

Virginia Coalition of Housing and Economic Development Researchers

# **Addressing the Impact of Housing for Virginia's Economy**

A REPORT FOR VIRGINIA'S HOUSING POLICY ADVISORY COUNCIL  
NOVEMBER 2017

---

Appendix Report 4:

Transportation, Housing Affordability, and Economic  
Development in the Commonwealth of Virginia

Thomas W. Sanchez

Virginia Tech

## Executive Summary

Transportation is the second-largest expenditure category for households after housing, accounting for nearly 20 cents of every dollar spent annually. Combined, housing and transportation represent a substantial portion of local, state, and national economic activity. A primary economic connection between housing and transportation is related to the tradeoffs that households make in terms of residential location and the remainder of their household budget they can spend on other needs. For example, as families are forced to spend thousands of dollars annually on owning and operating private vehicles (which are rapidly depreciating assets), they have less money to invest in homeownership. This, in turn, slows wealth creation and the ability to enjoy other benefits of homeownership. Our analysis shows a consistent relationship between high household cost burdens and low regional economic recovery from 2008 to 2013. We suspect that this relationship is not isolated to the analyzed period and will continue to be observable. We recommend that the Virginia Department of Transportation, Metropolitan Planning Organizations, and transit agencies within the state consider these dynamics as they plan infrastructure investments and other system improvements. Similarly, housing development planning throughout the state should consider other locational costs, such as transportation, in their planning process.

## Executive Takeaways

Findings suggest the following executive takeaways for Virginia's economy about the impact of household cost burdens of housing and transportation on housing affordability:

### **Housing Plus Transport Costs**

- ✓ Counties and regions with lower housing plus transportation costs have experienced better economic performance.
- ✓ Significant differences in these effects are seen across the state, especially for the southern and northern regions as well as for urban and rural areas.
- ✓ Low-income households face greater challenges with respect to housing location costs and regional economic opportunity.
- ✓ The period analyzed (2008 through 2013) represents a period of economic recovery within the State. We find that economic resilience varied throughout the State with particular differences geographically as well as for different household types.
- ✓ These results have implications for economic development efforts. High household and transport costs can be a significant burden for households throughout Virginia.

## Table of Contents

|                            |           |
|----------------------------|-----------|
| <b>Executive Summary</b>   | <b>2</b>  |
| Executive Takeaways        | 3         |
| <b>Table of Contents</b>   | <b>4</b>  |
| <b>List of Tables</b>      | <b>5</b>  |
| <b>List of Figures</b>     | <b>6</b>  |
| <b>List of Definitions</b> | <b>7</b>  |
| <b>Introduction</b>        | <b>8</b>  |
| <b>Literature Review</b>   | <b>18</b> |
| <b>Body of Findings</b>    | <b>18</b> |
| <b>Conclusion</b>          | <b>30</b> |
| <b>References</b>          | <b>32</b> |
| <b>Appendix 1</b>          | <b>37</b> |

Title page photo credit: Community Housing Partners

## List of Tables

**Table 1.** Correlation between Household Cost Burdens and Economic Indicators

**Table 2.** Summary of Economic Activity Measures and Household Cost Burdens by Region

**Table 3.** Transportation Planning Agencies Contacted

## List of Figures

**Figure 1.** Household Expenditure Levels by LAI Household Type

**Figure 2.** Percent Change in Total Employment, 2008–2013

**Figure 3.** Percent Change in Number of Establishments, 2008–2013

**Figure 4.** Percent Change in Total Payroll, 2008–2013

**Figure 5.** Estimated Percent Total H+T Household Expenditures for Median-Income Families

**Figure 6.** Relationship between Regional Household Cost Burden and Employment % Change

**Figure 7.** Relationship between Regional Household Cost Burden and Establishments % Change

**Figure 8.** Relationship between Regional Household Cost Burden and Payroll % Change

**Figure 9.** Highest and Lowest Household Cost Burden Deciles

## List of Definitions

**Household housing costs:** all expenses including rent or mortgage, interest, insurance, taxes, maintenance, and fees.

**Household transportation costs:** all expenses including car payments, insurance, gas, maintenance, tolls, parking, and transit fares.

**Housing Choice Voucher Program:** The housing choice voucher program is the federal government's major program for assisting very-low-income families, the elderly, and the disabled to afford decent, safe, and sanitary housing in the private market.

**Location Affordability Index:** The Location Affordability Index (LAI) consists of estimates of the combined household and transportation costs. The LAI is calculated using statistical regression modeling at the census block-group level for each of the 942 Core-Based Statistical Areas and at the county level for non-metropolitan counties.

**Location Efficiency:** Location efficiency encourages home ownership and to reduce transportation, land use, and environmental issues that many urban areas are currently faced with.

## Introduction

Transportation is the second-largest expenditure category for households after housing, accounting for nearly 20 cents of every dollar spent annually. Combined, housing plus transportation represent a substantial portion of local, state, and national economic activity. A primary economic connection between housing and transportation is related to the tradeoffs that households have to make in terms of residential location and the remainder of their household budget to spend on other needs. For example, as families are forced to spend thousands of dollars annually on owning and operating private vehicles (which are rapidly depreciating assets), they have less money to invest in homeownership, hindering wealth creation and the ability to enjoy other benefits of home ownership.

## Literature Review

The following summarizes the existing literature on transportation, housing, and economic development. In particular, we are interested in how the transportation and housing cost burden on households factors in local and regional economic performance. The literature shows relative agreement that transportation continues to provide critical support for the economy and contributes to economic growth. Some research has shown that well-designed infrastructure investments can increase economic growth, productivity, and land values while providing significant positive spillovers to areas such as economic development, energy efficiency, public health, and manufacturing. With respect to the relationship between housing and transportation, the economic development benefits and potential are less documented. The interaction between housing location and affordability depends on transportation; therefore, transportation costs affect the economic status of a household. The ability to get to work, school, or shopping is among the most fundamental needs and household location matters when considering successful community and economic development strategies in both local and regional contexts (Smith and Brooks, 2012).

*The Built Environment and Transportation*

The structure and development pattern of housing and transportation infrastructure of a region are a primary determinant of its economic efficiency (Sarzynski and Levy, 2010). How and where we build homes determines the need for and cost associated with transportation. Sprawling development increases infrastructure costs for cities, congestion causes greater levels of pollution, and long commutes affect businesses through lost productivity, greater levels of absenteeism and tardiness, and, ultimately, turnover when workers leave in search of a shorter commute (Haas et al., 2006). Haas et al. (2008) find that holding everything else constant, the built environment accounts for two-thirds of the variation in household travel activity. The built environment is enduring; therefore, cities and regions can lower housing and transportation costs by changing where and how they grow (CNT, 2010). Jewkes and Delgado (2012) state that “the growing dilemma for working families is that affordable housing and transit choices are limited and available jobs are often too far from affordable residential areas. This problem underscores the preservation and new development of transit-oriented housing” (p. 51).

*Housing Affordability = Housing + Transportation Costs*

Transportation costs are an often-overlooked expense of households, and the extent of these expenses is typically understood after committing to a location. Hickey et al. (2012) found that housing and transportation costs rose faster than income did during the 2000s. Transportation costs result from trips that households make as part of their daily routine, including commuting, errands, and other activities. For car owners, this includes the full costs of auto ownership, such as car payments, insurance, maintenance, and fuel. For transit riders, it includes the price of transit (fares and time costs). Housing costs for renters include rent and utilities. For homeowners, these costs include mortgage payments, property taxes, home insurance, utilities, and, where applicable, payments for home equity loans, condominium fees, or mobile home expenses (Hickey et al., 2012). Housing and transportation costs are the two largest expenses for most households in the United States. Combined, the costs of transportation and housing account for 52 percent of the average household's budget (Bernstein et al., 2005). For households earning 50 to 100 percent of the median

income of their metropolitan area, nearly three-fifths (59 percent) of income goes to housing and transportation costs (Hickey et al., 2012).

Multiple studies across regions have used various methods to analyze how transportation costs vary between locations. They then combined this information with that on housing costs to determine total household and transportation burden for households. Bernstein et al. (2005) used consumer expenditure data to obtain transportation and housing expenditures at the MSA level, and other studies achieved greater detail using census tract or block-level data by modeling transportation expenditure at the household level (see Sanchez et al., 2006; Haas et al., 2006). A model developed by the Center for Neighborhood Technology and the Center for Transit Oriented Development uses the census, transit system, National Household Travel Survey, and other data sources to estimate a household's auto use and ownership as well as transit use at the census tract level for particular household sizes and incomes. This model evolved into the Housing and Transportation Index (H+T), which calculates the transportation costs associated with residential location and provides a relative measure of a neighborhood's affordability. The H+T Index includes housing and transportation cost data for over 400 metropolitan regions, and a revised national location-affordability dataset and web-based portal containing location-affordability calculators for the public has been published, termed the Location Affordability Index (LAI; U.S. Department of Housing and Urban Development, 2015; Haas, Newmark, and Morrison, 2016). Many studies have used the H+T Index or its precursor in comparisons of transportation costs and burdens with characteristics of neighborhoods and households.

#### *Household Trends by Income level*

Haas et al. (2008) and Sanchez et al. (2006) established that locational characteristics have similar impacts on transportation costs regardless of household income. Therefore, studies can independently evaluate variations in household income levels using these calculations. Lipman (2006), Haas et al. (2006), Sanchez (2007), and Hickey et al. (2012) reached similar conclusions on the characteristics of neighborhoods in relation to their housing and transportation cost burdens: Although the combined cost of housing and transportation increases with distance to employment centers, the cost burden remains relatively constant. Overall housing costs tend to decline for moves

out of large metro areas, but transportation costs move in the opposite direction and negate gains in housing affordability (Greenlee and Wilson, 2016). In areas where families spend more on housing, they tend to spend less on transportation, and vice-versa (Lipman, 2006).

### *Low Income*

Lower-income households tend to have both high housing and transportation cost burdens. These households have the most to gain from locations with lower transportation costs. They locate in urban areas segregated by race and income, inner suburbs with fewer jobs, and in some regions, outer suburbs or satellite cities away from jobs and services and close to rural areas. Sanchez et al. (2006) found that for households earning less than \$35,000, the combined cost burdens are greater than 60 percent and as high as 71 percent with a larger proportion spent on transportation than other types of households. Haas et al. (2006) determined that households that spend more of their income for housing and transportation are more likely to have high unemployment, low education attainment, and low home ownership. Lower-income households are particularly burdened by higher transportation costs because these expenditures claim a higher percentage of their budgets even if they spend less absolute dollars (Bernstein et al., 2005). Low-income persons unable to purchase an automobile often reside in locations that are not well-connected by public transit to employment concentrations and amenities (Sanchez et al., 2006; Jones, 2000). Puentes (2008) found that the working poor (defined as households with income less than twice their poverty threshold) are two-thirds more cost-burdened by commuting than other workers are.

### *Moderate Income*

Moderate-income and working-class households tend to have exceptionally high transportation cost burdens. Moderate-income households (earning between \$35,000 and \$50,000) pay between 50 and 59 percent of their income on housing and transportation costs (Sanchez et al., 2006; Haas et al., 2006; Hickey et al., 2012), and such households in 17 of 28 metro areas spent more on transportation than on housing (Lipman, 2006). For the typical moderate-income homeowner carrying a mortgage, combined housing and transportation cost an average 72 percent of income.

High transportation costs are primarily because of long distances to services and employment as families flee employment centers and move to suburbs in search of a more affordable living situation. Working families who move far from work to find affordable housing end up spending their savings on transportation (CNT, 2010; Lipman, 2006). In the search for affordability, some working families may witness a rise in both their monetary expenses (e.g., commuting costs and extra childcare) and non-monetary expenses (e.g., opportunity cost of leisure and family time; Jewkes and Delgado, 2012).

### *High Income*

High-income households tend to locate in urban areas near employment centers and alternative transportation options or in wealthy suburbs. This group tends to have the lowest transportation cost burdens and higher relative housing costs. Higher-income households spend a smaller portion of their total budget on transportation, which may be exactly offset by increased housing expenditures. Higher-income individuals who pay more for housing also tend to pay more for transportation (Haas, Newmark, and Morrison, 2016, 9).

### *Location Efficiency*

The concept of location efficiency is frequently discussed. Location-efficient development consists of residential and commercial developments located and designed to maximize accessibility and overall affordability. Hickey et al. (2012) describe location-efficient areas as those where transportation costs are already low or where public investments will make transportation more affordable in the future. That is, location-efficient development is typically close to good transit and public services and has good walking and cycling conditions in addition to other features that reduce automobile dependency.

The concept and measures of location efficiency (such as the H+T Index) can be used by households to make informed decisions about where to locate and by cities to efficiently guide growth through informed policies. Research in reducing economic inefficiencies associated with high

combined housing and transportation cost burdens focuses on the interactions among housing, transit, and employment locations.

Increasing location affordability through the HUD Housing Choice Voucher Program (HCVP) has shown mixed results. Affordable neighborhoods that are accessible to public transportation are often found in distressed areas, and not all HCV recipients succeed in locating qualified housing (Walter and Wang, 2016). Research from Oregon by Tremoulet, Dann, and Adkins (2016) finds that overall, HCVP households are more likely to be located in areas with “high levels of residential and employment density, lower levels of car ownership, higher connectivity, more frequent and closer transit access, and higher Walk Score” (17). However, voucher recipients who moved out of urban areas tended to relocate to less location-efficient areas. This may indicate that voucher recipients are being edged out of location-efficient areas and that moving to suburbs may provide more affordable housing but also higher transportation costs.

### *Economic Well-Being and Development*

There are many economic benefits of household location efficiency. Improved location efficiencies are passed onto households, businesses, and governmental entities as cost savings. Access to amenities is theorized to provide a better quality of life (Steg and Gifford, 2005), health benefits (Litman, 2015), and wage growth (Roback, 1982). A reduction in the housing and transportation cost burden can greatly affect the economic wellbeing of households. Residents living in location-efficient neighborhoods require less time and expense. Bernstein et al. (2005) found that households in regions that have invested in public transportation reap financial benefits from having affordable transportation options. Lower transportation and housing cost burdens also allow people to access economic opportunities such as education, employment, and affordable goods. For example, transit service improvements may allow people to obtain additional education and jobs. High-quality public transit can increase labor participation in U.S. cities, and improving transport system diversity increases overall productivity and economic development (Sanchez, Shen, and Peng, 2004; Yi, 2006). In high-income cities, the availability of affordable rental housing in locations served by fast and frequent public transportation enables low-income households access to more opportunities,

including jobs, without the costs of owning and operating automobiles (Revington and Townsend, 2016).

Location efficiency tends to improve households' economic resilience, that is, households are better able to respond to unexpected financial burdens such as fuel price increases, vehicle failures, or income losses, reducing housing foreclosures. According to Rauterkus et al. (2010), the probability of mortgage foreclosure increases as neighborhood vehicle ownership levels rise, after controlling for income. Kaza et al. (2016) determined that increasing neighborhood job diversity and local accessibility reduces mortgage default risks. Commute time (Pivo, 2013) and median vehicle ownership rates (Henry and Goldstein, 2010) can also increase the probability of default. Neighborhoods that are more walkable have been associated with fewer foreclosure defaults (Gilderbloom, Riggs, and Meares, 2015). Implementing location efficiency into mortgages may be a very effective tool to leverage access to affordable housing in transit-rich large metropolitan areas (Greenlee and Wilson, 2016). Properties foreclosed because of defaulted mortgages contribute to increased blight and criminal activity (Ford et al., 2013), reduce a city's tax base, and absorb municipal resources when cities are forced to maintain vacant properties (Coulton et al., 2008). High concentrations of foreclosed properties have also been shown to decrease nearby property values (Frame, 2010; Gangel, Seiler, and Collins, 2013; Immergluck and Smith, 2005).

### *Employment and Higher Wages*

The location efficiency of an area plays a large factor in attracting employees and talent to a region. Location-affordability factors, including regional wages and economic vitality, costs of commuting to employment opportunities, and overall housing affordability all inform the household decision to move (Renkow and Hoover, 2000). Multiple studies have shown that increasing access to employment centers throughout a region leads to better employment opportunities and increased earnings (Blumenburg, 2003; Blumenburg and Ong, 2002; Holzer and Martinson, 2005; Waller, 2005; Macek, 2001). The availability of affordable commuting options improves workers' ability to overcome the distance between home and work and increases short- and long-term earnings (Waller and Blumenberg, 2009; Waller, 2005; Burgess 2004; Blumenberg and Schweitzer, 2006; Blumenberg and Ong, 2002).

Access to affordable transportation and commuting options is a key factor in the economic mobility of working low-income households (Roberto, 2008). Low-skilled labor is frequently constrained in central cities by inaccessibility to automobiles and insufficient public transit (Gautier and Zenou, 2010; Sanchez, 1999; Raphael and Rice, 2002). Location-inefficient regions are likely to have spatial mismatches that result in involuntary unemployment among low-income, uneducated city (predominantly minority) residents. For households that have high transportation and housing cost burdens, the spatial arrangement may make it difficult for them to travel to the jobs they are qualified for as the cost to get to the place of employment outweighs the marginal economic benefit of that job. When these otherwise employable individuals find themselves unemployed, “the region experiences a loss of productivity in the form of underutilized human capital, thus reducing economic growth” (Sarzynski and Levy, 2010).

The effect of decreased housing and transportation cost burden is equivalent to that of an increase in consumer income, particularly for lower-income households. Higher transportation and housing costs means that workers demand higher wages to compensate for their individual travel time and expenses, and thus, commuting becomes a cost of the production process. The travel time and expenses that individuals incur in moving to and from retail shopping centers represent costs of consumption and may reduce the price that consumers are willing to pay for goods and services accordingly. Regional economies tend to benefit when consumers shift their transportation expenditures from vehicles and fuel to transit services or general consumer goods. One million dollars of fuel expenditure shifted to a typical bundle of consumer goods adds 4.5 jobs to the U.S. economy, and each million shifted from general vehicle expenditures (vehicles, servicing, insurance, etc.) adds about 3.6 jobs (Chmelynski, 2008). Each 1% of additional regional travel shifted from automobile to public transit increases regional income about \$2.9 million, resulting in 226 additional regional jobs (Miller, Robison, and Lahr, 1999).

### *Business Costs and Formation*

Household location decisions influence labor supply and wages demanded by workers to compensate for their commuting costs, negatively impacting businesses and reducing the workers' personal welfare. A spatial mismatch between jobs and housing locations may result in longer travel

times, increasing the costs of production for firms and reducing available leisure and labor time for individuals, which may constrain economic growth (Sarzynski and Levy, 2010). In a national survey of over 300 companies, two-thirds believe that a shortage of accessible affordable housing “is having a negative impact on retaining qualified entry-level and mid-level employees” and more than half attribute some level of employee turnover to the resulting long commutes (Urban Land Institute, 2007). In addition, long daily commutes owing to lack of accessible affordable housing may contribute to traffic congestion (Wardrip, Williams, and Hague, 2011). Congested roads can reduce the profitability of local businesses by increasing operating costs and by shrinking the area from which businesses expect to draw both customers and workers (Cambridge Systematics, Inc., 2005). Cities that fail to address congested roads “may find their competitive edges slipping away to more favorable locations” (Hartgen and Fields, 2006, 38)

Location-inefficient areas also have high public service costs, requiring higher tax burdens for a given level of public goods. These higher tax burdens serve as disincentives for firm location while simultaneously reducing capital and income available for spending within the region (Sarzynski and Levy, 2010).

#### *Benefits of Infrastructure and Location-Efficient Development*

Development of location-efficient communities with a low disparity in household housing and transportation costs can provide regional economic benefits. Iams and Kaplan (2006) found that improving access to areas with undeveloped resources (including land for housing, business, and tourism activities) can foster economic development. More accessible (i.e., location-efficient) land-use patterns are expected to increase employment, economic productivity, land values, and tax revenues owing to the combined effects of improved accessibility, reduced transportation costs, agglomeration efficiencies (i.e., increased productivity as more activities are located close together), public services provision efficiency, and reduced land consumption. CNT (2010) determined that if 50% of projected new households were to move to compact rather than dispersed neighborhood in a fast-growing area such as Phoenix, it would achieve a \$2.1 billion annual surplus for the local economy by better directing its growth. A smaller region like Charlotte, which is expected to double in size, could save an aggregate of \$239.8 million annually by 2030. Burer et al. (2014) estimated

nationwide transportation cost savings at approximately \$2.2 trillion over 10 years if all new development was targeted toward smart-growth communities (50% greenfield vs. 50% infill). These estimates do not include the potential savings in terms of sustainability improvements or improvements in regional quality of life.

Increased density of development can make an area more economically efficient. Carruthers and Ulfarsson (2008) find that the density of developed land reduces local government spending and estimate that if the entire nation's land use developed 25% more densely, 2002 fiscal year local public expenditures would have been \$3.63 billion less. Sarzynski and Levy (2010) state that regions that coordinate activity around existing infrastructure may reduce transportation costs for businesses, workers, or residents. This also reduces public service costs for government, which may translate into lower costs for business and residents in these areas. The paper then says that for established cities, investment in regional transportation infrastructure provides similar benefits without changing locations of businesses and residences. The savings are monetary and immediate and they may improve the desirability of particular locations and influence future location decisions and economic activity.

Gains made in housing affordability through moving are often offset by additional transportation costs associated with new locations (Greenlee and Wilson, 2016). Understanding this may provide an impetus to reduce suburbanization and promote infill and location-efficient development. Location affordability can explain overall patterns of mobility toward larger metropolitan areas with a more-robust transportation infrastructure despite higher housing costs (Greenlee and Wilson, 2016, 15). Equitable access requires measures to preserve and create affordable housing in these areas.

Recent research also indicates that redevelopment without gentrification is possible when transportation is considered. In weak housing market cities, transportation are a larger factor than housing costs in determining overall location affordability (Tighe and Ganning, 2016).

Transportation costs are more affordable in neighborhoods that have undergone redevelopment than in stable or declining neighborhoods (Tighe and Ganning, 2016, 8). Declining neighborhoods face the toughest affordability challenges, and virtually the entire affordability gap existing in such neighborhoods is attributable to unaffordable transportation costs. (Tighe and Ganning, 2016, 11). As declining cities struggle to maintain services and amenities to their residents, an increased focus

on transportation in decision-making can benefit low-income residents living in declining neighborhoods and improve quality of life for residents throughout the city.

Regions may also benefit by providing subsidies to individuals that face difficulties conducting their daily activities with existing transportation options. Travel subsidies typically include free or reduced transit fares (e.g., for children, students, the disabled, or the elderly) when the primary barrier limiting travel is affordability. Subsidized parking or car-sharing arrangements may also be provided when existing public transit offerings are not adequate to provide mobility to jobs. These individually targeted subsidies should reduce personal travel costs and improve labor supply decisions and alleviate some of the negative employment consequences of spatial mismatch (Sarzynski and Levy, 2010).

## Body of Findings

Drawing from the previous literature, we expect excess household financial burden to have local or regional economic impacts. In this study, we are interested in how household cost burdens correlate with indicators of economic development, such as business formation, employment, and aggregate payroll. We used the HUD LAI, which models household housing and transportation costs using County Business Patterns data. The analysis is more descriptive than predictive, but it offers initial insights on the relationship between household costs for housing and transportation and economic activity. In addition to the descriptive analysis, we followed up with five regional planning organizations and the transit organizations within each region to determine whether they use household costs as part of their planning processes.

### *HUD Location Affordability Index*

The HUD LAI provides estimates of combined housing and transportation costs for households at a variety of geographic aggregations. The LAI was formed using the Center for Neighborhood Technology's H+T Index to more accurately represent costs associated with residential location

choices. More detail on these data can be found on the HUD LAI Portal at <http://www.locationaffordability.info/lai.aspx>

### *Analysis Period*

The economic downturn around 2008 challenged the whole country as well as individual states and regions. The economic performance data used in this analysis represent the period of recovery by including indicators for the years 2008 and 2013. Our analysis focuses not only on the relationship between household cost burdens and economic activity but also on the relationship between cost burdens and economic resilience throughout Virginia. Ideally, the analysis would include two time periods (e.g. 2008-2013 and 2013-2018) so correlations for the two periods can be compared. In addition, a comparison of changes in cost burdens and economic activity between periods could also be useful. After reviewing the LAI data, the 2008 and 2012 data were found to not be comparable, which would lead to unreliable results. Therefore, we used LAI data for 2012 and County Business Patterns data for 2008 and 2013. We expect the next release of LAI data to allow us to look at the relationship between changes in household costs for housing and transportation as well as changes in local/regional economic activity.

### *Descriptive Analysis*

We first used the LAI to look at trends in household cost burdens based on the eight household types modeled by the LAI (see Figure 1). Average household transportation costs (T) range from 15% for single professionals to 64% for very-low-income individuals. Concurrently, average combined housing and transportation costs (H+T) range from 35% for single professionals to over 100% for very low-income individuals (see Figure 1).

Using these data for all counties and independent cities in Virginia, we can compare the estimated household cost burdens for the eight types of households and the indicators of economic activity (i.e., change in number of business establishments, employment, and payroll). Figures 2, 3, and 4 show the variation of economic activity throughout Virginia. The maps show that there was

significant variation in economic change across the state with slight declines in statewide employment and number of establishments from 2008–2012, both around 2%. Furthermore, total payroll increased by about 10% during this period.

Figure 1. Household expenditure levels by LAI household type

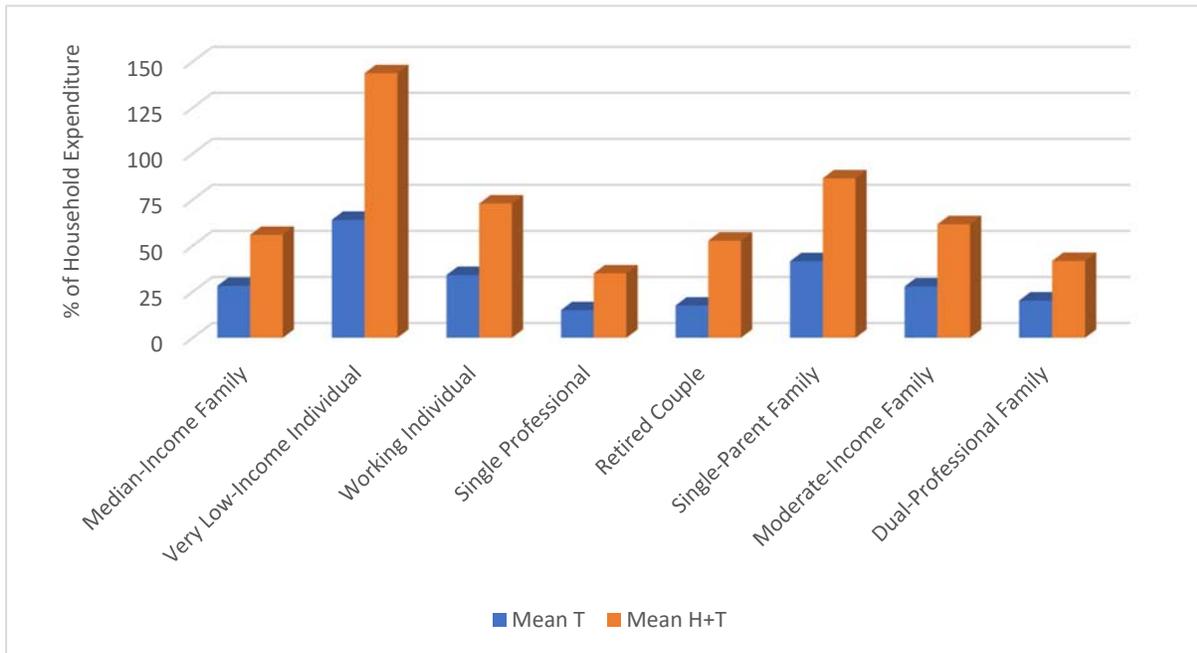


Figure 2. Percent change in total employment, 2008–2013

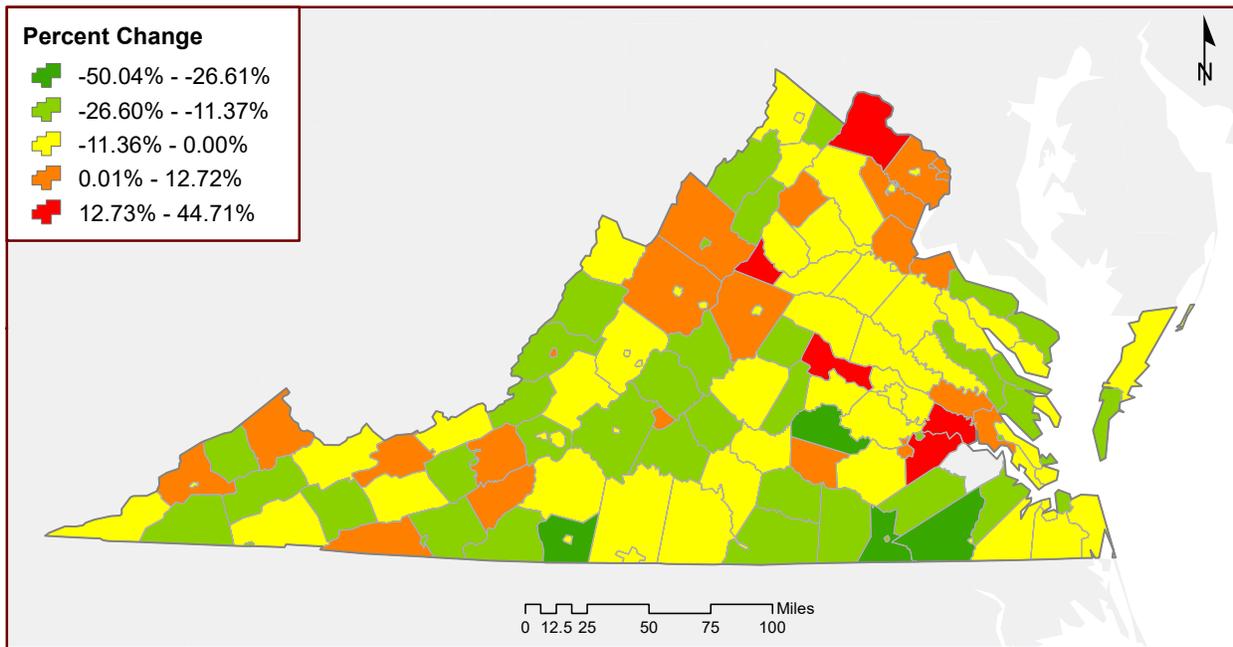


Figure 3. Percent change in number of establishments, 2008–2013

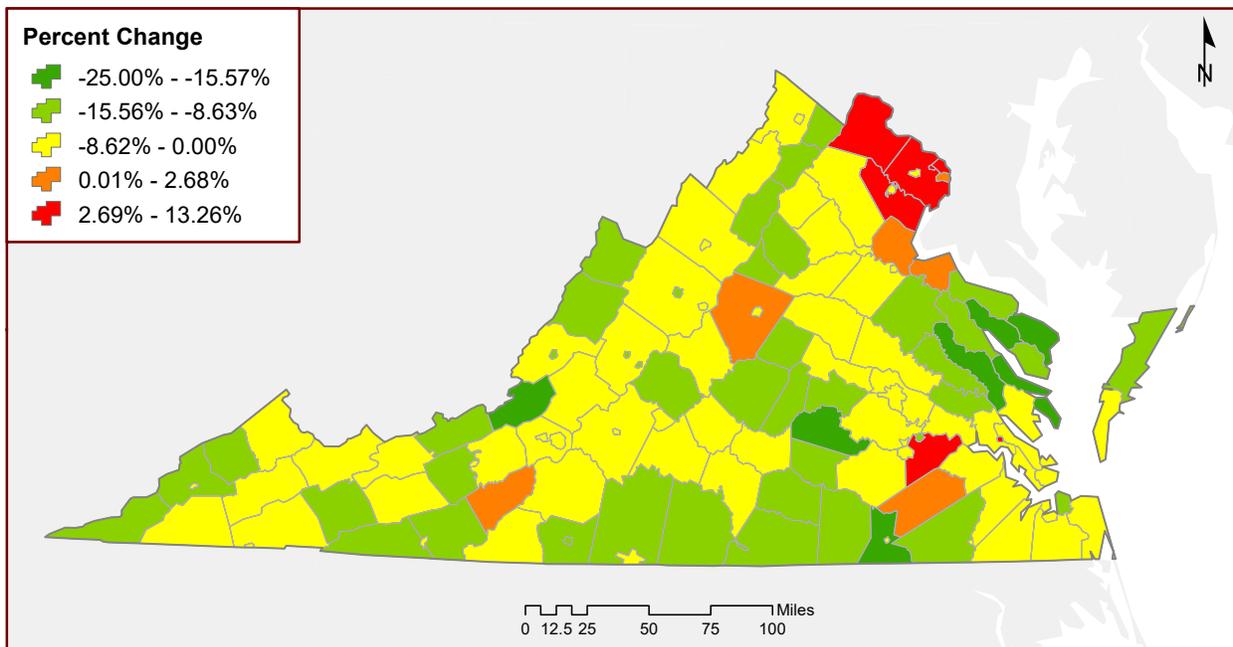
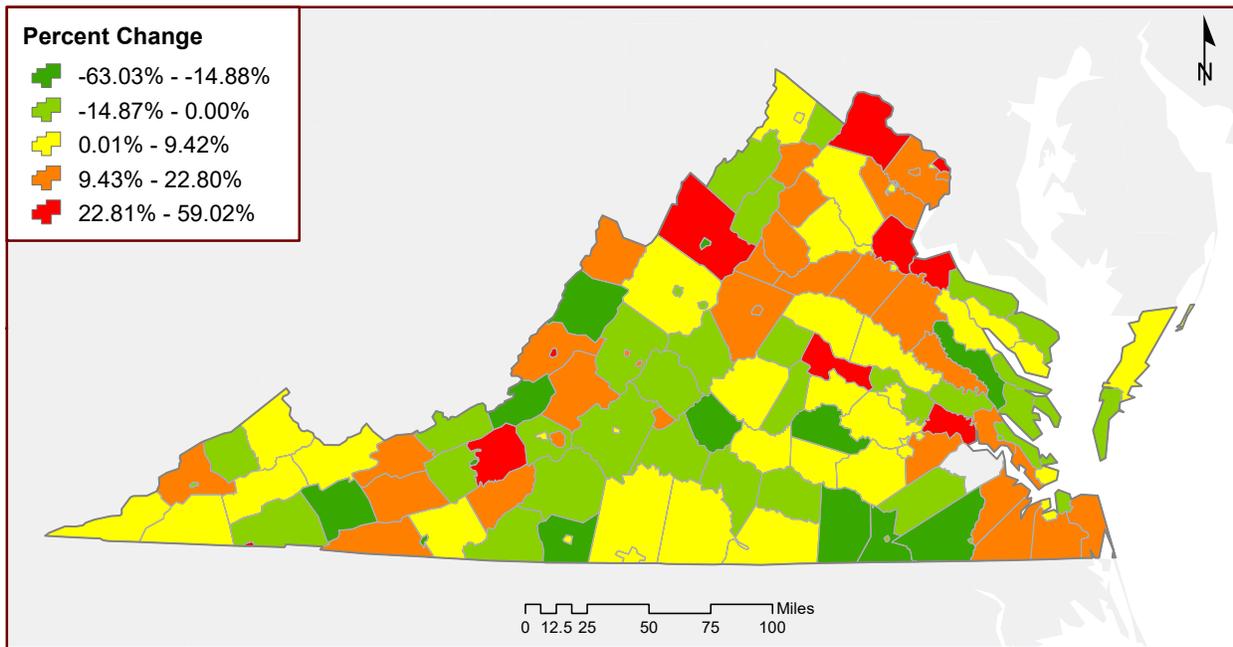
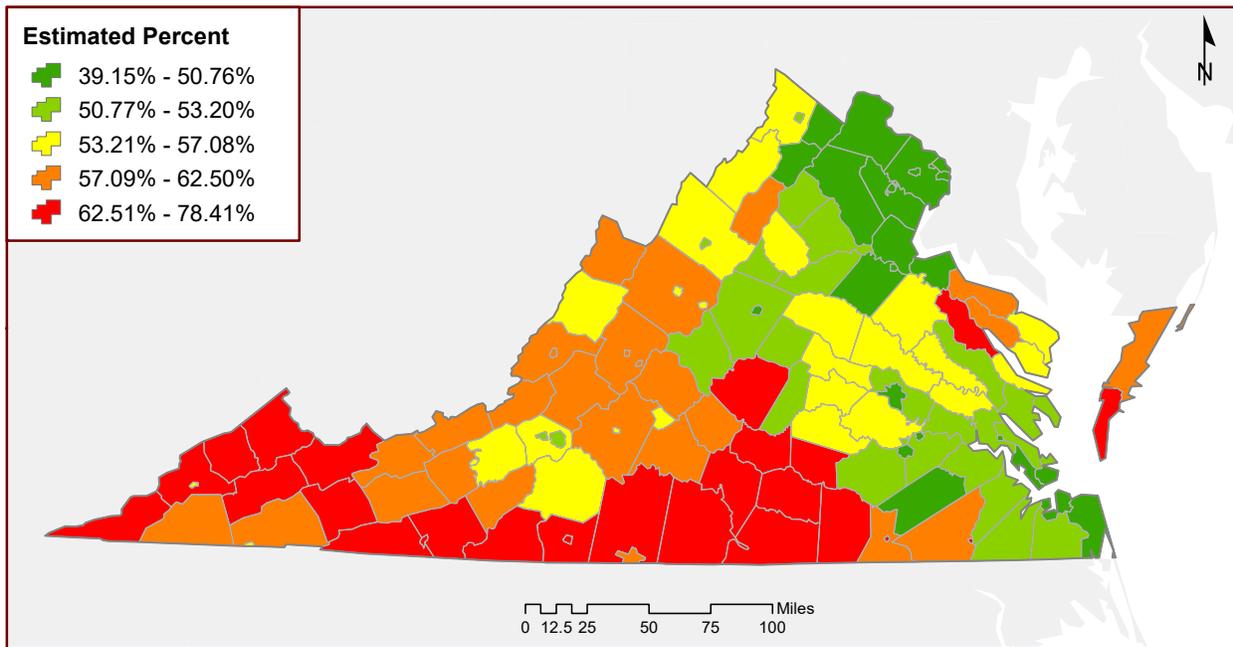


Figure 4. Percent change in total payroll, 2008–2013



Across all counties and independent cities, the housing and transportation cost burden for all LAI household types were negatively correlated with the change in number of establishments and number of jobs as well as with payroll, except for very-low-income individuals. Households comprised of very-low-income individuals appear unaffected by local or regional changes in employment changes or payrolls. While we cannot be certain about the direction of causality (e.g., whether high household costs cause declines in economic activity or vice-versa), the patterns are consistently negative across these household types throughout Virginia. We can assume that the case of very-low-income individuals indicates that they were not significantly impacted by changes in economic activity primarily because their situations are among the most challenging (see Table 1). Figure 5 shows the variation in H+T costs for median-income families.

Figure 5. Estimated percent of total H+T household expenditures for median-income families



Compared to the maps of economic activity across the State (Figures 2–4), the estimated housing and transportation cost burdens for median-income households shows a distinct pattern: the southern and western parts of Virginia experience the highest rates of cost burden, and the northern and eastern parts experience the lowest. At this scale, household income levels are a likely determinant of cost burdens, in direct relationship to economic indicators.

Table 1. Correlation between household cost burdens and economic indicators

| Household Type             | Change         | Change     | Change   |
|----------------------------|----------------|------------|----------|
|                            | Establishments | Employment | Payroll  |
| Median-Income Family       | -0.451**       | -0.322**   | -0.255** |
| Very-Low-Income Individual | -0.397**       | -0.096     | -0.095   |
| Working Individual         | -0.472**       | -0.319**   | -0.257** |
| Single Professional        | -0.465**       | -0.321**   | -0.255** |
| Retired Couple             | -0.487**       | -0.300**   | -0.239** |
| Single-Parent Family       | -0.464**       | -0.318**   | -0.253** |
| Moderate-Income Family     | -0.463**       | -0.312**   | -0.245** |
| Dual-Professional Family   | -0.444**       | -0.320**   | -0.250** |

\*\*Significant at the 0.01 level

In addition to the statewide analysis of counties, we compared the 11 state regions (see Table 2). Similar to counties, regions with lower housing and transportation cost burdens also experienced increased economic activity or recovery. Figures 6, 7, and 8 show that the differences in household costs and economic performance highlights the differences between a low-cost-burdened region like Northern Virginia and high-cost-burden regions like the Northern Neck and South-Central Virginia.

Table 2. Summary of economic activity measures and household cost burdens by region

|                       | <b>Establishments</b> | <b>Employment</b> | <b>Payroll</b>  | <b>% HH H+T</b> |
|-----------------------|-----------------------|-------------------|-----------------|-----------------|
| <b>Region</b>         | <b>% Change</b>       | <b>% Change</b>   | <b>% Change</b> | <b>Average</b>  |
| Charlottesville       | -2.7%                 | -2.7%             | 13.8%           | 65.2%           |
| Hampton Roads         | -5.1%                 | -7.0%             | 5.4%            | 66.9%           |
| Lynchburg             | -6.4%                 | -5.7%             | 4.8%            | 67.5%           |
| Northern Neck         | -12.4%                | -10.8%            | -1.9%           | 70.6%           |
| NOVA                  | 3.7%                  | 4.4%              | 16.0%           | 66.9%           |
| Richmond              | -2.7%                 | -2.9%             | 4.4%            | 67.2%           |
| Roanoke/Blacksburg    | -5.7%                 | -5.6%             | 6.9%            | 67.7%           |
| South-Central         | -9.6%                 | -11.5%            | 0.3%            | 73.1%           |
| Staunton/Harrisonburg | -4.2%                 | -3.7%             | 5.3%            | 67.6%           |
| SW                    | -7.2%                 | -8.5%             | 5.9%            | 73.3%           |
| Winchester            | -6.2%                 | -5.5%             | 4.8%            | 66.6%           |
| <b>Total</b>          | <b>-2.1%</b>          | <b>-2.0%</b>      | <b>10.4%</b>    | <b>68.8%</b>    |

The table shows a relatively strong relationship between the estimated transportation costs for Virginia households and measures of economic activity between 2008 and 2013. This relationship was consistent at both the regional and county level. Additional time-series data are required to further explore whether the observed trend was a function of the particular period examined,

whether reduced household cost burdens influence economic vitality, or whether a causal relationship exists between household cost burdens and economic vitality in either direction.

Figure 6. Relationship between regional household cost burden and employment % change

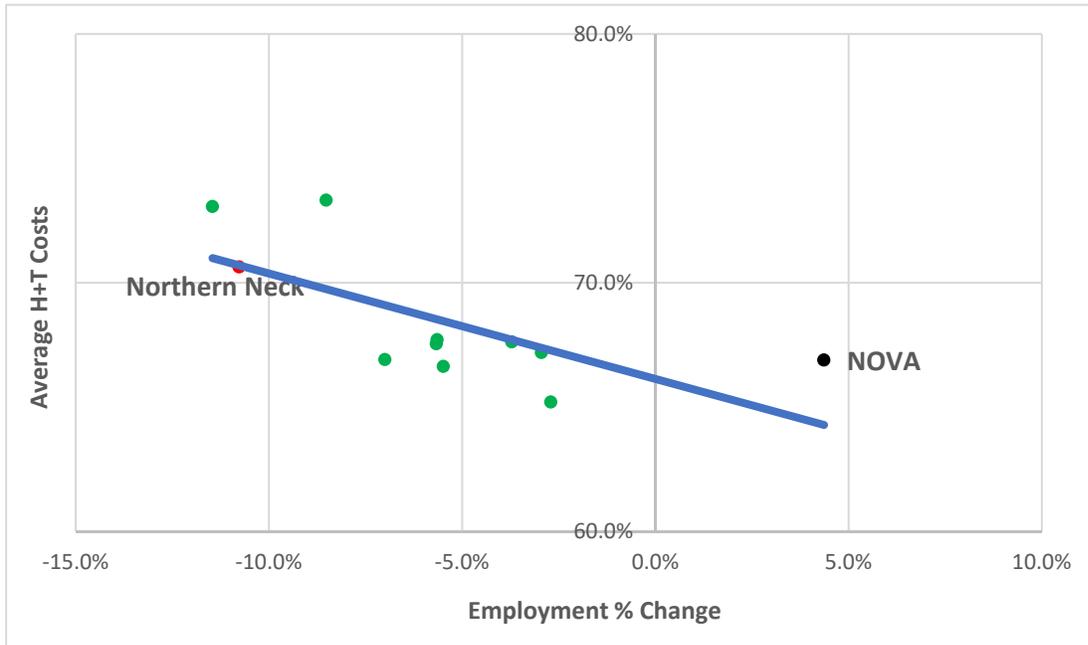


Figure 7. Relationship between regional household cost burden and establishments % change

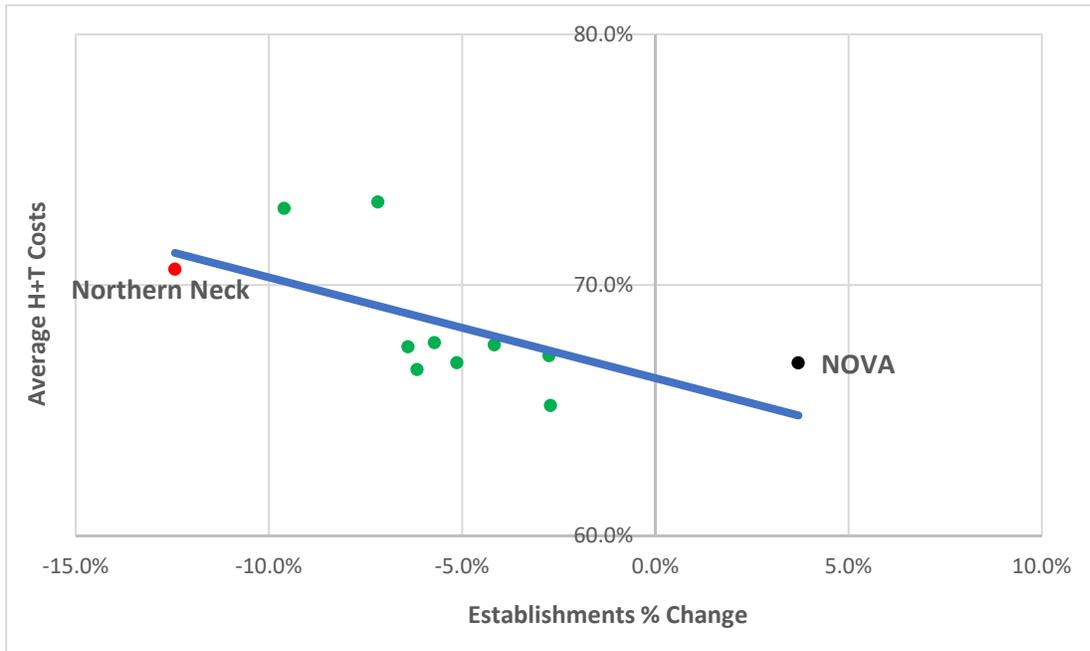
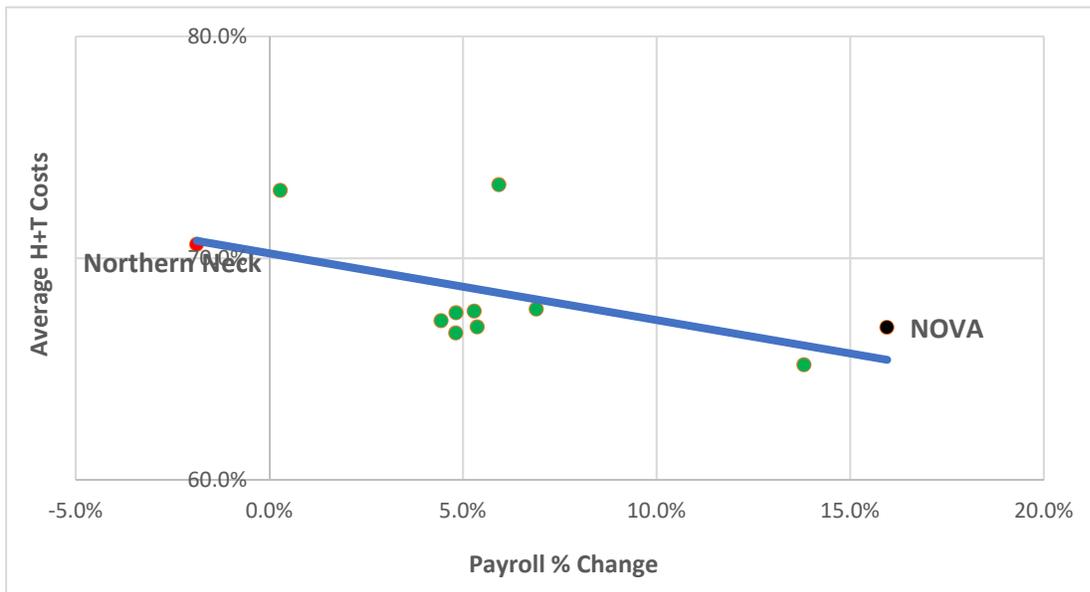


Figure 8. Relationship between regional household cost burden and payroll % change

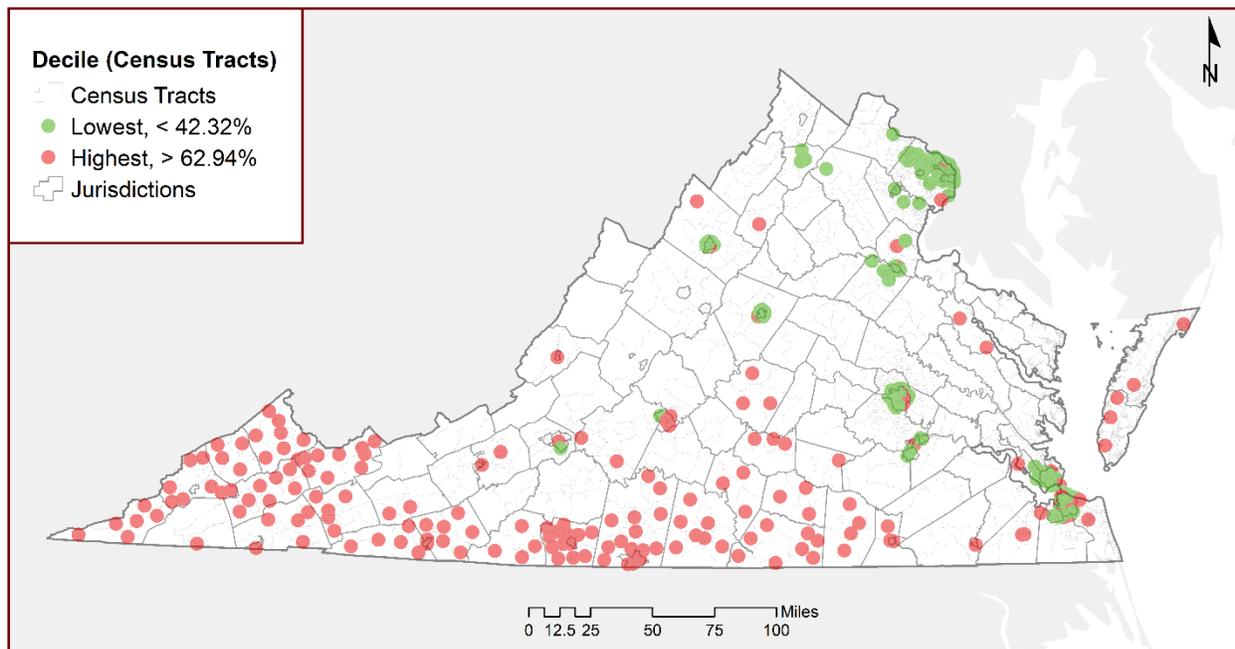


We must also consider the appropriateness of the geographic units of analysis. The regions included exhibited variation despite that housing affordability and transportation access can vary between individual census tracts. In contrast, the impacts of economic activity are not as granular and are better detected at larger aggregations such as at the county level. From a policy perspective, matching these geographic units is important to be consistent with other jurisdictional controls and effects.

Because housing and transportation costs can vary at a neighborhood scale, we compared cost burdens at the sub-county level. This can potentially identify specific areas that include transit-oriented development, transit corridors, or areas of jobs–housing balance. While the LAI data are modeled at the census block group level and can be aggregated to census tracts, the economic data we analyzed for counties and regions are not available at the sub-county level. Despite this, we mapped census tracts across the State and tracts that represented the highest and lowest household cost burdens to find locations exhibiting relatively high or relatively low costs (see Figure 9).

The census tract-level map is similar to the county map. The increased granularity highlights variability within regions and counties. The patterns better reflect areas with higher levels of job density, affordable housing options, and increased transportation access. A comparison of the highest and lowest tract by decile group shows that the high-cost locations are disbursed and mostly rural, with some exceptions. Conversely, the low-cost-burden locations are mostly urban and in the northern counties and independent cities (see Appendix 1 for the lists). Overall, 64% of low-cost tracts are located in independent cities, compared to 24% of high-cost tracts. Including Arlington County and Fairfax County tracts (which are both very urbanized) 94% of all low-cost tracts are in cities. These locations, while mostly urbanized, spend less on combined housing and transportation relative to incomes. Henry County, Pittsylvania County, and Tazewell County include some of the most cost-burdened census tracts while also suffering from particularly weak economic conditions since 2008.

Figure 9. Highest and lowest household cost burden deciles



## Conclusion

The growing body of literature on how housing and transportation cost burdens negatively impact households has implications for local and regional economic vitality. These high costs affect many households (especially those with lower incomes) by leaving little disposable income for savings, retirement, health care, and education, causing families to be economically vulnerable.

These impacts extend beyond the household to local and regional business activities, particularly during slow employment growth and downturns such as the last recession. The results of our analysis show a consistent relationship between high household cost burdens and low regional economic recovery from 2008 to 2013. We suspect that this relationship is not isolated to the analyzed period and that it will continue to be observable. We recommend that the Virginia Department of Transportation, Metropolitan Planning Organizations, and transit agencies within the state consider these dynamics as they plan infrastructure investments and other system improvements. Similarly, housing development planning throughout the state should consider other locational costs, such as transportation, in their planning process.

### Note:

To supplement these results, we contacted 10 organizations responsible for transportation planning and service delivery (see Table 3). The objective was to determine whether any organizations are currently using combined housing and transportation costs for households as part of their modeling or planning activities. Out of the 8 responses received, none said that they have used these data; however, several mentioned that they are considering such data for future planning efforts.

Table 3. Transportation Planning Agencies Contacted

| <b>Type</b> | <b>Agency</b>   |
|-------------|---|
| MPO         | National Capital Region Transportation Planning Board |
| Transit     | DC Metro  |
| MPO         | Hampton Roads Transportation Planning Organization    |
| Transit     | Hampton Roads Transit                                 |
| MPO         | Richmond Area MPO                                     |
| Transit     | Greater Richmond Transit Company                      |
| MPO         | Fredericksburg Area MPO                               |
| Transit     | Fredericksburg Regional Transit                       |
| MPO         | Roanoke Valley MPO                                    |
| Transit     | Valley Metro  |

## References

- Bernstein, S., Makarewicz, C., and McCarthy, K. (2005). *Driven to Spend: Pumping Dollars Out of Our Households and Communities*. Center for Neighborhood Technology.
- Blumenberg, E. (2003). Transportation Costs and Economic Opportunity among the Poor. *The Access Almanac* 23 (2003): 40–41.
- Blumenberg, E., and Ong, P. (2002). Cars, Buses, and Jobs: Welfare Participants and Employment Access in Los Angeles. *Transportation Research Record: Journal of the Transportation Research Board*, 1756, 22–31. doi:10.3141/1756-03
- Blumenberg, E., and Schweitzer, L. (2006). Devolution and Transport Policy for the Working Poor: The Case of the US Job Access and Reverse Commute Program. *Planning Theory & Practice*, 7(1), 7–25. doi:10.1080/14649350500497364
- Burgess, S. (2004). Where are the Good Jobs? The Role of Local Geography. In *Moving Up or Moving On: Who Advances in the Low-Wage Labor Market?* New York: Russell Sage Foundation.
- Cambridge Systematics Inc. and Texas Transportation Institute. (n.d.). *Traffic Congestion and Reliability: Trends and Advanced Strategies for Congestion Mitigation*. Cambridge, MA: Author.
- Carruthers, J. I., and Ulfarsson, G. F. (2003). Urban Sprawl and the Cost of Public Services. *Environment and Planning B: Planning and Design*, 30(4), 503–522. doi:10.1068/b12847
- CNT. (2010). *Penny Wise Pound Foolish: New Measures of Housing + Transportation Affordability*. Chicago, IL: Center for Neighborhood Technology.
- Chmelynski, H. (2008). *National Economic Impacts per \$1 Million Household Expenditures*. Spreadsheet based on IMPLAN Input–Output Model, Jack Faucett Associates ([www.jfaucett.com](http://www.jfaucett.com)).
- Coulton, C., Schramm, M., and Hirsh, A. (2008). *Beyond REO: Property Transfers at Extremely Distressed Prices in Cuyaboga County, 2005–2008*. Cleveland, OH: Case Western Reserve University, Mandel School of Applied Social Sciences, Center on Urban Poverty and Community Development. Retrieved from [http://blog.case.edu/msass/2008/12/09/20081209\\_beyond\\_Reo\\_final.pdf](http://blog.case.edu/msass/2008/12/09/20081209_beyond_Reo_final.pdf)
- Ford, F., et al. (2013). *The Role of Investors in the One-to-Three Family REO Market: The Case of Cleveland*. Cambridge, MA: Joint Center for Housing Studies of Harvard University.

- Frame, W. S. (2010). *Estimating the Effect of Mortgage Foreclosures on Nearby Property Values: A Critical Review of the Literature*. Atlanta, GA: Federal Reserve Bank of Atlanta. Retrieved from [http://www.frbatlanta.org/-/media/Documents/research/publications/economic-review/2010/vol95no3\\_frame.pdf?la=en](http://www.frbatlanta.org/-/media/Documents/research/publications/economic-review/2010/vol95no3_frame.pdf?la=en)
- Gangel, M., Seiler, M. J., and Collins, A. (2013). Exploring the Foreclosure Contagion Effect using Agent-Based Modeling. *The Journal of Real Estate Finance and Economics*, 46, 339–354.
- Gautier, P. A. and Zenou, Y. (2010) Car Ownership and the Labor Market of Ethnic Minorities, *Journal of Urban Economics*, 67, pp. 392–403.
- Gilderbloom, J. I., Riggs, W. W., and Meares, W. L. (2015). Does Walkability Matter? An Examination of Walkability's Impact on Housing Values, Foreclosures and Crime. *Cities*, 42, 13–24. Retrieved from <http://doi.org/10.1016/j.cities.2014.08.001>
- Greenlee, A. J., and Wilson, B. K. (2016). Where Does Location Affordability Drive Residential Mobility? An Analysis of Origin and Destination Communities. *Housing Policy Debate*, 1–24. doi:10.1080/10511482.2016.1163611
- Haas, P. M., Makarewicz, C., Benedict, A., Sanchez, T. W., and Dawkins, C. J. (2006). *Housing & Transportation Cost Trade-Offs and Burdens of Working Households in 28 Metros*. Center for Neighborhood Technology, 2.
- Haas, P., Makarewicz, C., Benedict, A., and Bernstein, S. (2008). Estimating Transportation Costs by Characteristics of Neighborhood and Household. Transportation Research Record: *Journal of the Transportation Research Board*, (2077), 62–70.
- Haas, P. M., Newmark, G. L., and Morrison, T. R. (2016). Untangling Housing Cost and Transportation Interactions: The Location Affordability Index Model—Version 2 (LAIM2). *Housing Policy Debate*, 26(4-5), 568–582.
- Hartgen, D. T., and Fields, M. G. (2006). *Building Roads to Reduce Traffic Congestion in America's Cities: How Much and at What Cost?* Los Angeles, CA: Reason Foundation.
- Henry, J., and Goldstein, D. (2010). *Reducing Foreclosures and Environmental Impacts through Location-Efficient Neighborhood Design*. Retrieved from <https://www.nrdc.org/energy/files/LocationEfficiency4pgr.pdf>
- Hickey, R., Lubell, J., Haas, P., and Morse, S. (2012). *Losing Ground: The Struggle of Moderate-Income Households to Afford the Rising Costs of Housing and Transportation*.

Holzer, H. J., and Martinson, K. (2005). *Can We Improve Job Retention and Advancement among Low-Income Working Parents?* Madison, WI: Institute for Research on Poverty.

Iams, A., and Kaplan, P. (2006). *Economic Development and Smart Growth: 8 Case Studies on the Connections Between Smart Growth Development and Jobs, Wealth, and Quality of Life in Communities.* Washington, DC: International Economic Development Council.

Immergluck, D., and Smith, G. (2005). *There Goes the Neighborhood: The Effect of Single-Family Mortgage Foreclosures on Property Values.* Chicago, IL: Woodstock Institute. Retrieved from [https://www.woodstockinst.org/sites/default/files/attachments/TGTN\\_Report%20\(1\)\\_0.pdf](https://www.woodstockinst.org/sites/default/files/attachments/TGTN_Report%20(1)_0.pdf)

Jewkes, M. D., and Delgado, L. M. (2010). Weaknesses of Housing Affordability Indices Used by Practitioners. *Journal of Financial Counseling and Planning*, 21(1), 43–52.

Jones, M.G. (2000). *Coordinating Transportation Services for Low Income Workers.* The Finance Project, October.

Kaza, N., Riley, S. F., Quercia, R. G., and Tian, C. Y. (2016). Location Efficiency and Mortgage Risks for Low-Income Households. *Housing Policy Debate*, 1–16. doi:10.1080/10511482.2016.1159972

Lipman, B. J. (2006). *A Heavy Load: The Combined Housing and Transportation Burdens of Working Families.* Washington, D.C.: Center for Housing Policy.

Litman, T. (2015). *Evaluating Public Transit Benefits and Costs.* Victoria Transport Policy Institute. Retrieved from <http://www.vtpi.org/tranben.pdf>

Macek, N. M., et al. (2001). *What Is the Effect of Commute Time on Employment?.* Washington, DC: National Research Council.

Pivo, G. (2013). The Definition of Affordable Housing: Concerns and Related Evidence. Working paper. Retrieved from [http://www.desktoporiginator.com/resources/file/fundmarket/pdf/hoytpivo\\_mfhousing\\_affordabl\\_chousingdef\\_122013.pdf](http://www.desktoporiginator.com/resources/file/fundmarket/pdf/hoytpivo_mfhousing_affordabl_chousingdef_122013.pdf)

Puentes, R., and Tomer, A. (2008). *The Road... Less Traveled: An Analysis of Vehicle Miles Traveled Trends in the US,* Brookings Institution.

Raphael, S. and Rice, L. (2002) Car Ownership, Employment, and Earnings. *Journal of Urban Economics*, 52, 109–130.

Rauterkus, S. Y., Thrall, G. I., and Hangen, E. (2010). Location Efficiency and Mortgage Default. *The Journal of Sustainable Real Estate*, 2, 117–141.

Renkow, M., and Hoover, D. M. (2000). Commuting, Migration, and Rural–Urban Population Dynamics. *Journal of Regional Science*, 40, 261–287. doi:<http://dx.doi.org/10.1111/0022-4146.00174>

Revington, N., and Townsend, C. (2016). Market Rental Housing Affordability and Rapid Transit Catchments: Application of a New Measure in Canada. *Housing Policy Debate*, 1–23. doi:10.1080/10511482.2015.1096805

Roback, J. (1982). Wages, Rents, and the Quality of Life. *Journal of Political Economy*, 90, 1257–1278. doi:<http://dx.doi.org/10.1086/261120>

Roberto, E., and Brookings Institution. (2008). *Commuting to Opportunity?: The Working Poor and Commuting in the United States*. Washington, DC: Brookings Institution, Metropolitan Policy Program.

Sanchez, T. W., Makarewicz, C., Haas, P. M., and Dawkins, C. J. (2006, August). Transportation Costs, Inequities, and Trade-Offs. In the *Annual Meeting of the Transportation Research Board*, Washington, DC, January.

Sanchez, T. W. and Brenman, M. (2007). *The Right to Transportation: Moving to Equity*, Chicago: American Planning Association.

Sanchez, T. W. (1999) The Connection Between Public Transit and Employment: The Cases of Portland and Atlanta, *Journal of the American Planning Association*, 65, 284–296.

Sanchez, T.W., Shen, Q., and Peng, Z. (2004). Transit Mobility, Jobs Access and Low-Income Labour Participation in US Metropolitan Areas. *Urban Studies*, 41(7), 1313–1331.

Sarzynski, A. and Levy, A. (2010). *Spatial Efficiency and Regional Prosperity: A Literature Review and Policy Discussion*. George Washington Institute of Public Policy (GWIPP). White Paper.

Smith, J. R., and Brooks, A. (2012). Transit Oriented Development is Good Community Development. In *Investing in What Works for America's Communities*, 255–263. Federal Reserve Bank of San Francisco.

Steg, L., and Gifford, R. (2005). Sustainable Transportation and Quality of Life. *Journal of Transport Geography*, 13, 59–69. doi: <http://dx.doi.org/10.1016/j.jtrangeo.2004.11.003>

- Tighe, J. R., and Ganning, J. P. (2016). Do Shrinking Cities Allow Redevelopment Without Displacement? An Analysis of Affordability Based on Housing and Transportation Costs for Redeveloping, Declining, and Stable Neighborhoods. *Housing Policy Debate*, 1–16. doi:10.1080/10511482.2015.1085426
- Tremoulet, A., Dann, R. J., and Adkins, A. (2016). Moving to Location Affordability? Housing Choice Vouchers and Residential Relocation in the Portland, Oregon, Region. *Housing Policy Debate*, 1–22. doi:10.1080/10511482.2016.1150314
- Urban Land Institute. (2007). *Lack of Affordable Housing Near Jobs: A Problem for Employers and Employees*. Retrieved from <http://www.housingcolorado.org/images/uploads/47ab69762a6aa>
- Waller, M. (2005). *High Cost or High Opportunity Cost? Transportation and Family Economic Success*. Washington, DC: Brookings.
- Waller, M., and Blumenberg, E. (2009). The Long Journey to Work: A Federal Transportation Policy for Working Families. In *Taking the High Road: A Metropolitan Agenda for Transportation Reform*. Washington, DC: Brookings.
- Walter, R. J., and Wang, R. (2016). Searching for Affordability and Opportunity: A Framework for the Housing Choice Voucher Program. *Housing Policy Debate*, 1–22. doi:10.1080/10511482.2016.1163276
- Wardrip, K., Williams, L., and Hague, S. (2011). *The Role of Affordable Housing in Creating Jobs and Stimulating Local Economic Development*. Center for Housing Policy, MacArthur Foundation.

Appendix 1. Lowest and Highest Cost Burden by Census Tract

| Jurisdiction          | Avg.  |     | Jurisdiction         | Avg.   |     |
|-----------------------|-------|-----|----------------------|--------|-----|
|                       | H+T   | No. |                      | H+T    | No. |
| Alexandria city       | 38.5% | 20  | Accomack County      | 64.4%  | 2   |
| Arlington County      | 40.3% | 34  | Bedford County       | 64.9%  | 2   |
| Charlottesville city  | 39.2% | 9   | Bristol city         | 66.4%  | 1   |
| Fairfax city          | 39.1% | 1   | Brunswick County     | 67.8%  | 4   |
| Fairfax County        | 41.0% | 22  | Buchanan County      | 72.7%  | 7   |
| Fauquier County       | 39.3% | 1   | Buckingham County    | 65.0%  | 3   |
| Fredericksburg city   | 26.4% | 5   | Carroll County       | 67.4%  | 6   |
| Hampton city          | 39.2% | 8   | Charlotte County     | 68.6%  | 3   |
| Harrisonburg city     | 37.8% | 5   | Charlottesville city | 74.0%  | 2   |
| Hopewell city         | 41.6% | 2   | Chesapeake city      | 67.2%  | 2   |
| Loudoun County        | 41.1% | 1   | Covington city       | 63.1%  | 1   |
| Lynchburg city        | 41.1% | 1   | Danville city        | 65.7%  | 6   |
| Manassas city         | 41.2% | 1   | Dickenson County     | 68.4%  | 4   |
| Newport News city     | 40.6% | 3   | Emporia city         | 69.0%  | 2   |
| Norfolk city          | 37.5% | 25  | Essex County         | 63.7%  | 2   |
| Petersburg city       | 39.2% | 2   | Fairfax County       | 68.7%  | 2   |
| Portsmouth city       | 38.1% | 5   | Franklin city        | 77.3%  | 1   |
| Prince William County | 42.0% | 2   | Fredericksburg city  | 103.9% | 1   |
| Richmond city         | 37.4% | 32  | Galax city           | 78.1%  | 2   |
| Roanoke city          | 41.5% | 1   | Grayson County       | 69.4%  | 5   |
| Spotsylvania County   | 41.0% | 3   | Greensville County   | 64.3%  | 1   |
| Stafford County       | 42.3% | 1   | Halifax County       | 65.7%  | 7   |
| Warren County         | 40.0% | 3   | Hampton city         | 97.5%  | 2   |

|              |              |            |                      |        |    |
|--------------|--------------|------------|----------------------|--------|----|
| <b>Total</b> | <b>38.8%</b> | <b>187</b> | Harrisonburg city    | 152.2% | 1  |
|              |              |            | Henry County         | 66.7%  | 12 |
|              |              |            | Lee County           | 69.6%  | 6  |
|              |              |            | Lunenburg County     | 67.6%  | 3  |
|              |              |            | Lynchburg city       | 82.4%  | 3  |
|              |              |            | Martinsville city    | 72.2%  | 2  |
|              |              |            | Mecklenburg County   | 66.8%  | 8  |
|              |              |            | Montgomery County    | 64.6%  | 1  |
|              |              |            | Newport News city    | 69.8%  | 1  |
|              |              |            | Norfolk city         | 71.4%  | 5  |
|              |              |            | Northampton County   | 68.6%  | 3  |
|              |              |            | Nottoway County      | 65.5%  | 1  |
|              |              |            | Page County          | 66.3%  | 1  |
|              |              |            | Patrick County       | 64.8%  | 4  |
|              |              |            | Pittsylvania County  | 65.1%  | 12 |
|              |              |            | Portsmouth city      | 66.3%  | 1  |
|              |              |            | Prince Edward County | 67.4%  | 3  |
|              |              |            | Prince George County | 63.8%  | 1  |
|              |              |            | Radford city         | 64.7%  | 1  |
|              |              |            | Richmond city        | 82.3%  | 5  |
|              |              |            | Roanoke city         | 63.1%  | 1  |
|              |              |            | Rockingham County    | 63.6%  | 1  |
|              |              |            | Russell County       | 68.5%  | 7  |
|              |              |            | Scott County         | 63.6%  | 1  |
|              |              |            | Smyth County         | 66.8%  | 5  |
|              |              |            | Stafford County      | 63.3%  | 1  |

|                     |              |            |
|---------------------|--------------|------------|
| Suffolk city        | 64.0%        | 3          |
| Tazewell County     | 65.5%        | 10         |
| Virginia Beach city | 66.7%        | 2          |
| Washington County   | 64.9%        | 4          |
| Wise County         | 65.9%        | 8          |
| Wythe County        | 64.0%        | 2          |
| <b>Total</b>        | <b>68.8%</b> | <b>187</b> |