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

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Rural areas facing declining populations and limited economic growth have attempted a variety of strategies to counter these trends. Traditional strategies include developing value-added agriculture and resource-based industries, recruiting new industrial firms, and tourism/retirement-based strategies. More recently, analysts and policymakers have reconsidered a regional system approach to developing rural places (Rusk 1995; Galston and Baehler 1995; Henry and Barkley 1997). The relatively stronger economic performance of urban centers suggests that nearby places may be able to benefit from outsourcing or networking with urban-based firms as well as allowing an expanded labor base to commute to jobs in urban places.

The potential for growth in urban centers to spillover and benefit rural places can be examined in the context of the classic Muth-Mills model of urban land use. Within this framework, employment opportunities are concentrated in an urban center which is characterized by higher wages, housing prices and population densities than its rural surroundings. Households tradeoff housing and commuting costs for wages in deciding where to live (Muth 1969; Mills 1972; Alonso 1964). Typically, although not necessarily, employment location in these models is fixed in the Central Business District (CBD) with individuals free to choose residential location anywhere in the metropolitan area. The concentration of employment opportunities in urban centers with less expensive housing in outlying regions suggests a rural version of the "spatial-mismatch hypothesis." Rather than inner city residents commuting to jobs in the suburban fringe (Holzer 1991), the rural version involves workers commuting from rural counties to job opportunities in urban counties.

This study uses a household utility maximizing model to examine how wages, housing prices and commuting time affect the joint decisions of where to live and where to work. A multinomial logit framework is applied to a sample from the 1990 Census Public Use Microdata Sample (PUMS) of 9,438 working-age (ages 22-62) residents of a 31 county region in central Iowa. Individuals choose whether to reside in a metropolitan or nonmetropolitan market, and also choose whether to work in the community in which they live or to commute to another town. 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 job/residence 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 are 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. Results from this study help inform public policy on regional approaches to economic development.

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

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

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 $V_{W_i} > 0$, $V_{C_{ii}} < 0$ and $V_{P_i} < 0$.

The householder objective is to choose a residence and job so as to max (V_{MM}, V_{MN}, V_{NM}, V_{NN}). The optimality condition requires that the optimal residential and job locations i^* and j^* satisfy

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

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

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

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 $P_N < P_M$. If for any householders,

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

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). Metropolitan wages will exceed nonmetropolitan wages even with $T_N < T_M$ if the disamenity of higher urban living costs exceeds the positive amenities of living in the metropolitan area.

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) $$V_{ij} = \alpha_W W_j + \alpha_C C_{ij} + \alpha_P P_i + T_i + e_{ij} ; \qquad i, j = M, N$$

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 $T_N = \beta_N$. Relative taste for metropolitan areas is assumed to be of the form

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

where A is respondent age, K is the number of children in the household, E is years of education of the householder, and Y is nonlabor income.

The other specification choice is for the commuting costs, C_{ij}, which are assumed to depend on the length of commuting time, τ_{ij}, age, presence of children and nonlabor income. The assumed functional form is

(7) $$\alpha_C C_{ij} = \beta_C + \gamma_\tau \tau_{ij} + \gamma_A A + \gamma_K K + \gamma_E E + \gamma_Y Y; \quad i \neq j$$

$$= \gamma_\tau \tau_{ii} \quad ; \quad i = j$$

Commuting costs are expected to lower utility so that $\alpha_C < 0$. Consequently, if a factor X increases commuting costs, its attached coefficient γ_X will be negative. Because commuting costs must increase in the time required for the commute, γ_τ must be negative.

Inserting (6) and (7) into (5) yields the following system of equations:

(8) $$V_{MM} = \beta_M + \alpha_W W_M + \gamma_\tau \tau_{MM} + \beta_{MA}A + \beta_{MK}K + \beta_{ME}E + \beta_{MY}Y + \alpha_P P_M + e_{MM}$$

$$V_{MN} = (\beta_M + \beta_C) + \alpha_W W_N + \gamma_\tau \tau_{MN} + (\beta_{MA} + \gamma_A)A + (\beta_{MK} + \gamma_K)K + (\beta_{ME} + \gamma_E)E + (\beta_{MY} + \gamma_Y)Y + \alpha_P P_M + e_{MN}$$

$$V_{NM} = (\beta_N + \beta_C) + \alpha_W W_M + \gamma_\tau \tau_{NM} + \gamma_A A + \gamma_K K + \gamma_E E + \gamma_Y Y + \alpha_P P_N + e_{NM}$$

$$V_{NN} = \beta_N + \alpha_W W_N + \gamma_\tau \tau_{NN} + \alpha_P P_N + e_{NN}.$$

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 14 coefficients. This is a restricted form of the general multinomial logit specification which would have 24 coefficients. 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 four restrictions come from imposing equal marginal effects of A, K, E and Y on utility of commuting, regardless of whether the commute is from M to N or N to M.

Data. The empirical specification is applied to data from the 5 percent Public Use Microdata Samples (PUMS) of the 1990 United States Census. We concentrate on individuals aged 22-62 to avoid complications caused by social security and retirement. Our study includes PUMS regions that form a rural to urban continuum of 31 counties from southern to north central Iowa. A total of 9,438 usable household records were included in the sample.

We require cross-sectional variation in wages and commuting times for identification. However, it would be incorrect to use observed wages or commuting time for individuals since these are chosen simultaneously with locational choice. Our strategy was to use average wages by education level and job location as the expected wage level in each market. To hold constant labor supply, averages were taken over full-time workers who are not self-employed. Consequently, averages were computed for each of six education levels: < 8 years, 9-11 years, 12 years, 13-15 years, 16 years, and 17+ years. For each householder including those not employed or self-employed, expected wages were assigned using the average wage for the householder's education level. A similar strategy was used to assign expected commuting time for each of the four options. Thus, each individual has an expected wage and commuting time determined by the individual's education level for each potential choice.

Housing prices depend on both the quality of the housing stock and the price of land. To adjust for housing quality differences, we report housing cost as the annual payment for housing divided by the number of rooms. For the residential location not selected, housing costs were assigned based on the average price per room paid by residents of the same education level. Implicitly, this procedure assumes that relevant housing opportunities in the other location are defined by the type of housing consumed by householders of the same education level.

The remaining variables are self-explanatory. Age, education and number of children are taken directly off the PUMS tapes. Nonlabor income is the sum of reported savings, dividends, rent, government transfer payments, and other nonlabor income.

Empirical Results. The parameters of the multinomial logit model for both samples are reported in Table 1. 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 at the 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.

The remaining variables have interesting implications for residential preferences and tastes for commuting. The parameters β_{M_i} will be positive if the variable is associated with an increased interest in metropolitan residence. 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 lower the probability of commuting. More educated householders are more likely to live in metropolitan areas, and are less likely to commute, although the effect is not precisely estimated. Householders with more unearned income prefer to live in nonmetropolitan areas, and are also less likely to commute.

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. Table 2 reports elasticities which incorporate all possible cross effects of wages and housing prices rather than comparative static results. The comparative static elasticities are appropriate for an individual householder, but if wages for all commuters to metropolitan markets increase, then wages must be rising for residents of the metropolitan area as well. For example, an increase in metropolitan wages will increase incentives to live and work in the metropolitan area, but will also increase incentives to live in the nonmetropolitan area and commute to the metropolitan area. Therefore, the elasticity of MM with respect to W_M includes the direct effect on MM (.60) plus a feedback effect from NM (-.11) for a total effect of .49. Similarly, the effect of W_M on incentives to live in the metropolitan area includes the positive effect on MM and the negative effect on MN. Similar methods are used to establish total elasticities for other wages and housing prices.

An increase in average metropolitan wages increases metropolitan resident employment by a greater proportion than it increases commuters into the metro. A ten percent increase in metropolitan wages will raise metro residents by 4.8 percent, reduce nonmetro residents by 3.1 percent and increase total commuters (increased NM net of decreased NM) by 3.5 percent.

Increases in nometro wages, W_N, have a larger proportional effect on commuters from the metro than on nonmetro resident employment. Consequently, equiproportional increases in metropolitan and nonmetropolitan wages raise metropolitan populations and lower nonmetropolitan populations.

Residential and job location decisions are less sensitive to housing prices. A ten percent increase in metro housing costs reduces metro residence by .9% and increases nonmetro residence by .5%. Nonmetropolitan housing costs raise metro populations and lower nonmetro populations, but the elasticities are one-third smaller. An equiproportional increase in housing costs across all markets causes a very small population shift toward nonmetropolitan areas.

The last column in Table 2 measures the effects of increased commuting time. Every ten percent reduction in commuting time raises nonmetropolitan population by .7% while it reduces the metropolitan population by 2.1 percent. 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. The wage increase required in the metropolitan market over the local market is 5.2 percent if we use the comparative static wage elasticity or 9.6 percent if we use the total wage elasticity. Therefore, the implied elasticity of W_M with respect to commuting time lies in the range (.5, 1.0).

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 and Extensions. This study shows that an empirical model of individual joint choices of residential and job locations can yield plausible results. Nonmetropolitan residents tradeoff 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 theoretical model.

The results suggest that transportation improvements that lower commuting time will increase nonmetropolitan populations and will increase the number of nonmetropolitan commuters to metropolitan markets. If instead, policies encouraged wage growth in both markets, 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 non-metropolitan residents are willing to commute to the metropolitan markets if they live within one hour's distance or if transportation improvements bring them within one hour's distance.

These results demonstrate the interdependence of economic growth between urban and rural markets. Changes in wages and housing prices in one market affects the number of commuters and population growth in the other market. The interdependence between the markets suggests the economic development plans should be conducted on a regional basis rather than concentrating only on the metropolitan market or only on the nonmetropolitan market.

Table 1: Coefficients from the Restricted Multinomial Logit Model of Residential and Job Location Choices

Coefficients	1[a]	2[b]
Location-specific		
α_W	.081*	.035*
	(3.90)	(2.17)
γ_τ	-.052*	-.078*
	(2.39)	(4.88)
α_P	-.012*	-.009*
	(2.22)	(2.30)
Individual		
β_{MA}	-.013*	-.019*
	(4.88)	(8.37)
γ_A	-.008*	-.014*
	(2.10)	(3.98)
β_{MK}	-.185*	-.161*
	(7.46)	(7.58)
γ_K	-.007	.125
	(.21)	(.43)
β_{ME}	.068*	.092*
	(5.51)	(8.62)
γ_E	-.008	-.007
	(.46)	(.50)
β_{MY}	.030*	.008
	(2.89)	(1.31)
γ_Y	-.002	-.045*
	(.10)	(3.18)
Constants		
β_M	-.637*	-.753*
	(3.37)	(4.81)
$\beta_M + \beta_C$	-2.79*	-1.99*
	(5.70)	(4.13)
$\beta_N + \beta_C$	-.057	.804
	(.12)	(1.59)
N	6549	9438
Log likelihood	-6536.9	-8806.1

*significant at the .05 level.

[a]Sample of householders aged 16-61, excluding self-employed and those not employed.

[b]Sample of householders aged 11-61, including self-employed and those not employed.

Table 2: Total Responses of Residential and Job Location Choices to Wages and Housing Prices[a]

	Percentage Change in						
Node Choice	W_M	W_N	W_M, W_N	P_M	P_N	P_M, P_N	C_{ij}
MM	.49	-.42	.07	-.09	.06	-.03	.25
MN	-.46	.55	.09	-.09	.06	-.03	-1.52
NM	.41	-.42	-.01	.05	-.03	.02	-1.58
NN	-.46	.36	-.1	.05	-.03	.02	.25
Metro Residence	.48	-.40	.07	-.09	.06	-.03	.21
Nonmetro Residence	-.31	.22	-.08	.05	.03	.02	-.07
Commute	.35	-.36	.00	.04	-.03	.02	-1.58

[a]Based on the elasticities reported in Table 3 for the sample excluding the self-employed and those not employed.

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Appendix: Values Used for Node-specific Wages, Commuting Time and Housing Costs, by Education Level[a]

Education Level		Node			
		MM	MN	NM	NN
< 8 yrs:	W[b]	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

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