Commuting Behavior of Western U.S. Residents
The Journey to Work Estimated in Distance Traveled

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ABSTRACT

The estimation and interpretation of commutes to work has been studied extensively with respect to gender, race, and income. While the literature is extensive in these areas, there has been little research on the regional differences between U.S. states and territories. Since data which reports the commute to work is in average minutes, the distance traveled is estimated using estimates of the distance between home and work county centroids. The models differ in the estimation of the in-county commutes. The first assumes that the commute is equal to the radius of the county and the second estimates the commute as a weighed distance based on place location. Two data sets are compared, U.S. National Guard data and U.S. census data. The goal of the paper is to make conclusions about the commuting behavior of western residents through the use of these estimates, and therefore to provide a estimation method for distance commutes which can be used in further research. It is concluded that the radius method of estimation may be an over estimation, in particular in the western states. Since the non-western states are generally more homogeneously populated, this overestimation is not observed. Therefore it is recommended that the place location method be used for similar research, in particular studies dealing with western states. Suggestions are made for further research and recommendations are made for the U.S. Army National Guard in regards to recruiting.

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1. Introduction

The estimation and interpretation of commutes to work has been studied extensively with respect to gender, race, and income. While the literature is extensive in these areas, there has been little research on the regional differences between U.S. states and territories. There is a perception that in the western portion of the United States, people must travel farther distances for many job and entertainment opportunities. The wide open spaces between the developed and densely populated areas which define much of the geography of the region have added to this assumption. This paper seeks to extend the understanding of regional and geographical impacts on the journey to work by examining the commuting behavior of one specific occupation, the National Guard, and the commuting behavior across U.S. civilian job participants.

In addition to examining regional differences, this paper presents an estimation method for determining the average distance to work traveled in miles. Previous literature which has investigated the journey to work has used data which measures average travel time in minutes. Data which reports the commute to work in terms of distance is not available for the entire U.S. in county form (Demo, 1994). The most extensive journey to work data is estimated by the U.S. Census Bureau which reports the commute to work in minutes, providing the home and work counties. The average commute to work does not vary significantly across counties or states (U.S. Census County and City Data Book: 1994) providing evidence that people may be making a trade off between distance and time when making the commute to work, unless one believes congestion is consistent in every city.

The U.S. average time spent commuting to work is 19.48 minutes, while the average for
non-western states is 19.70 minutes and for western states is 16.97 minutes, a difference of 2.73 minutes or 1.8 miles at an average speed of 40 miles per hour (the definitions of non-western and western states used in this paper are presented in section 3). These averages indicate that there is not a considerable difference between the time travelled to work among different regions of the country and that if converted to distance by using an average rate travelled, that there is not much variance in terms of distance as well.

In areas and regions which are not densely populated and do not have congested highways, individuals can travel farther in a shorter amount of time than those in highly populated and congested cities. An underlying effect of the trade-off between distance and time may be that individuals in the west (where there are less congested and densely populated states) are more likely to travel farther to work. In order to test this hypothesis the distance traveled is estimated using the work and home county centroid locations.

This paper will investigate two issues. Implications as to the distance traveled to work will be made for western and non-western residents using distance estimates calculated. In addition to this, the methods of estimation will be tested to determine which is a better indicator of the distance traveled to work. Since this type of data is difficult to obtain, this method could provide a method of distance estimation which could be used in similar studies in the future.

2. Journey to Work Models

Most of the literature which has discussed journey to work issues have concentrated on income, racial, and gender differences (Wheeler 1969, Zax and Kain 1991, Zax 1990, Singell and Lillydahl 1986, Peters and MacDonald 1994, Vogt et al. 1993). The general conclusions are:
1) as income and job status increase so does the distance traveled to work, and 2) non-whites and women are less likely to travel large distances to work. The results of the studies of non-whites and women are dependent upon the specific social variables and factors which are unique to these groups.

Higher income and status occupations generally are associated with longer commutes to work because of the urban area structure of most U.S. cities (Wheeler 1969). The central business district (CBD), where a majority of work opportunities are located, does not provide all of the amenities of a suburban lifestyle and therefore those who can afford to move from the CBD are more likely to. The work trip therefore increases with the salary and status of the job.

Zax and Kain (1991) and Zax (1990) find that non-white workers in the same income range as whites are less likely to commute large distances because segregated neighborhoods restrict their residential choices. The residence of non-white workers who work in the CBD is found to be significantly closer to the city center than those of similar whites.

Women typically travel shorter distances to work than males for three specific reasons (Singell and Lillydahl 1986, Peters and MacDonald 1994). First, women’s willingness to commute is restricted by the different value that they place on time due to their domestic responsibilities (Erikson 1977, Fox 1983). Second, the spatial distribution of occupations which are traditionally held by women closely matches the spatial distribution of households (Hanson and Johnston 1985). Third, the jobs in which women have traditionally held do not provide the compensation for a longer journey to work such as increase benefits or income (Peters and MacDonald 1994, Singell and Lillydahl 1986, Vogt et al. 1993). Vogt et al. found that as the
benefits and salaries of women become more equitable to that of men, the journey to work is not significantly different between the two cohorts.

If given similar opportunities in mobility and job opportunity between men and women and between whites and non-whites, it is likely that the journey to work would become more equal among these groups. This may also be the case when comparing different regions of the country. Like women and non-whites, residents in the Western U.S. also face constraints, geographical constraints. Most of the Western U.S. is less densely populated than the rest of the nation suggesting that traveling distances for many labor and entertainment opportunities are much longer. However, it may be the case that most employment opportunities lie in the central urban areas, most employees live in to these areas, making this distance traveled to work similar to the rest of the nation.

3. The Data

The data analysis preformed in this paper involves two county level sources, the Department of Defense Reserve Components Common Personnel Data System (RCCPDS) and the City and County Data Book 1994 from the U.S. Census Bureau. The RCCPDS data set contains personal and military characteristics of 411,067 enlisted members of the Army National Guard (ARNG) in 1989. The data set excludes officers, who are often full time ARNG, members of highly specialized occupations, such as pilots or medical officers. Non-officer members, included in this data set, are part time employees who report for duty once a month and one full month in the summer. The data base includes information on: gender, age, marital status, dependents, civilian occupation, home county, unit county, county characteristic, military
speciality, pay grade, and unit characteristics. The Census Bureau data set is an extensive listing of 1990 census data which covers one in six million American households and includes statistics on population, housing, labor, income, births, deaths, education, trade, and crime. The journey to work is reported in average minutes traveled to work per county.

The western states grouping used in this study includes the ten states of Washington, Oregon, Idaho, Montana, Wyoming, Nevada, Utah, Colorado, Arizona, and New Mexico. The non-western grouping includes the remaining 38 continental U.S. states with the exception of Virginia. This state had to be dropped from the analysis because of inconsistencies between the two data sets concerning the configuration of the county and independent cities.¹

The distance traveled is estimated using a dbase program which measures the distance between the centroids of the home and unit counties.² Using this estimation method, the distance estimated for those individuals who live and report to their units in the same county is zero. To correct for this, county land area is used to determine an estimate for half the total distance of the county.³ The commuting distance within the county is a key parameter for this analysis since a large number of the observations fall in this category. The radius of the county is assumed to be the distance traveled for those who live and work in the same county (Isard 1979).

¹It is believed by the author that dropping Virginia from the analysis will not affect the results of the study considerably since it is assumed that the state is not significantly different, regarding to labor markets and commuting patterns, than other states in the non-western category, in particular its surrounding states.

²This method was first used in the development of the Regional Recruiting Potential Model, a PC program designed for the U.S. Army National Guard to indicate the optimal recruiting and unit placement choices. The latest version, 3.4, was developed in 1992 by the Oak Ridge National Laboratory Regional Studies Program staff.

³The approximation of the total distance of each county is estimated using total land area as an approximation of the area of a circle, from this the radius is calculated.
The first observations are made using the RCCPDS data comparing the regional groupings. The commuting patterns by commuting distance are listed in Table 1. This table indicates that National Guard members in non-western states more often make the smallest trips to work, between 0 and 40 miles, and that western residents are making longer trips than non-western residents, which have been divided into three groups. The table has been divided by in county and out of county commutes in order to determine the degree of these effects which is due to the large size of western counties. The average size of western counties is 2817.12 sq. miles, about four times greater than the average non-western county size of 692.62 sq. miles. Therefore the large size of these counties could effect commuting behavior as well as the distance estimates. This will be investigated farther in section 4.

Comparing the average trip distance by individuals for the two regions indicates that, on average, non-western National Guard members are traveling 36.49 miles to duty while western members are commuting an average of 58.72, an average of 20 more miles. Table 2 reports the percentage of members who report in their home county.

National Guard members could be traveling further distances for a variety of reasons. The members in the west may actually be limited as to where they report because of geographical constraints and unit constraints, due to a smaller number of units in the region. This also may be an indication that National Guard members may travel farther since this is a part time obligation. The trip is required only an average of once a month, and therefore may not represent the same commuting patterns as civilian workers.
Table 1

<table>
<thead>
<tr>
<th>Commute Distance</th>
<th>Non-Western States</th>
<th>Western States</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in county</td>
<td>out of county</td>
</tr>
<tr>
<td>0 - 40 miles</td>
<td>53.69%</td>
<td>27.33%</td>
</tr>
<tr>
<td>41 - 75 miles</td>
<td>2.56%</td>
<td>8.80%</td>
</tr>
<tr>
<td>75 - 100 miles</td>
<td>0.00%</td>
<td>2.34%</td>
</tr>
<tr>
<td>100 + miles</td>
<td>0.21%</td>
<td>5.07%</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th></th>
<th>Non-Western States</th>
<th>Western States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Near Home</td>
<td>56.46%</td>
<td>64.26%</td>
</tr>
</tbody>
</table>

The U.S. Census journey to work data, a county to county matrix arranged by home and work counties, include average commutes for 110,073,251 individuals residing in the 47 states chosen for the analysis. The average distance to work is determined for each county based on the same methods as used for National Guard commutes, for each county and region, non-west and west. The average distances over 250 are dropped, (0.45% of the data set) based on the
assumption that these distances traveled to work do not represent typical commuting behavior. These outliers exist for a few reasons. Some occupations such as truck driving and sales require long commutes from home. Also, it is possible that the legal residence of some individuals is not the same as where they are currently residing and working near.

The comparison of commuting patterns between non-western and western states using the U.S. census data has similar implications as the National Guard data. Analysis of these data are reported in tables 3 and 4. The percentage of those commuting within their own counties is greater for individuals residing in western counties. The highest concentration of commutes for both non-western and western states is in the smallest commute, 0 to 40 miles, and this commute is made within the county of residence. In both data bases the western states have a higher concentration of percent of those commuting in the middle grouping, 41-75 miles, indicating that western residents may travel further distances to work. However since most of these commutes are within home county, this conclusion may be a result of the estimation method which is used to estimate the distance.

The average commute for individuals living in non-western states is 23.16 miles and 39.45 for those in the west. Compared to civilian averages, the National Guard averages for both non-western and western states are about 1.5 times greater. Since both of these averages are greater for the National Guard, in the same proportion, this could indicates that National Guard members may be willing to travel further distances to duty than civilian employees to work, because of the smaller frequency of trips, as stated earlier.
Table 3

Commuting Patterns by Region
U.S. Census 1990
(radius method of estimating distance)

<table>
<thead>
<tr>
<th>Commute Distance</th>
<th>Non-Western States</th>
<th>Western States</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in county</td>
<td>out of county</td>
</tr>
<tr>
<td>0 - 40 miles</td>
<td>62.92%</td>
<td>19.62%</td>
</tr>
<tr>
<td>41 - 75 miles</td>
<td>6.66%</td>
<td>2.49%</td>
</tr>
<tr>
<td>75 - 100 miles</td>
<td>0.00%</td>
<td>0.36%</td>
</tr>
<tr>
<td>100 + miles</td>
<td>0.41%</td>
<td>0.54%</td>
</tr>
</tbody>
</table>

Table 4

Working Near Home
(radius methods of estimating distance)
(percent of civilian employees working in their home county)

<table>
<thead>
<tr>
<th></th>
<th>Non-Western States</th>
<th>Western States</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>69.99%</td>
<td>85.05%</td>
</tr>
</tbody>
</table>

4. Testing for a Bias

The average county size of western states is four times greater than the average of non-western states indicating that the total distance of these counties will be greater than that of non-western states, therefore since in-county commutes are estimated using the county areas, they are more likely to be larger for the western states. These estimates may result in higher commuting
averages for western states possibly compounding the commuting implications for the region. Although western counties are large, the densely populates areas are sparsely located, leaving many vast open spaces. If the populated areas are centrally located in a large county, and estimate of half the distance of the county to work, may be an over estimate for commutes to work. This is tested in this section by calculating average commuting distances using places data for each county. It is assumed that if a bias is detected for commutes within counties, resulting in higher estimated distances for western states, that a bias is likely to exist for out of county commutes as well.

The data which is used in this section is U.S. Census Places Data for 1987. The data base includes a listing of 3035 U.S. places, their population, longitude, and latitude. A place is defined by the census as any area in which 500 or more people reside. A weighed average commute per county is estimated by the following process. The largest place per county and the distances to all remaining places are calculated. A distance traveled of 5 miles is assumed for those residing in the largest place. The distances are then weighed by population for each place to arrive at a weighed average per county.

The commuting data is re-estimated substituting the new average distances for in-county commutes, replacing the estimate of half the county distance. The results for the National Guard data are presented in tables 5 and 6.

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4 A more recent data base is not available for county level analysis. At the present, a data set is being developed at the Oak Ridge National Laboratory, Regional Studies Program using 1990 census data.
Table 5

Commuting Patterns by Region
U.S. National Guard
(place location method of estimating distance)

<table>
<thead>
<tr>
<th>Commute Distance</th>
<th>Non-Western States</th>
<th>Western States</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in county</td>
<td>out of county</td>
</tr>
<tr>
<td>0 - 40 miles</td>
<td>51.86%</td>
<td>26.78%</td>
</tr>
<tr>
<td>41 - 75 miles</td>
<td>3.01%</td>
<td>8.89%</td>
</tr>
<tr>
<td>75 - 100 miles</td>
<td>0.95%</td>
<td>2.40%</td>
</tr>
<tr>
<td>100 + miles</td>
<td>0.89%</td>
<td>5.21%</td>
</tr>
</tbody>
</table>

Table 6

Working Near Home
(place location method of estimating distance)
(percent of National Guard members reporting in their home county)

<table>
<thead>
<tr>
<th></th>
<th>Non-Western States</th>
<th>Western States</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>56.71%</td>
<td>64.47%</td>
</tr>
</tbody>
</table>

Comparing the different estimation methods using tables 1 with 5, and 2 with 6, the non-western state estimates do not vary much. The western estimates vary substantially. The major grouping for these estimates is in the small commutes, 0 to 40 miles within the same county, as in Table 1, but this has increased to a percent which is similar to non-western residents. A total of 78.64 percent of the non-western residents make the small commute, compared to 72.32 percent
for western residents. The difference between these percentages cannot support the hypothesis that western residents travel farther to work. The average commute for non-western residents is 36.33 miles and for western residents is 44.96 miles. This average drops 0.16 miles for non-western residents, and 13.76 miles for the western average, indicating that place location affects job location and commutes in the larger western counties. Therefore National Guard unit location may be an important issue for the National Guard recruiters to consider, especially in western states.

New calculations are made for the U.S. census data using the same estimation method as above for the National Guard. The results are reported in tables 7 and 8.

Table 7

<table>
<thead>
<tr>
<th>Commute Distance</th>
<th>Non-Western States</th>
<th>Western States</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in county</td>
<td>out of county</td>
</tr>
<tr>
<td>0 - 40 miles</td>
<td>67.40%</td>
<td>18.62%</td>
</tr>
<tr>
<td>41 - 75 miles</td>
<td>5.80%</td>
<td>2.51%</td>
</tr>
<tr>
<td>75 - 100 miles</td>
<td>3.02%</td>
<td>0.37%</td>
</tr>
<tr>
<td>100 + miles</td>
<td>1.71%</td>
<td>0.56%</td>
</tr>
</tbody>
</table>
Commuting Behavior in the Western U.S. Residents

Table 8

<table>
<thead>
<tr>
<th>Working Near Home</th>
<th>(percent of civilian employees working in their home county)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Western States</td>
<td>77.93%</td>
</tr>
<tr>
<td>Western States</td>
<td>85.09%</td>
</tr>
</tbody>
</table>

Comparing the estimation methods using table 7 with 3 and 8 with 4, there evidence that there is not much change in the data results for the non-western states, like the National Guard comparison. There is also a similar increase in the number of western residents who make small commutes, supporting the implications made from the National Guard data. The average commute for non-western residents is 25.36 miles, a 2.2 mile increase in the average obtained from the previous estimation method. The average commute for western residents is calculated as 19.8 miles, a 19.65 mile decrease in the average. These average changes strongly support the conclusion made above that the place location affects job locations and commutes to a much higher degree for western counties.

5. Results

The results of this investigation are that on average, western residents do not travel further distances to work. Even though densely populated and developed areas may be located further distances than in other parts of the country, people generally live and work near the populated regions. Job opportunities are located in the populated areas, generally where people live, making the commuting distances small.
This conclusion can be made from the estimates of distance which are calculated using two different methods. The comparison of these methods, in-county commutes which are estimated using county radius lengths and place location weighted averages, concludes that a change in the measurement of commuting patterns is observed between the two methods. The measurement change is recognized most in the western states. Therefore, the estimates using the radius method may be an over estimate for the western states resulting from a larger average county size.

6. Conclusions and Recommendations

This paper estimates the distance traveled to work in order to compare the commuting behavior of western residents to that of the rest of the country. It is necessary to estimate commuting distance because the data is not provided in most journey to work databases, instead it is reported in average minutes of commuting time. The goal of the paper is to make conclusions about the commuting behavior of western residents through the use of these estimates, and therefore to provide an estimation method for distance commutes which can be used in further research.

The two methods which are used to estimate distances both estimate the distance traveled to work as the distance between home and work county centroids. They differ in the estimation of the in-county commute. The first model estimates these commutes based on the radius of the county. The second model calculates a weighed average of the commuted distance for each county based on the location of places and their prospective populations. It is concluded that the radius method may be an over estimation, in particular in the western states. Since the non-
western states are generally more homogeneously populated, this overestimation is not observed. The two estimates result in the same conclusions for the non-western states using the two data sets presented in the model.

It is recommended that for future research using distance estimates that the places location method be used. Further studies could test this method using zip code data to determine the distance traveled to work between home and work zip code centroids.

Recommendations that can be made for the U.S. Army National Guard who must optimally locate their units and actively recruit their members, based on these conclusions are first to target larger commuting markets than the average commuting area traveled by civilian employees because it is found that National Guard members will travel farther to duty than to civilian jobs. But, this distance should not increase for western state recruiting, since these residents do not travel any further than non-western residents. The second recommendation is that when locating units in the west, locate them near or in populated areas, since individuals do not travel far from these areas for work.
References


