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Job Creation and Persistence in Services and Manufacturing

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Abstract

An important new literature on gross employment flows has produced a great outpouring of stylized facts. In this paper we examine one aspect of this literature through the lens of dynamic models and theories of industrial evolution. We extend the Davis and Haltiwanger methodology for analysis of the persistence of gross job creation, distinguishing the persistence of new jobs from business births and from expansions. The persistence rates are then compared with those expected in each sector if average annual job creation and destruction were distributed across the business population independently of the prior year's changes. The results provide a basis for discussing aspects of the different dynamics of job creation in services and manufacturing.

Key words: Entrepreneurship – Industry Evolution – Job Flows – Services

JEL-classification: J6 - L6 - L8 - M13

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1. Introduction

The literature and issues focusing on gross employment flows are important. As the recent literature reviews by Sutton (1997) Caves (1998) and Davis and Haltiwanger (1999) make clear, this research has a long tradition. However, it is only in the last decade that economists have 'picked the lock' of numerous census bureaus and organized the primary economic census data so that the births, deaths, survival and growth of individual business units can be traced.

This research has born the fruit of a great outpouring of stylized facts, where no more than impressions had existed before. But the interpretation of these facts is less clear. According to Caves (1998, p. 1947) while the importance of research on employment flows is manifest to the economy, its development has not been theory driven. In fact, figuring out which theoretical models the stylized facts shed light on "is itself an exercise in hunting and gathering." This literature can be interpreted through the lens of dynamic models and theories of industrial evolution and therefore should be of importance for evolutionary economics (Katsoulacos, 1994, Dopfer 1995). Jovanovic (1982), Pakes and Ericson (1995), Hopenhayn (1992) and Lambson (1991) have all developed models of industry evolution that can help us better understand the underlying patterns of gross job flows. Much of the empirical analysis in recent studies of firm-level and plant-level employment dynamics is explicitly couched in terms of this type of theory (Evans, 1987 and Dunne, Roberts, and Samuelson, 1989). Davis and Haltiwanger (1992), looking at gross job flows for the period 1978-1983, found that learning and initial conditions provide a plausible explanation for the strong and pervasive relationship between job reallocation rates and plant age. These results lead

to the conclusion that passive learning stories are quite useful for interpreting variations in job reallocation intensity across different types of plants and manufacturing industries.[1]

There are several limitations to the interpretation of the gross jobs flows literature through the lens of industrial evolution. First, if learning and initial conditions are important, then the focus should be on new firms, rather than on existing plants (establishments). However, research data sets differ importantly on how they treat new and/or small firms. Some only sample small units and others cut them off at some arbitrary point. Second, labor economists have focused much of their work on gross employment flows and not on size issues per se. Finally, because of data limitations, labor economists and industrial organization economists alike have typically focused on the manufacturing sector of the economy, to the exclusion of the much larger and more dynamic service sector (DHS, 1996, Audretsch 1995, Klepper 2002).[2]

While some useful conclusions may be drawn from study of the manufacturing sector, it can be misleading for the whole economy, especially as the manufacturing sector continues to shrink relative to the rest of the economy (Acs, Armington and Robb, 1999). This raises the question, “How do these results based on manufacturing hold up for other sectors of the economy that are generally less capital intensive and have higher rates of employment growth and higher entry rates?” The service sector also

[1] Davis and Haltiwanger (1992) examined job reallocation behavior and the passive learning story within the manufacturing sector. While learning about initial conditions provided a plausible explanation for the sharp and pervasive relationship between job reallocation rates and plant age, on the more fundamental matter of explaining the overall magnitude of job reallocation, the passive learning story is far less successful. Learning about initial conditions accounts for a small portion, 11-13 percent, of total job reallocation.

[2] For a recent exception see Klomp and Thurik (1999).

differs substantially from manufacturing in terms of the nature of demand shocks, the ability to hold inventories and the differences in labor relations, all of which might differentially influence employment flows. A comparison is useful for these reasons alone.

In this paper we focus on these limitations in the job flows literature by comparing the gross job flows and the persistence of new jobs in the service sector and manufacturing sector of the economy. The persistence of new jobs is the extent to which job creation endures (is not reversed) in subsequent years. High rates of gross job creation are viewed as desirable if they result in high net growth rates, or if they are facilitating technological or demand changes, even when offset by high rates of job destruction in other establishments (Audretsch and Mahmood, 1994). But the same high job creation rates are viewed as undesirable if large proportions of those new jobs are lost within the next few years. A high persistence rate implies more stable employment. Analyzing the fraction of newly created jobs which are destroyed in subsequent years provides a way to identify types of establishments or sectors whose new jobs are less stable than average.

We make three original contributions. First, we use the Census Bureau's new Longitudinal Establishment and Enterprise Microdata (LEEM) to calculate annual gross and net job flow rates for manufacturing and services establishments in single and multi-unit firms, and compare these growth rates with those from Census' older Longitudinal Research Data (LRD) on manufacturing. Second, we investigate the differences in the persistence of new jobs from establishment births and from expansions, looking at industry, firm type, and establishment size differences. Third, we

calculate expected one-year persistence rates based on the gross job flow rates of all establishments for comparison with that of growing establishments.

Section II of this paper provides a theoretical framework for thinking about gross job flows in services and manufacturing and why they should be similar. Section III discusses the LEEM data and their characteristics. Section IV explores the differences in job creation rates for services and manufacturing for establishments in single unit and multi-unit firms. Section V introduces measures of persistence. Section VI constructs comparators for these persistence rates, based on the assumption that the survival of jobs in expanding establishments is similar to that in all establishments. Section VII summarizes our findings. We find that the persistence of job gains from births (newly created establishments) was much greater than that from expansions of existing establishments in both services and manufacturing, even after four years.

II. A Theoretical Framework

Jovanovic, Pakes and Ericson, Hopenhayn and Lambson have all developed models of industry evolution that can help us better understand the underlying patterns of gross job flows. These models all suggest that the enduring differences in the size distribution of firms and firm growth rates result less from the effects of the fixity of capital than from the effects of “noisy” selection and incomplete information. If this is the case, then the persistence of jobs in the service sector should not be substantially different between that in the much more capital-intensive manufacturing sector (Lucas, 1978 and Lucas and Prescott, 1971).

Jovanovic (1982) stresses the selection effects associated with passive learning about initial conditions. A firm's underlying efficiency level cannot be directly observed but is learned over time through the process of production. A firm that accumulates favorable information about its efficiency expands and survives, whereas a firm that accumulates sufficiently unfavorable information exits. Firms differ in size not because of the fixity of capital, but because some learn that they are more efficient than others. In this model firms and potential entrants know the entire equilibrium price sequence, and based on it, they make entry, production, and exit decisions. A one-time entry cost is borne at the time of entry. Thereafter, only production cost are incurred, where efficient firms grow and survive and the inefficient decline and close.

Pakes and Ericson (1995) develop a theory of firm and industry dynamics in which investment outcome involves idiosyncratic uncertainty. The stochastic outcomes of an individual firm's investment, coupled with competitor investment outcomes determine the probability distribution over future profitability streams. A plant's investment outcome may improve its position relative to competitors, thus leading to expansion, or it may involve a relative deterioration, thus leading to contraction and possibly exit. Investment in the Ericson-Pakes model thus entails elements of active learning and selection. This model builds in an explanation for perpetual entry and exit. Hence, the active learning theory embeds technical change into a rich model of firm-level heterogeneity and selection.

Lambson (1990) stresses differences in initial conditions, or uncertainties about future conditions, that lead firms to commit to different factor intensities and production techniques. These differences in turn lead to heterogeneity in firm-level responses to

common cost and demand shocks. According to Hopenhayn (1992), even firms that produce identical products with identical technologies can face idiosyncratic cost disturbances. For example, energy costs and tax burdens are often heavily influenced by local conditions. Exogenous, idiosyncratic cost disturbances lead to contraction at some firms and simultaneously, expansion at other firms. The above theories account for several factors that would plausibly account for simultaneous job creation and destruction within narrowly defined sectors of the economy.

While interesting as a way to think about job flows, these models do not serve to predict how the patterns of job creation would differ across diverse sectors of the economy, such as services and manufacturing. However, it would follow from these dynamic models that if learning and noisy selection are more important than the fixity of capital, job growth and persistence should be similar for sectors with substantially different capital intensity, other things being constant. If fixity of capital is more important then learning and selection, capital-intensive sectors should have higher persistence rates than less capital-intensive sectors because of sunk costs. Of course, one could easily imagine a noisy selection process with different entry fees and different means and variances of the efficiency parameters across sectors. This could generate very different employment flow patterns.

III. Measurement of Gross and Net Changes in Establishment Employment

To accurately measure changes in the businesses that are active, we need longitudinal data that will allow us to track each business location, analyzing its startup, survival, growth, and shrinkage. A new database recently constructed by the Bureau of the

Census allows us to quantify and analyze these changes. The Longitudinal Establishment and Enterprise Microdata (LEEM) file provides comprehensive, detailed, annual data for tracking of all business establishments with employment, not only for the manufacturing sector, but also for nearly all U.S. establishments with employment. [3]We use these data to measure the average annual growth (and shrinkage) of employment in both new and existing service and manufacturing establishments, and to investigate the persistence of the new jobs created in these.

The LEEM file has multiple years of annual data for each U.S. private sector (non-farm) business with employees. This analysis was based on a LEEM file that tracked employment, payroll, and firm affiliation and (employment) size for the more than eleven million establishments that existed at some time during 1989 through 1995. This file was constructed by the Bureau of the Census from its Statistics of U.S. Business (SUSB) files, which were developed from the economic microdata underlying Census' County Business Patterns.[4] These annual data were linked together using the Longitudinal Pointer File associated with the SUSB, 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,

[3] Also known as the Business Information Tracking System (BITS).
[4] 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 further information on the SUSB files, see Armington (1998).

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, whether the firm has only a single location or multiple locations (multi-unit), and the total employment of that firm. Only 4 percent of firms have more than one establishment, but they account for over half of total employment.

Establishments that continue their operations can usually be tracked through time using the LEEM, even if their identification numbers are changed due to changes in their location, firm type, legal form, or ownership. Therefore, it is generally possible to clearly identify the startup (birth) of a new establishment or the termination (death or closure) of an establishment, as distinguished from the appearance of a new identification number or the discontinuance of an old one.

For this study of changes in service and manufacturing establishments, we included all U.S. establishments in the LEEM with positive employment in any year from 1989 through 1995 if their most recent industry classification was in the non-financial services sector or in manufacturing. These comprise Standard Industrial Classifications (SIC) 7000 through 8999 for services and SIC 2000 through 3999 for manufacturing.

Using annual data on employment in each establishment, we can calculate gross job flows for various categories of businesses, in addition to their net job growth. However, the employment change reported for each establishment represents only the net change in number of jobs in that establishment. Since particular positions may have been eliminated and others created without any net change in employment, the gross job change rates for establishments will understate the true rates of gross job creation and destruction in the economy.

We follow the method developed by Davis, Haltiwanger and Schuh (DHS) (1996) among others, for measuring gross job flows. For any specified class of establishments, we identify the following gross job flows relative to a base year, t:

B(t+1) = Births or startups -- employment in period t+1 in all establishments with positive employment in t+1 and no employment in t;

$\Delta X = X(t+1)-X(t)$ = Expansions -- employment change from period t to t+1 for all establishments with positive employment in t and larger employment in t+1;

$\Delta C = C(t)-C(t+1)$ = Contractions -- employment change between period t and t+1 for all establishments with positive employment in t and smaller, but positive, employment in t+1;

D(t) = Deaths or closures – employment in period t in all establishments with positive employment in t and no employment in t+1.

If the level of employment in qualifying establishments with stable employment between the two periods is denoted by S(t), then the levels of employment may be calculated as:

$E(t) = X(t) + C(t) + D(t) + S(t)$ and $E(t+1) = X(t+1) + C(t+1) + B(t+1) + S(t)$.

The net change in employment between the two periods is calculated as:

$\Delta E = E(t+1) – E(t) = \Delta X + B(t+1) - D(t) - \Delta C$.

The sum of the absolute value of all gross job flows is called the gross reallocation of jobs between t and t+1, and it may be thought of as the total turnover in jobs, which are contemporaneously created in some establishments and destroyed in others. We define job flow rates (designated by the corresponding lower case letters: b, x, c, and d) by dividing the sum of each type of change by the mean employment of all establishments in years t and t+1:

$M(t,t+1) = (E(t) + E(t+1))/2$ is the mean establishment employment.

The corresponding net growth rate is:

$net(t) = \Delta E / M = b + x - c - d.$

This mean-based growth rate (also employed by DHS) is a convenient approximation to the continuous, or compounded, growth rate.[5] Use of the mean as the divisor for calculating growth and flow rates avoids the problems of asymmetry and unbounded range in discrete-time rates (calculated traditionally by dividing change by the total number of jobs in the initial period). These mean-based job flow rates vary from a maximum of 200 percent for establishment births, to a minimum of –200 percent for establishment deaths.

IV. Gross and Net Job Creation Differences in Services and Manufacturing

The structure of the service sector is quite different from that of the manufacturing sector. Single-unit establishments (single-location firms) predominate in services (53% of employment) while manufacturing is predominately in establishments that belong to multi-unit firms (71%). The two sectors also differ considerably in the size distribution of their establishments. Nearly 16% of employment in services was in establishments with less than 10 employees, while less than 4% of manufacturing employment was in such tiny establishments. Employment in the service sector in 1995 accounted for

[5] The continuous growth rate is calculated as the difference in the natural logarithms of the employment levels: $\ln E(t+1) - \ln E(t)$. Its values are virtually identical to those of the mean-based rate for changes below 10 percent, and are similar for changes up to 100 percent. The continuous rate is not defined for births or deaths, because the log of zero is not defined. Both calculations have the merit of symmetry, so that a change from a to b will have the same value with the opposite sign as a change from b to a. The

about a third of total private non-farm employment in the U.S., and was almost double that of the manufacturing sector.

The net growth rates for all types of service and manufacturing establishments are shown in the upper right part of Table 1. Here we see that services grew at an annual rate of 3.8 percent, while manufacturing lost jobs at an annual rate of -0.9 percent during the period from 1989 to 1995. Thus their net growth rates differed by 4.6 percentage points. Looking below those summary figures, at the gross flow components of growth, it is obvious that the positive components – gains from expansions and births – were much higher in services. However, the negative flows – losses from deaths and contractions – were quite similar, although those in services were slightly higher than those in manufacturing. It is apparent that the net job losses in manufacturing were not primarily attributable to elevated rates of job losses, although the closures and down-sizing attracted much attention in the popular press. It was depressed rates of job creation during this period that accounted for the net losses in manufacturing employment.

The average net growth and the gross job flow rates in establishments in multi-unit firms are usually lower than those in single unit firms. Manufacturing is predominately in multi-unit establishments, which accounted for 71.6 percent of manufacturing employment in 1989, falling slightly to 71.0 in 1995. Services, on the other hand, had less than half of its employment in multi-units. But the multi-unit employment share of services increased substantially, from 42.6 percent in 1989 to 46.7 in 1995.

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mean-based rate has the additional merit of being additive, so that the net growth rate can be calculated as the sum of the birth and expansion rates, less the death and contraction rates.

The average annual net growth rates in Table 1 show that employment growth for single unit firms in manufacturing was positive, but that for services it was three times the rate for manufacturing. Examining the differences in gross job flow rates for single units reveals that most gross flow rates were similar, except for the relatively low rate of job gains from births of single unit manufacturing establishments (new firms). Losses from contraction of single units are the only case in which manufacturing flow rates were higher than comparable service flow rates, and the very small difference is probably due to the unusually low contraction rate of single unit service establishments.[6]

The net growth rate, and all component gross flow rates, for multi-units were lower than for the comparable single units, as expected from previous work on the whole economy.[7] The differences between service and manufacturing growth rates for multi-unit establishments are consistently larger than those for single unit establishments, both for net growth and for each of the gross flow components. Multi-unit manufacturing had particularly low gains from expansions and births during this period, contributing substantially to the overall net job loss rate for manufacturing.[8]

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[6] On average in the economy, job loss rates from deaths are half of those from contractions, and job gains from births are half of those from expansions. Similarly, net growth can generally be allocated two-thirds to the net of expansions over contractions, and one-third to the net of gains from births over losses from deaths.

[7] See the discussion of single versus multi-unit's growth in Acs, Armington, and Robb (1999).

[8] The substantially higher growth rate of single unit service establishments might appear to be inconsistent with the reported increase in the share of services employment in multi-unit establishments. Apparently most of the huge (both relative and absolute) increase in multi-unit employment is due to the reclassification of single-unit firms/establishments to multi-unit status. This would occur whenever a single-unit firm was acquired by a multi-unit firm, and whenever a single-unit firm converted to multi-unit status by opening additional establishments (locations). Classification is based on each establishment's characteristics at the beginning time period (except births at t+1).

Making direct comparisons with other studies of average gross job flow rates is difficult because of differences in geographical coverage, the time period, sampling units and methodologies for constructing the datasets. [9] For example, state level data is difficult to compare with national data because of the states' use of reporting units that are a mixture of establishments, firms and taxpaying units (Leonard, 1987). Lane, Isaac, Stevens (1996) report from a state sample study that job reallocation rates are almost identical for manufacturing and non-manufacturing in Maryland, while we find that at the national level they are almost 50 percent higher in services (Acs, Armington and Robb, 1999). Therefore, we compare our results with those from the LRD used by DHS (1996), which is also based on Census data collected at the national level. The LRD covered the time period 1973-1988 for the manufacturing sector only. Most of 130,000 establishments in their file are larger multi-unit establishments. Tiny firms were excluded, and other small firms may be underrepresented or imputed.

We compare the LEEM with the LRD for single and multi-unit establishments for manufacturing. The multi-unit comparison is more reliable because the larger multi-unit manufacturing firms are well represented in the LRD. As shown in the bottom section of Table 1, for the period 1973-1988 the average annual growth rate in multi-unit employment was –1.3%. Between 1989-1995 the employment growth rate in multi-unit manufacturing continued that downward trend, falling at –1.7% per year. The reallocation rates for the different time periods using the different databases were remarkably similar for multi-units, 19.0 for the LRD versus 17.5 for the LEEM respectively. In both cases job destruction was greater than job creation. The biggest difference was in single-unit establishments where small firms were losing employment

[9] For example, see Davis and Haltiwanger (1999) Table 3.1 for several examples of different coverage.

in the earlier period, but grew slightly during the 1989-1995 period. Based on the similarities for the multi-unit establishments, we are confident that both the data and methods used are reasonably close to identical, if not strictly comparable.

V. Persistence of new jobs in services and manufacturing

We again follow DHS (1996, technical appendix, p. 191) in defining the n-year persistence of job creation as the percentage of newly created jobs at time t that remain filled[10] at each subsequent year through t+n. This persistence rate, p(n), is calculated for each category of establishments, for each year of job creation, t, by summing the number, P(n), of new jobs that persist in year n, and dividing by the sum of the newly created jobs from year t. If an establishment's employment, e(t), is greater than its prior year employment, e(t-1), then it has created e(t) – e(t-1) jobs in year t. The number of new jobs that persist in a subsequent year t+n is:

$$P(n) = \text{Max}\{0, \min[\, e(t)-e(t-1),\ e(t+1)-e(t-1),\ \ldots,\ e(t+n)-e(t-1)\,]\},$$

where the n years persistence rate $p(n) = P(n) / \{e(t)-e(t-1)\}$. We calculate persistence rates of new jobs separately for establishment births, where e(t-1) is zero and all jobs in year t are new jobs, and for expansions, where e(t-1) is positive.

[10] The LEEM provides only the actual number of employees in March of each year, and we measure job creation as the sum of the net increases over a year for the establishments that increased their employment (from zero for births, and from a positive number for expansions). Thus we cannot determine whether any particular new position has been retained with an employee holding it – we can only determine the extent to which overall employment in the establishment is reduced, reversing part or all of the original job creation.

Let us look first at the differences in persistence rates in these two sectors where we control only for the type of initial job creation – births versus expansions. Figure 1 shows the *average persistence* over the subsequent four years of new jobs that were created in 1989-1991. The higher pair of lines represents the decreasing fraction of jobs from births that remain in each of the subsequent years following the startup of a new establishment. For new jobs from manufacturing births, this proportion ranges from around 74% surviving one year, down to about 47% surviving throughout 4 subsequent years. The comparable persistence rates for jobs created by service establishment births run a few points lower than for manufacturing for service business startups. This higher risk to new jobs in new service businesses might reflect their generally lower capital requirements (and therefore fewer sunk costs and lower potential losses from failure), or their greater scope for learning and noisy selection (because most service businesses are very sensitive to local market demand conditions, which are difficult to determine without trying). These persistence rates are actually very close to the business survival rates reported by Bates and Nucci (1989) and others, suggesting that most jobs lost soon after businesses start up are associated with their failure, and subsequent closure. Those new establishments that survive rarely reduce their employment from their starting size, so there is little downside risk other than failure.

The persistence of new jobs from expansions was substantially lower than that from births, ranging from 61% for a single year for both industries, down to 34% for manufacturing jobs and 32% for service jobs after 4 years. It is commonly assumed that new jobs in new businesses are much riskier than new jobs in existing businesses, due to the relatively high failure rates of young businesses, so the finding that

persistence rates for expansions were much lower than those for births was very surprising. Furthermore, the close similarity of these rates for manufacturing and services was unexpected, since manufacturing is considerably more capital intensive than services.

When we compare these persistence rates to those found by DHS (1996) for all gross job creation in manufacturing between 1973 and 1988, we find those for births to be slightly higher than their earlier one and two year persistence rates, and those for expansions to be slightly lower. For gross job creation in manufacturing they found one and two-year persistence rates of 70.2% and 54.4%.[11] However, for young plants they reported substantially higher persistence rates, averaging 79% for one year (DHS, 1995 Table 4.6, p. 79), which is very close to the average of what we found for later births in manufacturing.

We next investigated how the persistence of new jobs varied with the type of establishment – single unit (independent firm) versus multi-unit (branch plant or secondary location). Looking at the Total lines in Table 2, which show average one-year persistence of jobs created during the period from 1989 to 1993, we see that the persistence of new jobs in single-unit establishments is lower than that in multi-unit establishments, regardless of industry sector or type of growth. Since multi-unit establishments generally benefit from the greater knowledge base and financial capacity of their headquarters' capacity, it is not surprising that their new jobs are more persistent. Indeed, in many cases the multi-unit establishments are replications of other locations owned by the firm, so their uncertainty is attributable only to differences in

[11] These are slightly lower than the average annual persistence rates found in Denmark, 71.0%, Netherlands, 77.9%, Norway, 72.7%, and France 73.4% (Davis and Haltiwanger, 1999, Table 3.6.

local factors. This is also consistent with the generally lower reallocation (and growth) rates for employment in multi-unit establishments.

For new jobs in expansions, the persistence levels are quite similar across sectors and establishment types. The small differential between single and multi-unit types is consistent across sectors, with single units about 4 percentage points lower than multi-units. This differential is somewhat greater in service establishment births, and it reaches a high of over 17 percentage points in manufacturing births. New manufacturing plants started by existing firms have extremely high job persistence, while new independently owned manufacturing firms have relatively low job persistence. This relationship strongly suggests that the learning and noisy selection process contributes strongly to evolution of businesses – the sunk capital in manufacturing establishments would be similar in both single and multi-unit establishments, but the multi-unit establishment births tend to be fairly well-researched and financed replications of other establishments owned by the same firm, while single-unit births are more likely to be innovatively experimental, and therefore their jobs involve much higher risk of early termination.

We had expected that the persistence of new jobs would increase with the original size of the business, as a result of the probable more professional management and higher sunk costs of capital for larger businesses. But this was not generally true, as can also be seen in Table 2. Looking at the average annual one-year persistence rates for each type of establishment change (birth or expansion), for each sector (services or manufacturing), and for each type of establishment (single or multi-unit), the general pattern across establishment size is one of remarkable consistency over the

first three size classes (less than 500 employees at birth or before expansion), and various differences for the largest size class.[12] Persistence did increase slightly in the largest size class for single-unit service births and expansions, and for multi-unit service expansions and single unit manufacturing expansions. However, persistence fell for the two categories that have the fewest members, the very large multi-unit service births and single unit manufacturing births. The reason for the low level of persistence in 500+ manufacturing single births is that while in manufacturing multi-units the learning is already incorporated in multi-unit births, but not in single units. In the remaining categories the largest size class showed little difference from the smaller sizes in new job persistence. On the whole, this suggests that persistence is independent of the size of establishments. These results are very consistent with models of learning and noisy selection (Jovanovic, 1982), entry (and exit) of new firms in models of evolution (Hopenhayn, 1992) and entrepreneurship (Lazear, 2002) in industry dynamics.

VI. Job persistence in growing establishments compared to that for all

In this section we calculate expected one-year persistence rates based on the gross job flow rates of all establishments, rather then just the new and growing establishments, and ask the question, “Are the new jobs in new and expanding establishments more, or less, stable than the average job in a sector?”

[12] Nearly all of the persistence rates for new jobs in expansions fall between 62% and 66%, indicating that about a third of the new jobs in expansions are lost by the subsequent year, regardless of category of business. The only exception to this was the higher rate for the category of very large multi-unit service establishments. This class of businesses is probably dominated by large schools and hospitals, which

In the case of establishment births, all jobs are new jobs, so their expected persistence is the same as the survival rate of the average job, which is 1 minus the loss rate from contractions and deaths. Table 3 shows this expected persistence of new jobs from births, using average contraction and death rates for the period from 1990 to 1994, for comparison with the average persistence of new jobs created from 1989 to 1993. Since the two sectors differ little in average job destruction rates, there is little difference in the expected persistence of new jobs from births in the two sectors. Multi-unit manufacturing establishments had the lowest job destruction rates (death and contraction losses), so their expected persistence of new jobs from births is highest.

The actual persistence of new jobs from births (of new firm formations) of single units in both services and manufacturing is considerably below that expected for existing establishments, based on average rates of contraction and death. This difference represents the additional risk involved in new business formations. In firm births, regardless of the sector, the entrepreneur must take this risk, and hope to learn that the planned new business really has the capacity, efficiency, and market that were anticipated. In services births we see that actual persistence of new jobs is 10 to 13 percentage points less than expected for all services. In manufacturing births the difference between actual and expected persistence of new jobs is 20 percentage points for single units, but less than 8 percentage points for multi-units. This repeats the pattern we noted for the actual persistence rates for births, where multi-unit manufacturing births had very high persistence rates, which were probably due to the high proportion of cases in which the new plant is a very well planned replication of

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are predominately non-profit institutions. Most non-profits have very low job reallocation rates, and therefore have lower probabilities of job losses, especially right after they have expanded.

other locations of the multi-location firm. At the same time, the single-unit manufacturing births had exceptionally low job persistence rates, in part because new independent manufacturers usually involve much higher levels of innovation, market development, and other uncertainty.

The expected persistence of new jobs from expansions is much more complex to calculate, even roughly. There are three major reasons for this additional complexity. First, the job destruction rate for all establishments is based on their total employment, but our estimated persistence rate for new jobs from expansions should be calculated as a fraction of only the new jobs. Secondly, the establishment level job changes are net annual changes within each establishment, so our measures of the actual persistence of new jobs are likely to have been reduced by the subsequent loss of some older jobs within some of these expanding establishments. Thirdly, the job losses counted against the survival rate of new jobs from expansions are limited to the number of prior gains, whether the establishments contract or close completely.

In order to calculate a rough measure of the expected persistence of new jobs from expansions we assume, as before, that for each category (defined by sector and establishment type) the probabilities of job losses in businesses that expanded their employment in the previous year are the same as those for the population of all businesses in that category in the previous year. We also assume that the distribution of job losses from contractions is similar to that of job expansions within each category of establishments. Otherwise, if for instance, all losses were from very large establishments and all gains were made by small establishments, it would not be useful to project the overall loss rate to calculate an expected persistence rate for new jobs.

The actual distributions of losses and expansions are not identical, but they appear to be similar enough for this exercise to be useful. We also assume, for simplicity, that the various rates of gross job changes for each category of establishment are constant in consecutive years, and they are indeed very similar across time. Finally, we assume that all relevant establishments stay in the same category (of sector and establishment type) during the two years involved in determining each expected persistence rate.

For a given previous year gain of ΔX jobs from expansion of establishments with employment of X before expansion, the expected persistence of the gain in each category of establishments is:

1 – (expected loss rate from contractions + expected loss rate from deaths).

The expected loss rate from contractions must take into account all three of the constraints that are listed above. We first calculate the probable loss of jobs from contractions in establishments that expanded in the previous year in the category, which is the product of the category's contraction rate times its expanded employment in expansions:

$c * (X+\Delta X)$.

We then calculate the probability of contraction (which equals the employment-weighted share of contractions in the total population of establishments in the category) times the gains from expansions:

$C/E * \Delta X$.

The expected loss of new jobs from expansions due to subsequent contraction is then the lesser (or minimum) of the above two probable loss calculations, since we are only interested in the limited job losses from contractions up to the number previously gained

from expansions. This limited expected loss is then divided by the number of new jobs from expansions in the category to calculate the expected loss rate from contractions:

$$1/\ \Delta X * \text{Min}\ [\ c * (X+\Delta X),\ (C/E * \Delta X)\ ].$$

The expected loss rate from subsequent deaths of establishments in each category is much more straightforward. If an establishment that expanded in the previous period dies, then all of its new jobs from expansion are lost, as well as all of its older jobs. Thus the probability of job loss from death, or the share of total employment in deaths (which equals the employment-weighted share of deaths in the total population of establishments) is the expected loss rate from death:

$$D / E\ .$$

The weighted averages of these calculations for new jobs from expansions in each year from 1990 to 1994 are shown in the lower part of Table 3. Actual persistence in every category of expanding establishments was substantially higher than expected persistence, indicating that those establishments that expanded were far less likely to reduce their employment in the subsequent year than the average establishment. The differences were higher for multi-unit establishments than for single unit ones. Multi-unit manufacturing locations, which had the lowest gross expansion rate among our categories, had the highest actual persistence and the lowest expected persistence.

The results in Table 3 indicate that for births actual average annual one-year persistence is less than the expected. However, for expansion by existing plants the annual one-year average persistence is greater than expected. Within each category of change type and establishment type these results are very similar across sectors. This similarity between the behavior of the highly capital-intensive manufacturing sector, and

the generally low-capital service sector once again affirms that noisy selection and learning apparently play a more important role than the fixity of capital in guiding industrial evolution.

VII. Conclusions

The newly emerging literature on gross employment flows is important because it may give us insights into the evolution of industries. In this paper we have looked at several aspects of employment flows in two industry sectors of very different capital intensity, to evaluate the competing theories of sunk capital versus learning and noisy selection for explaining the determinants of change and the evolution of industry. In this literature noisy selection and entry are suppose to play a more important role than the fixity of capital in explaining the size distribution of firms and firm growth. We find substantial support for the theories of noisy selection, and active and passive learning, from the works of Jovanovic, Pakes and Erickson and Hopenhayn, in contrast to the traditional role asserted for sunk capital as determinant of employment flows and business survival.

First, all of the separate gross job flows, which are the components of new job persistence (job gain rates from expansion and births, and job losses from deaths and contractions) were greater for single unit establishments/firms that for establishments which were parts of multi-unit firms, even when controlling for industry. Second, the persistence of job gains (or fraction of job increases in an establishment which survive to subsequent years) from births was much greater than that from expansions of

existing establishments, even after four years. Third, the persistence rates for new jobs from births and from expansions did not vary with the size of the establishments, except for some decrease with size of large multi-unit births in services and large single-unit births in manufacturing – both fairly rare. Fourth, when we compare the one-year actual persistence of new jobs from births to the expected persistence of all jobs, it shows that the additional job loss risk contributed by the newness of business is much greater for single unit businesses (new independent firms) than for new locations of multi-unit firms, and is least for new manufacturing branch plants.

Finally, what we found most striking in this paper is the similarity of the overall employment flows and persistence for the two sectors. We think this suggests that a noisy selection model could match up well to these new national data describing the dynamics of private sector employment, in terms of establishment entry and exit and expansion and contraction, but such formal modeling is beyond the scope of this paper.

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Table 1: Net and Gross Job Creation Rates in Services and Manufacturing

1989-1995 Average annual mean-based percentage change rates

	Single Units		Multi-units		All Types		
	Services	Manufactures	Services	Manufactures	Services	Manufactures	Serv.-Manuf.
Net Growth	4,5	**1,4**	2,9	**-1,7**	3,8	**-0,9**	4,6
Expansion	12,2	11,4	10,2	6,4	11,2	7,8	3,4
Birth	7,0	4,9	5,2	2,2	6,2	3,0	3,2
Death	5,7	5,6	3,6	2,7	4,7	3,5	1,2
Contraction	9,0	9,3	8,8	7,7	8,9	8,1	0,8
Reallocation	33,9	**31,3**	27,8	**19,0**	31,1	**22,5**	8,6

Source: Tabulation of the Longitudinal Establishment and Enterprise (LEEM) file of the Center for Economic Studies of the Bureau of the Census, Department of Commerce.
Annual job flow measures reflect March-to March establishment-level employment changes.

Net and Gross Job Creation Rates in Manufacturing

1973-1988 Average annual mean-based percentage change rates

	Single Units	Multi-units	All Types
	Manufactures	Manufactures	Manufactures
Net Growth	**-0,2**	**-1,3**	**-1,1**
Job Creation	12,7	8,1	9,8
Job Destruction	12,9	9,4	10,3
Reallocation	**25,5**	**17,5**	**19,4**

Source: Tabulation of the Longitudinal Researach Database (LRD) file of the Center for Economic Studies of the Bureau of the Census, Department of Commerce, shown in DHS (1996) Table 2.1, p. 19 and Table 4.1, p. 61.
Annual job flow measures reflect March-to March establishment-level employment changes.

Figure 1: Average Persistence of Jobs Created in 1989-1991 over 1 to 4 Years

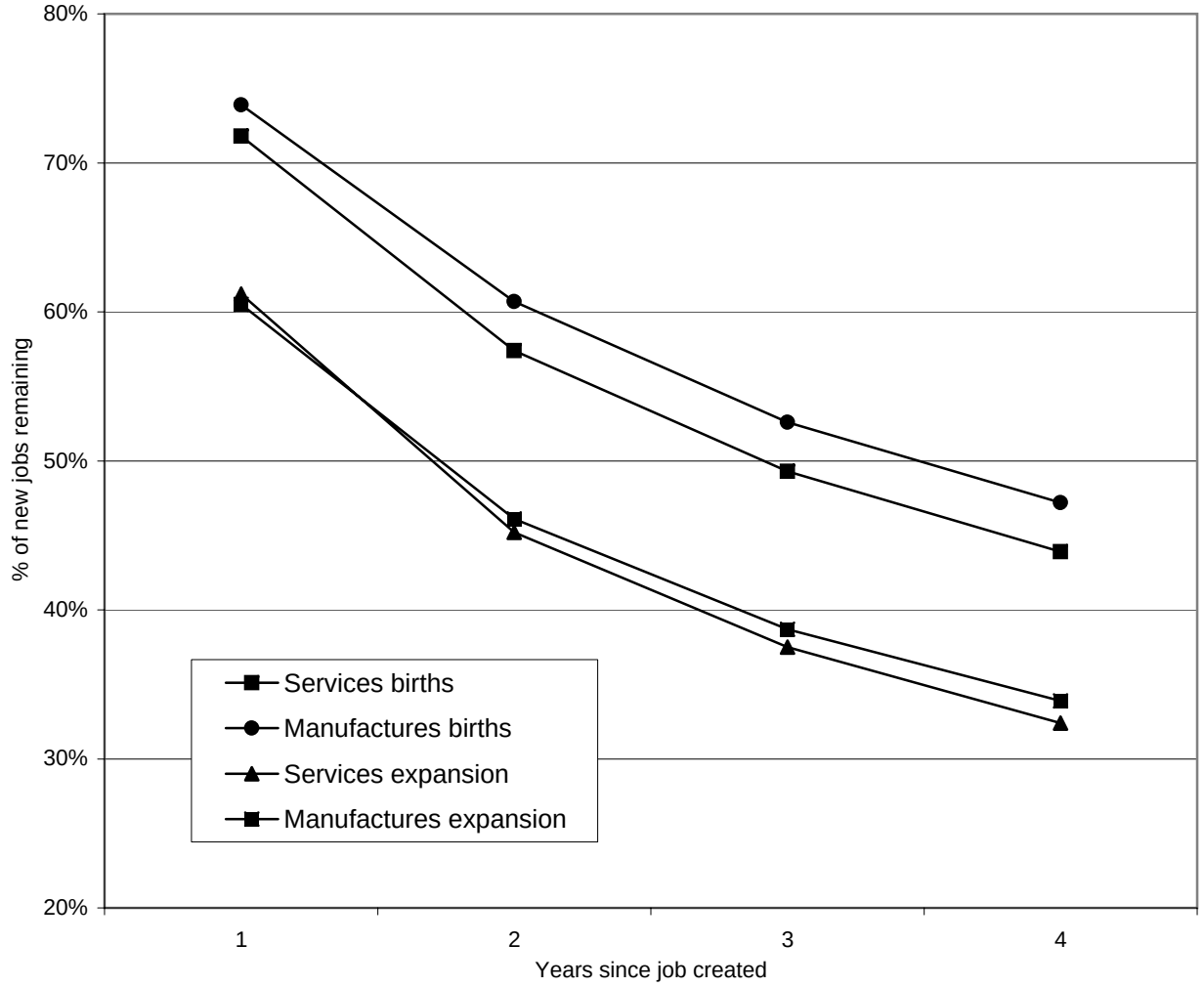

Table 2: Average Annual One-year Persistence of Jobs Created

1989-1993
% of jobs created annually which remain in following year
Firm-types are single unit and multi-unit

	New jobs in establ.births		New jobs in expansions	
	Single	Multi-unit	Single	Multi-unit
Services establishments				
1-19 empl.	70,6%	83,9%	59,2%	62,2%
20-99	69,3%	79,5%	62,4%	63,3%
100-499	70,7%	77,4%	61,7%	62,7%
500+	73,3%	67,5%	64,8%	72,7%
Total	**70,7%**	**77,1%**	**60,7%**	**64,9%**
Manufacturing establishments				
1-19 empl.	68,8%	81,0%	59,7%	63,5%
20-99	66,5%	81,3%	61,6%	66,4%
100-499	56,0%	80,3%	64,2%	65,8%
500+	37,5%	82,5%	68,0%	64,8%
Total	**64,0%**	**81,3%**	**61,4%**	**65,5%**

Source: Tabulation of the Longitudinal Establishment and Enterprise (LEEM) file of the Center for Economic Studies of the Bureau of the Census, Department of Commerce.

Table 3: Actual versus Expected* Average Annual One-year Persistence of New Jobs from 1989-1993

	Actual	Expected
Services births		
Single units	70,7%	84,4%
Multi-units	77,1%	86,7%
Manufacturing births		
Single units	64,0%	84,1%
Multi-units	81,3%	89,0%
Services expansions		
Single units	60,7%	54,9%
Multi-units	64,9%	54,0%
Manufacturing expansions		
Single units	61,4%	49,7%
Multi-units	65,5%	44,6%

* Expected if the establishments with new jobs behaved in the following year like the average of all establishments in 1990-1994.
Source: Tabulation of the Longitudinal Establishment and Enterprise Microdata (LEEM) file of the Center for Economic Studies of the Bureau of the Census, Department of Commerce.