 2000
Gloucester	0.44%	-0.02%	Hampton Roads	Essex	0.16%	-0.02%	River Country
Isle of Wight	0.35%	0.02%	Hampton Roads	King and Queen	0.05%	0.00%	River Country
James City	0.79%	0.07%	Hampton Roads	King William	0.15%	0.02%	River Country
Southampton	0.16%	-0.03%	Hampton Roads	Lancaster	0.14%	0.00%	River Country
York	0.89%	0.18%	Hampton Roads	Mathews	0.07%	0.00%	River Country
Chesapeake	3.36%	0.02%	Hampton Roads	Middlesex	0.10%	-0.01%	River Country
Franklin	0.13%	-0.02%	Hampton Roads	Northumberland	0.10%	-0.01%	River Country
Hampton	1.72%	-0.39%	Hampton Roads	Westmoreland	0.14%	-0.04%	River Country
Newport News	2.56%	-0.29%	Hampton Roads	Alleghany	0.15%	0.02%	Roanoke Valley
Norfolk	3.04%	-0.71%	Hampton Roads	Botetourt	0.32%	0.01%	Roanoke Valley
Poquoson	0.12%	-0.01%	Hampton Roads	Craig	0.04%	0.00%	Roanoke Valley
Portsmouth	0.93%	-0.17%	Hampton Roads	Franklin	0.51%	0.00%	Roanoke Valley
Suffolk	1.13%	0.21%	Hampton Roads	Roanoke	1.10%	0.07%	Roanoke Valley
Virginia Beach	5.57%	-0.29%	Hampton Roads	Covington	0.10%	-0.02%	Roanoke Valley
Williamsburg	0.27%	-0.06%	Hampton Roads	Roanoke	1.59%	-0.36%	Roanoke Valley

County	Average Market Share	Δ 2000-2012	Region	County	Average Market Share	Δ 2000-2012	Region
Augusta	0.70%	-0.01%	Shenandoah Valley	Buchanan	0.22%	-0.04%	Virginia's e-Region
Bath	0.08%	-0.02%	Shenandoah Valley	Dickenson	0.14%	-0.04%	Virginia's e-Region
Highland	0.02%	0.00%	Shenandoah Valley	Lee	0.22%	-0.03%	Virginia's e-Region
Page	0.22%	-0.02%	Shenandoah Valley	Russell	0.27%	-0.08%	Virginia's e-Region
Rockbridge	0.24%	-0.01%	Shenandoah Valley	Scott	0.22%	-0.04%	Virginia's e-Region
Rockingham	0.75%	0.03%	Shenandoah Valley	Tazewell	0.56%	-0.09%	Virginia's e-Region
Shenandoah	0.42%	0.01%	Shenandoah Valley	Wise	0.45%	-0.08%	Virginia's e-Region
Buena Vista	0.06%	-0.01%	Shenandoah Valley	Norton	0.12%	0.00%	Virginia's e-Region
Harrisonburg	0.71%	-0.02%	Shenandoah Valley	Chesterfield	4.06%	0.03%	Virginia's Gateway
Lexington	0.06%	-0.01%	Shenandoah Valley	Dinwiddie	0.22%	0.03%	Virginia's Gateway
Staunton	0.37%	-0.08%	Shenandoah Valley	Prince George	0.31%	0.04%	Virginia's Gateway
Waynesboro	0.31%	0.05%	Shenandoah Valley	Surry	0.06%	0.01%	Virginia's Gateway
Halifax	0.41%	-0.04%	Southern Virginia	Sussex	0.09%	-0.01%	Virginia's Gateway
Henry	0.58%	-0.19%	Southern Virginia	Colonial Heights	0.47%	-0.03%	Virginia's Gateway
Patrick	0.15%	0.00%	Southern Virginia	Hopewell	0.25%	-0.06%	Virginia's Gateway
Pittsylvania	0.49%	-0.09%	Southern Virginia	Petersburg	0.39%	-0.09%	Virginia's Gateway
Danville	0.73%	-0.19%	Southern Virginia	Brunswick	0.14%	-0.03%	Virginia's Growth Alliance
Martinsville	0.23%	-0.06%	Southern Virginia	Charlotte	0.11%	-0.02%	Virginia's Growth Alliance
Bland	0.05%	-0.01%	Virginia's aCorridor	Greensville	0.08%	-0.01%	Virginia's Growth Alliance
Carroll	0.24%	-0.03%	Virginia's aCorridor	Lunenburg	0.10%	-0.03%	Virginia's Growth Alliance
Grayson	0.12%	-0.03%	Virginia's aCorridor	Mecklenburg	0.36%	-0.01%	Virginia's Growth Alliance
Smyth	0.31%	-0.07%	Virginia's aCorridor	Nottoway	0.16%	-0.02%	Virginia's Growth Alliance
Washington	0.62%	-0.04%	Virginia's aCorridor	Emporia	0.11%	0.00%	Virginia's Growth Alliance
Wythe	0.36%	-0.02%	Virginia's aCorridor	Amelia	0.10%	-0.02%	Virginia's Heartland
Bristol	0.29%	-0.04%	Virginia's aCorridor	Buckingham	0.13%	0.00%	Virginia's Heartland
Galax	0.15%	-0.03%	Virginia's aCorridor	Cumberland	0.09%	-0.01%	Virginia's Heartland
				Prince Edward	0.27%	-0.01%	Virginia's Heartland

Counties and cities lost market share in the region, including Smyth (-0.07%), Bristol (-0.04%) and Washington (-0.04%).

Virginia's e-Region has an average market share of 2.21% in the State. Tazewell and Wise played a pivotal role in attracting retail customers to the region. Since 2000, all the Counties and

Virginia's Growth Alliance region has an average market share of 1.07% in the State. Mecklenburg and Nottoway played a pivotal role in attracting retail customers to the region. Since 2000, all the Counties and cities lost market share in the region including Brunswick (-0.03%) and Lunenburg (-0.03%).

Virginia's Heartland region has an average market share of 0.58% in the State. Prince Edward and Buckingham played a pivotal role in attracting retail customers to the region. Since 2000, all the Counties and cities lost market share including Amelia (-0.02%), Cumberland (-0.01%) and Prince Edward (-0.01%) in the region.

Retail Strength Model

The retail strength of the economy is explained by the following equation:

Retail Pull Factor = f (Income, Urbanmass, Property Value, Commuter flows, Major Hwy)

The retail pull factor can be explained by retail customers, buying power of the customers and the quality of the retail sector. The urban mass, commuter flows and presence of a major highway represents the retail customers, the per capita income represents the buying power of the customers and the property value represents the quality of the retail sector.

Table 2. Variables and Description of variables

Variable	**Description**
Income	County/City per capita income in 2012
Urbanmass	The square root of population of each County/City
Property value	The real and personal property value of each County/City
Commuter flow	The size and direction of retail commuter flows
Major Hwy	An indicator of a major highway intersecting the County/City

The analysis was conducted for 134 counties and cities in Virginia in order to identify the factors that have a significant effect on retail activity in the economy. The primary data sources are - sales tax from Department of Taxation, population from US Census Bureau and personal

income from Bureau of Economic Analysis. The data for this study spans over a decade (2000-2012).

The results of the linear regression model are presented in table 3 below suggest an R-square of 96.42, indicating that the model is successful in explaining the variance of the dependent variable, retail trade pull factor . All the variables – income, urbanmass, property values and commuter flows are significant at the 95% confidence level, except major highway, which is significant at the 90% confidence level. The sign for income is negative indicating that if the incomes are higher, then the retail pull factor tends to be lower i.e., high income customers tend to travel farther to purchase retail goods and services. Similarly, the sign for property values is negative indicating that if the property values are higher, then the retail pull factor tends to be lower, i.e., retail customers whose property values are high tend to travel farther to purchase retail goods and services or they have multiple homes to reside in. The urbanmass or square root of population of the county has a positive sign indicating that a higher population indicates a higher retail pull factor, i.e., population centers tend to be hubs for retail activity and attract customers. The commuter flows have a positive sign indicating that a higher commuter flow indicates a higher retail pull factor. The major highway has a positive sign indicating that the presence of a major interstate highway indicates a higher retail pull factor i.e, a major highway tends to attract more retail customers to a region because of ease of access to the highways.

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Table 3. Retail Strength Regression results

Regression Statistics	
Multiple R	0.964231291
R Square	0.929741982
Adjusted R Square	0.919811501
Standard Error	0.266922326
Observations	134

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	121.6258983	24.3251796	341.417876	3.4614E-72
Residual	129	9.190931104	0.07124752		
Total	134	130.8168294			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Income	-0.000016	0.000006	-2.618432	0.009891	-0.000028	-0.000004	-0.000028	-0.000004
Urbanmass	0.008442	0.001013	8.332007	0.000000	0.006437	0.010446	0.006437	0.010446
Property Values	-5.15E-12	1.47E-12	-3.514309	0.000609	-8.05E-12	-2.25E-12	-8.05E-12	-2.25E-12
Commuter flows	0.000013	0.000002	7.092404	0.000000	0.000009	0.000017	0.000009	0.000017
Major Hwy	0.090817	0.047799	1.899976	0.059668	-0.003755	0.185388	-0.003755	0.185388

Figure 4. Retail Sales Breakdown by Industry

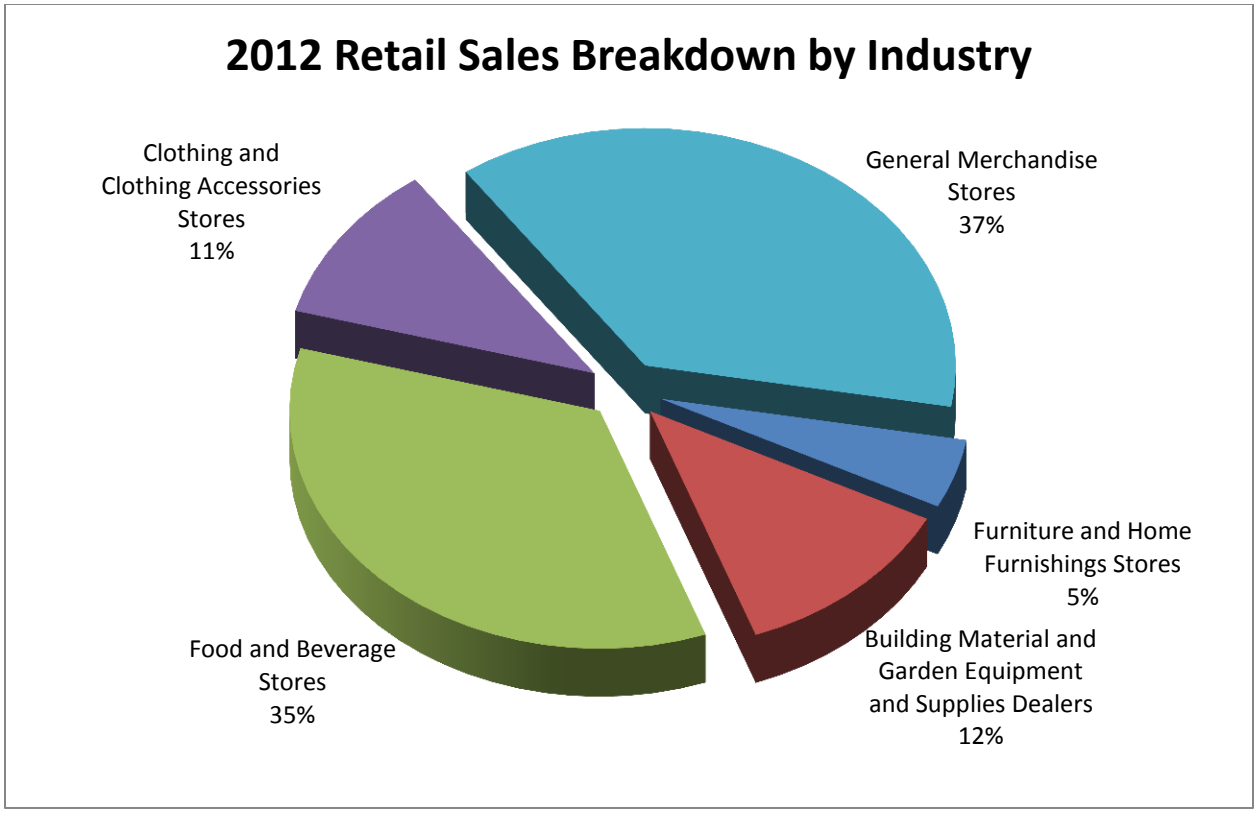


Figure 4 above indicates the breakdown of retail sales by industry in the State of Virginia. In terms of percentage retail sales, a majority of the retail sales were in the general merchandise stores (37%), followed by food and beverage (35%), building materials, garden equipment and suppliers (12%), clothing and accessories (11%) and furniture as well as home furnishing stores (5%).

The retail sales trends are illustrated in figures 5 and 6. Between 2000 and 2004, the retail sales tax revenue was reported in a wide range of categories. The greatest increase in retail sales were seen in the lumber sector (39.86%), followed by miscellaneous sector (22.26%) and restaurants (21.96%). While the fuel sector displayed a decline of 8.42%, the machinery sector grew by 4.49% and the general merchandise grew by 4.87%.

Figure 5. Retail Sales Trends 2000-2004

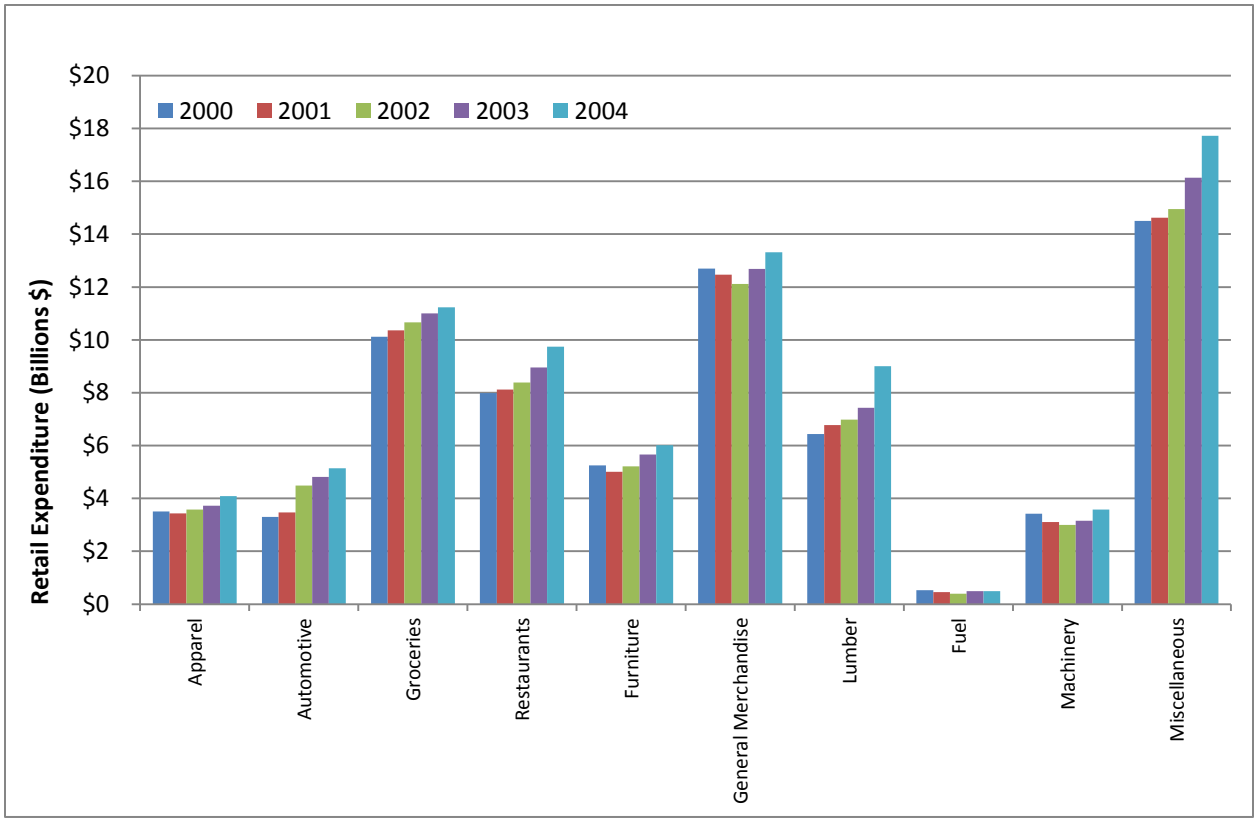
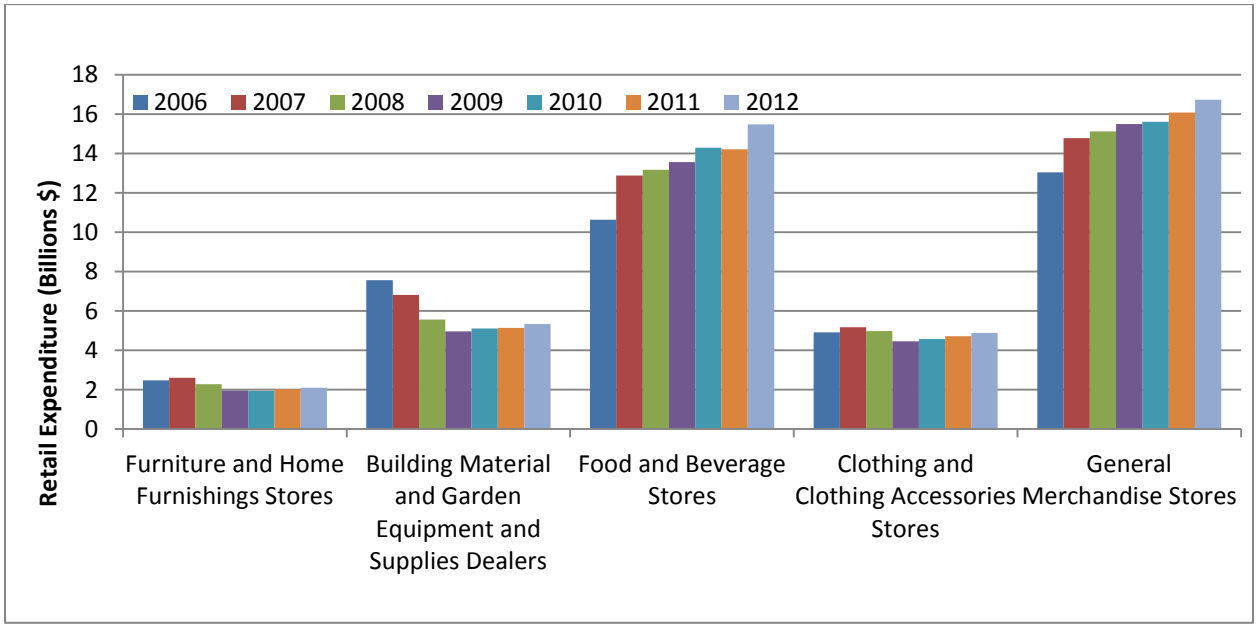


Figure 6. Retail Sales Trends 2006-2012



After 2006, the data was consolidated in to five main categories as seen in figure 6. Between 2006 and 2012, the state faced a recession and a lot of sectors declined, including the building materials, garden supplies and equipment (-29.35%), furniture and home furnishings sector (-15.26%) and clothing and accessories (-0.67%). The sectors that experienced a growth in this period includes food and beverages (45.49%) and general merchandise stores (28.41%).

Conclusions

The food and retail trade analysis in Virginia indicates concentration of retail activity over the last decade. While the dominance of Northern Virginia, Greater Fredericksburg, Central region and Northern Shenandoah Valley grew with an increase in retail activity, the market share of all other regions experienced a decline in the market share. The analysis shows that agglomeration occurred in the regions of increased market share. This study explained the variability of retail pull factors across counties in Virginia and the trends in retail sectors over the past decade. The strength of retail activity was successfully explained by the per capita income, urban mass, property values, commuters and presence of a major highway. Further, the market share analysis provided an insight on the major retail centers in the State and the trends over the past decade. The buying power index highlighted the purchasing power of retail customers across counties and cities in Virginia.