The Effects of Housing Prices, Wages, and Commuting Time on Joint Residential and Job Location Choices

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An empirical model of joint decisions of where to live and where to work demonstrates that individuals make residential and job location choices by trading off wages, housing prices, and commuting costs. Wages are higher in metropolitan markets, but housing prices are also higher in urban areas. Consumers can live in lower priced nonmetropolitan houses and still earn urban wages, but they incur commuting costs that increase with distance from the city. Improvements in transportation that lower commuting time will increase nonmetropolitan populations and will increase the number of nonmetropolitan commuters to metropolitan markets. Equal wage growth across labor markets causes a shift in relative population from rural to urban markets, while an equiproportional increase in housing prices causes a population shift toward rural areas.

Key words: commuting, housing costs, residential-job location choice, utility maximizing.

Traditional rural economic development efforts have included strategies such as industrial recruitment, small business development, and business retention and expansion programs in order to increase employment, income, and population bases of rural communities (Rosenfeld, Shaffer). However, rural economic growth has not kept pace with metropolitan economic expansion. Geographically isolated areas and resource dependent communities are less likely to be successful in achieving income and population growth (Barkley and Henry, Drabenstott and Smith) and the employment base in rural areas is increasingly concentrated in low-skilled, low-wage jobs (Wojan). The more rapid rates of economic and population growth in rural counties adjacent to metropolitan centers suggest that urban spillovers or urbanization economies are important factors in affecting the economic performance of rural areas (Henry and Drabenstott, Drabenstott and Smith).

Much of the research on interregional interactions builds on Roback's pioneering model that allows interregional amenity differences to be bid into interregional differences in wages and land rents. Early applications of these models were concerned with processes of suburbanization, urban decline, and overall metropolitan growth. In this interregional framework, population and economic activity in a metropolitan region adjust to allow for efficient distribution of firms and individuals (Adams et al.; Benabou; Henry, Barkley, and Bao). Other related applications of this interregional modeling approach have examined the local versus regional effects of amenities, (Blomquist, Burger, and Hoehn; Voith 1991, 1993) and the bi-directional effects of public investments and economic activities in cities and suburbs (Voith 1998). In each of these studies, economic activities occurring in one region are found to generate broader regional effects and economic adjustments, rather than only occurring locally.

In addition to job creation opportunities spilling over from stronger, more rapidly growing metropolitan economies, rural areas adjacent to metropolitan areas can expand their population by providing housing and commuting opportunities. Household choices of where to live and work involve trade-offs between wages, commuting time, and living costs. The classic works of Alonso, Muth, and Mills present the implications of distance

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from a central business district for housing prices, wages, and population densities. Several studies have found empirical results consistent with elements of the Alonso, Muth, and Mills (AMM) model. McMillen and Singell found that wages fall as probability of living outside the central city rises. Renkow and Hoover found that recent rural population growth was more affected by new residents trading longer commutes for lower home prices. Carlino and Mills; Boarnet; Freedman and Kern; and Henry, Barkley, and Bao present evidence that residence and job location are jointly determined. However, none of these studies consider all the major elements of the AMM framework: wages, commuting costs, housing prices, residential choice, and job location. Consequently, they cannot address the issues of how these factors interact to alter choices of where to live and where to work. However, it is exactly those questions that must be answered to identify which towns might benefit from proximity to an urban labor market.

This study fills this gap by using the Public Use Microdata Sample of the 1990 Census to examine how wages, housing prices, and commuting time affect the joint decisions of where to live and where to work. A restricted multinomial logit framework is applied to a sample of 6214 working-age (ages twenty-four to sixty-two) residents of a thirty-one county region in central Iowa. Individuals choose whether to reside in metropolitan Des Moines or in the nonmetropolitan communities around Des Moines. They also choose whether to work in the community in which they live or to commute. In fact, all four possible residence/job location pairs occur in the data, although relatively few individuals reside in metropolitan communities and commute to nonmetropolitan jobs.

The model yields plausible estimates of the roles of economic variables on the joint residence/job location choices. In particular, the probability of residing in an area is negatively influenced by housing price levels but positively influenced by wage levels. Incentives to commute are greater the higher the wages in the other market. As a consequence, commuters have higher wages than do noncommuters, a requirement of the utility maximizing model. The probability of choosing the commuting option is negatively related to the commuting distance, with probability going to zero when the one-way commute approaches one hour. Consequently, the extent of the labor market around a metropolitan area is the distance that can be traveled in one hour.

The empirical results point to several avenues of rural economic development. Improving transportation routes from rural areas to metropolitan labor markets will increase rural populations. Policies which raise housing costs across rural and urban markets will shift population toward rural areas, while policies that lower rural versus urban housing costs will be even more favorable toward rural areas.

Theory

Householders are assumed to jointly select a residential location and a work location so as to maximize utility. Indirect utility at residence i with job location j is given by

$$(1) \quad V_{ij} = V(W_j, C_{ij}, P_i, T_i) \qquad i, j = \text{M, N}$$

where M designates a metropolitan location and N designates a nonmetropolitan location, and where W_j is the wage the householder could earn in job location j, C_{ij} is the cost of commuting from residential location i to job j, P_i is the cost of living in residential location i, and T_i is a vector of observed and unobserved locational preferences. Indirect utility is assumed to increase with the wage and decrease with commuting time and living expenses, so that $V_{W_j} > 0$, $V_{C_{ij}} < 0$, and $V_{P_i} < 0$.

The householder objective is to choose a residence location and job location $V_{ij} = \max(V_{\text{MM}}, V_{\text{MN}}, V_{\text{NM}}, V_{\text{NN}})$.[1] The optimality condition requires that the residential and job locations i^* and j^* satisfy

$$(2) \quad V(W_{j^*}, C_{i^*j^*}, P_{i^*}, T_{i^*}) \geqq V(W_j, C_{ij}P_i, T_i) \quad \forall\ i \neq i^*\ j \neq j^*.$$

Equation (2) implies that commuters will require a wage premium over wages in their local market. An individual selecting a commuting job over a local job must have

$$(3) \quad V(W_j, C_{ij}, P_i, T_i) \geqq V(W_i, C_{ii}, P_i, T_i)$$

[1] We will be applying the model to data on a specific metropolitan area and its environs, so we do not allow the choice of moving to or from the region. Therefore, the choice here assumes that the household has already decided which region of the country to live in.

where $C_{ii} < C_{ij}$. Because local tastes and prices are the same for the same residential location, W_j must be greater than W_i for (3) to hold. Therefore, we would expect average wages for commuters to exceed average wages for noncommuters, other things equal.

Equation (3) implies that as C_{ij} increases, $W_j - W_i$ must increase to compensate commuters. Therefore the gap between wages for commuters and noncommuters will rise as the distance between the metropolitan and nonmetropolitan areas increase. However, there is no requirement that average wages in the metropolitan and nonmetropolitan areas differ overall.

Average wages will differ across the two markets if $P_M \neq P_N$. By definition, nonmetropolitan areas have lower population density than urban areas. If higher population per square mile causes land prices to be bid upward, we would expect housing costs to be greater in metropolitan than in nonmetropolitan markets. Because housing costs are a significant share of consumer budgets, it is reasonable to assume that $P_N < P_M$.

Consider the cross-area commuting combination MN and NM and assume that $C_{MN} = C_{NM} = C$. If on average

$$(4) \quad V(W_M, C, P_M, T_M) \geqq V(W_N, C, P_N, T_N)$$

then $W_M > W_N$ provided that $T_N \geqq T_M$ (average taste for nonmetropolitan residence is no lower than average taste for metropolitan residence). Average metropolitan wages will exceed nonmetropolitan wages even with $T_N < T_M$ if the disutility of higher urban living costs exceeds the positive amenities of living in the metropolitan area.[2]

Empirical Specification

The model requires data on home and job location choices, residential prices, and wages for two contiguous locations, one metropolitan and the other nonmetropolitan. Householders are allowed four choices,

MM: live and work in the metropolitan area

MN: live in the metropolitan area and commute to the nonmetropolitan area

NM: live in the nonmetropolitan area and commute to the metropolitan area

NN: live and work in the nonmetropolitan area.

The general form of the indirect utility from each joint choice, V_{ij}, is given by equation (1). To operationalize (1), we assume the linear form

$$(5) \quad V_{ij} = \alpha_W W_j + C_{ij} + \alpha_P P_i + T_i + e_{ij} \quad i, j = \text{M, N}$$

The effect of local amenities such as climate, crime rate, cultural attractions, or public services will be captured by the residential fixed effects, T_M and T_N.[3] The taste variables will only affect choices if they differ in impact across the two areas. Without loss of generality, we specify taste for nonmetropolitan residence to be $T_N = \beta_N$.[4] Given this baseline taste for nonmetropolitan areas, relative taste for metropolitan areas is assumed to be of the form

$$(6) \quad T_M = \beta_M + \beta_{MA} A + \beta_{MK} K + \beta_{ME} E + \beta_{MY} Y + \beta_{MF} F$$

where A is respondent age, K is the number of children in the household, E is years of education of the householder, Y is nonlabor income, and F indicates whether or not the respondent is female. The coefficients β_{MA}, β_{MK}, β_{ME}, β_{MY}, and β_{MF} will be positive if the variable is associated with a preference for urban over nonmetropolitan residence. If taste for nonmetropolitan living gets stronger with age, education, wealth, or raising children, or if women have stronger preferences for nonmetropolitan living, then their respective coefficients will be negative.

The other specification choice is for the commuting costs, C_{ij}. These are assumed to depend on the length of commuting time, τ_{ij}, but also on age, education, presence of children, nonlabor income, and gender. Commuting might be expected to be more dif-

[2] Note: this does not imply that no one will commute from M to N. However, M to N commuters must be paid at least $E(W_M)+C$. If, on average, $W_M > W_N$, then there will be relatively few jobs in N that would induce someone to commute from M to N. In our sample, only 1% are M to N commuters compared to 12% N to M commuters.

[3] Because all observations are from a restricted geographic area, climatic or geological amenities will be similar across M and N. These variables would become more important if the empirical frame were broadened to incorporate choice of region or state.

[4] If there are differential fixed costs of location in M versus N, those would be incorporated into node-specific constant terms β_M and β_N also. As the model already assumes that the household has opted for this particular region, fixed costs of locating in M versus N are likely to be similar.

ficult with age if younger workers have more energy. Children might make commuting more costly, if only because coordinating child care and job responsibilities is complicated when they are located thirty minutes apart. Education would proxy for the value of time while commuting, but it should also be positively related to the ease of obtaining information on job openings across labor markets. Increased nonlabor income may increase leisure demand and/or lower the marginal utility of income, lowering the incentives to accept higher pay in exchange for a longer commute. Women and men may differ in the value of the disamenity they attach to commuting.

The assumed functional form for commuting costs from residence location i to job location j is

$$(7)\qquad \begin{aligned} C_{ij} &= \alpha_C + \gamma_\tau \tau_{ij} + \gamma_A A \\ &\quad + \gamma_K K + \gamma_E E \\ &\quad + \gamma_Y Y + \gamma_F F \qquad i \neq j \\ &= \gamma_\tau \tau_{ii} \qquad\qquad\qquad i = j. \end{aligned}$$

The coefficients $\gamma_A, \gamma_K, \gamma_E, \gamma_Y$, and γ_F will be negative if the variable is associated with greater commuting costs across areas. If commuting time lowers utility, then $\gamma_\tau < 0$. Inserting (6) and (7) into (5) yields the following system of equations:

$$(8)\qquad \begin{aligned} V_{\text{MM}} &= \beta_{\text{M}} + \alpha_W W_{\text{M}} + \gamma_\tau \tau_{\text{MM}} + \alpha_P P_{\text{M}} \\ &\quad + \beta_{\text{MA}} A + \beta_{\text{MK}} K + \beta_{\text{ME}} E \\ &\quad + \beta_{\text{MY}} Y + \beta_{\text{MF}} F + e_{\text{MM}} \\ V_{\text{MN}} &= (\beta_{\text{M}} + \alpha_C) + \alpha_W W_{\text{N}} + \gamma_\tau \tau_{\text{MN}} \\ &\quad + \alpha_P P_{\text{M}} + (\beta_{\text{MA}} + \gamma_A) A \\ &\quad + (\beta_{\text{MK}} + \gamma_K) K + (\beta_{\text{ME}} + \gamma_E) E \\ &\quad + (\beta_{\text{MY}} + \gamma_Y) Y + (\beta_{\text{MF}} + \gamma_F) F \\ &\quad + e_{\text{MN}} \\ V_{\text{NM}} &= (\beta_{\text{N}} + \alpha_C) + \alpha_W W_{\text{M}} + \gamma_\tau \tau_{\text{NM}} \\ &\quad + \alpha_P P_{\text{N}} + \gamma_A A + \gamma_K K + \gamma_E E \\ &\quad + \gamma_Y Y + \gamma_F F + e_{\text{NM}} \\ V_{\text{NN}} &= \beta_{\text{N}} + \alpha_W W_{\text{N}} + \gamma_\tau \tau_{\text{NN}} + \alpha_P P_{\text{N}} \\ &\quad + e_{\text{NN}}. \end{aligned}$$

If the error terms are independently drawn from an extreme value distribution, then multinomial logit estimation is appropriate for equation (8). The system of equations has sixteen coefficients. This is a restricted form of the general multinomial logit specification which would have twenty-seven coefficients.[5] The imposed restrictions include that the marginal utility of wage income α_W is equal across choices, as is the marginal utility of commuting time γ_τ. Similarly, living costs have the same marginal utility across residential locations. These assumptions impose six restrictions. The remaining five restrictions come from imposing equal marginal effects of A, K, E, Y, and F on utility of commuting, regardless of whether the commute is from M to N or N to M.[6]

Data

The empirical specification is applied to data from the 5% Public Use Microdata Samples (PUMS) of the 1990 United States Census. We concentrate on householders aged twenty-four to sixty-two. Concentration on the householder insures that we are observing individuals actually involved in decision making for the household. While the householder can be male or female, 80% of the sample has a male designated as householder. Avoiding those under twenty-four sidesteps complications caused by respondents who are still going to school and may be making residential choices based on factors other than wages and housing prices. Similarly, those over sixty-two may have working location and residential choices influenced by pensions and social security rather than the factors in this model. For similar reasons, individuals already retired before age sixty-two were also excluded from the sample.[7]

[5] These would include a constant term and coefficients on W_i, τ_{ij}, P_i, A, E, K, Y_i, and F in each of the first three equations. Coefficients in the NN choice would be normalized to zero to insure that the probabilities across all four choices add up to one.

[6] The test of the restricted model against the unrestricted model is distributed $\chi^2(11)$. The test statistic has a marginal significance level of around 0.005. Nevertheless, as with the imposition of homogeneity in prices or symmetry in the case of demand system estimation, it is reasonable to impose the restrictions because of their consistency with theory. In our application, the estimates of α_w, γ_τ, and α_P did not differ in sign across nodes and were generally of similar magnitudes. The results of the unrestricted model are reported in the appendix.

[7] The concentration on the householder choice as representative of the entire household is a simplification. Justification lies in the finding that labor earning for the household head, typically male, rise after a move, while labor earnings for the spouse fall on average (Ehrenberg and Smith). Consequently, residential decisions appear to be driven by the income opportunities of the householder.

The model requires measures of an individual's expected wage and commuting time for each of the four residence/job location choices. However, we only observe a wage and commuting time for the choice actually taken. Furthermore, it would be incorrect to use observed wages or commuting time for the choice taken since these wages and commuting times are chosen simultaneously with locational choice. Consequently, we need to derive estimates of expected wages and commuting time for each potential choice for each individual.

The PUMS data have some clear advantages for our study. Most importantly, they include information on housing prices, commuting time, and wages as well as metropolitan versus nonmetropolitan residence and job site. However, the data set does not reveal county of residence. Consequently, it does not allow us to use available indicators of local amenities, land prices, road conditions, or labor market information that would be useful instruments for endogenous wages, housing prices, and commuting costs. Future work on residential location would benefit tremendously if better locational indicators could be incorporated into the PUMS data.

Our study includes PUMS regions that form a rural to urban continuum of thirty-one counties from southern to north central Iowa. A total of 8876 usable household records were included in the sample. The analysis will concentrate on 6214 of these, excluding the self-employed and those out of the labor force. The metropolitan residents in the sample are in the Des Moines SMSA, while the nonmetropolitan residents are in the PUMS regions surrounding Des Moines. Although the data include whether the place of residence and the place of work are designated as metropolitan or nonmetropolitan, no narrower geographic designator is provided. As a result, instruments for the endogenous variables must be generated from the variables included in the PUMS.

Given these limitations, we predict wages using education level, age, and gender as instruments. The regression was conducted over the subsample of householders who are working full time and are not self-employed.[8] Separate regressions by metropolitan and nonmetropolitan labor market are reported in the appendix. The overall fit of the regressions was weak. However, the parameters were precisely estimated and matched stylized facts about returns to education, gender, and life cycle earnings profiles. Using the parameters of the earnings function, expected wages were assigned for both the metropolitan and nonmetropolitan labor market, based on householder's age, education level, and gender. Node specific averages are reported in table 1A.

A similar strategy was attempted to predict commuting time. However, commuting time was dictated by residential location. Regressions of commuting time on age, education, and gender resulted in few precisely estimated parameters. Predicted values generated from a model with many poor instruments would lead to significant measurement error problems. Consequently, a simpler specification was used in which commuting time was set at node-specific averages by education level for each individual. The commuting time values used are reported in table 1A.

Housing prices depend on both the quality of the housing stock and the price of land. The latter is the better measure of the relative cost of living, but absent information on actual city of residence, land prices are not an option. The PUMS data offer a partial solution. While detailed information on housing quality is not available, the number of rooms is reported. Therefore, we can measure housing cost as the annual payment for housing divided by the number of rooms. For homeowners, the annual payment was assumed to be the implied payment on a thirty-year loan with a fixed 8% interest rate, plus estimated annual real-estate tax divided by the number of rooms. For renters, the annual cost of housing was set at twelve times the monthly rent, divided by the number of rooms. If housing is a normal good, housing quality will vary by earnings level. We allowed for this complication by allowing residential housing price per room to vary by education level. Therefore, for the residential location not selected, housing costs were set by the average price per room paid at the other locale by residents of the same education level. The assigned housing costs are reported in table 1A.

The remaining variables are self-explanatory. Age, education, gender, and number of children are taken directly off the

[8] As is common in the literature, we exclude part-time and self-employed workers from the sample because their wage levels depend on labor supply choices. For example, Blank found that part-time workers earn less per hour than otherwise identical full-time workers. Averett and Hotchkiss found that benefits were also lower for part-time workers. In addition, self-employed individuals have complete control over their hours worked, making income and hours worked endogenous.

Table 1A. Average Node-Specific Wages, Commuting Time, and Housing Costs, by Education

Education Level		Node: (Residence, Job) (M, M)	(M, N)	(N, M)	(N, N)
<8 yrs:	W^a	8.14	10.14	9.08	8.77
	τ	16.0	28.2	38.1	16.0
	P	920	920	556	556
9–11 years:	W	10.45	11.13	10.28	8.66
	τ	16.9	35.9	35.2	14.8
	P	1078	1078	684	684
12 years:	W	12.07	10.59	10.45	8.71
	τ	17.5	31.4	34.8	15.2
	P	1158	1158	694	694
13–15 years:	W	14.19	14.63	12.88	12.26
	τ	16.2	35.3	34.7	12.7
	P	1324	1324	909	909
16 years:	W	23.59	22.60	13.78	14.46
	τ	14.3	60.0	40.5	11.2
	P	1635	1635	998	998
17+ years:	W	16.11	16.61	13.26	19.37
	τ	16.9	23.5	40.3	14.0
	P	1463	1463	1290	1290

Note: Averages based on samples of full-time workers aged 16–65 who are not self-employed.
[a] W is the hourly wage, τ the commuting time (in minutes), and P the annual cost of housing per room.

PUMS tapes. Nonlabor income is the sum of reported interest, dividends, rent, government transfer payments, and other nonlabor income.

Empirical Results

The sample statistics are reported in table 1B. Our reported results are for the 6214 PUMS respondents who are employed but not self-employed. If labor force participation or occupational choices are made jointly with locational choices, then exclusion of the self-employed or specialists in home production would amount to selecting on the dependent variable. However, preliminary estimation of the model reported in the appendix showed that the results were quite robust to inclusion or exclusion of the self-employed and householders who are not employed.[9]

Several stylized facts from table 1B are worth emphasizing. First, average commuting time for those working outside their

[9] As a practical matter, it was not obvious how one would properly assign expected commuting time or wages to those not employed. For many of the self-employed, especially farmers, job location and residential location were identical, so commuting was not an issue.

Table 1B. Sample Means by Residential and Job Location

Variable	Node: (Residence, Job) (M, M)	(M, N)	(N, M)	(N, N)	All Metro Residents	All Nonmetro Residents
Average commuting time (minutes)	17.3	36.9	35.5	15.3	17.9	19.1
Average housing price ($/room/100)	11.5	10.8	8.5	6.6	11.5	6.9
Average hourly wage ($/hour)	13.4	14.0	12.4	11.4	13.4	11.6
Age	38.4	37.3	38.4	39.4	38.4	39.2
Average no. of children	0.87	1.02	1.08	1.08	0.87	1.08
Average education level (years of schooling)	11.6	11.8	11.0	11.0	11.6	11.0
Average unearned income ($/1000)	0.94	0.80	0.71	0.72	0.94	0.72
Female	0.28	0.19	0.17	0.21	0.28	0.20
No. of observations	2135	67	759	3253	2202	4012

residential location is two to three times the commuting time for those working in their residential location. For those working in their residential area, metropolitan residents have slightly longer commutes than nonmetropolitan residents. Metropolitan residents were more educated, had higher nonlabor income, and had smaller families than nonmetropolitan residents. Commuters were younger, more educated, atypically male, and had lower nonlabor income than noncommuters.

Consistent with the theory, commuters have higher wages than noncommuters in both markets.[10] Also, as speculated above, housing costs are lower in the nonmetropolitan areas. The higher metropolitan housing costs require that wages be higher in the metropolitan market, as confirmed by the data. While these sample statistics are supportive of the underlying theoretical model, the stronger test comes from the estimation of the structural model.

The parameters of the multinomial logit model for both samples are reported in table 2. In general, the model performed quite well. Most of the parameters are precisely estimated and correspond well to the theoretical model. Wages attract residents and commuters, while higher housing prices reduce incentives to reside in an area. As commuting time increases, incentives to commute decline. These results imply that longer commutes require higher wages to leave a worker better off than working in their place of residence. Areas with higher housing costs required higher wages to meet a worker's opportunity utility at other residential locations, or else wages must exceed those in other labor markets sufficiently to induce nonresidents to commute. These comparative static results correspond well to the underlying theory.[11]

The remaining variables have interesting implications for residential preferences and tastes for commuting. The parameters β_{Mi} will be positive if the variable is associated with an increased interest in metropolitan residence, and γ_i will be positive if variable i increases willingness to commute. The results suggest that older householders are less likely to commute and prefer to live in nonmetropolitan areas. Householders with children also prefer to live in nonmetropolitan areas. Interestingly, children do not appear to have a big impact on the probability of commuting. The estimate of γ_k is negative, but not large or statistically signifi-

Table 2. Coefficients from the Restricted Multinomial Logit Model of Residential and Job Location Choices

Coefficients	
Location-specific	
α_W	0.065*
	(7.69)
γ_τ	−0.054*
	(2.44)
α_p	−0.047*
	(7.69)
Individual	
β_{MA}	−0.019*
	(6.27)
γ_A	−0.015*
	(3.49)
β_{MK}	−0.186*
	(7.05)
γ_K	−0.049
	(1.42)
β_{ME}	0.061*
	(4.43)
γ_E	−0.042*,
	(2.39)
β_{MY}	0.028*
	(2.65)
γ_Y	0.007
	(0.43)
β_{MF}	0.40*
	(6.03)
γ_F	−0.26*
	(2.53)
Constants	
β_M	−0.232
	(1.06)
$\beta_M + \alpha_C$	−1.38*
	(2.56)
$\beta_N + \alpha_C$	0.77
	(1.56)
N	6214
Log likelihood	−6147.2
Pseduo R^2	0.29

Note: Sample of householders aged twenty-four to sixty-two excluding self-employed and those not employed.
*Significant at the 0.05 level.

[10] Note that commuters from M to N earned more than those who lived and worked in M. This means that the (M, N) group earned well above the average pay for all jobs in N ($14/hour versus $11.45). The relative scarcity of jobs in N paying wages above $E(W_M)$ leads to relatively few commuters from M to N.

[11] Wieand, White, and Yinger have developed the theory of residential choice when there are multiple employment centers. The strong performance of the empirical model herein suggests that the simpler monocentric model still has currency in the Midwest and would probably do well in most inland states that still have significant rural populations surrounding relatively dispersed cities.

Table 3. Elasticities of Residential and Job Location Choices with Respect to Wages, Commuting Time, and Housing Price

	Elasticity
Hourly wage choices: M-M	0.56[a]
	(−0.30)[b]
M-N	0.73
	(−0.10)
N-M	0.75
	(−0.10)
N-N	0.34
	(−0.38)
Commuting time choices: M-M	−0.59
	(0.31)
M-M	−1.87
	(0.02)
N-M	−1.69
	(0.23)
N-N	−0.37
	(0.41)
Housing price choices: M-M	−0.35
	(0.18)
M-N	−0.53
	(0.01)
N-M	−0.30
	(0.04)
N-N	−0.17
	(0.17)

Note: Based on parameters in table 2.
[a]Direct effect of node-specific change in an exogenous variable on own node choice.
[b]Feedback effect of node-specific change in an exogenous variable on the other three node choices is reported in parentheses.

cant. More educated householders are more likely to live in metropolitan areas but are less likely to commute to them if they live in the nonmetropolitan areas. Householders with more unearned income also prefer to live in metropolitan areas, as do women. Women are more averse to commuting than are men.

Elasticities

Our primary interest is in the first three parameters. It is useful to convert these to elasticities to derive further implications of the empirical estimates. The comparative static elasticities are reported in table 3. These elasticities measure the impact of a node-specific variable, X, on node choice under the assumption that X is unchanged at the other nodes. For example, an individual could experience a change in job opportunities that changes expected wages for a particular job location without altering expected wages at other job locations. Similarly, an improvement in transportation could change expected commuting time between locations but not within locations. These comparative static elasticities will show how individuals will respond to location-specific job offers. However, one could not have a change in local housing costs that would not simultaneously alter expected residential prices for both working in the local market and commuting to the other market while living in the local market. Therefore, our discussion concentrates on the comparative static elasticities for commuting time and wages.

Residential and job location choices respond inelastically to changes in wages. A 10% increase in the expected metropolitan wage raises incentives to reside and work in the metropolitan area by 5.6% but increases incentives to commute from a nonmetropolitan area by 7.5%. Increases in the expected nonmetropolitan wage raise incentives to live in the nonmetropolitan area by 3.4% but raise incentives to commute from the metropolitan area to a nonmetropolitan job by 7.3%. The larger wage elasticity for commuting than for working in the own residential location is consistent with the presumption that the fixed costs of changing a commute are lower than the fixed costs of changing residence. In other words, it will take a larger wage offer to induce an individual to move than that necessary to induce an individual to commute.

A percentage change in commuting time to a job alters the probability of commuting across markets more than it alters the probability of commuting within a market. Because average commuting time across markets is two to three times greater than average commuting time within a market, the differences in the elasticities are roughly comparable to the differences in mean commuting times across markets. The magnitudes of the elasticities imply that incentives to commute across markets decrease rapidly as the commuting time between the metropolitan and nonmetropolitan markets increases. A 10% increase in commuting time between metropolitan and nonmetropolitan areas reduces the proportion of commuters across the markets by 17 to 19%, evaluated at sample means. With mean commuting time of about thirty-six minutes one way, this implies that the probability of commuting from nonmetropolitan to metropolitan markets goes to zero at just under a one-hour commuting time.[12]

The comparative static elasticities are appropriate for an individual householder. However, if wages for all commuters to metropolitan markets increase, then wages must be rising for residents of the metropolitan area as well. Table 4 reports elasticities which incorporate all possible feedback effects of wages and housing prices. For example, the impact of an increase in metropolitan wage, W_{M}, on the incentive to select MM must also take into account the impact of W_{M} on the incentive to select NM. Therefore, the elasticity of MM with respect to W_{M} includes the direct effect (0.56) plus the feedback effect from NM (−0.10) for a total effect of 0.46. Similarly, the effect of W_{M} on incentives to live in the metropolitan area include the positive effect on MM and the negative effects on MN, weighted by their respective population shares. Similar methods are used to establish total elasticities for other wages and housing prices.

A 10% increase in average metropolitan wages increases metropolitan resident employment and employment of commuters into the metro by nearly identical proportions (4.6% and 4.5%, respectively). While some of the increase in MM comes from reduced commuting out of the metro, the MN source is numerically very small. The more important source is the reduction in NN, with some opting to commute to the metro and others moving to the metro to work. A 10% increase in metropolitan wages will raise metro residents by 4.3%, reduce nonmetro residents by 2.4%, and increase total commuters (increased NM net of decreased MN) by 3.8%, Node choice is less sensitive to changes in nonmetropolitan wages. Consequently, residential populations react less elastically to increases in W_N than to W_{M}. A 10% increase in W_N lowers metro resident populations by 3.7% but raises nonmetro populations by just 1.9%.[13] Because metropolitan labor supply is more wage sensitive, an equiproportional increase in metropolitan and nonmetropolitan wages raises metropolitan population and lowers nonmetropolitan population. In addition, if W_{M} and W_{N} increase by the same proportion, commuting across markets is reduced.

Residential and job locations are less affected by housing prices than by wages. A 10% increase in metro housing costs reduces metro residence by 3.4% and increases nonmetro residence by 1.9%. Similarly, increases in nonmetropolitan housing costs raise metro populations and lower nonmetro populations, but the elasticities are one-third smaller in magnitude. The effect of equiproportional increases in housing costs across all markets causes a relative shift of population toward nonmetropolitan areas with an increase in commuting. Comparing the third and sixth columns of table 4, one can determine that equiproportional shocks to wages and prices (i.e., W_{M}, W_{N}, P_{M}, and P_{N} all increase by the same proportion) will cause a slight shift of the population away from cities and toward

[12] A separate study by Khan, Orazem, and Otto found that local labor markets spanned a three-county area in the Midwest. It takes about one hour to drive across three counties by highway.

[13] Renkow's finding that rural wages are more sensitive to local demand shocks than are urban wages is consistent with our finding of less elastic labor supply in nonmetropolitan markets.

Table 4. Total Elasticities of Residential and Job Location Choices to Wages and Housing Prices

	Percentage Change in						
Node Choice	W_{M}	W_{N}	W_{M}, W_{N}	P_{M}	P_{N}	P_{M}, P_{N}	C_{ij}
MM	0.46	−0.39	0.07	−0.34	0.21	−0.13	0.25
MN	−0.40	0.35	−0.05	−0.35	0.21	−0.14	−1.64
NM	0.45	−0.39	0.06	0.19	−0.13	0.06	−1.67
NN	−0.40	0.33	−0.07	0.19	−0.13	0.06	0.25
Metro residence	0.43	−0.37	0.07	−0.34	0.21	−0.13	0.19
Nonmetro residence	−0.24	0.19	−0.05	0.19	−0.13	0.06	−0.11
Commute	0.38	−0.33	−0.05	0.15	−0.10	0.05	−1.67

Note: Based on the elasticities reported in table 3.

nonmetropolitan areas. However, commuting is unchanged when all wages and prices change by equal proportions.

The last exercise conducted in table 4 was to measure the total effects of increased commuting time. The exercise assumes a common percentage shock to commuting time to and from the metropolitan market. When MM and NN increase by the same proportion, commuters decrease by roughly the same proportion in both markets. However, commuters are a much more important fraction of the nonmetropolitan population. Consequently, the negative effect on the nonmetropolitan commuter population is sufficiently large to cause a net reduction of the nonmetropolitan population. Over time, improvements in highways have reduced commuting times from rural to urban markets. Every 10% reduction in commuting time raises nonmetropolitan population by 1.1% while it reduces the metropolitan population by 1.9%. The disproportionate share of the increase in the metropolitan population comes from an increase in commuters to metropolitan jobs.

The large negative effect of commuting time on probability of commuting implies a substantial associated disamenity. Therefore, a wage premium over the local wage is required to compensate commuters for the disamenity. A 10% increase in commuting time lowers nonmetropolitan population by 1.1%.[14] Holding housing prices fixed, the real wage increase required in the metropolitan market over the local market is 7.7% if we use the comparative static wage elasticity, or 12.8% if we use the total wage elasticity.[15] Therefore, the implied elasticity of W_M with respect to commuting time lies in the range (0.7, 1.3). Of course, commuters can also be compensated by lower housing prices as distance from the metropolitan area increases. Thus, the required gradient in nominal wages will be less than the real wage gradient implied by the elasticity of W_M with respect to commuting time. In fact, the implied elasticity of P_M with respect to commuting time is even larger than the elasticity of W_M with respect to commuting time.

As distance to the metropolitan area increases, the wage premium commuters will require increases. Given an invariant distribution of metropolitan wages, the costs of job search necessary to capture progressively higher commuting reservation wages are expected to increase, and so there will be an inverse relationship between number of commuters and distance from the metropolitan market, even as the wage premium paid to more distant commuters increases.

Conclusions

This study shows that an intraregional empirical model of individual joint choices of residential and job locations can yield plausible results. Nonmetropolitan residents trade off lower housing costs for lower wages in the local labor market. Those that opt to commute to urban markets trade off higher wages for the disamenity of commuting time. All of these results are consistent with the underlying predictions of the Alonso–Mills–Muth model. That residential choices were influenced by differences in wages and housing prices is also consistent with previous interregional empirical studies based on the Roback model. A valuable extension of this work would be to nest our model of intraregional job/residence choice within the broader choice of which region in which to live.

Our results suggest that improvements in transportation that lower commuting time will increase nonmetropolitan populations and will increase the number of nonmetropolitan commuters to metropolitan markets. If, instead, policies encouraged economic expansion in both markets which increased wages equally, population growth would be concentrated in metropolitan areas. Consequently, improvements in transportation to metropolitan markets may be an effective means of extending economic gains to rural areas. It appears that nonmetropolitan residents are willing to commute to the metropolitan markets if they live within one hour's distance or if transportation improvements (or speed limit changes) bring them within one hour's distance. These results are consistent with the Renkow and Hoover study in North Carolina where metro areas were increasingly drawing commuters

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[14] Using the sample population in table 1, the number of nonmetropolitan commuters falls by 127, but 83 remain in the nonmetropolitan market in local jobs, so the nonmetro population decreases by 44.

[15] With 759 commuters initially, and with a commuter elasticity with respect to W_M of 0.75, the implied wage increment necessary to include 44 more commuters is $(44)/(0.75)(759) = 0.077$ or 7.7%. If the NM elasticity with respect to W_M is 0.45, the compensating differential is $(44)/(0.45)(759) = 0.128$ or 12.8%.

from surrounding (less than 35 miles) and from second-ring counties (between 35 and 70 miles) when interstate highways were present. Alternatively, policies which lower housing prices in nonmetropolitan areas or cause an overall increase in both metro and nonmetro housing prices will cause a shift of population away from cities. The opposite policies will shift the population to the urban center.

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Appendix

Hourly Wage Equations for Metropolitan and Nonmetropolitan Labor Markets, 1990

	Metropolitan	Nonmetropolitan
Education		
8 to <12 years	3.08*	1.19
	(4.61)	(.99)
12 years	4.07*	1.77
	(4.60)	(1.06)
>12 to <16 years	6.54*	4.28*
	(9.30)	(3.22)
≥16 years	14.7*	8.29*
	(12.8)	(3.66)
Age		
30 to 34 years	2.42*	1.40
	(4.92)	(1.31)
35 to 39 years	3.73*	2.01
	(7.49)	(1.89)
40 to 44 years	4.49*	2.24*
	(8.67)	(1.97)
45 to 49 years	5.44*	3.58*
	(9.57)	(2.86)
50 to 54 years	5.64*	4.87*
	(8.78)	(3.82)
55+ years	4.57*	6.46*
	(6.38)	(4.96)
Female	−3.94*	−4.11*
	(11.1)	(5.09)
Constant	6.64*	7.80*
	(9.2)	(5.8)
R^2	0.16	0.02
N	2910	3404

*Significant at the 0.05 level.

Unrestricted and Restricted Forms of the Joint Model of Residential and Job Location

	Unrestricted		Restricted[b] 1	Restricted[b] 2
Wage(α_W)				
MM	0.75			
	(2.42)[a]			
MN	0.466		0.081	0.035
	(4.22)		(3.90)	(2.17)
NM	0.094			
	(2.69)			
Commute time (γ_τ)				
MM	−0.231			
	(3.20)			
MN	−0.088		−0.052	−0.078
	(2.85)		(2.39)	(4.88)
NM	−0.035			
	(1.00)			
Housing price (α_P)				
MM	−0.003			
	(0.37)			
MN	−0.086		−0.012	−0.009
	(1.84)		(2.22)	(2.30)
NM	−0.018			
	(2.40)			
Children				
MM	−0.189	Metro[c]	−0.185	−0.161
	(7.39)		(7.46)	(7.58)
MN	−0.072	Commute	−0.007	0.013
	(0.68)		(0.21)	(0.43)
NM	−0.019			
	(0.55)			
Nonlabor income				
MM	0.029	Metro	0.030	0.008
	(2.76)		(2.89)	(1.31)
MN	0.013	Commute	−0.002	−0.045
	(0.26)		(0.10)	(3.18)
NM	0.001			
	(0.05)			
Education				
MM	0.054	Metro	0.068	0.092
	(1.69)		(5.51)	(8.62)
MN	−0.103	Commute	−0.008	−0.007
	(1.43)		(0.46)	(0.50)
NM	−0.015			
	(0.82)			
Age				
MM	−0.014	Metro	−0.013	−0.019
	(5.07)		(4.88)	(8.37)
MN	−0.025	Commute	−0.008	−0.014
	(2.01)		(2.10)	(3.98)
NM	−0.008			
	(2.03)			
N	6549		6549	9438
$\mathcal{L}$	−6524.2		−6536.9	−8806.1

[a]Estimated *t*-statistics in parentheses.
[b]Column 1 is the sample excluding the self-employed and those working at home. Column 2 includes those groups.
[c]Metro means metropolitan residence choice. Commute means commuting from N to M or M to N.
Notes: All estimates are from maximum likelihood of restricted or unrestricted multinomial logit models. Estimates also included node-specific constants for MM, MN, and NM.