Discussion Papers on Entrepreneurship, Growth and Public Policy

2306

Employment effects of business dynamics: Mice, Gazelles and Elephants

by

Zoltan J. Acs
George Mason University and
Max Planck Institute of Economics

Pamela Mueller
Max Planck Institute of Economics

Number of Pages: 29

The *Papers on Entrepreneurship, Growth and Public Policy* are edited by the Group Entrepreneurship, Growth and Public Policy, MPI Jena.
For editorial correspondence, please contact: egppapers@econ.mpg.de

ISSN 1613-8333

Max Planck Institute of Economics
Group Entrepreneurship, Growth and Public Policy
Kahlaische Str. 10
07745 Jena, Germany
Fax: ++49-3641-686710

Employment effects of business dynamics: Mice, Gazelles and Elephants

Zoltan J. Acs
George Mason University
School of Public Policy
4400 University Drive, MS 3C6
Fairfax, VA 22030, USA
Phone: +1 703 993 1780
Fax: +1 703 993 2284
Email: zacs@gmu.edu

Max Planck Institute of Economics
Entrepreneurship, Growth and Public Policy
Kahlaische Str. 10
07745 Jena, Germany

Pamela Mueller
Max Planck Institute of Economics
Entrepreneurship, Growth and Public Policy
Kahlaische Str. 10
07745 Jena, Germany
Phone: +49 3641 686 723
Fax: +49 3641 686 710
Email: pmueller@econ.mpg.de

Abstract

This paper examines the relationship between business dynamics and employment effects in 320 U.S. Metropolitan Statistical Areas (MSA). Much of the theoretical work on industry dynamics focuses on the role of noisy selection and incomplete information on entry and survival. We extend this research by looking at the impact of firm heterogeneity on employment persistence. We find that only start-ups with greater than twenty employees have persistent employment effects over time and only in large diversified metropolitan regions. Therefore, both the type of entry and the characteristics of the region are important for employment growth.

JEL-Classification: J6, L6, L8, M13.

Keywords: Industry dynamics, new business formation, employment effects, regions

1 Introduction

New (small) business formation burst into the news in the early 1980's in large part because of the research conducted by one individual—David Birch. Birch had put together an extremely innovative and potentially powerful database. For years Dun and Bradstreet has collected data on firms and establishments in the U.S. economy. Vendors could obtain credit and financial information on companies to which they were selling on credit. Businesses such as marketing firms could also use the data collected by Dun and Bradstreet to identify potential customers. Birch, who was affiliated with MIT's Center for the Study of Neighborhood and Regional Change, used the data to study the dynamics of business and employment effects in the U.S. The data enabled him to identify the birth, death and growth of establishments and to analyze establishments of different sizes and longevity (Birch, 1981).

Birch made two seminal contributions, which have, unfortunately, been often overlooked in the subsequent controversy over his methods and conclusions (Davis, Haltiwanger and Schuh, 1996b). First, he pieced together an extremely rich and powerful data set that allowed researchers, for the first time, to study business dynamics for the full spectrum of business and industries in the U.S. Until then, economists had been content studying highly aggregated government data that masked the birth, death and growth of businesses. Today, there are better data sets available for studying the economy, for example the Linked Census of Manufacturing data (Dunne, Roberts and Samuelson, 1989) and The Longitudinal Research Database (Davis, Haltiwanger and Schuh, 1996a). The Bureau of the Census Longitudinal Business Database (LBD) has been developed at the Center for Economic Studies and provides longitudinal business data with information on employment payroll, industry and geography from 1975 to 2001 for establishments and firms with at least one employee (Jarmin and Miranda,

2002). A precursor to the LBD is the Longitudinal Establishment and Enterprise Microdata database (LEEM) jointly developed by the Census Bureau and the U. S. Small Business Administration (Acs and Armington, 1998). The newly established Kauffman Firm Survey (KFS) allows the tracking of new firms over time with an emphasis on financial development, high technology and women-owned firms (for details, see Haviland and Savych, 2005, pp. 28).

Birch's second major contribution is his systematic study of small businesses which stimulated research and debate on small firms. Few economists had studied small business in the U.S. economy before Birch, even though these businesses constituted a large fraction of employment and sales in the economy (Brock and Evans, 1989). One interesting aspect of his work focuses on the classification of different types (age and size) of establishments. "Of all the net new jobs created in our sample of 5.6 million businesses between 1969 and 1976, two-thirds were created by firms with twenty or fewer employees (Birch 1981, p. 7)." He goes on to say, "Another distinguishing characteristic of job replacers is their youth. About 80 percent of the replacement jobs are created by establishments four years old or younger." Finally, "Whatever they are doing, however, large firms are no longer the major providers of new jobs for Americans (Birch 1981, p. 8)." Today we know that small businesses do not generate the vast majority of jobs. However, they do produce a majority of new jobs and a greater number of jobs than we would expect based on their share of employment (Haltiwanger, 2006).

We now know that the real issue in business dynamics is not so much size but age. Most new firms are small; most new plants are often larger than new independent firms and their parent firm is large most of the time (Armington and Acs, 2004). However, we do not know as much about the rapidly growing business that started out

larger than the new firm but smaller than establishments of large firms. These so-called Gazelles are new rapidly growing firms, which have sales in excess of $100,000 and grow at least 20 percent a year for 4 years, represent the most dynamic sector of the economy. The purpose of this paper is to examine the employment effects of business dynamics in a regional context (Fritsch and Mueller, 2004). Employment effects are similar to persistence of jobs. However, while employment persistence looks at how long the job lasts, a form of survival, employment effects focus on surviving firm employment. Employment effects have three aspects. First, they examine the impact of employment creation by $firm_j$ in $time_t$. Second, employment effects look at both the creation of new jobs as well as the displacement of existing jobs. Third, employment effects study the path of employment created by $firm_j$ over time. Fritsch and Mueller (2004, 2007) and Mueller, van Stel and Storey (2007) found employment effects to first, increase employment directly (employment creation in entry cohorts), second to crowd out inefficient incumbents lowering employment (as well as shrinking and exit of the entrants) and third to challenge incumbents leading to an increase in employment in these incumbent businesses.

While the theoretical literature suggests that noise selection plays an important role in industry dynamics, it does not give a lot of insight into what role different types of entrants plays (Armington and Acs, 2004). In other words, what is the impact on employment five years from now of new firms, rapidly growing firms and plants that entered today? In this vein we revisit a question raised by David Birch thirty some years ago "Who Creates Jobs: Mice, Gazelles or Elephants?" The most interesting insight of Birch was that it was the rapidly growing establishments, Gazelles, which were responsible for most of the employment growth in regional economies.

The next section of this paper presents the theoretical framework for understanding the relationship between business dynamics and employment effects. The third section presents data and measurement issues. The forth section presents the empirical results over time, and the fifth section examines regions with a high concentration of rapidly growing establishments in detail. The final section offers a summary and conclusions.

2 The relationship between business dynamics and employment effects

The literature and issues focusing on gross employment dynamics 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 merely impressions had existed before. However, the interpretation of these facts is less clear. According to Caves (1998), while the importance of research on employment dynamics 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" (Caves, 1998, p. 1947). This empirical 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 employment 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; Dunne, Roberts and Samuelson, 1989). Davis and Haltiwanger (1992), looking at gross employment 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]

These models all suggest that enduring differences in the size distribution of firms and firm growth rates result less from the effects of capital intensity than from the effects of "noisy" selection and incomplete information. If this is the case, then the persistence of employment growth in the service sector should not be substantially different from the more capital-intensive manufacturing sector (Lucas, 1978; Lucas and Prescott, 1971). Moreover, differences in employment growth should not be different between regions based on a different industry mix.

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 over time not because of capital intensity, 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

[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 to 13 percent, of total job reallocation.

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 ones decline and close.

Pakes and Ericson (1995) develop a theory of firm and industry dynamics in which investment outcomes involve 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 in comparison to competitors, thus leading to expansion. However, it may also involve a relative deterioration, thus leading to contraction and possibly exit. Investment in the Pakes-Ericson 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 employment dynamics within narrowly defined sectors of the economy or regions.

While these models are interesting as a way to think about business dynamics, they do not predict patterns of employment creation. They do not account for differences across sectors of the economy, such as services and manufacturing, firm heterogeneity, types of business startups and regions. However, it can be concluded from these dynamic models that if learning and noisy selection are more important than capital intensity, business dynamics should be similar for sectors with substantially different capital intensity, other things being constant. If capital intensity is more important then learning and selection, capital-intensive sectors should have higher persistence rates than less capital-intensive sectors because of sunk costs. Acs and Audretsch (1989a and 1989b) found that even small firms are not significantly deterred from entering industries that are relatively capital intensive. 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 dynamics patterns.

There are several limitations to the interpretation of the employment dynamics literature through the lens of industrial dynamics. First, if learning and initial conditions are important, then the focus should be on new establishments, rather than on incumbents. However, research data sets differ substantially 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 effects 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, with the exclusion of the much larger and

more dynamic service sector (Davis, Haltiwanger and Schuh, 1996b, Audretsch 1995, Klepper 2002).[2]

More recently, as new and larger data sets have become available, we are now starting to see a much richer examination of the economy (Acs and Armington, 2006, Acs and Storey, 2004, Haltiwanger, 2006; for an overview, see also Haviland and Savych, 2005)). Armington and Acs (2004) looked at several aspects of employment dynamics 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 supposed to play a more important role than the fixity of capital in explaining the size distribution of firms and firm growth. They 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 dynamics and business survival.

3 Data and Measurement Issues

This paper examines the effect of business dynamics on employment changes at the regional level. The econometric analysis accounts for time lags that might be involved for the employment effects to evolve. The Metropolitan Statistical Areas (MSAs) are used to test the relationship between start-up activity and employment growth. These areas consist of at least one urbanized area of 50,000 or more inhabitants and its adjacent zone of influence, e.g., neighboring cities or towns and adjoining areas. According to the MSA definition developed in the year 2000, there are currently 370 metropolitan areas in the United States. Although the Metro Areas do not cover the entire country, about 80 percent of all new businesses founded occur within metro areas

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

(Lee et al., 2004). However, due to a change of definition of the MSAs in 2000 and the availability of other relevant data, complete data for all variables are only available for 320 MSAs.

The data on business dynamics are derived from the Longitudinal Establishment and Enterprise Microdata (LEEM) and were provided by the U.S. Small Business Administration (for a detailed explanation of LEEM, see Armington and Acs, 2004; Acs and Armington, 2004). The LEEM allows analyzing multiple years of annual data for every US private sector (non-farm) business with employees. The current LEEM file facilitates tracking employment, payroll and firm affiliation and (employment) size for establishments that existed at some time between 1989 and 2002. A business establishment (location or plant) is the basic unit of the LEEM data. An establishment is a single physical location where business is conducted or where services or industrial operations are performed. 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 is described by the LEEM. Additional data for each establishment and year identify the firm (or enterprise) to which the establishment belongs and the total employment of that firm. These firms (may also be called an enterprise or a company) are the largest aggregation of business legal entities under common ownership or control. In most cases, establishment and firm data are identical since the majority of firms are composed of only a single legal entity which operates a single establishment. About four percent of firms have more than one establishment, and, therefore, a small number of start-ups are set up as a new location of an existing firm (see Acs and Armington, 2004 for details).

Data on regional employment were provided by the US Bureau of Labor Statistics and are taken from the Current Employment Statistics (CES) Survey. The

Current Employment Statistics (CES) Survey is a monthly survey of business establishments which provides estimates of employment, hours and earnings data by industry for the nation as a whole, all states and most major metropolitan areas. Persons on establishment payrolls who receive pay for any part of the pay period which includes the 12th of the month are counted as employees. Persons are counted at their place of work rather than at their place of residence; those appearing on more than one payroll are counted on each payroll.

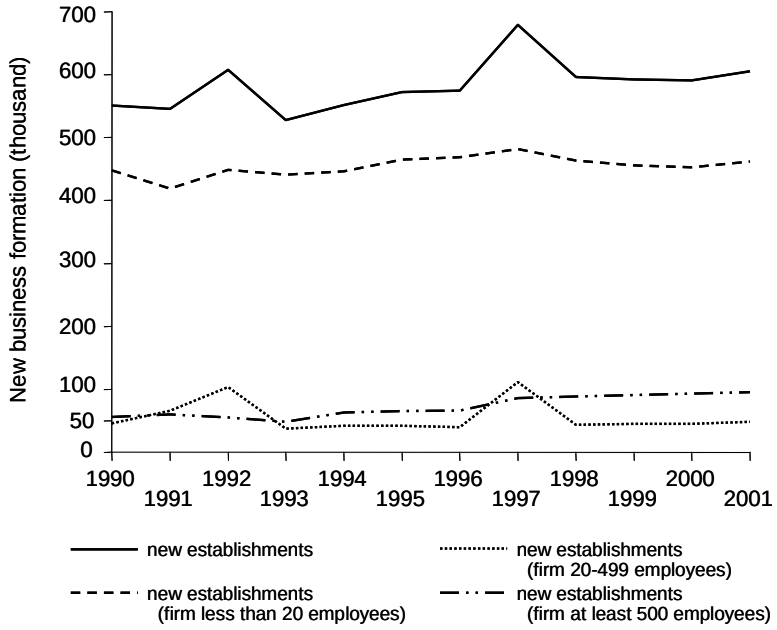

Figure 1: New business formation over time in MSAs

The number of newly founded establishments has steadily increased since 1990 with two abrupt rises in 1992 and 1997 (figure 1). There were about 550,000 new establishments in 1990 and 605,000 in 2001. The majority of new establishments belong to a firm with less than 20 employees (about 78 percent). Most of these establishments are identical to a firm and are not a new location or plant. On average, ten percent of the new establishments either started with 20 to 499 employees or belong to an existing parent company this size. Both sharp increases are mainly driven by this group of new establishments. It can be clearly noticed that the number of new

establishments belonging to a firm with at least 500 employees increased steadily. Its share increased from 10 to 16 percent since 1990. Most of these establishments are new locations and plants of existing firms, and it can be assumed that these establishments have different preconditions than independent start-ups. These entrants may be larger in their first year of activity and experience better initial conditions.

In order to examine regional differences in new business formation activity, it is useful to control for differences in the size of regions and to account for the economic potential of each region. Therefore, start-up rates are estimated according to the labor market approach defined as new establishments per 1,000 employees. Table 1 gives an overview of the start-up rate in the 50 Metropolitan Statistical Areas with the highest start-up rate. Florida provides evidence of high start-up rates; six of the top ten MSAs are located in Florida. Interestingly, the top ten MSAs regarding the start-up rate of all firms and small firms (less than 20 employees) are nearly identical. However, not all MSAs with a high start-up rate based on small establishments also exhibit a high start-up rate based on large firms (greater than 500 employees) or establishments belonging to a large parent company. If the start-up rate is sorted by establishments that belong to a firm with at least 500 employees, ten out of the top 20 are not even listed in the top 50 of the overall start-up rate (all establishments), e.g., Fayetteville-Springdale-Rogers (AR), Jacksonville (FL), Stamford-Norwalk (CT), Tallahassee (FL) and Denver (CO).

Table 1: New business formation rates, average 1998-2001, for selected Metropolitan Statistical Areas, sorted by overall start-up rate

		Average start-up rate 1998-2001 (establishments per 1,000 employees)			
MSA	MSA Name	All firms	firm <20 employees	firm 20-499 employees	firm ≥500 employees
1150	Bremerton, WA	13.42	11.25	0.92	1.25
5345	Naples, FL	12.02	10.14	0.69	1.19
7490	Santa Fe, NM	11.85	9.88	0.58	1.39
6580	Punta Gorda, FL	11.43	9.53	0.48	1.42
5910	Olympia, WA	11.33	9.72	0.58	1.04
2710	Fort Pierce-Port St. Lucie, FL	11.25	9.25	0.64	1.36
2700	Fort Myers-Cape Coral, FL	11.24	8.76	0.77	1.72
2680	Fort Lauderdale, FL	11.00	9.19	0.65	1.16
2995	Grand Junction, CO	10.71	8.92	0.66	1.14
8960	West Palm Beach-Boca Raton, FL	10.51	8.65	0.65	1.21
4100	Las Cruces, NM	10.31	7.97	0.84	1.50
860	Bellingham, WA	10.30	8.82	0.62	0.85
7460	San Luis Obispo-Atasc.-Paso Robles, CA	10.25	8.53	0.69	1.03
2620	Flagstaff, UT-AZ	10.25	8.26	0.74	1.26
3605	Jacksonville, NC	10.12	7.69	0.95	1.49
2020	Daytona Beach, FL	10.10	8.30	0.60	1.20
740	Barnstable-Yarmouth, MA	10.08	8.68	0.62	0.78
9200	Wilmington, NC	10.06	8.34	0.61	1.10
5330	Myrtle Beach, SC	9.99	7.88	0.82	1.30
4890	Medford-Ashland, OR	9.80	8.23	0.65	0.92
5000	Miami, FL	9.78	8.37	0.55	0.85
5190	Monmouth-Ocean, NJ	9.70	8.26	0.50	0.93
2670	Fort Collins-Loveland, CO	9.68	7.98	0.62	1.08
1580	Cheyenne, WY	9.57	7.60	0.54	1.43
4080	Laredo, TX	9.36	7.69	0.68	0.99
1350	Casper, WY	9.31	7.09	0.68	1.54
5140	Missoula, MT	9.28	7.78	0.53	0.97
8200	Tacoma, WA	9.25	7.65	0.56	1.03
5790	Ocala, FL	9.24	7.61	0.54	1.09
7500	Santa Rosa, CA	9.23	7.82	0.57	0.84
2750	Fort Walton Beach, FL	9.18	6.98	0.73	1.47
1125	Boulder-Longmont, CO	9.16	7.37	0.58	1.22
4880	McAllen-Edinburg-Mission, TX	9.03	7.25	0.78	1.00
7080	Salem, OR	9.01	7.20	0.79	1.02
5380	Nassau-Suffolk, NY	8.93	7.69	0.41	0.83
6690	Redding, CA	8.90	7.33	0.63	0.93
7120	Salinas, CA	8.86	7.30	0.66	0.90
3285	Hattiesburg, MS	8.85	6.59	0.84	1.42
1080	Boise City, ID	8.62	6.60	0.56	1.45
7480	Santa Barbara-Santa Maria-Lompoc, CA	8.60	6.97	0.70	0.93
6015	Panama City, FL	8.59	6.52	0.79	1.29
7510	Sarasota-Bradenton, FL	8.59	7.05	0.48	1.06
880	Billings, MT	8.54	6.67	0.61	1.27
3040	Great Falls, MT	8.47	6.65	0.58	1.24
3060	Greeley, CO	8.35	7.12	0.45	0.79
8735	Ventura, CA	8.35	6.58	0.63	1.14
2400	Eugene-Springfield, OR	8.28	6.88	0.62	0.78
7485	Santa Cruz-Watsonville, CA	8.28	7.17	0.50	0.61
7320	San Diego, CA	8.25	6.55	0.67	1.03
5660	Newburgh, NY-PA	8.21	6.72	0.51	0.98

Source: Start-ups from 1989–2001 LEEM file, US Bureau of the Census, Employment from CES Survey

Start-up rates are strongly correlated over time, and a large part of the variation of regional start-up rates can be explained by previous start-up activity (table 2; see also Acs and Armington, 2006, chapter 3). However, the multiple regressions show that the high correlations decrease over time (column IV, table 2). The start-up rate in year *t* is mostly determined by the start-up rate from the previous year and only to some degree by the start-up rate from ten years ago. This high degree of multicollinearity is also found in Germany, Great Britain and the Netherlands (Fritsch and Mueller, 2004, 2007; Mueller, van Stel and Storey, 2007, van Stel and Suddle, 2007). Although we find a strong correlation year by year, there are changes over time. The results indicate that regions do change over time. Across all regions, the start-up rate varies between 3 and 18 new establishments per 1,000 employees.

Table 2: Correlation of start-up rates over time

	Start-up rate (*t*)			
	(I)	(II)	(III)	(IV)
Start-up rate (*t-1*)	0.8871**	—	—	0.6125**
	(114.48)			(16.79)
Start-up rate (*t-5*)	—	0.9148**	—	0.2805**
		(106.86)		(6.92)
Start-up rate (*t-10*)	—	—	0.8502**	0.0824**
			(39.82)	(3.20)
R^2-adjusted	0.7869	0.8369	0.7223	0.9195
F-Value	13106.36	11420.10	1585.27	2065.06
Observations	3549	2226	610	610

Pooled regression, beta-coefficients, t-values in parentheses

In order to analyze the long-term relationship between business dynamics and employment effects, we regress start-up rates in year *t* and each of the preceding six years on employment change over a three year period (percentage change between *t* and *t*+3). Due to the strong correlation of start-up rates over time, it can be expected that the regression model will suffer from a high degree of multicollinearity (table 2). Therefore, the Almon lag method is used to avoid these problems of multicollinearity (for details see van Stel and Storey, 2004; Greene, 2003). This method imposes

restrictions on the parameters of the start-up rates therewith the estimated coefficients of the start-up rates are a function of the lag length. We include the variable population density to control for other regional factors such as movement of people, house prices and wages. The empirical analysis accounts for the years 1990 to 2003. The fixed effect estimator is used in the regressions in order to control for unobserved regional specific effects.

4 Empirical Results

New establishments have a strong positive employment effect the year they enter the market (table 3). The empirical results show that the effects are decreasing over time. From the unrestricted regression, we also find a negative employment effect of business dynamics, which might also be due to the high degree of multicollinearity. The results of the Almon polynomial lags indicate that the employment effect is decreasing over time but is never negative. Interestingly, those new establishments set up four or five years ago have a higher impact on employment growth than new establishments that entered two or three years ago. The results suggest that the employment effects of business dynamics fade away after six years.

Table 3: Impact of new business formation on employment change

	Employment change 3 years (%) (establishments of all firms)			
	(I) unrestricted regression	(II) regression with Almon polynomial lags		
Start-up rate (*t*)	2.324**	α_1	2.446**	2.446
	(13.06)		(18.40)	
Start-up rate (*t-1*)	1.295**	α_2	-1.833**	1.144
	(6.89)		(8.59)	
Start-up rate (*t-2*)	-0.247	α_3	0.587**	0.676
	(1.24)		(7.19)	
Start-up rate (*t-3*)	-0.696**	α_4	-0.057**	0.701
	(2.89)		(6.70)	
Start-up rate (*t-4*)	1.678**			0.878
	(11.19)			
Start-up rate (*t-5*)	0.355*			0.867
	(2.37)			
Start-up rate (*t-6*)	0.000			0.328
	(0.000)			
Population density	-0.150**			-0.187**
	(3.72)			(3.95)
Constant	-3.230			-13.620
	(0.36)			(1.27)
R^2-adjusted	0.4831			0.4260
F-Value	109.47			147.79
Log-likelihood Value	-3978.67			-4062.40
Observations	1569			1569

Notes: Significant at * 5%, ** 1%; absolute value of the *t*-statistics in parentheses.

The employment effects over time are illustrated in figure 2. It can be clearly seen that the overall employment effect is positive leading to the conclusion that business dynamics lead to employment growth but the employment effects last only for about six years. Furthermore, our results support the outcomes of Fritsch and Mueller (2004, 2007) as well as Mueller, van Stel and Storey (2007). Both studies found new businesses to have a strong positive employment effect shortly after entering the market, the effects decrease over time and reach a second maximum after about five years before the employment effects fade away.

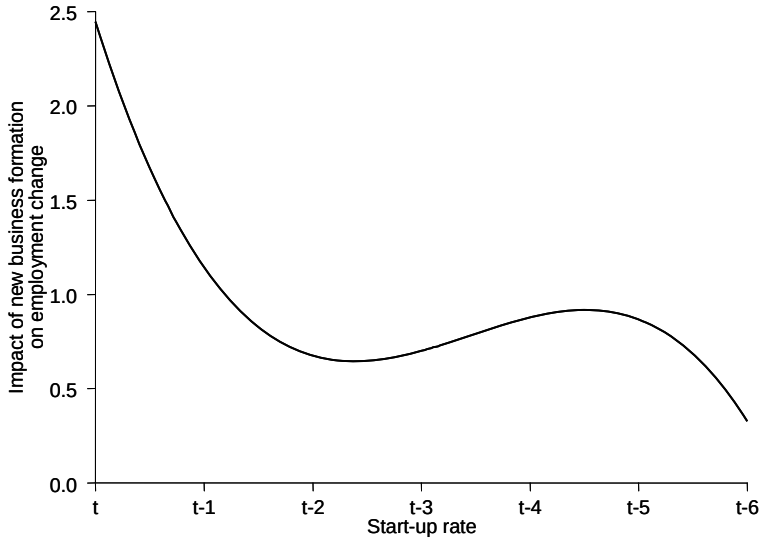

Figure 2: Employment effects over time – all new establishments

In order to gain further insight into the relationship of business dynamics and employment effects, we differentiate new establishments according to the size of the parent company. First, we analyze the employment effects of new firms with less than 20 employees; in this case, the new establishment is mostly identical to a new firm. Second, we focus on the employment effects of new establishments that count either between 20 and 499 employees or belong to a parent company with 20 to 499 employees. Finally, we address new establishments of firms with more than 500 employees. This distinction is expected to shed light on the question which new establishments cause the shape of the distribution of employment effects. We expect the long-term effects to be more pronounced for larger entrants or new locations and plants of multi-unit companies. New plants or locations of existing firms are most likely supported by their parent company which results in better initial conditions. Furthermore, larger entrants have better survival chances and are more likely to create employment over time (Bruderl, Preisendorfer and Ziegler, 1992). These new establishments are more likely to stimulate the performance of incumbent businesses, which consequently leads to employment growth in the region.

Table 4: Impact of new business formation on employment change, by size of firm

	Employment change 3 years (%)											
	Establishments, firms <20 employees				Establishments, firms 20-499 employees				Establishments, firms ≥500 employees			
	(I)	(II)			(III)	(IV)			(V)	(VI)		
	Un-restricted	Regression with Almon polynomial lags			Un-restricted	Regression with Almon polynomial lags			Un-restricted	Regression with Almon polynomial lags		
Start-up rate (*t*)	3.198**	α_1	3.250**	3.250	1.925**	α_1	1.182**	1.182	-2.489**	α_1	-2.234**	-2.234
	(11.33)		(14.95)		(2.87)		(2.66)		(4.03)		(4.66)	
Start-up rate (*t-1*)	2.400**	α_2	-1.121**	2.238	0.677	α_2	-1.016*	0.904	-4.320**	α_2	-3.286**	-4.918
	(7.44)		(2.85)		(0.95)		(2.14)		(7.52)		(4.22)	
Start-up rate (*t-2*)	1.244**	α_3	0.112	1.442	-0.366	α_3	0.836**	1.706	-6.644**	α_3	0.603	-6.404
	(4.27)		(0.75)		(0.54)		(5.25)		(8.62)		(1.77)	
Start-up rate (*t-3*)	0.798*	α_4	-0.002	0.851	-1.810**	α_4	-0.099**	2.997	-7.107**	α_4	-0.001	-6.701
	(2.27)		(0.10)		(2.57)		(6.87)		(10.77)		(0.03)	
Start-up rate (*t-4*)	0.600*			0.456	4.040**			4.184	-5.811**			-5.814
	(2.08)				(7.41)				(8.43)			
Start-up rate (*t-5*)	0.175			0.249	2.390**			4.676	-3.129**			-3.752
	(0.85)				(4.67)				(4.08)			
Start-up rate (*t-6*)	0.227			0.220	1.624**			3.881	-0.760			-0.522
	(1.18)				(3.27)				(0.86)			
Population density	-0.150**			-0.152**	-0.125**			-0.162**	-0.143**			-0.143**
	(3.84)			(3.88)	(3.51)			(9.98)	(2.94)			(8.60)
Constant	-17.360*			-17.486*	19.035**			17.220**	53.127**			53.175**
	(2.05)			(2.07)	(2.84)			(4.74)	(6.69)			(19.11)
R^2-adjusted	0.4755			0.4763	0.5311			0.3093	0.4435			0.2960
F-Value	82.46			164.89	123.91			205.46	67.37			199.14
Log-likelihood Value	-3990.12			-3990.96	-3902.31			-4027.84	-4036.61			-4038.83
Observations	1569			1569	1569			1569	1569			1569

Notes: Significant at * 5%, ** 1%; absolute value of the t-statistics is in parentheses

The distinction of the three groups of new establishments indicates that the magnitude of the employment effects and the distribution of the effects over time mainly depend on the size of the firm. Market entry of small new establishments is limited to short-term employment effects. In this case, the employment effects decrease over time and are negligible after five years (table 4, column I and II). We do not detect a long-term employment effect for this group of new establishments. The distribution of the employment effects are illustrated in figure 3.

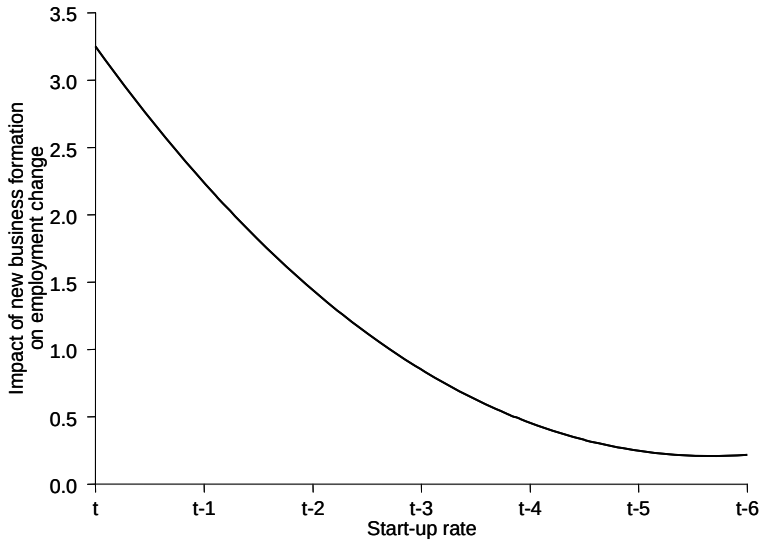

Figure 3: Employment effects over time – new establishments of firms <20 employees

New establishments of firms with 20 to 499 employees or new firms of this size are mainly responsible for the lagged employment effect of business dynamics (table 4, columns III and IV). The results clearly indicate that this group of new establishments unfolds its employment effect after a time lag of two years. New establishments set up five years ago have the strongest employment effect. An explanation for their strong long-term employment effect may be that these establishments are more likely to increase their level of productivity soon after entry due to their entry size and initial conditions. The employment effects may be attributed to the creation of employment in these start-up cohorts as well as employment in incumbents who are challenged by their

entry. The distribution of the employment effects for this group of entrants are illustrated in figure 4.

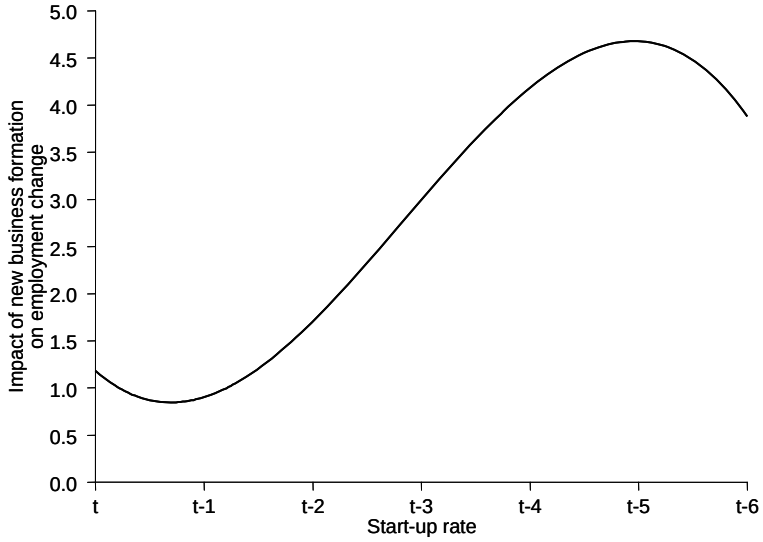

Figure 4: Employment effects over time – start-ups of firms 20-499 employees

The distinction between the new establishments according to the size of the firm reveals that a negative employment effect may also exist. The entry of new establishments of parent companies with at least 500 employees has strong negative employment effects. However, the employment effect turns positive six years after entry. One explanation for this phenomenon may be that most of these entrants are new locations of large multi-unit corporations and that these establishments may enter the market with a high productivity level. Thus, their entry forces existing businesses to exit the market which leads to employment losses in the region. Nevertheless, it can be expected that their entry is important since they force inefficient business to leave the market which leads to a positive employment effect in the long run. The employment effects of this group of entrants over time are illustrated in figure 5.

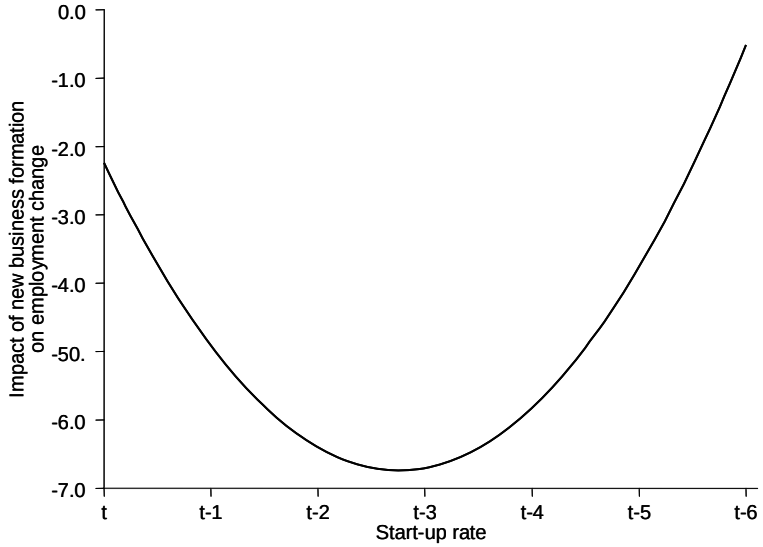

Figure 5: Employment effects over time – start-ups with firm ≥500 employees

5. Gazelle Regions

Birch concluded that rapidly growing establishments, Gazelles, were responsible for most of the employment growth in regional economies. Given the very important difference between new (small) firm entry (Mice) and rapidly growing new firms (Gazelles), we take a closer look at Gazelles and Gazelle regions in this section. Gazelle regions are those that have a predominance of rapidly growing companies, namely at least one percent of the total number of Gazelles are located in each of these MSAs. Table 5 gives an overview of new establishments of firms with 20-499 employees and the average concentration of these new establishments. About 4.2 percent of all Gazelles in the United States are located in Los Angeles, followed by Chicago and New York City each with 3.2 percent and Washington D.C. with 2.4 percent. Interestingly, 40 percent of all the Gazelles are located in only 20 MSAs, which are mostly the largest cities in the United States.

Table 5: Classified Gazelle Regions

MSA Code	MSA	Average start-up rate (firms 20-499 employees)	Average concentration of new establishments (firms 20-499 employees)
4480	Los Angeles-Long Beach, CA	0.69	4.25%
1600	Chicago, IL	0.52	3.18%
5600	New York, NY	0.51	3.18%
8840	Washington, DC-MD-VA-WV	0.72	2.35%
520	Atlanta, GA	0.80	2.27%
1920	Dallas, TX	0.82	2.14%
3360	Houston, TX	0.72	2.06%
6160	Philadelphia, PA-NJ	0.58	2.00%
2160	Detroit, MI	0.57	1.79%
1120	Boston, MA-NH	0.58	1.67%
6200	Phoenix-Mesa, AZ	0.82	1.62%
5120	Minneapolis-St. Paul, MN-WI	0.64	1.54%
7600	Seattle-Bellevue-Everett, WA	0.73	1.39%
7320	San Diego, CA	0.92	1.38%
2080	Denver, CO	0.78	1.21%
7040	St. Louis, MO-IL	0.60	1.16%
7360	San Francisco, CA	0.78	1.16%
6780	Riverside-San Bernardino, CA	1.00	1.15%
8280	Tampa-St. Petersburg-Clearwater, FL	0.74	1.13%
720	Baltimore, MD	0.65	1.07%
5775	Oakland, CA	0.79	1.06%
5000	Miami, FL	0.70	1.03%
6280	Pittsburgh, PA	0.61	1.01%

Start-up rate = establishments per 1,000 employees

The Gazelle regions are concentrated on the west coast and east coast as well as around Chicago. Most of the Gazelle regions are also the home to major universities and research facilities. Furthermore, these regions are characterized by a high share of employment in the creative class and service class (Florida, 2002, pp. 237ff.)

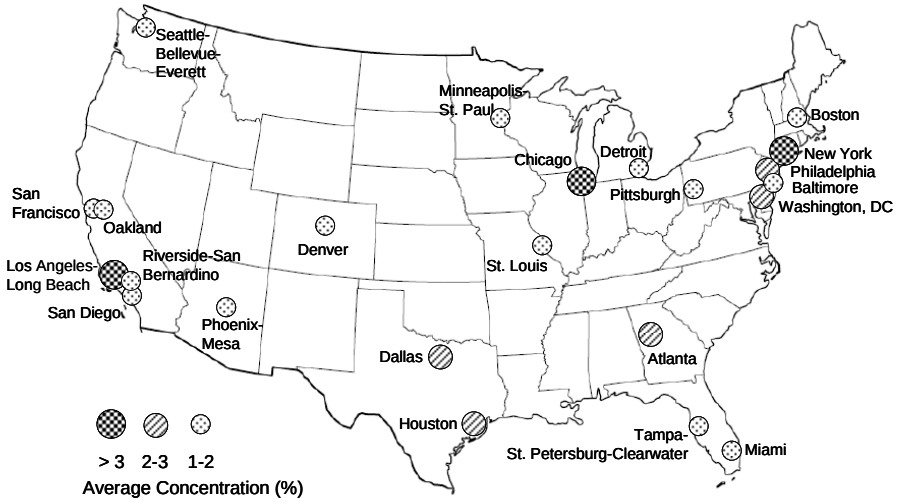

Figure 6: Map of Gazelle regions

The empirical analysis includes an interaction dummy in order to differentiate between regions that have a predominance of Gazelles and regions with low presence of Gazelles. The results indicate that the basic pattern of the employment effects is similar for both types of regions. However, Gazelle regions experience a stronger direct employment effect of start-ups than regions with a lower concentration of Gazelles (table 6, column I and II). The initial employment effects at the time new firms start their activity is almost twice as much. Similar to our results presented in table 3, where we did not differentiate between establishments or regions, the employment effects fade away after about five years whether a new establishment is set up in a Gazelle region or not.

Further analysis shows that the location of a fast growing establishment is critical. In comparison to Mice and Elephants, in which case it does not matter where they are set up, Gazelles develop strong, long-term employment effects after entry. For Gazelles, we find positive short-term employment effects, negative employment effects two years after entrance and pronounced long-term employment effects in the long run. Gazelles unfold their major employment effects after they have been in business for at least five years (table 6, column III and IV).

Table 6: Impact of new business formation on employment change: Gazelle-regions

	Employment change 3 years (%)							
	Establishments (all firms)				Establishments (firms 20-499 employees)			
	(I) unrestricted regression	(II) regression with Almon polynomial lag			(III) unrestricted	(IV) regression with Almon polynomial lag		
Gazelle regions								
Start-up rate (*t*)	5.419**	α_1	4.578**	4.578	2.674	α_1	2.520	2.520
	(5.39)		(6.56)		(0.66)		(1.50)	
Start-up rate (*t-1*)	2.041*	α_2	-2.797**	2.399	-3.256	α_2	-4.231**	-0.454
	(2.30)		(3.46)		(0.72)		(2.56)	
Start-up rate (*t-2*)	-0.720	α_3	0.671*	1.243	-8.427*	α_3	1.360*	-1.324
	(1.15)		(2.35)		(2.27)		(2.38)	
Start-up rate (*t-3*)	-2.332**	α_4	-0.053	0.792	-11.896**	α_4	-0.103*	-0.708
	(3.11)		(1.93)		(3.05)		(2.38)	
Start-up rate (*t-4*)	2.497**			0.723	2.367			0.778
	(5.78)				(0.91)			
Start-up rate (*t-5*)	-0.760			0.719	-0.630			2.518
	(0.89)				(0.22)			
Start-up rate (*t-6*)	-0.047			0.458	0.896**			3.894
	(0.07)				(0.30)			
Non-gazelle regions								
Start-up rate (*t*)	2.241**	α_1	2.363**	2.363	1.815**	α_1	3.185**	3.185
	(12.90)		(14.86)		(2.70)		(11.83)	
Start-up rate (*t-1*)	1.229**	α_2	-1.823**	1.077	0.599	α_2	-1.090*	2.197
	(6.48)		(8.16)		(0.84)		(2.46)	
Start-up rate (*t-2*)	-0.283	α_3	0.596*	0.634	-0.341	α_3	0.104	1.413
	(1.38)		(7.13)		(0.50)		(0.61)	
Start-up rate (*t-3*)	-0.690**	α_4	-0.058	0.684	-1.704*	α_4	-0.001	0.825
	(2.79)		(6.81)		(2.40)		(0.05)	
Start-up rate (*t-4*)	1.681**			0.878	3.998**			0.429
	(11.18)				(7.25)			
Start-up rate (*t-5*)	0.356			0.868	2.371**			0.219
	(0.12)				(4.62)			
Start-up rate (*t-6*)	-0.019			0.302	1.602**			0.190
	(0.12)				(3.22)			
Population density	-0.122**			-0.172**	-0.099**			-0.132**
	(3.46)			(3.79)	(3.30)			(3.76)
Constant	-7.515			-16.797	16.166**			-19.477**
	(0.95)			(1.63)	(2.84)			(2.59)
R^2-adjusted	0.4949			0.4328	0.5438			0.4866
F-Value	82.67**			100.45**	94.74**			109.38**
Log-likelihood Value	-3957.06			-4051.05	-3877.15			-3972.94
Observations	1569			1569	1569			1569

Notes: Significant at * 5%, ** 1%; absolute value of the t-statistics is in parentheses.

The results suggest that the average employment effects of Gazelles are the same as those of the small firms if they are not in a Gazelle region (see figure 6 for illustration of the results). This raises questions about the role of the region in which the new establishment is set up. Gazelle regions are predominantly larger cities of the United States which exhibit a highly competitive environment. New firms have to grow rapidly in order to increase their likelihood of survival. Furthermore, incumbent firms might be more likely to absorb the challenge due to the entrance of new establishments and react by increasing their efficiency. If learning and initial conditions are important for the

employment effects of new businesses, rapidly growing firms in Gazelle regions might benefit from the business environment in these regions. The favorable business environment might also be characterized by a high degree of creativity (Florida, 2002), innovation activity, high level of productivity and a well-developed venture capital market and labor market.

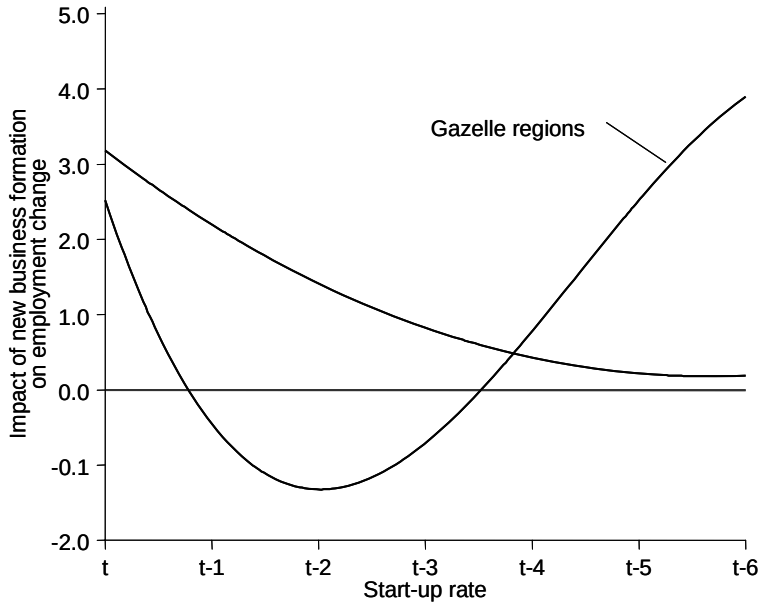

Figure 6: Employment effects – start-ups of firms 20-499 employees: Gazelle regions vs. other regions

5 Conclusion

Much of the theoretical work on industry dynamics focuses on the role of noisy selection and incomplete information on entry and survival. This paper extends research industry dynamics by looking at the impact of firm heterogeneity on employment persistence. We find that firm heterogeneity has an important impact on employment effects over time. Moreover, we also find that it also depends on the regional characteristics of the location of the start-up. Some regions are more receptive

to certain types of start-ups than others. Therefore, both the type of entry and the characteristics of the region are important for employment growth.

In comparison to other results, i.e., Germany, Great Britain or the Netherlands, the results for the United States show that the effect of new (small) establishments on employment is mainly in the initial years after set-up and the employment effect decreases over time. The induced long-term effect found in the two European studies was only found for rapidly growing firms in the United States. Therefore, we conclude that the initial conditions are more favorable for larger start-ups and new locations and plants of existing firms. Future research should also differentiate between new independent firms and new locations of existing firms in combination with a distinction of entry size.

References

Acs, Zoltan J. and Catherine Armington, 2006, *Entrepreneurship, Geography, and American Economic Growth*, Cambridge University Press, New York.

Acs, Zoltan J. and Catherine Armington, 2004, 'Employment Growth and Entrepreneurial Activity in Cities', *Regional Studies* **38**(8), 911-927.

Acs, Zoltan J. and Catherine Armington, 2002, 'The Determinants of Regional Variation in New Firm Formation', *Regional Studies* **36**(1), 33-45.

Acs, Zoltan J. and Catherine Armington, 1998, Longitudinal Establishment and Enterprise Microdata LEEM Documentation, Center for Economic Studies, U. S. Bureau of the Census, CES 98-9.

Acs, Zoltan J. and David B. Audretsch, 1989a, 'Small-Firm Entry in U. S. Manufacturing', *Econometrica* **56**(2), 255-256.

Acs, Zoltan J. and David B. Audretsch, 1989b, 'Births and Firm Size', *Southern Economic Journal* **56**(2), 467-475.

Acs, Zoltan J. and David J. Storey, 2004, 'Introduction: Entrepreneurship and Economic Development', *Regional Studies* **38**(8), 871 – 877.

Armington, Catherine and Zoltan J. Acs, 2004, 'Job Creation and Persistence in Service and Manufacturing', *Journal of Evolutionary Economics* **14**, 305-329.

Audretsch, David B., 1995, *Innovation and Industry Innovation*, MIT Press, Cambridge, Mass.

Birch, David L., 1981, 'Who Creates Jobs?', *The Public Interest* **65**, 3-14.

Brock, William A. and David S. Evans, 1989, 'Small Business Economics', *Small Business Economics* **1**(1), 7-20.

Bruderl, Preisendorfer, Ziegler, 1992, 'Survival chances of newly founded business organizations', *American Sociological Review* **57**(2), 227-242.

Caves Richard E., 1998, 'Industrial organization and new findings on the turnover and mobility of firms', *Journal of Economic Literature* **36**(4), 1947-1982.

Davis Steven J. and John Haltiwanger, 1992, 'Gross job creation, gross job destruction, and employment reallocation', *Quarterly Journal of Economics* **107**(3), 819-863.

Davis Steven J. and John Haltiwanger, 1999, 'Gross job flows', in Ashenfelter O, Card D (eds). *Handbook of Labor Economics*, Volumes 3 and 4, Elsevier Science, Amsterdam, Netherlands.

Davis Steven J., John Haltiwanger and Scott Schuh, 1996a, *Job creation and destruction*, MIT Press. Cambridge Mass.

Davis, Steven J., John Haltiwanger and Scott Schuh, 1996b, 'Small business and job creation: Dissecting the myth and reassessing the facts', *Small Business Economics* **8**(4), 297-315.

Dopfer, Kurt, 1995, special issue, Global economic evolution: Knowledge variety and diffusion in economic growth and development, *Journal of Evolutionary Economics* **5**(3), 181-339.

Dunne Timothy, Mark J. Roberts and Larry Samuelson, 1989, 'The growth and failure of U. S. manufacturing plants', *Quarterly Journal of Economics* **104**(4), 671-698.

Evans, David S., 1987, 'Tests of alternative theories of firm growth', *Journal of Political Economy* **95**(4), 657-654.

Florida, Richard, 2002, The rise of the creative class, Basic Books, New York.

Fritsch, Michael and Pamela Mueller, 2004, 'The Effects of New Business Formation on Regional Development over Time', *Regional Studies* **38**(8), 961-975.

Fritsch, Michael and Pamela Mueller, 2007, 'The Effect of New Business Formation on Regional Development over Time: The Case of Germany', *Small Business Economics (this issue)*.

Greene, 2003, *Econometric Analysis*, 5th edition, Prentice Hall, Upper Saddle River, NJ.

Haltiwanger, John, 2006, *Entrepreneurship and job growth*, Paper presented at the Ewing Marion Kauffman – Max Planck Conference on Entrepreneurship and Economic Growth, May 2006, Munich Germany.

Haviland, Amelia and Bogdan Savych, 2005, A Description and Analysis of Evolving Data Resources on Small Business, RAND Working Paper, Kauffman-RAND Center for the Study of Small Business and Regulation.

Hopenhayn, Hugo A., 1992, 'Entry, exit and firm dynamics in long run equilibrium', *Econometrica* **60**(5), 1127-1150.

Jarmin, Ron S. and Javier Miranda, 2002, *The Longitudinal Business Database*, CES Working Paper 02-17.

Jovanovic Boyan, 1982, 'Selection and the evolution of industry', *Econometrica* **50**(3), 649-670.

Katsoulacos, Yannis, 1994, Special issue, Evolutionary and Neoclassical Perspectives on Market Structure and Economic Growth, *Evolutionary Economics* **4**(2), 151-271.

Klepper Steven, 2002, 'The capabilities of new firms and the evolution of the U. S. auto industry', *Industry and Corporate Change* **11**, 645-666.

Klomp Luuk and Roy A. Thurik, 1999, 'Job flows of firms in traditional services', in Acs Z, et. al., (eds), *Entrepreneurship, Small and Medium Sized Enterprises and the Macroeconomy*, Cambridge University Press, Cambridge, UK.

Lambson, Val Eugene, 1991, 'Industry evolution with sunk costs and uncertain market conditions', *International Journal of Industrial Organization* **9**(2), 171-198.

Lee, Sam Youl, Richard Florida and Zoltan J. Acs, 2004, 'Creativity and Entrepreneurship: A Regional Analysis of New Firm Formation', *Regional Studies* **38**(8), 879-891.

Lucas, Robert E. Jr., 1978, 'On the size distribution of business firms', *Bell Journal of Economics* **9**(2), 508-523.

Lucas, Robert E. Jr. and Edward C. Prescott, 1971, 'Investment under uncertainty', *Econometrica* **39**(5), 659-681.

Mueller, Pamela, Adriaan J. Stel and David J. Storey, 2007, 'The Effects of New Firm Formation on Regional Development over Time: The Case of Great Britain', *Small Business Economics, present issue*.

Pakes, Ariel and Ericson Richard, 1995, 'Markov-perfect industry dynamics. A framework for empirical work', *Review of Economic Studies* **62**(1), 53-82.

van Stel, Adriaan J. and David J. Storey, 2004, 'The Link between Firm Births and Job Creation: Is there a Upas Tree Effect?', *Regional Studies* **38**(8), 893-909.

Van Stel, A.J. and K. Suddle, 2007, 'The Impact of New Firm Formation on Regional Development in the Netherlands', *Small Business Economics*, present issue.

Sutton John, 1997, 'Gibrat's legacy', *Journal of Economic Literature* **35**(1), 40-59.