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The Impact of Geographic Differences in Human Capital on Service Firm Formation Rates

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Abstract

Although human capital externalities are a key variable in theories of economic growth, there has been little investigation of the mechanism by which these externalities are realized. We examine the relationship between the local levels of human capital and firm formation rates and find that formation rates differ with the share of adults with college degrees, especially for industries that normally require college-educated founders. They also differ strongly with the local concentration of existing establishments in the same sector, especially for industries serving non-local markets, suggesting that an important mechanism is the spillover of relevant knowledge.

JEL Classification: R1, L80, J24, M13, O3

Key Words: Firm formation, Knowledge spillovers, Entrepreneurship, Human capital, Regional growth

1. INTRODUCTION

This study refines our earlier investigation of the impact of differences in local human capital resources on local differences in new firm formation rates (Armington and Acs [2]). Since the mid-eighties the role of education and human capital externalities has been recognized as a key variable in theories of economic growth. Models posited by Romer [28], Lucas [23] and Krugman [19] link such externalities within a geographically bounded region to higher rates of growth. Lucas [22] emphasizes that the economies of metropolitan areas are a natural context in which to understand the mechanics of economic growth, and an important factor contributing to this growth is the catalytic role of human capital externalities within the cities. While the benefits of human capital to individuals have been extensively studied, economists are now realizing that individuals do not capture all of the benefits from their own human capital. Some benefits spill over to their colleagues and observers -- through discussions, example, publications, and even more positive attitudes toward change, risk, and new knowledge.

Several interesting findings provide some groundwork for our study. First, Rauch [25] finds that cities with higher average levels of human capital also have higher wages and land rents. Second, Glaeser et al [13] find that for a cross section of cities a key economic determinant of growth is level of schooling, just as has previously been found for countries. They suggest that higher education levels influence later growth, not through increased savings, but by promoting higher rates of growth of technology through spillovers. Finally, Simon and

Nardinelli [29, 30] find historical evidence for both the United States and the United Kingdom that cities with more knowledgeable people grow faster in the long run because (a) knowledge spillovers are geographically limited to the city and (b) knowledge is more productive in the city within which it is acquired.

However, none of these studies asks the question, “What type of activity do agents pursue that leads to faster economic growth?” This question is important because if we wish to explain how growth occurs we need to identify the transmission mechanism from human capital to growth. Jovanovic and Rob [16] develop a model where individual agents augment their knowledge through pair-wise meetings at which they exchange ideas. In each time-period, each individual seeking to augment his knowledge meets an agent chosen randomly from a distribution of agents. The higher the average level of human capital of the agents the more “luck” the agents will have with their meetings and the more rapid will be the diffusion and growth of knowledge. If this knowledge contributes to technical innovations, new products, processes, or markets, we have a microeconomic foundation not only for the impact of human capital externalities on total factor productivity, but also for making those external effects dependent on both the average level of human capital and the local intensity of individuals with relevant knowledge or examples to share.

This paper extends research reported in Armington and Acs [2] that focused on firm formation in six sectors: distributive, manufacturing, business services, extractive retail trade and local market. The current paper focuses on the rapidly growing service sector and sub-sectors of service industries that are

defined by their educational requirements and primary markets. The authors were fortunate to have limited access, through the Center for Economic Studies of the U.S. Bureau of the Census, to comprehensive U.S. microdata on recent service firm formations, which they grouped into labor market areas for this analysis. These data were crucial for our primary goal -- to examine how the sensitivity of firm formation rates to local differences in human capital and other local economic conditions varies as a function of the market segment and location and the entrepreneurial characteristics typical of various industry sub-sectors. We empirically investigate how the new firm formation rates for various sub-sectors of service industries are influenced by human capital differences in 394 labor market areas, while controlling for other regional characteristics that are also likely to affect firm formation rates. This analysis contributes to the regional growth literature, with its focus on human capital closely following much earlier work of Jacobs [14] and Marshall [24]. This paper also contributes to the recent cross-sectional literature that argues that new ideas are important for economic growth (Glaeser et al [12] and [13]). The focus on new firm formation also contributes to the growing literature on entrepreneurship (Lazear, [20], Krueger and Pischke, [18], Evans and Jovanovic, [10]).

Section 2 presents the data and discusses measurement of the new firm formation rate. Section 3 examines how and why the new firm formation rates in the service sector vary across geographic regions. Section 4 presents the empirical model, and the basic results for the service sector as a whole are in section 5. Section 6 examines results for nine subsectors of the service sector

and our conclusions are briefly discussed in the final section. We find that the extent of human capital already in a region has a significant effect on the new service firm formation rate. The service firm formation rate is even more sensitive to how densely populated (with establishments per thousand people) the local service sector already is. The greater this density is, the more probable are the relevant knowledge spillovers, and the more likely that the resulting new ideas will lead to new firm formations.

2. MEASUREMENT OF NEW FIRM FORMATION RATE

The Data

This study uses a new database that the Bureau of the Census has constructed for study of entry, survival, and growth in different types of businesses. The Longitudinal Establishment and Enterprise Microdata (LEEM) file has multiple years of annual data for every U.S. private sector (non-farm) business with employees. The current LEEM file facilitates tracking employment, payroll, and firm affiliation and (employment) size for the more than eleven million establishments that existed at some time during 1989 through 1998. This database was constructed by the Bureau of the Census from its Statistics of U.S. Business (SUSB) files,[1] which were developed from the microdata underlying the aggregate data published in Census' County Business Patterns. These annual data describing establishments were linked together using the SUSB Longitudinal Pointer File, which facilitates tracking establishments over time, even when they change ownership and identification numbers.

The basic unit of the LEEM data is a business establishment (location or plant). An establishment is a single physical location where business is conducted or where services or industrial operations are performed. The microdata describe each establishment for each year of its existence in terms of its employment, annual payroll, location (state, county, and metropolitan area), primary industry, and start year. Additional data for each establishment and year identify the firm (or enterprise) to which the establishment belongs, and the total employment of that firm.

A firm (enterprise or company) is the largest aggregation (across all industries) of business legal entities under common ownership or control. Establishments are owned by legal entities, which are typically corporations, partnerships, or sole proprietorships. Most firms are composed of only a single legal entity that operates a single establishment—their establishment data and firm data are identical, and they are referred to as "single unit" establishments or firms. The single unit businesses are frequently owner-operated. Only 4 percent of firms have more than one establishment, and they and their establishments are both described as multi-location or multi-unit. [2]

New firm formations include both new single-unit firms with less than 500 employees, and the primary locations of new multi-unit firms with less than 500 employees, firm wide. Those new firms that had 500 or more employees in their first year of activity appear to be primarily offshoots of existing companies.[3] Single unit firm formations in year t are identified on the LEEM as non-affiliated establishments with a start-year of t or t-1 that had no employment in March of

year t-1, and had positive employment below 500 in March of year t. This avoids inclusion of either new firms that have not yet actually hired an employee, or firms recovering from temporary inactivity.[4] The 'start-year' is the year that the establishment entered the Census business register. We have also included most of the relatively few multi-unit firms (1500 to 6000 per year) that appeared to start up with less than 500 employees in multiple locations in their first year. We limited multi-unit firm formations to those whose employment in their new primary location constituted at least a third of their total employment in the first year.[5] This rule effectively eliminated the 600 to 1000 new firms each year which were apparently set up to manage existing locations -- relatively small new headquarters supervising large numbers of employees in mainly older branch locations which were newly acquired, or perhaps contributed by joint venture partners.

The Unit of Observation

Within the United States, there are many levels of geographic units that have some economic data associated with them. Common politically defined units include states, counties, cities and towns. But such politically defined units have boundaries that rarely represent the borders of functional economic areas. The U.S. Bureau of the Census has defined census tracts (areas of 3,000 to 5,000 residents) to facilitate collection of detailed data on where people live, and Metropolitan Statistical Areas (MSAs) for aggregation of politically defined urban units into more functional metropolitan areas. Most of the data collected for

these measurement units are based on where people live, rather than where they work or shop.

Data for geographic units based on the location of business establishments (where people work) are needed for measuring the effect of location-specific economic growth, productivity, employment, and other economic factors. These are also collected primarily for various political units – particularly for states and counties. Although local government units (cities and towns) generally collect some economic data, these are rarely comparable across areas, because such data are frequently dependent on local tax laws. The city has the advantage of being a smaller geographic unit, within which there is reasonably integrated economic and social activity, which might be important for spillovers operating in dense areas. However, city boundaries are often quite arbitrary relative to the local patterns of economic activity, and their relatively small size allows them to be substantially influenced by conditions in neighboring political units.[6]

State and county level business data collected by the federal government are generally comparable across all the states, but most states are composed of multiple, diverse economic areas. Therefore analyses of economic data based on states as geographic units usually suffer from aggregation problems due to the diversity of economies with a state. On the other hand, many integrated local economic areas cross both state and county boundaries, and people and businesses flow freely back and forth across these boundaries, so the economic

behavior of agents within a given state or county may be significantly affected by unmeasured influences from adjacent areas in other states or counties.

Metropolitan Statistical Areas (MSAs) are multi-county units that are defined to include all of the densely populated areas surrounding the larger cities. These geographic units do a better job of ensuring that people both live and work within their boundaries. However, they are based on residential population densities, without regard for where people work. In addition, they are periodically redefined to keep pace with changing urban population patterns, and they exclude large areas of the country whose local economies are not centered on large cities.

The geographic unit of analysis chosen for this study, Labor Market Areas (LMAs), substantially avoids all of the problems associated with the units discussed above. LMAs are aggregations of the 3,141 US counties into 394 geographical regions based on the predominant commuting patterns (journey-to-work). Each LMA contains at least one central city, along with the surrounding counties that constitute both its labor supply and its local consumer and business market.[7] Many of the 394 LMA's cut across state boundaries, because local economic activity patterns often cross such boundaries. The LMA unit of observation has the advantage of including both the employment location and the residence location of the population and labor force within the same area. Being based on counties, a wide variety of data collected at the county or zip-code level can be aggregated to construct LMA-level data. Finally, the 394 LMAs together

cover the whole country, so that their data can be aggregated to U.S. totals, and all areas are represented. [8]

The Sector of Inquiry

This paper focuses on the service sector of the U.S. economy. Why do we feel that the service sector is preferable to manufacturing for analysis of new firm formation? First, there has been widespread concern among economists and policy makers alike about the dynamics of the service sector. The slowness of productivity growth in services, together with its rising share in nominal GNP and in employment, has been accused of exerting a major drag on productivity growth of the overall economy and its competitive performance. Second, the service sector has been growing much faster than other sectors, increasing its share of private employment from 28.3% in 1990 to 32.8% in 1998. Third, the broad range of firms in the service sector employ workers with a wide variety of skills, and tend to be more labor-intensive than capital-intensive, so that area differences in human capital may have a stronger impact on the service sector than on more capital-intensive sectors. Fourth, new firm formation rates are much higher in the service sector than in the manufacturing sector (Acs and Armington, [2]). Indeed, cities with high concentrations of manufacturing have typically been the slowest growing cities over the past twenty years. Finally, much of the growth in service jobs has been in new firms. While some of these new firms merely replace older establishments that have closed, many others serve new markets, provide new services, or apply innovative techniques to compete with older businesses.

The local economic impact of formation of a new service firm is much broader than the immediate impact we can measure from the number of new jobs they create in the first year. New service firms may be providing the local market with services that were not previously available, or competing with existing providers to drive down prices or improve services. If their services are exportable, the new businesses may be generating income from outside the region, and perhaps contributing to a local specialized cluster that will attract yet more businesses and employees. And of course the new firms will buy products and other services from local businesses.

The Firm Birth Rate

In this paper we study gross new firm formation rates, not the net change in numbers of firms or establishments in an area. To the extent that the ultimate issue is explaining the relative growth of regions, the net change might be of interest, but that is for a much later study. What we are investigating is not the equilibrium result of new firm formation, but the factors accounting for differences in rates of new firm formation, a process that captures local differences in entrepreneurship, restructuring, innovation, industrial evolution and development. The factors contributing to explanations of local differences in firm deaths, plant entry and exit, all of which affect the net numbers of establishments, are far beyond the scope of this paper, and generally not strongly related to local human capital.

Firm birth rates are calculated for each of the 394 LMAs, based on new firm formations during each of three recent time periods -- 1990 through 1992,

1993 through 1995, and 1996 through 1998.[9] Because the Labor Market Areas vary greatly in size, the absolute numbers of new firm formations must be standardized by some measure of the LMA size before it is meaningful to compare them across areas. When dealing with the whole service sector, firm formation rates are calculated as the number of new firms per thousand members of the labor force in the LMA in the prior year. This labor force approach has a particular theoretical appeal, in that it is based on the theory of entrepreneurial choice proposed by Evans and Jovanovic, [10]. A worker starts each new business, and the labor market approach implicitly assumes that the entrepreneur starts the new business in the labor market where he or she lives and previously worked.

When comparing new firm formation rates for different sub-sectors of the service industry we need to standardize for the differences in sizes of both areas and sub-sectors. For this purpose we express new firm formation rates in terms of the number of new firms relative to the number of establishments already in existence in that sub-sector and LMA. This could be termed the ecological approach, because it considers the amount of start-up activity relative to the size of the existing population of businesses.

Two considerations of timing of the firm birth rate data should be noted. While new firms enter the business register underlying the LEEM file on a nearly continuous basis, their employment data are reported only for a pay period in March of each year. Since we require positive employment before recognizing a new firm, if a firm begins hiring after March, we do not count its formation until the

following year. Therefore, each specified year's firm formation counts actually represent firms that hired their first employees sometime between April of the prior year and March of the specified year, for an average of nine months lagged reporting (Acs and Armington, [1]). Further, Reynolds et al [27] and others have shown that the time between an individual's decision to create a new firm and the start of the resulting economic activity averages about two years, and is often longer. With such lags in the initialization and reporting of new firm formations, we do not expect to be able to identify a lag structure between differences in their annual rates and the regional factors associated with these differences, even though we have nine years of annual data on new firm formations.

Variations in Regional New Firm Formation Rates

Table 1 shows annual variations in the numbers of new firm formations and the birth rate for service firms in the U.S. Gross service firm formations were increasing fairly steadily during the 1990s, to just under 200,000 in 1998, which accounts for nearly two fifths of all firm formations. Net service firm births, defined as annual firm formations minus firm deaths during the same year, average only about 25,000 during the 1990s, and vary widely. Net firm births in services accounted for about two thirds of the net firm births in all industries in most of these years (not shown). The rate of new service firm formation per thousand workers in the labor force increased from 1.375 in 1990 to 1.452 in 1997, and it fell slightly in 1992 and again in 1998. Services accounted for 35.1% of all firm formations in 1990, and increased their share to 38.4% of all firm

formations in 1998. At the same time, employment in services increased from 28.3% of total to 32.8.

Table 2 looks at some of the regional variation across LMAs in the new firm formation rates, again using the number of new service firm formations per thousand workers in the labor force. Table 2a shows the twenty LMAs that have the highest average birth rates in the period of 1996 through 1998, as well as the twenty lowest. The top twenty LMAs ranked by birth rate had an average annual service firm formation rate of 2.26 per thousand of labor force, while the lower extreme averaged only a third as many new service firm formations, with 0.77 per thousand of labor force. Note that the list of LMAs with the highest birth rates appears to be almost evenly divided between very large LMAs and relatively small LMAs, but all the LMAs in the lowest birth rate group were relatively small.

Table 2b lists the LMAs with the largest and smallest populations in 1995. There is considerable variation in the birth rates of the large LMAs, varying from Miami FL with a birth rate of 2.52 new service firms per thousand of labor force down to Bridgeport CT with only 1.24. These 15 largest LMAs had an average new firm formation rate of 1.67, with an average corresponding three-year increase in employment of 4.68 percent. At the same time, the smallest 15 LMAs averaged only 1.00 new service firm formations per thousand labor force, with only half the rate of growth in employment. This raises the question, which we will address later, of whether larger places typically have other characteristics which account for their higher service firm formation and higher growth rates, or

whether it is the larger size of these economic areas that contribute to their higher average rates of new service firm formation and employment growth.

3. WHY DO BIRTH RATES VARY ACROSS ECONOMIC AREAS?

It is clear from the previous section that the service firm formation rates vary greatly across local economic areas. Recently a growing literature has sought the determinants of such local variation in rates of new firm formation, and has identified a number of factors that contribute to these differences. The agglomeration effects that contribute to new firm formation can come both from demand effects associated with increased local population, income, and business activity, and from supply factors related to the quality of the local labor market and business climate.

Among areas with broadly similar regional demand and business climate characteristics, there are further differences in rates of new firm formation and economic growth that are associated with the specific qualities of their human capital, and the propensity of locally available knowledge to spillover and stimulate innovative activity which culminates in new firm formations. First, highly educated populations provide the human capital embodied in their general and specific skills for implementing new ideas for creating new businesses (Glaeser, Scheinkman and Shleifer [12]). Second, they also create an environment rich in local knowledge spillovers, which support another mechanism by which new firm start-ups are initiated and sustained (Reynolds, Miller and Maki [27]). Third, to the extent that new firms use skilled labor intensively, they are more likely to be

located in cities with concentrations of highly educated labor in order to reduce the costs of hiring a crucial input (Rauch [25]). Thus, regions that are richer in educated people should have more start-up activity. Variation in local new firm formation rates should be positively related to local educational attainment rates. Furthermore, areas, which already have relatively intense development of service businesses, will have higher levels of new service firm formations, resulting in large part from spillovers of relevant specialized knowledge (Littunen [21]). We would expect that areas with relatively high shares of high-school dropouts would have lower rates of new firm formation.

Lazear [20] has contributed insights into one mechanism that contributes to the higher firm formation rates in larger cities, based on the presence of higher levels of individuals with a 'career' life-mode and a college education. Because their dominant value is the advancement of their career, although they are most likely to be working in large hierarchical private or public sector organizations, they will start their own businesses if this becomes the best way in which to benefit from their skills, knowledge and expertise. Individuals can be expected to choose self-employment only if W(se) > W. These businesses are often technologically advanced, innovative and with good marketing capabilities. Career mode entrepreneurs are often concentrated in large metropolitan areas and smaller attractive cities.

In fact, the 1990's saw an increase in the incidence of highly educated individuals starting new businesses, especially in the technologically advanced sectors of the economy, like computers, biotechnology, and internet-dependent

businesses (Acs, FitzRoy and Smith [3]). However, there was also an increase in startups of many service businesses using relatively unskilled labor for services such as building cleaning, security, detective, and secretarial services. These may be started by career-oriented individuals who have recognized opportunities or developed new ideas to allow them to compete favorably in these markets, based on their own experiences or on spillovers from others.

New firm start-ups should be positively associated with higher levels of local human capital (including relevant knowledge spillovers):

(1) Firm Birth Rate $_{Lt+2} = \alpha_L$ + ß Human Capital $_{L\,t}$ + γ [X] $_{Lt}$ + e $_L$

where X is a vector of control variables, the subscript $_L$ indexes LMAs, t refers to time and e is stochastic disturbance. The conditioning information set is a vector of exogenous population and business variables specific to each labor market area L.

In a world of perfect information, employed agents confronted with new economic knowledge would not face a choice between developing the innovation as an employee within their existing firm, or taking the idea outside by starting up their own firm with it. However, the asymmetry of such knowledge leads to a host of agency problems spanning incentive structures, monitoring and transaction costs. The existence of such agency costs, and the resistance of bureaucracies to change, provides an incentive for agents with new ideas to form their own new firms. (The potential profit that might accrue to the entrepreneur in

excess of his salary (if any) provides a further incentive to take the risks of self-employment.) And further, this same asymmetric nature of information causes the rate of new firm start-ups to vary from city to city, depending on the underlying knowledge conditions in each (Audretsch, [6]),

Similarly, the equilibrium distribution of labor (people) and capital (firms) across cities was constantly changing during this period in which rapid changes in technology and relative demand for outputs caused some industries to become unprofitable and others more profitable (Jorgenson [15]). Across cities the local entrepreneurial response to these changes in supply and demand varied greatly, leading to variations in the firm formation rate, and in the proportion of entrepreneurs.

4. EMPIRICAL MODEL

From the above discussion, it should be clear that the major hypotheses concerning the regional variation in firm formation rates deal with differences in levels of human capital and opportunities for spillovers, while controlling for local differences in a set of other regional characteristics which are likely to affect new firm formation rates. To test the basic hypothesis that the new firm formation rates are positively related to the level of human capital in a region, we estimate a regression model where the dependent variable is the average annual new service firm formation rate (dividing gross births by the labor force in thousands) for 1996-1998.[10] This is analogous to the method used by Keeble and Walker [17] and Armington and Acs [2]. The explanatory (independent or exogenous)

variables include both the human capital variables discussed below, and the regional control factors discussed later.

Human Capital Variables

To measure the level of human capital in each local economy we use two measures of educational attainment in each region, and a measure of the relative intensity of businesses in the same sector. The share of *college graduates* is defined as the number of adults with college degrees in 1990 divided by the total number of adults. This is a proxy measure that covers both technical skills needed in the economy, such as those of engineers and scientists, and skills needed to start and build a business, like finance and marketing and complex reasoning. In 1990, an average of 16 percent of the adult (at least 25 years old) population of the U.S. had a college degree,[11] but this varied from a low of 6 percent to a high of 32 percent across LMAs. Its simple correlation with the new firm formation rates in LMAs is 0.29 and we expect it to be positively related to the birth rate, even after controlling for other important factors (Glaeser et al, [13]; Rauch, [25]; Simon and Nardinelli, [30]). Prior U. S. empirical work has presented rather convincing evidence at the individual level that, ceteris paribus, educational attainment levels are positively associated with new business formation (Evans and Leighton, [11] and Bates [7]).

The second measure of educational attainment that we use is the *high-school dropout* rate, defined as the percentage of adults (population 25 years or older) without college degrees who do not have high school degrees in 1990.[12]

This high school dropout rate should be a good proxy for the proportion of unskilled and semi-skilled labor in the LMA, and we expect it to be negatively related to the formation rate for most types of service firms. While many personal and business service activities do employ large numbers of high-school dropouts, few of the dropouts have the skills to start and manage a new firm themselves. In fact, the simple correlation between our high-school dropout rate and the new firm formation rate is –0.27. Nationally, 33 percent of non-college adults were high-school dropouts in 1990, and this varied from 17 to 60 percent across LMAs.

Formal education itself does not usually provide either the skills or the inspiration to start a new business. But higher education trains individuals to rationally assess information, and to seek new ideas. Therefore more educated people are more likely to acquire useful local knowledge spillovers from others who are involved in research or in managing some service business. The quantity or probability of potentially useful knowledge spillovers is expected to be a function of the number of similar business establishments, relative to the population of the economic area. *Service-industry intensity* is defined as the number of service establishments in the region divided by the region's population in thousands. The greater the number of establishments relative to the population, the more spillovers should be facilitated due to density of establishments in that industry (Ciccone and Hall, [8]).

Regional Control Variables

The human capital variables whose impact we are analyzing are not the only explanation for differences among LMAs in new firm formation rates. We control for differences in a number of other regional characteristics that are commonly thought to influence the rates at which new firms are formed. Summary statistics are provided in Table 3 for the new firm formation rates, and for all of the regional socio-economic variables that are discussed above and below.

Population growth is the average annual rate of change in the local population in a previous period (calculating the two-year change from the ratio of, for instance, for 1996-1998 firm formations, the 1995 population divided by 1993 population, and taking the square root of that two-year change ratio to calculate the compounded annual change ratio). Population growth may function as both a supply and a demand variable. A growing population increases the supply of potential founders of new businesses, and it increases the demand for consumer services. It captures the extent to which cities are relatively attractive to both migrants and immigrants, for living and for doing business. Population growth in a region stimulates growth in both the quantity and variety of businesses servicing that region's consumers. This growth usually takes place by a combination of expansion of existing businesses and creation of new businesses.

Income growth is the region's average annual rate of increase of personal income per capita in the prior two years, calculated using the same formula as for population. Income growth in excess of population growth captures local growth in labor productivity, and concomitant increases in local average quality of life. There are several mechanisms by which faster growing incomes might contribute

to higher rates of new firm formation. Increasing per capita income is likely to increase disposable income, leading to greater demand for a wider range of income-elastic services. In addition, higher income growth rates may enable potential new business founders to raise local capital more easily at lower cost, thereby facilitating new firm formation. Higher growth rates of either population or per capita income during the preceding period are expected to promote higher firm formation rates (Reynolds, [26]).

We control for agglomeration effects in each region primarily by including the log of population as a control variable, since we expect proportional differences in population to impact the new firm formation rates (rather than absolute value differences). Agglomeration effects are expected to have a positive impact on the start-up rate. Lucas [23] asserts that the only compelling reason for the existence of cities would be the presence of increasing returns to agglomeration of resources, which make these locations more productive. However, agglomeration effects may be more complex, and have effects that vary across different types of service sub-sectors.

The *unemployment rate* is calculated for the two-year period prior to our start-up measurement period – for example, for 1996-1998 formations we use the average number of unemployed in 1994 and 1995 divided by the labor force in 1994. Audretsch and Fritsch [5], and Armington and Acs [2] have found conflicting results for this variable -- it is not clear whether, or when, the impact of local differences in unemployment rates is negative or positive. The simple correlation between the unemployment rate and the firm birth rate is close to zero

and is not statistically significant. Use of the unemployment rate as a measure of local economic distress, or local business health, suggests that higher unemployment should be associated with fewer new firm formations. But a number of studies of new firm formation in the 1980s put heavy emphasis on the possible positive explanatory power of unemployment (Evans and Leighton, [11], Storey, [31]). Unemployment had then increased significantly in several countries and stayed at very high levels over an extended period. It was suggested that when workers were unemployed they might be more likely to start their own businesses. This activity, in turn, might reduce the unemployment rate, as the resulting new firms employ not only the owners, but also others. This effect of unemployment may dominate in the service industries, with its generally lower capital requirements.

All-Industry intensity is the total number of private sector establishments in the region, divided by the region's population. Some prior studies have attempted to assess the potential for positive effects from spillovers using either the population density, or establishment density, measured as the number of units per square mile. But these are more indicative of physical crowding than of communication opportunities for knowledge spillovers. This general business intensity may also be thought of as the ratio of an area's business density (establishments per square mile) to its population density (people per square mile), which is a rough measure of the local pressure on business resources for which any new business must compete. Since we have already taken into consideration the local intensity of establishments in the service sector, we

expect that the greater the intensity of all establishments, the higher the local costs of land and labor, and the lower the service firm formation rate will be (Acs, FitzRoy and Smith, [3]). However, if spillovers from other industries are more important than those from similar industries (Glaeser, [12]), this all-industry intensity might be positively related to formation rates of new service firms.

Establishment size is a proxy for the broad structure of business in the region. It is measured for 1996 to 1998 formations as the total area employment in 1994 in all industries, divided by the number of all-industry establishments in 1994 in the area. A local business structure with no dominant large firms may offer fewer barriers to entry of new firms and more opportunities for knowledge spillovers. Furthermore, where small firms predominate in a geographical area there is a much broader population of business owners, and more individuals may visualize their own careers as leading to the founding of independent new firms. Thus the average size of area establishments should be negatively related to the new firm formation rates, since larger average size indicates greater dominance by large firms or branch plants (Armington and Acs, [2]). Because nearly all young businesses are small, and most large establishments are considerably older than average, differences in the average size of establishments may also be a proxy for the differences in the average age of local business establishments. In fact, over time a high rate of new firm formation will lead to lower average establishment size in an area.

Many of these control variables are correlated with each other, and some may be partially endogenous to others. Although all of the independent variables

reflect a time period prior to the firm formations, most of them represent regional differences that are likely to persist over time. The general agglomeration variable, log of area population, is only correlated .35 with the formation rate, but it is correlated .61 with college share of adults and .51 with the average size of area establishments in all industries. Future differences in area rates of growth in population and income certainly result from current differences in area firm formation rates. Spatial differences in unemployment are influenced by local variations in industry mix, demographics (including educational attainment), and other relatively stable factors (such as local unemployment insurance regulations), in addition to the relative health of the local economy and tightness in the labor market, which we use it as an indicator for.[13] In fact, much of the economic geography literature today is concerned with cumulative growth mechanisms in which cause and effect appear to be simultaneous. [14] This study only attempts to sort out a few new details in this complex of interrelationships.

5. EMPIRICAL RESULTS FOR ALL SERVICES TOGETHER

Table 4 shows the results of least squares regression on the 1990-1992, 1993-1995 and 1996-1998 average annual firm formation rates for the service sector for 394 Labor Market Areas. We present standardized beta coefficients[15], so that each parameter indicates the sensitivity of birth rate variation to normalized variation in the corresponding independent variable. The t-ratios shown for each were calculated from the simple estimated standard errors. These were also calculated with a correction for heteroscedasticity, with results that were very

similar to the uncorrected standard errors. The estimated coefficients are generally consistent with our expectations, but with several important exceptions. The explanatory and control variables together explain about two-thirds of the regional differences in new service firm formations rates.

Only two of the three human capital variables showed the hypothesized relationships. First, for human capital measured by share of college graduates, the coefficients are positive and statistically significant for all except the 1993-95 periods, confirming that regions with higher shares of college-educated adults have higher firm formation rates. This positive result on human capital is consistent with previous research (Storey, [31]). The 1993-95 period was one of recovery from the short recession in 1991, which had resulted in a fall in service firm formations in 1992. It appears that the service firm formation rate is less sensitive to the areas' educational attainment levels during such a recovery period.

The positive and statistically significant coefficient for high-school dropouts as a share of the non-college adult population is at first surprising -- however it is consistent with our earlier results for the whole economy (Armington and Acs, [2]). There we suggested that after controlling for the proportion of adults with college degrees,[16] the additional effect of a greater share of less educated workers is to facilitate the startup-up process by providing cheap labor for the new firms. Even the most sophisticated businesses need some relatively uneducated workers to do the manual labor. Thus, the relationship between educational attainment and new firm start-ups at the regional level may be U-

shaped, with both low levels and high levels of education conducive to firm formation and growth. We will examine this issue in greater depth when we analyze subsector data for services formations, distinguishing by educational requirements for founders.

Thirdly, the coefficient on intensity of service establishments is positive and statistically significant, suggesting that regions that already a relatively strong supply of service establishments will have higher rates of new service firm formation, as predicted by the theory of regional spillovers (Jovanovic and Rob, [16]). Indeed, this factor has the strongest relationship of any of our independent variables. The 0.63 value estimated for 1996-98 for the standardized coefficient indicates that a locality with a service establishment intensity that is one standard deviation more intense than the mean will be likely to have firm startup rates that are 0.63 of a standard deviation higher than the mean. When we tried replacing this measure of service establishment intensity with the share of employment in services, the estimates were much weaker, so we conclude that it is important that the local service sector have many business establishments, rather than many employees with service experience.

Furthermore, once we control for the intensity of service establishments, the additional intensity of all establishments is negatively related to service firm formation in 1996-98, and insignificant in earlier periods. This suggests that start-ups are facilitated by spillovers from clusters of similar establishments, but that a relatively high intensity of other types of establishments may actually discourage new service firm formation. Business crowding, in general,

apparently does not lead to higher rates of service firm start-ups. These results shed additional light on the debate between diversity and specialization (Glaeser, [12]), supporting the view that spillovers have important positive effects within broad industry sectors, but do not play an important positive role across sectors. This finding is consistent with that of Acs, FitzRoy and Smith [3] who found no spillovers across unrelated industries. We could better distinguish the separate effects of the intensity of related and unrelated industries in the area, and avoid the inflation of the parameter on service intensity by its inclusion in all-industry intensity if we replaced the intensity of all establishments with the intensity of non-service establishments. This substitution was made in exploratory work on 1996-98 formations, which showed that the parameter on service intensity fell somewhat, but not dramatically, and the estimates for the other parameters in the model remained similar. However, because it was not feasible to use this formulation consistently for the subsequent analysis of sub-sectors of services, and only limited results could be released in accord with Census confidentiality restrictions, we chose to use the broader all-industry intensity model consistently throughout this research.

While the results for the three time periods shown in table 4 are broadly similar, there is one additional difference to be noted. The estimated coefficient on the unemployment rate is positive and statistically significant for 1990-1992, when the economy was undergoing a small recession, but it is negative and barely significant during 1993-1995 and insignificant during 1996-1998, suggesting that this positive effect disappears as the economy improves, or as

mean unemployment falls. These results are inconsistent with some previous research (Storey, [31]) that generally found a negative relationship between unemployment and start-ups in a cross sectional analysis. Our results raise the possibility that during recessions more workers turn to entrepreneurship, as the competition for positions as employees is stiffer. Although higher relative unemployment rates were associated with higher relative service formation rates in the subsequent period, there is no evidence that the formerly unemployed workers were the ones starting the new businesses. Moreover, the service firm formation rate actually fell, nationally, during the 1991 recession (as measured in the year ending in March 1992). It may be that the unemployment rate was serving as a proxy for omitted variables in the previous research cited, but those effects were more precisely attributed to the additional variables we have controlled for in this study, robbing the unemployment variable of its apparent effect.

The signs on the other control variables are as expected. Local population growth differences had a very strong positive influence on new service firm formation rates. When local labor force growth was substituted for population growth its estimated parameter was much lower, suggesting that this local growth variable is functioning more as an indicator of growth in demand for services than as an indicator of the supply of either entrepreneurs or labor. Regions that have higher per capita income growth, and those with higher levels of agglomeration (of population) have higher rates of service firm formation. The average size of all local business establishments has a strong negative relationship to service

firm formation rates – local dominance by large businesses appears to inhibit the formation of new businesses, while the presence of many smaller businesses may serve both to stimulate competition and to facilitate knowledge spillovers.

6. SUBSECTORS WITHIN THE SERVICE INDUSTRY

The service sector defined by the Standard Industrial Classification system incorporates a huge variety of diverse businesses. Our capacity to disaggregate this sector was severely limited by data disclosure constraints, which allowed it to be divided into no more than 9 sub-sectors. Our first priority was to better distinguish the relationship of our human capital variables to the startup rates of various types of service activities, hypothesizing that an important aspect of this linkage is the supply of educationally qualified potential entrepreneurs. Therefore, our primary classification of the 150 4-digit industries was based on the educational requirements expected of the founders of most new firms in each industry code, using three categories for this dimension. The second important industry characteristic to control is its target market, so that we can better account for the effect of local differences in the demand for various types of services. We categorized the market segment served by each of the service industry codes using three categories. Together, these defined 9 service sub-sectors, within which the service activities are fairly homogeneous with respect to these two dimensions – educational requirement and market segment.

A major factor affecting the supply of new service firms is the availability of individuals with the qualifications generally needed to recognize the

opportunities, identify new services, markets, or delivery systems, organize the new firm, and hire the first employees. We therefore expected that the sensitivity of service firm formation rates to the relative supply of adults with various levels of education would differ across service sub-sectors distinguished by typical educational requirement of their founders. We distinguish activities that are most frequently started by people who do not have college degrees (called 'high school' level for simplicity), from those generally requiring an 'advanced' (graduate, post-graduate, or professional) degree, and assigned the remainder to 'college.' These allocations were based on subjective judgments, using our general knowledge of service industries, supplemented by the detailed descriptions of the 4-digit SIC classes in the 1987 Standard Industrial Classification Manual.[17]

An obvious reason for variation across locales in their rates of new service firm startups is variation in local demand for services, so we distinguished three general markets – local consumers, local businesses, and non-local (broader regional, national, or export) markets. Each four-digit Standard Industrial Classification code was assigned to one of these market segment categories, based on close reading of the descriptions of the activities within the definition of the code. It was expected that a substantial portion of the variation in startups of local consumer service firms would be associated with differences in population growth. Similarly, it was expected that locales with more businesses (intensity relative to the population) would be associated with higher rates of local business service firm formations. New service firms serving a broader, non-local market

should be considerably less sensitive to these local market differences. Thus, this dimension was expected to improve the control of local variation in demand for new service firms.

The resulting sub-sector classifications for each 4-digit SIC are listed in the Appendix, where they are ordered by SIC code within each sub-sector. Data on the number of establishments and employees in each 4-digit SIC in 1995 are included, so that it is easy to pick out the larger industry codes dominating each sub-sector. This Appendix also shows the net growth rates for numbers of establishments and their employment between 1995 and 1998, as well as the number of new firm formations during 1996 through 1998 per hundred (1995) establishments for each industry code.[18]

Table 5 provides a summary of the diverse firm formation rates and relative sizes (shares of total service employment) for these nine services-sub-sectors defined according to their market segments and founders' education requirements. Looking first at how the new firm formation rates differ by education requirement, note that they are quite similar for all three categories, ranging only from 8.33 for advanced degrees, up to 9.29 for those types of service industry businesses that are probably founded by individuals with only a high school education. But when we segment the service sector by primary market, we find that the firm formation rate for service businesses that focus on local consumer markets (which account for about 55 percent of employment in services) is only 7.18 new firms per hundred establishments in that market category. At the other extreme, the segment of services that caters to non-local

markets was creating new firms at nearly twice that rate -- 12.66 new firms per hundred existing establishments -- but it accounts for only 19 percent of employment in services.

For the nine sub-sectors defined by the education requirement and the market segment together, the firm formation rate was highest, at 14.78, for businesses in non-local markets with founders normally having advanced degrees. The largest industry groups in this sub-sector are engineering and management consulting and computer programming services, all of which are subject to rapid innovation and turnover. The sub-sector requiring the same advanced degree for founders, but serving the local consumer market, had only 5.31 new firms for each hundred existing establishments, and this sub-sector is dominated by medical offices and religious organizations. Businesses that normally require a college degree for their founder had formation rates that were quite similar across all three of the market segments. Businesses commonly founded by those with no more than a high school degree also showed great variation across market segments, with high formation rates for non-local market (primarily the hotel and motel group), and low ones for the local consumer market (including various repair, cleaning and beauty services and child day care).

The first sub-sector regression model reported in Table 6 is a simple pooled regression on average new firm formation rates for 1996 through 1998, where each observation is a sub-sector in an LMA. Thus, there are 3546 observations, from each of the nine sub-sectors in each of the 394 LMAs. If we

use $_{L}$ to indicate LMA and $_{EM}$ to indicate sub-sectors distinguished by Education and Market, we can specify this model as follows:

(2) Birth rate$_{LEM}$ = f (Coll $_{L}$, HighSch Drop $_{L}$, Subsector estab intensity $_{LEM}$, Pop gro $_{L}$, Income gro $_{L}$, Pop log $_{L}$, Unempl $_{L}$, Estab Size $_{L}$, All-ind estab intensity $_{L}$).

Most coefficients fall somewhat, relative to the all-service model results shown in Table 4, suggesting that the independent variables are not equally important to all of the sub-sectors. The coefficient on the all-industry establishment intensity, which had been somewhat elevated as a result of some collinearity between the all-service-industry intensity and the all-industry intensity, falls substantially in this pooled sub-sector regression, because there is little multi-collinearity between the individual service sub-sector intensity levels and the all-industry intensity. Using the more detailed sub-sector formation rates and sub-sector intensity rates also reduces the adjusted R-squared, because some of the additional variation in formation rates across sub-sectors is not as well explained.

Obviously, this simple pooled sub-sector model estimates only a single coefficient to represent an average of how all sub-sectors relate to each exogenous variable. But when we discussed the reasons for defining those sub-sectors, we focused on some expected differences in their coefficients with some of these variables. If we estimated each sub-sector model separately, we could not easily restrict the coefficients on the locality variables that should be

unaffected by sub-sector differences. Alternatively, we could estimate the model separately for each of the dimensions – education and markets. But that fails to make use of the information we have on how these LMAs differ on both dimensions simultaneously, so the results would be subject to aggregation errors, which could be avoided by making use of both dimensions simultaneously.

In order to allow for variation in the estimated coefficients of variables that should be sensitive to our sub-sector dimensions, while controlling consistently for other regional characteristics, we expand the independent variables to be sub-sector-specific for the dimensions we want to test. Naturally, we expected the educational attainment variables to be sensitive to the education requirement dimension. We also wanted to investigate how the intensity of existing establishments in each sub-sector affected the rate of new firm formation in different market segments. We anticipated that sub-sectors that differed in education requirement might also differ in their relationship to income growth rates and unemployment rates. Market segment was expected to affect how the startup rate varied with population growth, the average size of local establishments, and the intensity of all business establishments in the locality. Since little is known about the residual agglomeration effect that is represented by the logarithm of population, we did not try to anticipate whether it would be sensitive to either Market segment or the Educational requirement, and we therefore tested it with both dimensions.

Using the previous notation, this more detailed pooled estimation model has the following form:

(3) Birth $rate_{LEM}$ = f (Coll $_L$* Dum_E, HighSch Drop $_L$* Dum_E, Subsector estab intensity $_L$* Dum_M, Pop gro $_L$* Dum_M, Income gro $_L$* Dum_E, Pop log $_L$* Dum_E * Dum_M, Unempl $_L$* Dum_E, Estab Size $_L$* Dum_M, All-ind estab intensity $_L$ * Dum_M).

Each of the exogenous variables is now in the form of cross products with dummies for the Education requirement or/and the Market segment. The three dummies for each dimension take the usual form of a dummy variable, with a value of zero unless the observation is for the segment specified for that dummy variable. We first standardized all of the nine exogenous variables and the endogenous variable to have a mean of zero and a standard deviation of one, within each of the nine sub-sectors. Therefore, each represents a relative measure for the LMA, within the sub-sector. Then we created dummy variables for each of the three values for each of the sub-sector dimensions – Market and Education. Finally, we multiplied each exogenous variable times the appropriate three dummies to create three specialized exogenous variables for each of the relevant dimensions of the sub-sectors. Thus the original 9 exogenous variables in the pooled sub-sector model expand to 30 variables – since log of population has been multiplied by each of 3 education dummies and each of 3 market dummies, and each of the other variables has been multiplied by each of 3 dummies of one type. This allows us to estimate the model across all sub-

sectors simultaneously, while distinguishing among the dimensions we wanted to test for differences in estimated coefficients.

The results of the estimation of this model are shown in the last six columns of Table 6. Looking first at the human capital variables in this estimated model, we see that the relationship between an area's share of adults with college degrees and it service firm formation rate is stronger for the sub-sectors generally requiring a college education, but tiny and not significant for the formation rate of service businesses requiring only a high school education for the founder. There is also a significant positive relationship between the share of adults with college degrees and the formation rates of service businesses normally requiring an advanced degree for the founder, since there is substantial similarity between the distribution of college degrees and that of advanced degrees.

The positive and statistically significant coefficient for the relationship of shares of high-school dropouts to formation of new service firms that require advanced degrees might suggest that such businesses are more dependent on having a large pool of unskilled labor. The statistically insignificant coefficients for the impact of the share of high school dropouts on formation rates in the sub-sectors of services that require only high school or college degrees suggests that such businesses are not as sensitive to the supply of unskilled labor. However, having found that higher shares of high school dropouts are not strongly positively associated with higher formation rates for service businesses requiring less than college education for their founders, but for those requiring advanced

degrees, we conclude that the explanation of the positive coefficients on high school dropout share is a mystery that needs further focused research.

The relative intensity of establishments in the same sub-sector of services is a significant explanatory variable for all market segments, but the formation of new firms serving non-local markets is particularly sensitive to the prior existence of similar businesses. An area whose sub-sector intensity of services for non-local markets is one standard deviation above average will tend to have similar new firm formation rates .77 of a standard deviation above average. This corroborates the many prior case study analyses that addressed the spillover effects of certain rapidly growing local industry clusters (usually of high-technology firms with non-local markets), and suggests that these spillover effects are particularly important for businesses that are not focusing on local markets. However, there is also a strong clustering effect for local business services, and a smaller, but very significant one for local consumer services.

Most of the estimated coefficients for regional characteristics crossed with education or market dummies were similar to those estimated without such distinctions. However, the differences that appeared are quite illuminating. The population variable was crossed with all six dummies, since we did not have a clear concept of what the additional agglomeration effect was that was being captured by population, only that it was needed to prevent systematic underestimation of formation rates in large Labor Market Areas. The estimated parameters on population for the sub-sectors of services requiring college degrees of their founders, and for those serving non-local markets were both

under 0.02 and insignificant.[19] Perhaps the high coefficient on sub-sector intensity for non-local services has captured all of the relevant agglomeration effects for that sub-sector. In contrast, formation rates for services to local markets, both consumers and businesses, are sensitive to the size of the local economic area, even after controlling for both the local population growth rate and the local business intensity.

Distinguishing the impact of population on formation rates by the education requirement for founders, it appears that larger population contributes a bit to the formation rate of service firms requiring advanced degrees, but it slightly reduces the formation rate of firms normally started by high school dropouts. This might be interpreted as additional evidence of the positive effects from greater volumes of knowledge spillovers for highly educated potential entrepreneurs, versus the negative effect of greater competition in larger markets for services provided by less educated entrepreneurs.

The coefficient on unemployment is positive and statistically significant only for service firms normally started by college graduates. This provides some clarification of the conflicting results found in previous studies of the effects of unemployment levels on new firm formation rates. Apparently, after controlling for regional differences in income growth rates, areas with higher unemployment tend to have higher new firm formation of services requiring founders with college degrees, but not those normally founded by high school dropouts or those with advanced degrees.

Finally, the negative coefficient on average size of local businesses is strongest for formation of new firms serving local consumer markets, suggesting that areas dominated by large businesses are less likely to have a dynamic consumer service sub-sector. The coefficient on the intensity of all establishments is both tiny and insignificant for formations of firms serving either local businesses or local consumers, contrary to our expectations that a higher intensity of business establishments would lead to higher formation rates for business services. It has a significant negative impact only for formation of new firms serving non-local markets, and that impact is quite small.

These results suggest that the regional differences in new firm formation rates do indeed depend to a large degree on the educational requirements and the market served by the newly formed firms. In particular, the local levels of educational attainment impact primarily the firm formation rates of the types of firms that are normally founded by better educated entrepreneurs, and do not affect startup rates for those normally founded by individuals with less than a college degree. While formation rates of all service businesses are higher in areas with higher intensities of similar service establishments, new formations of firms serving non-local markets are three times more sensitive to this than those serving local consumer markets, and those serving local business markets are twice as sensitive as those serving local consumers.

7. CONCLUSIONS

This paper has used a model of geographic variation in firm birth rates, focusing on their relationship to local human capital and the potential for knowledge spillovers from existing similar businesses. A key variable for the firm birth rate, as for economic growth, both within cities and within countries, is the educational attainment of the labor force. Although the actual knowledge acquired with a college degree seldom suffices as the basis for a successful new business, the analytical methods learned in college facilitate both future acquisition of knowledge and openness to new ideas received as spillovers from other activities in the area. Indeed, after controlling for basic differences in the underlying rates of population growth, the strongest factor accounting for differences in new firm formations was the local intensity of other similar businesses in the area. These results suggest that higher education influences later growth through the increased discovery and implementation of innovative ideas, resulting in more new firm formations.

In addition to the positive impact of higher proportions of adults with college degrees on rates of new firm formation, we also found an additional positive impact of higher proportions of high school dropouts among the non-college-educated portion of the adult population. However, when we examined this for various sub-sectors of the service sector, we found it to be strong only for service activities that normally are started and managed by persons with advanced degrees. Therefore that coefficient appears to indicate a stronger tendency to start such businesses in areas that have relatively more unskilled (or cheap) labor resources.

Population growth was the most important of the regional characteristics used to control for other area differences that were likely to affect new firm formation rates. The unemployment rate appears to be unimportant except in years of recession, when higher unemployment rates contribute to higher firm formation rates.

Many of the most interesting explanations for the connection between growth and human capital levels across countries have focused on productive externalities generated by schooling. The potential for these externalities differs greatly across cities in the U.S., depending on both the levels of education of their work force, and on the strength of the presence of existing businesses in the same industry sector. It appears that an important mechanism by which these externalities contribute to economic growth in cities is through their impact on the level of entrepreneurship. And entrepreneurship provides the catalyst for increasing productivity, as well as increasing diversity and volume of goods and services produced in an area.

This research raises an important issue that should be followed up in future research. Do the economic and human capital characteristics of regions also influence the survival, growth and failure of new firms? In other words, do the same regional characteristics that promote entrepreneurial activity also promote faster growth rates and/or longer or greater survival rates for new busineses?

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[1] The SUSB data and their Longitudinal Pointer File were constructed by Census under contract to the Office of Advocacy of the U.S. Small Business Administration. For documentation of the SUSB files, see U. S. Small Business Administration (1999).

[2] The LEEM data cover all private sector businesses with employees, with the exception of those in agricultural production, railroads, and private households. This is the same universe that is covered in Census' annual County Business Patterns publications, but establishments with positive payroll during a year and no employment in March of that year are not counted for that year for this project.

[3] Annually, there were less than 150 such large apparent births of single-unit firms, with an average of about 1500 employees each. About a third of these larger single unit firms were employee-leasing firms or employment agencies, while the remainder were widely distributed across industries. However, examination of the new firms with 100-499 employees in their first year showed that most seemed to be credible startups, frequently in industries that are associated with large business units, such as hotels and hospitals. Since this study is not concerned with the employment impact of startups, there is no danger of the bulk of the data on smaller startups being swamped by that of a few larger startups that might actually be offshoots of existing businesses. Therefore, the startups with 100 to 499 employees were included, if they qualified otherwise.

[4] About 400,000 new firms generally appear in the business register (with some positive annual payroll) the year before they have any March employment, and we postpone their 'birth' until their first year of reported employment. An average of 90,000 older firms each year with employees in year t-1 have no employees in March of year t, but recover some employees the following year.
[5] We tested a similar rule using one-half, and found that the primary difference was in quite small multi-unit firms, where the smaller share was more credible for the first year.
[6] For example the city of Baltimore is smaller than the County of Baltimore, and many of the people that work in Baltimore city live outside the city limits. In addition, a large proportion of the people in adjacent counties work and shop in other parts of the urban agglomeration of which Baltimore is the center.
[7] These LMA's are defined according to the specification of Tolbert and Sizer (1996) for the Department of Agriculture, using the Journey to Work data from the 1990 U.S. Census of Population. They are named according to the largest place within them in 1990. Some LMA's incorporate more than one MSA, while others separate some of the larger MSA's into more than one LMA, depending on the commuter patterns. A few smaller independent (usually rural) Commuting Zones have been appended to adjacent LMA's so that each LMA had a minimum of 100,000 population in 1990. Alaska and Hawaii each are treated as a single integrated LMA. See Reynolds 1994 for further discussion of LMAs.
[8] We code the location of each establishment according to its initially specified state and county in the LEEM, since we are focusing on formations. The few businesses that report operating statewide (county = 999), or are missing their county code, have been placed into the largest LMA in each state.
[9] In fact, birth rates were calculated for each annual period from 1990 through 1998, but these were found to be quite consistent in their rank ordering across LMA's, so the average of the three most recent years was used for most of this analysis. Using period averages serves both to smooth out irregularities and to minimize the possibility of disclosure problems with very small numbers of annual births for the smaller LMAs and subsectors.
[10] Although we have annual firm formation data for 1990 through 1999, we have chosen not to use pooled cross-section time series regressions, because most of the independent variables describing the characteristics of the LMAs change very little over time, and the errors from omitted variables will be nearly identical for each LMA from year to year, so the diagnostic statistics from such an analysis would be very misleading.
[11] This number has fallen considerably since then, but more recent data on educational attainment from the 2000 Census of Population had not yet been released at the county level, which is needed to construct the LMA level data.
[12] We used only the adults without college degrees as the base for this calculation, rather than all adults, in order to decrease the negative correlation of the high-school dropout rate with the share of adults with college degrees. College share of adults is correlated -.70 with high-school dropout share of adults, and this falls to -.59 when we calculate only the high-school dropout share of non-college adults.
[13] The use of deviations from long-term averages of each area's unemployment rate in future work might facilitate isolating the long-term structural causes of local unemployment from shorter term variations, but both contribute to the spatial differences in the relative tightness in the labor market and the health of the local economy. In addition, the long and uncertain lags in the timing of new business formations (between the original formation decision and the registering of employees, which triggers recognition of the start-up) preclude the usefulness of time series analysis until much more is understood about both the theory and the facts.
[14] We have also abstained from considering financial variables and regional knowledge factors such as research and development expenditures. The availability of adequate financial resources to fund new firms is an important determinant of new firm formation, which we hope to take into account in subsequent research. Both university-based and industrial research and development activity are probably important contributors to regional new firm start-up rates through spillovers.
[15] These can be calculated from the ordinary coefficients, but it is more illuminating to view them as being estimated from standardized variables. In this case, rather than using the levels, ratios

and percents whose means and deviations are shown in Table 3, we would transform each variable by subtracting its mean value (calculated from all 394 LMA values) and then divide this adjusted value by the standard deviation of all 394 values. These transformed values will have a mean of zero and a standard deviation of one, and each value represents the deviation of that particular LMA from the mean. Since the 394 LMAs constitute the universe at a point in time (rather than a sample of areas), it is apparent that the resulting standardized beta coefficients can be interpreted quite simply as measures of the impact of a standard deviation difference in the independent variable on the standardized dependent variable. For example, using standardized variables, if we estimate that $x = 0.1y + 0.5z$, then we can say that each standard deviation in the value of y is associated with 0.1 of a standard deviation of x, and each standard deviation of z is associated with half of a standard deviation of x. Obviously, it follows that x is five times more sensitive to z than to y.

[16] Note that when estimated for 1996-98 without the High school dropout rate, the coefficient for College degree falls to .10 and when estimated without College, the coefficient on High school dropout falls to .12, while other coefficients remain substantially the same.

[17] We originally hoped to base this classification on the BLS occupational distribution data for each three-digit industry group, and to use subjective judgment only to distinguish among the 4-digit codes within each 3-digit group. However, we found that many activities requiring academic skills or advanced training for leadership positions reported occupational distributions very heavily weighted toward semi-skilled and unskilled workers. Hospitals and hotels were extreme examples of this contrast between educational requirements for workers and those for the individual responsible for starting the business. Similarly, classification of self-employed workers by SIC was not at all representative of the qualifications of the owners or managers of new employee firms in that SIC. Many self-employed workers serve under contract to large firms, and few need to deal with the management or financial challenges of employee businesses.

[18] The Appendix entries do not sum to the national totals for each subsector because of the infrequent occurrence of establishments that were never classified to the 4-digit level. These were generally assigned to the four digit code that had the most establishments reported within the SIC classification provided, but are not included in the aggregate data in the Appendix.

[19] These were later omitted, which had the effect of very slightly strengthening a few of the remaining estimates. Unfortunately, disclosure constraints prevented our showing both sets of results.