

Establishment Size by Sector and County-Level Economic Growth

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ABSTRACT. Median household income is found to grow faster in counties with smaller manufacturing, retail, wholesale, and service establishments.

KEY WORDS: establishment size, income growth

JEL CLASSIFICATION: O47

1. Introduction

Many studies in recent years have explored factors associated with economic growth. Education (e.g., Barro, 1991), financial structure (e.g., Rajan and Zingales, 1998; Levine et al., 2000) and openness of trade (e.g., Sachs and Warner, 1997) are among the significant factors identified in cross-country samples. Within the U.S., an empirical association between financial structure and subsequent income growth has been reported at both the state level (Jayaratne and Strahan, 1996) and the county level (Collender and Shaffer, 2002).

There are theoretical reasons to expect an association between establishment size and economic growth as well, possibly through a technological channel, a labor channel, or other mechanisms. First, Schumpeter postulated that larger firms can foster more rapid technical innovation, which might contribute to enhanced economic growth; Shaffer (2002) has formalized such a theoretical linkage. Second, it is possible that firms of different sizes may tend to invest unequally in the human capital of their

employees (Zabojnik and Bernhardt, 2001) or to provide unequal incentives for their employees to invest in human capital (Rajan and Zingales, 2001), thereby creating differentials in the time path of productivity and income as a function of firm size. Third, previous studies have noted that smaller firms create larger numbers of new jobs, although these jobs tend to be less permanent than those at larger firms (Davis and Haltiwanger, 1992; Rob, 1995; Davis et al., 1996); to the extent that employment growth contributes to income growth, these findings also suggest that economic growth might be a function of firm size. Finally, alternative theories of firm growth and empirical studies have found mixed results concerning possible associations between firm growth and firm size (Sutton, 1997; Eeckhout and Jovanovic, 1998; Klette and Griliches, 2000), which might have an additional impact on overall economic growth.

Motivated by such considerations, this study explores the empirical association between the growth rates of median household income at the county level and the average size of establishments in each of four sectors: manufacturing, retail, wholesale, and services.¹ The findings indicate that smaller establishments in each of the four sectors are significantly and robustly associated with faster subsequent growth of median household income.

The following section discusses the empirical model and data, Section 3 reports the results and addresses issues of robustness, and Section 4 concludes.

2. The model and data

As noted above, a theoretical basis for predicting an association between economic growth and

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average establishment size can be developed from several directions, with some hypotheses (e.g., Rajan and Zingales, 2001) suggesting different associations for different sectors or industries. Here we address this question empirically for the manufacturing, retail, wholesale, and service sectors. The basic empirical growth equation for county i is:

$$\text{Growth}_i = \text{Constant} + \beta \text{Estabsize}_i + \gamma [\text{Conditioning Set}]_i + \text{Error}_i \quad (1)$$

Growth is the average percentage change in median household income from 1979 to 1989.² Establishment size by county is measured several ways in alternate specifications, both as a test of robustness and to shed light on potential nonlinearities in the empirical associations.³ One measure is the average employment per establishment within each sector as of the week including March 12, 1978, using data from the *County Business Patterns*. Another is the percentage of establishments within the indicated sector having total employment less than various levels (5, 10, 20, and 50). Equation (1) is estimated using a single measure of establishment size from each sector in turn, resulting in four separate sets of estimates for each measure of establishment size.

The conditioning information set is a vector of exogenous control variables specific to each county. These variables are drawn from an intersection of available data and factors found significant in previous empirical growth studies. *Education*, measured as the logarithm of the percentage of population aged 25 and over who have completed at least 4 years of college as of 1980, reflects the accumulated level of human capital and is expected to exhibit a positive coefficient. The logarithm of *per capita money income* as of 1979 is intended to capture the convergence effect noted by Barro and Sala-i-Martin (1992). Its coefficient is expected to be negative. Both variables are similar to those used in recent studies of economic growth such as Rajan and Zingales (1998), Levine et al., (2000), and Cetorelli and Gambera (2001).

Each county's *population as of 1980* is a measure of market size as in Cetorelli and Gambera (2001). *Local government expenditures*

per capita (1981–1982) is similar to a measure of government size used by Levine et al., (2000) as an indicator of macroeconomic stability, following Easterly and Rebelo (1993) and Fischer (1993). The *growth of total county employment* by sector between March 1977 and March 1979 is intended to control for any serial correlation in growth rates, as suggested by Blanchard and Katz (1992).⁴

Alternative specifications also include the *share of manufacturing* relative to other sectors in each county as of 1978, as in Shaffer (2002). This variable is defined as the ratio of manufacturing employment to the total employment across the four sectors in our sample, and is intended to address the hypothesis that larger manufacturing establishments were associated with a larger manufacturing sector relative to other sectors in a given county. Because the service sector grew faster than the manufacturing sector during the sample period, the average size of manufacturing establishments might then reflect a spurious correlation unless we control for the initial share of manufacturing.

Table I presents descriptive statistics for the sample variables. The source of data for all variables subsequent to 1979 is the *County and City Data Book* published by the U.S. Bureau of the Census, 1988 and 1994, as provided online at fisher.lib.virginia.edu/ccdb. Earlier data were obtained from the *County Business Patterns*, as provided online in the Geostats section of fisher.lib.virginia.edu. Median household income grew by 67.44% on average over the decade 1979–1989, corresponding to an average annual growth rate of 5.29%. Individual counties experienced income growth ranging from 4.30 to 148.60%, the latter corresponding to an average annual growth rate of 9.53% compounded annually.

Because of the potential nonlinear relationship between these variables and growth, I use natural logarithms of most of the regressors as in many previous studies. Each sector exhibits substantial variation in average establishment size across counties, with the ratio of largest to smallest equal to 568 for manufacturing, 10.9 for retail, 26.4 for wholesale, and 85.8 for service firms. This sample should therefore embody ample variation to afford the possibility of

TABLE I
Descriptive statistics

Variable	Mean	SD	Skewness	Kurtosis
Income growth	67.44	19.36	0.29	0.51
Education	16.18	260.02	55.01	3027.34
Initial <i>percapita</i> income	14340	3383	0.83	1.37
Population in 1980	74234	239664	15.63	387.50
Government expenditure <i>percapita</i> , 1981–1982	975.6	393.6	1.96	9.22
Mfg. share, 1978	0.385	0.195	0.126	–0.759
Job growth, 1977–1979				
Manufacturing	1.107	0.346	2.155	30.725
Retail	1.175	0.687	21.629	608.944
Wholesale	1.132	0.181	4.404	94.136
Service	1.199	0.265	3.139	35.598
Avg. estab. size, 1978				
Manufacturing	55.69	40.83	1.81	6.38
Retail	7.95	2.83	0.87	0.63
Wholesale	8.80	3.75	1.29	3.10
Service	8.46	3.99	3.67	51.35

Income growth is the percentage change of median household income, 1979–1989, from the *County and City Data Book* (Washington, D.C., U.S. Bureau of the Census, 1988 and 1994). Avg. estab. size is the natural logarithm of average employees per establishment as of 1978, from *County Business Patterns*. Mfg. share is the total employment of manufacturing establishments divided by the combined employment of manufacturing, retail, wholesale, and service establishments as of 1978. Other variables are defined in the text and are entered here (and in the regressions) as natural logarithms, and taken from the *County and City Data Book*.

detecting any systematic association that may exist between average establishment size and income growth rates. Figure 1a–d depict histograms of average establishment employment by sector, to convey more information about the sample distribution of these variables. Another

way of parsing the data is to focus on the percentage of establishments in each sector employing fewer than a specified number of workers, as reported in the *County Business Patterns* (not shown in the table for brevity); the percentage of establishments employing fewer

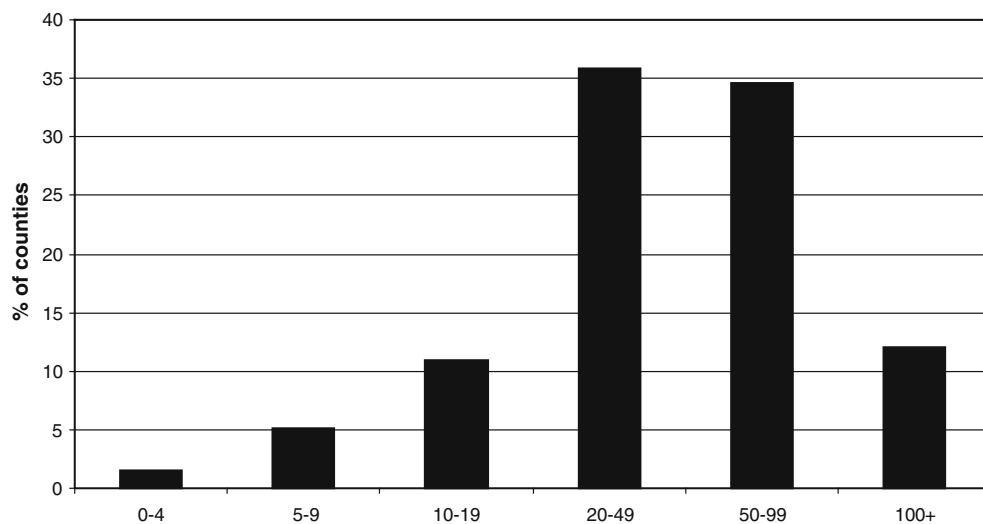


Figure 1a. Average manufacturing establishment employment.

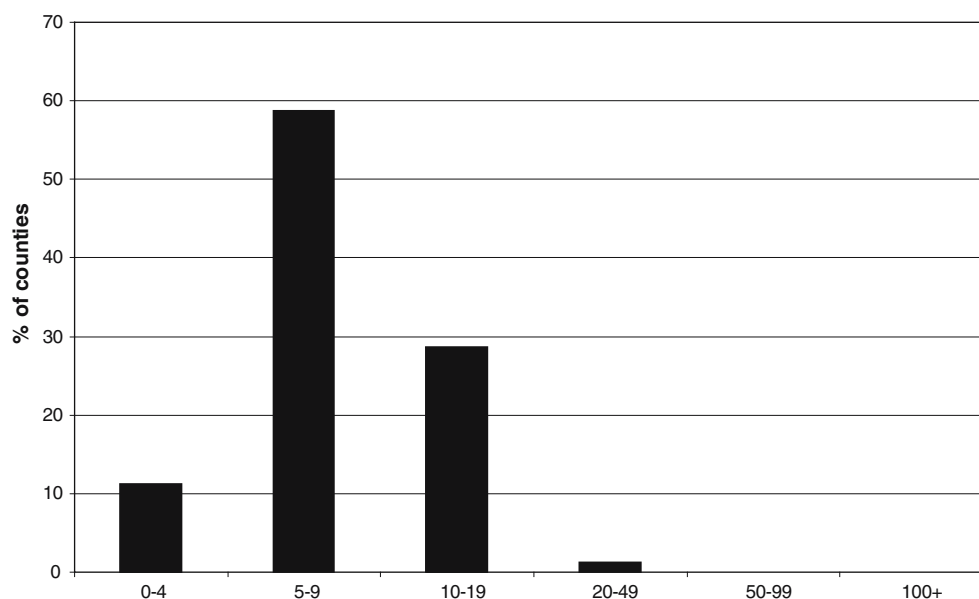


Figure 1b. Average wholesale establishment employment.

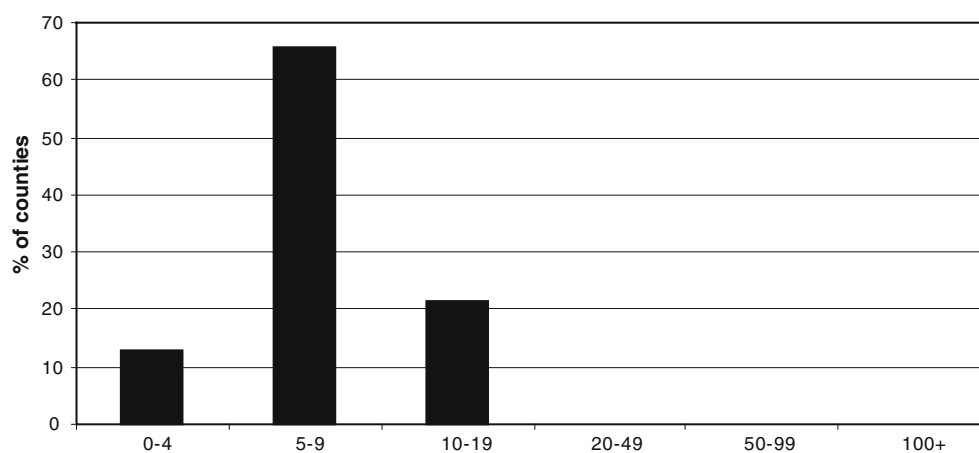


Figure 1c. Average retail establishment employment.

than 10 (respectively, 50) workers in the average county was 52.3% (80.7 %) in manufacturing, 79.5% (98.5%) in retail, 75.5% (98.5%) in wholesale, and 86.3% (97.2%) in service establishments.

The initial data set contained 3,030 counties. Missing values or zeroes (such as counties with no manufacturing firms) reduced the number of usable observations to a total of 2617–2685 across the various manufacturing regressions, 2649–2979

for the retail regressions, 2507–2847 for the wholesale regressions, and 2625–2957 for the service regressions.

3. Results

Tables II–V report the estimated coefficients for all specifications by sector. All control variables exhibit consistently significant coefficients, with two exceptions. Initial income typically takes a

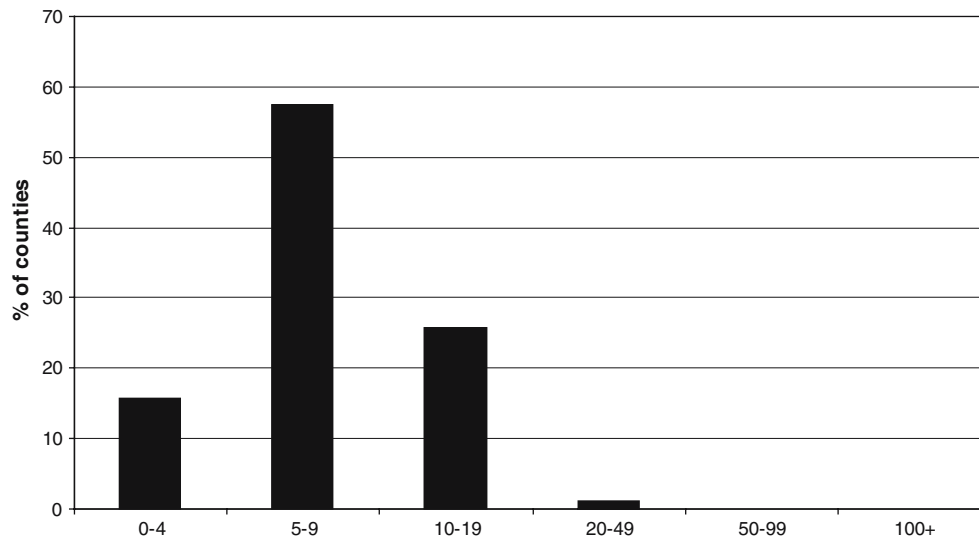


Figure 1d. Average service establishment employment.

negative coefficient, consistent with the convergence hypothesis of Barro and Sala-i-Martin (1992), but is significant only in the first two specifications that included wholesale establishment size (Table IV). Growth in sectoral employment (1977–1979) exhibits a significantly positive coefficient for the manufacturing and retail sectors, but is insignificant for the wholesale sector and sometimes marginally significant for the service sector. As in previous studies, education exhibits a uniformly positive coefficient, consistent with productivity of human capital. Population exhibits a positive coefficient, consistent with agglomeration economies.

Relative government expenditure exhibits a negative coefficient, which could be consistent with any of at least three hypotheses. First, government assistance may tend to be directed toward areas anticipated to be in need of financial stimulus (such as low-growth areas). Second, areas with low growth potential may have a lower opportunity cost of government expenditures (i.e., such funds may be less productive in the private sector and thus efficiently reallocated to the public sector). Third, one might hypothesize that government expenditures tend to contribute less to local income growth than do market-directed, private-sector expenditures. Our data cannot distinguish among these competing explanations.

It is interesting that those counties with larger initial shares of manufacturing, relative to other sectors, experienced faster income growth on average. Since the service sector grew more rapidly during the sample period, it is possible that a larger initial manufacturing share provided greater scope for expansion of the other sectors in those counties.

The primary variable under investigation, average establishment size, exhibits a negative and highly significant coefficient in every specification for each sector, with the sole exception of the second service regression (Table V). Consistent with these results, the percentage of establishments with fewer than 5 or 10 employees takes a highly significant, positive coefficient in every sector. The percentage of establishments with fewer than 20 employees takes a significantly positive coefficient in the manufacturing and retail sectors, but not generally in the wholesale or service sectors.⁵

Table II depicts the results for the manufacturing sector. The negative coefficients on the average manufacturing establishment size (significant at the 0.001 level or better) indicate that median household income grew faster from 1979 to 1989 in counties that had smaller manufacturing establishments in 1978. The absolute magnitude and significance of the coefficients on average manufacturing establishment size are

TABLE II
Ex ante manufacturing establishment size and *ex post* per-household income growth cross-sectional regressions 1979–1989

Intercept	127.9 (2.42)**	88.5 (1.40)	112.9 (2.04)**	79.8 (1.30)	113.1 (2.04)**	72.1 (1.18)	117.2 (2.04)**	71.7 (1.16)
Education	7.82 (2.62)*	11.90 (3.09)*	8.29 (2.80)*	10.59 (2.89)*	8.27 (2.79)*	10.83 (3.00)*	8.38 (2.72)*	10.94 (2.97)*
Initial <i>percapita</i> income	-4.31 (-0.67)	-2.36 (-0.30)	-3.91 (-0.60)	-2.48 (-0.33)	-4.10 (-0.63)	-2.44 (-0.33)	-4.43 (-0.66)	-2.90 (-0.39)
Population (1980)	3.09 (6.41)*	4.30 (9.26)*	2.46 (5.67)*	2.08 (4.70)*	2.56 (5.89)*	2.30 (5.21)*	2.42 (5.48)*	2.34 (5.25)*
Govt. expend. <i>percapita</i>	-9.49 (-8.04)*	-7.84 (-6.80)*	-8.81 (-7.87)*	-7.43 (-6.27)*	-8.90 (-7.88)*	-7.50 (-6.31)*	-8.81 (-7.77)*	-7.53 (-6.35)*
Mfg. job growth (1977–1979)	3.46 (3.05)*	2.95 (2.51)**	2.79 (2.97)*	3.86 (3.28)*	2.80 (2.98)*	3.94 (3.41)*	2.81 (2.97)*	3.95 (3.44)*
Mfg. share (1978)	—	39.84 (10.85)*	—	15.32 (5.28)*	—	18.16 (6.40)*	—	19.95 (6.82)*
Avg. mfg. estab. size (1978)	-2.23 (-3.33)*	-9.57 (-12.75)*	—	—	—	—	—	—
%MfEst < 5	—	—	13.36 (4.07)*	17.47 (5.16)*	—	—	—	—
%MfEst < 10	—	—	—	—	11.21 (3.48)*	18.86 (5.84)*	—	—
%MfEst < 20	—	—	—	—	—	—	8.08 (2.35)**	20.03 (6.09)*

The dependent variable is the average growth rate of median household income, 1979–1989, in percent. *t*-statistics, computed from White heteroskedasticity-consistent standard errors, are in parentheses and *p*-values are indicated as *0.01 and **0.05. All right-hand variables are entered as natural logarithms except Mfg. job growth 1977–1979, %MfEst < 5, %MfEst < 10, and %MfEst < 20. %MfEst < *j* denotes each county's percent of manufacturing establishments with total employment less than *j* employees. Data are from the County and City Data Book (Washington, D.C., U.S. Bureau of the Census, 1988 and 1994) except Mfg. job growth 1977–1979, Avg. mfg. estab. size, %MfEst < 5, %MfEst < 10, and %MfEst < 20, which are from County Business Patterns.

TABLE III
Ex ante retail establishment size and *ex post* per-household income growth cross-sectional regressions 1979–1989

Intercept	92.7 (1.55)	60.1 (0.96)	50.7 (0.83)	10.9 (0.17)	30.7 (0.49)	-17.4 (-0.27)	-22.6 (-0.35)	-72.5 (-1.06)
Education	12.52 (4.00)*	14.12 (3.84)*	11.87 (4.02)*	13.64 (3.87)*	11.75 (3.96)*	13.80 (3.90)*	12.25 (3.88)*	14.03 (3.76)*
Initial <i>percapita</i> income	-2.30 (-0.32)	0.23 (0.03)	-2.85 (-0.41)	-0.18 (-0.02)	-2.98 (-0.43)	0.007 (0.00009)	-3.03 (-0.42)	-0.20 (-0.03)
Population (1980)	5.15 (9.94)*	4.79 (8.40)*	3.54 (8.36)*	3.17 (6.71)*	3.84 (8.73)*	3.42 (7.11)*	4.48 (9.10)*	4.08 (7.79)*
Govt. expend. <i>percapita</i>	-7.83 (-7.72)*	-7.11 (-6.13)*	-7.45 (-7.33)*	-6.66 (-5.77)*	-8.08 (-8.03)*	-7.25 (-6.29)*	-8.93 (-8.85)*	-7.95 (-6.87)*
Ret. job growth (1977–1979)	2.92 (3.09)*	4.82 (2.08)**	2.89 (3.11)*	4.55 (2.00)**	3.11 (3.16)*	5.18 (2.25)**	3.26 (2.50)**	5.76 (2.44)**
Mfg. share (1978)	—	9.93 (3.24)*	—	10.25 (3.39)*	—	10.98 (3.67)*	—	11.02 (3.64)*
Avg. ret. estab size (1978)	-17.53 (-9.57)*	-18.57 (-9.24)*	—	—	—	—	—	—
%RtEst < 5	—	—	47.84 (8.70)*	53.12 (8.61)*	—	—	—	—
%RtEst < 10	—	—	—	—	62.82 (8.55)*	71.92 (8.87)*	—	—
%RtEst < 20	—	—	—	—	—	—	110.18 (8.80)*	120.40 (9.00)*

The dependent variable is the average growth rate of median household income, 1979–1989, in percent. *t*-statistics, computed from White heteroskedasticity-consistent standard errors, are in parentheses and *p*-values are indicated as *0.01 and **0.05. All right-hand variables are entered as natural logarithms except Ret. job growth 1977–1979, %RtEst < 5, %RtEst < 10, and %RtEst < 20. %RtEst < *j* denotes each county's percent of retail establishments with total employment less than *j* employees. Data are from the County and City Data Book (Washington, D.C., U.S. Bureau of the Census, 1988 and 1994) except Ret. job growth 1977–1979, Avg. ret. estab. size, %RtEst < 5, %RtEst < 10, and %RtEst < 20, which are from County Business Patterns.

TABLE IV
Ex ante wholesale establishment size and ex post per-household income growth cross-sectional regressions 1979–1989

Intercept	227.6 (12.21)*	197.0 (10.25)*	129.4 (2.07)**	91.8 (1.41)	123.4 (1.97)**	85.3 (1.31)	128.1 (2.03)**	91.7 (1.40)
Education	14.04 (11.23)*	16.93 (11.88)*	8.58 (2.54)*	10.28 (2.58)*	8.82 (2.60)*	10.57 (2.64)*	8.83 (2.62)*	10.59 (2.66)*
Initial <i>percapita</i> income	-17.26 (-7.86)*	-15.69 (-6.83)*	-6.08 (-0.81)	-3.44 (-0.42)	-6.28 (-0.83)	-3.63 (-0.45)	-6.32 (-0.84)	-3.70 (-0.46)
Population (1980)	3.24 (7.85)*	2.46 (5.12)*	2.71 (6.23)*	2.21 (4.73)*	2.93 (6.52)*	2.45 (5.12)*	2.63 (5.96)*	2.08 (4.30)*
Govt. expend. <i>percapita</i>	-8.32 (-7.63)*	-6.75 (-5.77)*	-8.14 (-7.47)*	-7.07 (-5.85)*	-8.22 (-7.56)*	-7.23 (-6.00)*	-8.14 (-7.46)*	-7.11 (-5.86)*
Wh. job growth (1977–1979)	-0.06 (-0.10)	0.38 (0.52)	-0.38 (-0.67)	0.02 (0.03)	-0.39 (-0.71)	2.3E-5 (3.9E-5)	-0.27 (-0.50)	0.11 (0.18)
Mfg. share (1978)	—	16.18 (7.06)*	—	12.14 (3.73)*	—	11.95 (3.67)*	—	12.22 (3.75)*
Avg. wh. estab. size (1978)	-2.41 (-2.33)**	-2.50 (-2.25)**	—	—	—	—	—	—
%WhEst < 5	—	—	7.90 (2.72)*	11.01 (3.46)*	—	—	—	—
%WhEst < 10	—	—	—	—	12.83 (3.76)*	15.61 (4.18)*	—	—
%WhEst < 20	—	—	—	—	—	—	8.42 (1.49)	9.42 (1.52)

The dependent variable is the average growth rate of median household income, 1979–1989, in percent. *t*-statistics, computed from White heteroskedasticity-consistent standard errors, are in parentheses and *p*-values are indicated as *0.01 and **0.05. All right-hand variables are entered as natural logarithms except Wh. job growth 1977–1979, %WhEst < 5, %WhEst < 10, and %WhEst < 20. %WhEst < *j* denotes each county's percent of wholesale establishments with total employment less than *j* employees. Data are from the *County and City Data Book* (Washington, D.C., U.S. Bureau of the Census, 1988 and 1994) except Wh. job growth 1977–1979, Avg. wh. estab. size, %WhEst < 5, %WhEst < 10, and %WhEst < 20, which are from *County Business Patterns*.

TABLE V
Ex ante service establishment size and ex post per-household income growth cross-sectional regressions 1979–1989

Intercept	125.2 (2.11)**	100.4 (1.54)	78.2 (1.33)	46.8 (0.72)	78.2 (1.34)	56.8 (0.88)	105.8 (1.89)**	91.5 (1.43)
Education	9.73 (2.94)*	11.08 (2.79)*	10.16 (3.07)*	11.89 (2.89)*	10.16 (2.97)*	11.53 (2.82)*	9.39 (2.89)*	10.92 (2.79)*
Initial <i>percapita</i> income	-5.01 (-0.70)	-3.32 (-0.41)	-4.34 (-0.60)	-2.49 (-0.30)	-4.78 (-0.65)	-3.05 (-0.37)	-5.19 (-0.73)	-3.38 (-0.42)
Population (1980)	2.65 (5.72)*	1.90 (3.80)*	3.30 (6.94)*	2.83 (5.47)*	2.87 (6.26)*	2.33 (4.64)*	2.36 (5.55)*	1.74 (3.72)*
Govt. expend. <i>percapita</i>	-8.30 (-7.90)*	-7.41 (-6.25)*	-7.57 (-7.22)*	-6.60 (-5.52)*	-7.90 (-7.64)*	-7.16 (-6.06)*	-8.16 (-7.82)*	-7.28 (-6.16)*
Svc. job growth (1977–79)	1.52 (1.50)	2.20 (1.79)**	1.36 (1.38)	2.00 (1.60)	1.40 (1.42)	2.23 (1.86)**	1.58 (1.64)**	2.12 (1.77)**
Mfg. share (1978)	—	11.10 (3.58)*	—	10.70 (3.40)*	—	10.16 (3.28)*	—	11.48 (3.69)*
Avg. Svc. estab. size (1978)	-2.53 (-2.54)*	-1.43 (-1.33)	—	—	—	—	—	—
%SvEst < 5	—	—	32.98 (6.51)*	37.85 (6.46)*	—	—	—	—
%SvEst < 10	—	—	—	—	38.87 (4.85)*	36.12 (3.98)*	—	—
%SvEst < 20	—	—	—	—	—	—	19.92 (1.72)**	8.07 (0.62)

The dependent variable is the average growth rate of median household income, 1979–1989, in percent. *T*-statistics, computed from White heteroskedasticity-consistent standard errors, are in parentheses and *p*-values are indicated as *0.01, **0.05, and ***0.010. All right-hand variables are entered as natural logarithms except Svc. job growth 1977–1979, %SvEst < 5, %SvEst < 10, and %SvEst < 20. %SvEst < *j* denotes each county's percent of service establishments with total employment less than *j* employees. Data are from the *County and City Data Book* (Washington, D.C., U.S. Bureau of the Census, 1988 and 1994) except Svc. job growth 1977–1979, Avg. svc. estab. size, %SvEst < 5, %SvEst < 10, and %SvEst < 20, which are from *County Business Patterns*.

greater when controlling for the initial manufacturing share, with absolute *t*-statistics above 12. The last six regressions shown in the table indicate that faster income growth occurred in counties where a higher percentage of manufacturing establishments were small. In the regressions that did not control for the initial share of manufacturing, the magnitude and significance of that association was stronger for smaller thresholds (i.e., the coefficient on the percent of manufacturing establishments with fewer than five employees is larger and more significant than that on the percent of manufacturing establishments with fewer than 10 employees, which in turn is larger and more significant than that on the percent of manufacturing establishments with fewer than 20 employees), though this pattern is not apparent when controlling for initial manufacturing share.

Table III reports the results for the retail sector. The pattern of coefficients is very similar to that in Table II. Here, the absolute *t*-statistic on the coefficient of retail establishment size measures never falls below 8.5 in any specification. The significance of this coefficient is high despite some multicollinearity: the Pearson correlation coefficient between the average retail establishment size and initial income (respectively, county population) is 0.57 (respectively, 0.40). Income grew faster in those counties having a smaller average retail establishment size initially, or those having a larger proportion of small retail establishments.

Table IV displays the results for the wholesale sector. Here, there are two main differences from the previous tables. First, the coefficient on initial per capita income is significantly negative in the first two specifications, consistent with the convergence hypothesis supported in many previous studies. Second, although the coefficient on the average wholesale establishment size is significantly negative as in the other sectors, the level of significance is somewhat lower, with absolute *t*-values near 2.3. Income grew significantly faster in counties having a higher percentage of wholesale establishments with fewer than 5 or 10 employees, but was not significantly associated with the percentage of wholesale establishments with fewer than 20 employees.⁶ Thus, the results in the first two specifications appear to be driven by

the presence of very small wholesale establishments.

Table V presents the results for the service sector. These coefficients are similar in sign and significance to those in the previous tables, except that the coefficient on average service establishment size is not significantly different from zero in the second specification (controlling for initial share of manufacturing). The various regressions indicate that income grew faster in counties where the percentage of service establishments had fewer than 5 or 10 employees, but not where the percentage of service establishments had fewer than 20 employees.⁷

The magnitudes of the estimated linkages are such that an increase of one standard deviation in the average establishment size (as shown in Table I) is associated with a slower average 10-year growth rate of median household income of 5.3% points in the most significant manufacturing specification, 5.3–5.7% points in the retail specifications, 0.9% points in the wholesale regressions, and 1.0% point in the first service regression. These increments correspond to 7.8% of the sample mean income growth for manufacturing (respectively, 7.9–8.4% for retail, 1.3% for wholesale, and 1.5% for the service sector). Thus, while statistically significant and robust empirical associations are found for all four sectors, the largest associations in magnitude are found for the manufacturing and retail sectors. Together, these estimates would predict that a county in which the average establishment size is one standard deviation above the sample mean in all four sectors would have a slower income growth rate by nearly 1% point per year compared to a county at the sample mean. Alternatively, these estimates imply that a county with the sample's minimum average establishment size is predicted to have more rapid income growth than one with establishment sizes at the sample means, by (for manufacturing) as much as 2.35% annually, or (for retail) as much as 1.47% annually. These magnitudes represent economically meaningful effects.

The control variables may be endogenous over time, but are predetermined and therefore unlikely to cause simultaneity bias in regressions on subsequent growth of income, as in the "weakly exogenous" regressors assumed by Levine et al.,

(2000). I did not attempt an instrumental variables estimation because of the absence of theory and data to instrument establishment size and because of recognized problems with instrumental variables (e.g., Nelson and Startz, 1990).

4. Conclusion

This study has presented evidence on empirical linkages between average establishment size (respectively, the percentage of establishments that are small) and economic growth, estimated separately for four sectors in a nationwide sample of more than 2500 U.S. counties. Such linkages may be theoretically predicted through a variety of channels, including technological innovation, labor, and firm dynamics, though our tests cannot address these hypothesized mechanisms. Statistically significant, economically meaningful, and robust negative associations are found empirically between income growth rates and measures of size of manufacturing, retail, wholesale, and service establishments. The similarity of results across sectors is contrary to what might be expected from the analysis of Rajan and Zingales (2001), suggesting that a different mechanism is at work than they hypothesized – possibly different mechanisms in different sectors.

Because the available data cannot definitively address any question of causality, the empirical regularities reported here can be interpreted as raising interesting questions for further research. Among the useful applications of such research might be not only the underlying reasons for these regularities, but also any interactions between those factors and public policies toward economic growth, small business, and related issues.

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Notes

¹ Shaffer (2002) has addressed a similar question using a smaller and more homogeneous sample of U.S. cities.

² Although the 2000 edition of the *County and City Data Book* reports median household income for 1997, that figure –

unlike earlier figures – is a model-based estimate and therefore less useful for empirical research of this type. In addition, income growth from 1989 to 1997 would be a shorter horizon than the 1979–1989 horizon used here.

³ The author is grateful to an anonymous referee for suggesting these variations.

⁴ The author is grateful to an anonymous referee for suggesting this variable.

⁵ Note that these variables are not the same as the percentage of counties with an average establishment employment less than particular levels, as depicted in Figure 1a–d. In particular, as indicated in the previous section, the percentage of establishments with more than 50 employees is substantial in quite a few counties. Additional regressions (not reported in the tables for brevity) indicated that the coefficient on the percentage of establishments with fewer than 50 employees was not significant in the manufacturing sector ($t = 1.29$) but was significant in the retail sector ($t = 4.09$).

⁶ Other regressions (not reported in the table for brevity) found that income growth rates were not significantly associated with the percentage of wholesale establishments having fewer than 50 employees ($t = -0.94$ and -0.87 in two alternate specifications with and without controlling for initial manufacturing share).

⁷ Other regressions (not shown in the table for brevity) indicated that income did not grow faster in counties having a higher percentage of service establishments with fewer than 50 employees ($t = -0.23$ and -0.99 in alternate specifications with and without controlling for the initial share of manufacturing).

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