COMMUTING AND WAGES IN THE BLACK HILLS OF SOUTH DAKOTA AND WYOMING

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ABSTRACT

This paper examines the effect commuting has on wages in the Black Hills of South Dakota and Wyoming. As there is no major metropolitan area within commuting distance, commuting patterns are likely to differ from those found in and around large cities. Given these differences, prior research that has focused on national or metropolitan data may not be relevant to the region. The results suggest longer commutes are associated with higher pay, but the rate of compensation is significantly lower than estimates using metropolitan data. Furthermore, professionally qualified workers are not compensated for longer commutes. It is argued that professionally qualified workers have limited job opportunities within the town where they reside, thus may be forced to commute to find appropriate employment in their field. The analysis may be applicable to other regions of the American West that have similar labor market characteristics as the Black Hills.

INTRODUCTION

Labor market theory suggests workers may be compensated for job characteristics that are considered unpleasant. All else constant, workers should consider length of commute, either measured in time or distance, to be one of those unpleasant characteristics. Building on this assumption, Ehrenberg and Smith (1983) demonstrate how length of commute would be associated with higher wages. Similarly, by estimating a simple labor supply model incorporating commuting time in a utility maximizing framework, Wales (1978) finds that commuting time is implicitly valued, on average, at about two-thirds the wage rate.

As suggested by Kostiuk (1990), empirical tests of compensating wages have produced mixed results, possibly due to data limitations and problems of self-selection. A few studies, however, find compensating wages for commuting (Leigh (1986); Zax (1991); Lawnicki (2002)). This paper focuses on the connection between commuting and wages in a labor market typical of many areas in the intermountain west region of the United States. The studies cited above analyze data that, if not entirely from a large metropolitan area, have at least a significant urban component. Workers in or near large metropolitan areas may be partially rewarded for commuting by gaining access to housing markets with different characteristics. In contrast, housing in or near small cities does not differ much based on distance from the city center, thus wage differentials are more likely to be indicative of compensation for commuting.

The Black Hills Region of South Dakota and Wyoming has a relatively low population density, and the nearest city with a population in excess of 100,000 is more than 250 miles away. The largest city in the region, Rapid City, had a population of approximately 60,000 as of 2002, and is technically considered a metropolitan statistical area. However, the labor market and housing dynamics are not similar to those found in large U.S. cities. It would not be uncommon to find residents commuting out of the city to job opportunities in other towns or at businesses located near unpopulated tourist locations. For instance, 6% of Rapid City residents travel at least 30 miles one-way to work, which is far enough to reach several small cities in the Black Hills. In addition, 3.2% travel at least 50 miles one way, which would reach Spearfish, the second largest city in the survey area with a population of approximately 10,000. Furthermore, the distance between the center of Rapid City and anything that could be considered suburbs is too minimal to be labeled a commute as the term is typically used. Thus, most commuting in the region is not suburb to inner city, but rather from one small city to another, and all of the cities experience both in and out commuting. Moss, Jack, and Wallace (2004) support this type of commuting behavior for non-urbanized regions, as they find that rural workers often commute beyond the boundaries of the immediate labor market within their locality.

The variability of labor markets is discussed in Partridge and Nolan (2005), who study commuting on the Canadian prairies. Even though their sample region has a low population density, they nonetheless suggest that it provides “a different dimension of commuting behavior than more densely populated regions (e.g. Ontario or the U.S. Midwest), or very sparsely populated rural areas in the U.S., like Montana or the Dakotas, with no large urban centres.” This notion is supported by Clemente and Summers (1975), who demonstrate that many of the variables associated with commuting in metropolitan areas are insignificant when applied to less urbanized regions.

The Black Hills is a good region to test for compensating wages for commuting, as the complications associated with commuting for housing reasons are limited. Furthermore, the cost of commuting is likely to differ between small and large cities, thus compensating wages in large metropolitan areas may not be similar to those found in less populated areas. For instance, as noted by Hole and Fitzroy (2005), small town commuters generally face a different transportation environment than urban commuters; there is typically less road congestion, less access to public transportation, and more free parking.

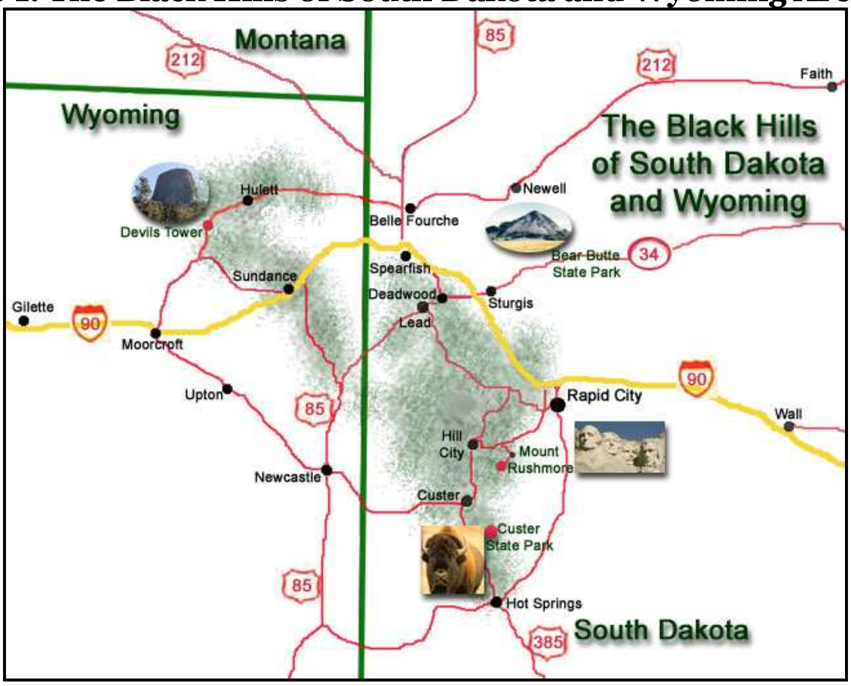
The empirical analysis that follows suggests that, all else constant, commuters are generally rewarded with higher wages in the Black Hills. In particular, commuters who travel more than 25 miles one-way to work earn, on average, about 10% more than their non-commuting counterparts. However, when the sample is separated into professional and non-professional workers, the wage advantage for commuters disappears for professional workers. This result is interesting, and may be reflective of the characteristics of the labor market studied. For instance, Green (1997) suggests that semi-rural areas are attractive locations for dual-career households, and that such households are willing to commute in order to enjoy the amenities the region provides.

Costa and Kahn (2000) note some of the problems associated with dual worker families living outside metropolitan areas, and indicate that these problems are likely to be more severe for highly educated partners. Given the limited number of job opportunities in each city in the Black Hills, a highly educated couple would be relatively less likely to find appropriate work for both members of the household in the city where they reside. As such, a commute would be necessary for at least one partner to reach an available job. Consequently, the individual may not require compensation for the commute, as there would have been no local option to fall back on.

DATA

The data are from a telephone survey of the Black Hills Region of South Dakota and Wyoming conducted between October and December 2002. A map of the Black Hills region is provided in Figure 1. The survey area spreads from Moorcroft, Wyoming, east to Rapid City, South Dakota, south to Edgemont (located just south of Hot Springs), and north to Belle Fourche. The communities included in the survey account for over 10,000 square miles of territory, and yet the total population was less than 200,000 at the time of the survey.

Figure 1. The Black Hills of South Dakota and Wyoming Area Map



Phone numbers were determined by using a random number generator to create lists of every possible number associated with each telephone prefix in the sample region. Prior to a call being placed, all selected numbers were checked on a reverse lookup site to eliminate business numbers. At least 3 attempts were made for each remaining number, with calls placed both day and night as well as during weekends. The number of completed surveys from each community was in proportion to the relative population of that community in the sample region.

The sample consists of 650 full time and part time workers between the ages of 18 and 65. Survey respondents were asked a number of questions concerning their education level, work history, etc., as well as the number of miles they travel to work. Since traffic congestion is a minor issue in the survey area, relative commute distance is likely to be a good estimate of relative commute time. Summary statistics for the variables used in the study are provided in Table 1.

Table 1. Variable Descriptions and Summary Statistics

Variable	Description	Mean	Standard Deviation
Wage	Hourly wage rate	13.3859	7.0408
Age	Years of age	41.3662	11.6889
Agesquare	Square of years of age	1847.5785	1002.5357
School	Years of education	14.0877	1.9853
Tenure	Tenure with current employer (months)	41.7431	21.2234
Fulltime	Dummy variable = 1 if full time	0.7369	0.4406
Seasonality	Dummy variable = 1 if non-seasonal job	0.9554	0.2066
Gender	Dummy variable = 1 if male	0.3954	0.4893
POO	Dummy variable = 1 if professionally-oriented occupation	0.3231	0.4680
Commute	Dummy variable = 1 if commuting distance is greater than 25 miles	0.1123	0.3160
Dcomm	Max. distance worker is willing to commute (in miles)	26.0862	22.1653

Of the 650 workers, approximately 74% were employed full time. For the purpose of this study, full-time employment is defined as 40 hours a week or more. Approximately 11% of workers are commuters when the cut-off point is one-way trips greater than 25 miles. *Dcomm* is the maximum one-way distance each respondent indicated they would be willing to travel for work. The average maximum acceptable commute was approximately 15 miles greater than the average actual commute. Table 2 provides an occupational distribution of the 650 respondents, as well as the system used to classify professionally qualified and non-professionally qualified occupations. Approximately 30% of the workforce would be professionally qualified according to the definition in Table 2.

The average male travels 13.2 miles to work, while the average female commute is 9.6 miles. The distances are less than estimates from Crane (2007), who finds an average commute of 14.1 miles for males and 11.8 miles for females. When Crane reduces the sample to residents of rural metropolitan areas, the average commute jumps to over 17 miles for males and approximately 15 miles for females. This supports the premise that commuting patterns in the Black Hills region differ from commuting patterns in rural areas that are near one or more large cities.

Table 2. Distribution and Classification of Occupations.

Occupational Category	Number	Percent	Classification*
Nurses and Health Workers	47	7.23	P
Education Professionals	26	4.00	P
Professional Specialties	80	12.31	P
Managers/Administrators	44	6.77	P
Business Owners	13	2.00	P
Sales/Customer Service Workers	35	5.38	N
Secretaries/Administrative Support	135	20.77	N
Laborers	112	17.23	N
Maintenance/Service Workers	102	15.69	N
Armed Services	18	2.77	N
Clerks	19	2.92	N
Other non-professionals	19	2.92	N
Total	650	100.00	

A "P" signifies occupations that are classified as professionally oriented, and those with an "N" are classified as non-professionally oriented.

COMMUTING AND WAGES

A simple analysis of the raw data indicates that commuters do earn higher wages, and that the wage premium increases with length of commute. For instance, workers who travel more than 35 miles to work earn, on average, $2.42 more per hour, which translates into an 18% wage advantage. Workers who travel more than 25 miles one-way earn about 14% more, while workers who travel more than 15 miles only have a 4% wage advantage over those who traveled 15 miles or less.

The direct comparison of wages to commute distance does not control for other worker characteristics that should affect wages, such as education, job tenure, age, etc. Thus the following equation is estimated using OLS to determine the marginal impact of commuting on wages:

$$\ln W = \alpha_0 + \alpha_1 Age + \alpha_2 Agesquare_i + \alpha_3 School_i + \alpha_4 Tenure_i + \alpha_5 Fulltime_i + \alpha_6 Seasonality_i + \alpha_7 Gender_i + \alpha_8 POO_i + \alpha_9 Comm_i + \varepsilon_i \quad (1)$$

where $\ln W$ is the hourly wage specified in log value and modeled as a function of age (Age_i), square of worker's age ($Agesquare_i$), years of education ($School_i$), tenure at current job ($Tenure_i$), full-time/part-time status ($Fulltime_i$), job seasonality ($Seasonality_i$), gender ($Gender_i$), occupational classification (POO_i), and commuting/non-commuting status ($Commute_i$). Age is used as proxy for years of work experience, and thus may be expected to increase at a decreasing rate. $Fulltime_i$ is a binary variable to account for workers' part-time/full-time status. Similarly, $Seasonality_i$ is included to differentiate seasonal employment from year-round work. $Commute_i$ is a 0-1 indicator of commuting, with $Commute_i = 1$ if the one-way distance is greater than a specified number of miles. The variable $Gender_i$ identifies the wage difference between male and female workers, and POO_i indicates the wage advantage of professionally qualified workers compared to their non-professional counterparts.

Equation (1) treats commuting as a job attribute, in which case it is appropriate to include it as an explanatory variable. Leigh (1986) notes that most decisions concerning where to live and where to work are not simultaneous. This would appear to be true for the Black Hills region, where housing decisions are primarily based on which community is seen as most compatible for the individual or family. For instance, an individual is unlikely to move to a new town in an effort to reduce their commute, especially if there are children involved. Thus, businesses that are relatively isolated from the type of worker they need to employ, all else constant, may need to offer higher wages. As an example appropriate to the region, restaurants and other tourist businesses that are located near unpopulated scenic areas will have to draw workers from nearby towns. If these workers have similar job opportunities within the town where they reside, they should require higher pay to cover the cost of the commute.

It is not obvious what travel distance should separate commuters from non-commuters. Thus, the model specified in equation (1) is estimated for 3 possible commuting distances: greater than 15 miles, greater than 25 miles, and greater than 35 miles. For example, in the second column of Table 3 the *commute* variable equals 1 for all workers who traveled at least 15 miles to work, and zero otherwise. In the third column of Table 3, the *commute* variable equals one for all workers who traveled at least 25 miles to work, and 0 otherwise. As such, all 650 observations are used for each estimated equation. The OLS estimates for each of these specifications are provided in Table 3. Ignoring the commute variables, all of the coefficients, with the exception of *Fulltime*, are statistically significant at the 10 percent level or higher and of the expected sign. The coefficients on the *age* and *agesquare* coefficients imply that experience increases wages, but at a deceasing rate. Workers in professionally oriented occupations earn approximately 30% more than non-professional workers, and males receive an approximate 12% wage advantage over female workers. The Black Hills region has several tourist attractions, and thus a significant amount of seasonal employment. The results in Table 3 indicate that, all else constant, year-round workers earn about 13% more than similarly qualified seasonal workers.

The coefficient on the *commute* variable is positive and statistically significant for the specifications where commuting is defined as travels in excess of 25 miles. Workers who commute more than 25 miles earn approximately 10% more than their non-commuting counterparts, and workers who travel more than 35 miles receive an approximate 12% wage advantage. Beck and Jansma (1982) suggest that 15 miles be used as the threshold for defining commutes in rural areas. However, if commuting is defined as one-way travels of more than 15 miles, the coefficient becomes insignificant. This result is consistent with research from Redmond and Mokhtarian (2001), who find that workers perceive some benefits for short commutes, and thus the ideal commute is not zero. With respect to the Black Hills, the results suggest a significant number of workers do not negatively view commutes less than 25 miles.

Table 3. OLS Estimates of Log Wage Equation

Variable	>15 miles	>25 miles	>35 miles
Constant	0.6279**	0.6256**	0.6203**
	(3.37)	(3.37)	(3.34)
Age	0.0280**	0.0277**	0.0273**
	(3.81)	(3.77)	(3.72)
Agesquare	-0.0003**	-0.0003**	-0.0003**
	(3.34)	(3.32)	(3.24)
School	0.0482**	0.0488**	0.0493**
	(5.91)	(6.00)	(6.03)
Tenure	0.0055**	0.0055**	0.0055**
	(7.43)	(7.50)	(7.42)
Fulltime	0.0546	0.0523	0.0561*
	(1.60)	(1.54)	(1.65)
Seasonality	0.1252*	0.1271*	0.1347*
	(1.80)	(1.84)	(1.94)
Gender	0.1207**	0.1181**	0.1153**
	(4.02)	(3.95)	(3.83)
POO	0.2939**	0.2917**	0.2908**
	(8.43)	(8.40)	(8.36)
Commute	0.0242	0.0974**	0.1184*
	(0.68)	(2.16)	(1.94)
Adj-R^2	0.3971	0.4011	0.4002
F-Statistic	48.50	49.29	49.12
F-Stat. Probability	0.00	0.00	0.00
Observations	650	650	650

Note: Absolute values of t-statistics are in parenthesis; levels of statistical significance are represented by *(10%) and **(5%).

OCCUPATIONAL CLASSIFICATION

Professionally oriented occupations require a certain level of cognitive skill and education, and as such would be expected to receive a higher level of compensation. However, workers with professional qualifications may face a relatively small market of potential employers, and thus may need to commute just to reach appropriate employment opportunities. To test the effect that professional status has on compensation for commuting, the sample is split into professionally oriented and non-professionally oriented occupations.

The results for non-professional workers are provided in Table 4. Consistent with the approach used above, the full sample of non-professional workers is used to estimate the wage equation for three different definitions of the *commute* variable. The results continue to suggest a wage advantage for commutes in excess of 25 miles, as the coefficients on the commute variables continue to be positive and statistically significant at the 5% level. Furthermore, the coefficients are greater than those from the full sample, suggesting a wage advantage of about 13% for the 25-mile classification and

20% for the 35-mile classification. There continues to be no significant wage advantage if commuting is defined as travels in excess of 15 miles.

Table 4. OLS Estimates of Log Wage Equation: Non-Professional Occupations

Variable	>15 miles	>25 miles	>35 miles
Constant	0.5271**	0.5414**	0.5315**
	(2.45)	(2.53)	(2.48)
Age	0.0270**	0.0267**	0.0258**
	(3.44)	(3.42)	(3.31)
Agesquare	-0.0003**	-0.0003**	-0.0003**
	(3.10)	(3.08)	(2.95)
School	0.0594**	0.0588**	0.0598**
	(5.51)	(5.49)	(5.59)
Tenure	0.0053**	0.0053**	0.0052**
	(6.30)	(6.31)	(6.23)
Fulltime	0.0467	0.0455	0.0484
	(1.20)	(1.18)	(1.26)
Seasonality	0.1082	0.1077	0.1230
	(1.29)	(1.29)	(1.47)
Gender	0.1558**	0.1507**	0.1483**
	(4.28)	(4.16)	(4.09)
Commute	0.0418	0.1290**	0.1993**
	(0.95)	(2.31)	(2.55)
Adj-R^2	0.2548	0.2624	0.2644
F-Statistic	19.77	20.52	20.72
F-Stat. Probability	0.00	0.00	0.00
Observations	440	440	440

Note: Absolute values of t-statistics are in parenthesis; levels of statistical significance are represented by *(10%) and **(5%).

The results presented above specify commute in miles, where previous studies regarding the wage implications of commuting do so with respect to time. Gordon, Lee, and Richardson (2004) report information on average travel speeds of commuters, which they indicate is 32.6 miles per hour for workers residing in towns, rural areas, or suburbs. For non-professionals who commute over 35 miles to work, the 20% wage advantage can be converted into an approximate hourly wage given the average commute time and wage level of individuals in this category. This calculation suggests that workers in the Black Hills are compensated, per hour, at about 10% the wage rate, significantly less than the 37% found by Leigh (1986) using national data. The results suggest that commuting in the Black Hills may not be as disagreeable as commuting in many other regions of the country, even after comparing commutes of equal time duration.

The results for professionally qualified workers are provided in Table 5. The coefficients on the commute variables are insignificant regardless of the assumption concerning length of commute. Professionally qualified workers appear not to require a wage advantage to commute, even when commuting is defined as one-way travels greater than 35 miles. This is consistent with the following view: workers with professional qualifications have limited employment options when living in a small town, thus some need to expand their search area to find appropriate work. Businesses that need to draw professional workers from longer distances may be able to do so without increasing the wage, as there are not significant non-commuting employment options to compete with.

Table 5. OLS Estimates of Log Wage Equation: Professional Occupations

Variable	>15 miles	>25 miles	>35 miles
Constant	1.0610**	1.0402**	1.0524**
	(2.35)	(2.31)	(2.33)
Age	0.0318	0.0314	0.0316
	(1.62)	(1.60)	(1.61)
Agesquare	-0.0003	-0.0003	-0.0003
	(1.30)	(1.28)	(1.28)
School	0.0321**	0.0333**	0.0325**
	(2.47)	(2.55)	(2.49)
Tenure	0.0053**	0.0053**	0.0053**
	(3.35)	(3.36)	(3.35)
Fulltime	0.0673	0.0599	0.0616
	(0.89)	(0.80)	(0.83)
Seasonality	0.1378	0.1439	0.1405
	(1.11)	(1.16)	(1.13)
Gender	0.0494	0.0508	0.0514
	(0.91)	(0.94)	(0.95)
Commute	-0.0266	0.0103	-0.0204
	(0.42)	(0.13)	(0.20)
Adj-R^2	0.1680	0.1673	0.1674
F-Statistic	6.27	6.25	6.25
F-Stat. Probability	0.00	0.00	0.00
Observations	210	210	210

Note: Absolute values of t-statistics are in parenthesis; levels of statistical significance are represented by *(10%) and **(5%).

Referring to actual commute distances, professional workers traveled over 3 miles more, on average, than non-professionals. In addition to actual commute, the survey asked individuals to indicate the maximum distance they were willing to commute. Non-professionals indicated an average maximum commute of 25 miles, while professional workers indicated an average maximum one-way distance of 28 miles. Thus, compared to non-professional workers, professionals are willing to travel longer for work, do travel longer for work, but do not receive higher wages than their non-commuting counterparts.

SAMPLE SELECTION BIAS

If workers who choose to commute have high levels of unmeasured ability relative to commuting jobs, OLS should overestimate the wage advantage of commuting. On the other hand, if there is positive selection into non-commuting, OLS will underestimate the wage advantage. Therefore, estimating wage compensation for commuting excluding unobserved productivity differences could create selectivity bias. To correct for this potential problem, the wage effects associated with commuting are estimated using Heckman's (1979) two-stage procedure for addressing self-selection bias.

The first step in the Heckman method is to create a dichotomous decision selection model that estimates whether or not workers choose to commute. The selection equation is estimated using probit regression analyses on the cross-sectional data to predict commuting based on age, human capital, and other demographic, job, and family characteristics. The results are then used to compute an inverse Mill's ratio (IMR), which reflects the truncation of a normal distribution in the sample. This measure is then used as an instrumental variable to obtain unbiased estimates in the log wage equation, necessitating separate equations for the commuting and non-commuting samples. The Appendix provides a more detailed explanation of the estimation procedure used to correct for self-selection bias.

Table 6 presents the estimates for the reduced-form probit equation when commuting is assumed to be one-way travels greater than 15 miles. The estimated equation, which is described in the Appendix, contains all the variables entering the wage equation, as well as an additional variable that should affect the decision to commute. The additional variable, *Dcomm,* represents the maximum distance each individual is willing to commute. This is an ideal variable to explain commute, as it should pick up much of the individual costs associated with commuting. For instance, individuals with fewer family responsibilities will likely be willing to commute longer distances. Consistent with the Heckman (1979) procedure, *Dcomm* is only included in the probit equation, as it should not have an independent effect on wages.

The results from Table 6 indicate, as expected, that those with a greater willingness to commute are indeed more likely to commute, as the coefficient on *Dcomm* is positive and significant. Full-time workers are also more likely to commute, which would be expected. Year-round workers are less likely to commute, perhaps picking up on the tendency for isolated tourist businesses to operate on a seasonal basis. The coefficients for the remaining variables from the wage equation, such as education, do not significantly affect the decision to commute.

Table 6. Estimation Results of the Probit Model (>15 miles)

Variable	Estimate	t-statistic
Constant	-1.1157	-1.44
Age	0.0376	1.18
Agesquare	-0.0003	-0.95
School	-0.0426	-1.28
Tenure	-0.0048	-1.58
Fulltime	0.3340**	2.24
Seasonality	-0.6186**	-2.44
Gender	0.0293	0.24
POO	0.1693	1.21
Dcomm	0.0153**	5.77
Log-Likelihood	-329.3774	
Observations	650	

Note: Levels of statistical significance are represented by *(10%) and **(5%).

Table 7 provides the estimates for the second step of the Heckman procedure, henceforth referred to as Heckit estimates, where wage is the dependent variable. Column 2 represents the estimates of the wage equation for workers traveling more than 15 miles to work, and column 3 provides estimates of the wage equation for the sub-sample of workers traveling less than 15 miles. The coefficient on the Inverse Mills Ratio, λ, is negative and statistically significant in the commuting equation, indicating positive selection into commuting. Thus, OLS estimates will overestimate the compensating wage for commuters.

The selectivity-corrected compensating wage for commuting is calculated as

$$100 \text{ x } [(e^{x\hat{\beta}_c} - e^{x\hat{\beta}_n}) / e^{x\hat{\beta}_n}] \quad (2)$$

which yields a 1.8% wage penalty for commuters. The OLS estimates reported in Table 3, which do not control for self selection, indicate a 2.42% wage advantage for commuters traveling more than 15 miles to work. Thus, this example demonstrates how positive self selection into commuting results in an upward bias in the OLS estimate of the *commute* coefficient, although it should be noted that the OLS estimate at 15 miles was not statistically significant. To determine the impact self selection bias has on the wage effects of commuting, the Heckman procedure is repeated for the remaining specifications presented in Tables 3, 4, and 5.

Table 8 summarizes the OLS estimates initially presented in Tables 3, 4, and 5. In addition, Table 8 includes the selectivity corrected estimates for each distance and/or occupational classification using the method described above and in the Appendix. For brevity, the remaining reduced-form probit equations are not presented. The first two columns refer to estimates for the full sample, in which controlling for selection bias reduces the wage advantage of commuters in the 25-mile classification from 9.7% to 6.9%. This is consistent with the probit equation for this specification, which indicated positive self selection into commuting. However, in the full sample, the OLS estimate is similar to the Heckit estimate for travels in excess of 35 miles. As the distance increases in the full sample, there is less self-selection into commuting, thus the wage difference between the OLS and Heckit estimates evaporates for commutes greater than 35 miles.

Table 7. Heckit Estimates: Log Wage Equation (>15 miles)

	Heckit	
Variable	Commuting	Non-commuting
Constant	1.3184**	0.5293**
	(3.36)	(2.20)
Age	0.0323**	0.0254**
	(2.03)	(2.85)
Agesquare	-0.0004**	-0.0002**
	(2.02)	(2.48)
School	0.0183	0.0580**
	(1.15)	(5.50)
Tenure	0.0085**	0.0053**
	(5.92)	(6.00)
Fulltime	0.0365	0.0422
	(0.44)	(1.06)
Seasonality	0.1778*	0.1373
	(1.71)	(1.39)
Gender	0.1276*	0.0993**
	(1.93)	(2.79)
POO	0.2314**	0.2885**
	(2.98)	(6.53)
λ	-0.2811*	0.0422
	(1.94)	(0.39)
Adj-R^2	0.4079	0.4007
Observations	133	517

Note: Absolute values of t-statistics are in parentheses; levels of statistical significance are represented by *(10%) and **(5%).

Table 8 provide a similar comparison for non-professional workers. The OLS and Heckit estimates are rather similar, as the estimated wage difference is less than 3 percentage points, and continues to suggest a significant wage advantage for commutes in excess of 25 miles. The probit equations for non-professionals did not indicate significant self-selection into either commuting or non-commuting at any of the distances estimated, hence the relatively small difference between the OLS and Heckit estimates.

Table 8. Estimated Wage Differentials (%): OLS and Heckit

	Overall		Professional		Non-Professional	
Distance	OLS	Heckit	OLS	Heckit	OLS	Heckit
>15 miles	2.42	-1.80	-2.66	-12.15	4.18	-0.45
>25 miles	9.74	6.91	1.03	-11.20	12.9	10.38
>35 miles	11.84	11.84	-2.04	-7.09	19.9	22.50

Note: The Heckit wage differentials are estimated as 100 x ($[(e^{x\hat{\beta}_c} - e^{x\hat{\beta}_n})/e^{x\hat{\beta}_n}]$. The differentials in the table are the predicted wage premiums averaged over all workers with those characteristics.

The results for professional workers are also provided in Table 8. The probit equations generally indicate positive selection into commuting for professionals, suggesting workers with greater unmeasured ability are more likely to commute. Accordingly, the OLS estimates noticeably overestimate the wage advantage for professional commuters. Specifically, the estimates suggest a possible wage penalty for commuting, where the OLS estimates indicated no connection between commuting and wages. Thus, the primary conclusions from the OLS results continue to be supported after controlling for self selection. First, non-professional workers receive a wage advantage for commuting. Second, the wage advantage is less than estimates from prior research using data from metropolitan areas. And third, professionally qualified workers appear to have limited job opportunities in the Black Hills of South Dakota and Wyoming, and thus business do not feel the competitive pressure to offer higher wages to compensate for length of commute for this group. Indeed, after adjusting for self selection into commuting, it is possible that professionals who commute may even receive a wage penalty relative to similar professionals who work closer to home.

CONCLUSION

Compensating wage theory suggests that, all else constant, workers may prefer jobs that are closer to home. If so, workers will demand higher wages for jobs that require a long commute. Previous research offers some limited support for this theory. However, these studies typically analyze data that is primarily, if not completely, urban in nature. Commuters in a rural labor market may not find commuting time as disagreeable as their urban counterparts. For instance, lack of traffic congestion may reduce some of the uncertainty and annoyance associated with commuting in urban areas, and rural commuters are not inconvenienced by the need for public transportation, as parking would be more available, and perhaps cheaper, in less populated areas.

To test the effect of commuting on rural wages, this study utilizes data from an area with relatively low population density and several scattered small cities. Commuting to obtain lower housing prices is likely to be less relevant, or even non-existent, in regions similar to the Black Hills. Thus, the region arguably provides a good labor market to analyze compensation for commuting, as some of the complexities associated with the determination of commute length are reduced.

The results suggest workers in general are compensated for length of commute, at least for one-way commutes in excess of 25 miles. However, the approximate wage advantage per hour of commute time is lower than estimates from studies that utilize data with a significant metropolitan component. This difference suggests that commuters in the Black Hills region may not view time spent commuting as negatively as workers in high-traffic regions. This result could be relevant to other sparsely populated areas of the U.S.

The empirical analysis indicates that professionally qualified workers do not receive compensation for commuting. This result is consistent with research suggesting professionals, especially professional couples, face labor market disadvantages when choosing to locate in areas with low levels of urbanization. A potential explanation is that professionals may not have a sufficient number of employment options near home in areas with low population, at least suitable to their expectations. As such, employers do not need to compete with non-commuting options for professional workers, and thus do not offer a wage advantage. Further research could focus on other labor market outcomes in regions similar to the Black Hills. Such research may reinforce the theory that professionals indeed face a tougher labor market as compared to their big-city counterparts.

The analysis also finds positive self selection into commuting, depending on the type of worker and estimated trip length. The positive self selection into commuting indicates the wage advantage of commuters is partly explained by unobserved productivity differences. However, self-selection appears to be relevant for professional workers only, thus the conclusions drawn from the OLS estimates continue to hold. Specifically, non-professional workers receive a compensating wage for commuting, but professionals do not. Furthermore, the wage advantage for commuting continues to be significantly less than that found in prior research.

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REFERENCES

Beck, R. & J. D. Jansma (1982). Spatial and socioeconomic factors influencing labor force participation rates. *Journal of the Northeastern Agricultural EconomicsCouncil*, 11(2), 61-69.

Clemente, F. & G. Summers (1975). The journey to work of rural industrial employees. *Social Forces*, 54(1), 212-219.

Costa, D. & M. Kahn (2000). Changes in the locational choice of the college educated, 1940-1990. *Quarterly Journal of Economics*, 115(4), 1287-1315.

Crane, R. (2007). Is there a quiet revolution in women's travel? Revisiting the gender gap in commuting. *Journal of the American Planning Association*, 73(3), 298-316.

Ehrenberg, R.G. & R.G. Smith (1983). *Modern Labor Economics, Theory and Public Policy*. Glenview, Illinois: Scott, Foresman and Co.

Gordon, P., B. Lee, & H.W. Richardson (2004). Travel trends in U.S. cities: Explaining the 2000 census commuting results. Lusk Center for Real Estate, University of Southern California.

Green, A.E. (1997). A question of compromise? A case study of evidence on the location and mobility strategies of dual career households. *Regional Studies*, 31(7), 641-657.

Heckman, J. J., (1979). Sample selection bias as a specification error. *Econometrica*, 47,153-161.

Hole, A.R. & F.R. Fitzroy (2005). Commuting in small towns in rural areas: the case of St. Andrews. *International Journal of Transportation Economics*, 35(1), 77-92.

Kostiuk, P. F. (1990). Compensating differentials for shift work. *Journal of Political Economy*, 98(5), 1054-1075.

Lawnicki, V.F. (2002). Econometric analysis of compensating wage differentials for commuting. Ph.D. dissertation, University of Wyoming.

Leigh, J.P. (1986). Are compensating wages paid for time spent commuting? *Applied Economics*, 18, 1203-1213.

Moss, J. E., C. G. Jack, & M. T. Wallace (2004). Employment location and associated commuting patterns for individuals in disadvantaged rural areas in Northern Ireland. *Regional Studies*, 38(2), 121-136.

Partridge, J. & J. Nolan (2005). Commuting on the Canadian prairies and the urban/rural divide. *Canadian Journal of Administrative Sciences*, 22(1), 58-72.

Redmond, L. & P. Mokhtarian (2001). The positive utility of commute: modeling ideal commute time and relative desired commute. *Transportation*, 28, 179-205.

Wales, T. J. (1978). Labour supply and commuting time. *Journal of Econometrics*, 8, 215-226.

Zax, J.S. (1991). Compensation for commutes in labor and housing markets. *Journal of Urban Economics*, 30(2), 192-207.

APPENDIX: CORRECTION FOR SELF SELECTION

Let z_{ik} be a group of variables k, which represent the characteristics of individual i who determines whether or not to commute to work – measured by latent variable d_i associated with being employed. Furthermore, γ_k are the coefficients that reflect the effect of these variables on the decision to commute. Moreover, let x_{is} be a group of variables s, which represent the characteristics of individual i receiving the corresponding level of wage compensation, and β_i are the coefficients reflecting the effect of these variables on wage compensation. Accordingly, the Heckman model takes the following form:

$$d_i = \sum_{k=1}^{K} \gamma_k z_{ik} + u_i , \qquad (3)$$

$$\ln w_i = \sum_{s=1}^{S} \beta_s x_{is} + \theta \lambda_i + \varepsilon_i , \qquad (4)$$

where equation (3) is the probit model and equation (4) is a two-equation model with estimates of wage compensation (in logs) for commuting and non-commuting workers, respectively. The two error terms, u_i and ε_i, are jointly normally distributed and follow a bivariate normal distribution $\phi(0, 0, \sigma_{u_i}, \sigma_{\varepsilon_i}, \rho_i)$, where $\phi(\bullet)$ is the standard normal density function, and $\Phi(\bullet)$ is the bivariate normal cumulative distribution function.

The inverse Mill's ratio, λ_i, contained in equation (4) is measured as $\phi(\gamma_k z_{ik})/\Phi(\gamma_k z_{ik})$ for the sub-sample of commuting workers and $-\phi(\gamma_k z_{ik})/(1-\Phi(\gamma_k z_{ik}))$ for the sub-sample of non-commuting workers. The estimate of the coefficient $\theta = \rho_i \sigma_{z_i}$ on each sub-sample indicates the nature of self selection into the sub-sample. If one assumes the error terms in equation (3) are identically and independently distributed normally, then the estimation of the equation is straightforward. If, on the other hand, u_i is correlated with the error term (ε_i) in the selection equation, correction for self-selection bias in the sample is required.