Who Creates Jobs? Small vs. Large vs. Young*

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Abstract: There's been a long, sometimes heated, debate on the role of firm size in employment growth. Despite skepticism in the academic community, the notion that growth is negatively related to firm size remains appealing to policymakers and small business advocates. Basically, they argue that small firms grow faster than larger firms and are more important as a source of job creation. In this paper, we provide a more nuanced perspective on this debate. Using data from the Census Bureau Business Dynamics Statistics and Longitudinal Business Database, we explore the many issues regarding the role of firm size and growth that have been at the core of this ongoing debate (such as the role of regression to the mean). We find that the relationship between firm size and employment growth is sensitive to these issues. However, our main finding is that once we control for firm age there is no systematic relationship between firm size and growth. Indeed, once we control for firm age, we find that firms with between 5 and 499 employees have lower net growth rates than the largest firms (10,000 or more workers) in the economy. Our findings highlight the important role of business startups and young businesses in U.S. job creation. Business startups contribute substantially to both gross and net job creation. In addition, we find an "up or out" dynamic of young (and small businesses). These findings imply that it is critical to control for and understand the role of firm age in explaining U.S. job creation.

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1. *Introduction*

One of the common cited beliefs in public discourse about the U.S. economy is that small businesses create the most jobs. Often the statement is something along the lines that "small businesses create X percent of net new jobs" in the U.S. where X is usually a large percentage. These statements allude to empirical studies, including the early work by Birch (1979, 1981, 1987), that find that growth is inversely related to firm size. However, it is also already well known that there are many statistical pitfalls underlying this characterization as described in detail in Davis, Haltiwanger and Schuh (1996) (hereafter DHS). DHS highlight issues associated with regression to the mean effects as well as the importance of distinguishing between gross vs. net job flows.[1] DHS document the importance of these issues using data on U.S. manufacturing establishments. A recent study by Neumark, Wall and Zhang (2008) (hereafter NWZ) uses the NETS database covering the entire U.S. economy. In this carefully done study, the authors avoid the misleading interpretations of the data highlighted by DHS. They find an inverse relationship between net growth rates and firm size in the U.S. private sector using data from 1992 to 2004.

Our primary contribution is to emphasize the role of firm age and especially firm births in this debate.[2] We use comprehensive data tracking all U.S. firms and establishments in the U.S. non-farm business sector from 1976 to 2005 from the Census Bureau's Longitudinal Business Database (LBD). Our main findings are summarized as follows. First, consistent with NWZ, when we only control for industry and year effects, we find an inverse relationship between net growth rates and firm size, although we find this relationship is quite sensitive to regression to the mean effects. Second, once we add controls for firm age, we find no systematic relationship between net growth rates and firm size. The key role for firm age is associated with firm births. We find that firm births contribute substantially to gross and net job creation. New firms tend to be small and thus the finding of a systematic inverse relationship between firm size and net growth rates is entirely attributable to most new firms being classified in small size classes.

Our findings highlight the importance of business startups for understanding firm and establishment employment growth dynamics in the U.S. Related to this finding, we find a rich "up or out" dynamic of young firms in the U.S. That is, conditional on survival, young firms grow more rapidly than their more mature counterparts. However, young firms have a much higher likelihood of exit so that the job destruction from exit is disproportionately high among young firms. More generally, young firms exhibit much more churning of jobs as evidenced by high rates of gross job creation and destruction.

These findings highlight the importance of theoretical models and empirical analysis that focus on the startup process – both the process of entry itself but also post-entry dynamics

[1] There are numerous other studies that have also raised concerns about the common claims. Brown, Hamilton and Medoff (1990) raise many of the same statistical issues as DHS but also explore the employer size wage differential.

[2] An important early study that also emphasized the role of firm age for growth dynamics is Evans (1987). The latter paper found an inverse relationship between firm growth and size and age using firm level data for U.S. manufacturing firms. As Evans points out, the work is based on data with substantial limitations but interestingly some aspects of his findings hold for our data that does not suffer from the same limitations. Specifically, the departures from Gibrat's Law are primarily for young and small firms. A variety of other studies have also examined the role of employer age for employer dynamics and employment growth including Dunne, Roberts and Samuelson (1989), Haltiwanger and Krizan (1999), Acs, Armington and Robb (1999). These latter studies focused on establishment-age.

especially in the first ten years or so of a firm's existence. This is not to deny the importance of understanding and quantifying the ongoing dynamics of more mature firms but to highlight that business startups and young firms are inherently different

Our findings contribute to the large literature on the connection between firm size and growth. One leading hypothesis is Gibrat's law that states that growth should be independent of firm size.[3] Our results show that there are substantial departures from Gibrat's law for young and small firms. In our preferred specification, for firms that are more than 10 years old and have more than 20 employees there are not large systematic differences in net growth rate patterns.

The paper proceeds as follows. In section 2, we provide further background on the literature. Section 3 describes the data. Section 4 presents the main empirical results. Section 5 provides concluding remarks.

2. Background

Investigating the relationship between employer size and net growth, while seemingly a straightforward exercise, poses numerous measurement and methodological challenges. First, to explore these issues properly a longitudinal business database is required tracking both establishments and firms. For purposes of this discussion as well as the subsequent empirical analysis, we use the definitions of establishments and firms as defined by the U.S. Census Bureau. Specifically, an establishment is a specific physical location where business activity occurs while a firm reflects all the establishments under common operational control. To help understand these concepts, a useful example is to think about a large, national chain in retail trade – an individual store is the establishment and the sum of the activity of all the establishments of the large, national chain is the firm.

For purposes of studying the relationship between employer size and growth, it is critical to have accurate information tracking the establishments over time as well as the parent firms that own the establishments. If the only data available are at the firm level, longitudinal tracking is complicated by the many changes in ownership as well as mergers, acquisitions and divestitures that are a ubiquitous feature of firm dynamics. Establishment-level job growth is a well-defined concept and has the virtue that when we observe an establishment grow we know there are net new jobs at that establishment. In contrast, firm growth may represent acquisitions or alternatively firm contraction may represent divestitures. It is also clear that having only establishment-level data is inadequate as well as we now discuss.

If the only data available are at the establishment level, the relationship between growth and the size and age of the establishment may be not provide much information about the relevant firm size and firm age. Again, a large, national retail chain is a useful example. In retail trade, firms' primary margin of expansion is by opening up new stores rather than the expansion of existing stores (see Foster, Haltiwanger and Krizan (2006) and Jarmin, Klimek and Miranda (2009)). This implies there are many new establishments of existing firms – for the core issues in this paper, the growth from such new establishments should be classified based upon the size

[3] See Sutton (1997).

and age of the parent firm, not the size and age of the establishment.[4] Much of the literature on employer size and net growth has primarily been based on establishment-level or firm-level data but not both which is a clear limitation.[5] A strength of the data we use is that both establishment and firm level information is available for the entire U.S. nonfarm private sector for a significant period of time. Our approach is to link the establishment-level growth to the firm characteristics and to do so on an employment-weighted basis so that our estimated effects reflect the aggregate contribution of a given firm size or firm age.

A related set of challenges is high quality longitudinal linkages as well as accurate detection of establishment and firm births. Given the ubiquitous changes in ownership among U.S. firms, it is essential to build longitudinal links based on high quality establishment linkages. Detecting when a new establishment first starts economic activity is critical as well and determining whether that new establishment is part of an existing firm or is a new firm is critical. Early versions of the D&B data used by Birch were plagued with problems along these lines with establishments and firms entering the database not so much when economic activity began but when the business applied for credit in a manner that showed up in the D&B data (see, Birley (1984) and Alrdrich et. al. (1988) for detailed discussion). The NETS data used by NZW is based on a much improved version of the D&B data although there are some open questions about the nature of the coverage in NETS.[6] A strength of our study is that the LBD has very high quality longitudinal linkages at the establishment-level as well as high quality linkages between establishments and firms. The latter, as described below, permits us to measure firm age for every establishment.

Another set of challenges emphasized by DHS is to recognize the statistical pitfalls in relating employer size and growth. One issue they highlight is the potential role of regression to the mean effects. Businesses that have recently had a transitory negative shock (or even a transitory negative measurement error) are more likely to grow while businesses that have recently had a positive transitory shock are more likely to shrink. This effect alone will yield an inverse relationship between size and growth. As Friedman (1992) states, this type of regression fallacy "is the most common fallacy in the statistical analysis of economic data". Practically this issue manifests itself in the method used to classify businesses into size classes. The early work by Birch and others has classified businesses into size classes using base year employment. That is, in quantifying the relationship between employer size and growth between t-1 and t, the employer size used is the size in t-1. Businesses that have had a negative transitory shock in t-1

[4] Although as discussed below, there is independent interest in the role of establishment size and age.

[5] DHS analysis is restricted to U.S. manufacturing establishments although they were able to construct a measure of firm size at the manufacturing level. Dunne, Roberts and Samuelson (1989) examine the role of establishment size and age for the growth and failure of U.S. manufacturing plants. Evans (1987) used firm-level continuers for U.S. manufacturing firms over the 1976-1980 period. Birch (1979, 1981, 1997) uses the D&B data that has both firm and establishment-level information although subject to the limitations of the D&B data. NZW use the NETS data that has both firm and establishment-level information.

[6] NWZ report about 13.1 million firms and 14.7 million establishments in a typical year. The LBD (and the closely related County Business Patterns) report about 6 million firms and 7 million establishments in a typical year that have at least one paid employee. The Census Bureau also reports more than 15 million additional *nonemployer* businesses in a typical year. It appears that NETS is some combination of employer and nonemployer businesses but does not reflect the universe of businesses. For our purposes, we focus on employer businesses. For discussion of the importance of nonemployer businesses and the relationship between nonemployer and employer businesses see Davis et. al. (2009). There also remain questions about how well NETS captures startups especially for small businesses.

are more likely to be small so are more likely to be classified in smaller size classes in the base (t-1) year. Businesses that have had a positive shock in t-1 are more likely to be large and so are more likely to be classified in large size classes in the base year. The implication is that regression to the mean effects will yield an inverse relationship between growth and size using base year size classifications.

DHS propose using an alternative classification method to mitigate the role of regression to the mean effects. They note that, while base year size classification yields a negative bias, using end year size classification yields a positive bias. That is, if businesses are classified into size classes based upon year t size, then transitory shocks would yield a positive bias to the relationship between net growth from t-1 to t and size. To avoid the negative or positive bias, DHS propose using a current size classification where current size is based on the average of employment in year t-1 and t. Using average size is a compromise between using year t-1 (base) or (end) year t size to classify firms.

Even though current-year (average) size is a compromise, it has limitations as well. Establishments that belong to firms with large permanent firm level shocks that induce the firm crossing over size class boundaries between t-1 and t will be classified into a size class that is in between the starting and ending size class. Recognizing this potential limitation, the Bureau of Labor Statistics has developed a dynamic size classification methodology (see Butani et. al. (2006)). [7] Specifically, the methodology attributes job gains or losses to each of the size classes that the firm passes through in its growth or contraction. Interestingly, the findings that compare results across size methods (see Butani et. al. (2006)) show that the patterns using the current size method for classification are quite similar to those that emerge using their dynamic methodology.[8]

In what follows, we present results using the base year and current size class methodology. This discussion as well as the findings by DHS and Butani et. al. (2006) make the current size class methodology our preferred methodology as it is inherently more robust to regression to the mean effects. However, we include the base year methodology for purposes of reference and also to explore the sensitivity of the results to this methodological issue.

DHS also emphasize avoiding inferences that arise from the distinction between net and gross job creation. Policy analysts are inherently tempted to want to make statements along the lines that "Small businesses account for X percent of net job creation". The problem with this approach is that since gross job flows dwarf net job flows, many different groupings of establishments can account for a large share the net job creation. That is, in the U.S., the average annual net employment growth rate has been about 2.2 percent from 1976 to 2005. Underlying this net employment growth rate has been an average annual gross job creation rate of 17.6 percent and a 15.4 percent average gross job destruction rate (statistics from the Business Dynamic Statistics (BDS) which is described below). Decomposing growth into components is problematic (at least in terms of interpretation) when some shares are negative. One way to see

[7] Related evaluation work on alternative methodologies by BLS is found in Odelia (2004). We also note that the BLS BED series releases net and gross job quarterly flows by a firm size measure. The firm size measure they use is based on a taxpayer ID definition of the firm so that for multi-unit establishment firms that have multiple taxpayer Ids their firm definition is somewhere between the establishment and overall firm.

[8] Acs, Armington and Robb (1999) in using a precursor to the LBD (the LEEM) at Census found evidence of regression to the mean using base-year size and current-year size measures similar to those used here.

this is that new firms account for about 3 percent of employment while net employment growth is around 2.2 percent. Using the share approach yields that new firms account for 135 percent of all net new jobs. While it is interesting that the net growth from new firms alone exceeds the average, it is misleading to say they account for 135 percent of net new jobs since many other firms are also creating jobs. We show a specific example of this issue using the BDS below. A more sensible approach that has been adopted in the literature is to look at the relationship between net growth rates and size. It is this latter approach that we primarily use in this analysis.

Before proceeding to the more formal analysis, it is instructive to examine the tabular output from the Business Dynamic Statistics on net job creation by firm size and firm age. The precise definitions of firm size and firm age are discussed below (and are the same used by the BDS and described on the BDS website). Table 1 shows the number of net new jobs by firm size and firm age class in 2005. The upper panel shows the tabulations using the base year size method and the lower panel the current year size method. A quick perusal of the table yields a number of interesting observations. About 2.5 million net new jobs were created in U.S. private sector in 2005. Strikingly, firm startups (firms with age 0) created about 3.5 million net new jobs. Interestingly, every other firm age class except for the oldest firms exhibited net declines in employment.[9] However, it would be misleading to say that it is only firm startups and the most mature firms that contributed to job gains. In both panels there are large positive numbers in many cells but also large negative numbers in other cells. It is also clear that there are substantial differences in these patterns depending on using the base year or current year size method although some common patterns emerge. For example, excluding startups, firms that have employment between 5 and 99 workers consistently exhibit declines in net jobs. We limit our discussion of the details of the firm size and age patterns here since the analysis that follows explores these issues at length.

As will become clear, the patterns reflect two basic ingredients. Obviously, whether the size/age class contributes positively or negatively depends on whether that size/age class has a positive or negative net growth rate. In addition, the magnitude of the positive or negative contribution depends not surprisingly on how much employment is accounted for by that cell. That is, a size/age class may have a large positive number not so much because it has an especially high growth rate but because it accounts for a large fraction of employment (e.g., a 1 percent growth rate on a large base yields many net new jobs).

3. *The Longitudinal Business Database*

For this study we use the Longitudinal Business Database. The LBD has been recently used to generate the public use statistics Business Dynamics Statistics (BDS).[10] The BDS includes tabulations of net and gross job flows at the national level but also by broad sector, state, firm size and firm age. While we use the micro data in the LBD for our analysis, many of the patterns we discuss can be readily seen in the public domain BDS.[11] We use the LBD rather than the BDS to be able to control for detailed industry effects in our analysis.

[9] A review of the BDS statistics for other years shows that the net job creation contribution of the oldest businesses is highly procyclical.

[10] Indeed, some of the basic patterns from the BDS are seen in Table 1.

[11] We use classifications not currently available in the BDS. For example, we control for detailed industry (4-digit SIC or 6-digit NAICS as appropriate) in our analysis. Currently, the BDS only releases tabulations at the broad

The Longitudinal Business Database (LBD) covers all business establishments in the U.S. private non-farm economy that file payroll taxes with the IRS. As such, it covers all establishments in the U.S. nonfarm business sector with at least one paid employee.[12] The file begins in 1976 and currently runs through 2005. The LBD includes information on detailed industry for every establishment. In the current paper, we use 4-digit SIC codes through 2001 and 6-digit NAICS codes after that. We note that the LBD (and in turn the BDS) employment and job creation numbers track closely those of the County Business Patterns program and the Statistics of U.S. Business program of the U.S. Census Bureau (see Haltiwanger, Jarmin and Miranda, 2009).

The unit of observation in the LBD is the establishment defined as the single physical location where business is conducted. Firms can own a single establishment or many establishments. In some cases these firms span multiple geographic areas and industries. Establishments can be acquired, divested or spun off into new firms so the ownership structure of firms can be very dynamic and on occasion complex. Each establishment record in the LBD has a firm identifier associated with it so it is possible to track the ownership structure of firms in any given year as well as changes over time. We use these firm level identifiers to construct firm level characteristics for each establishment in the LBD. Further details about the LBD and its construction can be found in Jarmin and Miranda (2002).

3.1 *Measuring Firm Age and Firm Size*

The construction of firm size measures is relatively straightforward. Firm size is constructed by aggregating employment across all establishments that belong to the firm. Employment for each establishment is obtained from administrative sources or Census collections. Employment represents the number of employees on payroll during the pay period including March 12. In this sense it is not unlike employment measures in other databases such as the County Business Patterns (CBP, Current Establishment Survey (CES) and the Quarterly Census of Employment and Wages (QCEW). There are some details in computing base year size and current size that are worth noting. For base year firm size, we use the firm size for year t-1 for all businesses except for new firms. For new firms, we follow the approach used by Birch and often by others and allocate establishments belonging to firm startups to the firm size class in year t. For current year size, we use the average of firm size in year t-1 and year t.

The construction of firm age presents more difficult conceptual and measurement challenges. We use the approach developed for the BDS and has been used in the recent literature (see, e.g., Davis et. al. (2006)). When a new firm ID arises for whatever reason, we assign the firm an age based upon the age of the oldest establishment that the firm owns in the first year of the new firm ID. The firm is then allowed to age naturally after that regardless of mergers or acquisitions and as long as the firm ownership and control does not change. An advantage of this approach is that firm births as well as firm deaths are readily and consistently

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sector level. We have replicated our main findings using an extended version of the BDS with cell based regressions at the detailed industry, age and size level of aggregation. We have also found that the basic patterns we report also hold using the public domain BDS controlling only for broad sector. More generally, we have found that the patterns we find in our regression analysis can be replicated using a cell-based regression approach with net employment growth rates defined at the industry by firm, size by firm and age by year level of aggregation.

[12] This is one clear distinction with the NETS database which apparently includes both employer and nonemployer businesses (but also apparently not the universe of both).

defined. That is, a firm birth is defined as a new firm ID where all the establishments at the firm are true births. Similarly, a firm death is defined as when a firm ID disappears and all of the establishments associated with that firm ID exit.[13]

A strength of our firm size and age measures is that they are robust to ownership changes. For a pure ownership change with no change in activity, there will be no spurious changes in firm size or firm age. When there are mergers, acquisitions, or divestitures, firm age will reflect the age of the appropriate components of the firm that has changed activity. Firm size will change but in a manner also consistent with the change in the scope of activity. In section 3.3 below, we provide further discussion on how our measurement methodology yields patterns of the relationship between net growth, firm size and firm age that are robust to ownership changes and M&A activity.

Before proceeding, we note that in the current paper we focus on growth dynamics of establishments and firms over the 1992 to 2005 period. The sample period is so that we can define firm age consistently for all establishments for firm age groups 1 through 15 with an additional right-censored group that are establishments that belong to firms that are 16 years or older (in 1992 these are firms that have an establishment that existed in 1976). As is clear from Table 1, the BDS has a larger number of age groups for the later years but also a smaller number of age groups for the earlier years. We use the 1992 to 2005 period and the 1-15, 16+ categories as a reasonable compromise.

3.2 Firm Size, Firm Age and Employment

This section describes firm size and firm age distributions. Figure 1 shows the share of total employment in each firm size class between 1992 and 2005 and Table 2 shows both the shares and average employment in each size class. For these basic facts, we report distributions for both base size and current size methodology. Interestingly, in terms of the cross sectional distribution there is essentially no difference between these two methods. Employment is highly skewed towards large employers. Small firms, those with fewer than 20 employees, employ about 20 percent of all workers in the non-farm private economy. By contrast large firms, those with 500 or more employees employ roughly 48 percent of all workers in the non farm economy. The largest firms, those with 10,000 or more employees employ close to one out of four workers.

Figure 2 shows shares of employment by firm age. About 3 percent of employment is accounted for by firm births and about 15 percent of employment is accounted for by firms less than 6 years old. However, more than half of employment is accounted for by firms more than 16 years old. Taken together, Figures 1 and 2 highlight that employment is concentrated in both larger and mature firms.

Size and age are positively correlated, large firms tend to be older and young firms tend to be small. Figure 3 shows the joint distribution of employment by firm size and firm age. It is apparent that most large businesses are mature businesses. Indeed, about 23 percent of employment is accounted for by firms that have more than 10,000 employees and are more than

[13] The unit of analysis in the BDS is the establishment. The BDS then identifies job creation from firm births but currently it does not provide information on the number of firm entries and exits.

16 years old. It is also apparent that most young businesses are small. The converse is less true. Conditional on being small, there is roughly a u-shaped pattern with respect to age.

The relationship between business startups and firm size is of particular importance in the results that follow. To highlight this relationship, Figure 4 shows the share of employment from startups in each size class using both methods. Table 3 provides the underlying statistics and employment counts. Using either classification, we find that startups account for a largeshare of employment in the smaller size classes, those with fewer than 20 employees. The contribution of startups declines with firm size and is negligible for the largest firm categories. While the qualitative patterns are similar, there is a notable difference in the share of employment in the smallest size class across the two methods. We find a general pattern that startups tend to be classified in smaller size classes using the current year size classification method.

It is also useful to abstract from the role of startups in examining the relationship between firm size and firm age. Figure 5 describes the age of the firm for the average worker employed at a continuing firm of a given size class. We exclude startups from the computation since this has a disproportional effect on small size classes.[14] The average employee of the largest US firms works for a company that is 28 years old. By contrast the average employee of the smallest US firms works for a company that is 11 years old.

3.3 The Establishment-Level and Aggregate Growth Rate Concepts

This section describes the establishment-level growth rate measures we use in the paper. Some basic notation is as follows. Let E_{it} be employment in year *t* for establishment *i*. In practice, this is a point-in-time measure reflecting the number of workers on the payroll for the payroll period that includes 12 March. We measure establishment-level employment growth as follows:

$$g_{it} = (E_{it} - E_{it-1}) / X_{it},$$

where

$$X_{it} = .5*(E_{it} + E_{it-1}).$$

This growth rate measure has become standard in analysis of establishment and firm dynamics, because it shares some useful properties of log differences but also accommodates entry and exit. (See Davis et al 1996, and Tornqvist, Vartia, and Vartia 1985).[15] In what follows, we refer to this as the DHS growth rate measure. Note that the DHS growth rate measure can be defined at any level of aggregation (establishment, local area, industry, etc.)

Measures of job creation and destruction at the establishment level are given by:

[14] Including startups reduces average age by 2 years in the smallest size class and has virtually no effect in the largest size class.

[15] The DHS growth rate like the log first difference is a symmetric growth rate measure but has the added advantage that it accommodates entry and exit. It is a second order approximation of the log difference for growth rates around zero.

$$JC_{it} = \max(g_{it}, 0)$$
$$JD_{it} = \max(-g_{it}, 0)$$

Job creation from entry at the establishment level is given by:

$$JC_{it} = \max(g_{it}, 0) * I\{g_{it} = 2\}$$

where I is an indicator variable equal to one if expression in brackets hold, zero otherwise, and g_{it} = 2 denotes an entrant.

Similarly job destruction from exit at the establishment level is given by:

$$JD_{it} = \max(-g_{it}, 0) * I\{-g_{it} = 2\}$$

where $g_{it} = -2$ denotes an exit.

Using these measures it is straightforward to generate aggregate measures of job creation and destruction as well as job creation and destruction from entry and exit, respectively (at any level of aggregation) given by:

$$JC_t = \sum_i (X_{it} / X_t) \max\{g_{it}, 0\}$$

$$JD_t = \sum_i (X_{it} / X_t) \max\{-g_{it}, 0\}$$

$$JC\_Entry_t = \sum_i (X_{it} / X_t) I\{g_{it} = 2\} \max(g_{it}, 0).$$

$$JD\_Exit_t = \sum_i (X_{it} / X_t) I\{g_{it} = -2\} \max(-g_{it}, 0)$$

Given these definitions, the following simple relationships hold:

$$g_t = JC_t - JD_t, \; JC_t = JC\_Cont_t + JC\_Entry_t \text{ and } JD_t = JD\_Cont_t + JD\_Exit_t$$

where JC_Cont and JD_Cont are job creation and job destruction for continuing establishments respectively.

In the analysis that follows we consider employment weighted regressions of establishment-level data. The employment-weighted regressions yield that the mean of the dependent variable is equal to the appropriate employment weighted mean. For example, consider a specification relating establishment-level net growth to the firm size categories in Figure 1. The employment-weighted regression on firm size dummies yields the aggregate net employment growth rate by firm size category. As we show in the appendix, employment-weighted establishment level growth rates for a given classification of establishments is

equivalent to employment weighted firm level growth rates for the same classification of firms in a manner that is robust to abstracting from firm ownership changes and M&A activity.

While the details are in the appendix, a few remarks help illustrate this critical point. First, by using establishment-level employment-weighted growth rates, we avoid spurious firm births, deaths or growth from ownership changes or M&A activity. For example, consider a 1000 person establishment that exhibits a net job gain of 100 jobs between year t-1 and t that also changes ownership between t-1 and t (i.e., is a divestiture from the originating firm and an acquisition for the destination firm). A naïve treatment of firm level data would treat the loss of 1000 for the divesting firm and the gain of 1100 for the acquiring firm. Our treatment is to count only the 100 net new jobs. Moreover, as discussed in the prior subsection, our firm size and firm age classification methods make clear how we are using the parent firm information in years t-1 and t to define the size and age characteristics.

While the employment-weighted establishment level net growth rates and employment weighted firm level net growth rate patterns are equivalent for any common classification, it is important to emphasize that further decompositions of net growth rate patterns into job creation, job destruction, establishment entry and establishment exit components are not the same at the firm and establishment-level. The reason is straightforward since within the same firm there may be some establishments expanding and opening while others are contracting and shutting down. In what follows, we explore such decompositions of net growth rate patterns into these components.[16]

3.4 The Establishment-Level Growth Rate Distributions

Before proceeding to the relationship between firm size, firm age and net growth, it is instructive to characterize the underlying distributions of establishment-level growth. Figure 6 shows the distribution of employment growth rates for all establishments, Panel A, as well as for continuing establishments, Panel B. Figure 6 reports both employment weighted and unweighted results. Growth rate distributions are annual net growth rates using data for all establishments between 1992 and 2005. Several patterns stand out. First, the U.S. economy is extremely dynamic with large numbers of establishments opening and closing at any given time. The upper panel of Panel A shows that approximately 20 percent of all establishments are new or die on average during this period in any given year. The lower panel of Panel A shows that in terms of employment establishment births and deaths account for a relatively smaller share of jobs, approximately 5.7 percent, an indication that many of these establishments are small.

Second, high churning in the economy is combined with substantial inertia. Figure 6 shows that approximately 30 percent of establishment-year records in the LBD exhibit no change in net employment from one year to the next. The share of jobs at establishments characterized

[16] Our analysis of continuing, entering and exiting establishments would also be enhanced if we more completely linked these to continuing, entering and exiting firms. In this respect, our analysis of entering establishments and entering firms is already satisfactory as we clearly distinguish between entering establishments of new firms (firm age 0 firms) and existing firms. However, in our analysis of exiting establishments we do not currently identify whether the establishment exit is associated with an exiting or continuing firm. We plan to explore these issues further in the next draft.

by zero employment growth account for approximately 13 percent of all jobs an indication that these establishments tend to be small. It is striking there is this much inertia at an annual frequency. Davis, Faberman and Haltiwanger (2006) report that about 80 percent of establishments have zero net employment change at a monthly frequency and about 30 percent of employment is at establishments that have zero employment change at the monthly frequency.

Third, it is clear there is considerable dispersion in establishment-growth. Within any given year, there are a substantial number of establishments as well as a substantial amount of employment at establishments with growth in excess of 10 percent and a substantial amount with growth less 10 percent. This dispersion highlights the dynamism of U.S. establishments but also highlights that it is important to be careful about net vs. gross job creation and destruction in the context of attributing growth by firm characteristics.

It is also instructive to explore the serial correlation properties of net growth rates at the establishment-level. Figure 7 shows the estimated autocorrelation patterns for all establishments using both the base size and current size classification methods. Interestingly, there is a negative correlation in all size categories. This reflects the presence and importance of transitory shocks. That is, growth one year tends to be at least partially reversed the following year. In addition, with the base size category the negative correlation is larger in magnitude for the smaller size classes. This suggests that the regression to the mean issues that make inferences about net growth and firm size are more of an issue for the very small businesses when using the base size category.

4. *The Relationship Between Net Growth, Firm Size and Firm Age*

This section presents the main empirical results of the paper. Our objective is to understand the relationship between net employment growth, firm size and firm age. We use a non-parametric regression approach to quantify these relationships. In our main specification, we regress net employment growth at the establishment-level on firm size classes by themselves, on firm age classes by themselves and by firm size and age together. We focus on employment-weighted specifications since this enables the coefficients to be interpreted in terms of the aggregate net employment growth rate at the aggregate level for the specified category. Since firm size and firm age distributions vary by industry and net growth rate patterns vary by industry, we control for detailed industry fixed effects. In addition, to abstract from cyclical or secular aggregate considerations we control for year effects. Given our non-parametric approach with industry and year fixed effects, our results are readily interpretable as employment-weighted conditional means.[17]

In what follows, section 4.1 presents the results where the dependent variable is net employment growth. Given the interesting patterns we find, section 4.2 presents results where we decompose the net employment growth into intensive and extensive margins by examining continuing, entering and exiting establishments. Finally, in section 4.3 we explore how the patterns look if we use establishment size and age categories. As discussed in the introduction

[17] We obtain virtually the same results using a cell-based regression approach described as follows. First, compute the net employment growth rate using the DHS methodology at the following level of aggregation: detailed industry, size, age, industry and year. Second, estimate same non-parametric regression specification with size, age, industry and year effects.

and section 2, the appropriate categories are firm size and firm age for the questions of interest in this paper. However, there is independent interest in the role of establishment size and age. In addition, many papers in the literature have been restricted to using establishment size and age categories so this analysis serves as a check to help understand how the results are sensitive to this potentially important discrepancy.

4.1. Net Employment Growth

Table 4 presents results on the role of firm size and firm age for net job creation. We report results using both base size and current size measures of firm size. Data for the regressions are available starting in 1976, the first birth cohort observed in the LBD. To ensure we have sufficient observations across the firm age distribution, we restrict the analysis to the period between 1992 and 2005 to allow firm age for the first birth cohort to accumulate to a minimum of 15 years with a common right censored category of 16+ years[18].

We start by reporting net employment growth rate patterns for firms of different size ignoring the impact of age. Column 1 shows the results using base-year size. In interpreting the results from these regressions, it is important to emphasize that the reported coefficients represent differences relative to the omitted groups. We observe high net employment growth rates for the smallest size firms (those with between 1 and 4 employees) relative to the largest size class. The average annual rate of net employment growth in this size class is 18.9 percent higher than that for the largest size firms. The effect declines monotonically as the size of the firm increases. The relative net employment growth premium for being small decreases to 6.1 percent, 3.3 percent and 1.7 percent for size classes 5-9, 10-19 and 20-49 respectively. It stays at less than 1 percent for the larger size classes. These patterns support the hypothesis of an inverse relationship between net growth and firm size when using size classes defined using the base-year method and are similar in character to those found recently by NZW.

Turning to the current-year (average) size measures in the second column, we see a significant drop in the magnitude of the estimated size effects relative to base year specifications. They are still significantly higher for the smallest size class at 4.2 percent (compared to 18.9 percent) but much reduced. We also observe that the highest net growth rates tend to be for size classes less than 500 but it's also worth noting this is not a strictly monotonic relationship. For example, we find reasonably high positive relative net growth rates for firms that are as large as 2500 to 4999 workers. Comparing the first two columns suggest the effects of regression to the mean are quite strong in the smallest size classes. This is not surprising given findings reported in Figure 7 showing that transitory shocks play a more important role for smaller businesses.

Our primary contribution is to explore what happens to these patterns when we control for firm age. Estimates from models that include only size categories are likely influenced by the omission of startups and age controls on the specification. From the results in section 3, we know many small firms are startups. These startups are likely to have a significant influence on the estimated size coefficient. We also know there is a positive correlation between size and age. This relationship is complex. There are many small firms that are old but relatively few make it

[18] Annual records for the LBD contain codes that describe how they relate to a record for the preceding year. The first year of source data for the LBD is 1975. Age can't be determined for these cases and they are in the 16+ category in the first year used in our analysis, 1992.

past the first few years so large firms are older on average. Many of these small firms shut down contributing significantly to job loss in the economy. There are also young firms that grow to be large quickly. Ideally we want to isolate these types of effects.

Column 3 reports net employment growth rate patterns for firms of different age but ignoring the role of firm size. Firm age is also treated in a non-parametric fashion. Establishments of new firms (true startups) are classified in the age zero class. Firms up to age 15 are classified each in their own category. Older firms are grouped together as a group defined 16 and older. There is a very large coefficient for firm startups reflecting the high net growth rate for business startups.[19] One can think about this effect as putting in a dummy variable indicating that the establishment is part of a startup so that then the remainder of the coefficients can be interpreted as reflecting the behavior of establishments abstracting from startups. In column 3, we find relatively high growth rates for the one year old firms relative to the most mature firms. The premium for being one year old is 3.4 percent. Interestingly, all other firm categories up to age 12 display negative net job creation relative to the oldest group with the largest negative effects for firms age 2 at -3.2 percent. It increases monotonically after that to -.5 percent for firms age 12. These results suggest that on average young firms shed jobs rapidly after age 1 contributing significantly to the overall job loss relative to old firms. However, as before these estimates are likely influenced by the omission of firm size controls.

Columns 4 and 5 report the results for firms of different size while simultaneously controlling for firm age. Column 4 has the results using base-year size while column 5 has the results using current-year size. The estimates for the size coefficients in columns 4 and 5 differ substantially from the analogous results in columns 1 and 2. Having controlled for firm age effects, column 4 shows no systematic relationship between net growth and base firm size. The smallest size class has the largest positive coefficient but the size classes in the range from 5 to 499 have the most negative coefficients. This implies that firms in the 5 to 499 range have lower net growth rates on average than the largest businesses, once we control for firm age. When we use current size (column 5), we also don't observe a monotonic relationship, but we do find a *positive* relationship between net growth and firm size for all the size classes up through 5000 workers. Using this size class methodology, small businesses with employment between 1 and 499 workers have substantially lower net growth rates than the largest businesses. While the details differ non-trivially depending on which size class method we use, the main point is that, once we control for firm age, there is no evidence that small firms systematically have higher net growth rates than larger businesses.[20]

The firm age patterns in columns 4 and 5 are of considerable interest in their own right. We focus on column 5 since this is the specification that includes the measure of firm size that is less subject to regression to the mean effects. We find that once we control for firm size there is substantially higher relative net growth in age 1 firms and a more general pattern of higher net growth for younger firms relative to the more mature firms. Of course, what stands out in both

[19] Recall at the establishment-level, the net growth rate for an establishment at a firm startup is equal to 2 using DHS methodology. The estimated coefficient in Table 3 for all firm age 0 establishments is close to 2 but not identical to 2 since this is a relative coefficient to the most mature firms.

[20] The patterns in Table 4 are, not surprisingly, roughly consistent with the simple tabulations from the BDS in Table 1 where we observed many negative net job cells for smaller businesses abstracting from startups.

columns 4 and 5 is the role of firm startups. Firm startups contribute substantially to net growth regardless of whether we control for firm size or how we control for firm size.

4.2. Different Margins of Adjustment

As illustrated in Figure 6, the economy is a complex aggregation of expanding, entering, contracting and exiting establishments and firms. Thus, the patterns we have reported in Table 4 may mask quite different patterns by size and age on different margins of adjustment. We have already seen the dominant role of firm startups in the patterns of net growth. In this section, we focus on the different margins of adjustment.

Our approach here is to decompose the net growth rate patterns into continuing establishments, entering establishments and exiting establishments. To accomplish this, we estimate a series of employment-weighted regressions with the same RHS variables as Table 4 but using a series of different LHS variables. In one specification, we restrict the sample to continuing establishments where the dependent variable is the net employment growth rate for such establishments. In alternative specifications, we use all establishments with the LHS variable equal to the job creation from establishment entry or alternatively the job destruction from establishment exit as defined in section 3. Since all specifications are employment-weighted the mean of the LHS variable is the aggregate component as defined (e.g., the aggregate net employment growth rate of continuing establishments). It is also important to note that all specifications include the full set of controls for year and detailed industry effects.

To facilitate the exposition of these regression results, we report the estimated coefficients from these alternative specifications in figures 8 and 9. Figure 8 shows the estimated coefficients from firm size effects while Figure 9 shows the estimated coefficients from firm age effects.[21] Each figure has four panels. The upper left panel shows the patterns we have already discussed from Table 4. The upper right panel shows net growth patterns for continuing establishment. The lower left panel shows the patterns for job creation from establishment entry and the lower right panel shows the patterns for job destruction from establishment exit. In interpreting these different components, it is important to emphasize that establishment entry and exit is a common phenomenon at continuing firms. Put differently, continuing establishments should not be interpreted as equivalent to continuing firms. Continuing establishment results are a component of what happens at continuing firms but only a component. Our remarks will help draw out these distinctions.

The upper right panel for continuing establishments shows stark differences in the patterns for small firms depending on the size class methodology. Using the base year methodology, the continuing establishments of the smallest firms have substantially higher net growth rates than the continuing establishments of the largest firms. Controlling for firm age has little impact on these patterns. In contrast, when using current year size, continuing establishments of small firms have about the same growth rate as continuing establishments of larger firms when we don't control for firm age. However, once we control for firm age,

[21] We also note that given the very large sample, the standard errors (not reported) are all very small (less than 0.0005 in all cases).

continuing establishments of small firms have lower growth rates than continuing establishments of larger firms. The stark differences here between base size and current size results for the continuing establishments of the smallest firms are consistent with strong regression to the mean effects since these are primarily relevant for continuing establishments. Moreover, as we have already highlighted, Figure 7 suggests that the role of transitory shocks is most important for the establishments of the smallest firms.

The lower left panel shows that controlling for firm age has a substantial impact on the relationship between job creation from establishment entry and firm size. Without firm age controls, smaller firms have higher job creation rates from establishment entry than larger firms. However, once we control for firm age, we find that for both the base year size and current year size methods that smaller firms have lower job creation rates from establishment entry than larger firms. In interpreting these findings, it is important to note that controlling for firm age abstracts from the contribution of firm startups. As such, the results in the lower left panel controlling for firm age provide insights into the relative job creation from establishment entry for continuing firms. The implication is that large continuing firms are more likely to have job creation from establishment entry than small continuing firms.

Turning to the patterns for job destruction from establishment exit, the lower right panel shows that there is a general pattern of greater job destruction from establishment exit for smaller firms than larger firms regardless of size class methodology or controlling for firm age. While the qualitative patterns are similar, job destruction from establishment exit is higher for smaller businesses using the current size relative to the base size methodology. This pattern is not due to regression to the mean effects since exit tends to be permanent.[22] Instead, it reflects the fact that the current size methodology more closely mimics the dynamic sizing method of the BLS – that is, small businesses are more likely to "pass through" the smallest size classes as they exit.

Note that controlling for firm age in the lower right panel of Figure 8 lowers job destruction although this effect is relatively small. When using the base year size method, controlling for firm age lowers the job destruction from exit for small firms. This makes sense as many of the young firms are small and as we will soon see younger firms have higher rates of job destruction from exit. There is a similar pattern but even a smaller impact of firm age when using the current year size method.

Many of the patterns in Figure 8 are easier to understand by comparing and contrasting with the patterns in Figure 9 that shows the analogous patterns for firm age. In Figure 9, the firm startup estimated coefficient is not reported in the upper left hand panel or the lower left hand panel since it is much higher and close to 2. The upper left panel shows the results from Table 4. The remaining panels show that the relatively weak relationship between firm age and net growth in the upper left panel masks richer dynamics for surviving and exiting establishments. In the upper right hand panel, we find that conditional on the establishment surviving (i.e., being a continuing establishment), young firms exhibit substantially higher growth than more mature firms. In contrast, the lower right hand panel shows that the job destruction due to establishment exit is higher for young firms than more mature firms. In combination, these two panels show an

[22] In a very small number of cases, an establishment shuts down temporarily.

"up or out" pattern for the establishments of young firms that is robust to controlling for firm size (and robust to whichever size class method is used).[23]

The lower left panel shows that there is not much of a relationship between job creation from establishment entry and firm age for firms with age greater than or equal to one. It is not correct to interpret this finding as suggesting establishment entry rates are small for firms one and older. The reported coefficients are relative effects compared to the omitted group so the correct interpretation for this (and other panels) is that there is not much difference in the creation rates from establishment entry across age classes. Moreover, it is critical to emphasize that that the firm age 0 coefficient (startups) is omitted from the chart since this coefficient is literally off the chart (close to 2). Still, it is interesting to compare these patterns with the lower left panel of Figure 8 where we observed that when we controlled for firm age, that largest businesses have higher creation rates from establishment entry than smaller businesses.

The results depicted in Figures 8 and 9 show that the margins of adjustment differ substantially across firm size and firm age classes. Figure 8 shows that the role of controlling for firm age on firm size effects is mostly associated with the impact of firm age on job creation from establishment entry and job destruction from establishment exit. Figure 8 also shows that the large differences associated with the size class methodology are especially present for continuing establishments – the establishments for which regression to the mean effects are relevant. Figure 9 shows that the overall firm age net growth relationship masks a rich "up or out" pattern for the establishments of young firms.

Figures 8 and 9 help highlight the volatility of young and small businesses are volatile along a number of dimensions. Figures 8 and 9 show that young and small businesses have higher rates of job destruction from exit. Moreover, Figure 9 shows that conditional on survival, the establishments of young firms have higher net growth rates. In unreported results (available upon request), we have also found that the continuing establishments of young firms exhibit higher rates of job creation and destruction – so the higher net growth rate for the continuing establishments of young firms in Figure 9 has high accompanying underlying volatility. Even the sensitivity in Figure 8 to the size class methodology for continuing establishments of small firms can be interpreted as reflecting high volatility. That is, high transitory shocks are a form of high volatility and it appears small firms are especially subject to a high variance of transitory shocks.[24]

4.3. Results using Establishment Age

In this section, we explore the role of establishment size and age. Since some datasets are limited in only having establishment-level information, it is useful to check how different the patterns are on this dimension. There is also independent interest in the role of establishment size and age – these characteristics reflect different characteristics that may be quite relevant for employment growth rate dynamics.

[23] In interpreting Figures 8 and 9 and for the results on job destruction from establishment exit in particular it is useful to note that most of the young and small businesses are single unit establishment firms. As such, establishment exit typically implies firm exit. Still, it would be of interest to explore the distinction between establishment and firm exit more completely which we plan to do in the next draft.

[24] Some caution in interpretation is required here since we don't observe shocks. It could be for example that small businesses are more responsive to transitory shocks given differences in adjustment costs.

Table 5 lists the results regressions highlighting the role of establishment size and age on net job creation. It is the equivalent to Table 4 with the difference that the size categories are truncated at 1000+. At the firm level, there is much activity in firms larger than 10,000 employees but for establishments there are relatively few establishments that large. The first column shows a strong inverse relationship between establishment size and net growth when using a base year size (now applied at the establishment level). However, the second column shows that this relationship is not robust to using current size. It appears as if those patterns are entirely due to regression to the mean effects.

The more interesting results are columns 4 and 5. In column 4, we find that even when we control for establishment age, there remains a strong inverse relationship between net growth and establishment size. This pattern is not robust to using current size. For establishment age, we find that establishment births obviously contribute substantially to net growth. Moreover, we find that age 1 establishments have higher net growth than more mature counterparts and for our preferred specification that virtually all ages have slightly higher growth than the oldest establishments.

Overall, the patterns for establishment size and age are similar to those for firm size and age with one notable exception. Controlling for firm age in Table 4 eliminates any systematic relationship between firm size and net growth. Controlling for establishment age in Table 5 has much less of an effect on the base year size approach. Two likely effects are at work here. First, regression to the mean effects are likely more important at the establishment than the firm level. That is, for multi-unit establishment firms the role of transitory shocks is less likely to shift firms across size classes. Second, firm age is a much more powerful control than establishment age.

5. *Concluding Remarks*

We use a recently developed longitudinal business database that tracks all establishments and firms in the U.S. nonfarm business sector over the last few decades to explore the role of firm size and firm age in employment growth. There is a widespread popular perception that small businesses create more or even most jobs in the U.S. We argue, as has the earlier literature, that the question of "what fraction of net new jobs are created by small businesses?" is not a well posed question. Still, it is certainly of interest to explore the relationship between firm size and net employment growth. We find some evidence in support of the popular perception along the following lines. If one looks at the simple relationship between firm size and net growth rates, there is evidence that net growth rates tend to be higher for smaller as opposed to larger businesses. We caution, however, that even this simple relationship is complicated by regression to the mean effects. Using the method that we argue is more robust to such concerns, the inverse relationship between net growth rates and size remains but is not overwhelming.

A more important and robust finding is the role of firm age. We find that once we control for firm age, the negative relationship between firm size and net growth disappears and may even reverse sign as a result of relatively high rates of shutdowns amongst the smallest firms. Our findings suggest that it is particularly important to account for business startups. Business startups account for roughly 3 percent of U.S. total employment in any given year. While this is a reasonably small share of the stock, it is large relative to the net flow which averages around 2.2 percent per year. Startups tend to be small so most of the truth to the popular perception is driven by the contribution of startups to net growth.

We also find rich dynamics among the young firms in the U.S. Young firms exhibit high rates of gross job creation and destruction. Consistent with this pattern, we find that young firms have very high job destruction rates from exit. However, we also find that, conditional on survival, young firms grow more rapidly than their more mature counterparts. In combination, our findings suggest a rich "up or out" dynamic of young firms.

Most of our focus in the analysis is on the net growth rate patterns by firm size and firm age (along with the underlying different margins of adjustment). However, our basic facts also show that large, mature businesses account for a large fraction of jobs. Firms over 16 years old that have more than 10,000 workers account for about 1 in 4 jobs in the U.S. private sector. In contrast, businesses that are young and small account for a relatively small share of the stock of jobs. It is important to keep this skewed distribution of employment in mind when interpreting the net growth rate patterns since the overall contribution to job growth depends both on the stock and the net growth rate patterns.

In closing, we think our findings help interpret the popular perception of the role of small businesses as job creators in a manner that is consistent with theories that highlight the role of business formation, experimentation, selection and learning as important features of the U.S. economy.[25] Viewed from this perspective, the role of business startups and young firms is part of an ongoing dynamic of U.S. businesses that needs to be accurately tracked and measured on an ongoing basis. Measuring and understanding the activities of startups and young businesses, the frictions they face, their role in innovation and productivity growth, how they fare in economic downturns and credit crunches all are clearly interesting areas of inquiry given our findings of the important contribution of startups and young businesses. In a related manner, it is important to not focus only on jobs per se but also on the role of these dynamics in the patterns of productivity and earnings behavior in the U.S. We think our findings show that the LBD and the BDS are rich databases to track U.S. business dynamics but it is also clear that additional information about the productivity and earnings dynamics need to be added to these databases and related analyses.

[25] There has, of course, been substantial theoretical development along these lines (e.g., Jovanovic (1982), Hopenhayn (1992) and Ericson and Pakes (1995)) and our findings, like others in the literature (e.g., Dunne, Roberts and Samuelson (1989) and DHS) provide broad empirical support for this class of models and ideas.

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Appendix: Establishment, Firm and Aggregate Net Growth Relationships:

In this appendix, we explore the relationships between employment-weighted establishment level net growth rates and employment-weighted firm level net growth rates. In considering these relationships, it is helpful to first abstract from ownership changes and M&A activity. In particular, consider initially an environment where there are no acquisitions or divestitures and where any whole firm ownership changes don't yield changes in firm ids (that is, when "Joe's Diner" becomes "Pete's Diner" the firm ID is longitudinally linked so there are no spurious firm births or deaths). Then the following identities hold:

$$g_{ft} = \sum_{i \in f} (X_{it} / X_{ft}) g_{it}$$

$$g_{st} = \sum_{f \in s} (X_{ft} / X_{st}) g_{ft} = \sum_{i \in s} (X_{it} / X_{st}) g_{it}$$

$$X_{ft} = \sum_{i \in f} X_{it}$$

$$X_{st} = \sum_{f \in s} X_{ft} = \sum_{i \in s} X_{it}$$

Where i indexes establishments, f indexes firms, s indexes classifications of firms and establishments into groups defined by s, X is the DHS denominator, and g is the DHS growth rate. That is, the employment-weighted net establishment employment growth aggregating all establishments in the same firm yields the firm net growth rate and the aggregate net growth rate can be generated either by first aggregating the establishment net growth to the firm level or by aggregating directly from the establishment-level net growth. This aggregate can be defined for any level of aggregation "s" where "s" can refer to economy-wide, industry, firm size, or firm age classifications. This implies that as long as the establishments are classified into groups "s" in a manner consistent with how firms are assigned to groups "s" that employment-weighted establishment-level growth patterns by classification "s" yield the employment-weighted firm-level growth patterns by classification "s". For our purposes, this implies under the assumptions stated that the employment-weighted net establishment level growth rate patterns by firm size class yield the relevant employment-weighted net firm level growth rate patterns by firm size class.

With M&A or ownership change activity, further considerations must be taken into account. Note first that whole firm ownership changes are in principle straightforward. That is, if all ownership changes are of the form where all establishments in a firm (including entering and exiting establishments) are subject to the same change in ownership then as long as the firm IDs have been properly linked then the above equivalency holds. The more complicated cases are those where there is M&A activity involving acquisitions and divestitures. The discussion that follows shows that our current methodology offers a reasonable way to treat and classify the net growth that is also associated with M&A activity.

An example is helpful to illustrate these issues and how our methodology offers a reasonable way to treat M&A activity in a consistent manner at the establishment and the firm level. Consider an establishment that has been involved in a divestiture and acquisition from t-1 to t.

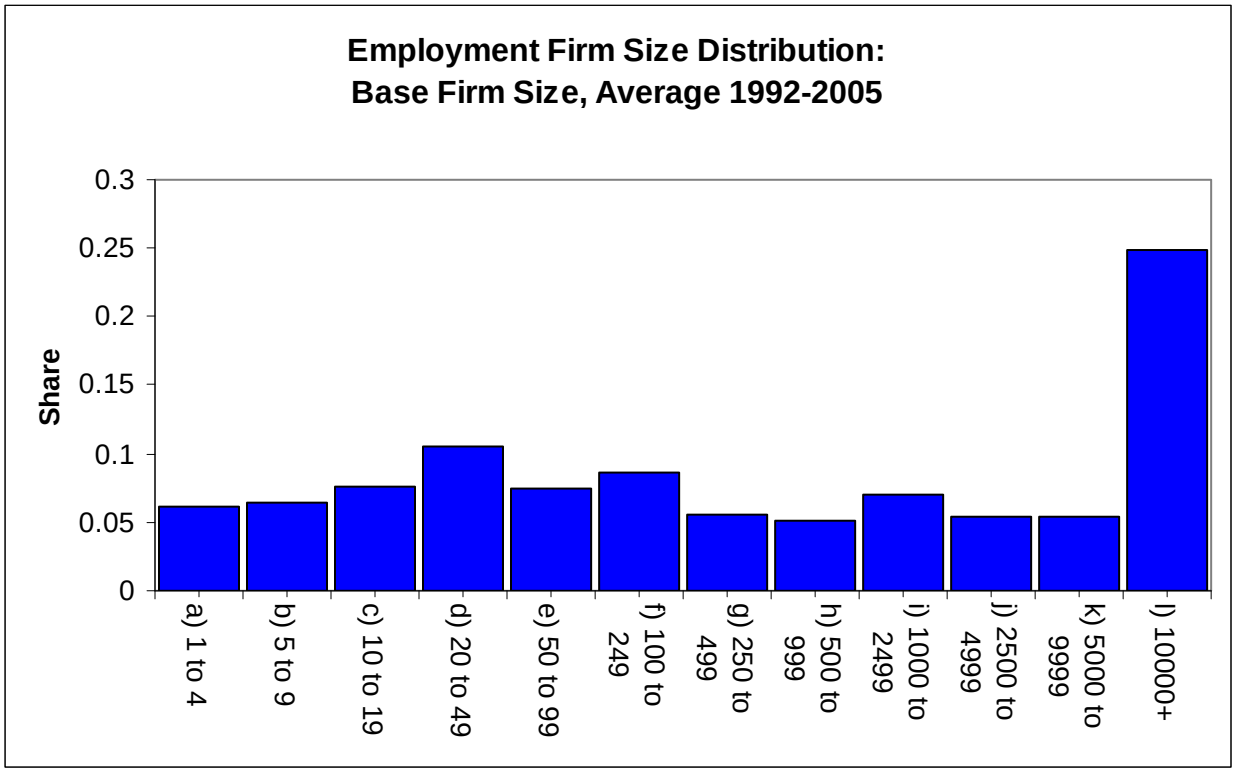
The establishment-level classification used in the analysis under the *current* size class methodology, assigns this establishment to the size class based upon the average of the firm that the establishment belonged to in t-1 and t. Suppose this establishment created 100 net new jobs. The method in the text would assign this net 100 new jobs to the average of the size classes of the divesting and acquiring firm.

If instead we first aggregated the data to the firm level we would need to make a number of assumptions. First, we would have to determine which firm gets the "credit" for the net new jobs (the divesting or acquiring firm or both). That is, we would want to start by defining the net employment growth for the firm as based on the continuing establishments of the firm, the true entering establishments, and the true exiting establishments. We would then want to only include any additional net growth from acquisitions or divestitures that represented true growth and not just changes in ownership. So if the establishment in question went from 1000 to 1100 workers between t-1 and t *and* we decided to allocate the net new growth to the acquiring firm, then we would only want to count the 100 new jobs (and obviously not the 1100 overall jobs) in computing net growth. But it is not clear why the acquiring firm (or for that matter the divesting firm) should be allocated the entire net new jobs. An alternative that would mimic what we do at the establishment-level would be a method that credits both acquiring and divesting firms and described as follows. First, define firm-level net growth for all firms in the absence of any acquisitions or divestitures (and avoiding any spurious firm births and deaths due to whole firm ownership changes). Then for any establishments involved in acquisitions or divestitures, treat the net growth like we currently do in the text – i.e., allocating to the average of the size of the acquiring (t) and divesting firm (t-1). Viewed from this perspective, our current method can be seen as a classification method that robust to M&A activity as well as ownership changes with a specific allocation rule that gives "credit" to both the acquiring and divesting firm for any net growth that occurs.

Note that for the base year size methodology, care must still be given to treating M&A activity but the decision on which firm to give credit to any net growth from establishments impacted by M&A activity is straightforward. That is, under the base year size methodology, it is the divesting firm that gets the "credit". For the establishment-level approach used in the text, it is also the divesting firm that gets the credit as the establishment is assigned the firm size class based on the t-1 firm.

Finally, it is also important to note that the above identities hold for net growth rates but not for the components of net growth such as gross job creation and destruction. That is, employment-weighted establishment-level gross job creation is not equal to employment-weighted firm-level gross job creation and so on. The reason is obvious since there can be within firm establishment-level creation and destruction.

Figure 1


Employment Firm Size Distribution:
Base Firm Size, Average 1992-2005
Share
0.3
0.25
0.2
0.15
0.1
0.05
0
a) 1 to 4
b) 5 to 9
c) 10 to 19
d) 20 to 49
e) 50 to 99
f) 100 to 249
g) 250 to 499
h) 500 to 999
i) 1000 to 2499
j) 2500 to 4999
k) 5000 to 9999
l) 10000+

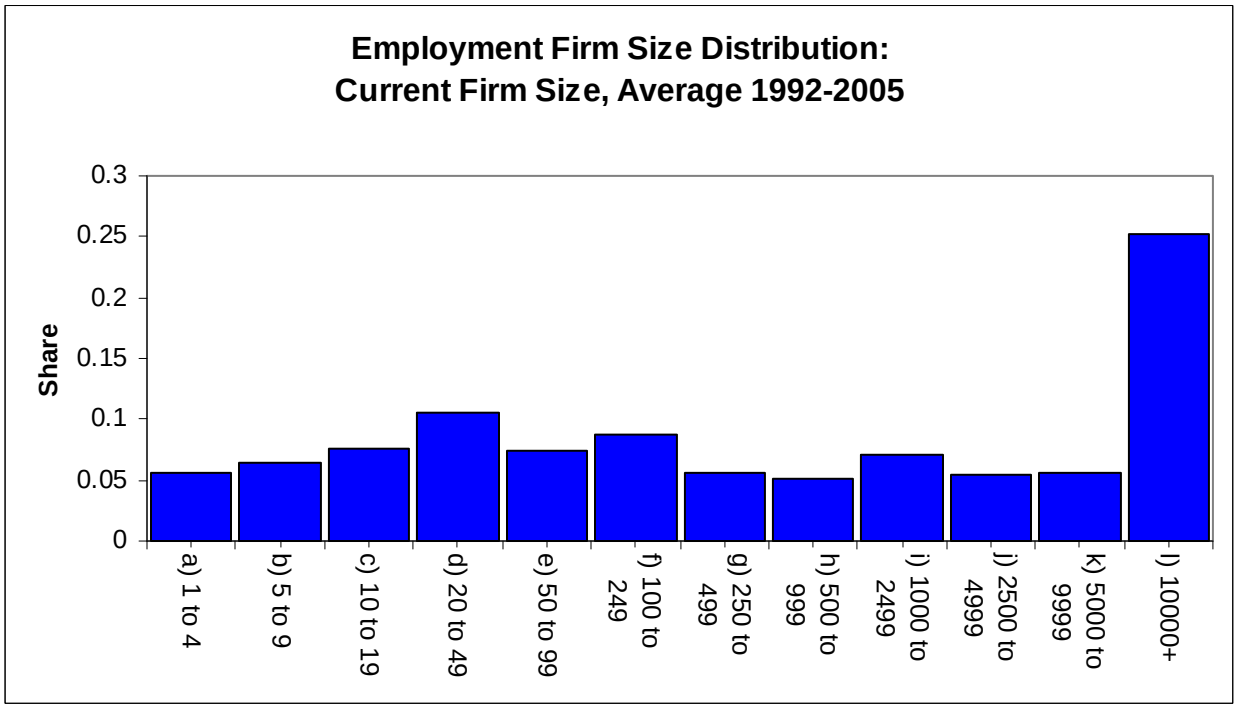

Employment Firm Size Distribution:
Current Firm Size, Average 1992-2005
Share
0.3
0.25
0.2
0.15
0.1
0.05
0
a) 1 to 4
b) 5 to 9
c) 10 to 19
d) 20 to 49
e) 50 to 99
f) 100 to 249
g) 250 to 499
h) 500 to 999
i) 1000 to 2499
j) 2500 to 4999
k) 5000 to 9999
l) 10000+

Figure 2

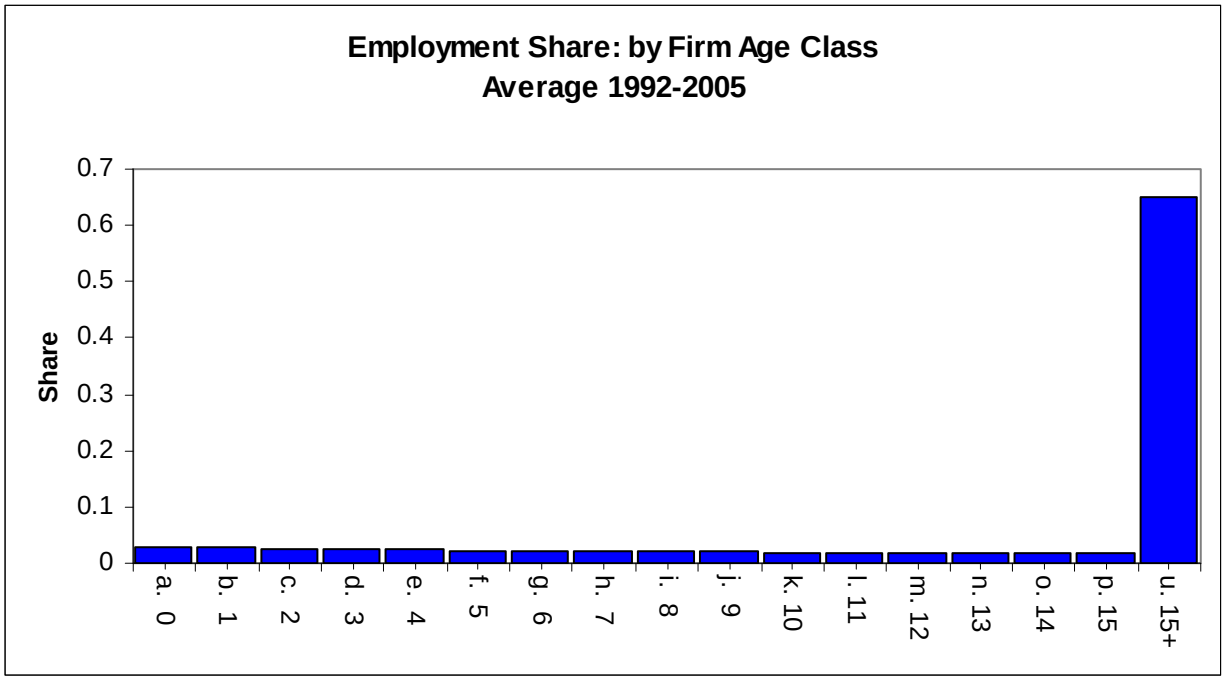

Employment Share: by Firm Age Class
Average 1992-2005
Share
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
a. 0
b. 1
c. 2
d. 3
e. 4
f. 5
g. 6
h. 7
i. 8
j. 9
k. 10
l. 11
m. 12
n. 13
o. 14
p. 15
u. 15+

Figure 3

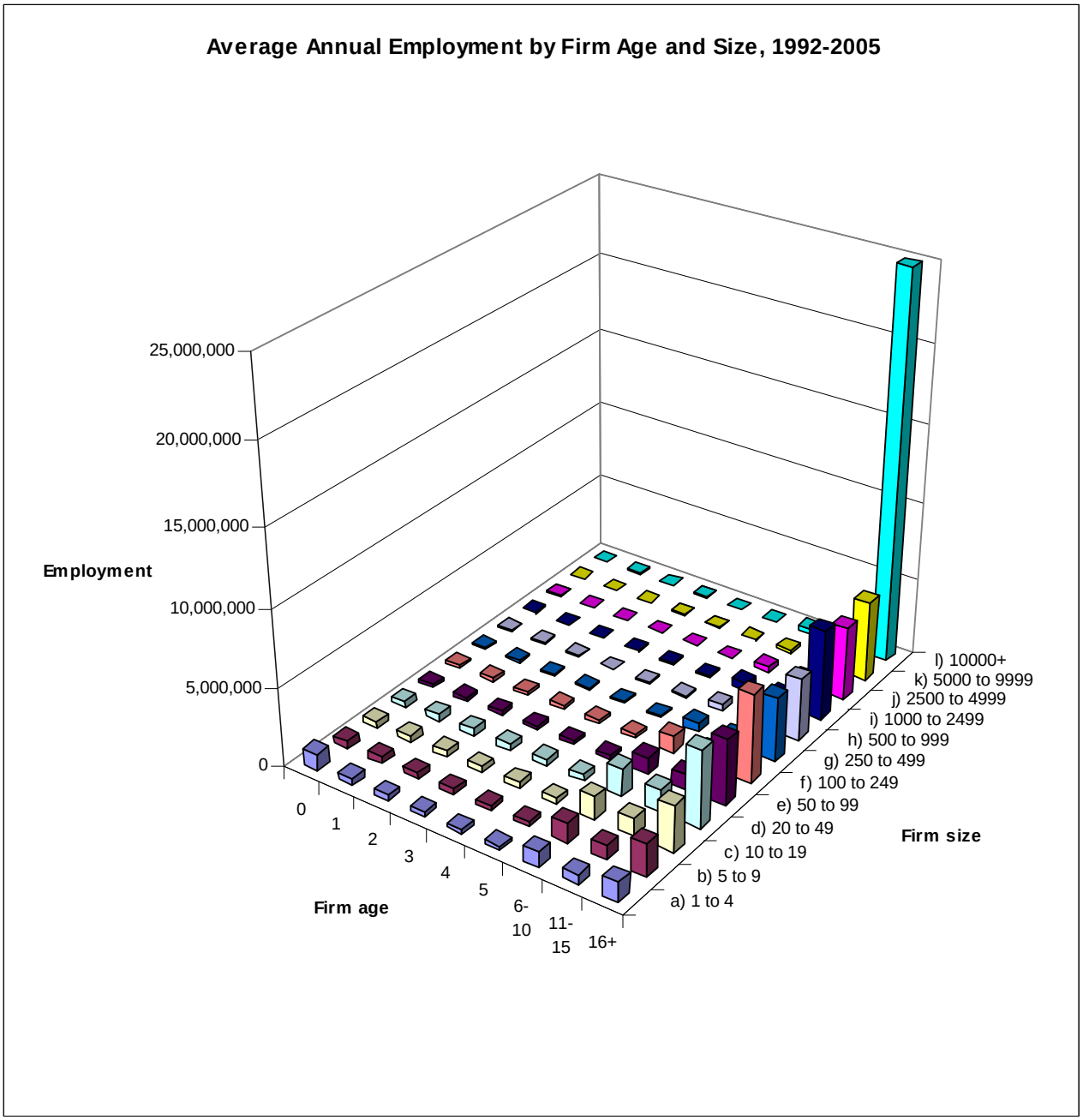
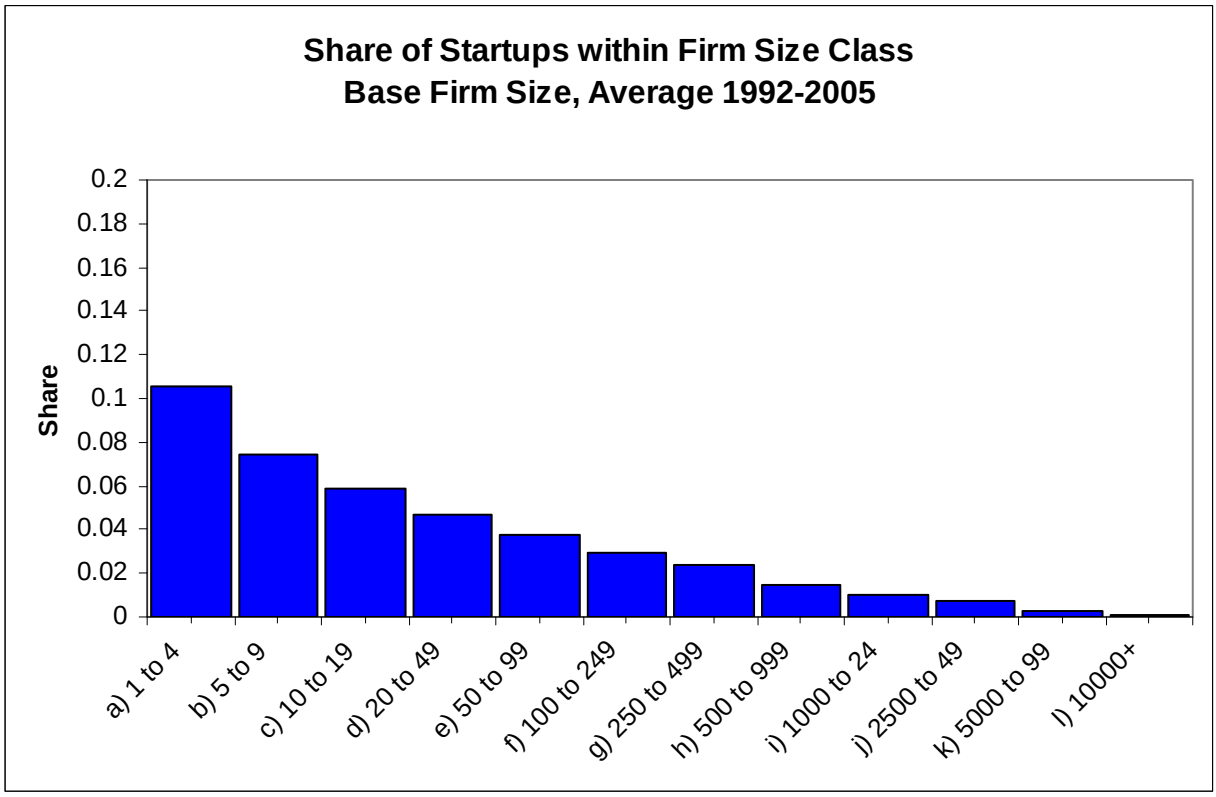

Average Annual Employment by Firm Age and Size, 1992-2005
Employment
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
0
Firm age
0
1
2
3
4
5
6-10
11-15
16+
Firm size
a) 1 to 4
b) 5 to 9
c) 10 to 19
d) 20 to 49
e) 50 to 99
f) 100 to 249
g) 250 to 499
h) 500 to 999
i) 1000 to 2499
j) 2500 to 4999
k) 5000 to 9999
l) 10000+

Figure 4


Share of Startups within Firm Size Class
Base Firm Size, Average 1992-2005
Share
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
a) 1 to 4
b) 5 to 9
c) 10 to 19
d) 20 to 49
e) 50 to 99
f) 100 to 249
g) 250 to 499
h) 500 to 999
i) 1000 to 24
j) 2500 to 49
k) 5000 to 99
l) 10000+

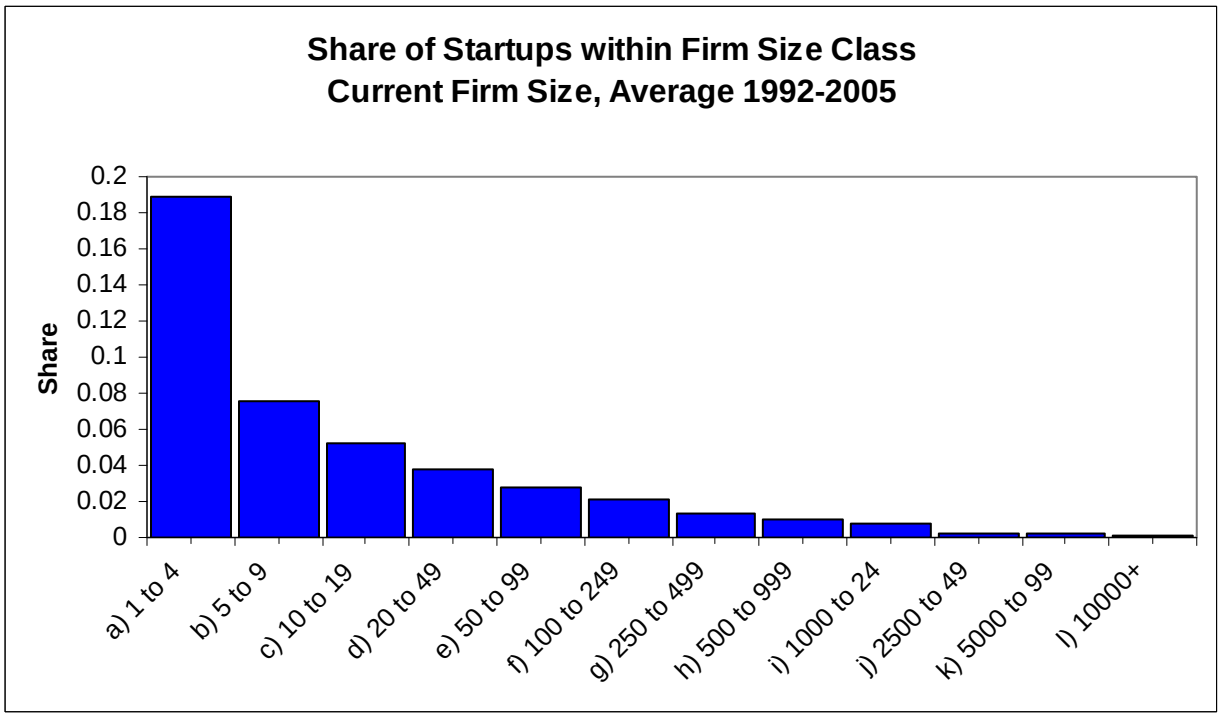

Share of Startups within Firm Size Class
Current Firm Size, Average 1992-2005
Share
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
a) 1 to 4
b) 5 to 9
c) 10 to 19
d) 20 to 49
e) 50 to 99
f) 100 to 249
g) 250 to 499
h) 500 to 999
i) 1000 to 24
j) 2500 to 49
k) 5000 to 99
l) 10000+

Figure 5

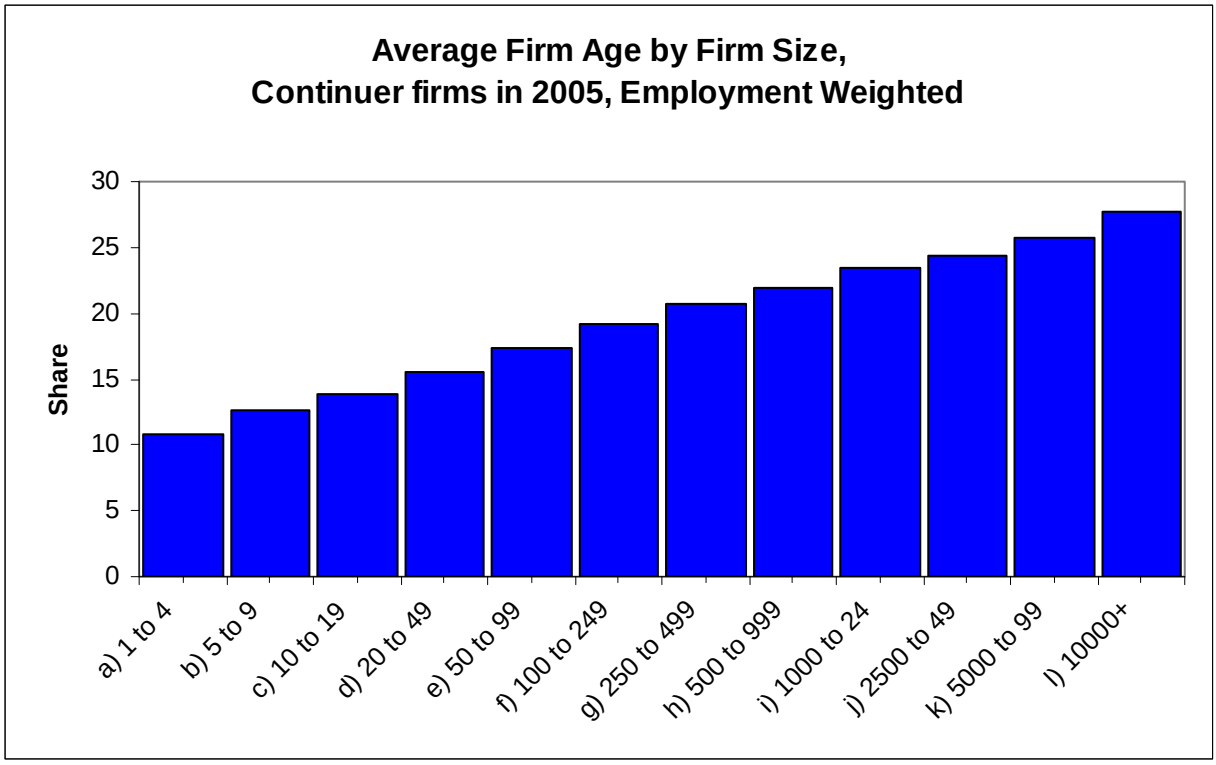
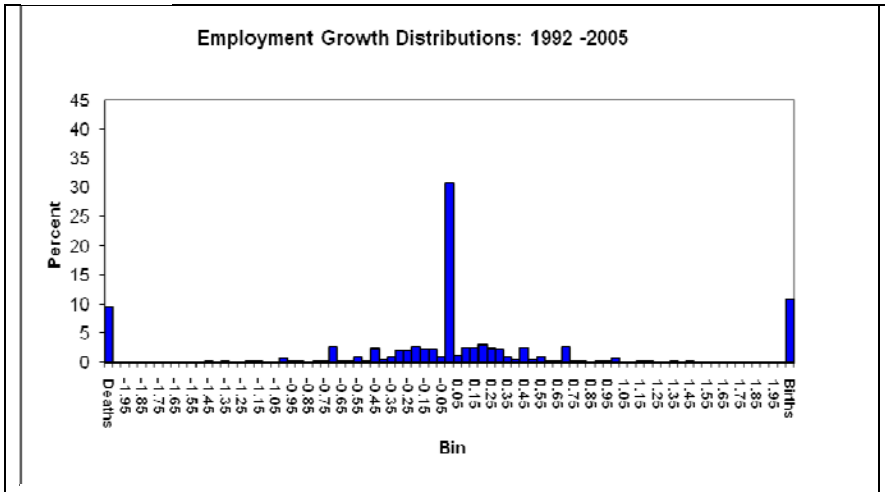
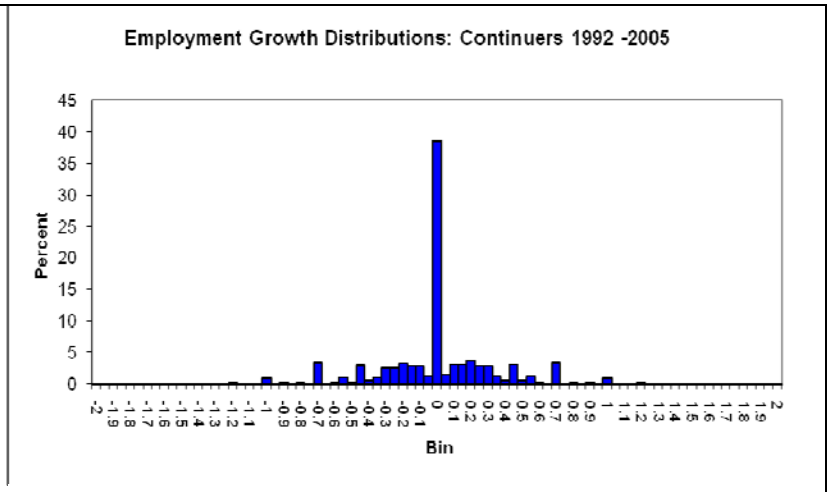

Average Firm Age by Firm Size,
Continuer firms in 2005, Employment Weighted
Share
30
25
20
15
10
5
0
a) 1 to 4
b) 5 to 9
c) 10 to 19
d) 20 to 49
e) 50 to 99
f) 100 to 249
g) 250 to 499
h) 500 to 999
i) 1000 to 24
j) 2500 to 49
k) 5000 to 99
l) 10000+

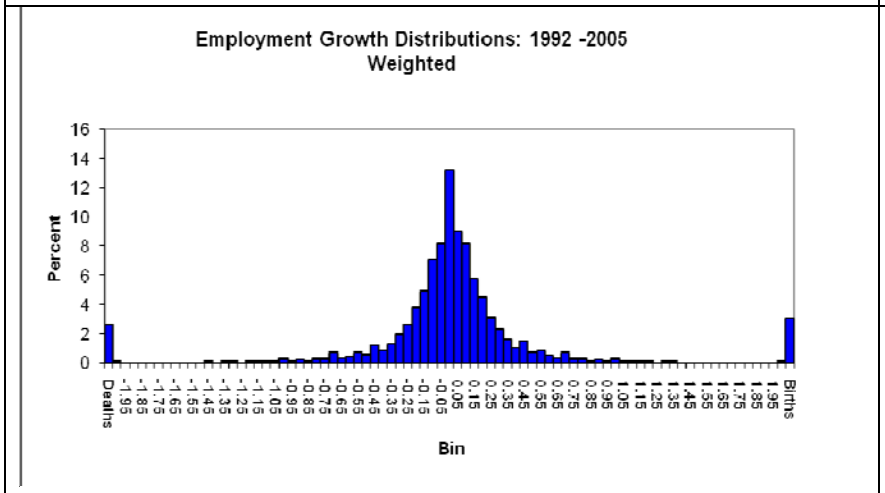
Figure 6

Panel A



Panel B





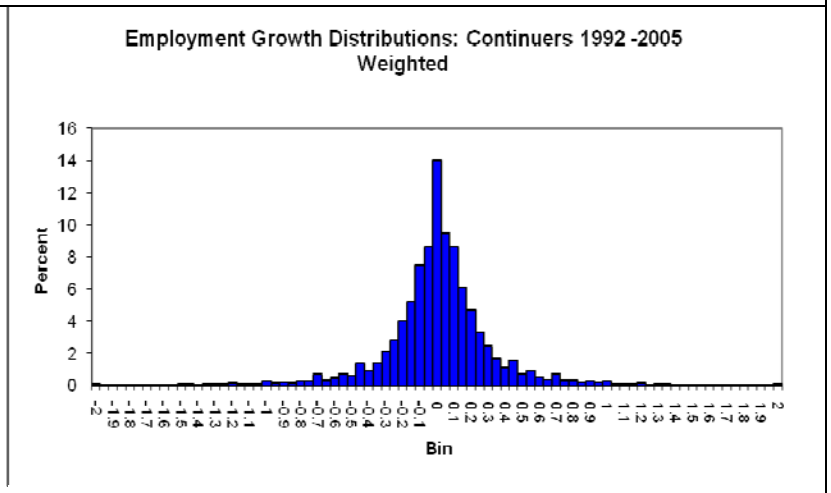
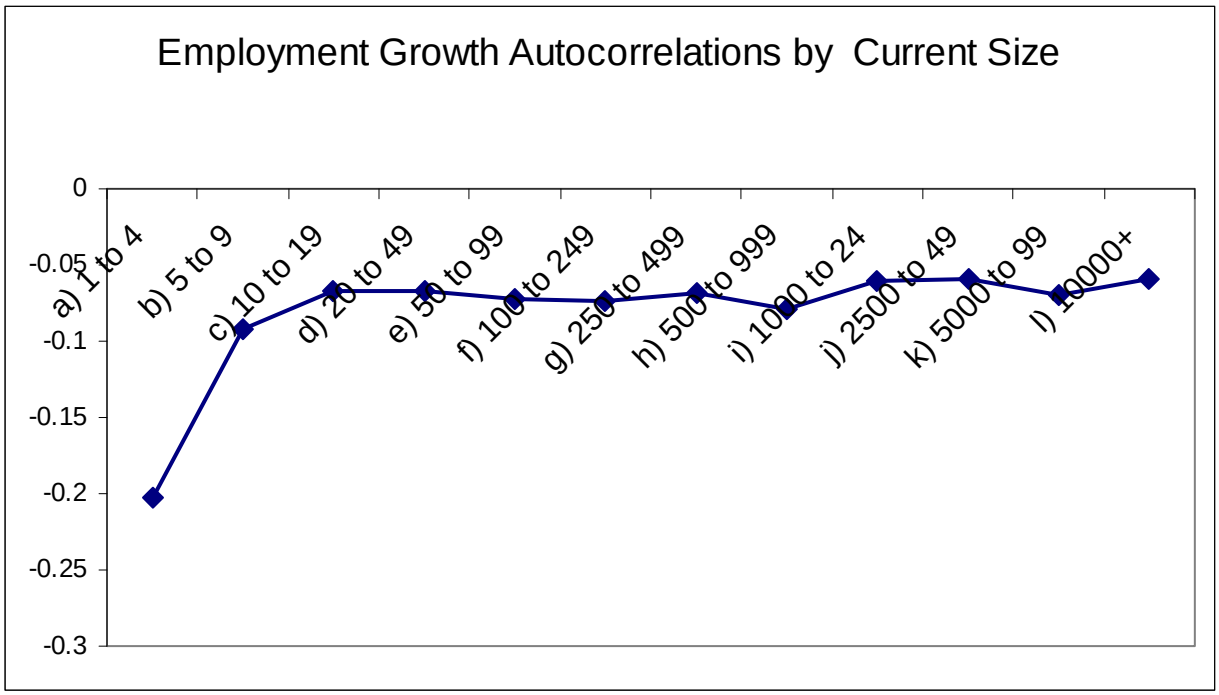


Figure 7


Employment Growth Autocorrelations by Current Size
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
a) 1 to 4
b) 5 to 9
c) 10 to 19
d) 20 to 49
e) 50 to 99
f) 100 to 249
g) 250 to 499
h) 500 to 999
i) 1000 to 24
j) 2500 to 49
k) 5000 to 99
l) 10000+

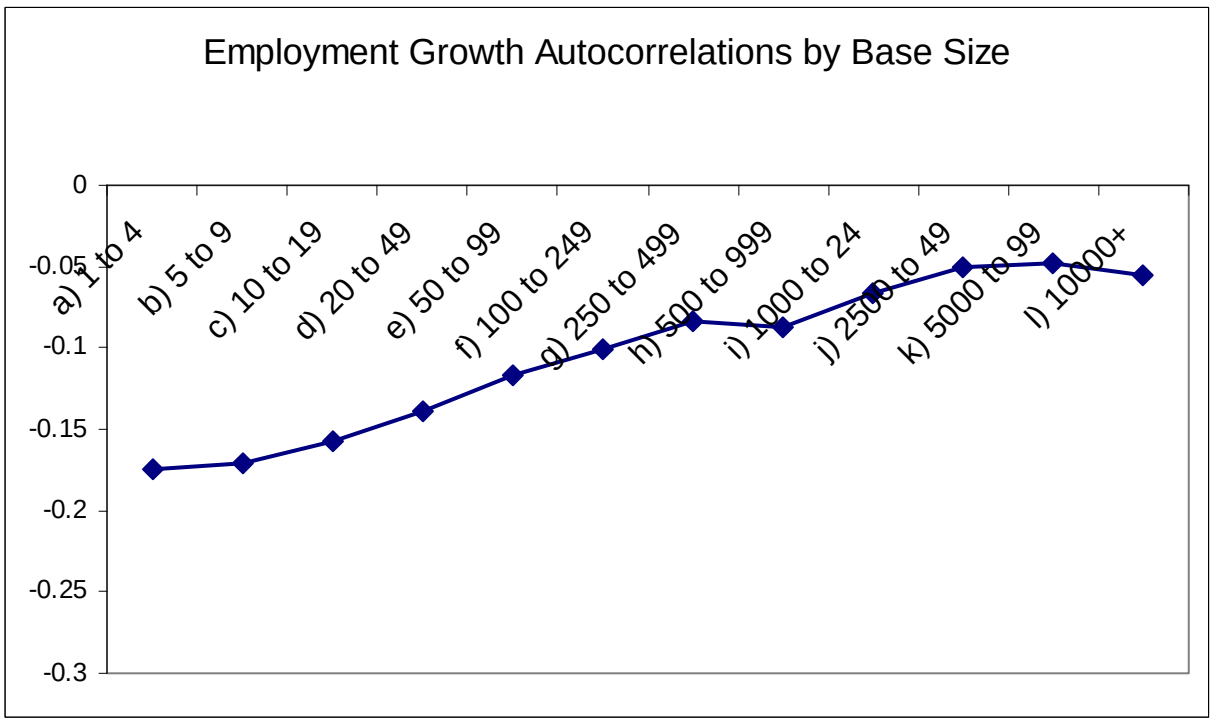
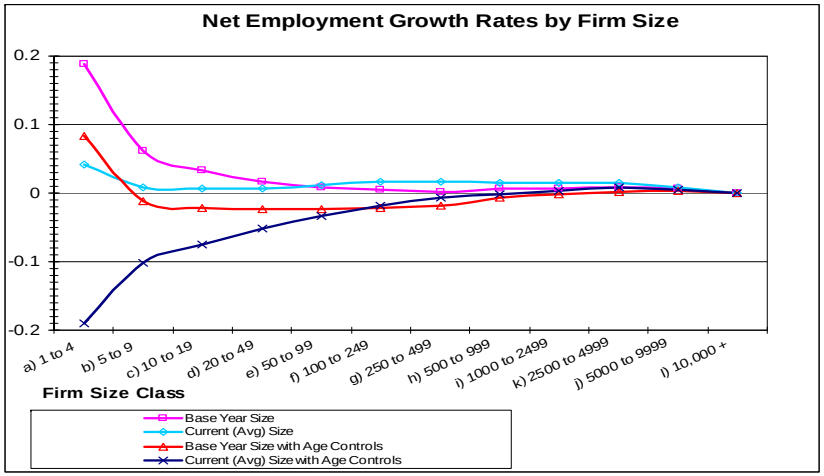
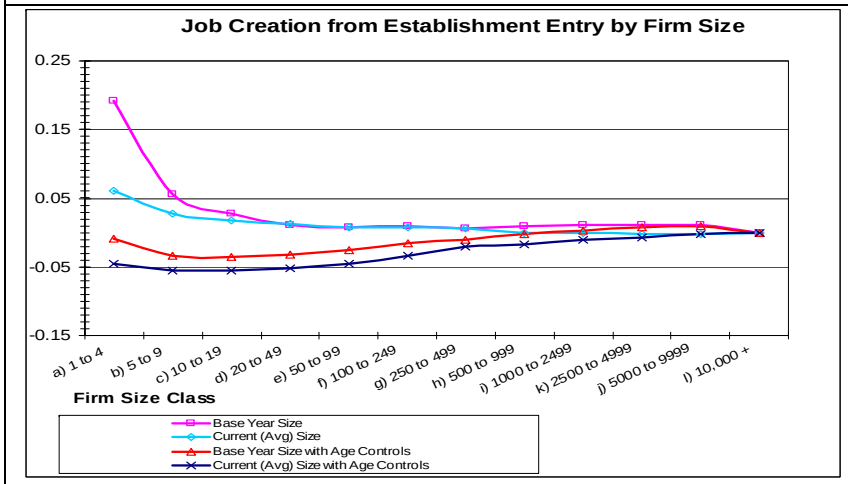

Employment Growth Autocorrelations by Base Size
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
a) 1 to 4
b) 5 to 9
c) 10 to 19
d) 20 to 49
e) 50 to 99
f) 100 to 249
g) 250 to 499
h) 500 to 999
i) 1000 to 24
j) 2500 to 49
k) 5000 to 99
l) 10000+

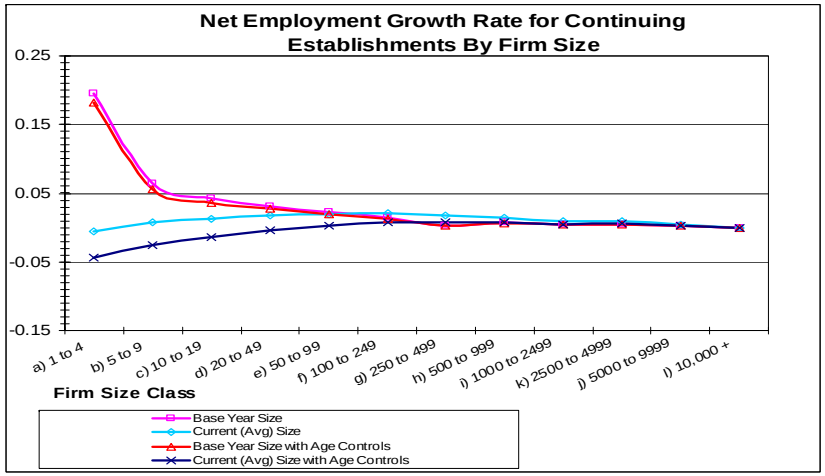
Figure 8: Alternative Estimates of the Firm Size Growth Relationship

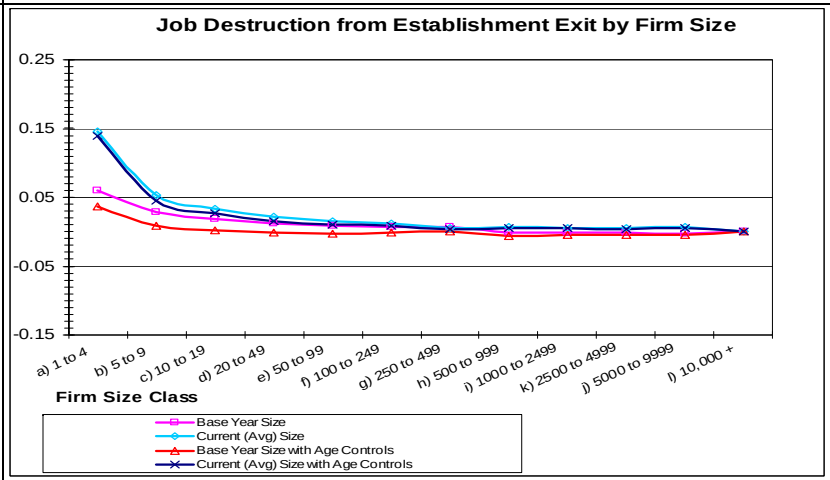
Panel A





Panel B

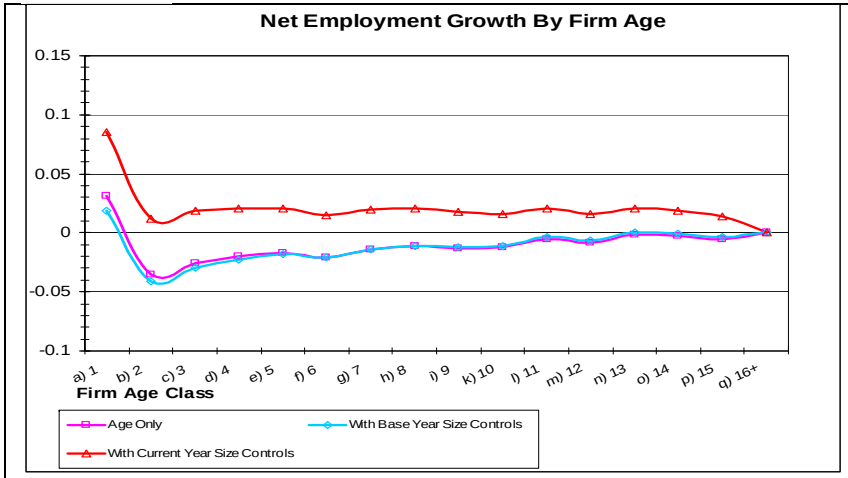


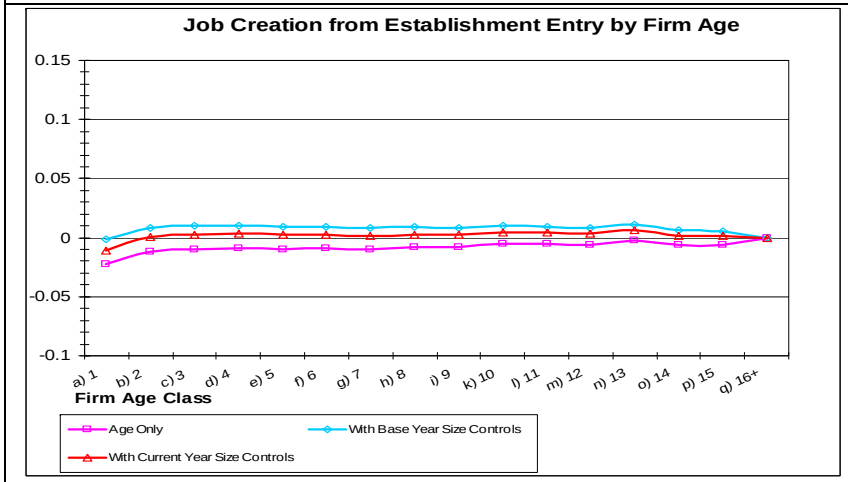


Note: Each reported point reflects the estimate for the size class in question relative to the omitted firm size class (10,000+)

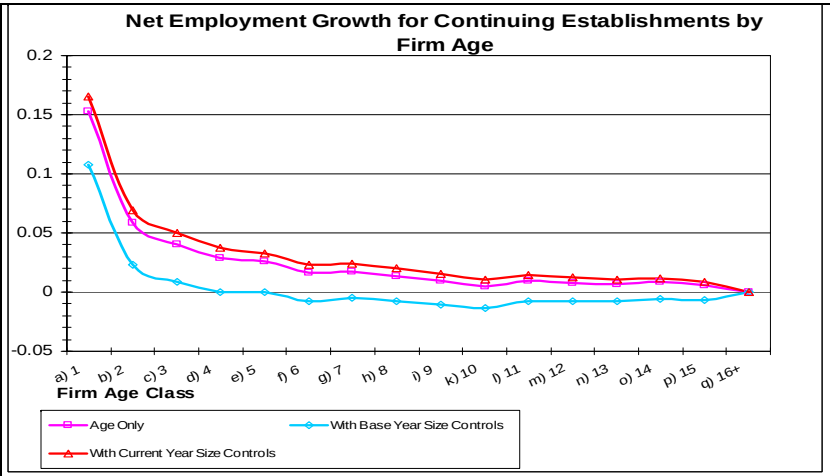
Figure 9: Alternative Estimates of the Firm Age Growth Relationship

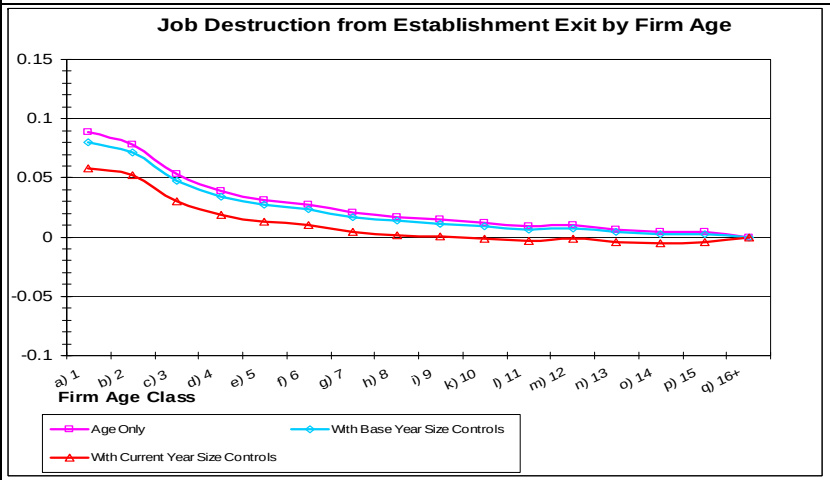
Panel A





Panel B





Note: Each reported point reflects the estimate for the age class in question relative to the omitted firm age class (16+)

Table 1 Net Job Creation by Firm Size and Firm Age, U.S. Private Sector, 2005

	Firm Size (Base Year)												
Firm Age	a) 1 to 4	b) 5 to 9	c) 10 to 19	d) 20 to 49	e) 50 to 99	f) 100 to 249	g) 250 to 499	h) 500 to 999	i) 1000 to 2499	j) 2500 to 4999	k) 5000 to 9999	l) 10000+	All
a) 0	731,515	503,644	498,317	553,181	313,511	292,348	157,120	151,518	186,087	131,178	D	D	3,518,419
b) 1	79,759	-12,547	-20,836	-47,837	-41,006	-57,188	-48,830	-5,476	-14,532	-20,131	211	-408	-188,821
c) 2	26,506	-24,840	-31,883	-44,488	-26,738	-18,026	-9,049	-13,579	-23,615	-12,782	D	D	-178,494
d) 3	7,535	-22,650	-26,855	-37,824	-15,918	-14,813	-8,981	-7,548	-11,581	-12,114	D	D	-150,749
e) 4	20,456	-18,442	-23,212	-29,616	641	-9,816	-4,301	-5,436	-298	-4,011	D	D	-74,035
f) 5	4,808	-19,792	-24,392	-29,425	-14,870	-6,222	-2,449	-6,849	-293	-3,418	D	D	-102,902
g) 6 to 10	14,577	-71,332	-99,235	-110,111	-40,652	-1,324	-9,452	5,437	-20,693	-13,945	-9,903	17,928	-338,705
h) 11 to 15	15,663	-47,730	-67,923	-81,876	-40,432	-27,666	-9,530	2,179	-2,028	22,441	6,140	69,409	-161,353
i) 16 to 20	5,673	-36,856	-58,236	-71,299	-35,979	9,780	-5,725	10,200	3,204	12,615	10,491	2,158	-153,974
j) 21 to 25	2,923	-28,173	-42,609	-51,490	-22,246	-13,346	3,901	10,269	36,484	10,075	9,889	-56,563	-140,886
k) 26+	1,016	-38,599	-71,235	-107,390	-48,873	10,309	19,924	85,473	56,436	143,701	58,245	307,517	416,524
m) ALL	910,431	182,683	31,901	-58,175	27,438	164,036	82,628	226,188	209,171	253,609	90,973	360,214	2,481,097

	Firm Size (Current)												
Firm Age	a) 1 to 4	b) 5 to 9	c) 10 to 19	d) 20 to 49	e) 50 to 99	f) 100 to 249	g) 250 to 499	h) 500 to 999	i) 1000 to 2499	j) 2500 to 4999	k) 5000 to 9999	l) 10000+	All
a) 0	1,157,210	541,230	453,073	445,091	236,121	216,911	151,518	128,772	188,493	D	D		3,518,419
b) 1	-188,206	-1,242	10,705	3,028	-20,046	-28,733	20,118	14,346	-6,509	7,898	-42	-138	-188,821
c) 2	-102,079	-34,487	-24,132	-15,745	-5,380	3,125	5,036	-9,743	-13,282	8,392	D	D	-188,295
d) 3	-77,770	-30,935	-25,119	-12,259	1,824	2,215	2,572	888	-10,155	D	3,699	D	-145,040
e) 4	-61,216	-27,141	-19,487	-7,210	1,630	2,221	3,505	6,655	7,375	-10,228	D	D	-103,896
f) 5	-54,616	-28,196	-23,791	-16,205	-2,595	6,890	5,779	11,703	-4,850	3,017	D	D	-102,864
g) 6 to 10	-190,115	-112,735	-99,872	-76,025	-17,730	13,713	26,305	19,344	5,364	26,494	23,546	43,006	-338,705
h) 11 to 15	-105,596	-74,905	-75,477	-60,259	-17,677	11,166	20,401	1,617	34,591	18,886	20,201	65,699	-161,353
i) 16 to 20	-74,278	-59,389	-61,306	-60,496	-13,235	12,172	27,334	6,559	4,413	16,969	14,550	32,733	-153,974
j) 21 to 25	-49,929	-43,548	-47,143	-42,924	-16,172	4,020	23,438	22,298	30,120	34,280	-46,129	-9,197	-140,886
k) 26+	-89,878	-83,682	-107,356	-114,182	-40,005	42,481	63,939	69,597	93,401	110,311	38,147	433,751	416,524
m) ALL	163,527	44,970	-19,905	42,814	106,735	286,181	349,945	272,036	328,961	253,373	71,269	581,191	2,481,097

Source: U.S. Census Bureau, Business Dynamics Statistics at http://www.ces.census.gov/index.php/bds/bds_home

Table 2

Employment Firm Size Distributions and Employment

Average, 1992-2005

Firm Size Class	Share of Employment (Base Size)	Avg Employment (Base Size)	Share of Employment (Current Size)	Average Employment (Current Size)
a) 1 to 4	0.061	6,406,352	0.055	5,831,743
b) 5 to 9	0.064	6,743,142	0.064	6,754,350
c) 10 to 19	0.076	8,007,175	0.077	8,081,992
d) 20 to 49	0.105	11,089,682	0.105	11,134,655
e) 50 to 99	0.074	7,869,962	0.074	7,880,766
f) 100 to 249	0.087	9,172,856	0.087	9,187,202
g) 250 to 499	0.056	5,930,095	0.056	5,881,189
h) 500 to 999	0.051	5,433,570	0.051	5,398,075
i) 1000 to 2499	0.070	7,407,325	0.070	7,401,133
j) 2500 to 4999	0.053	5,654,126	0.054	5,703,652
k) 5000 to 9999	0.054	5,722,462	0.055	5,855,149
l) 10000+	0.249	26,396,542	0.252	26,723,384

Table 3

Employment Startup Share and Employment: By Firm Size Class

Average, 1992-2005

Firm Size Class	Share of Startup Employment (Base Size)	Avg Employment (Base Size)	Share of Startup Employment (Current Size)	Average Employment (Current Size)
a) 1 to 4	0.105	675,474	0.189	1,098,360
b) 5 to 9	0.074	497,490	0.076	510,605
c) 10 to 19	0.059	467,880	0.052	422,806
d) 20 to 49	0.047	518,751	0.038	418,983
e) 50 to 99	0.037	294,703	0.027	217,213
f) 100 to 249	0.029	270,442	0.022	200,146
g) 250 to 499	0.024	144,073	0.014	81,552
h) 500 to 999	0.015	81,450	0.010	56,338
i) 1000 to 2499	0.010	72,643	0.007	56,507
j) 2500 to 4999	0.007	40,768	0.003	14,984
k) 5000 to 9999	0.003	14,838	0.002	13,383
l) 10000+	0.001	24,769	0.001	26,568

Table 4: The Relationship Between Net Growth, Firm Size and Firm Age

Parameter	(1) Base Size	(2) Current Size	(3) Age Only	(4) Base Size + Age	(5) Current Size + Age
Size a) 1 to 4	0.189	0.042		0.083	-0.190
Size b) 5 to 9	0.061	0.009		-0.011	-0.102
Size c) 10 to 19	0.033	0.006		-0.022	-0.075
Size d) 20 to 49	0.017	0.007		-0.024	-0.051
Size e) 50 to 99	0.009	0.011		-0.024	-0.034
Size f) 100 to 249	0.005	0.017		-0.021	-0.018
Size g) 250 to 499	0.002	0.016		-0.019	-0.007
Size h) 500 to 999	0.007	0.015		-0.006	-0.002
Size i) 1000 to 24	0.006	0.015		-0.002	0.003
Size j) 2500 to 49	0.008	0.015		0.001	0.009
Size k) 5000 to 99	0.006	0.009		0.003	0.005
Size l) 10000+					
Age a. 0			1.995	1.985	2.074
Age b. 1			0.031	0.019	0.085
Age c. 2			-0.035	-0.041	0.012
Age d. 3			-0.025	-0.029	0.019
Age e. 4			-0.020	-0.023	0.020
Age f. 5			-0.017	-0.018	0.021
Age g. 6			-0.020	-0.021	0.015
Age h. 7			-0.014	-0.014	0.020
Age i. 8			-0.011	-0.011	0.021
Age j. 9			-0.013	-0.012	0.017
Age k. 10			-0.012	-0.011	0.016
Age l. 11			-0.005	-0.004	0.020
Age m. 12			-0.008	-0.006	0.016
Age n. 13			-0.002	0.000	0.021
Age o. 14			-0.003	-0.001	0.018
Age p. 15			-0.005	-0.003	0.014
Age u. 16+					
R2	0.026	0.022	0.184	0.185	0.188
Obs	92,974,732	92,974,732	92,974,732	92,974,732	92,974,732

Notes: Standard Errors for all estimates are below 0.0005

Table 5: The Relationship Between Net Growth, Establishment Size and Establishment Age

Parameter	(1) Base Size	(2) Current Size	(3) Age Only	(4) Base Size + Age	(5) Current Size + Age
Size a) 1 to 4	0.304	0.034		0.236	-0.197
Size b) 5 to 9	0.170	0.006		0.137	-0.100
Size c) 10 to 19	0.134	0.003		0.115	-0.074
Size d) 20 to 49	0.107	0.000		0.096	-0.055
Size e) 50 to 99	0.083	0.001		0.075	-0.040
Size f) 100 to 249	0.064	-0.001		0.055	-0.027
Size g) 250 to 499	0.041	0.001		0.033	-0.013
Size h) 500 to 999	0.025	0.001		0.026	-0.007
Size l) 1000+					
Age a. 0			2.028	2.005	2.069
Age b. 1			0.063	0.035	0.083
Age c. 2			-0.007	-0.029	0.009
Age d. 3			0.001	-0.018	0.016
Age e. 4			-0.002	-0.020	0.011
Age f. 5			-0.001	-0.017	0.012
Age g. 6			-0.003	-0.018	0.008
Age h. 7			0.003	-0.011	0.014
Age i. 8			0.001	-0.012	0.011
Age j. 9			0.002	-0.011	0.011
Age k. 10			-0.002	-0.014	0.006
Age l. 11			0.002	-0.009	0.010
Age m. 12			0.003	-0.007	0.010
Age n. 13			0.003	-0.006	0.010
Age o. 14			0.003	-0.006	0.009
Age p. 15			0.001	-0.007	0.007
Age u. 16+					
R2	0.032	0.022	0.338	0.343	0.342
Obs	92,974,732	92,974,732	92,974,732	92,974,732	92,974,732

Notes: Standard Errors for all estimates are below 0.0004