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Establishment Size and Local Employment Growth

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ABSTRACT. In a sample of more than 2000 U.S. counties, smaller average establishment size is generally associated with faster subsequent growth rates of sectoral employment, both within and across sectors. The estimated effects are large in magnitude and thus economically important, and are consistent with several theories previously developed. These findings contribute toward a more precise understanding of the role of small businesses in economic growth and labor markets.

KEY WORDS: establishment size, employment growth

JEL CLASSIFICATION: J23, L11, O47

1. Introduction

Previous studies have noted that smaller firms create larger numbers of new jobs (Robbins et al., 2000), but those jobs tend to be less permanent than at larger firms (Davis and Haltiwanger, 1992; Davis et al., 1996; Rob, 1995). These opposing effects leave unanswered the important question of the net impact of firm size on social welfare. In that regard, Robbins et al. (2000) present evidence that gross state product and productivity have grown faster in states, where very small businesses employ a higher percentage of workers. Likewise, Shaffer (2002) finds that smaller firms in some sectors have been associated with faster subsequent income growth in a sample of U.S. cities.

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Most previous studies of employment patterns have focused on job changes within individual firms, overlooking potentially important aggregate effects that may reflect externalities and which are essential to an assessment of overall welfare. This paper represents a step toward filling that gap by presenting what appears to be the first exploration of an empirical association between average establishment size and subsequent growth rates of employment *by sector* at the county level. The cross-sectional sample comprises four sectors – manufacturing, retail, wholesale, and services – across more than 2000 U.S. counties.[1] In most cases, smaller establishments are found to be associated with faster subsequent growth rates of employment, both within and across sectors.

The primary contribution to previous research is three-fold. First, the vector of intra-sectoral and inter-sectoral effects on jobs is a broader and more policy-relevant question than merely firm-specific job growth, yet more precise than a single aggregate growth linkage. The finding of several significant cross-linkages between establishment size in one sector and subsequent employment growth in other sectors demonstrates a previously unexplored dimension of spillovers in labor markets. Second, the county-level, sector-specific sample is larger and more disaggregated than statewide samples previously used in such studies as Robbins et al. (2000). Third, job growth is a complementary dimension of social welfare to the more widely studied topic of income growth. The county-level database also complements previous studies of countries and states, in that counties tend to be quite open economies and are often more specialized economic units than countries or states.

The remainder of the paper is organized as follows. Section 2 discusses a variety of reasons why we might expect firm size to be associated

with growth, Section 3 presents the empirical model, Section 4 discusses the data and results, and Section 5 concludes.

2. Theoretical background

There are several reasons to expect that the average size of firms in a community might be associated with subsequent rates of employment growth, measured at various levels of aggregation. It is important to recognize *a priori* that any such association might take either sign; i.e., if size matters at all, there could be reasons why large firms might stimulate growth, and perhaps other reasons why small firms might stimulate growth. Resolving these disparate possibilities is intrinsically an empirical task.

One plausible mechanism for growth involves innovation. Schumpeter hypothesized that larger firms can foster more rapid technological innovation. More recent studies have found empirical associations between firm size and innovation, though not always in the direction Schumpeter predicted (Acs and Audretsch, 1988; Audretsch, 2002). Depending on whether the form of technological progress is capital-augmenting or labor-augmenting, such patterns could result in either faster or slower growth of employment among larger firms. Shaffer (2002) has formalized this argument with respect to income growth, and found empirical evidence that smaller firms in certain sectors are associated with faster subsequent income growth, but does not address the question of employment growth. Other studies have found evidence that innovating small firms grow faster on average than non-innovating firms, in both sales and employment (Freel, 2000), which is a special case of the topic studied here.

If indeed smaller firms are associated with faster income growth as indicated by Shaffer (2002) – whether or not due to technological innovation – such growth might be complementary with employment growth (e.g., wages are bid up due to increased demand for workers in a particular sector) or, conversely, it might occur at the expense of jobs (e.g., if capital investment makes each worker more productive, increasing the value of her marginal product, but also diminishing the need to employ as many workers). Exploring the empirical association between establishment size and employment growth can help address the important issue of whether per-household income growth has been accompanied by a labor-displacement effect. If so, then public policy might face an unwelcome tradeoff between promoting income versus promoting jobs.

Human capital comprises a separate mechanism potentially linking firm size with growth. Zabojnik and Bernhardt (2001) note that it is possible for firms of different sizes to invest unequally in the human capital of their employees. Rajan and Zingales (2001) similarly postulate that firms of different sizes provide unequal incentives for their employees to invest in human capital. Either hypothesis would predict differentials in the time path of productivity as a function of firm size; unless productivity has a completely neutral effect on equilibrium levels of employment, the result would then be an association between firm size and employment growth.

A separate strand of research has found that smaller firms may be less selective than larger firms in their hiring practices, perhaps because of a comparative advantage in utilizing "secondary" (less attractive) labor resources (Acs, 1999). Smaller firms may thus provide experience and on-the-job training to a broader segment of the population than larger firms on average, thereby making more individuals employable by other firms. This process would predict that faster employment growth in aggregate (either within a sector or, more generally, across a community or region) might be associated with smaller firms.

Another linkage may derive from the empirical labor literature, which has established that job turnover tends to be higher among smaller firms than at larger firms (Davis and Haltiwanger, 1992; Davis et al., 1996; Rob, 1995). If workers enjoy shorter tenure at smaller firms on average, this pattern could be reflected in aggregate employment growth, but that association could take either sign. Involuntary turnover due to layoffs would tend to elevate the unemployment rate and reduce employment growth. Conversely, voluntary turnover due to acceptance of more attractive alternatives might

be associated with lower unemployment rates and higher rates of employment growth. Previous studies have not attempted to distinguish between these two effects, though there is some indirect evidence consistent with the latter possibility.

In particular, a worker may gain more prompt exposure to a broader segment of the company's business in a smaller firm, due to a higher degree of integration across functions within the firm (Bowles, 1994). Cosh et al. (2000) find that training has a positive impact on employment growth at the firm level. Then, if broad exposure constitutes a form of training, one implication would be that smaller firms promote faster employment growth at the firm level. A related hypothesis is that employees in smaller firms may be more skilled as entrepreneurs, either by training or by self-selection, and thus able to contribute to faster growth; whether such growth may manifest itself in the labor market is an open empirical question.[2] If entrepreneurial workers are more likely to leave one firm in order to start a new company, then we might expect more spinoffs and startups in areas where incumbent firms are smaller. Alternatively, or in addition, if larger firms are perceived to be more aggressive competitors (for example, because of deeper pockets) and thus to constitute barriers to entry, startup firms may be more prevalent where the incumbent firms are smaller. Either way, because new firms have been found to be positively associated with growth in both the U.S. (Reynolds, 1999) and Germany (Audretsch and Fritsch, 2003), this mechanism would also predict faster growth where firms are smaller.

An intriguing possibility arises if there are economies of scale, such that firms smaller than the minimum efficient scale can produce at lower unit cost if they grow. Any cost savings that are passed along to customers in the form of lower prices will further stimulate demand, with the result that equilibrium output grows fastest where unit costs decline most steeply with scale. A stylized example illustrates this point formally.

Assume the demand function for a homogeneous product x grows exogenously as $x = A^t - Bp$ where p is the price of x, $A > 0$, and $B > 0$. Let the total cost of x be $a - cx$ with $a > 0$ and $c > 0$, so the industry is a natural monopoly.[3] Consider the simple breakeven pricing strategy, $p = a/x - c$. Then $\partial x/\partial t = x^2 A^t \mathrm{In}(t)/(x^2 - aB)$ so $\partial^2 x/\partial t \partial x = -2xaBA^t \mathrm{In}(t)/(x^2 - aB)^2 < 0$. This says that the rate of growth of output is slower for larger values of x. Then, if the firm's demand for labor is an increasing function of its output, the growth of employment is slower for larger firms.

If the industry contains multiple firms, the same result would apply to each firm and thus to the industry in aggregate. This mechanism therefore predicts that economies of scale would result in a negative association between average firm size and employment growth rates at both the firm level and the sector level, within a local market. In a related vein, previous empirical studies and alternative theories of firm growth have found mixed results concerning possible associations between firm growth and firm size (Eeckhout and Jovanovic, 1998; Klette and Griliches, 2000; Sutton, 1997), and these associations should manifest themselves in the dimension of employment as well (see also Hart, 2000). However, in this direct form, the hypothesis of economies of scale does not yield a predicted linkage between firm size in one sector and employment growth in another sector, as explored empirically below. Moreover, regional or national markets would undermine the ability of high-cost firms to pass along their costs in higher prices, at least in the absence of product differentiation.

Consideration of aggregate employment growth raises the possibility of spillover effects between neighboring counties, either positive or negative. Rapid growth in one county, due to whatever cause, might attract resources away from adjacent counties and thereby reduce growth in the latter counties. Conversely, as observed (for example) in recent years in the area encompassing northern Colorado and southeastern Wyoming, rapid growth in one county may spawn entry by new firms into an adjacent county, seeking to supply the growing demand in the first area, while avoiding some congestion costs. Because theory cannot predict a determinate sign of spatial spillover effects, the question is inherently empirical. Anselin et al. (2000) find evidence that spatial effects

of university research on rates of innovation can extend as far as a 75-mile range from a central city, suggesting that a test of spatial effects by a similar approach might be useful in the present context as well.

However, I do not implement such a test for three primary reasons. First, many U.S. counties span areas similar to the 75-mile cutoff observed by Anselin et al. Second, Anselin et al.'s sample (a subset of U.S. metropolitan statistical areas) contained fewer than 90 observations, in contrast to our sample of more than 2000 U.S. counties; while the construction of spatial measures is a practical undertaking for the smaller sample, it is not so for the much larger sample employed here. Third, policy implications of spatial externalities would entail two further complications: locally optimal policies and general equilibrium considerations. If a particular policy can stimulate local employment growth, the local community is likely to prefer it whether or not it operates at the expense of neighboring areas. Such a policy will therefore constitute a local policy equilibrium. If local growth occurs to some extent at the expense of growth in neighboring areas, the condition associated with faster growth may still be globally optimal if it is uniformly adopted across all areas.

These various considerations are neither mutually exclusive nor exhaustive. Rather, they are illustrative of the general notion that firm size may matter for employment growth in a variety of ways, prompting the need for empirical study of such effects.

The findings presented below can shed light on several of the points discussed above. First, in conjunction with prior research, they suggest that there is no empirical tradeoff between per capita income growth and employment growth as a function of establishment size, but instead the two dimensions of growth are complementary as related to establishment size. Second, significant associations are observed while controlling for levels of manufacturing investment and formal education (as discussed below), suggesting that the associations between employment growth and firm size are not an artifact of non-specific human capital or heterogeneous factor ratios. Third, the observed associations are not an artifact of higher job turnover *per se*, because employment growth is measured here as net increases in total employment rather than as the gross number of new hires.

At the same time, open questions remain. Additional research could usefully explore whether the observed associations are robust to controls for firm age, innovation, job turnover, or neighborhood effects, although controlling for county population (discussed below) potentially captures urbanization economies which comprise one channel of spillover effects. Overall, the findings here provide new evidence that warrants further consideration.

3. The empirical model

The basic empirical growth equation is:

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

where the subscript *i* refers to an observation for the *i*th county. The dependent variable is the average net growth of total establishment employment within a particular sector from 1982 to 1987, measured as the logarithm of the ratio of 1987 employment to 1982 employment. Estabsize is the logarithm of the average value added per manufacturing establishment, average sales per retail establishment and per wholesale establishment, or average receipts per service establishment, all as of 1982. Average establishment size could also be measured as employees per establishment. However, the dependent variable is a linear function of total sector employment, so this measure of size could bias the estimated coefficient if there are omitted variables that are correlated with total sector employment. Income growth regressions have previously been found robust to the definition of establishment size (Shaffer, 2002). Therefore, as a direct check on robustness in the sample here, an alternate set of regressions below measures establishment size by employment.

Several specifications of the model were fitted, using first a scalar Estabsize variable from each sector in turn (both intra-sector, corresponding to the sector represented in the dependent variable; and inter-sector, for each of the other three sectors), and then a vector of all four Estabsize

variables (to control for average establishment size in all four sectors simultaneously). The theories discussed above suggest that employability, transferability of human capital, and similar factors may operate to some extent across sectors as well as within sectors, but likely not uniformly across all sectors. The various combinations of sectors represented in the multiple specifications of Growth and Estabsize are intended to test for these distinct effects. The use of net job growth avoids possible bias from turnover *per se*.

The conditioning information set is a vector of control variables specific to each county. Based on previous studies of endogenous economic growth and on available data, six control variables are selected. Education is measured as the logarithm of the percentage of population aged 25 and over who have completed at least four years of college as of 1980, and reflects the accumulated level of human capital. 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). Both variables are similar to those used in recent studies of economic growth such as Glaeser et al. (1995), Rajan and Zingales (1998), Levine et al. (2000), and Cetorelli and Gambera (2001). In addition, education was found to be positively associated with sectoral employment growth in U.S. metropolitan areas by O hUallachain and Satterthwaite, 1992. Based on previously established theory and empirical studies, we expect the estimated coefficients to be positive on education and negative on initial income.

The logarithm of the ratio of government expenditures to total personal income is similar to a measure of government size used by Levine et al. (2000) and Shaffer (2002) as an indicator of macroeconomic stability, following Easterly and Rebelo (1993) and Fischer (1993).[4] The logarithm of each county's population as of 1980 is a measure of market size as in Glaeser et al. (1995) and Cetorelli and Gambera (2001). It is also similar to the total labor force variable used in O hUallachain and Satterthwaite (1992) and can be interpreted as measuring urbanization economies. Based on previous theory and empirical results, we expect positive coefficients on both government expenditure and population, noting that government expenditures can directly expand employment not only in the government itself but also in the private sector to the extent that governments purchase goods and services from private sources.

The natural logarithm of new capital expenditures in the manufacturing sector, as of 1982, is very similar to the "equipment investment" variable found by Sala-i-Martin (1997) to be an exceptionally robust regressor in empirical models of income growth. We therefore include it among the control variables here. Based on previous research, we would expect its coefficient to be positive if employment growth responds in the same direction as income growth.

Finally, we estimate the models both with and without the share of each county's manufacturing sector relative to other sectors as of 1982, as in Glaeser et al. (1995) and Shaffer (2002), measured here by the relative numbers of establishments. This variable is intended to control for a possible cause of spurious correlation, as follows. It is a well-known fact that the service sector grew faster than the manufacturing sector across the U.S. during the sample period. Thus, counties in which the manufacturing sector had a smaller initial share of the economy (relative to services) should have exhibited faster growth than other counties on average. If the average size of manufacturing establishments is positively correlated with the manufacturing sector's share of the economy, this correlation might produce a spurious negative association between manufacturing establishment size and subsequent growth, unless the initial sector share is explicitly controlled in the regression. By this reasoning, as well as by a straightforward application of the convergence argument of Barro and Sala-i-Martin (1992), we expect the coefficient on this variable to be negative in the manufacturing growth regressions, positive in the service growth regressions and combined sector growth regressions, and either positive or negative in the wholesale and retail growth regressions, depending on the sign of any complementarities between those sectors and services. Previous research has found positive signs on these coefficients in income growth regressions (Shaffer, 2002).[5]

Additional measures of investment and heterogeneous technology would be desirable as well (see for example the survey by Fagerberg, 1994; and Sedgley's (1998) state-level empirical analysis), but are not available for 1982 at the county level in the *County and City Data Book*. Similarly, data on patents and on research and development expenditures are reported at the state level but not at the county level, precluding their use in this study.[6]

Other desirable control variables could include the average age of establishments, to test whether size is serving as a proxy for new firms, which have been found to be positively associated with growth in the U.S. (Reynolds, 1999) and Germany (Audretsch and Fritsch, 2003). However, lacking access to county-level data on establishment age, I must relegate this issue to future research.

4. Data and results

Table I presents descriptive statistics for the variables defined above, all taken from the *County and City Data Book* published by the U.S. Bureau of the Census, 1988 and 1994. Though the initial dataset contained more than 3000 counties, missing values for several variables (primarily establishment sizes) constrained the usable sample to 2038 counties. Table II reports pairwise correlation coefficients among the variables used as regressors. Most of the correlations are fairly small. The highest correlation is between initial population and manufacturing investment (0.86), while the second highest (0.65) is between education and initial income-all control variables. A correlation of 0.52 between service establishment size and retail establishment size may induce some multicollinearity in the joint specifications, but size was otherwise less highly correlated across sectors. Average retail establishment size was somewhat correlated with education and initial income (0.55 and 0.58, respectively), but otherwise there was little correlation between establishment size and other control variables.

Table III reports the estimated regression coefficients on average establishment size by sector in each of the regressions outlined above, along with the adjust R^2 and regression F statistics. Because the cross-sectional sample does not raise issues of panel data, estimation was by OLS using White heteroscedastic-consistent standard errors.

Measured separately, establishment size in each sector is significantly and negatively associated with the subsequent rate of employment growth in the manufacturing sector in Tables III and IV; these results persist in the joint estimation with the exception of wholesale establishment size. Table V depicts a similar pattern for service establishment size.

TABLE I
Summary statistics

Variable	Mean	Std. deviation	Maximum	Minimum
% mfg. job growth	0.04552	0.3104	1.609	−1.642
% retail job growth	0.1728	0.1871	1.162	−0.709
% wholesale job growth	0.0532	0.3211	2.582	−2.275
% service job growth	0.3114	0.3154	2.846	−1.528
% aggregate job growth	0.1989	0.2015	2.048	−0.614
Education	2.3866	0.4130	3.833	1.131
Initial per capita income	8.7113	0.1956	9.438	8.039
Per capita government expenditure	2.4692	0.3214	4.874	1.416
Initial population	3.6680	1.1585	8.920	1.380
Avg. mfg. firm size	0.3404	0.8918	3.700	−2.639
Avg. retail firm size	−0.9097	0.3251	0.0712	−2.110
Avg. wholesale firm size	0.7541	0.5902	3.654	−2.015
Avg. service firm size	−1.7272	0.4162	1.107	−3.332
Initial mfg. share	−1.7239	0.8102	−0.331	−4.994

Note: All statistics are computed for the variables in logarithms, as used in the regressions.

TABLE II
Correlation coefficients of the regressors

	Educ.	Mfg. Inv.	Inc. 1979	Gov. Exp.	Pop. 1980	Avg. establishment size			
						Mfg.	Who.	Retail	Svc.
Education	1.00								
Mfg. Invest.	0.23	1.00							
Income, 79	**0.65**	0.29	1.00						
Gov. Exp.	−0.01	−0.03	−0.10	1.00					
Pop.'80	0.28	**0.86**	0.33	0.02	1.00				
Avg. estab.size									
Mfg.	0.09	0.18	0.17	−0.11	0.08	1.00			
Whol.	0.24	0.29	0.34	−0.06	0.30	0.33	1.00		
Retail	**0.55**	0.33	**0.58**	−0.09	0.38	0.30	0.38	1.00	
Svc.	0.41	0.27	0.47	−0.01	0.33	0.14	0.27	**0.52**	1.00

Wholesale employment growth does not appear significantly related to establishment size in the retail or service sectors in Table III or IV, but is negatively associated with the average wholesale establishment size in Tables III and IV, and with average retail establishment size in

TABLE III
Estimated coefficients on establishment size versus employment growth

Sector	Manufacturing		Wholesale		Retail		Service	
Dep. var.								
Mfg. job growth								
Separate	−0.062	(−6. 29)*	−0.036	(−2.43)**	−0.166	(−4.38)*	−0.096	(−3.66)*
R^2 [F]	0.03	[11.64]*	0.01	[5.28]*	0.02	[8.39]*	0.02	[7.04]*
Joint	−0.053	(−5.17)*	−0.017	(−1.17)	−0.089	(−2.20)**	−0.064	(−2.38)**
R^2 [F]	0.03	[10.37]*						
Wholesale job growth								
Separate	−0.013	(−1.27)	−0.126	(−7.84)*	−0.034	(−0.94)	−0.016	(−0.53)
R^2 [F]	0.05	[19.58]*	0.09	[34.84]*	0.05	[19.44]*	0.05	[19.34]*
Joint	−0.002	(−0.19)	−0.126	(−7.61)*	0.003	(0.06)	0.0fs7	(0.22)
R^2 [F]	0.09	[23.21]*						
Retail job growth								
Separate	−0.004	(−0.75)	−0.066	(−7.76)*	−0.048	(−2.12)**	−0.061	(−3.24)*
R^2 [F]	0.10	[37.79]*	0.13	[51.69]*	0.10	[38.88]*	0.11	[41.61]*
Joint	0.003	(0.59)	−0.064	(−7.32)*	−0.009	(−0.36)	−0.048	(−2.59)*
R^2 [F]	0.13	[36.30]*						
Service job growth								
Separate	−0.014	(−1.37)	−0.078	(−5.02)*	−0.020	(−0.49)	−0.225	(−7.39)*
R^2 [F]	0.04	[16.63]*	0.06	[22.17]*	0.04	[16.31]*	0.09	[33.39]*
Joint	−0.009	(−0.87)	−0.068	(−4.32)*	0.120	(2.92)*	−0.239	(−7.48)*
R^2 [F]	0.10	[26.68]*						
All-sector job growth								
Separate	−0.010	$(-1.70)^{+}$	−0.090	(9.31)*	−0.030	(−1.19)	−0.093	(−4.76)*
R^2 [F]	0.10	[40.62]*	0.16	[63.28]*	0.10	[40.44]*	0.12	[48.02]*
Joint	−0.003	(−0.44)	0.087	(−8.79)*	0.039	(1.58)	−0.086	(−4.52)*
R^2 [F]	0.17	[46.66]*						

Note: White (heteroscedastic-consistent) t-statistics in parentheses and regression F-statistics in square brackets, significant at the *0.01, **0.05, or $^{+}$0.10 level. R^2 is adjusted for degrees of freedom; by construction, it is the same for all columns in any row labeled "joint," as described in the text.

TABLE IV
Estimated coefficients on establishment size versus employment growth, measuring establishment size by employees, controlling for initial manufacturing share

Sector	Manufacturing		Wholesale		Retail		Service	
Dep. var.								
Mfg. job growth								
Separate	−0.094	(−6.68)*	−0.049	(−3.29)*	−0.170	(−4.48)*	−0.103	(−3.86)*
R^2 [F]	0.04	[11.71]*	0.02	[6.13]*	0.02	[8.22]*	0.02	[7.19]*
Joint	−0.076	(−4.07)*	−0.002	(−0.11)	−0.073	$(-1.72)^{+}$	−0.060	(−2.22)**
R^2 [F]	0.04	[9.63]*						
Wholesale job growth								
Separate	−0.104	(−7.57)*	−0.113	(−6.76)*	−0.025	(−0.70)	−0.003	(−0.11)
R^2 [F]	0.09	[30.67]*	0.9	[31.31]*	0.07	[21.32]*	0.07	[21.24]*
Joint	−0.078	(−4.47)*	−0.075	(−3.81)*	−0.057	(1.35)	0.020	(0.65)
R^2 [F]	0.10	[24.43]*						
Retail job growth								
Separate	−0.060	(−7.65)*	−0.056	(−6.24)*	−0.042	$(-1.88)^{+}$	−0.053	(−2.88)*
R^2 [F]	0.14	[49.38]*	0.14	[47.23]*	0.12	[39.89]*	0.12	[41.71]*
Joint	−0.043	(−4.32)*	−0.032	(−3.05)*	−0.024	(0.95)	−0.040	(−2.08)**
R^2 [F]	0.15	[36.98]*						
Service job growth								
Separate	−0.088	(−6.03)*	−0.067	(−4.10)*	−0.013	(−0.32)	−0.217	(−7.13)*
R^2 [F]	0.07	[23.42]*	0.06	[20.15]*	0.05	[16.78]*	0.09	[30.52]*
Joint	−0.076	(−4.28)*	−0.023	(−1.19)	0.168	(3.90)*	−0.227	(−7.03)*
R^2 [F]	0.11	[26.92]*						
All-sector job growth								
Separate	−0.082	(−9.90)*	−0.080	(−7.76)*	−0.022	(−0.92)	−0.084	(−4.35)*
R^2 [F]	0.17	[60.03] *	0.16	[57.33]*	0.13	[42.91]*	0.14	[48.48]*
Joint	−0.063	(−6.18)*	−0.046	(−3.85)*	−0.082	(3.20)*	−0.075	(−3.89)*
R^2 [F]	0.19	[48.86]*						

Note: White (heteroscedastic-consistent) t-statistics in parentheses and regression F-statistics in square brackets, significant at the *0.01, **0.05, or $^{+}$0.10 level. R^2 is adjusted for degrees of freedom; by construction, it is the same for all columns in any row labeled "joint," as described in the text.

the separate effects model of Table V. In the joint effects model, Table V also reports a modest positive association between average service establishment size and subsequent growth of wholesale employment.

Retail employment growth is negatively related to initial size of the average establishment in all sectors in the separate effects models of Tables IV and V, and in all but the manufacturing sector in the separate effects models of Table III. These effects persist in joint regressions in Table III for the retail and service sectors; in Table IV for the manufacturing, wholes, and service sectors; and in Table V for the retail sector.

Service employment growth is negatively related to the average establishment size in both the manufacturing sector in Table IV (and in the separate effects model of Table V), the wholesale sector in Table III (and in the separate effects model of Table IV), the retail sector in the separate effects model of Table V, and the service sector in Tables III through V. It is positively related to average retail establishment size in the joint effects models of Tables III and IV.

Total employment growth across sectors is negatively related to initial establishment size in the manufacturing, wholesale, and service sectors in all separate effects regressions (Tables III through V) and in the retail sector estimates of Table V. These associations persist in the joint effects estimates for the manufacturing sector (Table IV), wholesale sector (Tables III through V), the retail sector (Table V), and the service sector (Tables III through V) but are reversed for the retail sector in Table IV.

TABLE V
Estimated coefficients on establishment size versus employment growth, measuring establishment size by employees, controlling for initial manufacturing share

Sector	Manufacturing		Wholesale		Retail		Service	
Dep. var.								
Mfg. job growth								
Separate	−0.151	(−8.31)*	−0.048	(−1.81)$^{+}$	−0.116	(−3.46)*	−0.037	(−1.55)
R^2 [F]	0.06	[18.13]*	0.01	[5.04]*	0.02	[6.51]*	0.01	[4.73]*
Joint	−0.153	(−7.21)*	0.030	(1.05)	−0.030	(−0.80)	−0.012	(−0.54)
R^2 [F]	0.06	[12.96]*						
Wholesale job growth								
Separate	−0.084	(−4.79)*	−0.313	(−10.52)*	−0.132	(−3.99)*	0.023	(0.84)
R^2 [F]	0.08	[25.75]*	0.16	[55.57]*	0.07	[24.34]*	0.07	[21.58]*
Joint	−0.007	(−0.34)	−0.306	(−9.42)*	−0.040	(−1.03)	0.053	(1.98)**
R^2 [F]	0.16	[39.64]*						
Retail job growth								
Separate	−0.029	(−2.95)*	−0.044	(−3.37)*	0.162	(−8.36)*	−0.049	(−2.92)*
R^2 [F]	0.12	[40.99]*	0.12	[41.32]*	0.16	[54.31]*	0.12	[41.61]*
Joint	0.002	(0.18)	−0.016	(−1.17)	−0.151	(−7.17)*	−0.023	(−1.47)
R^2 [F]	0.16	[38.52]*						
Service job growth								
Separate	−0.030	(−1.68)$^{+}$	−0.017	(−0.68)	−0.109	(−2.91)*	−0.324	(−9.20)*
R^2 [F]	0.05	[17.29]*	0.05	[16.85]*	0.06	[18.76]*	0.15	[50.76]*
Joint	−0.007	(−0.38)	0.012	(0.46)	−0.018	(−0.44)	−0.321	(−8.73)*
R^2 [F]	0.15	[35.57]*						
All-sector job growth								
Separate	−0.042	(4.19)*	−0.083	(−5.52)*	−0.142	(−6.25)*	−0.102	(−5.09)*
R^2 [F]	0.13	[46.05]*	0.14	[49.32]*	0.15	[52.82]*	0.15	[51.87]*
Joint	−0.007	(−0.60)	−0.057	(−3.59)*	−0.095	(−3.75)*	−0.081	(−3.96)*
R^2 [F]	0.17	[43.48]*						

Note: White (heteroscedastic-consistent) t-statistics in parentheses and regression F-statistics in square brackets, significant at the *0.01, **0.05, or $^{+}$0.10 level. R^2 is adjusted for degrees of freedom; by construction, it is the same for all columns in any row labeled "joint," as described in the text.

These empirical linkages are remarkable in several respects. First, they extend to the labor market the income effects of establishment size previously noted by Shaffer (2002) and complement the indirect, state-level estimates reported by Robbins et al. (2000).[7] Second, the predominance of negative coefficients (where significant) lends further support to the anecdotal wisdom that smaller firms are generally associated with faster economic growth. Third, the appearance of several cross-effects from establishment size in one sector to employment growth in another, though not ubiquitous, demonstrates a previously unexplored dimension of spillovers in labor markets.

In these regressions, the control variables display varying effects, as reported in the appendix (Tables A1 through A3). Education exhibits the anticipated positive coefficient in all the employment growth regressions for the wholesale and retail sectors as well as for job growth across all sectors (Tables A1 through A3). In addition, it demonstrates a significantly positive coefficient in a subset of regressions for the service sector, though never when controlling for average wholesale establishment size. It was never significant in the manufacturing employment growth regressions. Overall, higher education is related to faster job growth in some but not all sectors, consistent with previous findings by O hUallachain and Satterthwaite (1992) and others.

Initial per capita income exhibits the anticipated negative coefficient in every retail employment growth regression, in a majority of the employment growth regressions for the wholesale sector and for all sectors combined (where the point estimate of its coefficient is always

TABLE VI
Estimated effects of one-standard-deviation increase in average establishment size on employment growth by sector

Source sector	Manufacturing	Wholesale	Retail	Services
Response sector				
Manufacturing				
Separate	−0.0553	−0.0212	−0.0540	−0.0400
Joint	−0.0473	–	−0.0289	−0.0266
Sep. + MfShr.	−0.0838	−0.0289	−0.0553	−0.0429
Jnt. + MfShr.	−0.0678	–	−0.0237	−0.0250
Table V sep.	−0.1023	−0.0180	−0.0432	–
Table V jnt.	−0.1037	–	–	–
Wholesale				
Separate	–	−0.0744	–	–
Joint	–	−0.0744	–	–
Sep. + MfShr.	−0.0927	−0.0667	–	–
Int. + MfShr.	−0.0696	−0.0443	–	–
Table V sep.	−0.0569	−0.1173	−0.0491	–
Table V jnt.	–	−0.1147	–	−0.0197
Retail				
Separate	–	−0.0390	−0.0156	−0.0254
Joint	–	−0.0378	–	−0.0200
Sep. + MfShr.	−0.0535	−0.0331	−0.0137	−0.0221
Jnt. + MfShr.	−0.0383	−0.0189	–	−0.0166
Table V sep.	−0.0196	−0.0165	−0.0603	−0.0182
Table V jnt.	–	–	−0.0562	–
Services				
Separate	–	−0.0460	–	−0.0936
Joint	–	−0.0401	0.0390	−0.0995
Sep. + MfShr.	−0.0785	−0.0395	–	−0.0903
Jnt. + MfShr.	−0.0678	–	0.0546	−0.0945
Table V sep.	−0.0203	–	−0.0406	−0.1206
Table V jnt.	–	–	–	−0.1195
All sectors				
Separate	−0.0089	−0.0531	–	−0.0387
Joint	–	−0.0513	–	−0.0358
Sep. + MfShr.	−0.0731	−0.0472	–	−0.0350
Jnt. + MfShr.	−0.0562	−0.0271	0.0267	−0.0312
Table V sep.	−0.0285	−0.0311	0.0529	−0.0380
Table V jnt.	–	−0.0214	−0.0354	−0.0302

Source: Tables I, III, IV and V.

negative), and in a subset of employment growth regressions for the wholesale sector. This finding is consistent with a form of convergence, in which low-income counties attract relatively more jobs. However, this income variable is never significant in the manufacturing growth regressions.

Per capita government expenditure exhibits a significantly negative coefficient in every regression for every sector except the manufacturing growth regressions, where it is never significant. This negative coefficient is contrary to a previously noted empirical association with income growth (Shaffer, 2002) but consistent with multiple hypotheses. For example, this result could reflect public decisions to focus government expenditures toward disadvantaged areas. Alternatively, it might reflect a negative marginal impact on labor markets of government expenditures. Further exploration of this effect may be useful for future research, but lies outside the scope of this paper, which is focused on the establishment size variables and not on the other control variables.

The coefficient on initial population is significantly positive in all regressions for every sector except the manufacturing growth regres-

sions, where it is significantly positive in a subset of regressions and takes a positive point estimate in the remainder. This robust finding suggests that employment has tended to grow relatively faster in more populous counties, consistent with the effect of urbanization economies found in previous studies.

The coefficient on manufacturing investment is significantly negative in a majority of manufacturing growth equations, suggesting that capital expenditures in the manufacturing sector functioned on average as a substitute for labor in this sample rather than as complementary to labor. This coefficient is never significant at conventional levels in the employment growth regressions for the wholesale and retails sectors. It is significantly negative in a subset of the growth regressions for service sector and for all sectors combined.

The coefficient on the initial share of manufacturing (Tables A2 and A3) is significantly negative in a majority of manufacturing growth regressions, as hypothesized, but positive in two of three specifications controlling for average manufacturing establishment size and once when controlling for the initial size of all establishments. It is significantly positive in every other regression measuring establishment size by value (Tables A1 and A2) but never significant in nonmanufacturing growth regressions controlling for establishment size by employment (Table A3). The majority of coefficients on average establishment size were not materially changed from the pattern shown in Table III, with the exception of manufacturing establishment size, where the inclusion of the initial share of manufacturing changed insignificant coefficients to significantly negative coefficients in the employment growth regressions for the wholesale, retail, service, and combined sectors.

Table VI summarizes the magnitudes of these estimated linkages, expressed as the change in sectoral employment growth associated with a one-standard-deviation increase in average establishment size within each sector.[8] The columns identify the "source" sector (i.e., within which the calculations assume a one-standard-deviation increase in average establishment size) while rows identify the response sectors (within which the associated change in employment growth is calculated). Blank entries represent cases in which the corresponding coefficients, reported in Tables III through V, were not statistically significant.

The estimated responses in manufacturing job growth rates are similar in size to the sample mean manufacturing job growth rate, larger in several cases, and over twice as large in two cases. Likewise, the estimated response of the wholesale job growth rate is nearly always larger than its sample mean, where statistically significant, and ranges up to twice the sample mean value. This implies that a one-standard-deviation increase in the average establishment size within each designated sector would have more than offset the entire growth of employment in the manufacturing and wholesale sectors over the sample period.

Estimated responses in the other sectors are somewhat smaller than the sample mean values, but are still economically meaningful. Overall, these estimates represent large effects. As in other empirical studies of the determinants of economic growth, these estimates might reflect some degree of reverse causality or spurious correlation, but the use of a five-year horizon for measuring ex post employment growth helps mitigate this possibility.

Some of the regressors may be endogenous over time; however, as employed in the regressions here, all 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 for this reason, and because of the absence of theory and data to instrument establishment size, as well as recognized problems with instrumental variables (e.g., Nelson and Startz, 1990).

5. Conclusion

This study has presented what appears to be the first empirical evidence of within-sector and cross-sector associations between average establishment size and subsequent growth rates of sectoral employment, for a sample of more than 2000 U.S. counties. The findings indicate a preponderance of negative linkages in which smaller

establishments are associated with faster subsequent job growth, both within a sector and across sectors. The estimated effects are not uniform across sectors but are large in magnitude and thus economically important, and are consistent with several theories previously developed.

Moreover, the county-level and sector-specific data used here are more disaggregated than in most prior studies and provide a larger sample. The findings here thus contribute modestly to a more detailed and precise understanding of the role of small businesses in economic growth and labor markets, and suggest a positive welfare benefit that complements previously identified linkages with income growth. This important new linkage warrants further study.

In conjunction with prior research, the findings here suggest that there is no empirical tradeoff between per capita income growth and employment growth as a function of establishment size, but instead the two dimensions of growth are complementary as related to establishment size. The empirical model and data imply that the observed associations are not driven by non-specific human capital (education), heterogeneous factor ratios (manufacturing equipment investment), urbanization effects (population), or exogenous differences in sector growth (manufacturing versus services). Likewise, the observed associations are not an artifact of higher turnover per se, because employment growth is measured here as net increases in total employment rather than as the gross number of new hires.

Further research may be fruitfully explored in several directions. First, the average establishment age could be included to test whether size is serving largely as a proxy for new firms. While startup firms have been found to be associated with growth, an additional, independent role for firm size may exist with regard to startups because smaller incumbents may be perceived as less hostile to entry and may also be associated with more entrepreneurial employees who are more likely to leave and start new businesses.

Second, a direct assessment of the association between job turnover and growth could address the question of whether higher turnover (as previously documented among smaller firms) is driven more by negative demand factors (layoffs) or positive demand factors (superior alternatives), and hence whether it is associated with slower or faster economic growth. This question, although clearly vital for public policy, lies beyond the scope of the present paper.

Third, in light of the extensive literature on technological innovation and growth, it would be useful to augment the model here with regressors controlling for local rates of innovation. Such a model could potentially distinguish between technology and other theoretical mechanisms as the driving force behind the observed empirical associations between establishment size and growth.

Fourth, there may be either positive or negative spatial externalities (spillover effects) in the observed patterns of growth. To the extent that such neighborhood effects extend beyond individual counties, direct measurement of spatial effects could identify whether there may be tradeoffs between one county's success and another's hindrance.

Finally, the observed negative association between government expenditures and sectoral employment growth raises a new puzzle that warrants further investigation. Although benign interpretations of that association may be proposed, it is important for public policy to learn the true reasons behind it.

APPENDIX

TABLE A1
Estimated coefficients of control variables in the regressions of Table III

Dependent variable	Control variable	Model testing effect of establishment size in which sector									
		Manufact.		Wholesale		Retail		Service		All four	
		Coef.	*t*	Coef.	*t*	Coef.	*t*	Coef.	*t*	Coef.	*t*
Mfg. job growth	Education	−0.017	−0.66	−0.002	−0.08	−0.023	0.90	0.016	0.62	0.009	0.32
	Income 79	0.004	0.08	0.016	0.27	0.030	0.53	0.038	0.65	0.060	1.07
	Gov. Exp.	−0.021	−0.78	−0.004	−0.17	−0.005	−0.21	0.003	0.10	−0.14	−0.54
	Pop.'80	0.008	0.93	0.005	0.54	0.024	2.22[b]	0.015	1.48	0.034	3.08*
	MfgInvst	−0.004	−1.01	−0.013	−3.21*	−0.012	−3.11*	−0.014	−3.41*	−0.005	−1.18
Whole. job growth	Education	0.086	3.53*	0.084	3.56*	0.094	3.71*	0.092	3.69*	0.082	3.22*
	Income79	−0.117	−2.19[b]	−0.046	−0.85	−0.112	−2.13[b]	−0.112	−2.06[b]	−0.049	−0.91
	Gov. Exp.	−0.097	−3.98*	−0.095	−3.97*	−0.094	−3.87*	−0.093	−3.84*	−0.096	−4.02*
	Pop.'80	0.045	4.83*	0.065	6.79*	0.048	4.65*	0.045	4.18*	0.064	5.89*
	MfgInvst	0.005	1.08	0.005	1.18	0.003	0.76	0.003	0.71	0.005	1.15
Retail job growth	Education	0.025	1.85[c]	0.024	1.77[c]	0.033	2.31[b]	0.037	2.58*	0.034	2.30[b]
	Income79	−0.141	−4.67*	−0.102	−3.40*	−0.131	−4.41*	−0.114	−3.79*	−0.081	−2.69*
	Gov. Exp.	−0.134	−9.82*	−0.134	−10.07*	−0.134	−9.95*	−0.129	−9.69*	−0.129	−9.71*
	Pop.'80	0.036	7.13*	0.047	9.01*	0.043	7.26*	0.046	7.72*	0.056	8.96*
	MfgInvst	0.003	1.15	0.003	1.37	0.002	1.04	0.002	0.83	0.002	1.02
Svc. job growth	Education	0.006	0.29	0.007	0.31	0.013	0.55	0.049	2.12[b]	0.029	1.21
	Income79	−0.074	−1.35	−0.030	−0.55	−0.072	−1.33	0.023	0.43	0.045	0.83
	Gov. Exp.	−0.143	−6.38*	−0.140	−6.26*	−0.140	−6.26*	−0.123	−5.70*	−0.124	−5.68*
	Pop.'80	0.048	5.52*	0.060	6.60*	0.049	4.50*	0.083	8.10*	0.081	7.28*
	MfgInvst	0.002	0.38	0.001	0.16	−0.001	−0.12	−0.001	−0.31	0.0004	0.11
All job growth	Education	0.030	2.08[b]	0.029	2.07[b]	0.037	2.44[b]	0.049	3.20*	0.038	2.37[b]
	Income79	−0.102	−3.00*	−0.051	−1.48	−0.097	−2.94*	−0.063	−1.88[c]	−0.023	−0.68
	Gov. Exp.	−0.136	−9.61*	−0.134	−9.66*	−0.133	−9.49*	−0.126	−0.24*	−0.128	−9.33*
	Pop.'80	0.043	7.50*	0.057	9.85*	0.045	6.61*	0.056	8.16*	0.065	9.05*
	MfgInvst	0.003	1.02	0.002	1.04	0.013	0.53	0.001	0.35	0.002	0.91

t-statistics are heteroscedastic-consistent (White), significant at the *0.01, [b]0. 05, or [c]0.10 level.

TABLE A2
Estimated coefficients of control variables in the regressions of Table IV

Dependent variable	Control variable	Model testing effect of establishment size in which sector									
		Manufact.		Wholesale		Retail		Service		All four	
		Coef.	*t*	Coef.	*t*	Coef.	*t*	Coef.	*t*	Coef.	*t*
Mfg. job growth	Education	−0.002	−0.09	−0.019	−0.73	0.011	0.42	0.004	0.14	0.015	0.54
	Income79	0.023	0.41	0.014	0.25	0.023	0.41	0.032	0.56	0.058	1.03
	Gov. Exp.	−0.018	−0.68	−0.013	−0.47	−0.012	−0.44	0.003	−0.12	−0.013	−0.51
	Pop.'80	0.017	1.80[c]	0.005	0.54	0.022	2.10[b]	0.014	1.38	0.034	3.06*
	MfgInvst	−0.007	−1.66[c]	−0.007	−1.72[c]	−0.008	−1.97[b]	−0.009	−2.22[b]	−0.006	−1.55
	MfgShare	0.261	3.33*	−0.186	−3.28*	−0.142	−2.60*	−0.151	−2.75*	0.163	1.59
Whole job growth	Education	0.127	5.23*	0.099	4.12*	0.119	4.67*	0.116	4.67*	0.102	4.01*
	Income79	−0.065	−1.22	−0.044	−0.82	−0.098	−1.88[c]	−0.102	−1.88[c]	−0.055	−1.04
	Gov. Exp.	−0.090	−3.77*	−0.087	−3.66*	−0.081	−3.38*	−0.081	−3.38*	−0.093	−3.93*
	Pop.'80	0.069	7.41*	0.065	6.84*	0.050	4.95*	0.047	4.42*	0.064	5.90*
	MfgInvst	−0.003	−0.55	−0.002	−0.05	−0.006	−1.16	−0.006	−1.21	−.0003	−0.06
	MfgShare	0.732	8.40*	0.169	2.62*	0.300	4.76*	0.301	4.71*	0.548	5.00*

TABLE A2
Continued

Dependent variable	Control variable	Model testing effect of establishment size in which sector									
		Manufact.		Wholesale		Retail		Service		All four	
		Coef.	*t*	Coef.	*t*	Coef.	*t*	Coef.	*t*	Coef.	*t*
Retail job growth	Education	0.050	3.68*	0.036	2.58*	0.050	3.37*	0.052	3.61*	0.047	3.10*
	Income79	0.108	−3.72*	−0.101	−3.39*	−0.122	−4.18*	−0.108	−3.63*	−0.085	−2.86*
	Gov. Exp.	−0.130	−9.89*	−0.128	−9.70*	−0.125	−9.46*	−0.121	−9.25*	−0.128	−9.73*
	Pop.'80	0.051	10.00*	0.048	9.10*	0.045	7.65*	0.047	8.01*	0.056	8.97*
	MfgInvst	−0.002	−0.88	−0.001	−0.47	−0.004	−1.49	−0.004	−1.51	−0.001	−0.43
	MfgShare	0.447	10.31*	0.134	4.25*	0.196	6.57*	0.188	6.23*	0.334	6.00*
Service job growth	Education	0.040	1.72[c]	0.021	0.90	0.032	1.34	0.064	2.71*	0.047	1.91[c]
	Income79	−0.031	−0.58	−0.029	−0.52	−0.061	−1.14	0.030	0.54	0.039	0.72
	Gov. Exp.	−0.137	−6.25*	−0.133	−5.98*	−0.130	−5.86*	−0.116	−5.37*	−0.121	−5.67*
	Pop.'80	0.068	7.64*	0.060	6.63*	0.051	4.71*	0.084	8.25*	0.081	7.28*
	MfgInvst	−0.005	−1.16	−0.004	−1.04	−0.007	−1.79[c]	−0.007	−1.62	−0.004	−1.15
	MfgShare	0.594	7.80*	0.153	2.90*	0.230	4.49*	0.183	3.55*	0.482	5.14*
All job growth	Education	0.063	4.31*	0.043	2.86*	0.057	3.64*	0.067	4.29*	0.054	3.34*
	Income79	−0.061	−1.86[c]	−0.049	−1.45	−0.086	−2.65*	−0.055	−1.68[c]	−0.028	−0.86
	Gov. Exp.	−0.130	−9.68*	−0.127	−9.35*	−0.123	−8.97*	−0.118	−8.77*	−0.125	−9.42*
	Pop.'80	0.062	10.91*	0.057	9.95*	0.048	6.97*	0.058	8.41*	0.065	9.08*
	MfgInvst	−0.003	−1.30	−0.002	−0.78	−0.006	−2.13[b]	−0.006	−2.06[b]	−0.002	−0.82
	MfgShare	0.576	12.61*	0.144	4.33*	0.236	7.33*	0.219	6.80*	0.435	7.60*

t-statistics are heteroscedastic-consistent (White), significant at the *0.01, [b]0.05, or [c]0.10 level.

TABLE A3
Estimated coefficients of control variables in the regressions of Table V

Dependent variable	Control variable	Model testing effect of establishment size in which sector									
		Manufact.		Wholesale		Retail		Service		All four	
		Coef.	*t*	Coef.	*t*	Coef.	*t*	Coef.	*t*	Coef.	*t*
Mfg. job growth	Education	−0.015	−0.56	−0.011	−0.39	0.022	0.78	0.006	−0.23	−0.005	−0.18
	Income79	−0.056	−0.96	−0.018	−0.30	0.017	0.29	−0.004	−0.06	−0.043	−0.71
	Gov. Exp.	−0.044	−1.61	−0.013	−0.48	−0.005	−0.21	−0.009	−0.36	−0.041	−1.50
	Pop.'80	0.022	2.36[b]	0.004	0.39	0.013	1.30	0.0005	0.06	0.023	2.28[b]
	MfgInvst	−0.006	−1.59	−0.008	−2.04[b]	−0.008	−2.00[b]	−0.010	−2.30[b]	−0.007	−1.65[c]
	MfgShare	0.321	4.24*	−0.149	−2.68*	−0.132	−2.42[b]	−0.133	−2.43[b]	0.335	4.00*
Whole job growth	Education	0.118	4.80*	0.127	5.36*	0.157	5.85*	0.116	4.68*	0.130	4.86*
	Income79	−0.133	−2.46[b]	−0.143	−2.94*	−0.076	−1.45	−0.114	−2.ll[b]	−0.147	−2.97*
	Gov. Exp.	−0.101	−4.10*	−0.100	−4.48*	−0.077	−3.24*	−0.082	−3.41*	−0.100	−4.43*
	Pop.'80	0.060	6.24*	0.091	9.03*	0.064	6.23*	0.044	4.59*	0.092	8.71*
	MfgInvst	−0.004	−0.77	0.002	0.45	−0.004	−0.84	−0.006	−1.16	0.002	0.52
	MfgShare	0.552	6.77*	0.168	2.75*	0.297	4.75*	0.305	4.82*	0.196	2.33[b]
Retail job growth	Education	0.047	3.39*	0.049	3.50*	0.094	6.11*	0.055	3.84*	0.095	5.94*
	Income79	−0.143	−4.83*	−0.140	−4.78*	−0.095	−3.36*	−0.124	−4.16*	−0.093	−3.23*
	Gov. Exp.	−0.132	−9.65*	−0.128	−9.71*	−0.119	−9.66*	−0.125	−9.45*	−0.120	−9.48*
	Pop.'80	0.043	8.19*	0.044	8.15*	0.060	10.88*	0.043	8.10*	0.063	10.76*
	MfgInvst	−0.003	−1.34	−0.003	−1.16	−0.002	−0.84	−0.004	−1.52	−0.002	−0.18
	MfgShare	0.286	6.94*	0.182	5.98*	0.195	6.64*	0.194	6.43*	0.179	4.08*
Service job growth	Education	0.032	1.36	0.033	1.40	0.063	2.45[b]	0.079	3.37*	0.083	3.36*
	Income79	−0.074	−1.34	−0.068	−1.22	−0.039	−0.71	0.008	0.16	0.011	0.21
	Gov. Exp.	−0.137	−6.03*	−0.131	−5.90*	−0.126	−5.74*	−0.127	−6.02*	−0.127	−5.88*

TABLE A3
Continued

Dependent variable	Control variable	Model testing effect of establishment size in which sector									
		Manufact.		Wholesale		Retail		Service		All four	
		Coef.	*t*	Coef.	*t*	Coef.	*t*	Coef.	*t*	Coef.	*t*
	Pop.'80	0.054	6.05*	0.051	5.10*	0.064	6.28*	0.081	8.45*	0.082	7.72*
	MfgInvst	−0.007	−1.63	−0.007	−1.73[c]	−0.006	−1.51[c]	−0.007	−1.60	−0.006	−1.61
	MfgShare	0.319	4.37*	0.224	4.44*	0.227	4.45*	0.185	3.61*	0.211	2.85*
All job growth	Education	0.056	3.78*	0.059	3.95*	0.097	5.97*	0.072	4.59*	0.097	5.84*
	Income79	−0.107	−3.18*	−0.104	−3.11*	−0.059	−1.81[c]	−0.071	−2.17[b]	−0.061	−1.82[c]
	Gov. Exp.	−0.133	−9.44*	−0.128	−9.49*	−0.118	−8.98*	−0.122	−9.08*	−0.124	−9.34*
	Pop.'80	0.051	8.64*	0.056	8.59*	0.063	10.01*	0.054	8.50*	0.074	10.57*
	MfgInvst	−0.005	−1.83[c]	−0.004	−1.47	−0.004	−1.59	−0.006	−2.03[b]	−0.003	−1.15
	MfgShare	0.363	8.20*	0.202	6.41*	0.232	7.33*	0.223	6.94*	0.218	4.74*

t-statistics are heteroscedastic-consistent (White), significant at the *0.01, [b]0.05, or [c]0.10 level.

Notes

[1] One might worry that counties are not sufficiently aggregated units to yield robust global welfare implications, especially if there are negative spillover effects between counties. However, higher levels of aggregation (to states or to nationwide samples) would mask significant heterogeneity among growth rates and average establishment sizes, and would excessively reduce the sample size.

[2] The author is grateful to an anonymous referee for this insight.

[3] Other factors such as antitrust restrictions may impose a non-monopoly structure even in such a case. Then we could specify each firm's cost function as $a - cx_i$, assume a fixed number of firms, and carry through the corresponding calculations under some assumption about strategic interaction among firms, such as Cournot-Nash. The same generic result would obtain in these cases as well. Note, however, that marginal-cost pricing will never be sustainable in a natural monopoly, regardless of the number of incumbents.

[4] Some studies of job growth have included taxes as an explanatory variable. However, the correlation between tax revenue and government expenditure is 0.973 across all U.S. counties for 1981–1982, rendering any tax variable redundant in our model.

[5] Audretsch and Fritsch (2003) include a similar adjustment to correct for a possible bias resulting from heterogeneous sector shares in combination with faster startup activity in the service sector than in the manufacturing sector in Germany.

[6] The U.S. Small Business Innovation Database contains innovations introduced to the U.S. market in 1982, compiled by physical address of the innovator, and some previous research has aggregated these figures to the MSA level (Anselin et al., 2000).

[7] Robbins et al. (2000) indicate that the Phillips curve may be lower for states with a higher percentage of small businesses (their Figure 1), but do not test directly for the impact of firm size on job creation. Their product market estimation provides indirect evidence that very small firms are associated with faster growth of gross state product (their Table 1), but those estimates are aggregated across sectors.

[8] Because the regressions do not control for the number of establishments, this exercise implicitly assumes that the number of establishments would adjust endogenously as the average establishment size changes. Thus, for example, an increase in average establishment size might be associated with mergers or acquisitions, and a decrease in average establishment size might be associated with new entry of smaller firms.

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