Metropolitan Washington Council of Governments
National Capital Region Transportation Planning Board

Estimating the Impact of
Exurban Commuters on Travel Demand

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VHB

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Executive Summary

The Metropolitan Washington Council of Governments, National Capital Region Transportation Planning Board (TPB) engaged Vanasse Hangen Brustlin (VHB) to estimate the impact of exurban commuters on travel demand in the TPB modeled region. Identification of exurban travel patterns to the TPB region will allow TPB's travel forecasting methods to continually evolve. A review of current literature covering exurban commuters and analysis of Census and other data over time tracks the growth of exurban travel in the TPB region and comparable areas. VHB attempted to develop methods for forecasting external trips by type of jurisdiction (central, inner and outer suburbs, etc.) by creating regression equations to test the relationship between external trips and the difference between employment and workers by jurisdiction. The test results show a very strong relationship between these variables for the TPB Central Jurisdictions and a less strong relationship for the outermost areas in the modeled region and for all areas with a negative difference between employment and workers. Several predictive equations for forecasting external trips in certain areas are contained in this memo. One other potential area for further analysis would be backcasting using some of the predictive equations.

Background

TPB requested that VHB research the magnitude of exurban commuters and their relationship to the TPB travel forecasting process. During FY 06 VHB researched the different methods used by MPOs to forecast external trips. An initial review of data from the 2000 Census Transportation Planning Program (CTPP) indicates that the TPB region experiences a significant level of external-internal (E-I) travel from workers who live outside the region, including many "extreme commuters" who live more than 100 miles away from the Capitol. The impacts on travel demand forecasting and regional transportation planning as exurban growth patterns continue to fuel larger numbers of extreme commuters are significant. Identification of exurban travel patterns to the TPB region will allow TPB's travel forecasting methods to continually evolve.

The long travel times experienced by commuters within the TPB region (internal trips) are well documented. Data from the 2003 release of the Census Bureau's American Community Survey (ACS) show that workers commuting from Prince William County in Virginia and Prince George's County in Maryland have average travel times that are exceeded nationally only by the four outer boroughs of New York City. Fairfax County (21) and the District of Columbia (45) also rank in the top 50 nationally for average commute times.[1] Among cities only, the District ranks in the top ten nationally for average commute times. Among the state rankings, all three TPB jurisdictions fell into the top ten for average commute times: Maryland (2), the District (4) and Virginia (9). Maryland and Virginia's positions are influenced not only by the travel times within the TPB region but also the characteristics of the other major metropolitan areas in each state – Baltimore and Hampton Roads, respectively.

Many of these same areas were highlighted by the ACS for their percentage of so-called "extreme" commuters, defined by the Census as traveling 90 minutes or more to work (one-way). Among the top ten counties with the highest average commuting times, Prince William, Prince George's, and Montgomery counties all appeared in the Census' subset with 4.5%, 3.8%, and 2.2% (respectively) of their workers making extreme commutes. At the state level, all three of the TPB jurisdictions also made the list of extreme commuting percentages, with 3.2% of Maryland, 2.3% of Virginia, and 2.2% of the District of

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[1] According to the ACS, the 2003 national commute time was 24.3 minutes; in contrast, Prince William's average was 36.4 minutes.

Columbia's workers making extreme commutes.[2] Nationally only two percent of workers faced extreme commutes.

The influence of the TPB region as a major job destination can even be seen in West Virginia, which ranked twelfth in commute times nationally and experienced the largest increase in average commute time between 1990 and 2000. While some of this ranking can be attributed to the dispersed employment base and difficult topography of the state (which impacts the transportation network), the eastern panhandle of West Virginia has become part of the new frontier for Washington-area workers seeking less-expensive housing and a particular lifestyle.[3] While Jefferson County is part of the TPB modeled network, Berkeley County (to the northwest) is not and is just one of a number of a growing sources of E-I trips. Other areas like Berkeley County which are just outside the TPB region are not found in the top ten for average commute times and thus are not highlighted in the ACS. These are the places where we find the E-I "super-extreme" commuters.

Literature Review

VHB conducted a review of literature in the popular, academic, and professional press on the topics of extreme commuting and internal-external travel. The popular press in particular has given the subject of extreme commuting significant coverage in the last several years, much of it surrounding the release of national detailed data on commuting times from the ACS. Yet most of the articles we located tend to start with the ACS figures as a jumping-off point to cover the growing margins of super-extreme commuters. In most cases, as in the TPB region, these workers live outside their MPO's modeling region. National Public Radio highlighted this segment of workers for a national audience with a story about the growth of Easton, PA, as part of the commuter-shed for New York City. Easton is 70 miles and up to two hours (one-way) away from Lower Manhattan. A 2006 *Newsweek* article interviews extreme commuters from the Chicago, Los Angeles, and San Francisco Bay areas and notes that the fastest growing departure time for workers nationally is between 5 and 6 am. The *Newsweek* article also touches on the relationship between transportation and housing costs that in many cases are causing workers to relocate their homes to these places 70, 80, even 100 miles or more from their job sites.

The above points are echoed in similar articles from *Business Week* (referencing commuters from the Upper Hudson Valley in New York and from northeastern Pennsylvania), USA Today (commuters from the Antelope Valley outside Los Angeles, others who regularly commute by commercial airline). As befits its name, *The New Yorker* in a 2007 article considers the extreme commuter by actually making the trip with a resident of Pike County, PA, to Midtown Manhattan. The commute is a four-seat intermodal E-I trip consisting of a drive alone segment, two commuter rail segments (two NJ Transit trains) and heavy rail [NYC subway]). The author also rides along on commutes in the Atlanta area. The same article also provides some comparisons with international commute times (we're better off than many Asian cities) and notes an award given by the Midas muffler company to a gentleman claiming to have the longest commute in the country – 372 miles (seven hours) round trip daily, from the Sierra Nevada mountains to Cisco Systems in San Jose, CA. A 2007 article from *The Christian Science Monitor* also uses Atlanta (which experienced the greatest increase in commuter times between 1990 and 2000) as its focus. *The New York Times* in a 2006 article examined extreme commuting in the airline industry, which may at first glance seem not relevant; however, these commuters a) are still E-I trips using part of the regional transportation network and b) depending on their work base and schedules, may be making a series of internal trips over several days once reaching the area – this is certainly the case with pilots and flight

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[2] Because of its unique jurisdictional status, the District of Columbia appears in both the subset of states and cities with extreme commuters.

[3] West Virginia's increase in commute times is also due to a similar pattern in the state's Northern Panhandle and surrounding areas by people working in the Pittsburgh area, as well as people commuting from other parts of the state to major job centers in Ohio.

attendants based out of Dulles International Airport. Locally, *The Washington Post* provided coverage on the extreme commuting issue with several articles.

Even the popular Internet-only media such as *Investopedia* (part of *Forbes*) tries to outline the financial and social costs and benefits associated with extreme commuting to assist household decision-makers. *Yahoo! Finance* weighs in on the same issues with the case of a commute from the Bay Area to the suburbs of Sacramento and also comments on the low participation in alternatives such as telecommuting. Finally, the subject of extreme commuting is now worthy of a documentary film called *Subdivided: Isolation & Community in America.* The director of the film is quoted in the previously-mentioned *Monitor* article. The 30-second trailer on the director's website is deliberately provocative, but viewing the full film was not possible as part of this review.[4]

Most of the popular press articles reference at least one of the major current academic and professional publications on the subject of commuting (extreme or otherwise). The Urban Mobility Report from the Texas Transportation Institute is used as one source of baseline data. Several studies have been published over the last several years using a combination of transportation and housing costs as a metric for regional affordability and whether or not a particular jurisdiction's essential workers (police, fire and rescue, teachers) can actually live there on their salaries – when the answer to that is consistently "no," the likelihood of extreme commuting in the area is much higher. These studies include A Heavy Load (2006) by the Center for Housing Policy (CHP) in conjunction with Virginia Tech and the University of California, Berkeley. In this study, Lipman, *et al.* compare these costs across many metro areas nationally: in Metropolitan Washington working families spend 60% of their income on housing (32%) and transportation (28%), three percent higher than the average of all sampled metropolitan areas. The definition of working families used in this report and its predecessor, Something's Gotta Give (*ibid., 2005*) are household incomes between $20,000 and $50,000 per year, but the challenges outlined in the report apply to higher income households as well. Cervero, Wachs, *et al.* (2006) provides further analysis of the CHP datasets and goes into further detail in seven metropolitan areas (including the Baltimore-Washington CMSA) using Census PUMS data. They ultimately develop logit models for different types of households and urban forms within each of the seven analyzed regions (and corresponding maps showing the breakdown and distribution of housing and transportation costs).

The most significant recent publication on commuting is Pisarski's Commuting in America III (2006, hereafter CIA III). Several key findings in CIA III apply directly to the challenges of dealing with extreme commuters and related E-I travel in transportation planning and forecasting:

- Sharp increases in the proportion of workers traveling more than 60 and more than 90 minutes to work
- Significant increases in the percentage of workers leaving for work before 6 AM
- Nationally, about 11% of work trips to the city center arrive from outside the metropolitan area

The report also asks the question: will long distance commuting continue to expand? This query underscores the future concern about E-I travel.

Data Analysis

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[4] According to the director's website the film has won many awards and is now available on DVD for a small fee.

VHB reviewed journey-to-work (JTW) data from the Census Transportation Planning Package (CTPP) Part 3 and other sources in order to analyze the origin-destination patterns of external trips in the TPB region. Our analysis included a comparison with previous data (1990, 1980, 1970, etc.), to track the change in regional external travel patterns over time.

The TPB modeled area contains 2,191 traffic analysis zones, including 47 external stations. Modeling external trips is an important step to ensure the accuracy in a regional travel forecast model. In addition to adding a separate commercial vehicle model, the current TPB model has revised external traffic forecasts. In previous versions of the model, the traffic growth at each external station was assumed to be three percent per year. In the current model, this growth assumption has been refined on a station-by-station basis based on an analysis of historical traffic growth, future capacity at each station, and future land use projections. The growth rate across all external stations now varies from 1.1% to 2.7% per year.

External Travel in 2000 (CTPP)

To examine regional exurban travel patterns, data tables from the 2000 CTPP part 3 were extracted and reviewed in detail. In this analysis, the workplaces were the counties and cities in the TPB region while the states of residence included Pennsylvania, Delaware, Maryland, Virginia, and West Virginia. These states provide a good base for capturing extra-regional work travel. Occasional trips into the modeled region from longer origins such as the New York metropolitan area were excluded from the analysis due to the infrequency of travel and small data sample.

Figure 1 shows the external commuter shed for the TPB region in 2000. As expected, the likelihood of making a work trip from an extra-regional origin to a regional destination is directly related to the distance from the region. Baltimore County and Baltimore City have the highest number of commuters; the destinations of these trips are considered in the detailed analysis of county-to-county flows. Most counties that have more than 100 external trips border the TPB modeled region or are adjacent to counties that border the TPB modeled region. There are three outlier counties that are far from the region and isolated from others with high productions: Allegheny County, Pennsylvania and Montgomery and Bedford counties, Virginia.[5]

The CTPP 2000 data were further filtered to better analyze regional external travel patterns. The following actions were taken:

- Post-Processing 1: Howard and Anne Arundel counties were eliminated from the set of destinations. The trips from other places such as Baltimore County to these two counties are actually internal trips in the Baltimore Metropolitan Council (BMC) model, but are immediately external to the TPB modeled area.

- Post-Processing 2: It was observed that the locations with more than 1,000 external commuter trips are generally within 100 miles of the Capitol, as shown in Figure 2. The distance of 100 miles represents a two-hour drive at an average speed of 50 miles per hour, near the upper limit

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[5] We speculate that these potential outliers might actually be legjtimate E-I or internal trips due to several reasons. The Allegheny, PA trips could be coded incorrectly and actually from Allegany County, MD (Cumberland area), although these would be eliminated by the post-processing step of excluding origins more than 100 miles from the Capitol. Similarly, origins from Bedford County (or Bedford City), VA (both near Lynchburg in the southwestern part of the Commonwealth), could also be incorrectly coded and attributed to Bedford County (or Bedford Borough), PA, north of Cumberland, MD. These trips would also be dropped in post-processing for being more than 100 miles from the Capitol. Finally, trips coded for Montgomery County, VA (the location of Virginia Tech's flagship campus in Blacksburg could be internal trips to a Tech campus within the TPB region (Falls Church, Alexandria, etc.) that were coded incorrectly on either the home or work end. Overall, these trips total approximately 500-600 more in the regional total, a small but potentially significant number.

of what most external travelers are willing to spend commuting, Therefore, jurisdictions more than 100 miles from the Capitol were also removed from the residence list.[6]

The state-level trip summaries are shown in Table 1(residence end) and Table 2(work end). Since Maryland and Virginia contain both home and work locations, areas inside and outside the TPB modeled region are shown on separate rows. CTPP 2000 reports 187,887 total external trips; approximately 63% of those trips were from external jurisdictions in Maryland and 66% were to internal jurisdictions in Maryland. After excluding Anne Arundel and Howard counties, the total external trips dropped by approximately 40%, among which 96% of those trips were from Maryland. After the first post-processing step, Maryland and Virginia contributed almost equally to the external travel market. Next, by excluding areas with commutes longer than 100 miles (post-processing 2), the total external trips decreased by approximately nine percent. Figure 3 shows the external commuter shed following all post-processing steps.

Table 1: External Trips from Residential Locations (State Level, CTPP 2000)

	Raw	Post-Processing 1	Post-Processing 2
Delaware	1,535	1,141	1,141
Maryland (Outside TPB Region)	118,740	45,956	45,032
Pennsylvania	14,980	12,923	10,112
Virginia (Outside TPB Region)	43,061	42,681	37,569
West Virginia	9,571	9,216	7,823
Total	187,887	111,917	101,677

Table 2: External Trips to Work Locations (State Level, CTPP 2000)

	Raw	Post-Processing 1	Post-Processing 2
DC	14,779	14,779	12,626
Maryland (Inside TPB Region)	123,840	47,870	44,968
Virginia (Inside TPB Region)	45,120	45,120	40,062
West Virginia (Jefferson)	4,148	4,148	4,021
Total	187,887	111,917	101,677

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[6] The buffer 100 miles from the Capitol was created using airline distance in GIS rather than a true travel time buffer, but we believe the jurisdictions eliminated are generally representative of travel times as well.
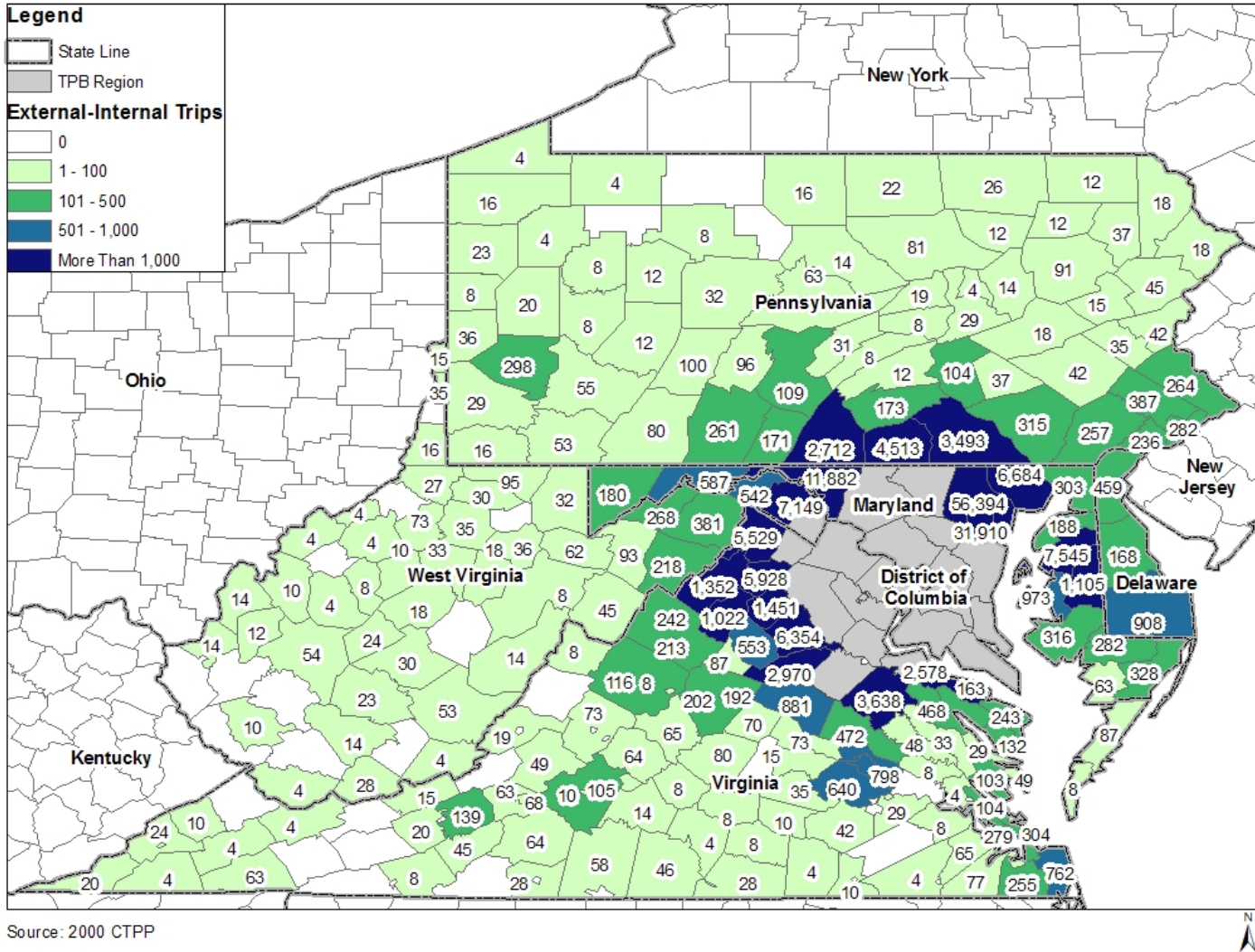
Figure 1: Year 2000 External Travel for COG/TPB

Source: 2000 CTPP

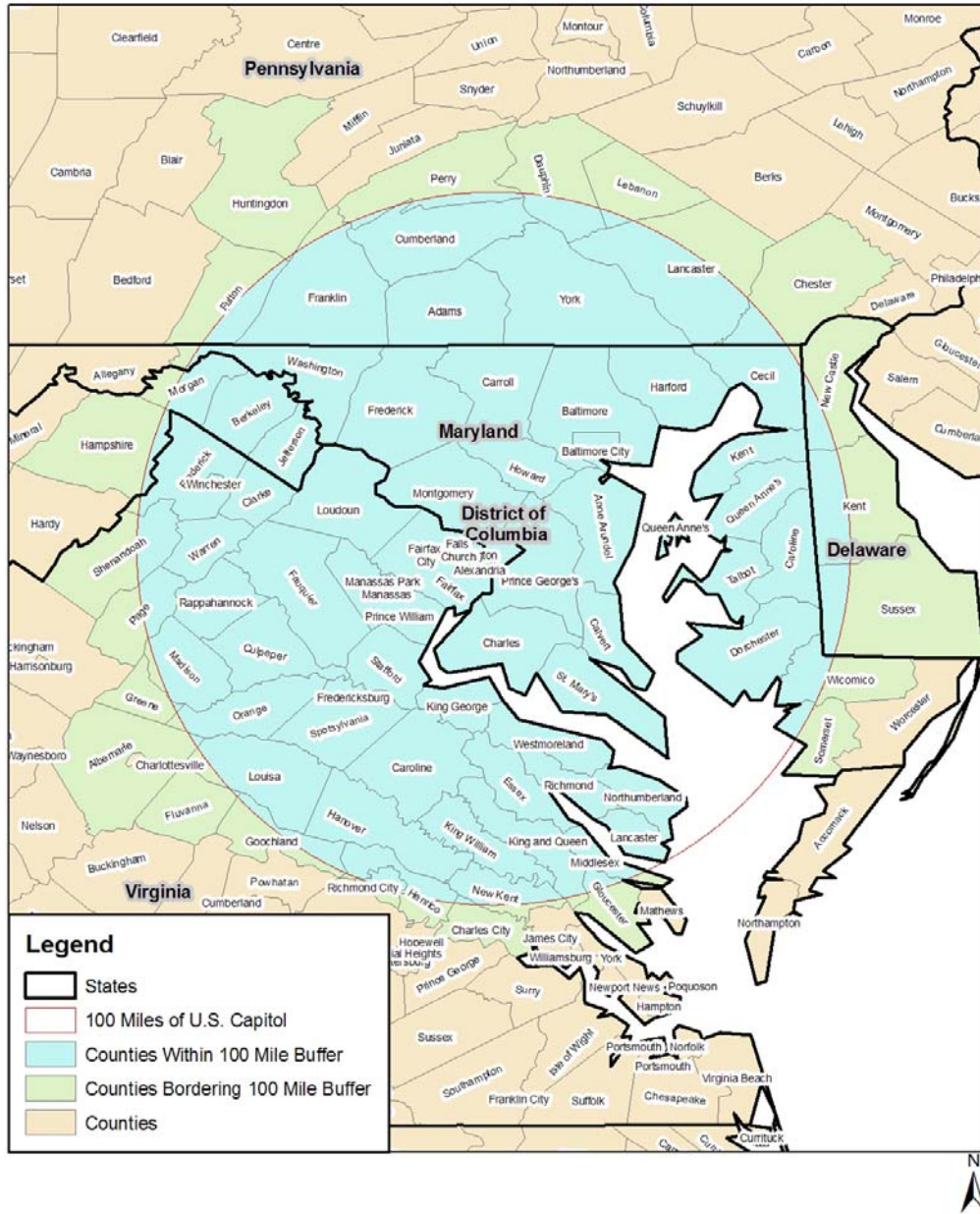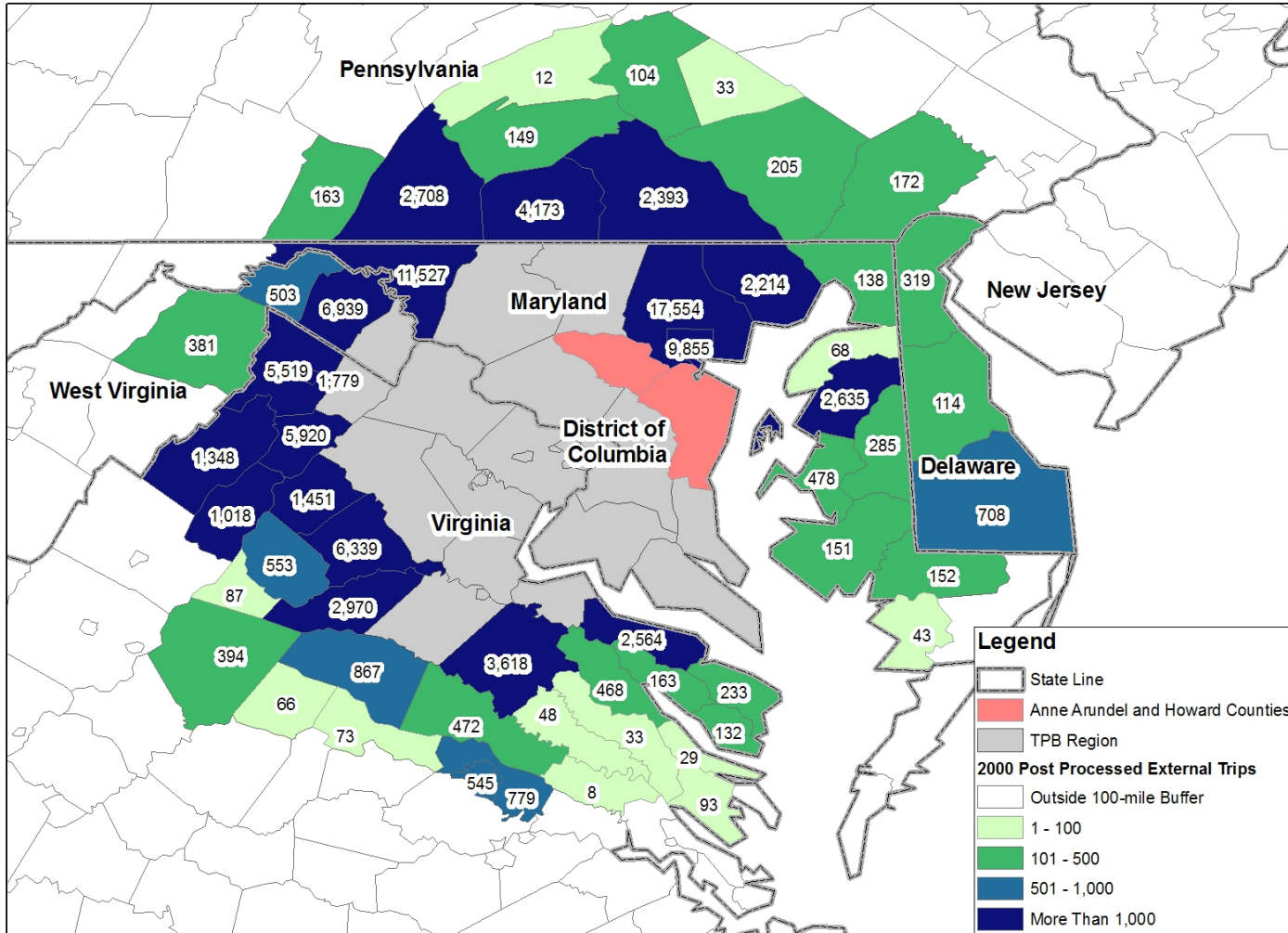**Figure 2: Counties within 100 Miles of U.S. Capitol**

Figure 3: Year 2000 External Travel for COG/TPB Modeled Region (After Post-Processing)

Source: 2000 CTPP

Year 2000 Comparison with Alternative Data Set

The Bureau of Economic Analysis (BEA) also publishes JTW data based on the Census figures.[7] BEA uses county-to-county commuter flows to conduct regional and local economic analyses, including looking at personal income at the local level. BEA adds up the number of commuting workers by industry to get county totals; however, since specific industry flows with fewer than three commuters are suppressed due to confidentiality rules, the BEA data differs from those found on the Census Bureau website. Table 3 compares the external travel summary using the CTPP and BEA data sources. The BEA summary shows approximately 3.9% fewer trips than the CTPP summary with raw data and 2.3% less using post-processed data. In general, these two sources are comparable.

Table 3: Comparison of 2000 External Travel between CTPP and BEA

2000 External Travel		Raw			After Post-Processing		
		CTPP	BEA	Difference	CTPP	BEA	Difference
Origin	Delaware	1,535	1,425	-7.2%	1,141	1,024	-10.3%
	Maryland (Outside TPB Region)	118,740	118,099	-0.5%	45,032	44,681	-0.8%
	Pennsylvania	14,980	13,475	-10.0%	10,112	9,838	-2.7%
	Virginia (Outside TPB Region)	43,061	39,042	-9.3%	37,569	36,177	-3.7%
	West Virginia	9,571	8,561	-10.6%	7,823	7,585	-3.0%
	Total	**187,887**	**180,602**	**-3.9%**	**101,677**	**99,305**	**-2.3%**
Destination	DC	14,779	14,202	-3.9%	12,626	12,593	-0.3%
	Maryland (Inside TPB Region)	123,840	121,418	-2.0%	44,968	44,250	-1.6%
	Virginia (Inside TPB Region)	45,120	40,977	-9.2%	40,062	38,495	-3.9%
	West Virginia (Jefferson)	4,148	4,005	-3.4%	4,021	3,967	-1.3%
	Total	**187,887**	**180,602**	**-3.9%**	**101,677**	**99,305**	**-2.3%**

Regional E-I Travel Growth

The TPB region and its surrounding areas have experienced significant housing and job growth over the past few decades; with that growth there has been a corresponding increase in external travel. VHB reviewed the BEA JTW data from 1970, 1980, and 1990 and compared them to the year 2000 data to reveal any changes in regional E-I travel patterns over time.[8] The same post-processing steps applied to the year 2000 data were applied to the older data to ensure comparability. The external commuter sheds for the years 1970, 1980, 1990, and 2000 based on the BEA JTW data are depicted in Figure 4, Figure 5, Figure 6, and Figure 7, respectively. As mentioned previously, the BEA 2000 data differs slightly from the CTPP 2000 data, and some suppression was in place at the residential counties with few trips in the area to ensure confidentiality. Ultimately, the BEA 2000 JTW data are used here to provide a better comparison over time. In addition to the maps, tables of county-to-county flows for each year in the series and summaries for origins and destinations arrayed by year are contained in the appendix to this memo.

As shown in Table 4, each state has grown at different levels in E-I travel between 1970 and 2000, with the highest percent growth occurring between 1970 and 1980 when total E-I trips more than doubled. The overall increase in external travel is 124% in 1970-1980, 84% in 1980-1990, and 24% in 1990-2000. The corresponding Compound Annual Growth Rate (CAGR) for each decade is eight, six, and two percent, respectively. Thus, the rate of growth in E-I travel has gone down over time.

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[7] Both BEA and the Census Bureau are part of the United States Department of Commerce.
[8] Note that in earlier decades more of these trips would be considered E-I when compared with today, as the TPB modeled region has expanded over time.

Figure 4: Year 1970 External Travel for COG/TPB Modeled Region (After Post-Processing)

Pennsylvania

120   464   401

62   907   1,685   **Maryland**   278

5,133   New Jersey

987   4,162

West Virginia   121

3

140   755   **District of Columbia**   143

13

311   443   59   **Delaware**

16   931   **Virginia**   19

177   24   90

83   593

1,242   58   63   5

5   34   12

Legend

State Line

Anne Arundel and Howard Counties

TPB Region

1970 Post-Processed External Trips

0

1 - 100

101 - 500

501 - 1,000

1,001 - 5,133

Source: BEA Journey-to-Work Data

N
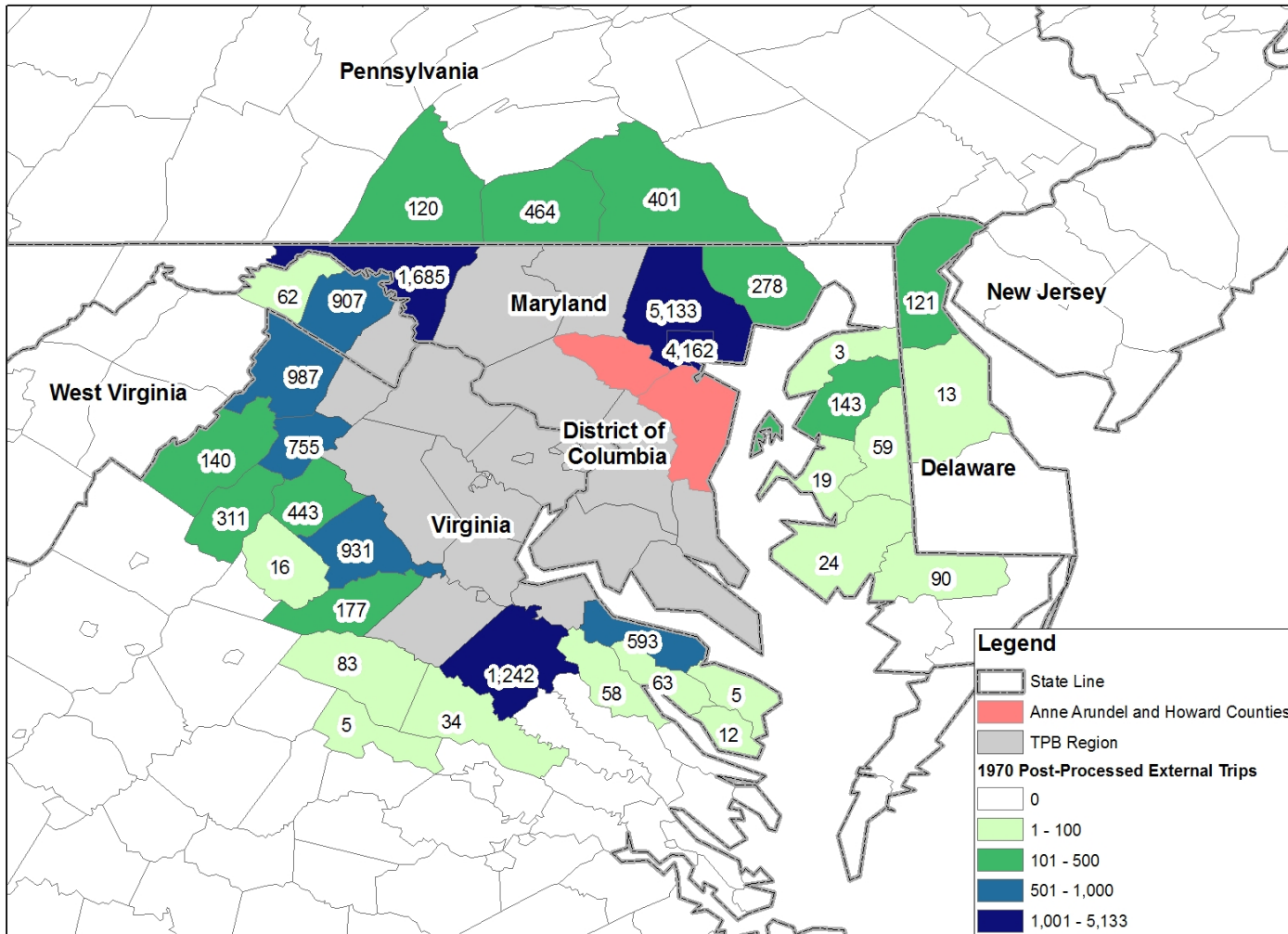
Figure 5: Year 1980 External Travel for COG/TPB Modeled Region (After Post-Processing)
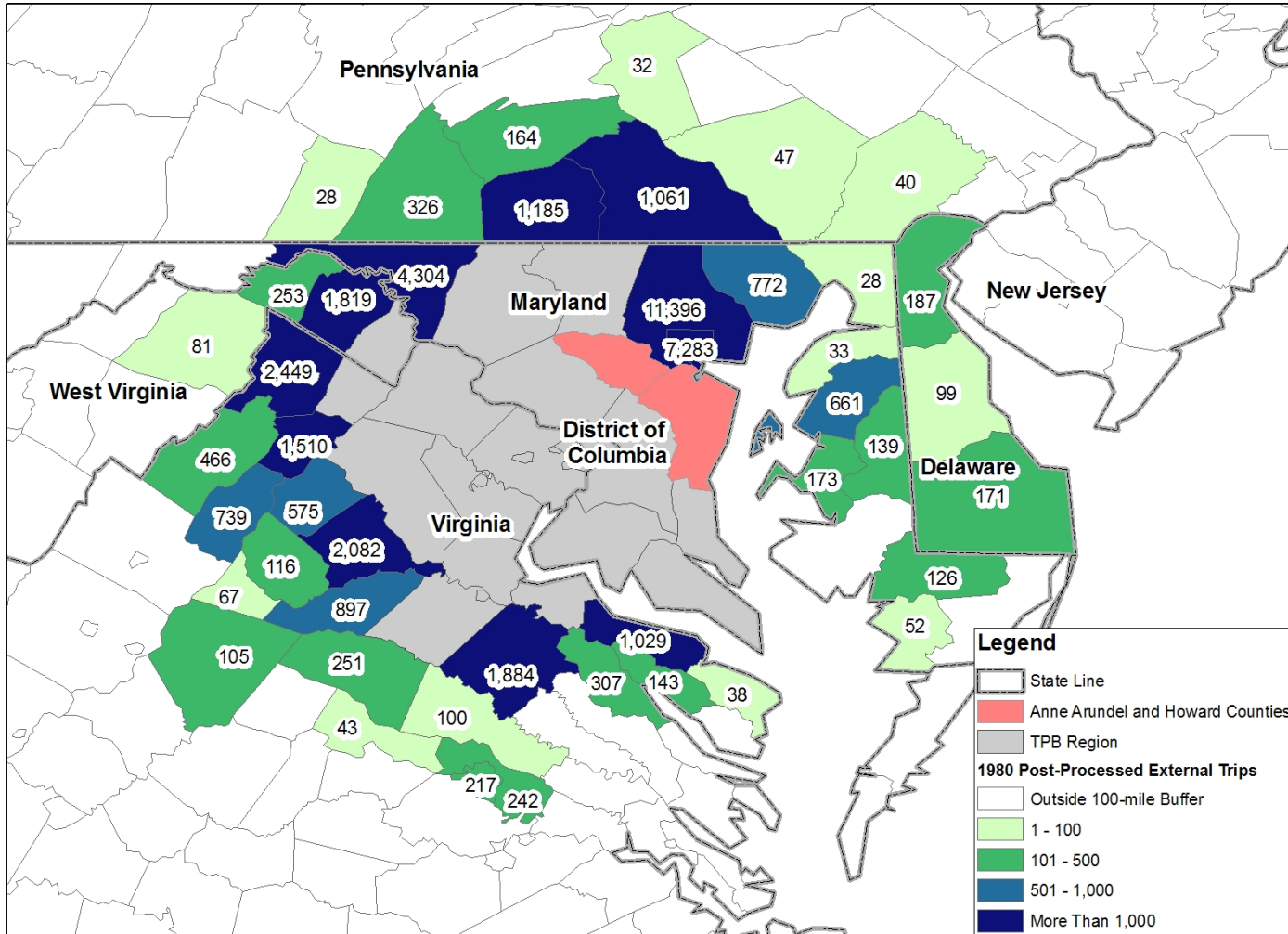
Source: BEA Journey-to-Work Data

Figure 6: Year 1990 External Travel for COG/TPB Modeled Region (After Post-Processing)
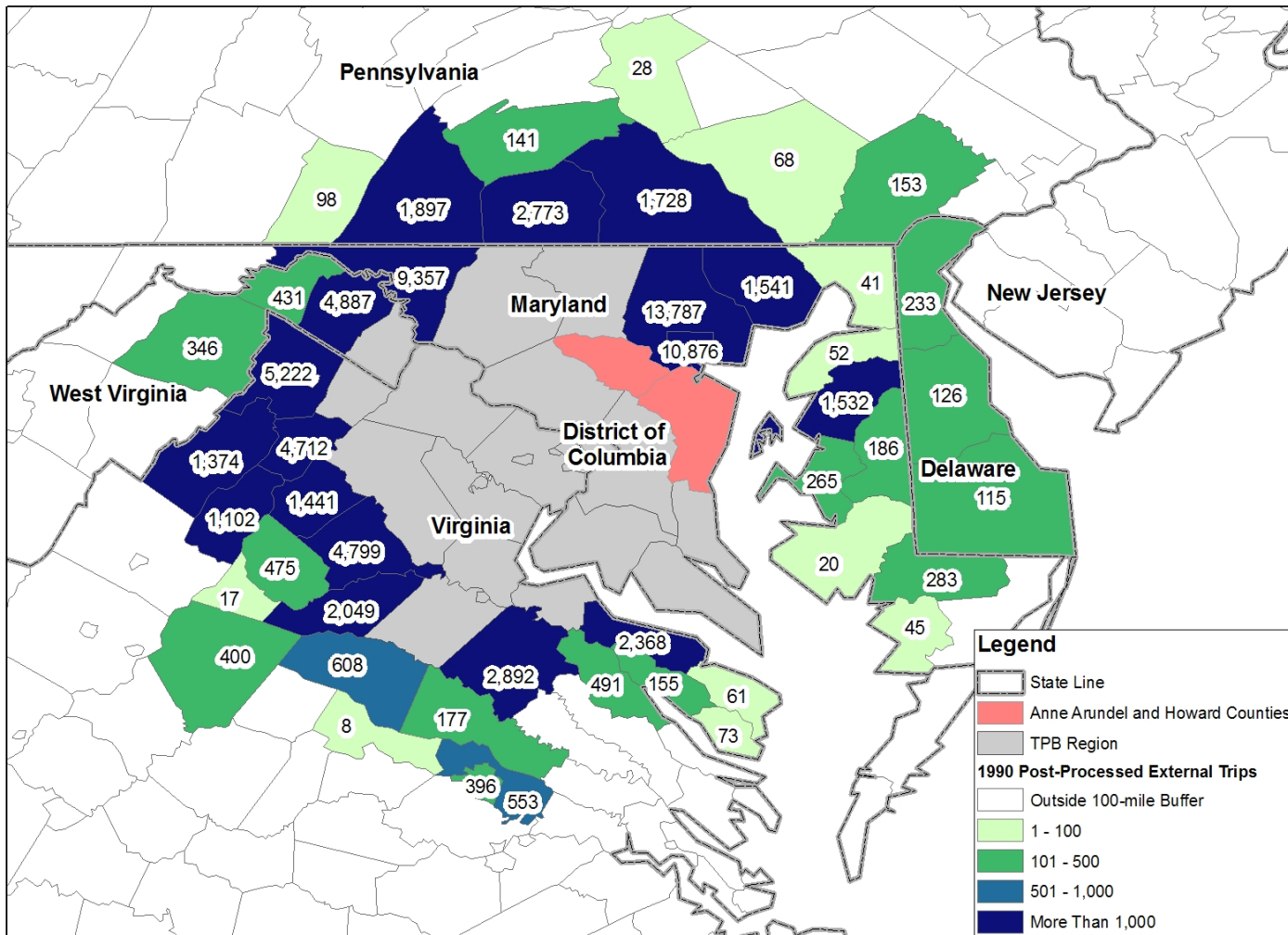
Source: BEA Journey-to-Work Data

Figure 7: Year 2000 External Travel for COG/TPB Modeled Region (After Post-Processing)

Legend

- State Line
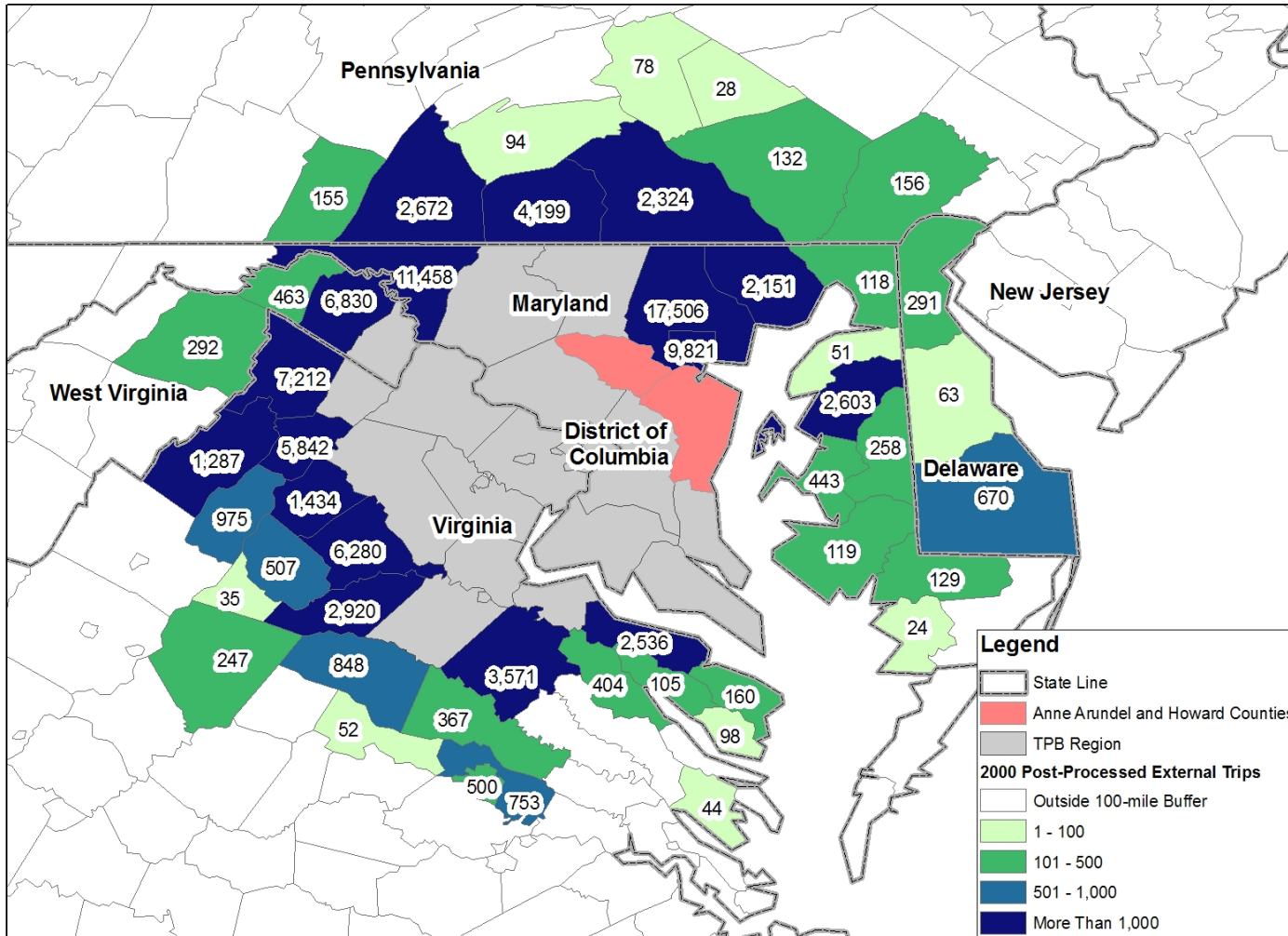- Anne Arundel and Howard Counties
- TPB Region

2000 Post-Processed External Trips
- Outside 100-mile Buffer
- 1 - 100
- 101 - 500
- 501 - 1,000
- More Than 1,000

Source: BEA Journey-to-Work Data

Table 4: Regional External Travel Change from 1970 to 2000 (BEA)

Regional External Travel		External Trips				Percent Growth		
		1970	1980	1990	2000	1970-1980	1980-1990	1990-2000
Origin	Delaware	134	457	474	1,024	241%	4%	116%
	Maryland (Outside TPB Region)	11,596	24,967	37,985	44,681	115%	52%	18%
	Pennsylvania	985	2,883	6,886	9,838	193%	139%	43%
	Virginia (Outside TPB Region)	5,855	13,260	29,373	36,177	126%	122%	23%
	West Virginia	969	2,153	5,664	7,585	122%	163%	34%
	Total	**19,539**	**43,720**	**80,382**	**99,305**	**124%**	**84%**	**24%**
Destination	DC	4,080	6,911	10,887	12,593	69%	58%	16%
	Maryland (Inside TPB Region)	8,960	21,903	35,888	44,250	144%	64%	23%
	Virginia (Inside TPB Region)	5,777	13,660	30,978	38,495	136%	127%	24%
	West Virginia (Jefferson)	722	1,246	2,629	3,967	73%	111%	51%
	Total	**19,539**	**43,720**	**80,382**	**99,305**	**124%**	**84%**	**24%**

Figures 8 through 10 show the *change* in external trips by jurisdiction between 1970 and 2000 by ten-year increments, and the CAGRs for the same periods are shown by state of residence in Figure 11 and workplace in Figure 12. There was growth in almost every external jurisdiction except for Dorchester County in Maryland and Lancaster County in Virginia. However, these two counties have zero trips to the TPB region reported in the BEA 1980 data. The highest growth for external travel occurred in Baltimore County, Baltimore City, and Washington County in Maryland. Between 1970 and 1980, all residence states experienced significant annual growth in external commuters, most of who travelled to Maryland and Virginia to work. Between 1980 and 1990, Pennsylvania, the Virginia external counties, and West Virginia continued to experience rapid growth. In terms of the destinations for those external travelers, Virginia and West Virginia had higher growth during this time. Between 1990 and 2000, Delaware had the highest percent growth but the overall number of external trips is just over 1,000, most of them from Sussex County. All the other residence states had a moderate percent growth but much more significant in absolute terms. All of the employment destinations experienced similar growth during this time.

Figure 8: Change in External Commuter Shed for the TPB Region from Year 1970 to 1980
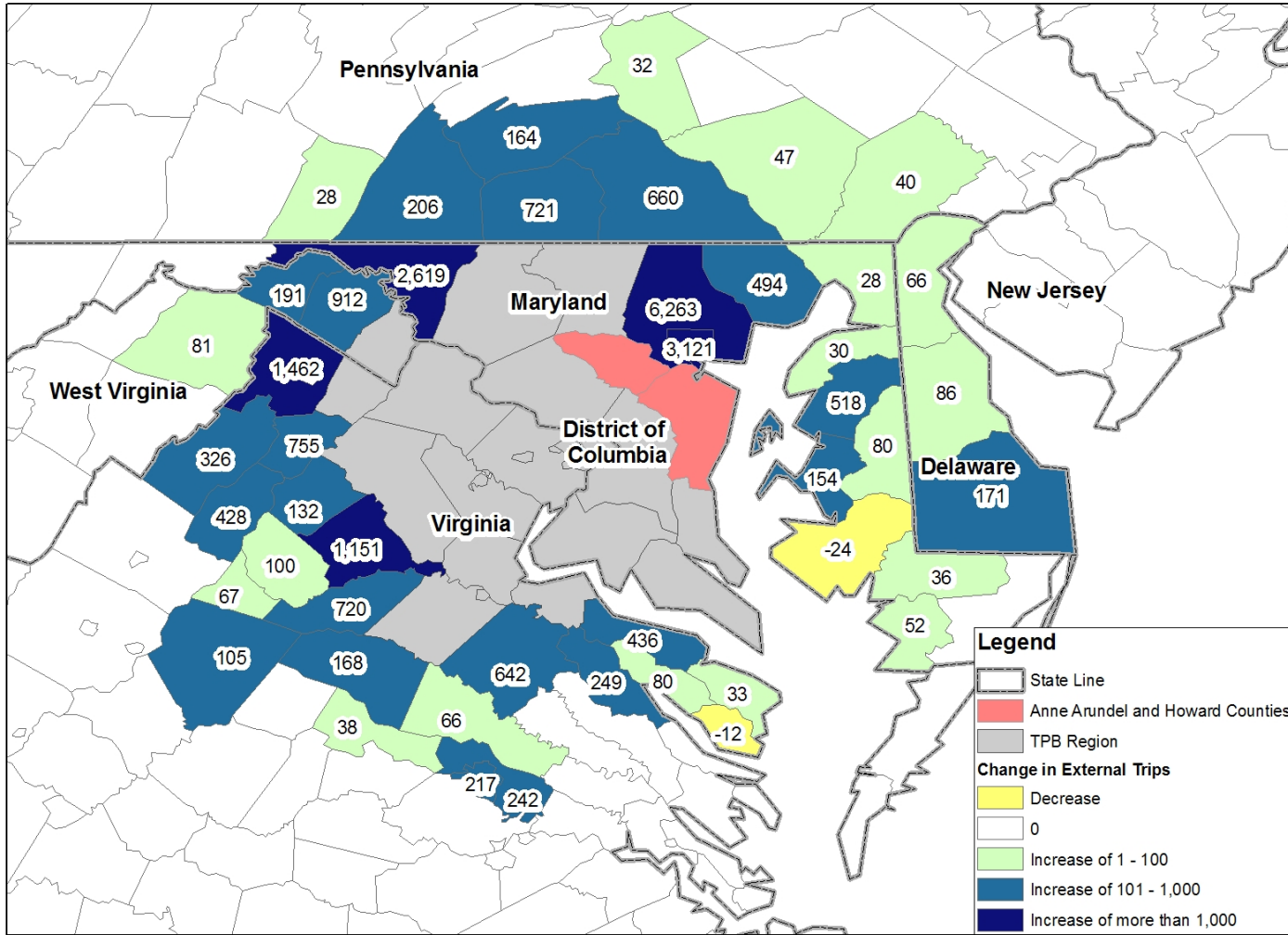
Source: BEA Journey-to-Work Data

Figure 9: Change in External Commuter Shed for the TPB Region from Year 1980 to 1990
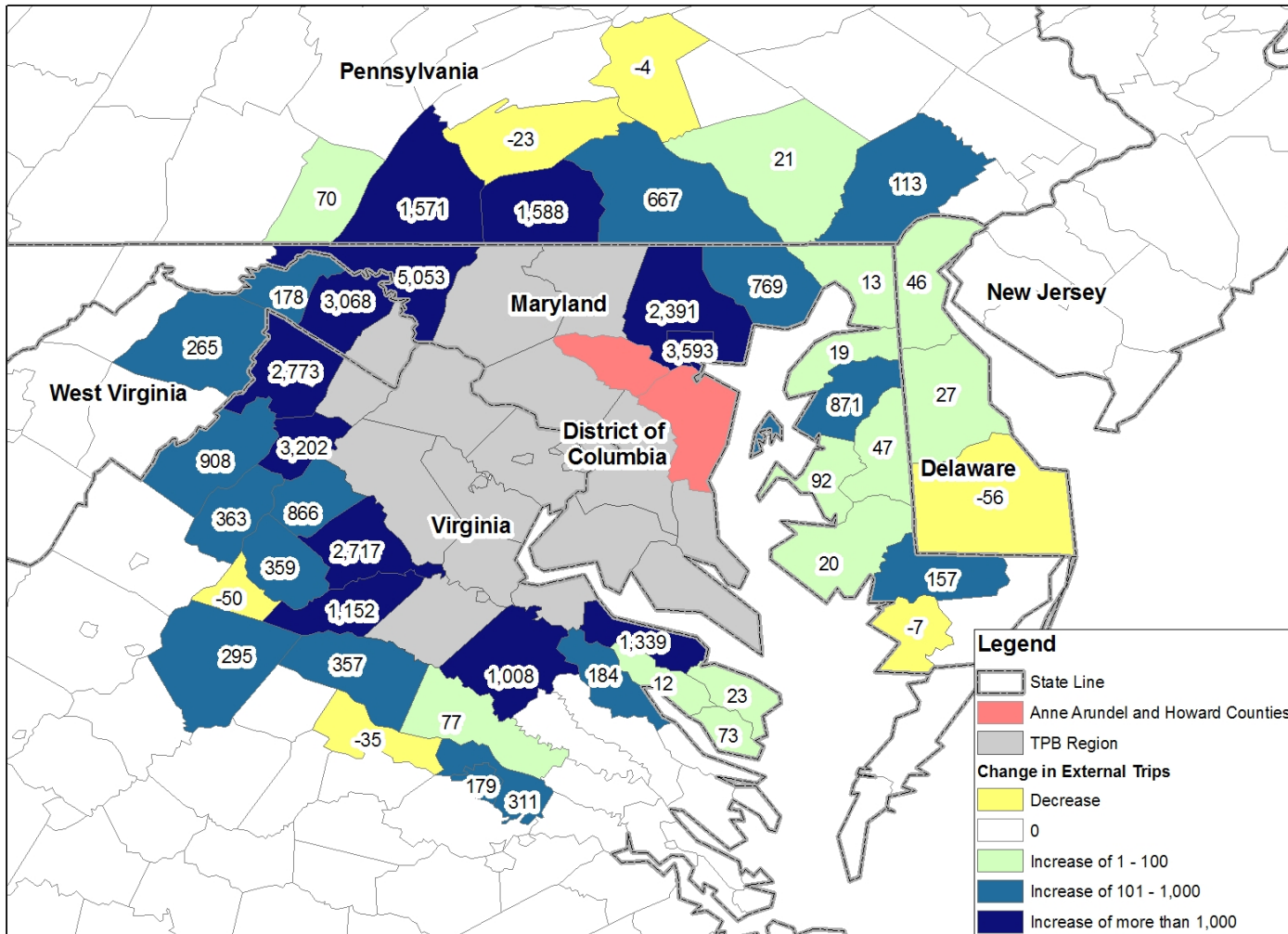
Figure 10: Change in External Commuter Shed for the TPB Region from Year 1990 to 2000

Pennsylvania

50

28

-47

64

57

775

1,426

596

3

32

2,101

Maryland

610

77

58

1,943

New Jersey

-54

3,719

-1

-63

West Virginia

1,990

-1,055

1,071

72

Delaware

-87

1,130

District of Columbia

178

555

-127

-7

Virginia

99

32

1,481

-154

18

871

-21

-153

240

679

168

-87

-50

99

44

190

25

104

200

44

Legend

State Line

Anne Arundel and Howard Counties

TPB Region

Change in External Trips

Decrease

0

Increase of 1 - 100

Increase of 101 - 1,000

Increase of more than 1,000

Source: BEA Journey-to-Work Data

N

Figure 11: Compound Annual Growth Rate for States of Residence over Time
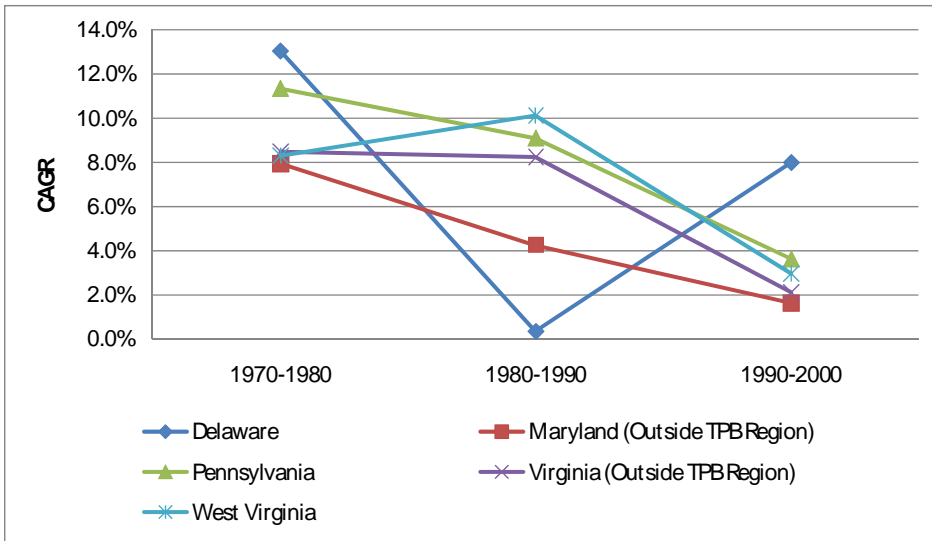
Figure 12 Compound Annual Growth Rate for States of Work over Time
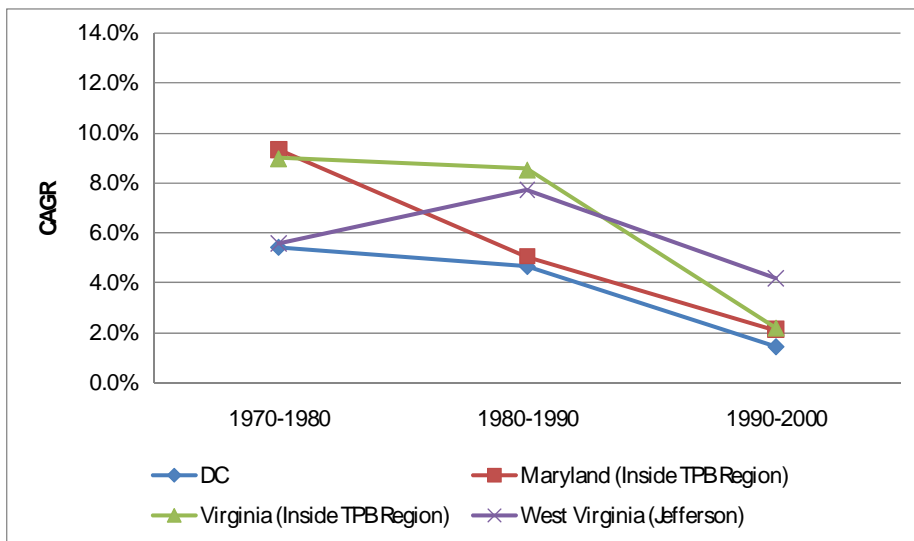
E-I Travel and Comparable Regions to TPB

The Federal Highway Administration report "Journey to Work in the United States and its Major Metropolitan Areas" presents the changes in terms of national and regional population and workforce, vehicle ownership, and travel to work characteristics that have occurred from 1960 to 2000 based on Census data. The following observations (many of them echoed in Pisarki's CIA reports, based on the same datasets) were listed in the report:

- Family structure has changed over the years. In 1960, 52 percent of the family consisted of married couples with children while in 2000, there were only 35 percent. Average household size declined more than one-fifth, from 3.3 persons per household in 1960 to 2.6 in 2000.

- The increase of women in the workforce has resulted in the rise in household income and household auto ownership. For instance, average number of vehicles per household went from just over 1.0 in 1990 to approximately 1.7 in 2000 (so, while household size may be going down, trips per household are increasing across all trip purposes and major origin-destination categories, including E-I trips).

- Metropolitan Statistical Areas (MSAs) continue to grow in both area and population. Most of the population growth in the major metropolitan areas has occurred in the suburban counties (depending on how these counties are treated in MPO models, this growth results in increased I-I and / or E-I trips).

- The choice of a private vehicle as the primary transportation mode to work has increased, among which driving alone continued to increase as carpools continued to drop.

- The percent of workers with a long commute has increased. In 2000, 14 percent of commuters traveled more than 45 minutes compared to 12 percent in 1990. At the same time, 29 percent of commuters traveled less than 15 minutes compared to 31 percent in 1990. In 2000, more families are living and working in the suburbs. Workers in major MSAs are commuting 45 and even 60 minutes (or more) one way to their jobs on a regular basis. As noted previously, in 2000, the top three MSAs with the longest average travel time were New York, Washington D.C., and Atlanta.

- The 2000 Census shows a significant increase in travel time in all MSAs, which may give workers incentive for considering other modes, changing work times, or telecommuting.

Although the report provides some information before 1990, the analysis focuses on demographics and worker flow changes, specifically the growth in suburban commuting,[9] from 1990 to 2000 for several large MSAs including Washington, D.C. and others that are comparable (see Table 5). Atlanta has a more detailed analysis and a longer time frame since it was selected as one of the case studies in the report. The San Francisco CMSA is similar to the TPB region in terms of both demographics and mode to work. The New York and Los Angeles CMSAs have much higher population, households, and workers, almost double or triple what the Washington D.C. CMSA has while the demographic data in the Atlanta CMSA are approximately half of those in the Washington area. Among the five CMSAs, the Washington D.C. MSA ranks number one in terms of workers per person and number four in terms of vehicles per household. The New York CMSA has the highest transit mode share and the lowest vehicles per household.

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[9] Suburban counties in the FHWA report are different from the external counties in the previous sections. Also, the MSAs are different (usually larger) from the regional modeled areas.

Table 5: Comparison of Journey to Work Profiles

Journey to Work Profile		New York-Northern New Jersey-Long Island (NY-NJ-CT-PA CMSA)	Washington-Baltimore, DC-MD-VA-WV CMSA	Los Angeles-Riverside-Orange County, CA CMSA	San Francisco-Oakland-San Jose, CA CMSA	Atlanta, GA MSA
Tot. Population	1990	19,549,649	6,727,050	14,531,529	6,253,311	2,959,950
	2000	21,199,865	7,608,070	16,373,645	7,039,362	4,112,198
Tot. Households	1990	7,158,586	2,491,041	4,900,720	2,329,808	1,102,578
	2000	7,735,264	2,871,861	5,347,107	2,557,158	1,504,871
Tot. Workers	1990	9,271,089	3,611,094	6,809,043	3,200,833	1,542,948
	2000	9,319,218	3,839,052	6,767,619	3,432,157	2,060,632
Workers per Person	1990	0.47	0.54	0.47	0.51	0.52
	2000	0.44	0.50	0.41	0.49	0.50
Vehicles per Household	1990	1.27	1.66	1.77	1.76	1.83
	2000	1.26	1.66	1.71	1.76	1.80
Mode to Work	2000	Drove alone (57%), Transit (25%), Carpool (9%), Work at home (3%), Other (6%)	Drove Alone (71%), Carpool (13%), Transit (9%), Work at home (3%), Other (4%)	Drove Alone (72%), Carpool (15%), Transit (5%), Work at home (4%), Other (4%)	Drove alone (69%), Carpool (13%), Transit (9%), Work at home (4%), Other (5%)	Drove alone (75%), Carpool (14%), Transit (3%), Work at home (4%), Other (4%)

The **New York-Northern New Jersey-Long Island (NY-NJ-CT-PA CMSA)** grew approximately 8.4 percent total population between 1990 and 2000. The corresponding percent change in population in the central counties and suburban counties are 3.3 and 8.9, respectively. The growth of both population and households in the 1990s far outpaced the growth of total workers, which was approximately 0.5 percent. The number of workers with commuting time longer than 30 minutes has increased in the 1990s. The analysis on place of work and commuting flows for New York was not included in the report due to the difficulties of reconciling geographic definitions over time.

The **Washington-Baltimore, DC-MD-VA-WV CMSA** has experienced population growth from 6.7 million in 1990 to 7.6 million in 2000, approximately 13.1 percent. Unlike New York, the central jurisdiction of Washington, D.C. had a decline of 5.7 percent in population while the suburban counties had a growth of 15.0 percent in the 1990s. The growth of households and workers from 1990 to 2000 was 15.3 percent and 6.3 percent, respectively. The number of workers with commuting time longer than 45 minutes has increased in the 1990s. There was a significant increase for the workers with more than a 60 minute commute. The analysis on journey-to-work data reveals that there was a decrease in the number of workers who live inside the MSA and work in the central city between 1990 and 2000. At the same time, there was a growth in terms of suburban internal and central-to-suburban county work flow.

The **Los Angeles-Riverside-Orange County, CA CMSA** has experienced population growth from 14.5 million in 1990 to 16.4 million in 2000, approximately 12.7 percent. The corresponding percent change in population in the central county and suburban counties are 7.4 and 20.9. The total households increased by 9.1 percent from 1990 to 2000. Despite population and household growth, total workers actually had a decrease of 0.6 percent. The number of workers with commuting time longer than 30 minutes has increased in the 90s. The analysis on journey-to-work data reveals similar work flow characteristics to Washington, D.C. area. There was a decline for the workers who work in the central county and a growth for suburban internal and central-to-suburban work flow.

The **San Francisco-Oakland-San Jose, CA CMSA** has experienced population growth from 6.3 million in 1990 to 7.0 million in 2000, approximately 12.6 percent. The corresponding percent change in population in the central county and suburban counties are 7.3 and 13.3 percent. The total households and worker increased by 9.8 percent and 7.2 percent separately from 1990 to 2000. The number of workers with commuting time longer than 30 minutes has increased in the 90s. The longer commute of over 60 minutes almost doubled during the same time period. The analysis on journey-to-work data reveals various growth levels in terms of central-county-internal, suburban-county-internal, central-to-suburban, suburban-to-central work flows.[10]

The **Atlanta, GA MSA** was one of the fastest growing metropolitan areas in the country in both workers and population. It has experienced a significant population increase from 3.0 million in 1990 to 4.1 million in 2000, approximately 38.9 percent. The corresponding percent change in population in the central county and suburban counties are 25.7 and 42.6, separately. Given the immense population and worker growth in Atlanta, travel time for commuters grew dramatically, especially for those who lived in the suburban and exurban areas. In 1980, one in three of the exurban workers commuted less than 15 minutes to work while in 2000, one in three exurban residents commuted for than 45 minutes to work. The number of residents commuting over 60 minutes nearly doubled from 1990 to 2000. The analysis on journey-to-work data reveals various growth levels in terms of central-county-internal, suburban-county-internal, central-to-suburban, suburban-to-central work flows. In the 90s Atlanta added twice as many jobs as workers in the central county. Job growth in suburban counties was high while exurban areas seemed to slow the job growth compared to the growth in population and workers. Among the new commuters traveled to the central county to work from 1990 to 2000, 94 percent lived in suburban counties and 6 percent lived in exurban. An increase was seen for both suburban-to-suburban flows and exurban-to-suburban flows.[11]

Forecasting External Trips

VHB attempted to develop methods for forecasting external trips by type of jurisdiction (central, inner and outer suburbs, etc.) by creating regression equations to test the relationship between external trips and the difference between employment and workers by jurisdiction. The test results show a very strong relationship between these variables for the Central Jurisdictions and a less strong relationship for the outermost areas in the modeled region and for all areas with a negative difference between employment and workers (areas with more employment than workers need to import workers from other jurisdictions; these trips are external to the jurisdiction though not necessarily to the region). Graphs of the regression analysis and the corresponding R^2 values are shown in Figures 13 through 15. The remaining tests of jurisdictions did not show a significant relationship between the variables and are contained in the appendix.

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[10] California MPOs now use the CalTrans Statewide Model for E-I flows for their regional models.

[11] The Atlanta MPO recently expanded its modeling region due to air quality conformity requirements; the expanded region allows them to now treat a greater number of previously E-I trips as I-I trips.

Figure 13: Regression of Number of External Trips vs. (Employment minus Workers) – Central Jurisdictions
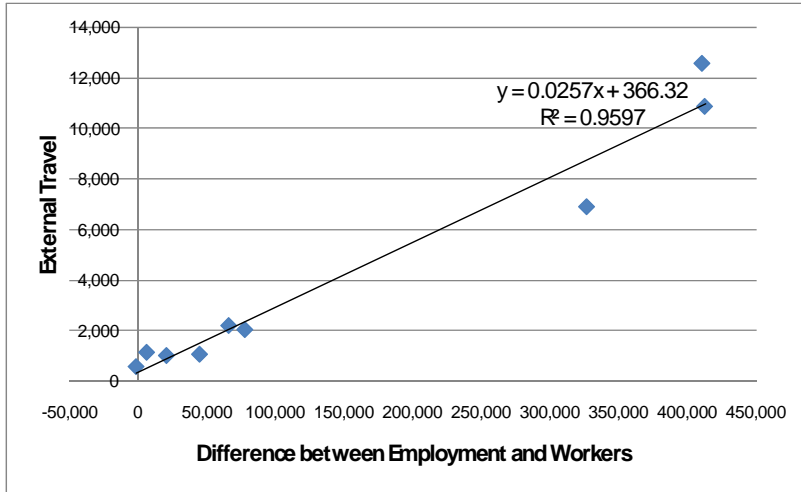
Figure 14: Regression of Number of External Trips vs. (Employment minus Workers) for Modeled Region – Fredericksburg Area Jurisdictions and Other Jurisdictions
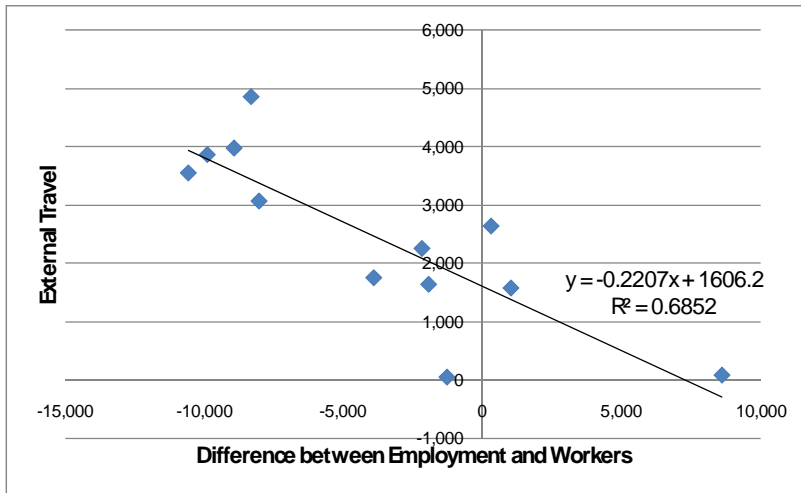
Figure 15: Regression of Number of External Trips vs. (Employment minus Workers) for areas with Negative Values of (Employment minus Workers) (Excluding Outliers)
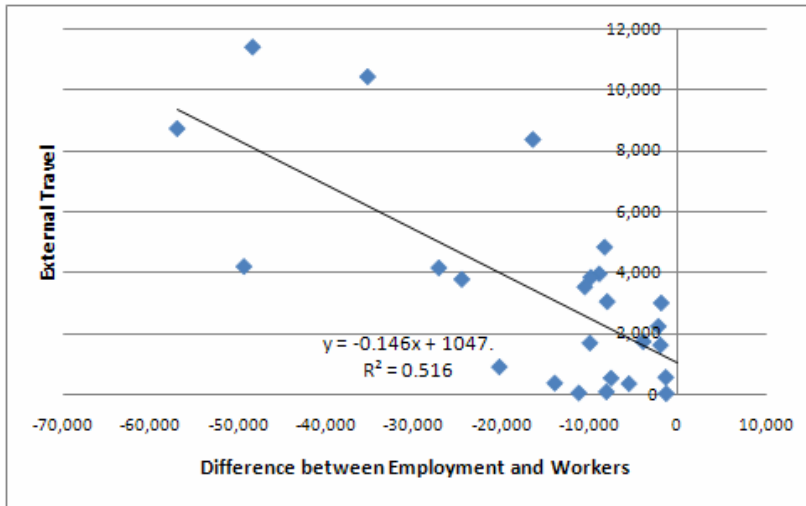
Implications for TPB Modeling Process

The impacts on travel demand forecasting and regional transportation planning as exurban growth patterns continue to fuel larger numbers of extreme commuters are significant (pun intended). Based on our regression analysis, several predictive equations for forecasting external trips in certain areas are contained in this memo. Many references have been made in the literature to the trade-offs between the social and time costs of long-distance commuting and the corresponding decrease in housing costs by moving farther away from a region's central jurisdictions. However, most of the traveler behavior considered by previous studies took place under (relatively) inexpensive gasoline (i.e., less than $2.50 per gallon for "regular" unleaded self-serve). The current actual price of gasoline nationally and regionally is now well beyond any of the forecast values contained in MPO models, and the most recent research is focusing on the elasticity of gas prices with regards to auto travel of all purposes and distances.[12] There are early Federal reports of decreased VMT nationally, but there are not enough data to consider future trends. It does seem likely that a continued increase in gas prices will eventually temper the growth in E-I trips, but much is dependent on the impact across different economic strata, something which should be addressed by further testing. One other potential area for further analysis would be backcasting using some of the predictive equations, the historical BEA data, and the actual boundaries of the TPB modeled region for 1970, 1980, and 1990 to see how well E-I travel was forecast in the past under previous models, as well as the effect of expanding the model boundary. For example, when Frederick County was added to the TPB region one possible effect may have been increased model sensitivity to and capture of "new" E-I trips from Washington County into the TPB region.

CIA III notes that detailed JTW analysis will become more challenging in the near future as some historical elements of the decennial CTPP data are replaced by the ACS and urges local supplemental data collection (and funding to support it). VHB echoes this call for more data, as the nature of E-I travel in the region will

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[12] Recent chatter on the TMIP listserv has referenced a January 2008 report by the Congressional Budget Office, reports from the Victoria Transport Policy Institute, and illustrated interest in this topic at the MPO, transit agency, and State DOT levels,

continue to change, dependent (or not) on changes in the price of gasoline. In the end, the TPB model must do a reasonable job at predicting this (for now) growing regional travel market.

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Appendix

Jurisdiction Types: TPB Modeled Region

Central Jurisdictions	District of Columbia, Arlington County, City of Alexandria
Inner Suburbs	Montgomery County, Prince George's County, Fairfax County, City of Fairfax, City of Falls Church
Outer Suburbs	Loudoun County, Prince William County, City of Manassas, City of Manassas Park, Calvert County, Charles County, Frederick County, Stafford County
Modeled Region – Baltimore Area Jurisdictions	Anne Arundel County, Carroll County, Howard County
Modeled Region – Fredericksburg Area Jurisdictions	King George County, Spotsylvania County (Modeled Portion Only), Fredericksburg City
Modeled Region – Other Jurisdictions	St. Mary's County, Clarke County, Fauquier County, Jefferson County

Regression of Number of External Trips vs. (Employment minus Workers) -- TPB Latest Modeled Region without Baltimore Area

$y = 0.017x + 3870.2$
$R^2 = 0.194$

External Travel

Difference between Employment and Workers
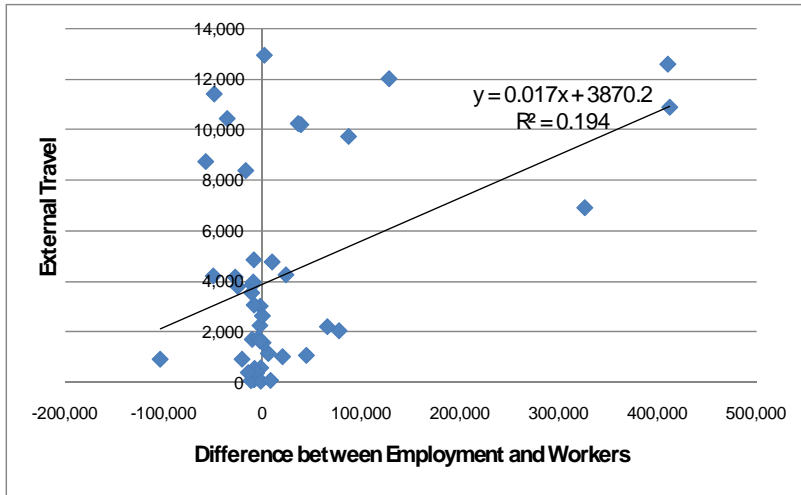
Regression of Number of External Trips vs. (Employment minus Workers) -- Suburban Jurisdictions

$y = 0.036x + 5536.6$
$R^2 = 0.151$

External Travel

Difference between Employment and Workers
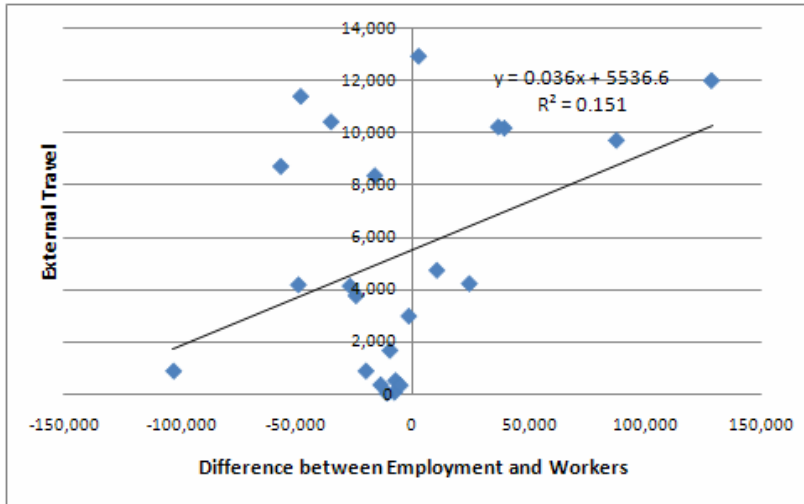
Regression of Number of External Trips vs. (Employment minus Workers) for areas with Positive Values for (Employment minus Workers)
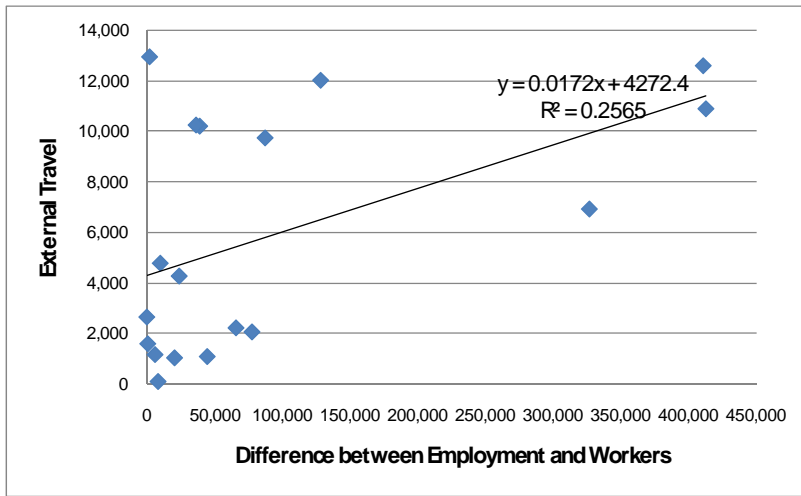
Historical Employment and Household Data for TPB Region

			Employment	Household	Workers/HH	Workers	Difference	External Travel
Central Jurisdictions	Washington DC	1980	666,000	253,100	1.34	339,154	326,846	6,911
		1990	747,300	249,600	1.34	334,464	412,836	10,887
		2000	743,600	248,300	1.34	332,722	410,878	12,593
	Arlington Cnty	1980	141,000	71,700	1.34	96,078	44,922	1,063
		1990	183,100	78,500	1.34	105,190	77,910	2,040
		2000	182,600	86,900	1.34	116,446	66,154	2,200
	Alexandria	1980	64,600	49,200	1.34	65,928	-1,328	572
		1990	92,200	53,300	1.34	71,422	20,778	1,011
		2000	89,300	61,900	1.34	82,946	6,354	1,140
Inner Suburbs	Montogomery Cnty	1980	302,000	207,300	1.34	277,782	24,218	4,254
		1990	465,500	282,000	1.34	377,880	87,620	9,731
		2000	474,300	324,600	1.34	434,964	39,336	10,198
	Prince George Cnty	1980	245,000	225,400	1.34	302,036	-57,036	8,736
		1990	310,400	258,000	1.34	345,720	-35,320	10,438
		2000	338,300	288,600	1.34	386,724	-48,424	11,412
	Fairfax Cnty	1980	241,100	216,800	1.34	290,512	-49,412	4,208
		1990	443,900	303,900	1.34	407,226	36,674	10,241
		2000	615,300	363,200	1.34	486,688	128,612	12,015
Outer Suburbs	Loudoun Cnty	1980	17,500	18,700	1.34	25,058	-7,558	545
		1990	39,300	30,700	1.34	41,138	-1,838	3,012
		2000	90,500	59,900	1.34	80,266	10,234	4,763
	Prince William Cnty	1980	48,000	112,800	1.34	151,152	-103,152	911
		1990	84,500	81,400	1.34	109,076	-24,576	3,790
		2000	119,800	109,700	1.34	146,998	-27,198	4,164
	Calvert Cnty	1990	14,700	17,000	1.34	22,780	-8,080	97
		2000	22,800	25,400	1.34	34,036	-11,236	60
	Charles Cnty	1990	38,700	33,000	1.34	44,220	-5,520	365
		2000	41,900	41,700	1.34	55,878	-13,978	383
	Frederick Cnty	1990	54,000	52,600	1.34	70,484	-16,484	8,379
		2000	96,300	70,100	1.34	93,934	2,366	12,946
	Stafford Cnty	1990	5,700	19,400	1.34	25,996	-20,296	913
		2000	30,500	30,200	1.34	40,468	-9,968	1,698
Rest Jurisdictions	Spotsylvania Cnty +	1990	19,200	22,200	1.34	29,748	-10,548	3,540
		2000	44,500	39,400	1.34	52,796	-8,296	4,848
	King George Cnty	1990	2,400	4,700	1.34	6,298	-3,898	1,743
		2000	9,200	6,100	1.34	8,174	1,026	1,567
	St. Mary's Cnty	1990	32,900	25,500	1.34	34,170	-1,270	39
		2000	49,600	30,600	1.34	41,004	8,596	73
	Clarke Cnty	1990	3,700	4,200	1.34	5,628	-1,928	1,630
		2000	4,400	4,900	1.34	6,566	-2,166	2,245
	Fauquier Cnty	1990	14,100	16,500	1.34	22,110	-8,010	3,058
		2000	17,200	20,200	1.34	27,068	-9,868	3,855
	Jefferson Cnty	1990	17,600	12,900	1.34	17,286	314	2,629
		2000	12,800	16,200	1.34	21,708	-8,908	3,967

Notes: Employment and household data were provided by MWCOG; 1980 data were from Round 3.5 - 1985 Update; 1990 data were from Round 5.1 - May 1994; 2000 data were from Round 7.0a - Oct 2006; Workers per household data were obtained from Journey to Work Trends report; External travel data were derived from BEA data.

County to County Flows (After Post-Processing)

Destination	1970	1980	1990	2000
DC, District of Columbia	4,080	6,911	10,887	12,593
MD, Calvert County	37	36	97	60
MD, Carroll County	2,784	4,863	6,839	9,178
MD, Charles County	151	235	365	383
MD, Frederick County	1,716	3,697	8,379	12,946
MD, Montgomery County	1,867	4,254	9,731	10,198
MD, Prince George County	2,405	8,736	10,438	11,412
MD, St. Mary's County	0	82	39	73
VA, Alexandria City	347	572	1,011	1,140
VA, Arlington County	976	1,063	2,040	2,200
VA, Clarke county	640	1,603	1,630	2,245
VA, Fairfax County,Fairfax City, Falls Church City	1,180	4,208	10,241	12,015
VA, Fauquier County	486	1,453	3,058	3,855
VA, King George County	522	992	1,743	1,567
VA, Loudoun County	198	545	3,012	4,763
VA, Prince William County, Manassas City, Manassas Park City	393	911	3,790	4,164
VA, Spotsylvania County, Fredericksburg City	983	2,144	3,540	4,848
VA, Stafford County	52	169	913	1,698
WV, Jefferson County	722	1,246	2,629	3,967
Grand Total	**19,539**	**43,720**	**80,382**	**99,305**

External Origins 1970-2000 (BEA Data)

Origin	1970	1980	1990	2000
DE, Kent County	13	99	126	63
DE, New Castle County	121	187	233	291
DE, Sussex County	0	171	115	670
MD, Baltimore County	5,133	11,396	13,787	17,506
MD, Baltimore City	4,162	7,283	10,876	9,821
MD, Caroline County	59	139	186	258
MD, Cecil County	0	28	41	118
MD, Dorchester County	24	0	20	119
MD, Harford County	278	772	1,541	2,151
MD, Kent County	3	33	52	51
MD, Queen Anne's County	143	661	1,532	2,603
MD, Somerset County	0	52	45	24
MD, Talbot County	19	173	265	443
MD, Washington County	1,685	4,304	9,357	11,458
MD, Wicomico County	90	126	283	129
PA, Adams County	464	1,185	2,773	4,199
PA, Chester County	0	40	153	156
PA, Cumberland County	0	164	141	94
PA, Dauphin County	0	32	28	78
PA, Franklin County	120	326	1,897	2,672
PA, Fulton County	0	28	98	155
PA, Lancaster County	0	47	68	132
PA, Lebanon County	0	0	0	28
PA, York County	401	1,061	1,728	2,324
VA, Albemarle County, Charlottesville City	0	105	400	247
VA, Caroline County	1,242	1,884	2,892	3,571
VA, Culpeper County	931	2,082	4,799	6,280
VA, Essex County	58	307	491	404
VA, Frederick County, Winchester City	987	2,449	5,222	7,212
VA, Gloucester County	0	0	0	44
VA, Goochland County	5	43	8	52
VA, Greene County	0	67	17	35
VA, Hanover County	34	100	177	367
VA, Henrico County	0	242	553	753
VA, Lancaster County	12	0	73	98
VA, Louisa County	83	251	608	848
VA, Madison County	16	116	475	507
VA, Northumberland County	5	38	61	160
VA, Orange County	177	897	2,049	2,920
VA, Page County	311	739	1,102	975
VA, Rappahannock County	443	575	1,441	1,434
VA, Richmond County	63	143	155	105
VA, Richmond City	0	217	396	500
VA, Shenandoah County	140	466	1,374	1,287
VA, Warren County	755	1,510	4,712	5,842
VA, Westmoreland County	593	1,029	2,368	2,536
WV, Berkeley County	907	1,819	4,887	6,830
WV, Hampshire County	0	81	346	292
WV, Morgan County	62	253	431	463
Grand Total	**19,539**	**43,720**	**80,382**	**99,305**

Year 1970 County-to-County Flow (BEA JTW Data)

Origin	DC, District of Columbia	MD, Calvert County	MD, Carroll County	MD, Charles County	MD, Frederick County	MD, Montgomery County	MD, Prince George County	MD, St. Mary's County	VA, Alexandria City	VA, Arlington County	VA, Clarke county	VA, Fairfax County, Fairfax City, Falls Church City	VA, Fauquier County	VA, King George County	VA, Loudoun County	VA, Prince William County, Manassas City, Manassas Park City	VA, Spotsylvania County, Fredericksburg City	VA, Stafford County	WV, Jefferson County	Grand Total
DE, Kent County	0		13	0		0	0					0								13
DE, New Castle County	111		10			0	0			0		0			0					121
DE, Sussex County	0					0	0		0	0		0			0					0
MD, Baltimore County	1,385	30	1,595	0	153	727	1,004	0	32	90		88			9	20		0		5,133
MD, Baltimore City	1,623	7	384	39	150	576	1,167	0	29	81		79			8	19				4,162
MD, Caroline County	0		0		42	17			0											59
MD, Cecil County	0					0	0													0
MD, Dorchester County	24					0	0													24
MD, Harford County	103		70		7	53	45	0	0			0						0		278
MD, Kent County	0						3			0										3
MD, Queen Anne's County	54	0	8	0		38	33		0	5		5			0					143
MD, Somerset County						0	0													0
MD, Talbot County	19			0		0	0					0								19
MD, Washington County	193		18		917	293	50		11	32		31			15				125	1,685
MD, Wicomico County	29		0			50	11					0								90
PA, Adams County	0		285	0	179	0	0		0	0		0			0					464
PA, Chester County	0		0			0	0					0								0
PA, Cumberland County	0			0		0	0					0								0
PA, Dauphin County	0						0			0										0
PA, Franklin County	0		0		120	0	0		0	0		0			0				0	120
PA, Fulton County	0				0	0			0			0			0					0
PA, Lancaster County	0					0	0													0
PA, Lebanon County												0								0
PA, York County	0		401	0		0	0		0			0					0			401
VA, Albemarle County, Charlottesville City	0					0	0		0	0		0			0		0	0		0
VA, Caroline County	85			28	3	2			47	133		129	0	50	13	30	698	24		1,242
VA, Culpeper County	73		0		0	0			66	130		201	265		34	6	126	59	5	931
VA, Essex County	0		6	0					0	0		0		34			18	0		58
VA, Frederick County, Winchester City	67				18	44	38		29	82	488	80	0	0	70	8	0		63	987
VA, Gloucester County												0								0
VA, Goochland County												0						5		5
VA, Greene County												0					0			0
VA, Hanover County	0								0			0			0		34	0		34
VA, Henrico County	0						0		0	0		0	0		0		0	0		0
VA, Lancaster County	0								0	0		0		12						12
VA, Louisa County	0			0					0	0		0	0		0	0	83	0		83
VA, Madison County	0								0	0		0	0	16	0	0	0	0		16
VA, Northumberland County	0								0			0		5						5
VA, Orange County	27				0	0			8	23		22	7	0	0	12	67	11		177
VA, Page County	0								36	103	0	131	8		10	23	0			311
VA, Rappahannock County	37				0	0			20	104		153	103		6	20				443
VA, Richmond County	0											0		59			4			63
VA, Richmond City	0			0		0			0	0					0	0	0	0		0
VA, Shenandoah County	0								14	39	21	38	15		4	9		0		140
VA, Warren County	76				0	0	0		41	114	81	185	72		53	117		0	16	755
VA, Westmoreland County	126			78	0	0	0	0	0	0		0		362	0	0	15	12		593
WV, Berkeley County	48		0		128	41	35		14	40	50	38	0		4	9			500	907
WV, Hampshire County	0					0	0					0	0		0	0				0
WV, Morgan County	0				44	0	0				0	0			0				18	62
Grand Total	**4,080**	**37**	**2,784**	**151**	**1,716**	**1,867**	**2,405**	**0**	**347**	**976**	**640**	**1,180**	**486**	**522**	**198**	**393**	**983**	**52**	**722**	**19,539**

Year 1980 County-to-County Flow (BEA JTW Data)

Origin	DC, District of Columbia	MD, Calvert County	MD, Carroll County	MD, Charles County	MD, Frederick County	MD, Montgomery County	MD, Prince George County	MD, St. Mary's County	VA, Alexandria City	VA, Arlington County	VA, Clarke county	VA, Fairfax County, Fairfax City, Falls Church City	VA, Fauquier County	VA, King George County	VA, Loudoun County	VA, Prince William County, Manassas City, Manassas Park City	VA, Spotsylvania County, Fredericksburg City	VA, Stafford County	WV, Jefferson County	Grand Total
DE, Kent County	35		0	0		52	12					0								99
DE, New Castle County	63		0			26	41			14		43			0					187
DE, Sussex County	39			0			100		0	0		32			0					171
MD, Baltimore County	1,849	36	2,644	57	182	1,470	4,352	36	50	330		382			8	0		0		11,396
MD, Baltimore City	2,489	0	574	53	83	808	2,873	46	51	147		134			25	0				7,283
MD, Caroline County	8		0			36	95					0								139
MD, Cecil County				0	0		28													28
MD, Dorchester County	0					0	0													0
MD, Harford County	184		105	0		57	254	0	14	107		51					0			772
MD, Kent County	0						9	24												33
MD, Queen Anne's County	207	0	0	15		56	321		0	12		50			0					661
MD, Somerset County	0					43	9													52
MD, Talbot County	60			0		49	55					9								173
MD, Washington County	276		18		2,564	971	112		14	10		182			29				128	4,304
MD, Wicomico County	14			11		29	45					27								126
PA, Adams County	48		617	0	305	101	83		0	0		31			0					1,185
PA, Chester County	24		0									16								40
PA, Cumberland County	74			0		53	4					33								164
PA, Dauphin County	32						0				0									32
PA, Franklin County	35		23		226	12	17		0	13		0			0				0	326
PA, Fulton County	0				26	2	0		0			0			0					28
PA, Lancaster County	0					0	0					47								47
PA, Lebanon County												0								0
PA, York County	43		882		18	42	58		0			18						0		1,061
VA, Albemarle County, Charlottesville City	15					0	32		13	11		7	0		0		27		0	105
VA, Caroline County	156			0		36	26		87	26		213		199	0	49	986	106		1,884
VA, Culpeper County	170			0		36	0		11	115		589	748		14	291	87	21		2,082
VA, Essex County	11			43		0			24	28		69		93				39	0	307
VA, Frederick County, Winchester City	95				29	64	12		32	36	1,396	315	86	0	276		45	12	51	2,449
VA, Gloucester County												0								0
VA, Goochland County												0					43			43
VA, Greene County												46					21			67
VA, Hanover County	0								0			28			0		55	17		100
VA, Henrico County	37						36		0	49		11	0		0		109	0		242
VA, Lancaster County	0								0	0		0			0					0
VA, Louisa County	76						0		0			44	0		0	23	108	0		251
VA, Madison County	13									0	0	40	18			0	45	0	0	116
VA, Northumberland County	0					0								38						38
VA, Orange County	57					0	28		38	39		75	93	11	0	84	459	13		897
VA, Page County	56					34	37		40	59	0	370	64		3	76	0			739
VA, Rappahannock County	36					0	0		42	13		201	263		13	7				575
VA, Richmond County	6											0		113				24		143
VA, Richmond City	66					32	0		22	0		19			0	0	78	0		217
VA, Shenandoah County	88					0	19		44	0	10	277	14		6	8		0		466
VA, Warren County	164				0	12	7		22	43	85	673	167		106	231		0	0	1,510
VA, Westmoreland County	128			56		52	0	0	17	11		71		538	0	0	144	12		1,029
WV, Berkeley County	184		0		186	154	35		27	0	53	61	0		52	0			1,067	1,819
WV, Hampshire County	20						0				32	25			0	4				81
WV, Morgan County	53				78	27	36				27	19			13				0	253
Grand Total	**6,911**	**36**	**4,863**	**235**	**3,697**	**4,254**	**8,736**	**82**	**572**	**1,063**	**1,603**	**4,208**	**1,453**	**992**	**545**	**911**	**2,144**	**169**	**1,246**	**43,720**

Year 1990 County-to-County Flow (BEA JTW Data)

Origin	DC, District of Columbia	MD, Calvert County	MD, Carroll County	MD, Charles County	MD, Frederick County	MD, Montgomery County	MD, Prince George County	MD, St. Mary's County	VA, Alexandria City	VA, Arlington County	VA, Clarke county	VA, Fairfax County/Fairfax City, Falls Church City	VA, Fauquier County	VA, King George County	VA, Loudoun County	VA, Prince William County, Manassas City, Manassas Park City	VA, Spotsylvania County, Fredericksburg City	VA, Stafford County	WV, Jefferson County	Grand Total
DE, Kent County	43		0	20		14	28					21								126
DE, New Castle County	126		0		56	14				29		8			0					233
DE, Sussex County	36					21	10		0	33		15			0					115
MD, Baltimore County	2,782	9	3,059	68	257	2,466	3,926	21	214	290		599			73	23		0		13,787
MD, Baltimore City	3,170	59	886	56	92	1,797	3,747	18	154	381		465			0	51				10,876
MD, Caroline County	35		0			21	130			0										186
MD, Cecil County	0			0		0	41													41
MD, Dorchester County	20					0	0													20
MD, Harford County	361		263		42	266	344	0	28	78		138				21				1,541
MD, Kent County	0						45	7												52
MD, Queen Anne's County	433	29	0	26		188	723		0	77		56			0					1,532
MD, Somerset County	0					2	43													45
MD, Talbot County	94			0		52	75					44								265
MD, Washington County	561		90		5,189	2,570	194		20	37		280			174				242	9,357
MD, Wicomico County	33		25			42	166					17								283
PA, Adams County	106		1,246	0	949	317	71		0	0		59			25					2,773
PA, Chester County	67		0			47	0					39								153
PA, Cumberland County	49			0		19	20					53								141
PA, Dauphin County	28						0			0										28
PA, Franklin County	133		90		1,063	336	51		0	22		122			39				41	1,897
PA, Fulton County	0				60	38	0		0			0			0					98
PA, Lancaster County	0					34	25					9								68
PA, Lebanon County												0								0
PA, York County	96		1,180		85	115	172		0			80			0					1,728
VA, Albemarle County, Charlottesville City	136					25	11		28	37		61			20	56		26		400
VA, Caroline County	239			28		4	23		35	96		183	0	207	38	154	1,579	306		2,892
VA, Culpeper County	247		0		110	0			49	72		1,483	1,646		197	669	203	123		4,799
VA, Essex County	31		30			22			18	63		115		97		0	85	30		491
VA, Frederick County, Winchester City	190				18	143	37		29	130	1,211	1,618	195	0	1,213	292	26		120	5,222
VA, Gloucester County												0								0
VA, Goochland County												0					8			8
VA, Greene County												15					2			17
VA, Hanover County	22									20		9		20			79	27		177
VA, Henrico County	95						18		0	45		143	0	39		37	149	27		553
VA, Lancaster County	47								0	0		26		0						73
VA, Louisa County	13					50			0	31		115	0	0		0	76	267	56	608
VA, Madison County	106									21	21	130	113		0	84	0	0		475
VA, Northumberland County	27					0				0		34		0						61
VA, Orange County	149					0	30		98	106		335	121	45	26	183	745	211		2,049
VA, Page County	102					98	88		21	54	0	386	95		34	187	37			1,102
VA, Rappahannock County	79					0	21		27	58		415	495		71	275				1,441
VA, Richmond County	30											0		86			39			155
VA, Richmond City	85					23	0		31	33		82			20	33	89	0		396
VA, Shenandoah County	116					52	87		44	65	31	514	60		177	206		22		1,374
VA, Warren County	305				0	123	80		68	154	91	1,896	333		378	1,284		0	0	4,712
VA, Westmoreland County	270			112		21	82	0	64	57		174		1,249	20	0	234	85		2,368
WV, Berkeley County	305		25		567	576	90		56	71	187	323	0		421	105			2,161	4,887
WV, Hampshire County	50					0	35				65	99			45	52			0	346
WV, Morgan County	70				57	83	11				24	80			41				65	431
Grand Total	10,887	97	6,839	365	8,379	9,731	10,438	39	1,011	2,040	1,630	10,241	3,058	1,743	3,012	3,790	3,540	913	2,629	80,382

Year 2000 County-to-County Flow (BEA JTW Data)

Origin	DC, District of Columbia	MD, Calvert County	MD, Carroll County	MD, Charles County	MD, Frederick County	MD, Montgomery County	MD, Prince George County	MD, St. Mary's County	VA, Alexandria City	VA, Arlington County	VA, Clarke county	VA, Fairfax County/Fairfax City, Falls Church City	VA, Fauquier County	VA, King George County	VA, Loudoun County	VA, Prince William County, Manassas City, Manassas Park City	VA, Spotsylvania County, Fredericksburg City	VA, Stafford County	WV, Jefferson County	Grand Total
DE, Kent County	43		0	0		0	20					0								63
DE, New Castle County	87		0		24	58				38		65			19					291
DE, Sussex County	132				112	151			44	54		148			29					670
MD, Baltimore County	3,668	60	3,875	95	550	2,990	4,715	22	94	440		757			155		35	50		17,506
MD, Baltimore City	3,040	0	965	90	113	1,760	2,915	0	204	249		410			45		30			9,821
MD, Caroline County	96		19			0	131			12										258
MD, Cecil County	29			38	22	29														118
MD, Dorchester County	35					26	58													119
MD, Harford County	465		319	16	330	695		39	34	99		154					0			2,151
MD, Kent County	39						12					0								51
MD, Queen Anne's County	775	0	22	18	309		1,200		33	72		135			39					2,603
MD, Somerset County	24					0	0					0								24
MD, Talbot County	175			18	73		149					28								443
MD, Washington County	474		161		7,150	2,355	254		48	74		284			264				394	11,458
MD, Wicomico County	42		0		45	42														129
PA, Adams County	100		1,865	20	1,725	314	51		12	22		63			27					4,199
PA, Chester County	14		19		41	44						38								156
PA, Cumberland County	0				34	29	8					23								94
PA, Dauphin County	29						25			24										78
PA, Franklin County	48		93		1,785	378	88		24	50		139			39				28	2,672
PA, Fulton County	12				61	50	8		8			12			4					155
PA, Lancaster County	28					65	0					39								132
PA, Lebanon County												28								28
PA, York County	97		1,815		195	42	123		34			0					18			2,324
VA, Albemarle County, Charlottesville City	180				0	0			0	0		67			0	0		0		247
VA, Caroline County	218		0	32	26				24	54		225	19	263	0	173	1,963	574		3,571
VA, Culpeper County	260			30	63	49			123	149		1,820	2,055		197	992	332	210		6,280
VA, Essex County	32		0		0					12		56		110		20	132	42		404
VA, Frederick County, Winchester City	284				71	201	26		76	80	1,507	1,900	234	20	2,074	540	0		199	7,212
VA, Gloucester County												44								44
VA, Goochland County												38					14			52
VA, Greene County												0					35			35
VA, Hanover County	53								0			80		55			141	38		367
VA, Henrico County	159					34			24	88		194	25		34	59	96	40		753
VA, Lancaster County	24								28	18		28		0						98
VA, Louisa County	100					39			25	44		194	12	15	22	56	277	64		848
VA, Madison County	0									65	0	105	119		20	100	84	14		507
VA, Northumberland County	24								44	30		37		25						160
VA, Orange County	163				63	19			99	95		310	183	35	48	220	1,310	375		2,920
VA, Page County	123				34	18			33	8	20	392	79		94	160	14			975
VA, Rappahannock County	113				18	44			34	35		316	513		93	268				1,434
VA, Richmond County	22											33		50				0		105
VA, Richmond City	115					0			54	0		44	124		0	55	73	35		500
VA, Shenandoah County	112				44	26			29	69	98	486	77		188	158	0			1,287
VA, Warren County	368				38	132	83		57	158	204	2,497	500		689	1,067		19	30	5,842
VA, Westmoreland County	199			130		0	139	12	53	32		272		960	22	68	412	237		2,536
WV, Berkeley County	499		25		1,075	465	64		0	85	340	369	39		605	110			3,154	6,830
WV, Hampshire County	44				39	0					28	91			72			0	18	292
WV, Morgan County	49				77	59	54				48	14			18				144	463
Grand Total	12,593	60	9,178	383	12,946	10,198	11,412	73	1,140	2,200	2,245	12,015	3,855	1,567	4,763	4,164	4,848	1,698	3,967	99,305