SCHOOL QUALITY AND THE URBAN-RURAL MIGRATION OF FIRMS

Alexander W. Marré[1]
amarre@ers.usda.gov

Anil Rupasingha
anil.rupasingha@ers.usda.gov

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[1] The authors are Research Economists at the U.S. Department of Agriculture's Economic Research Service, 1400 Independence Ave., SW, Mail Stop 1800, Washington, DC 20250-0002.

1. INTRODUCTION

The purpose of this study is to examine the relationship between school quality and the relocation of businesses from metro to nonmetro areas with a special focus on manufacturers. Relocation of businesses is identified by their migration across the counties and separated between urban and rural counties. While firm location in rural areas and other firm dynamics such as birth, death, expansion and contraction in rural areas have received considerable attention in the literature, migration of businesses from urban to rural areas or vice versa has received less attention. Previous studies attest that studying relocation by itself compared to other firm dynamics such as births and deaths has its own merits for several reasons. Hong (2014) argues that relocation of firms is a more frequent phenomenon than one thinks and it has significant local economic impacts. Lee (2006) shows that relatively large and growing firms are more likely to relocate.

Business recruitment and retention has been a long standing policy in the rural development sphere and therefore studying regional or local pull factors associated with firm relocation to rural areas or its counterpart (push factors associated with firm out-migration from rural areas) is significant from a policy perspective. While incorporating more general pull factors, in this paper, we pay a detailed attention to the human capital factors. In the early 1990s, the U.S. Department of Agriculture's Economic Research Service conducted a survey of rural manufacturers (Gale et al., 1999). The most often cited problem among these rural manufacturers was labor quality in rural areas. About 50% of respondents found it "increasingly difficult to find qualified workers for production jobs." Roughly 37% cited the quality of primary and secondary schools as a problem, and in the Delta region, a persistently poor region in the heart of the South, 25% cited the quality of local schools as a major problem. More recently, manufacturing job losses were second only to construction in rural areas between 2007 and 2011 (Goetz et al., 2013). Improving local conditions could be a potential solution to attracting firms and jobs. The aforementioned survey results suggest that the quality of local schools could be one factor that attracts firms, but there is little recent research on the topic.

Rural school quality could affect the location and expansion of rural manufacturers in two ways: (1) by increasing the skills and abilities of the local labor force, thus attracting firms and making them more productive and (2) by providing a desirable amenity that attracts potential employees to the locale (Gottlieb, 1994). With respect to (1), there is reason to believe that the quality of schools may be even more important today, given that globalization and skill-biased technological change has led to increasing skill requirements for manufacturing jobs. School quality may also play a role as an amenity, or quality of life factor that attracts people. School quality has been shown to drive rural population growth and could be an important way for firms to attract a high-skill labor force (Barkley et al., 1998).

Several studies have examined the role of education variables on firm location. Barkley and Keith (1991) and Keith and Barkley (1991) find that the stock of human capital – measured as the median level of school years in a county – was a determinant for high tech manufacturing employment in some rural areas. Lambert and McNamara (2009) and found that the education of the local labor force and availability of technical schools in a rural area could help attract food manufacturers.

This paper uses a count model to estimate the determinants of manufacturing firm and all firm location to rural areas from urban areas between 2009 and 2012, including controls for land and labor costs, taxes, market size, agglomeration effects, natural amenities, and measures of school quality (Arauzo-Carod et al., 2010; Goetz and Rupasingha, 2002). To the best of our knowledge, this is the first study of firm relocation between rural and urban areas within the United States and the only study to estimate the impacts of school quality on firm relocation behavior. Preliminary results from these models suggest that lower high school dropout rates and smaller class sizes may increase the expected count of firms relocating from urban to rural areas.

2. MODEL AND ECONOMETRIC APPROACH

Based on previous studies on industrial location, the primary objective of firm location or relocation is profit maximization. Relocation decisions are often made by firms because factors associated with their production may have changed, affecting their profits. These factors could be firms specific as well as location specific. The relocation is not without costs and these costs may be higher the farther a firm moves. However, these costs are factored into relocation decisions in the form of profit maximization. The fact that businesses still move far beyond their immediate vicinity implies that the benefits from relocating outweigh the costs. The underlying model for firm location decisions used in this study and in the firm location literature is a random utility or profit maximization model developed by McFadden (1974). A firm i faces $j = 1,\ldots,J$ spatial choices with expected profit at each location defined by:

(1) $\pi_{ij} = \beta' x_{ij} + \varepsilon_{ij}$.

Explanatory variables are specific to each region and firm *i* chooses the location *j* that yields the highest expected profit.

Using McFadden's (1974) framework, empirical studies use conditional logit models to estimate how spatial attributes affect the decision of firms to locate in a particular area. However, estimating a conditional logit model presents two key problems, as identified by Guimarães et al. (2003; 2004). First, estimating a conditional logit model with a large number of location choices is computationally burdensome. For this reason, many firm location studies have focused on inter-state or inter-region moves, even though there can be considerable variation in the explanatory variables within states. Second, as discussed in detail by Guimarães et al. (2004), the conditional logit model requires assuming the independence of irrelevant alternatives, namely that locations are equivalent after the explanatory variables in the model are controlled for. If there are unobserved place characteristics influencing each firm's location decision, then estimated coefficients will be biased.

Guimarães et al. (2004) prove that under certain conditions a Poisson regression can be used instead of a conditional logit model with equivalent results, allowing for a computationally-feasible estimation of a large set of alternative locations and controlling for the potential violation of the independence of irrelevant alternatives assumption underlying the conditional logit model. This approach has been used in the rural development literature in modeling the urban-to-rural migration of people using a random utility maximization framework (Rupasingha et al., 2015).

This paper uses a Poisson regression to estimate the determinants of firm relocations from metropolitan (urban) counties to nonmetropolitan (rural) counties. The explained variables (*movein_bus* and *movein_manu*) consist of the number of firms – all firms in the former case and manufacturing firms in the latter case – moving from each urban county to each rural county. Fixed effects are used to control for characteristics of the urban origin counties, while explanatory variables are measured for the rural destination counties. Determinants used in the model are similar to those used by Guimarães et al. (2004), with the addition of controls for educational attainment, school quality measures, natural amenities and distance.

A potential concern is endogeneity between the explanatory and explained variables. This model attempts to address the potential endogeneity between firms moving to a county and county-level characteristics in two ways. First, the explanatory variables are observed at time lags. Second, an advantage of the Poisson regression approach is that observations are at the level of county-to-county pairs. It is unlikely that firms moving in from one particular county to another particular county are so large as to influence the destination county characteristics (Rupasingha et al., 2015).

3. DATA

Descriptive statistics for the variables used in this analysis are presented in Table 1. Data on firm county-to-county movements comes from the National Establishment Time-Series database, a proprietary longitudinal database of all establishments in the United States. The database includes data on firm characteristics, including industry and relocation information, both of which are used to construct the explained variables for this analysis. Firm relocations were measured between 2009 through 2012 to capture post-recession moves up until the most recent year available. The maximum number of firms moving from an urban county to a rural county in this sample is 139, and the maximum number of manufacturing firms moving from an urban county to a rural county in this sample is 13.

The cost of labor, land, taxes, and of moving are all hypothesized to decrease the expected number of firms relocating to an area. Labor costs (*epj2000*) are measured by data from the Bureau of Economic Analysis's Regional Economic Information System (BEA-REIS). Land costs (*popdens2000*) are measured by population density from Census 2000. Taxes are measured by property tax revenue per capita from the Census Bureau's 2002 Survey of Local Government Finances. The cost of moving is measured by the centroid-to-centroid distance in miles between the origin and destination counties (*gcdhun* and *gcdhunsq*).

Market size and educational attainment of the population are hypothesized to have a positive effect on the expected number of firms relocating to an area. Market size (*pi2000mil*) is measured by total personal income from BEA-REIS. Indicators for highest level of educational attainment of the working-age (ages 25 to 64) population are percent with a high school diploma (*pcthsd2000*), percent with some college or associate's degree (*pctsmcol2000*) and percent with a college degree or higher (*pctcold2000*) from the 2000 Census. Agglomeration effects in Guimarães et al. (2004) are controlled for by measures of establishment density. However, establishment density and population density were highly correlated in the dataset used for this analysis. Therefore, employment shares by industry from the 2000 Census are used to control for agglomeration effects in this analysis.

School quality indicators include the high school dropout rate (*avgdrp912*) and student to instructor FTE ratio (*avgstudrat00*) as a measure of class size. Both indicators are from the U.S. Department of Education's Common Core of Data 2000 survey – a national dataset of all public schools. School spending is measured as the total expenditure per student from pre-K through 12^{th} grade (*avgexppup*) from the Census Bureau's 2000 Public School System Finances survey of all public schools in the nation. Since these indicators vary across districts, an enrollment-weighted average is calculated across all districts in each county. A final explanatory variable is the natural amenity's scale (*natamen*) available from the U.S. Department of Agriculture's Economic Research Service.

Table 1: Variable description and descriptive statistics

Variable	*Description*	*Mean*	*Std. Dev.*
movein_bus	Number of firms moving from metro county A to nonmetro county B, 2009-2012	0.02	0.40
movein_manu	Number of manufacturing firms moving from metro county A to nonmetro county B, 2009-2012	0.001	0.047
epj2000	Earnings per job (dollars), 2000	25,860.03	5,391.73
popdens2000	Population density, 2000	44.78	99.21
ptaxpc2002	Property tax revenue per capita, 2002	785.96	780.49
pi2000mil	Total personal income (millions of dollars), 2000	548.71	579.94
gcdhun	Great circle distance between origin and destination county (hundreds of miles)	8.67	5.10
gcdhunsq	Great circle distance (hundreds of miles) squared	101.18	114.85
pcthsd2000	% high school diploma or equivalent, ages 25-64, 2000	36.81	6.58
pctsmcol2000	% some college or associate's degree, ages 25-64, 2000	28.72	6.66
pctcold2000	% bachelor's degree or higher, ages 25-64, 2000	15.79	6.14
avgdrp912	High school dropout rate, enrollment-weighted average, 2000 school year	2.25	2.56
avgstudrat00	Student to instructor ratio for pre-K through 12^{th} grade, enrollment-weighted average, 2000 school year	7.25	6.25
avgexppup	Total expenditure to student ratio for pre-K through 12^{th} grade, enrollment-weighted average, 2000 school year	3,980.97	3,226.94

pctcons2000	% employed in construction, 2000	7.59	2.39
pctmanu2000	% employed in manufacturing, 2000	16.13	9.92
pctwhol2000	% employed in wholesale trade, 2000	2.76	1.12
pctret2000	% employed in retail trade, 2000	11.27	2.19
pcttrans2000	% employed in transportation and warehousing, and utilities, 2000	5.46	1.86
pctinfo2000	% employed in information, 2000	1.58	0.79
pctfin2000	% employed in finance, insurance, real estate, and rental and leasing, 2000	3.88	1.21
pctprof2000	% employed in professional, scientific, management, administrative, and waste management services, 2000	4.17	1.61
pcted2000	% employed in educational, health and social services, 2000	20.45	4.39
pctarts2000	% employed in arts, entertainment, recreation, accommodation and food services, 2000	6.94	3.47
pctothsvc2000	% employed in other services (except public administration), 2000	4.76	1.01
natamen	Natural amenities scale	-0.09	2.23

Notes: The variables *movein_bus*, *gcdhun* and *gcdhunsq* are for origin and destination county pairs. All other variables are nonmetro destination county characteristics. Industry employment shares in 2000 are also included as independent variables in the analysis. Descriptive statistics for these variables are available upon request.

4. RESULTS

Results of the Poisson regression models with origin-county fixed effects and robust standard errors are reported in Table 2 for all firms and Table 3 for manufacturing firms. There are several ways to calculate marginal effects for Poisson regression models (Long 1997, p. 223-6). Factor changes are used here: the marginal effect of each independent variable *k* is calculated as $\left(e^{\beta_k} - 1\right) \times 100$ and are reported in the results tables in the column to right of the estimated coefficients. Marginal effects of the estimated coefficients in the model are interpreted as the percentage change in the expected count for a unit change in each explanatory variable, holding all other explanatory variables constant.

Except for labor costs (*epj2000*, measured as average earnings per job), results from the standard firm location explanatory variables are mostly statistically significant in both models at the 1% level and have expected signs. As expected, two cost measures -- population density as a measure of land cost (*popdens2000*) and per capita property tax revenue as a measure of taxes (*ptaxpc2002*) – were estimated in both models to reduce the expected count of firms moving from metro counties to nonmetro counties between 2009 and 2012. Results were similar for both measures for all firms and for the subset of manufacturing firms. The effect of labor costs on the expected count of firm movement from metro counties to nonmetro counties was only statistically significant for all firms, but not in the model for manufacturing firms, suggesting that manufacturers relocating from metro areas to nonmetro areas may not be seeking cheaper labor.

Aside from the school quality measures, other variables in the models include market size (*pi2000mil*), agglomeration effects (not reported), natural amenities (*natamen*), and human capital measures. Market size, measured by total personal income, was statistically significant in both models and had the expected sign: nonmetro counties with more personal income appear to attract more firms from metro areas – both manufacturers and all firms – than other nonmetro counties, all else equal. As discussed in the previous section, agglomeration effects are measured in these models by industry-level employment shares rather than establishment density, as Guimarães et al. (2004) and others do. Most of the industry employment shares are statistically significant in both models. The USDA-ERS natural amenities scale was statistically significant only in the model for all firms, and was found to draw firms to nonmetro areas. Finally, of the human capital measures – percent of the population between the ages of 25 and 64 with a high school diploma (*pcthsd2000*), some college or associate's degree (*pctsmcol2000*), and bachelor's degree or higher (*pctcold2000*) – the percent with some college or associate's degree is the only statistically significant measure in both the total firm and manufacturing firm models, with roughly similar marginal effects.

School quality measures include the high school dropout rate (*avgdrp912*), student-to-teacher ratio (*avgstudrat00*) and total expenditure per student (*avgexppup*). The high school dropout rate is negative and statistically significant in both models at the 1% level. A one percentage point increase in the dropout rate is estimated to reduce the expected count of incoming firms by 2.8 percent. The effect is higher for manufacturers: a one percentage point increase in the dropout rate is estimated to reduce the expected count of manufacturing firms by 3.4 percent. The student-to-teacher ratio across all grades was also estimated to have a negative effect on attracting firms at the 5% level of statistical significance: an increase in one student per teacher reduced the expected firm count by roughly 0.6 percent. However, this variable was not statistically significant in the subsample of manufacturers. In both the full and the manufacturing sub-sample, average expenditure per pupil did not have a statistically significant effect, either.

Table 2. Fixed effect Poisson estimation results for all firms

Variable	*Est. Coeff.*		*Robust Std. Err.*	*M.E.*
epj2000	0.0000115	***	3.63 x 10^-6	0.00115
popdens2000	-0.000503	***	0.0001153	-0.05029
ptaxpc2002	-0.000443	***	0.0000758	-0.04429
pi2000mil	0.0003562	***	0.0000261	0.035626
gcdhun	-1.096978	***	0.0280721	-66.6121
gcdhunsq	0.0369781	***	0.0011301	3.76703
pcthsd2000	-0.0049488		0.0042516	-0.49366
pctsmcol2000	0.0254273	***	0.003306	2.575333
pctcold2000	-0.0018234		0.0051371	-0.18217
avgdrp912	-0.0284419	***	0.0102269	-2.80412
avgstudrat00	-0.0058141	**	0.0034701	-0.57972
avgexppup	-0.0000138		0.00001	-0.00138
pctcons2000	0.0938674	***	0.0082654	9.841409
pctmanu2000	0.0346221	***	0.0039515	3.522842
pctwhol2000	0.0451515	***	0.0146851	4.618635
pctret2000	0.1037757	***	0.0082522	10.93516
pcttrans2000	-0.0068634		0.0128345	-0.68399
pctinfo2000	0.0101233		0.0193695	1.017471
pctfin2000	0.1138909	***	0.0143134	12.06299
pctprof2000	0.1426051	***	0.0129658	15.32743
pcted2000	0.0241276	***	0.0066188	2.442103
pctarts2000	0.0551349	***	0.0056967	5.668315
pctothsvc2000	0.0938858	***	0.0153667	9.84343
natamen	0.0322028	**	0.0154019	3.272692
Fixed Effects	Yes			
Log L				
Wald	-82,369.27			
No. of obs.	5,708.16			
	1,575,792			

Note: *** p < 0.01, ** p < 0.05, * p < 0.1

Table 3. Fixed effect Poisson estimation results for manufacturing firms

Variable	*Est. Coeff.*		*Robust Std. Err.*	*M.E.*
epj2000	0.0000103		4.15E-06	0.00103
popdens2000	-0.0004945	***	0.0001318	-0.04944
ptaxpc2002	-0.0004239	***	0.0000879	-0.04238
pi2000mil	0.0003753	***	0.00003	0.037537
gcdhun	-1.042301	***	0.0293758	-64.7358
gcdhunsq	0.0348006	***	0.0011731	3.541323
pcthsd2000	-0.003348		0.0049637	-0.33424
pctsmcol2000	0.0264257	***	0.0037071	2.677795
pctcold2000	-0.0073348		0.0060282	-0.7308
avgdrp912	-0.0347275	***	0.0115889	-3.41314
avgstudrat00	-0.0054827		0.0040615	-0.54677
avgexppup	-9.48 x 10^-6		0.0000117	-0.00095
pctcons2000	0.0992893	***	0.0091191	10.43858
pctmanu2000	0.0377769	***	0.0043901	3.849952
pctwhol2000	0.0551272	***	0.0172339	5.667502
pctret2000	0.1084727	***	0.0092383	11.45745
pcttrans2000	-0.0118563		0.0148172	-1.17863
pctinfo2000	0.0236889		0.0216395	2.397171
pctfin2000	0.1215643	***	0.0160979	12.9262
pctprof2000	0.1537518	***	0.014666	16.62014
pcted2000	0.0299448	***	0.0073341	3.039765
pctarts2000	0.0589376	***	0.0063267	6.070905
pctothsvc2000	0.0997346	***	0.0170381	10.48776
natamen	0.0261739		0.0164976	2.651944
Fixed Effects	Yes			
Log L	-64,840.38			
Wald	74,370.96			
No. of obs.	941,904			

Note: *** p < 0.01, ** p < 0.05, * p < 0.1

5. CONCLUSION

The preliminary results shown here suggest that school quality could be a tool for rural communities to attract both all firms and manufacturers from urban areas. The results also suggest that the characteristics of rural schools may have differing effects on the likelihood that firms will relocate. In other words, the results from these models suggest that not all measures of school quality matter. The most consistent and strong results across both models is the dropout rate, which indicates that efforts to reduce dropout rates may be effective at attracting firms from urban areas. On the other hand, additional research is needed in the following areas:

- *Measurement error*: The school quality measures in this model are obtained at the district level. In some states, districts cross county boundaries, in which case the school quality measures are only assigned to the county in which the district office is located. Additional steps need to be taken to ensure the robustness of these results to this measurement error.
- *Robustness to other county-level characteristics*: School quality characteristics are likely to be highly correlated with other socioeconomic characteristics and the overall provision of public services in these nonmetro counties. The result would be that the school quality measures would be capturing the effects of other factors that may attract firms to a rural community. Additional steps will need to be taken to address the robustness of these effects to other community characteristics.
- *Types of firms*: Additional analysis is required to determine the types of firms that are moving from urban to rural areas to provide more context. For example, it is possible that the firms moving from urban to rural areas could be small employers, which is important information for policy-makers to know for weighing the costs and benefits of improving the quality of local schools.
- *Attracting urban vs. rural firms*: It is not clear if the characteristics attracting urban firms are any different from the characteristics attracting firms from rural areas and what the costs and benefits of attempting to attract urban versus rural firms might be.
- *Push factors associated with rural-to-urban firm relocation*: An additional topic of interest is whether low school quality is a factor that pushes firms to move to urban areas. Models using the framework posed here will be estimated with fixed effects for urban destination counties and location characteristics for rural origin counties.

Additional work will be needed in these areas to assess the robustness of these results. However, these results do suggest that improving local schools could be an effective rural development strategy for attracting firms to rural areas.

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