JRAP (2000)30:2

The Journal of Regional Analysis & Policy

Regional Labor Markets: The Relationship Between Industry Level Employment and In-commuting in Pennsylvania Counties

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Abstract. Hoping to generate employment opportunities for residents, communities often offer location incentives to businesses. But many newly created jobs may go to commuters rather than local residents, resulting in higher incentive costs per *local* job than perhaps anticipated. In this paper we examine the allocation of employment across space, emphasizing the propensity of commuters to "capture" jobs. Central to our work is an industry-level model of in-commuting, where commuters balance employment and wage opportunities with relative housing prices and travel costs. Using data from 65 Pennsylvania counties, our empirical results suggest that the proportion of jobs filled by in-commuters varies by industry, ranging from 0.036 (farming) to 0.498 (federal government). Thus communities courting employers should recognize that local benefits of employment growth might depend on the industry. Furthermore, when recruiting industries where there is a high propensity to commute, communities should pursue regional agreements when offering incentives so as to internalize some of the spillover effects.

1. Introduction

In many communities job creation and income generation are the overarching economic development goals. In Pennsylvania, for example, both municipalities and counties offer businesses a broad menu of location incentives - ranging from infrastructure development to tax abatements- in hopes of creating new jobs for local residents. While local gov-

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ernments recognize these programs have costs, they are often justified on the grounds that they spur economic development, thus ultimately enhancing the well being of local residents. Because the market place for industrial and population growth has become quite competitive, virtually all communities of any size offer as many incentives as they can. Consequently, it can be difficult to ascertain precisely which incentive or set of incentives yields desirable outcomes for the community.

Still, in instances where these strategies are successful there is no guarantee that jobs provided by local growth will go to local residents. Instead, non-residents--including both commuters and migrants--may fill many newly created jobs in any particular place. Existing out commuters may also opt to take a local job instead of one out-of-town yielding only nominal economic benefits to the local economy. Blanchard and Katz (1992) are among the strongest proponents of this view; suggesting new firms provide *no* long-term direct benefits to local residents. Instead, they argue that within "five to seven years, the employment response consists entirely of the migration of workers" (p. 34).

If it is true that employment growth accrues primarily to non-residents, then the most sought after benefit of local employment growth (i.e., new jobs for residents) will fail to materialize. In this case, communities offering incentives to attract businesses are in effect subsidizing the creation of employment opportunities for non-residents, with the result that incentive costs per *local* worker are much greater than anticipated. Consequently, the allocation of job-growth across spatial labor pools should be important to local policymakers.

In this paper we examine the relationship between employment opportunities and in-commuting. We focus on commuters because they can impact the level of demand for local public services (Shideler, 1999), and are a large source of income 'leakage' in a community. We begin by developing a theoretical framework where commuters are attracted to regions with relatively high wages, low unemployment and low housing costs. Once this basic framework is established we develop an empirical model to test the hypotheses suggested by the theoretical results.

While our theoretical model is consistent with the existing literature in residential and workplace choice, our empirical model improves on previous studies by disaggregating commuting by industry--in earlier studies a job in the manufacturing industry was treated the same as a job in the service industry. Yet treating all jobs similarly masks nuances about the importance of industry wages, job skill requirements and the like on the propensity of workers to commute. A consequence, then, is that we are in a difficult position to discern the number of so-called "good jobs" that will go to local residents.

By investigating commuting at the industry level we are able to glean insight into how employment changes in various industries affect commuting patterns. If there are industries where economic growth is primarily attractive to local residents, i.e., jobs that can be filled by the existing pool of workers, then this will have implications for the overall value of economic incentives in relation to the overall value of the jobs that are attractive to local workers.

Disaggregating commuting by industry provides dividends. Specifically, we find that commuters fill between 0.036 (farming) and 0.498 (federal government) of each employment opportunity, depending on the industry. A salient aspect of our results is that there is a moderate positive correlation between the proportion of jobs filled by in-commuters and the average earnings per worker in that particular industry. Simply put, the better the pay, the greater the ratio of in-commuters to jobs. This is an important finding for local policymakers to consider when they design economic incentive packages to attract "good jobs" to a community, as cost per local job might be higher than planned.

2. Theory Suggests Relative Wages, Employment and Prices Affect the Commuting Decision

In small, open economies, commuting is often an alternative to migration. In the context of a positive demand shock, employment growth in a locale may be filled in part by workers within the local labor shed, but not currently living in the community where the new jobs are located. Households may choose to commute rather than migrate because perceived transportation costs may not be as high as relocation costs, both real (e.g., moving) and psychic (e.g., local social networks). In Pennsylvania, for example, about 20 percent of workers commute across county borders and more than 75 percent of workers make inter-municipal commutes.

Theoretical treatments of commuting are largely restricted to the field of urban economics, where the allocation of housing and workplace is studied within a city (e.g., Jackman and Savouri 1992). A second strand of the commuting literature has evolved in transport economics, but these studies typically focus on modal aspects of commuting (e.g., Pickup and Town 1983). Commuting has received relatively little treatment in regional economics, which is somewhat surprising given the impacts of changing commuting patterns on regional labor supply.[1]

Like migration, commuting represents a response to relative economic incentives. Thus, it is possible to model commuting decisions in

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[1] While the commuting and migration aspects share a common theoretical framework, most previous research treats these phenomena separately. For example Bartik (1993) assumes that the SMSA is a complete labor market, with limited cross-boundary commuting. Similarly, because Treyz et al (1993) focus on US states, and Greenwood and Hunt (1989) study metropolitan areas, commuting is ignored.

an expected utility framework similar to that of migration.[2] Specifically, accounting for transportation costs, if a household expects to attain greater utility living in one place and working in another, there is increased likelihood it will commute. Formally, the probability that a household will live in a region (*-j*) other than where it works (*j*) can be written:

$$\Pr(commute) = \Pr(E(v_{-j}(\mathbf{p}, y; q)) \succ E(v_j(\mathbf{p}, y; q))) \tag{1}$$

where $E(v_r(p,y;q))$ is the expected indirect utility of the household with characteristics q in region r. Given this simple framework, the relevant commuting factors are those that affect the household consumption bundle (e.g., relative prices (p) and income (y), adjusted for transportation costs).[3]

The role of expected income in the household commuting decision depends on differential economic opportunities that consist of two parts—the expected wage and the probability of receiving that wage (Treyz et al. 1993). Regarding expected wages, theory focuses on earnings differentials across regions. Appealing to the neoclassical notions of factor mobility, it is argued that labor responds to wage rate differentials by moving until a new equilibrium is reached (e.g., Borts and Stein 1964; Smith 1974; 1975). In this decision, we expect commuters to be attracted to regions with relatively higher wages.

But relative expected wage differentials are not the sole factor that need be considered. It is also important to examine the probability that a household will receive the regional wage when investigating expected income. Accordingly, the second component of relative economic opportunity is the probability of getting a job.

While the basic concept is simple, determining the probability of employment is tremendously difficult. As noted by Isserman et al (1986), information is needed on job vacancies and the number of people seeking jobs (including discouraged workers who would reenter the job market should a job become available, under-employed workers, and adults who would, for the first time, enter the job market were appropriate jobs available); these data are not generally available at any level. Despite these difficulties, a number of proxies are available, including population (Greenwood and Sweetland 1972), the employment-to-population ratio (Dahlberg and Holmlund 1978), and the number of new hirings (Fields 1976).

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[2] For a review of the migration literature see Greenwood (1975; 1985), Clark (1982), Mueller (1982) and Knapp and Graves (1989).

[3] Tiebout (1956) implies commuting decisions may also be influenced by differences in workplace and resident community characteristics, such as the quality of local government services. We do not investigate these differences here.

The most prevalent measures of opportunity, though, are employment and employment growth (e.g., Muth 1971; Bartik 1993). Muth (1971) provides an early investigation into the importance of job opportunities in explaining net migration. Using data for urban areas in the 1950s, Muth finds that both jobs and wages are important in the household migration decision. Treyz et al. (1993) provide recent support for the importance of relative regional wages and employment opportunities on migration in the United States.

When examining the potential effect of employment on household commuting decisions it is necessary to also consider local unemployment. In the household's expected utility decision, areas with high relative local unemployment offer a lower expected probability of employment, leading to lower expected earnings. Thus, regions with high unemployment are unlikely to attract in-commuters, while current residents that are currently unemployed may move elsewhere.

Although the model thus described is similar to migration models, commuting offers some unique aspects that are not necessarily part of the migration decision; foremost among these is transportation costs. As noted by Muth (1969), transportation costs effectively lower income in two ways. The first is the transportation cost of travel, including auto maintenance and fuel expenses. The second is the opportunity cost of travel, which can include the time taken to commute to work. These costs affect the commuting decision because: i) they reduce the amount of income that is available for the household to consume other goods and services, and ii) traffic congestion can add "stress" as a dis-utility (Hamilton 1982).

Another factor that can affect the commuting decision is the price of housing (Beesley and Dalvi 1974). If housing costs (including property taxes) are higher near one's workplace than they are in an outlying area, the savings from an equivalent unit of housing may adequately compensate for any extra transportation costs. Previous tests of the importance of relative housing prices in the commuting decision support this hypothesis (Jackman and Savouri 1992; Renkow and Yoder 2000).

While the factors described above are micro-factors, it is possible to generalize to the regional level. To summarize, theory suggests that people consider relative regional wages (*relwage*) and local unemployment (*relunemp*), employment opportunities (*employment*), relative housing costs (*relhouse*) and transportation costs (*distance*) when deciding where to work (Simpson 1980; Evers 1989; Renkow et al. 1995). Accordingly, a general form of regional in-commuting for industry *i* can be

written:

$$incommute_i = f(relwage_i, relunemp, employment_i, relhouse, distance) \qquad (2)$$

3. Estimating an Empirical Model of Industry Level In-commuting

In this paper we estimate a (slightly altered) linear version of equation (2)[4], which we write:

$$\begin{aligned} incommute_i = g_0 + g_1 relwage_i + g_2 relunemp + g_3 employment_i + \\ g_4 relhouse + g_5 \text{extlabor} + g_6 extemployment + e_i \end{aligned} \qquad (2')$$

Equation 2' proposes factors related to the total number of in-commuters in a county, testing for the importance of local earnings, prices and employment opportunities. We suggest that in-commuters will be attracted to counties with higher earnings per worker *relative* to contiguous counties (γ_1>0) as well as greater employment opportunities (γ_3>0). Conversely, counties with higher unemployment rates relative to contiguous counties should be less attractive (γ_2<0). Employees preferring lower relative housing costs might be willing to commute (γ_4<0).

Finally, when specifying an aggregate model of in-commuting, it seems important to consider the availability of external labor, accounting for transportation costs (here, proxied by distance). If an economy is closed, then filling a job opportunity requires hiring a local person. But open economies (such as counties) allow workers to cross borders. As a result, it is essential to consider the size of the labor force that could potentially commute to fill new local jobs. If there is a large number of external workers available, especially *vis a vis* external employment opportunities, then it is reasonable to expect that competition for the local jobs will be greater (i.e., more in-commuting).

Relevant contiguous labor market indexes are created from the following gravity equations:

$$external\ \ labor_j = \sum_i (contiguous\ labor\ force_i / distance^2_{i,j}) \qquad (3)$$

$$external\ \ employment_j = \sum_i (contiguous\ employment_i / distance^2_{i,j}) \qquad (4)$$

The external labor force index (*extlabor)* is the sum of contiguous residential labor forces divided by the distance squared for each county contiguous with a particular county *j*. The external employment index (*extemployment*) is the sum of contiguous employment divided by distance

[4] Theory does not suggest a particular functional form for the aggregate model just described. We chose a linear model for simplicity and consistency with previous empirical work. Econometric results based on a logarithmic specification do not vary substantially from those we present in the next section.

squared for each county contiguous with a particular county *j*. Distance is measured as the right-angled distance between any two county population-weighted midpoints. These midpoints are calculated from a US gazetteer file downloadable from the US Census.

Transportation costs in both variables are proxied by the denominator. In particular, as the distance between county population centers increases, costs are assumed to increase, decreasing the likelihood of commuting. Overall, we expect that larger and more proximate contiguous labor forces will be positively associated with the number of in-commuters ($\gamma_5>0$). We also expect that greater external employment opportunities will lead to a lower level of industry in-commuting, *ceteris paribus* ($\gamma_6<0$).[5]

In specifying the empirical model we draw upon the *Journey to Work* files and other *BEA-REIS* data, as well as Census and Bureau of Labor Statistics data for 65 of the 67 counties in Pennsylvania.[6] All data are from 1990 and variable definitions and sample means are provided in Tables 1a and 1b, respectively.

Table 1a. Variable Definitions and Sources

Variable	Description	Source
incommute(i)	Number of in-commuters in industry *i*	BEA-REIS Journey to Work
employment(i)	Total industry employment	BEA-REIS
relwage(i)	Relative local industry wage (average local earnings per worker divided by average contiguous earnings per worker)	BEA-REIS
relunemp	Relative state unemployment (local unemployment rate divided by the contiguous unemployment rate)	BLS
relhouse	Relative regional housing prices (local median housing value divided by average contiguous median housing value)	1990 Census
extlabor	External labor force (sum of distance weighted contiguous labor force)	BEA-REIS and 1990 Census
extemp	External employment (sum of distance weighted contiguous employment levels)	BEA-REIS and 1990 Census

Table 1b. Means of County Level Variables Used in The Analysis

[5] Shaffer (1989) reviews various specifications of gravity models. The one we adopt is the most commonly used variant.

[6] Allegheny and Philadelphia Counties are major metropolitan counties and were excluded from the analysis.

Industry in-commuters	
Farming	37
AFF & Mining	194
Construction	868
Manufacturing	3,206
TCPU	927
Who & Ret Trade	2,455
FIRE	825
Services	2,877
Fed Government	398
State & Local Government	903
Industry employment	
Farming	1,227
AFF & Mining	1,142
Construction	4,207
Manufacturing	13,576
TCPU	3,318
Who & Ret Trade	15,772
FIRE	4,918
Services	19,621
Fed Government	1,051
State & Local Government	6,451
Industry earnings per worker	
Farming	$10,147
AFF & Mining	$24,412
Construction	$26,297
Manufacturing	$29,723
TCPU	$31,928
Who & Ret Trade	$16,269
FIRE	$14,147
Services	$18,603
Fed Government	$32,606
State & Local Government	$25,132
Median housing value	$62,584
Relative housing value	0.98
County unemployment rate	6.6%
Relative unemployment rate	1.09

Estimation Results

We used a Tobit model to estimate ten variants of equation 2', one for each of the one-digit SIC industries where all necessary data were available. The industries we examine are: farming; agricultural services and mining; construction; manufacturing; retail and wholesale trade; services; finance, insurance and real estate (FIRE); transportation, communications and public utilities (TCPU); state and local government; and federal government. In accordance with Madalla (1983), we chose the Tobit model to account for censored dependent variables. Here, the data is left censored at zero, since the number of in-commuters cannot be less than zero.[7]

The Tobit model is defined as follows:

$y_i = b$¢$x_i + e_i$ if RHS > 0
$y_i = 0$ otherwise

b is a *kx1* vector of unknown parameters; x_i is a *kx1* vector of known constants; e_i are residuals that are independently and normally distributed, with mean zero and a common variance s^2. Madalla shows how this model is estimated econometrically with maximum likelihood techniques.

In Table 2 we provide the parameter estimates. With respect to the focus of this paper, the most important coefficients are those of the industry employment variables. Here, the coefficients range between 0.036 (farming) and 0.498 (federal government). Using the manufacturing coefficient as an example, the interpretation is that for every manufacturing job in a typical county, about 0.145 of those jobs are filled by commuters. From an economic development perspective, if we are willing to use this coefficient to project job growth allocation across space, we might expect that creating 100 new manufacturing jobs in a county would result in about 15 of those jobs to go to in-commuters. The other 85 jobs, then, might go to migrants or local residents.

A second interesting result is the role of relative housing values. In all but one of the 10 industries we consider, the number of industry in-commuters increases as the ratio of local to neighboring housing values increases. The parameter is statistically significant at the five percent level for eight industries. This suggests that households may be sensitive to the vagaries of the regional housing market when making residential and workplace location decisions.

The performance of the relative unemployment rate and relative wage rate variables was disappointing in that few industries showed differences to be statistically important. With respect to the relative unemployment rate, the coefficients, though not statistically significant, generally show as local unemployment increases relative to contiguous counties there is actually a *greater* level of in-commuting, *ceteris paribus*. With respect to relative wage rate differences, the (generally statistically

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[7] We provide the number of censored observations in Table 2, ranging between 34 (farming) and zero (manufacturing). Madalla (1983) shows when there are no censored observations, the maximum likelihood estimate from the Tobit model is the same as the OLS estimate.

insignificant) parameter estimates indicate in-commuting is higher for most industries as local wages exceed regional wages.

Table 2. Parameter Estimates From County-level Tobit in-Commuting Regressions

Variable	**Farming**	**AFF & Mining**	**Construction**	**Manufacturing**	**TCPU**
Intercept	-270.601*	-723.085	-688.322	-3,202.788	-2,168.975
relunemp	58.810	237.302*	-55.681	-98.986	466.082
relhouse	66.090	304.234*	807.614*	2,451.281*	1,119.832*
relwage	41.516*	105.333	-490.767	-605.550	11.502
employment(i)	0.036*	0.210*	0.182*	0.145*	0.260*
extlabor	0.511*	-0.081	5.893*	22.670*	7.403*
extemployment	-0.447*	0.066	-5.391*	-19.116*	-6.832*
number of censored observations	34	12	5	0	5
log likelihood score	-185.933	-356.394	-453.392	-580.879	-463.731

Variable	**Wholesale and Retail Trade**	**FIRE**	**Services**	**Federal Govt.**	**State & Local Govt.**
intercept	-5,643.067	-2,949.704	-4,864.991	-1,466.177	-2,350.444
relunemp	840.089	526.635	391.029	285.733	299.446
relhouse	2,733.559*	1,203.843*	2,785.524*	618.595*	-301.055
relwage	575.809	351.948	-160.837	236.089	1,836.090
employment (i)	0.013*	0.128*	0.124*	0.498*	0,182*
extlabor	18,063*	7.208*	25.444*	1.413	4.380*
extemployment	-15.757*	-6.751*	-22.887*	-1.312	-4.135*
number of censored observations	1	10	1	15	1
log likelihood score	-566.748	-444.890	-572.567	-372.491	-520.610

Note: Figures marked with an * are statistically significant at the 5 percent level or greater.

Finally, in all industries but one, we find a positive and statistically significant relationship between industry in-commuting and the size of the distance-weighted external labor force, suggesting that commuting is greater in counties with a larger surrounding workforce, *ceteris paribus*. For these same industries, we also find a negative and statistically significant relationship between in-commuting and the number of distance weighted employment opportunities, *ceteris paribus*. Interpreting these coefficients simultaneously, our results suggest that as the ratio of employment opportunities-to-jobs decreases in surrounding areas, county in-commuting will be higher. Alternatively, people in surrounding counties will be more likely to commute into a central county as their local labor market weakens.

A Closer Look at the Relationship between Commuting and Earnings per Worker

In Table 3 we pair the employment coefficients with the earnings per worker data, showing a very interesting result. Here, we see that industries with higher earnings per worker, for the most part, have larger parameter estimates for the industry employment variable (correlation coefficient = 0.67). This relationship remains positive, but less strong, even if we remove the highest (federal government) and lowest (farming) wage industries (correlation coefficient=0.37).

These correlations hint that "good jobs"--defined as high earnings per worker--are quite often filled by in-commuters rather than local residents. Two reasons are likely. First, commuters must be compensated for their travels. Second, higher incomes offer greater flexibility in household location decisions. From an economic development perspective, this suggests that communities with strategies designed to create good jobs need to be aware that a substantial share of those jobs may not go to local residents.

Table 3. Commuting Propensities and Industry Earnings Per Worker

Industry	Earnings Per Worker	Employment Parameter
Farming	$10,147	0.036
FIRE	$14,147	0.218
Who & Ret Trade	$16,269	0.130
Services	$18,603	0.124
AFF & Mining	$23,412	0.210
State & Local Govt.	$25,132	0.182
Construction	$26,297	0.182
Manufacturing	$29,723	0.145
TCPU	$31,928	0.260
Federal Govt.	$32,606	0.498
Correlation coefficient	0.67	
Correlation coefficient (without high and low observations)	0.37	

4. Summary and Conclusions

The allocation of employment growth across space is important to local policy makers as they examine the *local* impacts of job creation. In this paper we develop a theoretical and empirical model of commuting to examine the propensity of commuters to fill local jobs. In the theoretical model, in-commuters balance transportation costs with differences in regional wages, housing prices and unemployment rates when making household and workplace location decisions.

The theoretical model is the basis of an industry-level model of in-commuting for Pennsylvania counties. We find that commuters fill between 0.036 and 0.498 of local employment opportunities. We also find some (crude) evidence that the ratio increases as industry earnings per worker increase. Our results also underscore the importance of local housing values, counties with relatively high housing costs will have more in-commuters.

It is important to recognize, though, that our model examines the *current* condition of local labor markets. Accordingly, the results must be carefully interpreted when making predictions about the spatial distribution of employment shocks. For example, when predicting the likelihood that a certain proportion of newly created jobs will be captured by commuters, our results should be used in concert with local knowledge, such as the availability of appropriately skilled labor, as industry-specific labor supply skills are not explicit in our model.

Notwithstanding this important caveat, we offer two general findings that can influence policy. First, there is a higher propensity for commuters to capture "good jobs" in a community, *ceteris paribus*. Thus, local development strategies offering costly development incentives to attract high-paying jobs could possibly generate greater costs per job than hoped for. If local leaders recognize that benefits of new employment spillover beyond the exact political jurisdiction in which the jobs are created, then there is the potential for collaboration amongst communities in sharing the cost of incentive packages so one community does not entirely absorb the costs of job creation.

The second policy suggestion is the need for communities to examine whether or not they are able to ensure a sufficient quantity of affordable local housing. If the local housing market is unable to absorb new, low-cost development, then it becomes more likely that employment growth will accrue to people commuting, rather than local residents.

From a community planning perspective, however, it remains to be seen whether a propensity to commute translates into a propensity to relocate. The relationships measured in this paper refer to the inter-industrial and inter-county labor flows during the 1990 census. The economy of Pennsylvania and of most of the rest of the United States has changed in many ways, and it will interesting to identify whether similar patterns are at work in 2000. Early evidence in many places suggests that ubiquitous nonfarm job growth is yielding substantially less in-migration and greater workforce participation levels among existing adults. Accordingly, it may be the case that even greater attention needs to be paid to commuting probabilities and industrial growth.

Finally, it must also be remembered that the broad, one-digit categorizations of the service industry as well as many of the others obscures much of the growth in the modern nonfarm economy. Much of the growth in service industries is in lower paying firms and activities, but significant employment growth is also accumulating in business services, medical, legal, accounting, and education services. The data analyzed in this study do not allow us to isolate the kind of pull that these emerging economic activities exerted on regional workforces in 1990 nor to differentiate them as we look to future job growth and future efforts to target industrial growth.

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