Long-Term Change in Firm Demography and Labor Market Outcomes: An Exercise in Mimecasting

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ABSTRACT

This paper is an investigation of the historical demography of firms spanning the period from the late-nineteenth century to the present day. Our ultimate goal is to identify and measure changes in firm births, deaths, and size that may have contributed to long-term change in labor-market dynamics.

This paper draws on a variety of historical evidence including a longitudinal data set of firms in the Milwaukee manufacturing sector in the 1890s. For the recent decades, we rely upon the Longitudinal Business Database (LBD) maintained by the Center for Economic Studies at the U.S. Census Bureau. We also consult a survey of manufacturing plants conducted in Milwaukee in the 1890s and four long-running time series that help bridge the 75-year gap between the Wisconsin data from the 1890s and the LBD data covering the period since the mid 1970's. These four are derived from (1) the periodic Censuses of Manufacturing, Transportation, and Trade, which are collectively called the Economic Census (EC), (2) the comprehensive century-long tabulations of the business population and business failures compiled by Dun & Bradstreet Corporation (D&B), (3) the business population series generated from the Social Security Administrations Records and published by the Office of Business Economics (OBE-SSA), and (4) the Bureau of Labor Statistics' Current Employer Survey data on labor turnover in manufacturing (BLS-CES). None of these are perfect, but each adds an insightful perspective on the changes in the structure of the American labor market and the security of employment against firm failure and downsizing. When brought together these pieces of evidence permit us to construct a more accurate record than what we could gain from each individually.

Because the historical datasets employ differing definitions, size categories, and coverage, we must gain our impression of long-term trends in firm demography by recompiling the LBD to mimic the definitions and coverage of the earlier data sources and thus provide a link with statistical continuity between the historical data and the modern economy. We dub this process "mimecasting."

Overall we find that manufacturing job instability due to firm demography in the 1890s was similar to what we observe in today's economy. The similarity of the endpoints, however, skips over a tumultuous interim period. Much high rates of labor churning were initiated by the Great Depression of the 1930s. While economic changes in the World War II years reduced these rates considerably, the rates remained above their pre-Great Depression levels well into the mid-1960s. Following a substantial reduction in rates beginning about 1965, the secular trend has been roughly constant.

"The further backward you look, the further forward you can see."
[Attributed to Sir Winston Churchill.]

Business firms can be thought of as living things. They are born; they grow and shrink; eventually they die. It is obvious, but sometimes overlooked, that this "demography" of firms is closely related to the dynamics of the labor market. When a firm or plant shrinks, some of its employees must take new jobs, leave the labor force, or become unemployed. Firm growth is a source of new jobs. Another source of new jobs, often of quantitative importance, is firm births. Plant closures and firm deaths cost all workers at the deceased firm their jobs.

Since World War II, data on labor force status, employment, and unemployment have been collected directly from individual respondents to the U.S. Census Bureau's Current Population Surveys. As an understandable consequence, both contemporary opinion and much formal economic analysis regard labor force outcomes as the product of individual decisions and as correlated with (if not explained by) individual characteristics. Yet, as we just noted, it makes just as much sense to view labor market dynamics as the consequence of firms' decisions. Of course, both sides of the labor market are relevant, however we believe that inadequate attention has been given to the life cycle of firms. In particular, we would expect the nature of unemployment – its average level, its frequency, its typical duration, and its correlation with individual characteristics such as age, race, gender, skill, education, and occupation – to be systematically related to the demography of the firms that provide employment, particularly to the birth and mortality rates of firms.

During the last twenty years several economists have explored the relationship between firm demography and labor market dynamics. Their findings with modern data confirm the view that the vital statistics of establishments are of quantitative significance for the labor market. Jonathan Leonard notes that "short durations of employment and high frequencies of disemployment are

typically thought of in terms of the characteristics of people. The statistics reveal tremendous turnover of the jobs themselves." His analysis of Wisconsin firms shows that:

> About one in every nine jobs disappears each year. More than one in every eight jobs is created every year. This is not during a great depression, nor a great boom. These are the magnitudes of gross job flows experienced in the average year between 1977 and 1982 [Leonard 1987, 147-149].

Timothy Dunne, Mark Roberts, and Larry Samuelson [1989a, 1989b] and Steven Davis and John Haltiwanger [1999] came to similar conclusions. We also know that firm births and deaths account for a large share of all job creation and destruction [Davis and Haltiwanger 1999: 2755]. The quantitative importance of firm births and deaths helps explain why *worker* turnover is highly concentrated in space and time and implies a possibly large role for idiosyncratic factors unrelated to individual worker characteristics in accounting for their employment histories.

If the demographic rates that govern firm and plant demography were stable over the long term, such observations may not have much practical importance for understanding unemployment trends or for engineering macroeconomic policy. Although there is little evidence on the long-run stability of the vital statistics of business establishments, there seems to be a growing sense that something has changed in American labor markets. Talk of a "new economy," downsizing, outsourcing, and job uncertainty suggests that the modern firm is somehow more volatile, jobs are typically shorter, and careers are more at risk [Hacker 2006]. Is this true? And, if so, when did the "great risk shift" occur? And, is there a new role for economic policy?

Up to this point, the job flow literature has focused, of necessity, on the cross-sectional analysis of differences across industries at a recent point in time. This literature suggests that just a few factors – firm size, firm age, and industry – explain a large share of the total variation in gross job flows [Davis and Haltiwanger 1999]. This finding might seem to leave little residual variation available to be explained by independent exogenous forces such as globalization, information technology, or new managerial practices, or by public policies such as bankruptcy protection, anti-trust legislation, or the introduction of unemployment insurance. Davis and Haltiwanger (1999)

emphasize the difficulty of drawing "strong inferences about the effects of economic policies and institutions" from the available cross-country comparisons. At the same time, they underscore the importance of such an effort. "Careful, disaggregated studies are essential to convincingly identify the effects of policies and institutions on labor market flows in a cross-country context" [Davis and Haltiwanger 1999: 2754]. This report initiates a response to their call, not in a cross-country context, but with a first attempt to construct a long-term study of change in firm demography that spans more than a hundred years.

From the perspective of business history it was an eventful century. It witnessed the appearance of not one, but several "new economies." One dramatic change was the consequence of the technological revolution in the generation and transmission of electrical power that reshaped the economy. As Bradford DeLong put it:

> without electricity, no mass production. Mass production in its turn brought the large joint-stock corporation, the continent- and then world-wide market in staple manufactured goods, the industrial labor union, and – in the United States – a significant edge in productivity levels and standards of living vis-à-vis the world's other industrial economies that has so far endured for a century [DeLong 2001].

Another revolutionary change was the federal government's assumption of responsibility for full employment and macroeconomic stability which produced wide-ranging and profound institutional and behavioral changes. Over the last century American's involvement in the world economy contracted markedly in the interwar period and then expanded in the post-war era, slowly at first, then rapidly. Many other examples of changes with institutional and policy significance come to mind. Our goal is to begin to untangle the way in which firm demography has been influenced by changes, over time, in the technological, policy and institutional environment firms operate in, and how changes in firm demography, in their turn, have contributed to long-term change in labor-market dynamics.

Outline of the Project

The data available for the period before the mid-1970s is spotty and appears with different levels of resolution. The sources of quantitative evidence available employ

idiosyncratic definitions with varying coverage of the economic sectors and geography. Until recently this lack of statistical uniformity has made it almost impossible to reach conclusions about long-run trends. What we have instead are non-quantitative and impressionistic narratives [D. Nelson 1975, Chandler 1977, Jacoby 1985 and 2004]. Ironically, our ability to overcome these difficulties with the historical record is only possible now because of a powerful new tool to examine firm demography and its relationship to labor market flows in *today's* economy. This is the Longitudinal Business Database (LBD) which has been constructed from the Business Register, a listing of all U.S. businesses.[1]

The Business Register is compiled from a number of sources including administrative data (primarily from quarterly payroll tax returns), the quinquennial Economic Censuses and annual surveys, and employers' reports of social security contributions and income tax withholding. The Business Register is maintained by the Census Bureau as the frame for the Economic Census. It is also integral to many economic statistical surveys including the Annual Survey of Manufactures (ASM) and the annual *County Business Patternss*. The Longitudinal Business Database is establishment based but includes identifiers to permit consolidation to the company level.[2] It covers all sectors of the economy (except farms and some government and not-for-profit establishments), includes all businesses with paid employment, and – most importantly – it links individual establishments longitudinally from 1976 to 2005 [Jarmin and Miranda 2002]. Table 1 presents the number of establishments in the LBD universe by economic sector. In 2005 there were approximately 6.6 million establishments.

For our purposes an important feature of the LBD is that the data it contains is at the level of the individual establishment and thus can be aggregated and cross-tabulated as required.

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[1] The Business Register is also known as the Standard Statistical Establishment List (or SSEL). For an overview see http://www.census.gov/econ/overview/mu0600.html.

[2] Establishments are plants or places of business with a specific geographical location. A firm or company is a business entity that owns or controls one or more establishments.

Because the historical datasets we have collected embody differing definitions, size categories, and coverage, we must gain our impression of long-term trends in firm demography by recompiling the LBD to mimic the definitions and coverage of the earlier data sources and thus provide a link with statistical continuity between the historical data and the modern economy. We dub this process "mimecasting."

As a demonstration of how the LBD might be used to explore the role of plant demography in *today's* economy and to introduce several definitions we present Figures 1 through 4. Figure 1 presents two time series relevant to the job security issue. We display the job destruction rates caused by plant closures or plant contractions ("downsizing") for both manufacturing and non-manufacturing sectors. Actual job loss would be greater since some jobs destroyed were restored in the same year (and thus were missed in the LBD) and some involuntary separations were replaced by new hires. Nevertheless, the magnitudes are surprising. Over the three decades displayed the average rate of job loss in manufacturing averaged 12.4 percent per year and exhibits a slight upward trend.[3] The average rate was even higher in the much larger non-manufacturing sector, 16.2 percent. The dashed red line presents the trend for the entire LBD universe. More than one in six jobs were destroyed every year either by firm failure, plant closure, or plant downsizing.

Far from seeing a large upward shift in job insecurity due to new harsh economic realities, the LBD reveals that the rate of job destruction has shown a slight but non trivial downward trend since 1977. This downward trend in business volatility has also been demonstrated by Davis, Haltiwanger, Jarmin and Miranda (2007). Far more evident than the trend in Figure 1 is the major impact in both sectors caused by the several recessions during this period. The recession of 1980-1982, the downturn of 1987, the recession of 1991-1992, and the most recent recession of 2001-2002 are all clearly evident.

Figure 2 displays the net job gain in the two sectors. Except for the year 2002, the

[3] Manufacturing would also reveal a slight trend reduction were it not for 2002. This year is the start of a recessionary period but also coincides with data processing changes in the Business Register files. We'll verify this number in later versions of this draft.

percentage change in employment in the non-manufacturing sector was always positive and cumulated over the 29 years to a 215 percent increase. Because the manufacturing sector has been shrinking in recent decades, the typical annual change in employment for this sector was negative. The cumulative loss over the period covered by the LBD was 21 percent. The relative stability of employment in the manufacturing sector during the expansion of 1993-2000, however, is noteworthy particularly because of the sharp decline of manufacturing employment that begins in 2001. The negative rates of change for the entire period 2001 through 2005 alone cumulate to a 19 percent decline in manufacturing employment. The contrast between the stability of the 1990s and the collapse following 2000 may have prompted talk of increasing job insecurity, but if so the LBD record suggests this decline was the result of the recession rather than the consequence of a long-run trend or evidence of a regime change in economic affairs.

Figures 3 and 4 present the components of the net job change for the manufacturing and non-manufacturing sectors respectively. The figures display the percentage change in employment due to plant births (green line) and due to plant deaths (black line). Obviously the former is always positive and the later negative. What is most noticeable here is that the birth and death rates are much more stable than the overall rate of change (as displayed in Figure 2 and reproduced here as the faint grey line). The implication of the relative stability of birth and death rates is that the net change in employment in continuing establishments is the major source of employment fluctuations. To follow up on these points Figures 3 and 4 also plot the contribution to employment gains by expanding establishments and the losses from contracting ones. Plant contraction seems to have had a greater impact on the business cycle than plant expansions, but both series move over the cycle in the expected directions. The figure also shows that changes in the employment at continuing plants exerts a greater influence on the labor market than the appearance of new establishments or the disappearance of existing workplaces.

The Milwaukee Firms Data Set

To examine trends in firm demography over a longer time horizon, we utilize a unique establishment-level dataset from manufacturing concerns surveyed by the Wisconsin Bureau of

Labor and Industrial Statistics between 1891 and 1899.[4] These data were collected as part of the Bureau's effort to "inspect all factories and workshops and to see that the laws regarding the protection of employees against accidents, the employment of women and children, etc., are complied with." The information on the workplaces was collected during the Bureau's regular, biennial inspection of factories and published in its *Fifth*, *Sixth*, *Eighth*, and *Ninth Biennial Reports* [1892, 1894, 1898, and 1900].[5] Like the LBD, the Wisconsin factory inspection reports provide a census of all establishments in operation at the time of the survey and a mechanism for linking establishments from one survey to the next. Here we report on data for the city of Milwaukee. We provide a full description of these surveys, including an assessment of their coverage and representativeness in Appendix WI.[6]

Apart from their scope, there are only two significant differences between the Milwaukee firms and the LBD data sets. One is that the Wisconsin factory inspection reports are available at two-year intervals whereas the LBD is available on an annual basis. The second is that the Wisconsin reports are restricted to manufacturing workplaces that employed five or more persons whereas the LBD includes all workplaces with paid employment. Fortunately, it is possible to aggregate and calibrate the LBD data to cover the same sectors and to put it on the same temporal basis as the Wisconsin factory inspection data. We will turn to that task shortly.

To put the Milwaukee data in context, we now briefly review the economic environment of the 1890s. By economic historians' account, the 1890s was a turbulent decade. The U.S. Gilded Age saw the coming of the industrial corporation, mass production, and continent-wide markets [Chandler 1977]. The middle of the decade was marred by a major economic depression which

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[4]There is virtually no need to distinguish establishment and firm level data from this source. There were very few multi-plant firms in Wisconsin in the 1890s.

[5] Inspections were carried out in 1895 but were not published in the *Seventh Report* [1896] because of budget cutbacks associated with the on-going depression.

[6] This and other appendices are available upon request.

was followed by the subsequent "Great Merger Wave" of 1898-1902.[7] It was a period where we should expect to see substantial economic transformation. Because the data from Wisconsin comes from inspections conducted in 1891, 1893, 1897, and 1899, interpretation of the data is assisted by reviewing the course of the economic downturn. In Figure 5 we present two indexes of the depression. The blue line (calibrated with the left-hand scale) is an annual unemployment rate proposed by two us in our review of the depression of the 1890s.[8] Superimposed on that is a profile based on the 13-commodity index of industrial production prepared by Jeffrey Miron and Christina Romer [1990].[9] To highlight the comparison of the two series, we present the percentage deviations from trend of a 13-month moving average of the original index. The right-hand scale is inverted so the rise in unemployment is more easily compared with the decline in industrial production. Given that the industrial production data is monthly while the unemployment estimates are annual, the correspondence between the two measures is reasonably close.

The Wisconsin plant inspections were conducted throughout the year (but concentrated in the summer months), so we have indicated with windows the approximate timing of the four inspection surveys.[10] Judging from the data displayed, the economy had just begun to move into recession in 1893. The business cycle chronology originally published by Arthur Burns and Wesley Mitchell [1946] and revised by Geoffrey Moore [1961: Appendix A] dates the peak in January 1893 [Carter *et al, Historical Statistics* 2006: Table Cb5-8]. Both series plotted in the graph strongly support the dating of the trough in 1894. Unemployment that year exceeded 11

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[7] On the depression see Carter and Sutch [1992]. The merger movement began in the mid-1890s and was characterized by the horizontal consolidation of competing firms in the same industry. On the merger movement see Lamoreaux [1985], O'Brien [1988], and Carter *et al.*, *Historical Statistics* [2006: Series Ch416-421].

[8] We plot the variant II unemployment rate based on the underlying work of William Shaw [1947]. The data is taken from Table 5 of Carter and Sutch 1992.

[9] The data are published in Carter *et al*., *Historical Statistics*, 2006: Series Cb29.

[10] The tick marks indicating the years are centered on June 30 of the year given.

percent and industrial production was 25 percent below trend. Both indicators agree that conditions were only slightly worse in 1897 than they had been in 1893. The economy was recovering from the depression in 1899 and was in significantly better shape that year than in 1897.

Manufacturing Plant Demography in the 1890s and Now

We now use the Milwaukee data to paint a portrait of plant demography in late-nineteenth century manufacturing in a major industrial center that we can compare with today's patterns. Our modern-day comparisons are calculated from the LBD. The modern data is manipulated to mimic the business population and the survey frequency of the Milwaukee data from the 1890s. Because of the similarity in the structure and coverage of these two data sources, we are able to avoid the problem of incomparable job flow measures – the primary problem plaguing the cross-country comparative studies of gross job flows reviewed by Davis and Haltiwanger [1999: 2754].

We report the main results of the paper comparing the demography of manufacturing plant in 1890s Milwaukee to their modern counterparts in the LBD in Table 2. Calculations for two-year intervals between survey dates are shown in the top panel of the table, while those for four-year intervals appear in the lower panel. Column 2.1 gives the net change in manufacturing employment between two survey dates as a proportion of the average of beginning- and end-period employment. It shows, for example, that in Milwaukee between 1891 and 1893, manufacturing employment grew 10.6 percent. The second through fifth columns break out the components of this net employment change, again expressed as a proportion of the average of beginning- and end-period employment. Thus, we find that in 1893, 11.5 percent of the manufacturing workforce was employed in plants that did not exist two years earlier (plant births column 2.2); another 15.9 percent held jobs created when existing plants expanded (column 2.4). Added together, these two components imply that over one-fourth of the 1893 manufacturing workforce held jobs that were new to the economy. Looking at the last two years of the nineteenth century (the row labeled Milwaukee 1897-1899), we find that the net job gain in Milwaukee manufacturing was even larger – 32.1 percent – as the economy recovered from the unusually severe depression of the 1890s. In

1899 nearly 45 percent of the jobs in Milwaukee manufacturing were ones that had not been in existence a mere two years earlier (columns 2.2 and column 2.4).

The high rates of job creation almost find their match in high rates of job destruction. Between 1891 and 1893, 6.7 percent of the 1891 workforce lost their jobs because of plant contraction (column 2.5) and another 10.0 percent because of plant closings or deaths (column 2.3). These figures are "low" relative to others in the decade of the 1890s because the Depression of 1894 had not yet hit the region at the time the Milwaukee survey was completed. Even so, about one-sixth of the 1891 workforce had lost its job because the job itself had disappeared. The first row under the subheading "Four-Year Changes" presents figures which span the Depression of the 1890s. Not surprising – and not only because we are viewing changes over four instead of two years – they indicate far greater job loss due to variations in firm demography. Over one-fourth of the 1893 jobs had disappeared by 1897 (column 2.3 plus 2.5), with more than 11 percent lost due to plant closings (deaths) (column 2.3).

Columns 2.6 and 2.7 display summary measures proposed by Davis and Haltiwanger for indicating the extent of the "reshuffling of job opportunities across locations" [Davis and Haltiwanger 1999: 2717]. The "gross job reallocation rate" shown in column 2.6 is the absolute value of the sum of employment gains and losses due to plant births, expansions, contractions, and deaths. The "excess job reallocation rate" shown in column 2.7 controls for macroeconomic conditions by subtracting net employment change (column 2.1) from the gross job reallocation rate (column 2.6). It measures locational shifts in the composition of employment demand after controlling for shifts in the employment level. It reflects the impact of changes in technologies, consumer tastes, institutions, and policy changes; competition from new firms; the arrival and departure of entrepreneurial individuals; and all other structural changes that affect the rate of job creation and destruction. Secular changes in this latter measure are precisely the ones we are trying to measure in this long-term study.

When we compare average rates for the 1890s with those for the modern period, we observe substantial differences in the rates of employment change due to plant births, deaths, expansions,

and contractions. Focusing first on the data for two-year changes, we find that the rate of employment change due to plant births and expansions in the 1890s are more than twice the level of those for the modern period. Differences in employment change due to plant deaths are more similar between the two periods and employment change due to plant contractions is over twice the level in the modern period as compared to the 1890s.

An obvious explanation for these differences is differences in net job gain: net job gain (column 2.1) averaged an impressive 21.4 percent in the 1890s as compared with a *negative* 2.4 percent for the modern period. The excess job reallocation rate, which measures locational shifts in the composition of employment demand after controlling for shifts in the employment level, is designed specifically to control for such differences. Comparing excess job reallocation rates we see that after controlling for conditions in the macro economy, job instability due to firm demography appears very similar in the two periods. For the two-year changes the numbers are 29.2 verses 31.9 percent. For the four year changes the numbers are 49.9 verses 49.3 percent.

Plant Demography by Plant Size

A reliable regularity in today's economy is that as plant size increases, the excess job reallocation rate falls [Davis and Haltiwanger, 1999: 2742]. Did plant size affect firm demography in late-nineteenth century Milwaukee manufacturing? Statistics reported in Table 3 suggest that it did. The table displays rates of net job gain, job creation, job destruction, gross job reallocation, and excess job reallocation by plant size over two-year intervals. For the modern data, we categorize the rates according to plant size bins of increasing size up to 1,000 or more employees. For the nineteenth century data there are fewer than 40 plants in any one year employing more than 250 workers, so our largest bin size is 250 or more. The data for Milwaukee is an average for two, two-year intervals, 1891 to 1893 and 1897 to 1899. The data for the nation was calculated from the LBD for 14 two-year intervals beginning with 1977 to 1979. With the exception of the jump in the job destruction rate in Milwaukee between the "100 to 250" and the "251+" categories, both the Milwaukee and the LBD data show regular reductions with increasing plant size in their job creation and job destruction rates, and, of course, in the rates that are calculated from these basic

series.

Comparing rates from the two sources, we see higher excess job reallocation rates in Milwaukee among very small plants and lower rates among the larger plants. In other words, it appears as if large size conferred greater employment stability in the nineteenth century than it does today.

To put this information to use in better understanding the findings from the previous section, we calculated the size of the plant employing the median worker from the Milwaukee firms data set and compared it to similar calculations from the LBD. The results are shown in Table 4. They reveal that the plant employing the median manufacturing worker was surprisingly large in the late-nineteenth century. Values for the various years range between 190 and 250 while those for years since 1977 range between 206 and 410. The important point for our argument is that the size of the firm employing the median worker is right around the point where the relationship between excess job reallocation rates in the Milwaukee and LBD data sets shift

Establishment Size in Historical Perspective

Since job creation and job destruction rates vary with establishment size, changes over time in the size distribution of establishments would change the rate of excess job reallocation. Here we construct a simulation to gage the impact of such secular changes in establishment size on the excess job reallocation measure of job volatility. We begin with a review of several measures of change in the size distribution of manufacturing establishments.

The typical business firm of today is often portrayed as a giant compared to its predecessors of a century ago. Textbooks speak authoritatively of the rise of big business, newspaper journalists remind us frequently of the impersonal and bureaucratic nature of the "modern large corporation," and almost everyone equates technological progress, the development of the multinational corporation, and the conglomerate merger movements with growth in firm size. In this report we compare this set of impressions against the quantitative record for manufacturing establishments, since we are able to compile a long detailed time series for this sector back into the nineteenth century. Contrary to the expectations described above, the evidence here suggests that

manufacturing plant size has actually changed very little over this long and eventful expanse.

For this exercise, we use data from the U.S. Censuses of Manufactures, which has data on the number of establishments and the number of workers at various manufacturing census dates. Average plant size, as calculated from this source, are reproduced as the dots in Figure 6.[11]

As indicated in the chart, the data for the nineteenth century includes hand trades (and excludes non-production workers) and are therefore not comparable to the figures for the twentieth century. Anthony O'Brien has made estimates of the average plant size for the latter half of the nineteenth century by removing the so-called "neighborhood" manufacturing industries, such as blacksmithing, harness making, and tinsmithing, "in which," according to the Census Office, "little, if any, power machinery is used, and which usually do only a local business" [O'Brien 1988: 644]. Using O'Brien's index we have extrapolated the twentieth-century definitions back to 1869 [O'Brien 1988: Table 2]. The graph also plots, with a red line, the average plant size for manufacturing derived from the LBD. The Figure shows a remarkably small average establishment size throughout the period for which data is available. The average plant, even at its peak in the 1960s, employed fewer than 60 workers.

It is important to note that *average* plant size has the potential of being misleading. The changing definition of manufacturing – particularly the changing rules for excluding very small firms – makes the counts of very small firms incomparable between census dates. A more reliable measure of the changing size distribution of establishments would look at the distribution of plants above an arbitrary minimum size. Figure 7 displays the number of establishments with more that 100 employees relative to the number with over 20 employees.[12] This metric presents a picture that is consistent with that shown in Figure 6. Very large plants increased their relative proportion in

[11] See Appendix CoM for sources and a description of the data.

[12] The data for 1900 to 1972 come from the periodic census of manufacturing. Our sources are the Census of Manufactures for 1900 [p. lxxiii], 1905 [p. cxviii], 1919 [Table 204: 286-287], 1929 [p. 61], 1939 [p. 119], and 1947 [p. 97], and the Statistical Abstract for 1976 [Table 1308]. The data for 1977-2006 are from the LBD.

the period 1905-1930 and began their decline in 1972.

Why the increase and then decrease in employment at the typical establishment? According to O'Brien, establishment size grew in the 1870s and 1880s as continuous-process production methods and innovations in marketing and distribution raised the optimal scale of plants in such industries as chemicals, primary metals, food processing, and machinery.[13] Since 1890, almost all of the increase in average establishment size occurred in the 1920s, probably a consequence of rapid electrification.

Prior to electrification, power was derived primarily from water wheels and was distributed throughout the factory by a complex system of shafts and belts. To minimize the loss of power through friction, power-using elements of the production process were located near the power source. This required expensive, multi-storied, heavily-reinforced factory buildings. By cheaply bringing power to wherever it was needed, electrification allowed factories to be housed in relatively inexpensive single-storied structures, reducing capital costs and making larger-scale plants more efficient.[14] As Figure 8 shows, 1920 electricity accounted for roughly half of all horsepower consumed in manufacturing. By 1930 this figure was 80 percent. The 1920s also witnessed a rapid growth in very large establishments.

As is apparent in both Figures 6 and 7, average plant size has been declining since 1972. The most recent figures report an average of approximately 42 employees per manufacturing establishment. Much of the decline in average size has been driven by the disappearance of very large establishments. Figure 9 plots the LBD data for the plant size at the 99th percentile of the size distribution. It shows a high of more than 750 in 1981 while data for the latest year, 2005, is only 525. Despite this recent decline in very large plants, the overall picture suggests a rather surprising constancy of the size distribution of manufacturing firms over the turbulent twentieth century. This

[13] In addition to O'Brien [1988: 640-643], see Chandler [1977].

[14] On electrification see Du Boff [1964], Hughes [1983], and David [1990]. The positive impact of electrification on the number of firms apparently overwhelmed the reverse force of a second merger wave that ran from 1916 to 1929, however a number of these mergers were in the financial sector which is not included in the data displayed here.

would imply relative stability for the excess job reallocation rate provided that the excess reallocation rates at each plant size remained stable

Figure 10 presents changes in the level of the excess job reallocation rate predicted by this conjectural exercise. There are two sets of estimates. In the first, we take excess job reallocation rates by establishment size calculated from the Milwaukee firms data set from the 1890s and weight them by the actual size distribution of manufacturing establishments in various years to construct one estimate of how gross job reallocation rates would have changed had relocation rates by establishment size remained constant at the 1890s level while the distribution of manufacturing establishments by size changed as they did. In the second, we take excess job reallocation rates by establishment size as calculated from the LBD for the modern period and weight them by the actual size distribution of manufacturing establishments in the various years to estimate the same change but with modern weights.

As expected, the conjectural estimates change relatively little over the course of the twentieth century. Two-year excess job reallocation rates fall from about 36 (using early rates) or 33 (using modern weights) in 1904 to about 30.5 by 1950. From that point they rise to an average of about 33 by 2005. This modest inverted-U trend in the secular movement of this conjectural gross job reallocation rate due to changes in establishment size is small by comparison to cyclical changes in excess job reallocation rates also evident in Figure 10.

The Growth of the Business Population

It will come as no surprise that there are more business firms today then there were in 1890. We have a fairly accurate enumeration of establishments and firms in the LBD from 1977 on. To push the data back before 1929 and into the nineteenth century we rely upon the records kept by the Dun & Bradstreet Corporation. D&B was, and still is, a credit rating firm which can trace its origins to the 1840s (see Appendix D&B for more details). The D&B data represent the number of companies, both incorporated and unincorporated, listed in the Dun & Bradstreet *Reference Books*. Because of the nature of its business, the company and its predecessors

attempted to maintain a comprehensive list of manufacturing, mining, wholesale and retail trade, contracting, and transportation companies in the United States. Excluded are firms in the "FIRE" sector (finance, insurance, real estate), professions, farms, railroads, non-commercial services, amusements, and one-person firms. National coverage was obtained by approximately 1871 and the *Reference Books* are regarded to be very complete through 1960 or 1970.[15]

In addition to the D&B records, the Office of Business Economics kept a record of firms for the period 1929 through 1963 [See Appendix BusPop for details]. Since the LBD allows us to consolidate the establishment counts to the firm level, we can produce a continuous annual series of the number of firms from 1929 to 2005, albeit with a ten-year gap from 1964 to 1976.[16] The last revision of the business population data was undertaken in 1963 and "revealed errors in earlier estimates for absolute number and rate of growth; these errors were due partly to the cumulative effect of imperfect estimates for discontinued businesses" [U.S. Bureau of the Census, *Historical Statistics* 1975: 909].[17]

To prepare the long-run picture of the size of the business population we restrict the LBD and OBE series we compute to the sum of firms in manufacturing, mining, construction, transportation, public utilities, and wholesale and retail trade. These restrictions are intended to match as closely as possible the scope and resolution of the D&B data. Inconsistencies in coverage remain but we believe that the match is close enough to discern the long-run trend in the business

[15] Davis , Haltiwanger, and Schuh are critical of the Dun & Bradstreet data, describing it as "an unsuitable database" for studying firm demography [1996, 70-72]. Despite these potential problems, the D&B data remain the only readily available source of data on business demography over most of the 20th century. We assume that issues with collection and processing that limits its useful for precise measurement, are constant over time allowing us to discern broad trends.

[16] We have interpolated data for the mining, transportation and public utilities (TPU), and finance, insurance, and real estate (FIRE) sectors for the years of World War II, 1947, 1950, and 1958 from unrevised data. The figures for these three sectors for 1959 were based on incomplete data and are unavailable for 1960-1963. See Appendix BP for the sources and documentation.

[17] It is unclear from the documentation we have consulted, but it would appear that the last benchmark of the OBE data was in 1955. "It should be noted," stated the official description, "that for periods following the first quarter of 1956 the estimates are essentially extrapolation which are subject to revision when later benchmark data become available" [Churchill 1959: 16]. Since no revisions of the 1956-1958 were made, we infer that no further benchmarking was undertaken.

population and to identify the major departures from that trend. The result of this judicious splicing is presented in Figure 11.

There are six evident disruptions of the series displayed in Figure 11. There is a quite noticeable downturn in the number of firms in the 1890s that coincides with depression of that decade and the subsequent "Great Merger Wave" of 1898-1902.[18] A small dip in the series coincides with World War I. After the considerable disruption of the Great Depression, World War II also witnessed a sharp decline in the number of firms. This was followed a rapid post-war recovery. There is an evident break in trend when the post-World War II period is contrasted with the pre-Great Depression period. The "conglomerate merger movement" beginning in the mid-1950s and culminating the late 1960s is marked by a dip in the series. The recession associated with the sharp monetary contraction of 1980-81 is also evident in the data. Our LBD data has a lower count than the D&B data for years of overlap (1977-1983)[19].

Firms New, Firms Departing, and Firms Failed

The Business Structure Division of the Office of Business Economics began recording the number of new business firms (not establishments) and the number of discontinued firms in 1940. New firms were those that came into existence for the first time; a change in ownership of an existing firm is considered a business transfer. We reproduce the data for new and discontinuing firms for a number of the important sectors of the economy in Appendix BP. We do not know the number of employees at these firms, but the firm creation and firm destruction rates are of interest in their own right. While the OBE apparently kept incomplete track of

[18] The merger movement began in the early 1890s and was characterized by the horizontal consolidation of competing firms in the same industry. On the merger movement see Lamoreaux [1985], O'Brien [1988], and Carter *et al*, [*Historical Statistics* 2006: Series Ch416-421].

[19] This is to be expected since one of the primary criticisms of the D&B data is that it fails to promptly remove closed establishments from its list. The Census BR and by extension the LBD does a better job of this. In addition, the LBD definition of a firm includes subsidiaries under the control of the parent company. These may be treated as different firms in the D&B data.

"disappearing" firms particularly after the mid-1950s the firm turnover statistics may nevertheless provide an indication of the *rates* of firm creation and destruction particularly for the turbulent years of World War II and the postwar recovery. We begin with the magnitudes for Manufacturing displayed in Figure 11.

The striking feature of the data is the sharp swing coinciding with the war. The business population dropped sharply in the two years following the attack on Pearl Harbor both because of an increase in firm disappearances and a fall in the rate at which new corporations were formed. Beginning in 1944 there was a strong reversal with a decline in discontinuances and an increase in firm formations. The cumulative effect was to increase the number of firms in both manufacturing and non-manufacturing in 1947 to much higher levels than were recorded in 1941. In manufacturing, for example, the number rose from 230 thousand in 1941 to 303 thousand in 1947. Even more dramatic was the swing in contract construction, shown in Figure 12.

For the period of overlap, these series are consistent with the picture portrayed by the Dun & Bradstreet data. They highlight the enormous discontinuities produced by the build-up to World War II and the reconversion of the economy to a peace-time basis. Apart from this wartime period, the data are consistent with evidence presented earlier that job creation and job destruction rates changed little over the twentieth century.

The BLS Labor Turnover Series

Another source of evidence on job creation and job destruction rates is labor turnover data.[20] Oliver Blanchard and Peter Diamond [1990] and Davis and Haltiwanger [1999] have used labor turnover data for this purpose for the post-World War II period, but these data are also available for earlier years. The Bureau of Labor Statistics (BLS) initiated the collection of turnover data for manufacturing on a monthly basis beginning in 1929 and continued these

[20] A brief history of labor turnover in the United States can be found in Owen [2004].

studies until 1982.[21] The BLS series was preceded by an "experimental" study undertaken by the Metropolitan Life Insurance Company which prepared monthly estimates for 1919 through May 1929 [Berridge 1929]. The turnover series can be pushed back further still, to 1910, using two government surveys pieced together with fragmentary data provided to the BLS by "a number of progressive firms … which have made serious attempts to cope with the problem of [labor] instability" [Brissenden and Frankel 1922: 208-211].[22] Here we assess the contribution of these data to our overall picture of the employment effects of job creation and job destruction rates across the twentieth century.

Labor turnover (or personnel turnover) is the movement of individuals into and out of employment at an individual business establishment. The positive components of turnover are "Accessions," the negative are "Separations." The original sources allow us to subdivide these two components into the subcategories indicated below:

Accessions			Separations			
New Hires	Recalls	Transfers	Quits	Discharges	Layoffs	All Other Separations

New hires are permanent and temporary additions to the payroll of workers who have never before worked at the establishment plus former employees rehired but not personally recalled. *Recalls* are former workers who have returned to employment after a period of layoff. *Transfers*

[21] The BLS data can be found in U.S. Bureau of Labor Statistics [1966: 45-48; 1972: 102; 1982: 109]. The BLS methodology was open to criticism for its limited scope (manufacturing was a declining sector in the US economy), for its focus on the employer rather than the worker (thus depriving researchers of information on the characteristics of workers who gain or lose employment), and for its inadequate sampling of firms with less than 50 employees which was thought to lead to an underestimate of the new hire rate [Cornog 1957, Utter 1982].

[22] Aside from the different origins of the three segments of the extended BLS series, there are also differences in coverage, sampling methodology, and definitions that make the attempt to combine them into a continuous series problematic. Arthur Ross, however, did exactly that after carefully noting the "grave difficulties" arising from the non-comparability of the three sources [1958]. He defended the procedure primarily by arguing that the series were good enough to illustrate "general tendencies and relationships" where "precision is not of crucial importance" [pp. 918-919]. The classic, and most careful, study of the BLS series is by Wladimir Woytinsky [1942]. The reader is referred to Woytinsky both for his detailed description of the data and his analysis of the trends in accessions and separations before World War II. Appendix BLS-CES reproduces the extended BLS series as an annual average of the monthly rates.

are former employees of other establishments within the firm who are new to the particular establishment.[23] *Quits* are terminations of employment that are voluntarily initiated by the employee for any reason other than retirement or service in the armed forces. *Discharges* are terminations initiated by the employer for cause (firings). *Layoffs* are suspensions from employment "without prejudice to the worker" expected to last more than a week.[24] *All Other Suspensions* include retirement, disability, death, and transfers to other establishments of the same firm. These counts are made for a specified time period (month, quarter, year). In most studies these quantities are expressed as rates per 100 employees on the payroll.[25]

Blanchard and Diamond [1990] and Davis and Haltiwanger [1999] transform the BLS's labor turnover data into estimates of job creation and destruction using the following equations:

(1) $\boldsymbol{pos} = a - \Theta q$ and

(2) $\boldsymbol{neg} = l + (1 - \Theta)q$

In these equations, ***pos*** and ***neg*** are job creation and job destruction, respectively, and a, q, and l represent accessions, quits, and layoffs. In the Davis-Haltiwanger approach, these values are expressed as *rates* using mean employment at the beginning and end dates as the denominator. The parameter Θ represents the fraction of quits that the employer replaces with new hires. Its value ranges between zero and one. In equation 1, these replacements are *subtracted* from accessions since replacement hiring maintains rather than expands employment. In equation 2, those quits that employers do not replace are *added* to layoffs since they represent a reduction in total employment. Blanchard and Diamond estimated the parameter Θ to be 0.85, a figure

[23] In the data described in what follows, transfers were separately tabulated beginning in January 1959. Before that date transfers were included in new hires.

[24] The suspension of business operations was a widespread practice in the late nineteenth century. Firms of that era often closed for a day or two at a time idling their entire workforce. Industrial suspensions of a week or less are called "Short Weeks." For a discussion of this practice and quantitative measures of its importance see Carter and Sutch [1992: 352-354].

[25] See the BLS *Handbook of Methods* [1966] for an extended discussion of the Bureau's definitions and methodology.

tentatively accepted by Davis and Haltiwanger, who also made an effort to estimate a cyclically sensitive Θ, after pointing out that the quit replacement rate could be expected to vary negatively with the business cycle.[26]

Here we follow Blanchard and Diamond and Davis and Haltiwanger and use turnover data to infer rates of job creation and job destruction. Unlike Davis and Haltiwanger we incorporate not only separations due to layoff and quits to our measures of job destruction but also separations due to dismissals and other reasons. These separations due to discharges and the "other" category constitute a large share of total separations so it is reasonable to include them here. While they are not as volatile as separations due to quits and layoffs, they nevertheless may play an important role in the dynamics of the economy. This may be particularly relevant when looking at changes spanning very long time periods.

As a substitute for equations (1) and (2), we propose the more inclusive definitions shown in equations (3) and (4):

(3) $\boldsymbol{pos} = a - \Theta'(q + d + o)$ and

(4) $\boldsymbol{neg} = l + (1 - \Theta')(q + d + o)$

Here the newly added terms d and o refer to the rates of separations due to dismissals and other reasons, respectively.

An important ambiguity regarding the BLS labor turnover data is whether they capture

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[26] In addition to the problem that Θ is unlikely to be a constant, both because of its probable cyclical behavior but also because it might well exhibit significant changes over the long run, Blanchard and Diamond highlight three ways in which this methodology misses some job creation and job destruction: (1) gross job creation and destruction within an establishment that cancel each other is not counted, (2) job creation that is offset by job destruction within a single quarter for a given establishment is missed, and (3) there is the "fact that firms may not be able to find workers to fill newly created jobs" [Blanchard and Diamond 1990: 110]. They say that there is nothing one can do about the first two problems. To respond to the third they add a measure of the change in the vacancy rate to the measure of job creation derived from turnover data. We are disinclined to follow them on this last adjustment since our interest is in the impact of firm demography on labor market flows. Jobs created but not filled produce no change in employment uptake.

employment change due to firm births and deaths. It would appear from the BLS's description of its sampling strategy that its survey missed most, if not all, of employment change attributable to newly-created and newly-destroyed establishments. In describing its procedures in the mid-1960s, the Bureau wrote:

> Each month the Bureau collects data on labor turnover actions from a sample of establishments drawn from a list of those subject to State unemployment insurance programs [U.S. Department of Labor, Bureau of Labor Statistics 1966: 35].[27]

It would seem that the BLS limited its survey of labor turnover to changes at establishments in operation during the survey month. The possible failure of the BLS series to take account of employment change due to establishment births and deaths is a potentially serious omission from the job creation and destruction estimates generated by equations (3) and (4). As we reported earlier (see Figure 3), between a quarter and one-third of all job creation and job destruction in the LBD occurred at new establishments or at establishments that went out of business.

There is a simple way of testing whether the BLS turnover data omits employment change due to establishment births and deaths. In his analysis, Wladimir Woytinski [1942] noted that the turnover data (if it were inclusive) imply an index of total manufacturing employment:

$$E_{t+1} = E_t + A_t - S_t \tag{5}$$

In this equation E_t is the number of workers employed at the beginning of the period, A is the number of accessions over the period and S the number of separations. Since we have a series of data on total employment at the middle of each period,[28] we can estimate E_t as the average between last period's BLS employment and this period's figure. We can then calculate an expected employment at the beginning of period t+1 and, equivalently, at the end of period t, if there had been no establishment births or deaths using the formula:

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[27] We are not entirely sure how the sample was drawn in the early years before the unemployment insurance program was established as part of the Social Security Act in the late 1930's. It is most probable that it is based on a sample of firms drawn from the 1927 and subsequent Censuses of Manufactures.

[28] This series comes from the BLS-CES web site and is presented as the employment mid-month [http://www.bls.gov/ces/home.htm, Series U30000003(n)]. It is clearly benchmarked to the census of manufacturing employment counts [Carter, *et al*, 2006: Series Dd5]. See Appendix BLS/CES.

(6) $E^{exp}_{t+1} = (1+a-s)\, E_t$

The variables *a* and *s* are the accession and separation rates for period t+1.[29]

An estimate of the net job creation from new and failing establishments that were missed (if any were) by the labor turnover data is:

(7) $N_t = E_{t+1} - E^{exp}_{t+1}$ and

(8) $n_t = 2N_t / (E_t + E_{t+1})$

In these equations N is the net number of jobs created through establishment births (job gains) and establishment disappearances (job losses) and n_t is the *rate* of net new job creation generated by this process. If N_t and n_t are zero, this means that the job turnover data fully capture employment change due to firm births and deaths.

Using these equations and the BLS labor turnover and employment data, it is easy to show that the BLS turnover data omit employment change due to firm births and deaths. We calculate the implied rate of employment change from missed firm births and deaths (n_t) and plot the data in Figure 14. It is apparent that on a month to month basis the discrepancy could be significant. The average absolute value of the residual is 0.7 percent and some values are quite substantial. Cumulated over the entire period from 1919 to 1981 the accession and separation data missed 27 percent of the net job growth in manufacturing employment.

If we assume that the BLS data missed all job creation and destruction from establishment births and deaths, we can construct an annual series of the net change from this source and then extend it to 2005 with the LBD data. The result is displayed in Figure 15. The high variance evident in the series implicit in the BLS data is much diminished in the LBD data. Whether this is due to lower vital rates for manufacturing firms in recent decades compared with

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[29] Since our source reports *a* and *s* at monthly rates, we raised (1+a-s) to the twelfth power to obtain an annual rate. See Appendix BLS/CES.

the pre-World War II period or to errors of measurement in the BLS surveys cannot be determined.

Although we have reservations about the assumption of a constant fraction of quits that are replaced ($\Theta = 0.85$), we present Figures 16 and 17 to characterize the long-run trends in job destruction and job creation by firms in continuous operation.[30] While the year to year changes cannot be confidently measured by this technique, we believe the long run trends shown are meaningful. Figure 16 suggests that job destruction at continuing plants (downsizing) took a sudden jump up with the onset of the Great Depression and then declined until the mid-1950s. The LBD data suggest that these rates have been relatively stable since 1977. Judging from the BLS turnover data job creation rates at plants in continuing operation, shown in Figure 17, were relatively low in 1929-1932 as the nation plunged into depression, but were surprisingly high after the economy began to recover in 1933. Thereafter this series shows a secular decline until the late 1970s. The LBD data suggest that this source of job growth has stabilized since 1977.

We use the turnover data to develop an imperfect (and downwardly biased) measure of excess job reallocation. The measure is imperfect and downwardly biased because we do not have separate measures of job change stemming from firm births and from firm deaths. Instead our measure is the net job change stemming from these two sources.

This measure provides a framework for calibrating long-term changes in net job reallocation rates between 1919 and 1981. To extend the series to 2005 we report excess job reallocation rates calculated from the LBD. Because the LBD is an annual series whereas the BLS job turnover reports annual averages of *monthly* rates, the LDB series will show less excess job reallocation. It misses job creation and job destruction that are offset within the year.

Results of these calculations are displayed in Figure 18. The most distinctive feature of the figure is the enormous amount of job churning that accompanied the Great Depression of the

[30] We cannot extend these series with the LBD data since the POS and NEG rates are based on monthly observations of turnover whereas the LBD can only observe the net change over the year. The annual LBD turnover series is

1930s. Even after controlling for the changes in the job growth rates, the excess job reallocation rate is above 67 percent throughout the 1930s, peaking at 108 percent in 1933. The economic build-up engineered to fight World War II substantially reduced the excess job reallocation rate, though not enough to allow the manufacturing sector to return to the low rates of the 1920s. Perhaps surprisingly, the figure suggests that the level of churning that took place during World War II and its immediate aftermath was not much greater that that displayed by the manufacturing sector throughout the 1950s and the first half of the 1960s. After 1964, however, manufacturing appears to have moved to a new, lower rate of excess job reallocation. While cyclical changes are evident, there is no noticeable trend from 1965 to the present.

Dun & Bradstreet Business Failures

In addition to compiling records on the number of business firms in operation, Dun & Bradstreet [D&B] reported data on the number of business failures with tabulations for several broad industries. Business failures as defined by D&B do not represent total business closings but only those resulting in losses to creditors. Businesses that discontinue operations for reasons such as inadequate profits, ill health, retirement, etc., are not recorded as failures if all creditors are paid in full. Unfortunately, the published records of D&B do not provide separate tabulations of the business population by industry. Thus we can compute a failure rate only for the D&B universe. This is displayed in Figure 19. What is most remarkable is the quite evident impact of the New Deal Bankruptcy Acts. Under the new provisions a firm in financial trouble that might otherwise have had to close, dismissing all of its workers, could remain operating under court supervision while the bankruptcy proceedings worked out arrangements with creditors. Since the D&B records do not include information of the number of employees of the firms it tracked, we cannot be precise about the number of jobs saved, but the number is likely to be substantial.

While we cannot compute a failure rate for manufacturing, mining, and construction

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necessarily lower than the monthly series since it excludes job creation and destruction that is offset within the year.

firms, we display the total number of failures in Figure 20. Amazingly, the D&B numbers suggest that something like 4,000 fewer firms failed each year in the late-1930s than in the first several years of the depression.

{Yet to come: Conclusions}

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Table 1: Number of Establishments in the Longitudinal Business Data Base

Economic Sector	SIC Codes \2	Year				
		1976	1980	1990	2000	2005
Agricultural Services	07	51,839	55,017	91,569	125,314	143,278
Mining	10-14	28,094	33,112	30,171	24,274	24,758
Construction	15-17	470,461	504,837	591,392	680,724	626,469
Manfacturing	20-39	340,995	353,580	383,104	376,842	340,697
Transportation and Public Utilities	40-47	179,257	190,133	241,396	316,616	323,834
Wholesale Trade	50-51	390,160	421,721	502,202	516,997	495,685
Retail Trade	52-59	1,383,644	1,401,586	1,549,330	1,574,911	1,630,950
Finance, Insurance, and Real Estate	60-67	440,351	472,626	561,280	711,991	816,456
Services	70-89	1,349,992	1,509,903	2,123,301	2,635,493	2,981,938
Total Universe of LBD \1		4,635,473	4,943,042	6,074,417	7,070,106	7,463,652

Source: Center for Economic Studies, Census Bureau, the detailed LBD is confidential [Title 13 and Title 26, US Code].

\1 Includes unclassified establishments.

\2 SIC codes are from the old Standard Industrial Classification System see http://www.census.gov/epcd/cbp/download/industry.ref. SIC codes have been replaced by North American Industrial Classification System codes (NAICS). For additional information on industrial classification see Sutch 2006.

Table 2: Employment Change in the Manufacturing Sector by Source, Milwaukee, 1891-1899, and the Nation, 1977-2005

			Employment change due to					
		Net job gain	Plant births	Plant deaths	Plant expansions	Plant contractions	Gross job reallocation	Excess job reallocation
		2.1	2.2	2.3	2.4	2.5	2.6	2.7
Location	Period	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Two-Year Changes								
Milwaukee	1891-93	10.6	11.5	-10.0	15.9	-6.7	44.1	33.5
Milwaukee	1897-99	32.1	14.7	-8.6	29.8	-3.8	56.9	24.8
	Average	***21.4***	***13.1***	***-9.3***	***22.9***	***-5.3***	***50.5***	***29.2***
The Nation	1977-79	9.1	7.6	-6.9	15.3	-7.0	36.8	27.7
The Nation	1979-81	-3.6	7.8	-8.7	9.4	-12.1	38.0	34.4
The Nation	1981-83	-12.0	5.9	-8.4	8.5	-18.0	40.8	28.8
The Nation	1983-85	8.0	8.4	-7.6	15.3	-8.1	39.4	31.4
The Nation	1985-87	-3.0	7.6	-10.0	10.6	-11.3	39.5	36.5
The Nation	1987-89	3.7	7.5	-7.8	13.1	-9.2	37.6	33.9
The Nation	1989-91	-5.4	6.4	-7.7	9.0	-13.1	36.2	30.8
The Nation	1991-93	-1.8	5.5	-7.1	11.1	-11.3	35.0	33.2
The Nation	1993-95	2.5	6.0	-6.7	12.6	-9.5	34.8	32.3
The Nation	1995-97	-0.6	5.8	-7.8	11.3	-9.9	34.8	34.2
The Nation	1997-99	-0.8	5.5	-7.5	11.2	-9.9	34.1	33.3
The Nation	1999-2001	-4.2	6.1	-9.0	10.4	-11.7	37.2	33.0
The Nation	2001-03	-18.1	7.0	-16.6	7.1	-15.5	46.2	28.1
The Nation	2003-05	-6.9	4.6	-11.3	9.9	-10.2	36.0	29.1
	Average	***-2.4***	***6.6***	***-8.8***	***11.1***	***-11.2***	***37.6***	***31.9***
Four-Year Changes								
Milwaukee	1893-97	-3.2	15.7	-11.1	9.2	-17.1	53.1	49.9
The Nation	1977-81	4.2	14.2	-14.8	15.2	-10.4	54.6	50.4
The Nation	1981-85	-2.6	14.1	-15.3	14.2	-15.5	59.1	56.5
The Nation	1985-89	0.4	13.5	-15.9	15.0	-12.1	56.5	56.1
The Nation	1989-93	-7.1	10.8	-14.1	12.1	-15.8	52.8	45.7
The Nation	1993-97	1.9	10.9	-13.4	16.1	-11.8	52.2	50.3
The Nation	1997-2001	-5.2	10.7	-15.8	13.6	-13.7	53.8	48.6

The Nation	2001-05	-24.3	9.3	-26.0	9.5	-17.0	61.8	37.5
	Average	***-4.7***	***11.9***	***-16.5***	***13.7***	***-13.8***	***55.8***	***49.3***

Sources:

1891-99 Milwaukee: Wisconsin Bureau of Labor, Census, and Industrial Statistics`[1892, 1894, 1898, and 1901], Carter and Sutch [2007]. *1977-2005 U.S.*: Longitudinal Business Database (LBD) maintained by the Center for Economic Studies, U.S. Census Bureau, with special calculations performed by Javier Miranda.

Documentation:

All data refer to plants with five or more employees in the beginning period. Employment change attributed to plant entry is the number of employees in the second period at plants that enter business between the two dates. Employment change attributed to plant expansions and contractions refer to the net change in the number of employees in plants in operation in both periods that increased or reduced employment between the two dates. Employment change attributed to plant exits refer to the number of employees in plants in operation in the first period but not in the second. All of the employment change measures are expressed as a percentage of the average of first and second period employment.

Gross job reallocation equals the sum of job creation (columns 2.2 and 2.4) and job destruction (the absolute values of columns 2.3 and 2.5). Excess job reallocation equals gross job reallocation (column 2.6) minus the absolute value of the net employment change (column 2.1). Our calculations follow the definitions of Davis and Haltiwanger [1999: 2717].

Table 3: Employment Change in the Manufacturing Sector by Establishment Size, Milwaukee, 1891-1899 and The Nation, 1977-2005

Change Over Two-Year Intervals

Employment Size Category	Net job gain	Job Creation	Job Destruction	Gross Job Reallocation	Excess job reallocation
Milwaukee, 1891-1893 and 1897-1899					
5 to 20	23.8	67.0	-43.2	110.1	86.3
21 to 50	25.8	53.9	-28.1	81.9	56.1
51 to 100	10.1	37.6	-27.5	65.1	55.0
100 to 250	29.2	35.8	-6.7	42.5	13.3
251+	13.8	24.8	-11.0	35.8	22.0
The Nation, 1977-1979 through 2003-2005					
5 to 20	-11.1	27.7	-38.9	66.6	54.0
21 to 50	-4.2	22.1	-26.3	48.5	41.0
51 to 100	-2.9	20.2	-23.1	43.3	36.9
100 to 250	-2.1	17.9	-20.0	37.9	32.3
251 to 500	-0.9	15.6	-16.5	32.2	27.2
501 to 1,000	-0.2	14.3	-14.5	28.8	24.5
1,000+	0.1	14.1	-13.9	28.0	24.0

Sources and documentation: See Table 2.

Table 4: Size of Plant Employing the Median Worker and Size of Median Plant, Milwaukee, 1891-1899 and The Nation, 1977-2005

Year	Size of Plant Employing the Median Worker	Size of Median Plant	Size of Plant located at the 99th Percentile of Plant Size	Plants with over 100 Employees as a Percent of those with 20 or More	Source
1891	190	29	601	30.0	Wisconsin Firms*
1893	225	34	683	29.4	Wisconsin Firms*
1897	195	18	636	29.3	Wisconsin Firms*
1899	250	21	750	31.2	Wisconsin Firms*
1977	339	9	721	30.9	LBD**
1980	410	10	718	30.7	LBD**
1990	262	9	620	29.1	LBD**
2000	240	7	600	29.4	LBD**
2005	206	6	529	28.8	LBD**

* Plants with five or more workers.
** All plants.

Figure 1

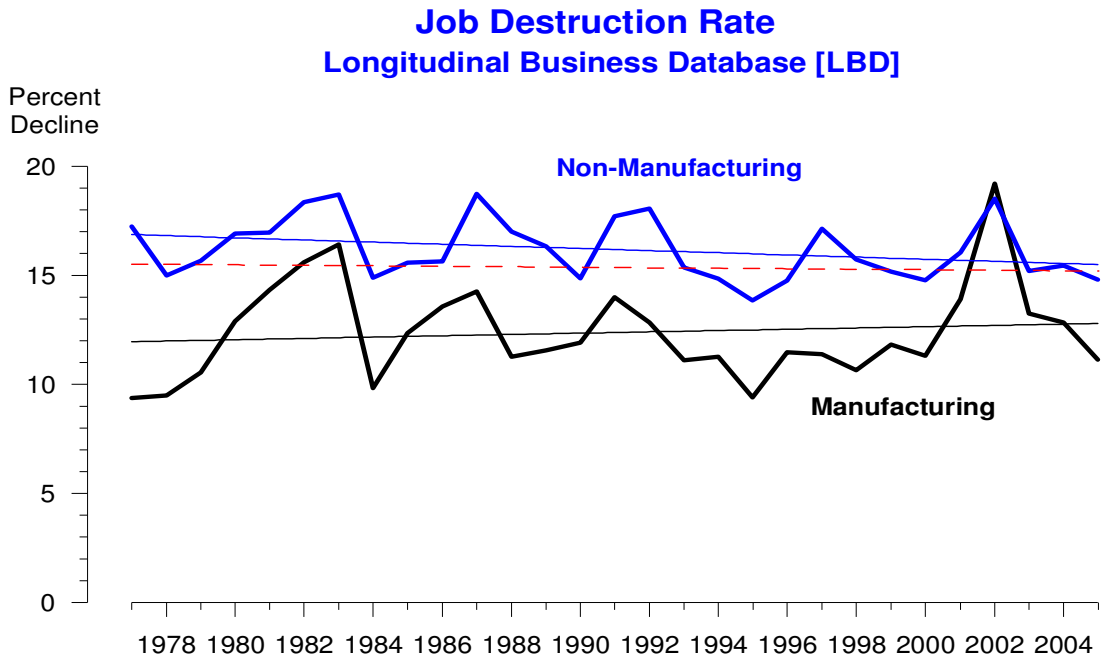

Job Destruction Rate
Longitudinal Business Database [LBD]
Percent
Decline
20
15
10
5
0
Non-Manufacturing
Manufacturing
1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004

Figure 2

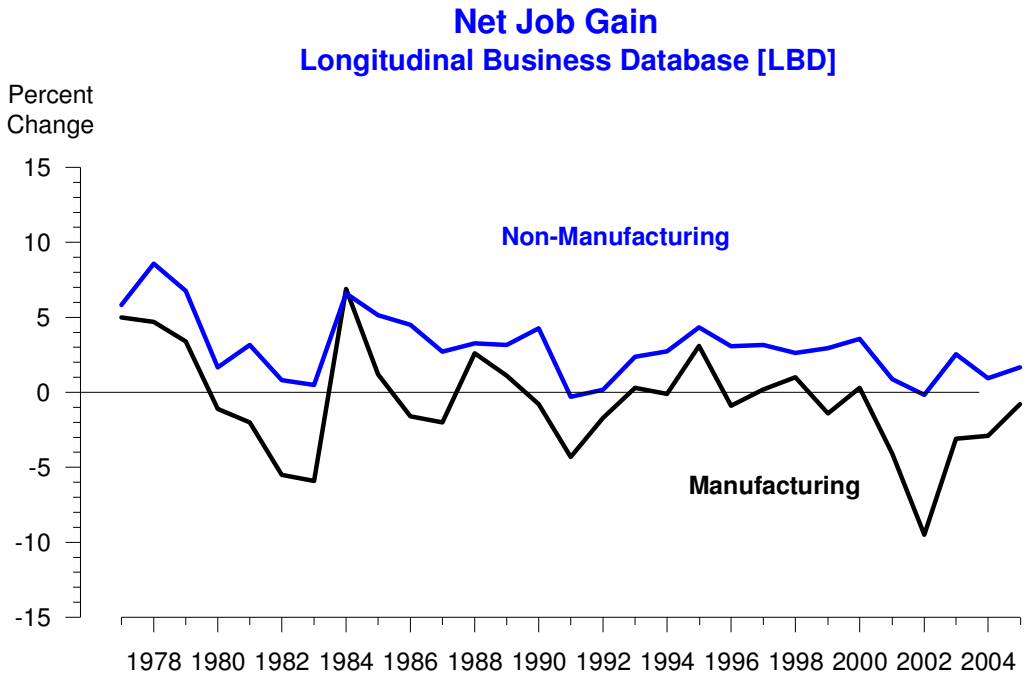

Net Job Gain
Longitudinal Business Database [LBD]
Percent Change
15
10
5
0
-5
-10
-15
Non-Manufacturing
Manufacturing
1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004

Figure 3

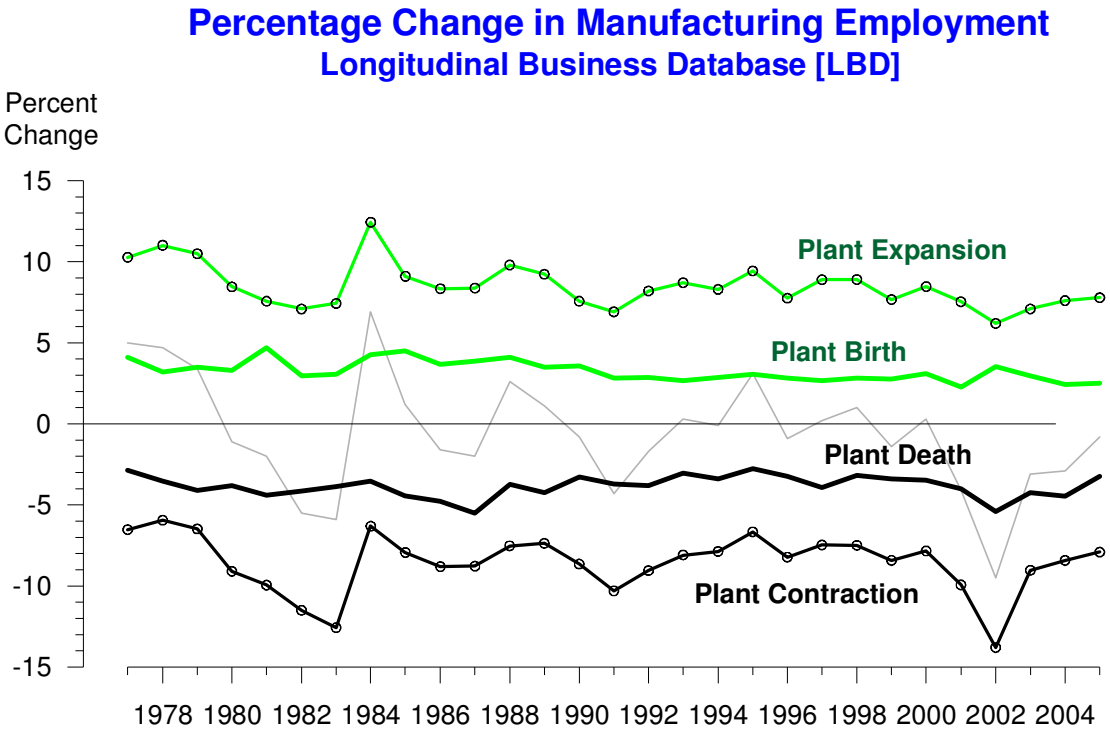

Percentage Change in Manufacturing Employment
Longitudinal Business Database [LBD]
Percent Change
15
10
5
0
-5
-10
-15
Plant Expansion
Plant Birth
Plant Death
Plant Contraction
1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004

Figure 4

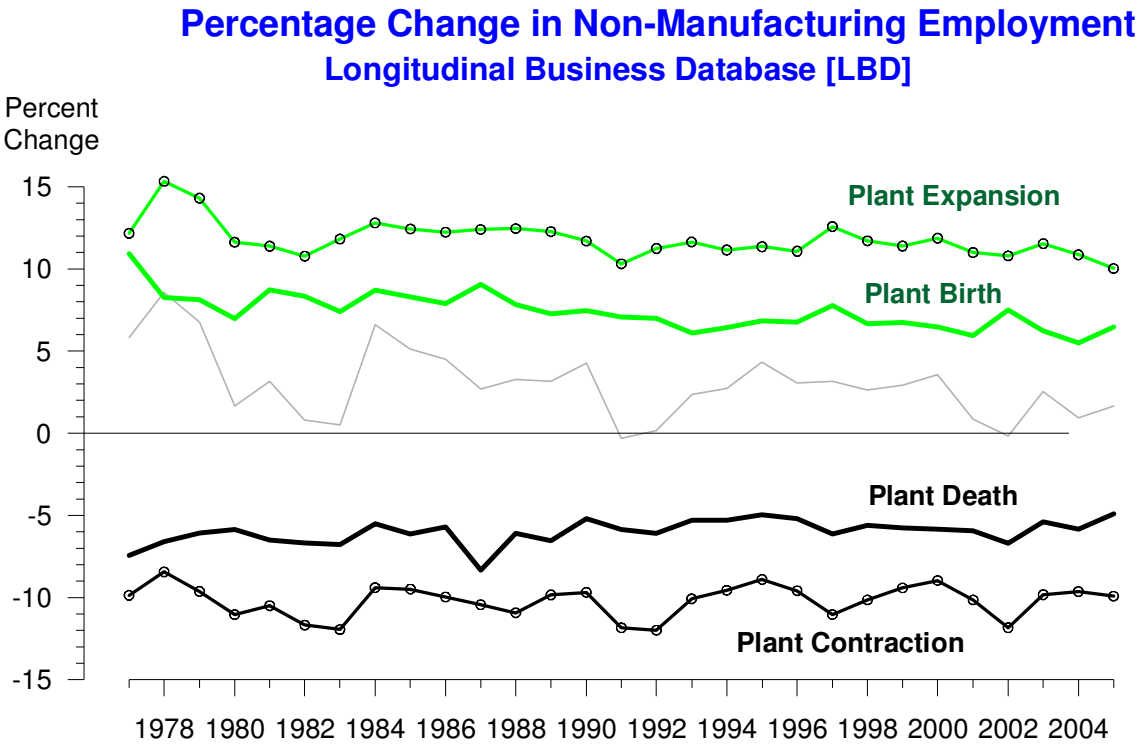

Percentage Change in Non-Manufacturing Employment
Longitudinal Business Database [LBD]
Percent Change
15
10
5
0
-5
-10
-15
Plant Expansion
Plant Birth
Plant Death
Plant Contraction
1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004

Figure 5

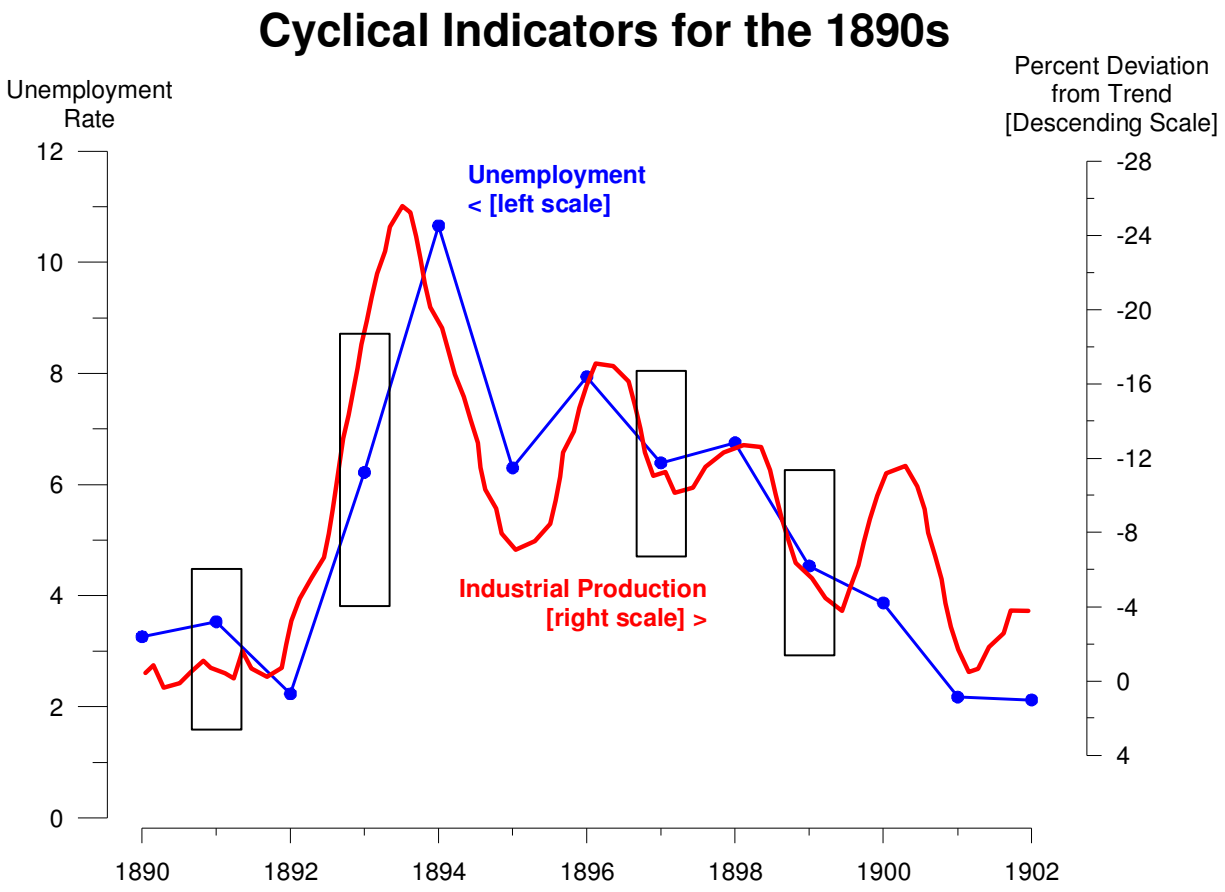

Cyclical Indicators for the 1890s
Unemployment Rate
Percent Deviation from Trend [Descending Scale]
Unemployment < [left scale]
Industrial Production [right scale] >
12
10
8
6
4
2
0
-28
-24
-20
-16
-12
-8
-4
0
4
1890
1892
1894
1896
1898
1900
1902

Figure 6

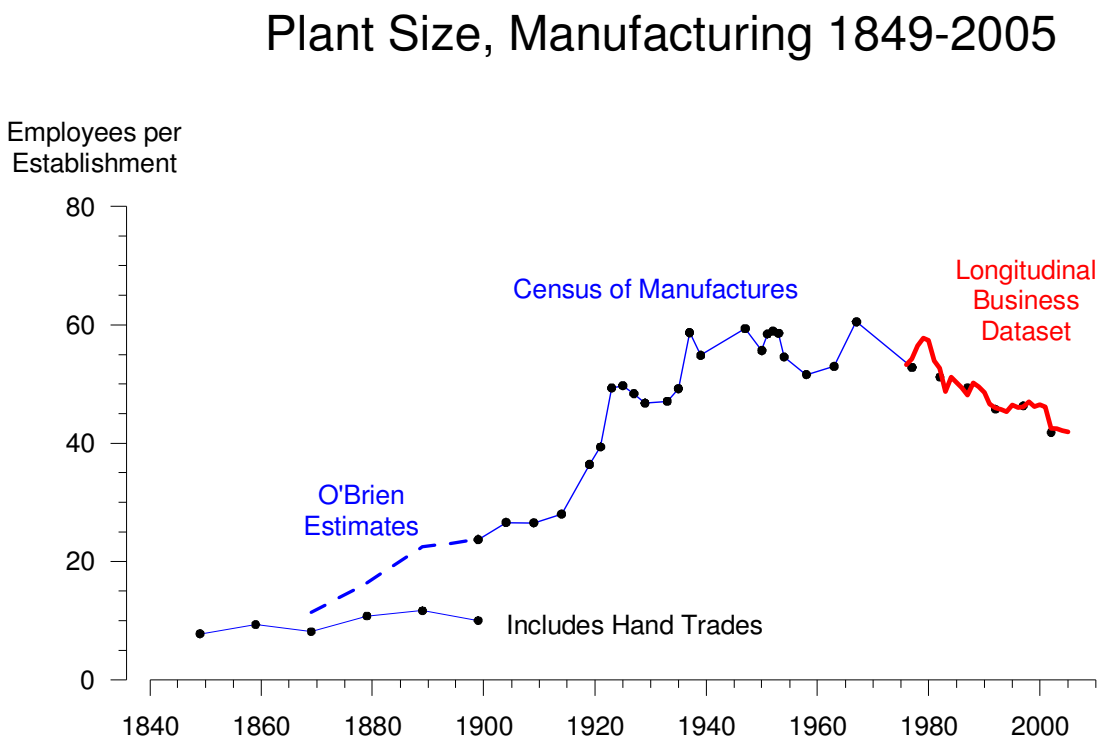

Plant Size, Manufacturing 1849-2005
Employees per Establishment
80
60
40
20
0
1840
1860
1880
1900
1920
1940
1960
1980
2000
Census of Manufactures
Longitudinal Business Dataset
O'Brien Estimates
Includes Hand Trades

Figure 7

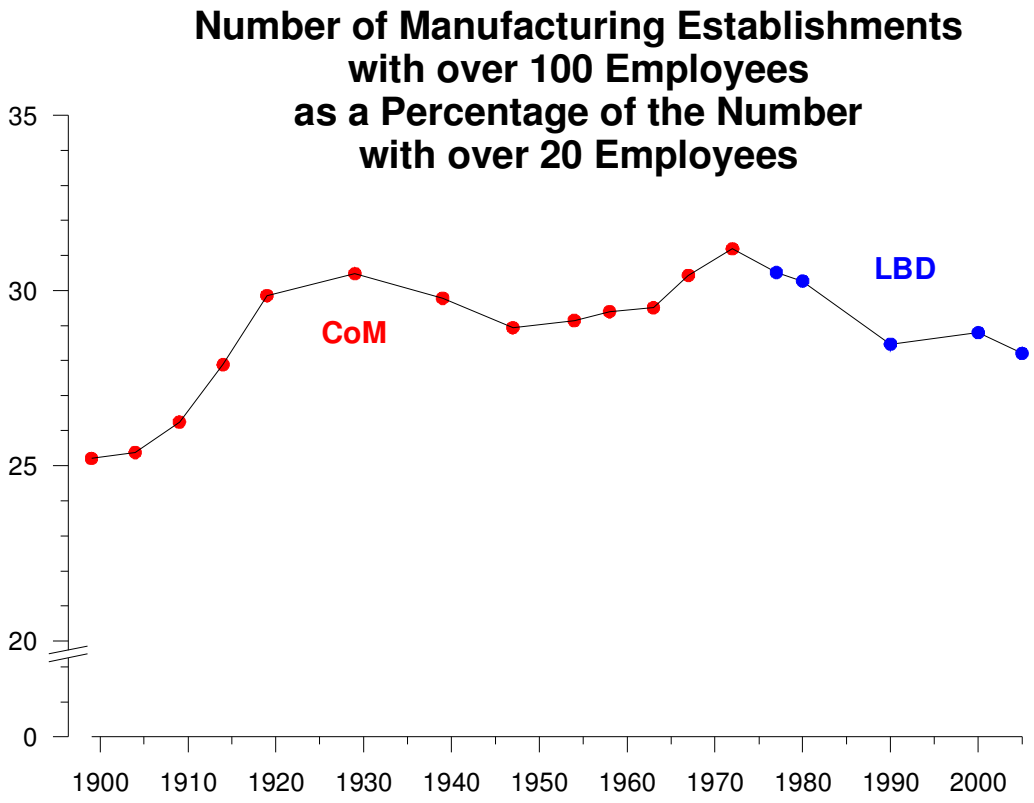

Number of Manufacturing Establishments
with over 100 Employees
as a Percentage of the Number
with over 20 Employees
35
30
25
20
0
CoM
LBD
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000

Figure 8

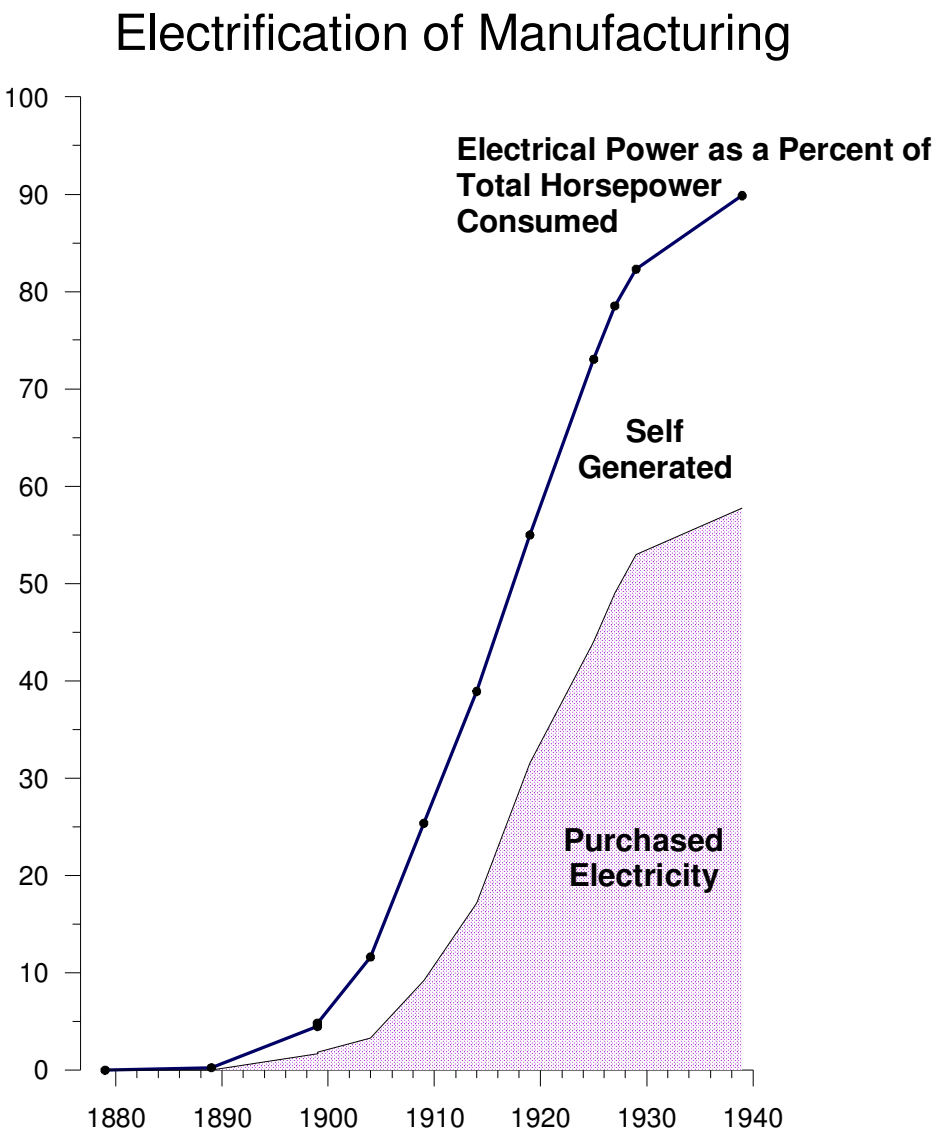

Electrification of Manufacturing
100
90
80
70
60
50
40
30
20
10
0
1880
1890
1900
1910
1920
1930
1940
Electrical Power as a Percent of Total Horsepower Consumed
Self Generated
Purchased Electricity

Figure 9

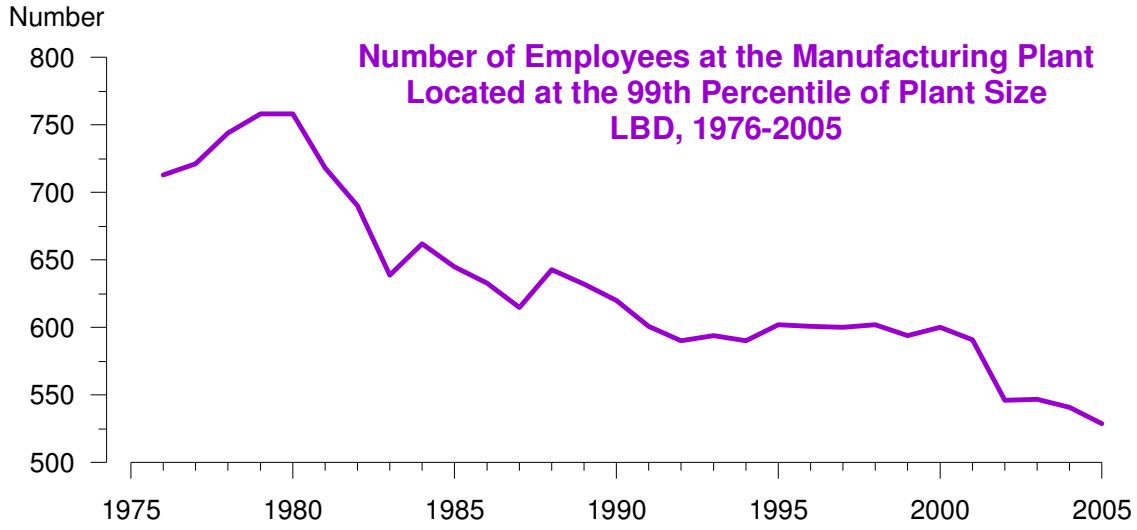

Number
800
750
700
650
600
550
500
1975
1980
1985
1990
1995
2000
2005
Number of Employees at the Manufacturing Plant
Located at the 99th Percentile of Plant Size
LBD, 1976-2005

Figure 10

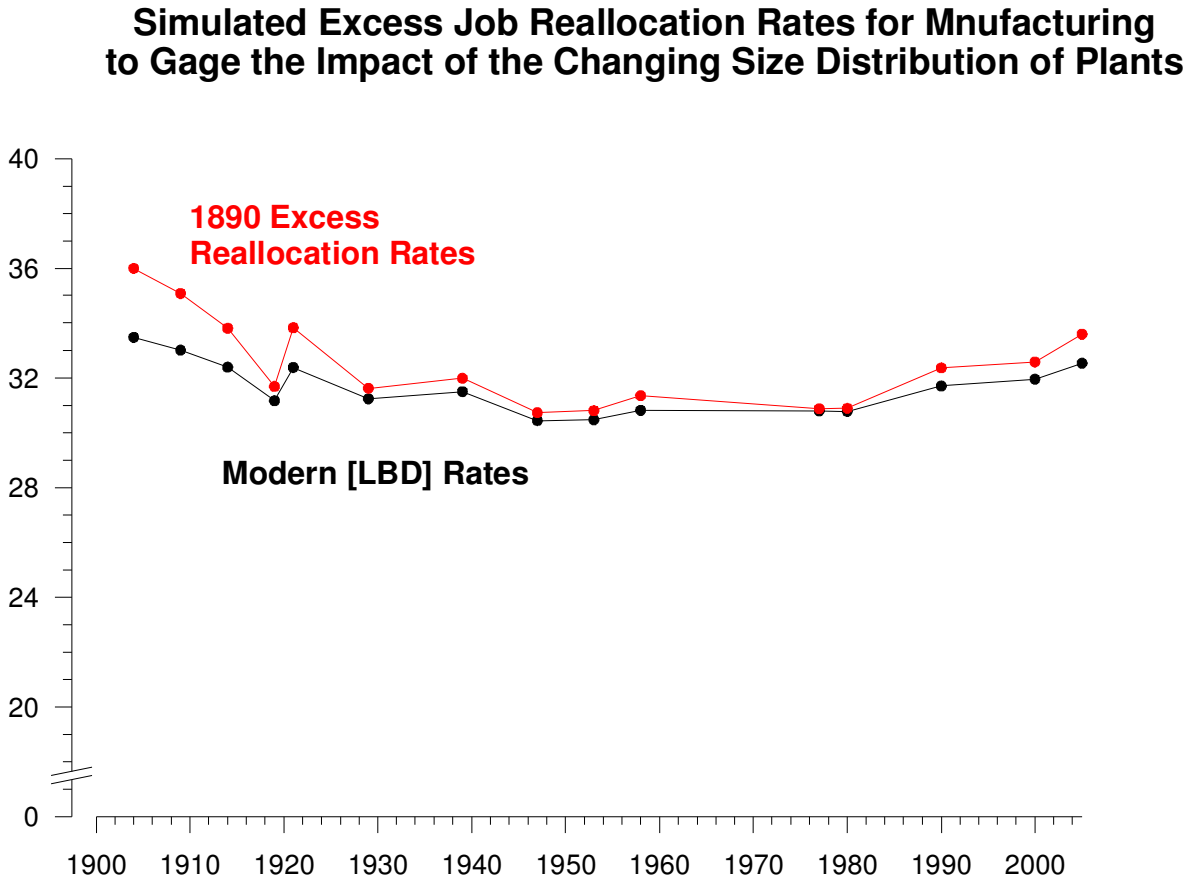

Simulated Excess Job Reallocation Rates for Mnufacturing
to Gage the Impact of the Changing Size Distribution of Plants
40
36
32
28
24
20
0
1890 Excess
Reallocation Rates
Modern [LBD] Rates
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000

Figure 11

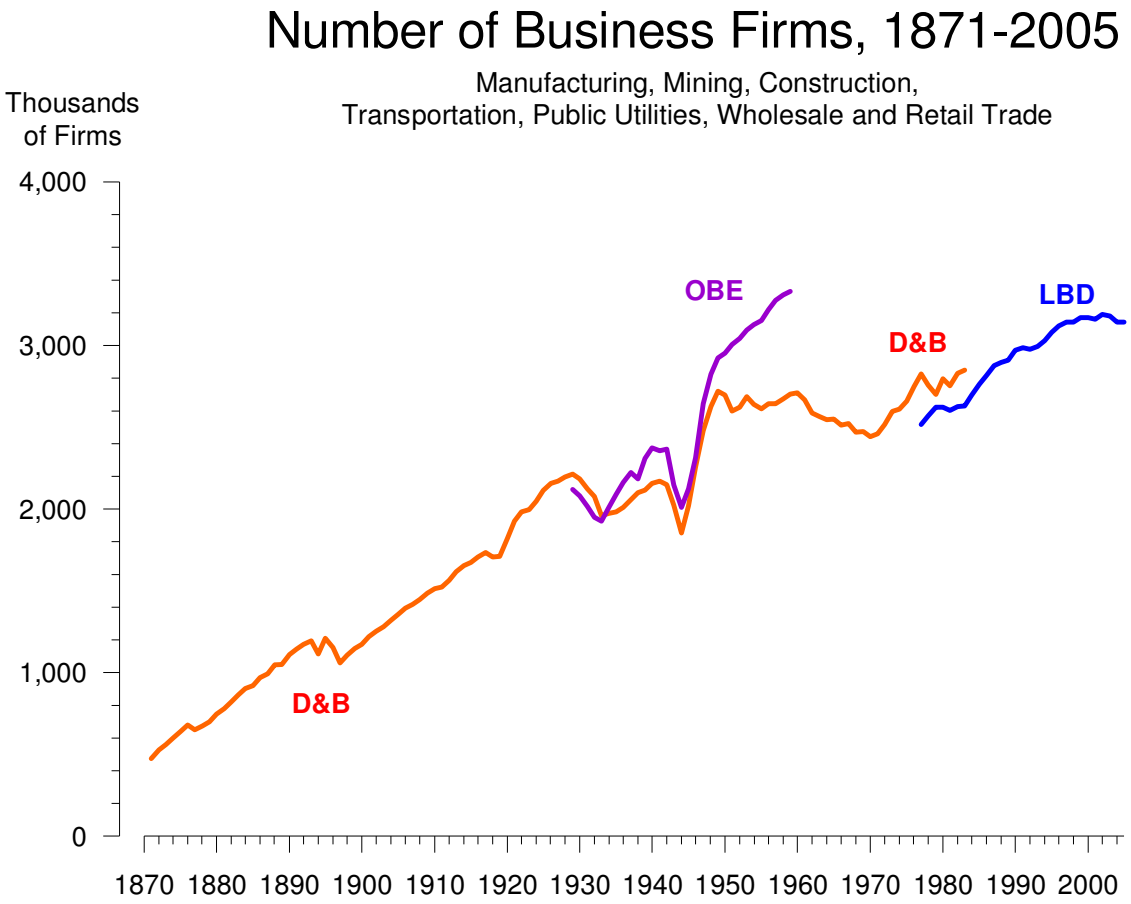

Number of Business Firms, 1871-2005
Manufacturing, Mining, Construction,
Transportation, Public Utilities, Wholesale and Retail Trade
Thousands
of Firms
4,000
3,000
2,000
1,000
0
OBE
LBD
D&B
D&B
1870 1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000

Figure 12

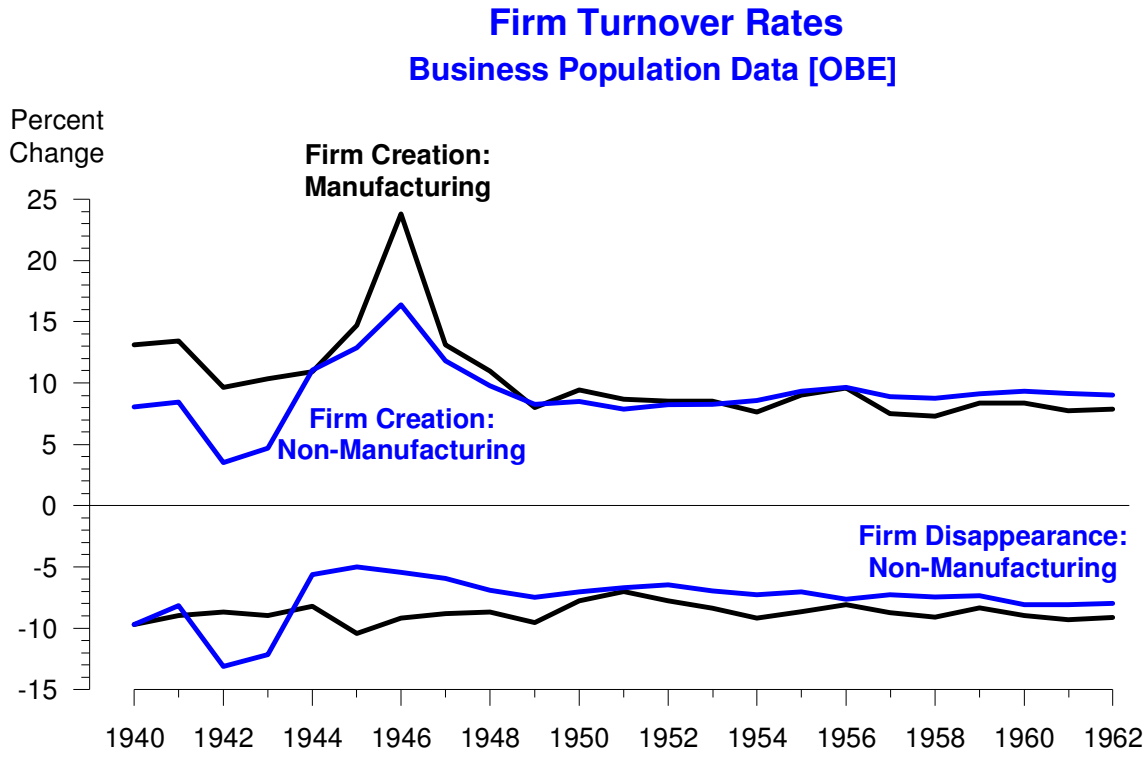

Firm Turnover Rates
Business Population Data [OBE]
Percent Change
Firm Creation: Manufacturing
Firm Creation: Non-Manufacturing
Firm Disappearance: Non-Manufacturing
25
20
15
10
5
0
-5
-10
-15
1940
1942
1944
1946
1948
1950
1952
1954
1956
1958
1960
1962

Figure 13

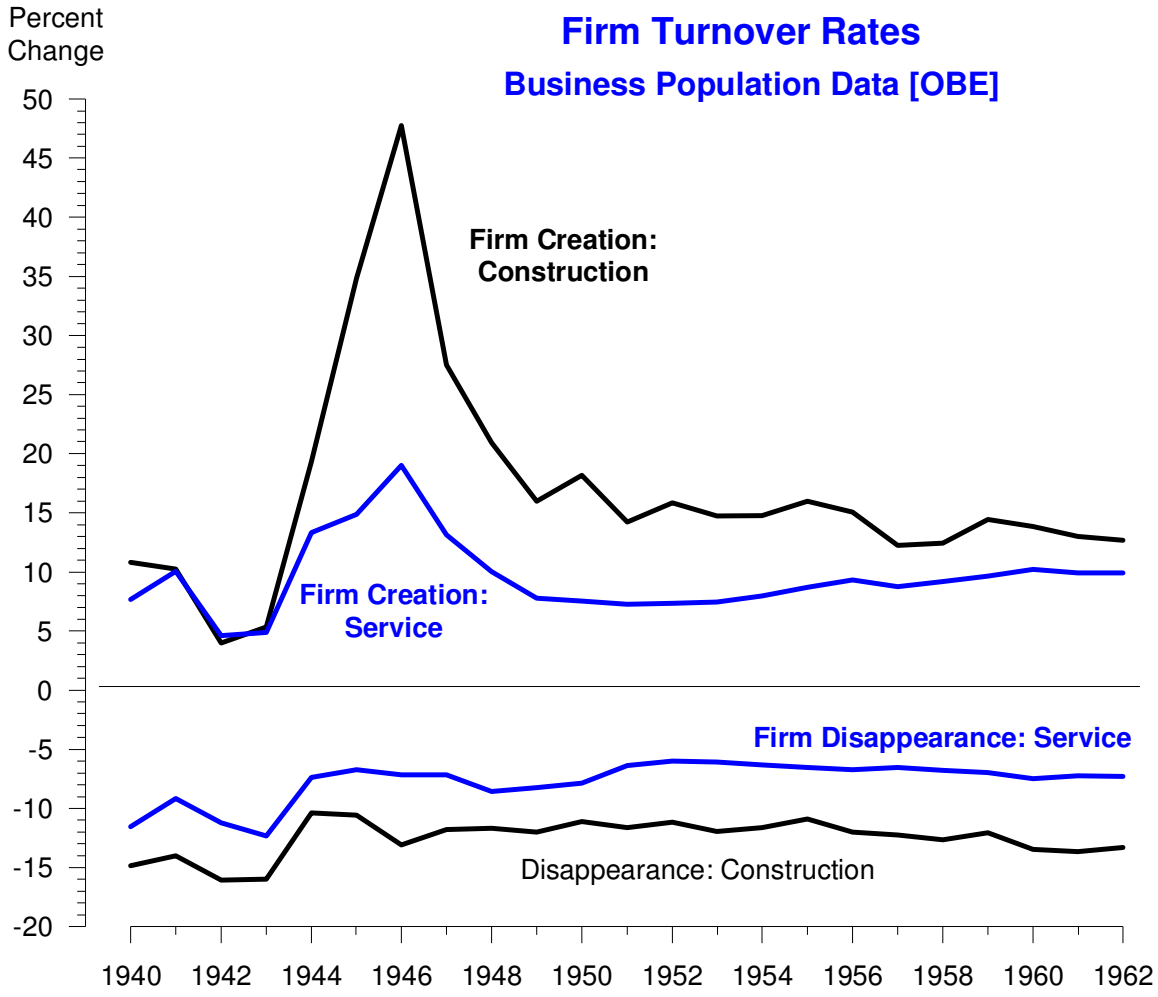

Percent Change
Firm Turnover Rates
Business Population Data [OBE]
Firm Creation: Construction
Firm Creation: Service
Firm Disappearance: Service
Disappearance: Construction
50
45
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20
1940
1942
1944
1946
1948
1950
1952
1954
1956
1958
1960
1962

Figure 14

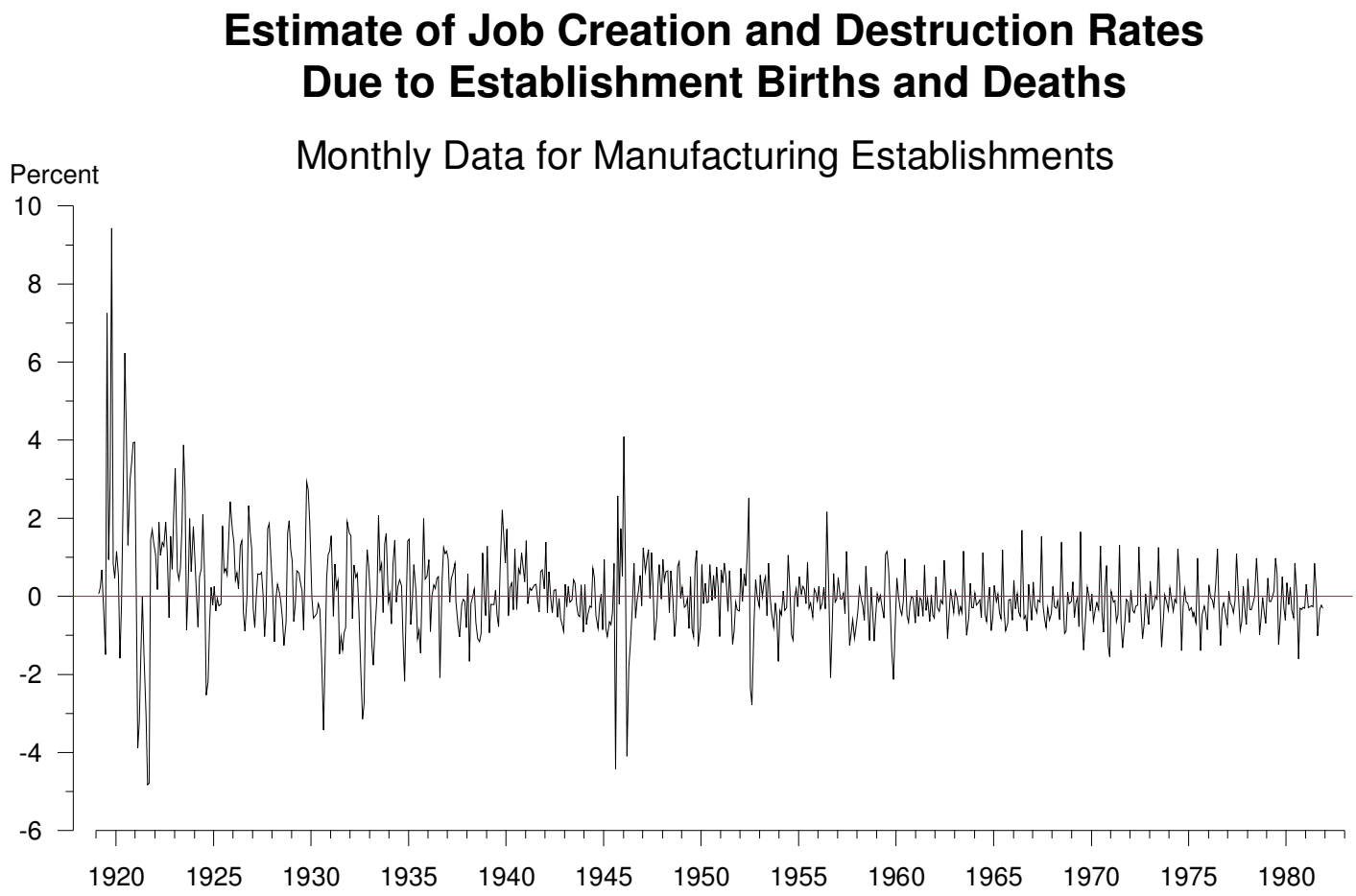

Estimate of Job Creation and Destruction Rates
Due to Establishment Births and Deaths
Monthly Data for Manufacturing Establishments
Percent
10
8
6
4
2
0
-2
-4
-6
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980

Figure 15

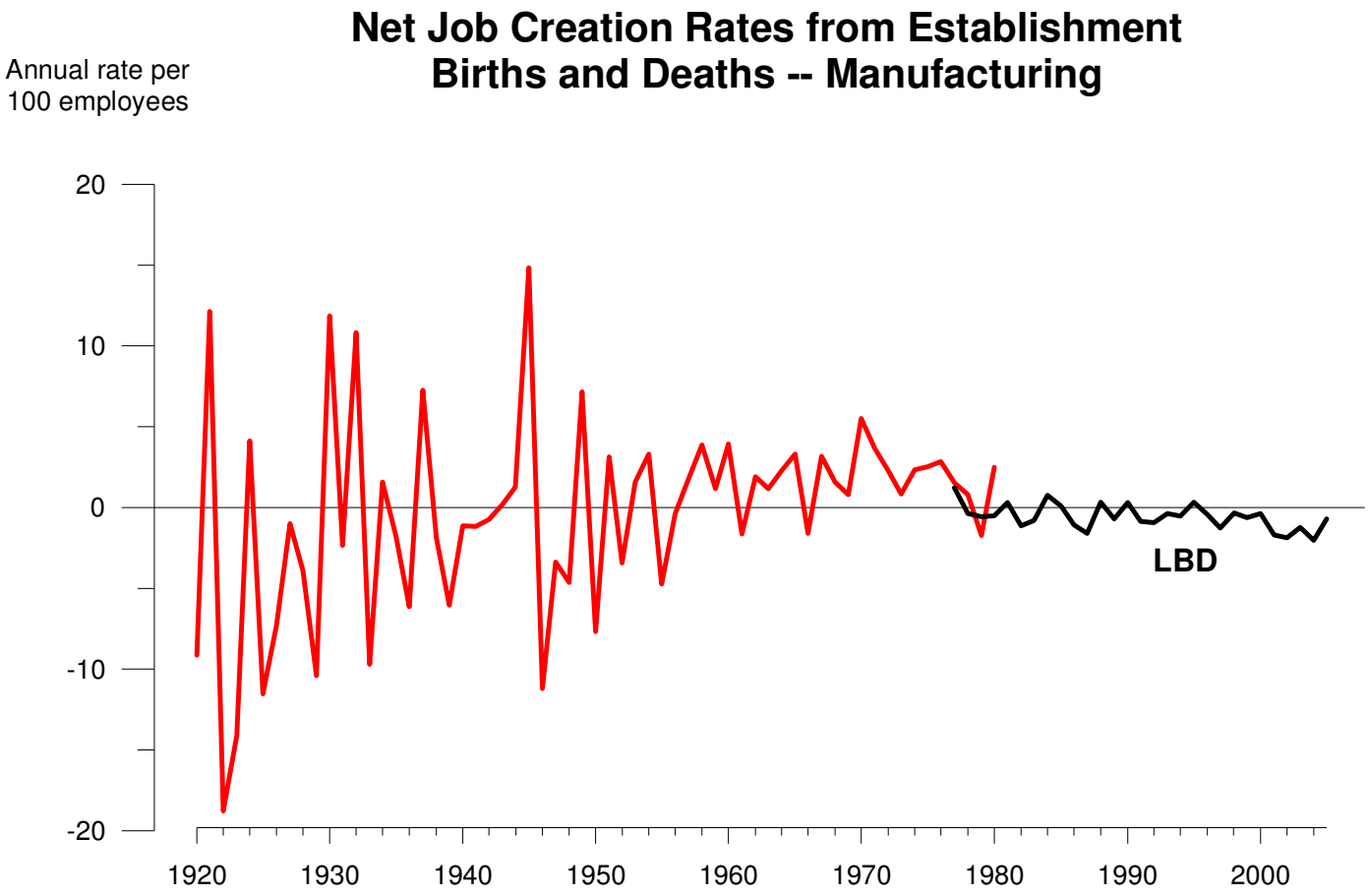

Net Job Creation Rates from Establishment Births and Deaths -- Manufacturing
Annual rate per 100 employees
20
10
0
-10
-20
1920
1930
1940
1950
1960
1970
1980
1990
2000
LBD

Figure 16

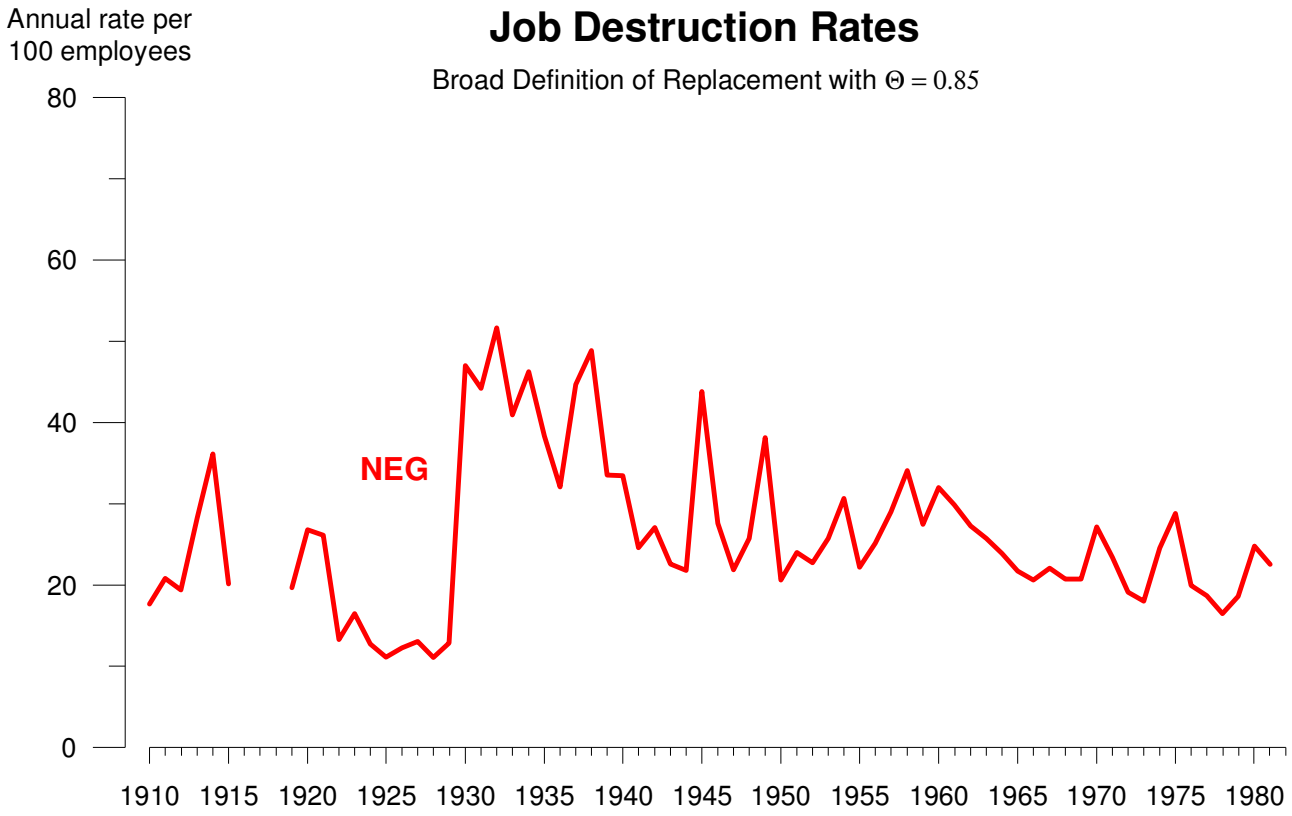

Annual rate per
100 employees
Job Destruction Rates
Broad Definition of Replacement with Θ = 0.85
80
60
40
20
0
NEG
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980

Figure 17

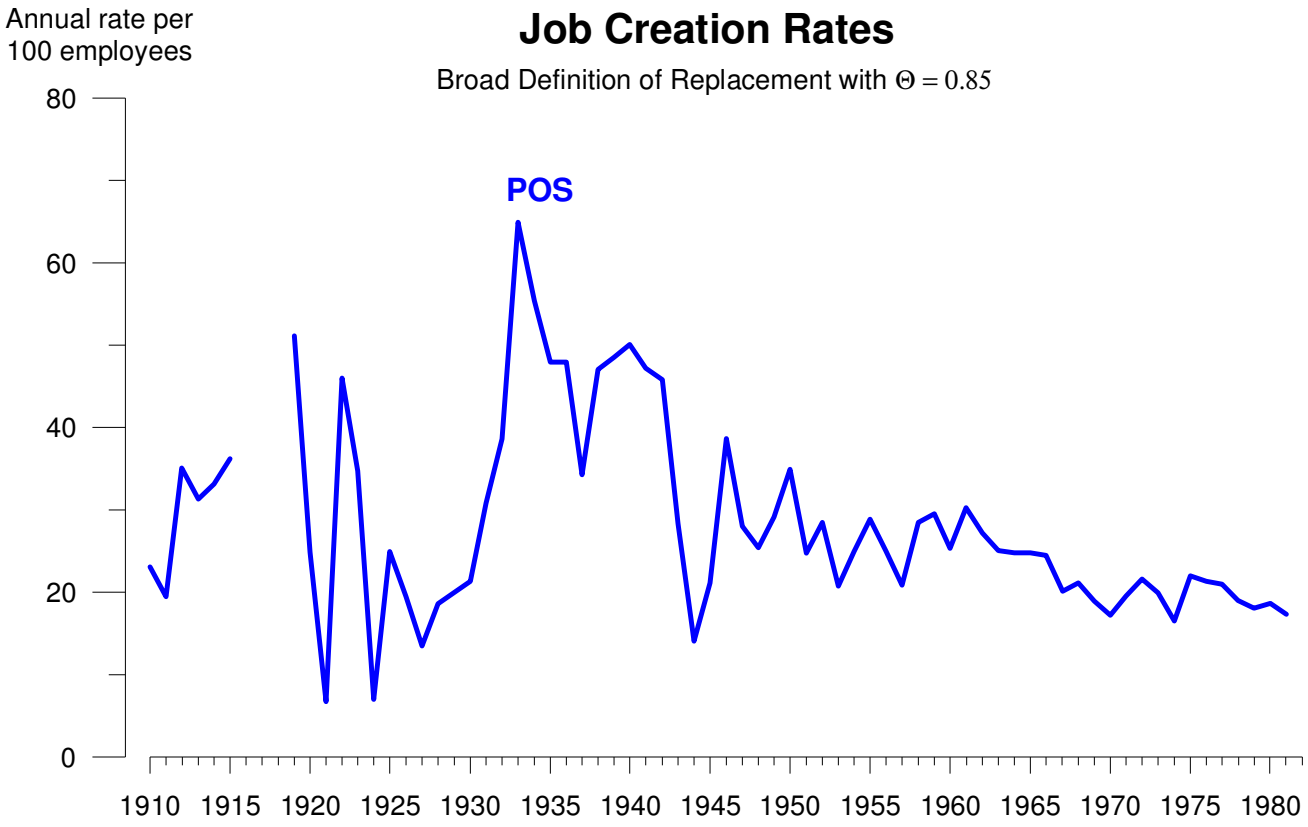

Annual rate per
100 employees
Job Creation Rates
Broad Definition of Replacement with Θ = 0.85
POS
80
60
40
20
0
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980

Figure 18

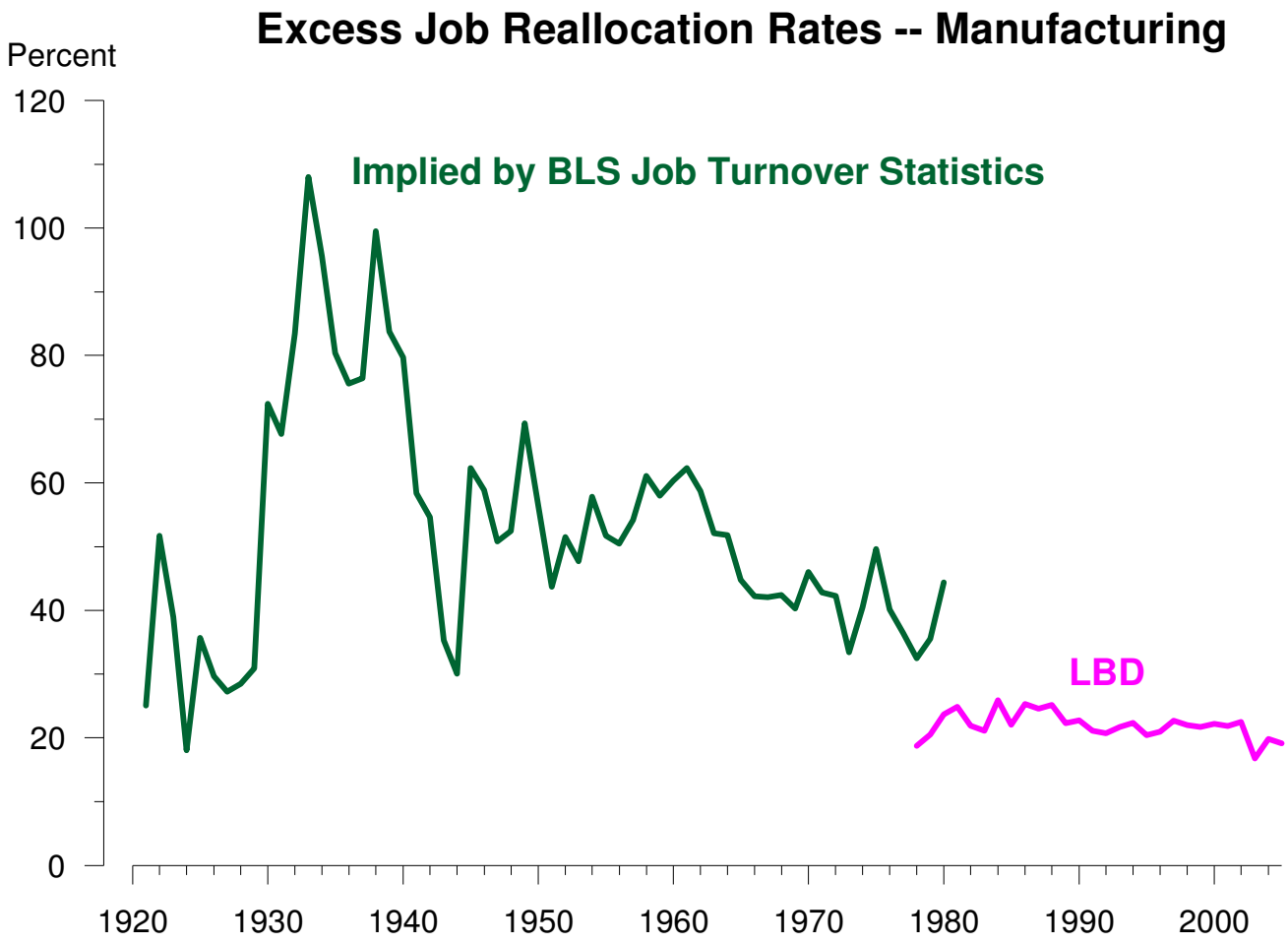
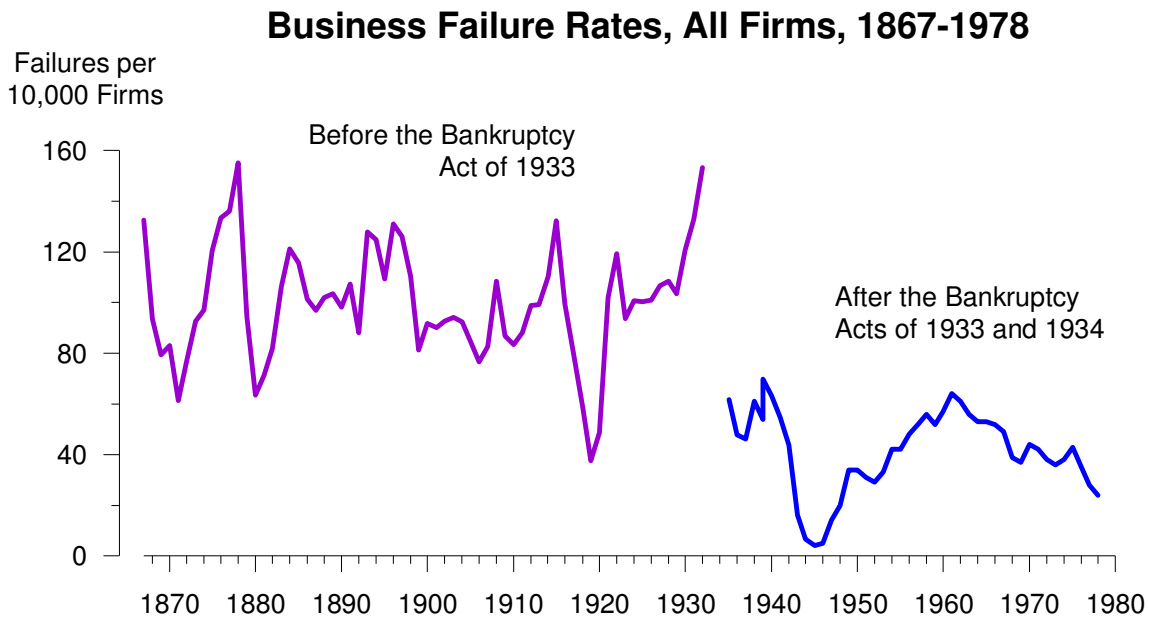
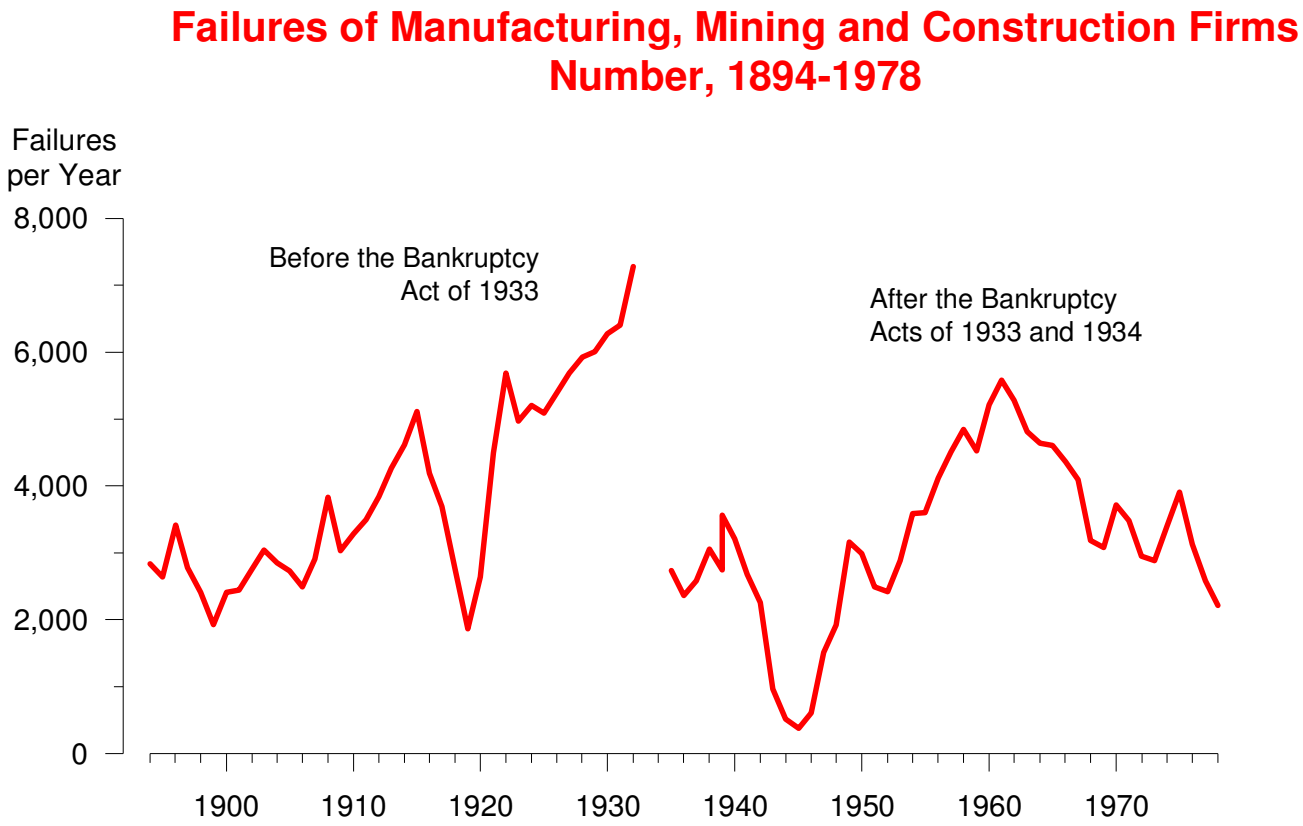

Excess Job Reallocation Rates -- Manufacturing
Percent
120
100
80
60
40
20
0
Implied by BLS Job Turnover Statistics
LBD
1920
1930
1940
1950
1960
1970
1980
1990
2000

Figure 19



Source: Appendix D&B.

Figure 20



Source: Appendix D&B.