

# Non-Metropolitan to Metropolitan County Commuting: Gateway to Prosperity or Barbarians at the Gate

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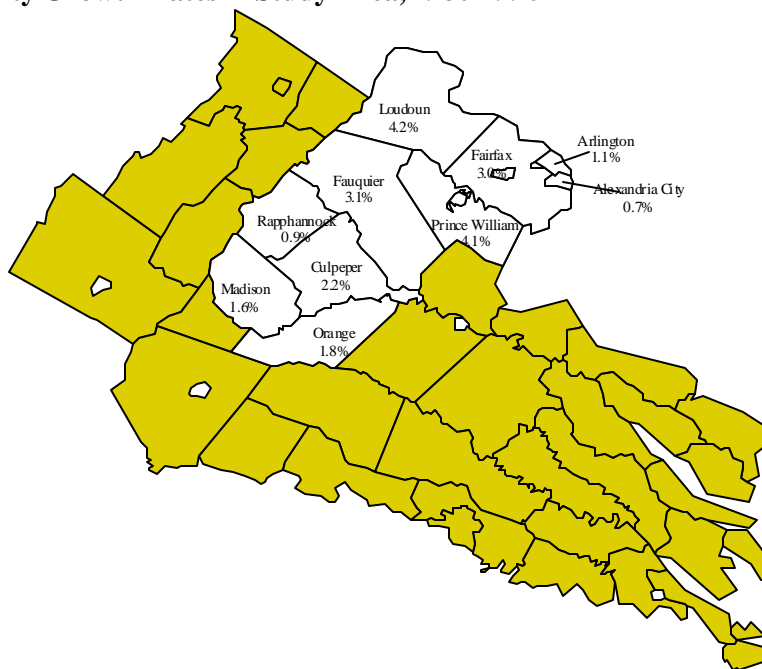
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## INTRODUCTION

Non-metropolitan counties adjacent to metropolitan areas often face development pressures from rapid residential population growth. The greater Washington, D.C. and Northern Virginia (NOVA) area, one of the fastest growing metropolitan centers in the United States, is a good example. United States census data indicate that the population of the NOVA metropolitan area, composed of Arlington, Fairfax, Loudoun, and Prince William counties and the independent cities of Fall Church, Alexandria, and Manassas, grew at an average rate of 2.8 percent per year between 1980 and 1990 (Figure 1). The population of Fauquier County, a non-metropolitan county<sup>2</sup> directly adjacent to the current metropolitan fringe, grew at a rate of 3.1 percent per year over the same period. The slightly more distant non-metropolitan counties of Culpeper, Madison, Orange, and Rappahannock grew at lower rates ranging from 0.9 percent to 2.2 percent. Further, over 3/4 of the population gains in this cluster of non-metropolitan counties was driven by the net in-migration of households.

**Figure 1: County Growth Rates in Study Area, 1980-1990**



Sources: County and City Data Book 1967, U. S. Bureau of the Census, pp 382-402;

Regional Economic Information System (REIS) CD-ROM 1969-1995, Bureau of Economic Analysis.

Population growth in non-metropolitan counties adjacent to metropolitan centers is almost always accompanied by rapid growth in commuting from non-metropolitan to metropolitan areas. The rate of growth of the resident out-commuting population in Culpeper, Fauquier, Madison, Orange, and Rappahannock counties has been more rapid from 1980 to 1990 than the rate of growth of residents employed within the county (Table 1).<sup>1</sup> Further, an examination of total commuting for the 1980 to 1990 period reveals that over half of the total increase in cross-county commuting in the five-county area occurred from Fauquier County to the NOVA metropolitan area.

<sup>1</sup> The analysis is restricted to 1980 and 1990, due to the availability of U.S. Census of Population data on cross-county commuting in those years.

<sup>2</sup> Fauquier County is classified as non-metropolitan in the analysis based on that designation at the time of the 1990 Census of Population. It was reclassified as metropolitan in 1993 based on the strength of its commuting linkages to the Washington, DC and NOVA metropolitan area.

**Table 1: Commuting Trends: Top Five Workplaces for Workers Residing in the Five Non-Metropolitan Counties, 1980-1990**

<i>Place of Residence</i>	<i>Place of Work</i>	<i>Number of Workers in 1980</i>	<i>Number of Workers in 1990</i>	<i>Annual Growth Rate</i> (%)
Culpeper	<i>Local:</i>			
	Culpeper	7,011	7,793	1.1
	<i>Outcommuters:</i>			
	Fauquier	748	1,646	8.2
	Fairfax <sup>1</sup>	589	1,483	9.7
	Prince William <sup>2</sup>	291	669	8.7
	District of Columbia	170	247	3.8
	<i>Outcommuters Total</i>	<i>1,798</i>	<i>4,045</i>	<i>8.4</i>
Fauquier	<i>Local:</i>			
	Fauquier	9,556	12,967	3.1
	<i>Outcommuters:</i>			
	Fairfax <sup>1</sup>	2,183	5,308	9.3
	Prince William <sup>2</sup>	2,167	3,643	5.3
	District of Columbia	723	997	3.3
	Loudoun	606	993	5.1
	<i>Outcommuters Total</i>	<i>5,679</i>	<i>10,941</i>	<i>6.8</i>
Madison	<i>Local:</i>			
	Madison	2,091	2,381	1.3
	<i>Outcommuters:</i>			
	Culpeper	828	1,142	3.3
	Orange	430	589	3.2
	Albermarle <sup>3</sup>	388	580	4.1
	Fairfax <sup>1</sup>	40	130	12.5
	<i>Outcommuters Total</i>	<i>1,686</i>	<i>2,441</i>	<i>3.8</i>
Orange	<i>Local:</i>			
	Orange	4,870	5,646	1.5
	<i>Outcommuters:</i>			
	Albermarle <sup>3</sup>	924	1,056	1.3
	Spotsylvania <sup>4</sup>	459	745	5.0
	Culpeper	428	725	5.4
	Fairfax <sup>1</sup>	75	335	16.1
	<i>Outcommuters Total</i>	<i>1,886</i>	<i>2,861</i>	<i>4.3</i>
Rappahannock	<i>Local:</i>			
	Rappahannock	1,203	1,320	0.9
	<i>Outcommuters:</i>			
	Fauquier	263	495	6.5
	Fairfax <sup>1</sup>	201	415	7.5
	Culpeper	323	293	-1.0
	Prince William <sup>2</sup>	7	275	44.4
	<i>Outcommuters Total</i>	<i>794</i>	<i>1,478</i>	<i>6.4</i>

<sup>1</sup> Fairfax County + Fairfax City + Falls Church City;

<sup>2</sup> Prince William County+Manassas City+Manassas Park City;

<sup>3</sup> Albermarle+Charlottesville;

<sup>4</sup> Spotsylvania+Fredericksburg;

Source: REIS CD-ROM 1969-1995, Bureau of Economic Analysis.

Note: The remainder of the study focuses on only commuting from the five counties to the Northern Virginia Metropolitan area.

Informed debate on policy options to mitigate the private and social costs of commuting must be predicated on a sound understanding of individual commuting decisions and likely reactions to policy interventions in these areas. The major private costs of commuting are the workers' travel time and travel related expenses. Social costs include the congestion that commuters impose on other road users and the pollution associated with increased automobile emissions (Vickrey, 1969). The fiscal impact of the escalating share of residents who live in non-metropolitan counties but work in adjacent metropolitan areas is also of increasing concern to local economic development planners and policy makers. Counties supply public services, such as primary and secondary education, and seek revenues from real property and other taxes to fund these services. Cross-county commuters may possess different demographic and employment characteristics from those of non-commuting county residents and may have different impacts on the revenues and expenditures of the county.

At the most basic level, cross-county commuting arises from the spatial separation of individuals' housing and employment locations. Policies to control the social costs of commuting can focus on changing the availability and cost of housing through zoning and property taxes or changing the costs associated with commuting through transportation infrastructure development (for example, more and better roads, trains, and buses), the imposition of road tolls, and automobile and gasoline taxes. Labor market policies to increase local employment options represent a third, and often overlooked, mechanism for influencing commuting patterns.

Despite the rapid growth in non-metropolitan to metropolitan area commuting and its potential impact on non-metropolitan counties, the factors underlying non-metropolitan residents' decisions to commute to metropolitan areas for employment have been the focus of only limited empirical analysis. This report presents results from a study of the earnings and non-earnings components of individual commuting decisions on the non-metropolitan fringe of the greater Washington D.C. and NOVA metropolitan area. The earnings component focuses on differences in earnings an individual can expect to receive in the local non-metropolitan labor market and the adjacent metropolitan labor market. The non-earnings component focuses on costs associated with commuting, including the value of one's time spent commuting, preferences for housing, and relative ease of finding employment in the two labor market areas. While the empirical results are specific to non-metropolitan Virginia counties within commuting distance of the greater Washington D.C. and NOVA metropolitan area, they have important implications for other rural communities facing increased commuting linkages with metropolitan areas.

## **WHERE DO THE DATA COME FROM?**

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Study data come from the 1990 United States Census Bureau Public Use Microdata Sample (PUMS). The PUMS provides detailed household and individual level information on the 5 percent sample of the United States population who completed the census long-form questionnaire. The PUMS is readily available to local policy analysts on a CD ROM diskette. To protect the identity of respondents, non-metropolitan counties are grouped together into Public Use Microdata Areas (PUMAs) with total populations of approximately 100,000 persons. The PUMA grouping of Culpeper, Fauquier, Madison, Orange, and Rappahannock counties is used in this study. Unfortunately, no information on household location within the PUMA grouping of five counties is available.

## **WHO ARE THE COMMUTERS?**

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A sample of resident individuals employed in the five non-metropolitan counties or commuting to metropolitan counties in NOVA or to Washington, D.C. in 1990 was drawn from the PUMA. Workers under 16 years of age, those with disabilities, those working less than 10 weeks in the previous year or on average less than 10 hours per week, and those attending school and working less than 20 hours per week are excluded from the sample, since the factors affecting their decisions to commute are fundamentally different from other workers. Of the 1,830 individuals in the final sample, 1,236 are employed within the five non-metropolitan counties and 594 commute to metropolitan NOVA counties or to Washington, D.C. Comparisons of the personal and household characteristics between the commuting and non-commuting sub-samples are made in Table 2. The average time spent traveling one-way to work for those employed in non-metropolitan counties is 19 minutes, while those commuting to the metropolitan area spend 50 minutes, on average, each way. For female, education levels, race, married, born in state, owner, recently moved, and self-employed and occupations, the mean can be interpreted as the portion of the sample with the characteristic, (e.g. 44 percent of the total sample is female). Commuters are more likely to be male and white, have higher levels of education, not have children, have been born outside of Virginia, live in more expensive homes, and receive higher average wages. Commuters are less likely to be self-employed (7 percent versus 11 percent for non-commuters) and less likely to work in sales and service (16 percent versus 22 percent), or agricultural sector positions (3 percent versus 5 percent).

## **RESULTS AND DISCUSSION**

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Large incentives to commute are created by higher earnings in metropolitan labor markets. A 35-year old, white, college educated male could expect to receive \$10.22 per hour in the non-metropolitan labor market and \$20.67 if he commutes to work in the Washington, D.C. and NOVA metropolitan area (Table 3). The resulting earnings gap is \$10.46 per hour. The earnings gap varies with characteristics that influence individual earnings in both labor market areas (that is females, age, blacks, and educational levels). But for every group the earnings gap is quite large and presents a significant incentive to commute.<sup>2</sup>

### **Factors Influencing Non-Metropolitan and Metropolitan Earnings**

Higher earnings in metropolitan areas are a major incentive for non-metropolitan to metropolitan area commuting for all workers. However, individuals face different earnings opportunities in both non-metropolitan and metropolitan labor markets based on personal characteristics. Personal characteristics that influence hourly earnings in non-metropolitan and metropolitan labor markets can be grouped as human capital and structural factors. Human capital factors directly affect productivity of a worker and thereby increase earnings. Educational attainment is perhaps the most commonly used measure of human capital. Five levels of educational attainment are identified in the study: less than high school, high school, some college, college, and post-graduate.

Empirical results from the study indicate individual hourly earnings increase at each successive level of educational attainment for both those living and working in non-metropolitan areas and those commuting to work in the metropolitan area. In the non-metropolitan labor market, individuals show a

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<sup>2</sup> The empirical method employed to estimate the earnings equations and the non-earnings component of commuting decisions is described in the appendix.

**Table 2: Characteristics of Workers Employed within the Five Non-Metropolitan Counties and Those Commuting to Work in the Metropolitan Area**

	<i>All workers</i>	<i>Locally employed workers</i>	<i>Workers commuting to metro area</i>
	-----Mean-----		
*One way commuting (minutes)	28.90	18.60	50.40
*Female	0.44	0.49	0.34
Age	38.30	38.50	37.70
Education:			
*Less than high school	0.21	0.24	0.15
High school	0.37	0.39	0.35
*Some college	0.25	0.21	0.32
College	0.14	0.12	0.14
More than college	0.05	0.05	0.05
Race:			
Black	0.12	0.12	0.10
*White	0.85	0.84	0.87
Married	0.69	0.69	0.70
No. of children in a household:			
No. children<6	0.31	0.30	0.33
*No. children>=6, <16	0.56	0.60	0.49
*Born in the State	0.57	0.63	0.44
*Rooms	6.40	6.22	6.76
*Owner	0.73	0.71	0.79
*Recently moved	0.55	0.51	0.64
Annual income of other household members (dollars)	2,235	2,189	2,332
*Self-employed	0.10	0.11	0.07
Occupations:			
Managerial, professional	0.24	0.23	0.26
Technical, administrative support staff	0.22	0.21	0.23
*Sales, services	0.20	0.22	0.16
*Agricultural	0.05	0.05	0.03
Construction	0.09	0.08	0.10
Other	0.22	0.22	0.21
*Weeks worked last year	48.58	48.09	49.60
*Hours worked per week	40.88	39.86	42.99
*Hourly wage rate (dollars)	12.11	10.87	14.70
No. of individuals	1,830	1,236	594

Two tailed t-tests are conducted for testing the hypotheses that the means of the two groups of observations are equal.

\* denotes significantly different means for local and commuting workers at the 5 percent level.

**Source: PUMS 1990**

they have a high school degree, and 21 percent less if they have some college but not a degree. Similarly, individuals with post-graduate study show 25 percent greater earnings. By contrast, in the metropolitan labor market, earnings are not significantly different for individuals with less than a college degree. Individuals who have not completed high school earn 17 percent less than those with a college degree. But those with high school degrees and some college earn only 6 and 10 percent less, respectively. Post-graduate studies, however, increase hourly earnings by 34 percent relative to a college education. Little return to education below a college degree occurs in the metropolitan labor market. However, the result should be viewed with caution since lower levels of education may have a significant influence on the

availability of jobs and the willingness of individuals to accept the wages offered. The results also indicate that, other things being held equal, individuals initially earn more with age in both labor markets, but earnings peak at 49 and 54 years of age in non-metropolitan and metropolitan labor markets, respectively, and then decline with age.

In contrast to human capital factors, structural factors influence potential earnings but not a worker's productive abilities. The two major structural factors captured in the study are gender and ethnicity. Females are expected to have lower earnings for two reasons. First, females are more likely, due to childbearing, to have spent extended periods out of the labor market and, therefore, have less work experience for a given age and educational level than male workers. Second, despite significant advances over the past few decades, female wages remain lower than male wages even after controlling for all potential gaps in human capital (Darity and Mason, 1998). Similarly, Blacks may still face significant discrimination in labor markets and receive lower earnings in non-metropolitan or metropolitan labor markets for a given level of human capital. The results suggest females earn 23 percent less than males in non-metropolitan labor markets and 24 percent less than males in metropolitan labor markets. Blacks do not show statistically different hourly earnings from whites in non-metropolitan labor markets. However, Blacks do show significantly lower earnings in metropolitan labor markets (20 percent less than whites).

## **Non-Earnings Factors Influencing Commuting Decisions**

The earnings gap is not, however, the only factor associated with the choice to commute from a non-metropolitan area. Workers also look at non-earnings commuting costs. Based on theoretical models of individual choice of job and housing location, three basic sets of determinants of the non-earnings commuting costs are specified in the analysis: value of leisure, preference for housing, and ability to find jobs. The first set identifies factors associated with differences in the individual's value of time not spent working. Gender, marital status, children under 5 or between 5 and 16, age, income of other household members, and hours and weeks worked are all expected to influence how individuals value non-work related time and, thus, the implicit cost of time spent commuting. Females still bear primary responsibility for many household activities, including child-care, that may raise the value of non-work related time and make them less likely to commute. Therefore, the influence of gender on commuting behavior is expected to be more pronounced when children are present in the household. Similarly, married individuals, older individuals, and individuals in households with significant sources of non-earnings income are expected to place greater value on non-work related time and be less likely to commute. The potential impact of individuals working longer hours per week and more weeks per year, by contrast, is not clear *a priori*. Longer employment hours increase the value of time not spent at work. However, longer employment hours reduce the ratio of time spent commuting to time spent working and, therefore, the costs of commuting as a portion of total earnings.

After controlling for the earnings component of commuting decisions by using the predicted ratio of metropolitan to non-metropolitan earnings, the results suggest that females and families with children between the ages of 5 and 16 are significantly less likely to commute to work in the metropolitan area. Hours worked per week, on the other hand, significantly increase the likelihood of commuting. Contrary to expectations, however, the income of other household members and age show no statistically significant relationship with commuting choice.



**Table 3: Predicted earnings gap for individual groups**

Gender	Age	Education	Race	Marital Status	Predicted wage rate in non-metro areas	Percent change from non-metro base	Predicted wage rate in metro areas	Percent change from metro base	Wage difference*
					(\$/hour)	(%)	(\$/hour)	(%)	(\$/hour)
<i>Male</i>	<i>35</i>	<i>College</i>	<i>White</i>	<i>Married</i>	<i>10.22</i>	<i>---</i>	<i>20.67</i>	<i>---</i>	<i>10.46</i>
<b>Female</b>	<b>35</b>	<b>College</b>	<b>White</b>	<b>Married</b>	<b>7.94</b>	<b>-22.3</b>	<b>15.78</b>	<b>-23.7</b>	<b>7.84</b>
Male	<b>20</b>	College	White	Married	7.25	-29.1	13.75	-33.5	6.50
Male	<b>50</b>	College	White	Married	11.29	10.5	24.59	19.0	13.30
Male	<b>65</b>	College	White	Married	9.80	-4.1	23.12	11.9	13.32
		<b>Less than high school</b>							
Male	35	<b>school</b>	White	Married	6.52	-36.2	17.27	-16.5	10.75
Male	35	<b>High school</b>	White	Married	7.45	-27.1	19.46	-5.9	12.01
Male	35	<b>Some college</b>	White	Married	8.06	-21.1	19.10	-7.6	11.04
Male	35	<b>More than college</b>	White	Married	12.80	25.2	27.70	34.0	14.90
Male	35	College	<b>Black</b>	Married	9.19	-10.1	16.63	-19.6	7.44
				<b>Not</b>					
Male	35	College	White	<b>married</b>	11.07	8.3	22.04	6.6	10.97

Note: The row with italic letters is for the base worker. Bold letters represent changes from the base.

\*Wage difference = Predicted wage rate in metro areas – Predicted wage rate in non-metro areas.

Source: PUMS.

The second set of non-earnings factors influencing commuting decisions is related to individual preferences for housing. Individuals with stronger preferences for ownership of large homes are more willing to live farther from a metropolitan area to take advantage of lower housing costs and are willing to bear the longer commutes associated with their choices. The results find that owning a home and the number of rooms in the home both increase the probability of commuting to a metropolitan area.

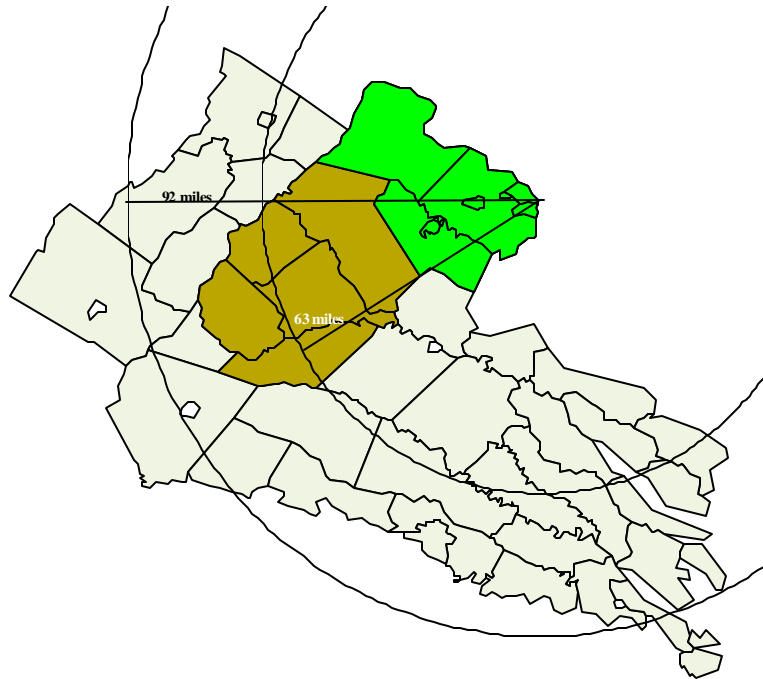
The third set of factors identifies constraints to the individual's choice of workplace location. Self-employment, occupational type, duration of attachment to the area, and race are all likely to influence the set of employment location options open to an individual. Self-employed individuals are more able to closely match employment location and housing location. Similarly, individuals in managerial and professional specialty occupations and individuals in technical and administrative support staff occupations are more likely to have to commute to match their skills to employment opportunities. The study finds that self-employed workers are, indeed, less likely to commute and those employed in technical and administrative support occupations are more likely to commute to metropolitan areas for employment. But individuals in managerial and professional occupations do not show a greater propensity to commute.

Two variables, born in the state and moved to the county in the previous five years, are used as indicators of attachment to the non-metropolitan area of residence. These variables may also capture the potential impact of longer periods of residence on local employment information networks and employment - residential location matches. Individuals who moved to the current housing location in the past five years are found to be more likely to commute, while those born in Virginia are more likely work in the non-metropolitan area where they live. Discrimination in labor markets may cause minorities to commute farther for employment (Raphael, 1998). The results suggest that, even after controlling for lower white to Black earnings gaps in non-metropolitan areas, Blacks are more likely to commute than whites. Finally, the ratio of predicted earnings in metropolitan and non-metropolitan areas, while positive for all sets of individual characteristics, does not influence commuting behavior. This result suggests that the large earnings premium for commuting for all groups provides no single group with a disproportionate incentive to commute.

## **The Pull of Metropolitan Area Labor Markets**

Predicted earnings gaps were used to calculate the outer radius of the area within which it is privately profitable for individuals to commute to the Washington D.C. and NOVA metropolitan area for employment. For a 35-year old, white, married, college educated male, the commuting radius was calculated under two assumptions about the value cost of the time spent commuting. The first assumes that the value to the individual of time spent commuting equals the expected hourly earnings in the non-metropolitan labor market. Following Small (1997), vehicle related costs of commuting are calculated at \$0.25 per mile and workers are also assumed to travel at 50 miles per hour and work 8 hours per day. Under these assumptions the worker should be willing to commute up to 1 hour and 50 minutes (92 miles) per day each way before potential earnings in the local labor market equal the earnings attained from commuting to the metropolitan area minus the time and vehicle costs of travel. Alternatively, if the value of time spent commuting is assumed to equal the higher metropolitan hourly earnings rate, individuals should be willing to commute a little over one hour (63 miles) per day each way. Beyond this distance, the estimated earnings in the non-metropolitan area exceed earnings in the metropolitan area minus the costs of commuting. Since most of the non-metropolitan areas in the study lie within this inner radius and all counties lie within the outer radius, under current conditions metropolitan labor markets will continue to be a major magnet for non-metropolitan residents (Figure 2).

**Figure 2: Distance of Labor Market Draw of Metropolitan Area**



Note: A 35-year-old, white, male worker with college education was chosen as the base. Most of the study area is within the inner radius of commuting (63 miles). All the study area is within the outer radius of commuting (92 miles).

## **IMPLICATIONS FOR NON-METROPOLITAN COUNTIES**

Two differences between commuters and non-commuters have significant potential fiscal implications for counties: real property values and number of children. The results indicate that individuals commuting to metropolitan areas for employment are both more likely to own, rather than rent, their houses and that they are more likely to reside in larger homes. Table 4 shows comparisons of assessed home values and property taxes paid by homeowners living and working in the five non-metropolitan counties and for those commuting to the Washington, D.C. and NOVA metropolitan area. Since real property taxes accounted for 46 percent of revenues collected by the five counties in 1990, the more expensive homes of commuters may present significant revenue opportunities for local officials (Auditor of Public Accounts, 1991). The results also suggest that restrictions on housing development might have a limited impact on the growth of non-metropolitan to metropolitan county commuting. Expected increases in housing prices accompanying housing supply restrictions may decrease the current lure of the metropolitan worker to non-metropolitan areas with relatively less expensive housing. On the other hand, given relatively strong preferences for large homes, commuters may be less responsive to price increases than current non-commuting residents.

**Table 4: Assessed house value**

	<i>Non-commuting residents</i>	<i>Commuting residents</i>
Average house value <sup>1</sup>	\$132,717	\$176,615

<sup>1</sup> Assessed housing values are for homeowners only. House value is assigned to each homeowner in the house.

Source: PUMS

Contrary to conventional wisdom, households with children are not more likely to commute. If anything, commuters appear to have fewer school-aged children (Table 5). Thus, despite concerns, non-metropolitan to metropolitan area commuters do not appear to impose additional negative fiscal impacts on non-metropolitan counties through disproportionate demands on local school resources. Further, in 1990, over 72 percent of local expenditures in the five counties went to public education (Auditor of Public Accounts, 1991). Even if commuters do impose disproportionate demands on other local public services, these demands are not likely to have a major impact on local fiscal balances.

**Table 5. Number of school aged children of commuting and non-commuting residents**

	<i>Non-commuting residents</i>	<i>Commuting residents</i>
Average No. children in a household <sup>1</sup>		
No. children < 6	0.30	0.33
No. children ≥ 6, < 16	0.60	0.49

<sup>1</sup> Number of children in a household is for all the workers (homeowners and renters).

Source: PUMS

Commuters may, however, demand larger investments in transportation infrastructure. Road congestion is an increasing problem, especially in Fauquier County where the majority of commuters to the Washington, D.C. and NOVA metropolitan area reside. Infrastructure investments can reduce congestion costs and commuting times in the short run and, thereby, increase private incentives for households to live in adjacent non-metropolitan areas and commute to work in the metropolitan area labor market. Thus, investments in transportation infrastructure are, in the long term, likely to promote further increases in road usage. The long-term aggregate impacts of improved transportation infrastructure on road congestion are unclear.

Metropolitan areas will also continue to attract non-metropolitan commuters as long as the large estimated earnings gap between non-metropolitan and metropolitan labor markets persists across all groups of workers. The results clearly suggest that weak local labor market opportunities in non-metropolitan areas are a major underlying cause of commuting behavior. Local communities can focus on attracting new firms into the area or on supporting the expansion of existing firms. However, non-metropolitan county governments adjacent to metropolitan areas must decide whether they wish to actively develop major commercial zones to provide local employment opportunities and bid up local wages. As is the case in Fauquier County, many non-metropolitan communities adjacent to expanding metropolitan areas are often more concerned with preserving the rural character of their localities than expanding commercial opportunities and a large fraction of the community may actively oppose commercial development.

Non-metropolitan counties will inevitably continue to face growth pressures from the expansion of adjacent metropolitan areas, particularly in the form of increased demand for residential housing. Growth is not necessarily a negative influence. The impact of growth will depend upon how it is managed. Understanding the commuting behavior of households is an important prerequisite for development of county strategic plans to manage these growth pressures. When alternative growth scenarios are clearly laid out, increased shares of out-commuting households may be an acceptable growth strategy, given the relatively minor impacts such growth appear to impose on the fiscal balances and rural character of non-metropolitan counties.

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## APPENDIX: THE EMPIRICAL METHOD

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### *Non-metropolitan and metropolitan area earnings equations*

Earnings benefits from commuting arise from differences in potential hourly wage earnings in the local (non-metropolitan) labor market and the metropolitan labor market. The logarithm of hourly earnings for workers working within the non-metropolitan counties,  $\text{LnWp}$ , and that for workers commuting to work in the metropolitan area,  $\text{LnWc}$ , are specified as functions of observed personal characteristics,  $X$ , as well as normally distributed error terms associated with unobserved characteristics,  $U_p$  and  $U_c$ .

$$\text{LnWp} = \text{XBp} + U_p \quad (1)$$

and

$$\text{LnWc} = \text{XBc} + U_c. \quad (2)$$

Significant differences in the returns to personal characteristics contribute to potential earnings differences that motivate commuting decisions.

### *Non-earnings factors influencing commuting decisions*

Individuals also chose to remain in the non-metropolitan labor market or commute to the metropolitan labor market based on non-earnings factors associated with the costs of commuting. The separate estimation of individual earnings equations in the two areas without controlling for non-wage factors associated with individual commuting choices is likely to produce biased estimates. When worker self-selection is controlled for the earnings component of the commuting choice can be specified as

$$W = \text{LnWc} - \text{LnWp}. \quad (3)$$

Let  $D$  represent the unobserved non-earnings commuting costs of a non-metropolitan resident.  $D$  is a function of observed personal and household characteristics,  $Z$ , and a normally distributed error term associated with unobserved characteristics,  $U$ .

$$D = ZQ + U \quad (4)$$

The empirical model assumes workers will compare  $W$ , the earnings gains from commuting, and  $D$ , the non-earnings costs of commuting, when deciding where to work. If  $W - D > 0$ , the workers are observed to commute. If  $W - D < 0$ , the workers are observed to work locally.