Industry Agglomeration and Investment in Rural Businesses

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Capital investment is a major contributor to economic growth. Over 40 percent of the increase in U.S. GDP from 1947 to 1973 and 1960 to 1990 is attributed to growth in the nation's capital stock (Barro and Sala-i-Martin). The close link between investment and overall economic vitality makes enhancing the capital stock a top priority for rural development. Deaton and Nelson (p. 87) define rural development as "[t]he allocation of physical, social, and human capital in a spatial pattern that provides adequate income for all families" and they suggest that "[t]he determinants of capital formation are central concerns for development." Castle (p. 622) proposes that "[t]he development and conservation of rural capital is of fundamental importance to rural people as they exercise their autonomy in addressing common concerns and pursuing their aspirations."

In recent years, the amount of equipment and machinery installed in rural Maine has lagged behind the capital investments made in more urbanized parts of the state. Between 1996 and 2000, the assessed value of production machinery and equipment per worker in Maine's eleven metropolitan and metropolitan-adjacent counties increased by 27.9 percent, compared to an increase of 10.8 percent in Maine's five nonmetropolitan and non-adjacent counties.[1] Differences in the growth rates of business property between metropolitan and nonmetropolitan areas in Maine are indicative of disparities in other measures of economic vitality between urban and rural areas in the United States (Gale). For example, between 1969 and 1997, the wages and salaries earned per worker in rural areas of the northeastern United States fell from 80 percent to 68 percent of the wages and salaries earned per worker in urban areas (Goetz).

This paper investigates the effects of local industry agglomeration on the investments in equipment and machinery made between 1995 and 1999 by Maine businesses. The analysis focuses on an existing establishment's decision to purchase new equipment and machinery, and the dollar amount invested per worker. Industry agglomeration is represented by county-industry and municipality-industry location quotients, which are a measure of an industry's concentration in a given region (e.g., county or municipality) relative to its concentration in the United States as a whole. The empirical analysis also controls for the effects of local industry age and competitiveness (i.e., average establishment size in local industry compared to average establishment size in U.S. industry) on business investment.

Data

The analysis presented in this paper focuses on the investments in equipment and machinery made between April 1995 and the end of 1998 by Maine establishments that were in operation at the beginning of 1995.[2] We do not consider the investments made by businesses that opened after the beginning of 1995. Our sample includes 19,432 establishments that were located in 342 Maine municipalities. Table 1 presents descriptive statistics on the entire sample of businesses, as well as the subset of 535 establishments that invested in new equipment and machinery between 1995 and 1999. The average establishment in the sample invested $238.4 per worker, while the average business that invested in new capital purchased an estimated $8,657 worth of equipment and machinery per employee.

Investment data are estimated based on an establishment's participation in a state-sponsored property tax reimbursement program, and the dollar amount of reimbursement received. The Business Equipment Property Tax Reimbursement (BETR) Program refunds to businesses, for up to twelve years, 100 percent of the local personal property taxes paid on "eligible" equipment and machinery. The BETR Program generally defines eligible business property as equipment and machinery that was placed in service in Maine after April 1 of 1995. By multiplying the dollar amount of BETR reimbursement received in 1998 by the inverse of the local property tax rate, we arrive at an estimate of the value of an establishment's equipment and machinery as of 1998. Since the reimbursement is claimed on equipment and machinery placed in service after April 1995, the value in 1998 represents the amount invested, accounting for depreciation, between April 1995 and the end of 1998.

We measure industry agglomeration, using location quotients, as the percentage of a region's establishments in an industry relative to the percentage of all U.S. businesses in the same sector. The detail of industry aggregation used in the analysis is the 3-digit SIC level for county-industries, and the 2-digit SIC level for municipality-industries.[3] Location quotients greater than one imply that the sector is concentrated in the region relative to the United States as a whole. The age of a local industry is measured as the average age of establishments operating in the county- or municipality-industry, weighted by establishment employment size. Competition in the local industry is measured as the number of establishments per worker in the local industry divided by the number of establishments per worker in the U.S industry (Glaeser et al.). A

competition ratio greater than one suggests that the industry is comprised of smaller (i.e., more competitive) establishments locally than in the United States as a whole.

Along with the industry agglomeration variables, the regression models include business characteristics related to the age of the establishment and its employment size relative to the U.S. industry average. These variables, which measure business conditions prior to the investment expansions, are used to control for the establishment's stage in its investment cycle.[4] Jovanovic and Stolyarov, and Cooper, Haltiwanger, and Power suggest that businesses infrequently invest in new equipment and machinery. As a result of the "spiked" nature of investments, Jovanovic and Stolyarov found that, when businesses invest, they create excess capacity and allow other inputs to "catch up" over time. Assuming that businesses with fewer workers than the national industry average are in the "catching up" stage of their investment cycle, we expect the employment size of a business relative to the national industry average to have a positive effect on an establishment's probability of investment and investment size. Cooper, Haltiwanger, and Power found that the likelihood of an investment project increases with the age of a plant's capital stock. We expect older Maine establishments to be more likely to invest, and invest larger amounts per worker, than young businesses.

The amount of capital invested per worker in the industry nationally accounts for sector-specific growth that may influence establishment investment. The industry investment variable is computed by taking the ratio of capital investment between 1995 and 1999 per dollar of employee compensation in 1995 in the establishment's 2-digit SIC industry, and then multiplying this ratio by the annual payroll per worker in 1995 in the establishment's 3-digit SIC industry. This provides an estimate of the amount invested in

the establishment's industry between 1995 and 1999, which we expect to have a positive effect on the amount invested per worker in Maine. Another industry variable used in the analysis is the growth rate of employment between 1996 and 1999 in Maine in the establishment's 3-digit SIC industry. This variable represents industry conditions for the establishment in Maine. Controlling for the amount of investment per worker in the U.S. industry, we expect establishments that are in industries that are growing rapidly in Maine to invest more per worker than establishments that are in declining sectors.

The local variables used in the analysis are the amount of capital invested per person in the establishment's municipality and the percentage of local businesses, other than the one in question, that received a BETR refund in 1998. Local investment is represented by the change in the assessed value of business equipment and machinery in the municipality between 1995 and 1999, divided by population size. We expect the amount of local investment per resident to have a positive effect on establishment investment. The percentage of businesses in the establishment's municipality that received a BETR refund in 1998 also controls for local investment conditions, as well as information spillovers about the availability of the BETR program. Correlation between the amount invested locally per resident and the percentage of businesses that participated in the BETR program is 0.275.

Empirical Results

We estimate two types of empirical models. The first is a logit model that looks at whether an establishment, in operation at the beginning of 1995, purchased new equipment and machinery between 1995 and 1999.[5] The second is a Tobit model that

examines the dollar amount invested per worker. A Tobit model, which estimates an ancillary parameter sigma, is used to analyze the amount of investment because of the censored nature of the dependent variable (Greene). The 18,897 establishments in the data set that did not invest in equipment and machinery between 1995 and 1999 have an investment level of 0.0, which is the lower limit in the Tobit regression.

Tables 2 and 3 show empirical results on the investment behavior of Maine businesses between 1995 and 1999. The two left-hand-side columns are logit results, and corresponding marginal effects, on an establishment's likelihood of investing in equipment and machinery. The right-hand-side columns in both tables show Tobit results, and marginal effects, on the amount invested per worker. The results presented in table 2 are from regressions that use county-industry agglomeration data measured at the 3-digit SIC level. Table 3 presents results from regressions that use municipality-industry agglomeration data measured at the 2-digit SIC level. Throughout the paper, the analysis based on the municipality-industry agglomeration data uses information on businesses in municipality-industry pairs that had five or more establishments in operation at the beginning of 1995.

Our results indicate that local industry agglomeration encourages investment activity in Maine businesses. Other things being equal, the county-industry and municipality-industry location quotients have a positive effect on an establishment's probability of purchasing new equipment, and the dollar amount of capital invested per worker. The marginal effects show that, at mean values, a one-unit increase in the county-industry and municipality-industry location quotient is associated with a 0.000565 percentage point and 0.000330 percentage point increase in an establishment's

probability of investment, respectively. Likewise, a one-unit increase in the county-industry and municipality-industry location quotient is associated with a $9.65 and $4.60 increase in the amount an establishment invests per worker.

The average age of businesses located in a county-industry has a positive effect on an establishment's probability of investment and the amount invested per worker. A one-unit increase in county-industry age is associated with a 0.00309 percentage point increase in an establishment's likelihood of investment and a $3.83 increase in the amount invested per worker. On the other hand, county-industry competition has a negative effect on an establishment's probability of investment and the amount invested per worker. A one-unit increase in the county-industry competition variable is associated with a 0.00029 decrease is an establishment's likelihood of investment and a $29.77 decrease in the amount invested per worker. Glaeser et al. found that local industry competition increases employment growth rates in city-industries, but that competition has a negative effect on wage growth. Given the close conceptual link between investment and earnings, our finding that county-industry competition discourages investment is consistent with the result that competition decreases wage growth.

The remaining control variables included in the regression models generally have the expected effects on business investment. Establishment age and its employment size relative to the national industry average have a positive effect on the probability of equipment purchase and the dollar amount invested per worker. Likewise, the amount invested per worker in the establishment's industry at the national level, the growth of the industry in Maine, and the percentage of local businesses that received a BETR incentive have a positive effect on both measures of establishment investment. In the regression

model that uses county-industry agglomeration data, the amount invested per local resident has a positive effect on establishment investment per worker. On the other hand, the amount invested per person in the establishment's municipality does not have a significant effect on the probability of equipment purchase.

Summary and Conclusions

Using data on a sample of Maine establishments in operation at the beginning of 1995, this paper examined the effects of local industry agglomeration on business investment. Our empirical results indicate that industry agglomeration, measured at the county-industry and municipality-industry levels, has a positive effect on an establishment's probability of investment and the dollar amount invested per worker between 1995 and 1999.

Our results are generally consistent with the findings reported in previous studies that investigated the effects of industry agglomeration on rural economic growth. Henry and Drabenstott (p. 67) found that rural industry clusters are a "major source of [employment] growth in rural areas." Further, Gibbs and Bernat found that, other things being equal, workers in rural industry clusters receive 13 percent higher earnings than rural workers employed by businesses that operate outside of industry clusters. The conceptual link between investment and earnings suggests that this wage premium may be explained, in part, by the positive relationship we found between business investment and industry agglomeration.

Endnotes

[1] Information on the assessed value of machinery and equipment in Maine counties is from the *Municipal Valuation Return Statistical Summary*, compiled by Maine Revenue Services. County-level employment information is from the Maine Department of Labor.

[2] This is referred to, elsewhere in the paper, as investments made between 1995 and 1999.

[3] The sample of establishments analyzed in the paper covers 55 2-digit SIC sectors and 265 3-digit SIC sectors.

[4] The ideal establishment characteristics to use in the analysis would be the age of the establishment's building and structures, and the capital to labor ratio in the establishment prior to the investment expansion. This information is not available.

[5] This is the same thing as examining whether an establishment applied for and received a tax reimbursement in 1998 for local personal property taxes paid on equipment and machinery placed in service between April 1995 and the end of 1998. Gabe and Kraybill, and Faulk have investigated business decisions to participate in tax incentive programs.

References

Barro, R.J., and X. Sala-i-Martin. *Economic Growth*. New York: McGraw Hill, 1995.

Barkley, D.L., and M.S. Henry. "Rural Industrial Development: To Cluster or Not to Cluster?" *Review of Agricultural Economics* 19(1997):308-325.

Castle, E.N. "A Conceptual Framework for the Study of Rural Places." *American Journal of Agricultural Economics* 80(1998):621-631.

Cooper, R., J. Haltiwanger, and L. Power. "Machine Replacement and the Business Cycle: Lumps and Bumps." *American Economic Review* 89(1999):921-946.

Deaton, B.J., and G.L. Nelson. "Conceptual Underpinnings of Policy Analysis for Rural Development." *Southern Journal of Agricultural Economics* 24(1992):87-99.

Ellison, G., and E.L. Glaeser. "Geographic Concentration in U.S. Manufacturing Industries: A Dartboard Approach." *Journal of Political Economy* 10(1997):889-927.

Faulk, D. "The Participation of Firms in Tax Incentive Programs." *Review of Regional Studies* 31(2001):39-50.

Gabe, T.M. "Local Industry Agglomeration and New Business Activity." *Growth and Change* 34(2003):17-39.

Gabe, T.M., and D.S. Kraybill. "Tax Incentive Requests and Offers in a State Economic Development Program." *Review of Regional Studies* 28(1998)1-14.

Gale, H.F. "Labor Productivity and Wages in Rural and Urban Manufacturing Plants." *Review of Regional Studies* 28(1998):13-26.

Gibbs, R.M., and G.A. Bernat. "Rural Industry Clusters Raise Local Earnings." *Rural Development Perspectives* 12(1997):18-25.

Glaeser, E.L., H.D. Kallal, J.A. Scheinkman, and A. Shleifer. "Growth in Cities." *Journal of Political Economy* 100(1992):1126-1152.

Goetz, S.J. "Rural Earnings Fall Further Behind…" *Network 00: A Quarterly Newsletter for Northeast Rural Development* 15(2000):1.

Greene, W. *Econometric Analysis: Fourth Edition*. Upper Saddle River, NJ: Prentice Hall, 2000.

Henderson, J.V. "Efficiency of Resource Usage and City Size." *Journal of Urban Economics* 19(1986):47-70.

Henderson, V. "Externalities and Industrial Development." *Journal of Urban Economics* 42(1997):449-470.

Henderson, V., A. Kuncoro, and M. Turner. "Industrial Development in Cities." *Journal of Political Economy* 103(1995):1067-1090.

Henry, M., and M. Drabenstott. "A New Micro View of the U.S. Rural Economy." *Economic Review* (Federal Reserve Bank of Kansas City) 81(1996):53-70.

Jaffe, A.B., M. Trajtenberg, and R. Henderson. "Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations." *Quarterly Journal of Economics* 108(1993):577-598.

Jovanovic, B., and D. Stolyarov. "Optimal Adoption of Complementary Technologies." *American Economic Review* 90(2000):15-29.

Kim, Y., D.L. Barkley, and M.S. Henry. "Industry Characteristics Linked to Establishment Concentrations in Nonmetropolitan Areas." *Journal of Regional Science* 40(2000):231-259.

Krugman, P. *Geography and Trade*. Cambridge, MA: The MIT Press, 1991.

Marshall, A. *Principles of Economics*. London: Macmillan, 1890.

Porter, M.E. *The Competitive Advantage of Nations*. New York: Free Press, 1990.

Romer, P.M. "Increasing Returns and Long-run Growth." *Journal of Political Economy* 94(1986):1002-1037.

Rosenthal, S.S., and W.C. Strange. "The Determinants of Agglomeration." *Journal of Urban Economics* 50(2001):191-229.

Table 1. Variable definitions and descriptive statistics

Variable Name	Variable Definition	Mean Values: [a]	
		Existing Businesses	Investing Businesses
Equipment purchase	1 if establishment received a BETR incentive in 1998 for equipment and machinery purchased between April 1995 and the end of 1998; 0 otherwise [d]	0.028 (0.164)	1.000 (0.000)
Investment per worker	Dollar amount of equipment and machinery purchased between April 1995 and the end of 1998 per establishment employee in 1996 [e]	238.4 (3,471.5)	8,657 (19,118)
Location quotient, county	Percentage of a county's businesses in 3-digit SIC category in 1995 divided by the percentage of U.S. businesses in the same category [f]	2.361 (5.647)	4.212 (11.22)
Industry competition, county	Number of establishments per worker in county-industry in 1995 divided by the number of establishments per worker in the U.S. 3-digit SIC industry [f]	1.748 (2.711)	1.305 (1.791)
Industry age, county	Average age of establishments in county 3-digit SIC industry, weighted by establishment employment size in 1995 [f]	12.93 (7.474)	15.53 (10.55)
Location quotient, municipality	Percentage of a municipality's businesses in 2-digit SIC category in 1995 divided by the percentage of U.S. businesses in the same category [f]	3.024 [b] (7.628)	3.910 [c] (8.853)
Industry competition, municipality	Number of establishments per worker in. municipality-industry in 1995 divided by the number of establishments per worker in the U.S. 2-digit SIC industry [f]	1.811 [b] (2.090)	1.503 [c] (1.552)
Industry age, municipality	Average age of establishments in municipality 3- digit SIC industry, weighted by establishment employment size in 1995 [f]	16.19 [b] (7.400)	16.99 [c] (8.384)

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Table 1, continued

| | | Mean Values: [a] | |
Variable Name	Variable Definition	Existing Businesses	Investing Businesses
Relative establishment size	Number of establishment employees divided by average number of employees per establishment in U.S. 3-digit SIC [f] industry, 1995	1.035 (3.147)	3.899 (13.66)
Establishment age	Establishment age, as of 1999 [g]	13.97 (11.02)	18.24 (14.75)
U.S. industry investment	Dollar amount of capital invested per worker in U.S. 3-digit SIC industry, 1995 to 1999 [h]	11,436 (14,282)	16,210 (16,664)
Maine industry growth	Growth rate of 3-digit SIC industry in Maine, 1996 to 1999 [g]	0.147 (0.256)	0.207 (0.370)
Local investment	Change in the assessed value of business equipment and machinery between 1995 and 1999 per municipality resident in 1995 [i]	840.6 (4,510)	1,821 (6,048)
Percent of other local businesses that invested	Percentage of other establishments in municipality that received a BETR incentive in 1998 for equipment and machinery purchased between April of 1995 and the end of 1999 [d]	0.025 (0.021)	0.034 (0.023)
Number of observations		19,432	535

[a] Standard deviations are shown in parentheses.

[b] Statistics based on 13,724 establishments operating in municipality-industry pairs with five or more businesses in 1995.

[c] Statistics based on 367 establishments operating in municipality-industry pairs with five or more businesses in 1995.

[d] Incentive information is from the Maine Department of Economic and Community Development.

Table 1, continued

[e] Methods used to estimate establishment-level investment figures are discussed in the text. Employment information is from ES-202 data.

[f] Computed using ES-202 and *County Business Patterns* data.

[g] Computed using ES-202 data.

[h] Computed using U.S. Bureau of Economic Analysis and *County Business Patterns* data.

[i] Computed using information from the *Municipal Valuation Return Statistical Summary*, compiled by the Property Tax Division of Maine Revenue Services.

Table 2. Effects of county-industry agglomeration on equipment purchase (logit) and investment per worker (Tobit)

Variable	Estimated coefficients:			
	Logit Results	Marginal Effects	Tobit Results	Marginal Effects
Intercept	-4.930*** (-38.58)	-0.101*** (-22.92)	-73,796.6*** (-24.04)	-1,514.4*** (-18.42)
Location quotient, county	0.027*** (6.707)	5.65E-04*** (6.605)	470.3*** (7.862)	9.651*** (7.622)
Industry competition, county	-0.141*** (-3.542)	-2.90E-04*** (-3.667)	-1,450.6*** (-3.629)	-29.77*** (-3.701)
Industry age, county	0.015*** (2.702)	3.09E-03*** (2.693)	186.8** (2.498)	3.834** (2.491)
Relative establishment size	0.092*** (9.062)	1.89E-03*** (8.460)	688.7*** (8.246)	14.13*** (7.776)
Establishment age	0.017*** (4.465)	3.41E-04*** (4.475)	226.1*** (4.502)	4.640*** (4.508)
U.S. industry investment	1.65E-05*** (6.604)	3.39E-07*** (6.640)	0.235*** (6.860)	4.83E-03*** (6.846)
Maine industry growth	0.968*** (6.589)	0.020*** (6.609)	12,474.6*** (6.326)	256.0*** (6.318)
Local investment	1.19E-05 (1.431)	2.45E-07 (1.431)	0.274** (2.529)	5.62E-03** (2.523)
Percent of other local businesses that invested	16.65*** (9.088)	0.343*** (9.219)	196,072.0*** (7.502)	4,023.7*** (7.582)
Sigma	NA	NA	29,049.9*** (28.22)	NA

Table is continued on following page.

Table 2, continued

| | Estimated coefficients: [a] | | | |
Variable	Logit Results	Marginal Effects	Tobit Results	Marginal Effects
Log-likelihood	-2,236.2	NA	-7,746.4	NA
Number of observations	19,432	19,432	19,432	19,432

t-values are listed in parentheses. ***, ** and * denote significance at the 0.01, 0.05 and 0.10 levels, respectively.

Table 3. Effects of municipality-industry agglomeration on equipment purchase (logit) and investment per worker (Tobit)

Variable	Estimated coefficients:			
	Logit Results	Marginal Effects	Tobit Results	Marginal Effects
Intercept	-4.978***	-0.105***	-55,985.8***	-1,203.5***
	(-26.55)	(-19.54)	(-18.51)	(-15.52)
Location quotient, municipality	0.016***	3.30E-04***	213.8***	4.596***
	(3.310)	(3.325)	(4.616)	(4.596)
Industry competition, municipality	-0.071*	-1.50E-03*	-365.3	-7.853
	(-1.897)	(-1.915)	(-1.218)	(-1.222)
Industry age, municipality	-1.87E-04	-3.96E-06	14.91	0.321
	(-0.026)	(-0.026)	(0.211)	(0.211)
Relative establishment size	0.073***	1.54E-03***	521.4***	11.21***
	(7.331)	(6.981)	(6.646)	(6.380)
Establishment age	0.021***	4.48E-04***	193.9***	4.168***
	(5.079)	(5.116)	(4.477)	(4.505)
U.S. industry investment	1.64E-05***	3.46E-07***	0.161***	3.45E-03***
	(4.464)	(4.491)	(4.174)	(4.191)
Maine industry growth	0.629***	0.013***	6,844.7***	147.1***
	(3.111)	(3.122)	(3.383)	(3.392)
Local investment	1.09E-05	2.30E-07	0.133	2.87E-03
	(1.146)	(1.146)	(1.383)	(1.383)
Percent of other local businesses that invested	22.36***	0.473***	191,132.5***	4,108.7***
	(8.425)	(8.786)	(6.921)	(7.071)
Sigma	NA	NA	22,001.6***	NA
			(22.88)	

Table is continued on following page.

Table 3, continued

Variable	Estimated coefficients: [a]			
	Logit Results	Marginal Effects	Tobit Results	Marginal Effects
Log-likelihood	-1,580.6	NA	-5,254.5	NA
Number of observations	13,724	13,724	13,724	13,724

t-values are listed in parentheses. ***, ** and * denote significance at the 0.01, 0.05 and 0.10 levels, respectively. Analysis based on establishments operating in municipality-industry pairs with five or more businesses in 1995.