# Volatility and Dispersion in Business Growth Rates: Publicly Traded versus Privately Held Firms

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## Abstract

We study the variability of business growth rates in the U.S. private sector from 1976 onwards. To carry out our study, we exploit the recently developed Longitudinal Business Database (LBD), which contains annual observations on employment and payroll for all U.S. businesses. Our central finding is a large secular decline in the cross sectional dispersion of firm growth rates and in the average magnitude of firm level volatility. Measured the same way as in other recent research, the employment-weighted mean volatility of firm growth rates has declined by more than 40% since 1982. This result stands in sharp contrast to previous findings of rising volatility for publicly traded firms in COMPUSTAT data. We confirm the rise in volatility among publicly traded firms using the LBD, but we show that its impact is overwhelmed by declining volatility among privately held firms. This pattern holds in every major industry group. Employment shifts toward older businesses account for 27 percent or more of the volatility decline among privately held firms. Simple cohort effects that capture higher volatility among more recently listed firms account for most of the volatility rise among publicly traded firms.

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# I. Introduction

We study the variability of business growth rates in the U.S. economy from 1976 onwards. To carry out our study, we exploit the recently developed Longitudinal Business Database (LBD) (Jarmin and Miranda, 2002a), which contains annual observations on employment and payroll for all establishments and firms in the private sector. Compared to other longitudinal business databases for the United States, the LBD is unparalleled in its comprehensive coverage over an extended period of time. The underlying sources for the LBD are periodic business surveys conducted by the Census Bureau and federal government administrative records.[2]

Macroeconomists increasingly recognize the importance of interactions between aggregate economic performance and the volatility and heterogeneity of business level outcomes. Idiosyncratic shocks are central to modern theories of unemployment. Frictions in product, factor and credit markets that impede business responses to idiosyncratic shocks can raise unemployment, lower productivity and depress investment. Financial innovations that facilitate better risk sharing can simultaneously encourage risk taking and investment, amplify business level volatility, and promote growth. Several recent studies hypothesize a close connection between declining aggregate volatility and trends in business level volatility. These examples of interactions between business level and aggregate outcomes help motivate our empirical study. Our chief objective is to develop a robust set of facts about the magnitude and evolution of business level volatility and the cross sectional dispersion of business growth rates in the U.S. economy.

Previous empirical work in this area yields an unclear picture. Several recent studies find a secular rise in average volatility among publicly traded firms. Examples include Campbell et al. (2001), Chaney, Gabaix and Philippon (2002), Comin and Mulani (2006), and Comin and Philippon (2005). In Figure 1, we replicate a key finding from the latter two studies. The figure shows that the average magnitudes of firm level volatility in the growth rates of sales and employment have roughly doubled since the early 1960s.[3] In a

[2] The LBD is confidential under Titles 13 & 26 U.S.C. Research access to the LBD can be granted to non-Census staff for approved projects. See www.ces.census.gov for more information. COMPUSTAT, which provides information on publicly traded firms only, has been the primary data source for recent work on firm level volatility.

[3] Firm level volatility is calculated from COMPUSTAT data as a moving ten-year window on the standard deviation of firm level growth rates. See equation (5) in section III below.

different line of research, Davis, Faberman and Haltiwanger (2006) and Faberman (2006) produce evidence of a downward trend in the excess job reallocation rate, a measure of cross sectional dispersion in establishment growth rates.[4] As seen in the top panel of Figure 2, the quarterly excess job reallocation rate in the U.S. manufacturing sector fell from about 12 percent in the early 1960s to 8 percent by 2005. The shorter time series in the lower panel shows a decline in excess job reallocation for the U.S. private sector from 16 percent or more in the early 1990s to less than 14 percent by 2005.[5] The data underlying Figure 2 are not restricted to publicly traded firms.

There is an unresolved tension between the evidence of rising firm level volatility and declining cross sectional dispersion in establishment growth rates. To appreciate the tension, consider a simple example in which all employers follow identical and independent autoregressive processes. Then an increase in the innovation variance of idiosyncratic shocks implies an increase in employer volatility *and* in the cross sectional dispersion of growth rates. Of course, it is possible to break the tight link between employer volatility and cross sectional dispersion in more complicated specifications. It is also possible that firm and establishment growth processes have evolved along sharply different paths in recent decades. Yet another possibility is that the restriction to publicly traded businesses in previous studies paints a misleading picture of firm level volatility trends in the economy as a whole.[6] A related possibility is that the economic selection process governing entry into the set of publicly traded firms has changed over time in ways that affect measured trends in volatility.

In what follows, we explore each of these issues. We find similar trends in cross sectional dispersion and firm level volatility, so the different measures cannot account for the contrast between Figures 1 and 2. Instead, the resolution turns mainly on the distinction between publicly traded and privately held businesses. For the private nonfarm sector as a whole, both firm level volatility and cross sectional dispersion

[4] Excess job reallocation equals the sum of gross job creation and destruction less the absolute value of net employment growth. Dividing excess reallocation by the level of employment yields a rate. One can show that the excess reallocation rate is equivalent to the employment-weighted mean absolute deviation of establishment growth rates about zero. See Davis, Haltiwanger and Schuh (1996).

[5] Job flow statistics for the whole private sector are from the BLS Business Employment Dynamics. They are unavailable prior to 1990.

[6] Acemoglu (2005), Eberly (2005) and Davis, Faberman and Haltiwanger (2006) question whether sample selection colors the findings in previous studies of firm level volatility.

measures show large declines in recent decades. For publicly traded firms, we provide independent evidence that cross sectional dispersion and firm level volatility have risen during the period covered by the LBD. We also show, however, that this rise for publicly traded firms is overwhelmed by the dramatic decline among privately held firms, which account for more than two-thirds of private business employment. Very similar results obtain when we treat establishments, rather than firms, as the unit of observation.

Two basic patterns hold across major industry groups. First, the volatility and dispersion of business growth rates are considerably greater for privately held firms. As of 1978, the average standard deviation of firm-level employment growth rates is 3.7 times larger for privately held than for publicly traded firms. This volatility ratio ranges from 2.3 in Services to 6.3 in Transportation and Public Utilities. Second, volatility and dispersion decline sharply among privately held businesses in the period covered by the LBD, and they rise sharply among publicly traded firms. The overall private-public volatility ratio falls to 1.6 by 2001, and it drops sharply in every major industry group. We refer to this phenomenon as "volatility convergence."

We also provide proximate explanations for these patterns. First, much of the decline in dispersion and volatility for the private sector as a whole, and for privately held firms in particular, reflects a decline in (employment-weighted) business entry and exit rates. Second, the age distribution of employment among privately held firms shifted towards older businesses in the period covered by the LBD. Because volatility declines steeply with age, the shift toward older businesses brought about a decline in overall volatility. We estimate that 27 percent or more of the volatility decline among privately held firms reflects the shift toward older businesses. Third, the evolution toward larger firms in certain industries, especially Retail Trade, accounts for about 10 percent of the volatility decline among nonfarm businesses during the period covered by the LBD.

Fourth, and perhaps most striking, changes over time in the number and character of newly listed firms played a major role in the volatility rise among publicly traded firms and in the volatility convergence phenomenon. There was a large influx of newly listed firms after 1979, and newly listed firms are much more volatile than seasoned listings. Moreover, firms newly listed in the 1980s and 1990s exhibit much greater volatility than earlier cohorts. Indeed, simple cohort dummies for the year of first listing in

COMPUSTAT account for 67 percent of the volatility rise among publicly traded firms from 1978 to 2001, and they account for 90 percent of the smaller rise over the 1951-2004 period spanned by COMPUSTAT. Other evidence discussed below also points to important changes over time in the selection of firms that become public.

The paper proceeds as follows. Section II reviews the role of idiosyncratic shocks, producer heterogeneity and risk-taking in selected theories of growth, fluctuations and unemployment. Section II also identifies several factors that influence business volatility and its connection to aggregate volatility. Section III describes our data and measurement procedures. Section IV presents our main empirical findings on volatility and cross sectional dispersion in business outcomes. Section V explores various factors that help to amplify and explain our main findings. Section VI offers concluding remarks.

## II. Conceptual Underpinnings and Theoretical Connections

Theories of growth and fluctuations in the Schumpeterian mold envision a market economy constantly disturbed by technological and commercial innovations. Firms and workers differ in their capacities to create, adopt and respond to these innovations, so that winners and losers emerge as unavoidable by-products of economic progress. According to this view, an economy's long term growth rate depends on how well it facilitates and responds to the process of creative destruction (Aghion and Howitt, 1998). Institutions and policies that impede restructuring and adjustment can mute the disruptive nature of factor reallocation – at the cost of lower productivity, depressed investment and, in some circumstances, persistently high unemployment (Caballero, 2006).

Empirical evidence supports the Schumpeterian view in its broad outlines. Large-scale job reallocation is a pervasive feature of market economies (Davis and Haltiwanger, 1999). The large job flows and high firm level volatility reflect the restructuring, experimentation and adjustment processes at the heart of Schumpeterian theories. Empirically, gross job flows are dominated by reallocation within narrowly defined sectors, even in countries that undergo massive structural transformations. Thus longitudinal firm and establishment data are essential for helping gauge the pace of restructuring and reallocation. Empirical studies also find that excess job reallocation rates decline strongly during the early lifecycle of firms and establishments (Davis and Haltiwanger, 1992, and Bartelsman, Haltiwanger and Scarpetta, 2004). This finding

indicates that experimentation and adjustment in the face of uncertainty about demand, technologies, costs and managerial ability are especially pronounced among younger businesses.

A closely related empirical literature highlights the role of factor reallocation in productivity growth. Over horizons of five or ten years, the reallocation of inputs and outputs from less to more productive business units typically accounts for a sizable fraction of industry-level productivity growth (Foster, Haltiwanger and Krizan, 2001). Several studies reviewed in Caballero (2006, chapter 2) provide evidence that trade barriers, entry barriers, impediments to labor mobility, and misdirected financing can hamper efficient factor reallocation and, as a result, retard restructuring and undermine productivity growth. In short, there are sound theoretical and empirical reasons to treat restructuring and factor reallocation as key aspects of growth and fluctuations. The business volatility and dispersion measures that we construct in this study capture the pace of restructuring and reallocation on important dimensions. In this respect, they are useful inputs into theories of growth and fluctuations in the Schumpeterian mold.

Theories of unemployment based on search and matching frictions (Mortensen and Pissarides, 1999, and Pissarides, 2000) rely on idiosyncratic shocks to drive job destruction and match dissolution. A greater intensity of idiosyncratic shocks in these models produces higher match dissolution rates and increased flows of workers into the unemployment pool. The measures of employer volatility and dispersion that we consider provide empirical indicators for the intensity of idiosyncratic shocks. Evidence regarding trends in these indicators can serve as useful inputs into theoretical explanations for longer term movements in the rates of unemployment and match dissolution. These indicators also provide grist for empirical studies of how long term changes in idiosyncratic shock intensity affect unemployment.

Another class of theories stresses the impact of risk-sharing opportunities on the willingness to undertake risky investments. Obstfeld (1994), for example, shows that better diversification opportunities induce a portfolio shift by risk-averse investors toward riskier projects with higher expected returns. Greater portfolio diversification also weakens one motive for organizing production activity around large, internally diversified firms. On both counts, improved opportunities for diversification lead to

more volatility and dispersion in producer outcomes. Empirical indicators of increased financial diversification include the rise of mutual funds and institutional investors, lower trading costs for financial securities, higher stock market participation rates by households, and greater cross-border equity holdings. Motivated in part by these developments, Thesmar and Thoenig (2004) build a model whereby a bigger pool of portfolio investors encourages listed firms to adopt riskier business strategies with greater expected profits. More aggressive risk-taking by listed firms also leads unlisted firms to adopt riskier strategies in their model, raising firm level volatility throughout the economy.[7] In the model of Acemoglu (2005), risk-taking by firms increases with aggregate capital accumulation, technical progress and financial development, so that firm volatility naturally rises with economic development. Acemoglu stresses that his model can deliver rising firm volatility accompanied by falling aggregate volatility.

In contrast, Koren and Tenreyro (2006) highlight a mechanism that generates declines in both aggregate and firm volatility as an economy develops. In their model, input variety rises naturally with economic development. As input variety expands, shocks to the productivity of specific varieties lead to less output volatility, provided that the correlation of variety-specific shocks is imperfect and not rising in the number of varieties. Koren and Tenreyro argue that this economic mechanism linking development to input variety helps to explain the negative relationship between GDP per capita and the volatility of GDP growth rates across countries and over time within countries. Whether economic development ultimately dampens firm volatility through the impact of greater input variety or amplifies it as a result of better opportunities for financial diversification is obviously an empirical question.

Another line of research stresses the role of competition in goods markets. Philippon (2003) considers a model with nominal rigidities that links goods-market competition to firm and aggregate volatility. In his model, greater competition in the form of a bigger substitution elasticity among consumption goods magnifies the effects of idiosyncratic shocks on profitability. As a result, greater competition leads to more firm

[7] French stock market reforms in the 1980s considerably broadened the shareholder base for French firms. Thesmar and Thoenig (2004) provide evidence that these reforms led to a rise in the volatility of sales growth rates among listed firms relative to unlisted ones. Their analysis sample contains about 5,600 French firms per year with more than 500 employees or 30 million Euros in annual sales, and that were never owned, entirely or in part, by the French state.

volatility in sales growth rates and a higher frequency of price adjustments. In turn, more frequent price adjustments dampen the response to aggregate demand disturbances in a calibrated version of the model. Thus, insofar as aggregate demand shocks drive aggregate fluctuations, Philippon's model produces divergent trends in aggregate and firm volatility. Comin and Mulani (2005) argue that increased R&D-based competition leads to more firm volatility but weaker comovements and, hence, lower aggregate volatility. As Acemoglu (2005) points out, however, R&D investments can act to increase or decrease competitive intensity, and the link to aggregate volatility is also tenuous. Comin and Philippon (2005) point to deregulation as a source of greater goods-market competition and rising firm level volatility. While deregulation is likely to increase firm volatility in the short term, its longer term impact is less clear. For example, when regulatory restrictions hamper horizontal consolidation, deregulation can lead to an industry structure with fewer, larger firms. Horizontal consolidation is, in turn, a force for less firm level volatility. The removal of regulatory restrictions on branching and interstate banking accelerated this type of evolutionary pattern in the U.S. banking sector (Jayaratne and Strahan, 1998).

Although much recent work focuses on the potential for better risk-sharing opportunities or greater goods-market competition to produce opposite trends in aggregate and firm level volatility, there is a simple mechanical reason to anticipate that micro and macro volatility will trend in the same direction. To see the argument, write the firm level growth rate as a linear function of $K$ aggregate shocks that (potentially) affect all firms and an idiosyncratic shock, $\varepsilon_i$, that affects only firm $i$:

$$\gamma_{it} = \sum_{k=1}^{K} \beta_{ik} Z_{kt} + \varepsilon_{it}, \quad i = 1, 2, ...N. \tag{1}$$

The aggregate growth rate is $\sum_i \alpha_{it} \gamma_{it}$, where $\alpha_i$ is firm $i$'s share of aggregate activity. Assuming mutually uncorrelated shocks, equation (1) implies the following expressions for firm level and aggregate volatility:

$$\text{Weighted Mean Firm Volatility} = \sum_{i=1}^{n} \alpha_{it} \sigma_{\varepsilon t}^2 + \sum_{i=1}^{n} \alpha_{it} \left[ \sum_{k=1}^{K} \beta_{ik}^2 \sigma_{kt}^2 \right] \tag{2}$$

$$\text{Aggregate Volatility} = \sum_{i}^{n} \alpha_{it}^2 \sigma_{it}^2 + \sum_{i}^{n} \alpha_{it}^2 \left[ \sum_{k=1}^{K} \beta_{ik}^2 \sigma_{kt}^2 \right] + 2 \sum_{j>i}^{n} \alpha_{it} \alpha_{jt} \left[ \sum_{k=1}^{K} \beta_{ik} \beta_{jk} \sigma_{kt}^2 \right] \quad (3)$$

In light of the positive comovements that typify aggregate fluctuations, we assume that the weighted cross-product of the $\beta$ coefficients is positive for each *k*.

Inspecting (2) and (3), we see that firm and aggregate volatility respond in the same direction to a change in any one of the shock variances, provided that the firm shares $\alpha_i$ and the shock response coefficients $\beta_{ik}$ are reasonably stable. In particular, a decline in the variability of aggregate shocks leads to a decline in both aggregate and firm volatility. Hence, insofar as the well-established secular decline in aggregate volatility reflects a decline in the size or frequency of aggregate shocks, we anticipate a decline in average firm volatility as well. Another argument stresses the importance of idiosyncratic shocks to large firms. Especially if $\sigma_i$ is independent of size $(\alpha_i)$ at the upper end of the firm size distribution, as in Gabaix's (2005) granular theory of aggregate fluctuations, trend changes in the idiosyncratic shock variance for, say, the 100 largest firms can be a powerful force that drives micro and macro volatility in the same direction. Of course, (2) and (3) do not require that aggregate and firm volatility trend in the same direction. A mix of positive and negative changes in the shock variances could drive micro and macro volatility measures in opposite directions, as could certain changes in the pattern of shock-response coefficients or the firm size distribution. Still, big trends in the opposite direction for micro and macro volatility strike us as an unlikely outcome.

Evolutions in market structure can also drive the trend in firm volatility, particularly in sectors that undergo sweeping transformations. Consider Retail Trade. The expansion of Wal-Mart, Target, Staples, Best Buy, Home Depot, Borders and other national chains has propelled the entry of large retail outlets and displaced thousands of independent and smaller retail establishments and firms. Jarmin, Klimek and Miranda (2005) report that the share of U.S. retail activity accounted for by single-establishment firms fell from 60 percent in 1967 to 39 percent in 1997. In its initial phase, this transformation involved high entry and exit rates, but over time the Retail Trade size distribution shifted towards larger establishments and much larger firms. Empirical studies routinely find a strong negative relationship between business size and volatility.

Hence, we anticipate that the transformation of the retail sector led to a secular decline in the volatility and dispersion of growth rates among retail businesses.

One other key issue involves the impact of developments that expand business access to equity markets. Financial developments of this sort can profoundly alter the mix of publicly traded firms and drive volatility trends among all listed firms that are unrepresentative of trends for seasoned listings and the economy as a whole. Some previous studies point strongly in that direction. For example, Fama and French (2004) report that the number of new lists (mostly IPOs) on major U.S. stock markets jumped from 156 per year in 1973-1979 to 549 per year in 1980-2001. Remarkably, about 10% of listed firms are new each year from 1980 to 2001. Fama and French also provide compelling evidence that new lists are much riskier than seasoned firms and increasingly so from 1980 to 2001. They conclude that the upsurge of new listings explains much of the trend increase in idiosyncratic stock return volatility documented by Campbell et al. (2001). They also suggest that there was a decline in the cost of equity that allowed weaker firms and those with more distant payoffs to issue public equity. Fink et al. (2005) provide additional evidence in support of these conclusions. Drawing on data from Jovanovic and Rousseau (2001), they report that firm age at IPO date (measured from its founding date or date of incorporation) fell dramatically from nearly 40 years old in the early 1960s to less than 5 years old by the late 1990s. They find that the positive trend in idiosyncratic risk is fully explained by the proportion of young firms in the market. After controlling for age and other measures of firm maturity (book-to-market, size, profitability), they find a negative trend in idiosyncratic risk. These studies imply that the selection process governing entry into the set of publicly traded firms shifted dramatically after 1979, and that the shift continued to intensify through the late 1990s.

## III. Data and Measurement

*A. Source Data: The LBD and COMPUSTAT*

The Longitudinal Business Database (LBD) is constructed from the Census Bureau's Business Register of U.S. businesses with paid employees and enhanced with survey data collections. The LBD covers all sectors of the economy and all geographic areas and currently runs from 1976 to 2001. In recent years, it contains over 6 million establishment records and almost five million firm records per year. Basic data items

include employment, payroll, 4-digit SIC, employer identification numbers, business name, and information about location.[8] Identifiers in the LBD files enable us to compute growth rate measures for establishments and firms.[9] Firms in the LBD are defined based on operational control, and all establishments that are majority owned by the parent firm are included as part of the parent's activity measures. We restrict attention in this study to nonfarm businesses in the private sector.

We also exploit COMPUSTAT data from 1950 to 2004.[10] A unit of observation in COMPUSTAT is a publicly traded security identified by a CUSIP. We exclude certain CUSIPs because they reflect duplicate records for a particular firm, multiple security issues for the same firm, or because they do not correspond to firms in the usual sense. Duplicate entries for the same firm (reflecting more than one 10-K filing in the same year) are few in number but can be quite large (more than 500,000 workers). We also exclude CUSIPs for American Depository Receipts (ADRs) – securities created by U.S. banks to permit U.S.-based trading of stocks listed on foreign exchanges. All together, we exclude approximately 1100 CUSIPs because of duplicates and ADRs. The presence of duplicates, ADRs and other features of COMPUSTAT imply the need for caution in measuring firm outcomes and in linking COMPUSTAT records to the LBD.

We use COMPUSTAT to supplement the LBD with information on whether firms are publicly traded. For this purpose, we created a bridge file that links LBD and COMPUSTAT records based on business taxpayer identification numbers (EINs) and business name and address.[11] Missing data on equity prices, sales and employment data for some COMPUSTAT records do not cause problems for our LBD-based analysis, because we rely on LBD employment data whether or not the COMPUSTAT data are missing. Our matching procedures also work when there are holes in the COMPUSTAT data. In particular, we classify a firm in the LBD as publicly traded in a given year if it matches to a COMPUSTAT CUSIP by EIN or name and address, and if the CUSIP has non-missing equity price data in the same year or in years that bracket the given year.

[8] Sales data are available in the LBD from 1994. Sales data from the Economic Censuses are available every five years for earlier years. More recent years in the LBD record industry on a NAICS basis.
[9] See the data appendix regarding the construction of longitudinal links, which are critical for our analysis.
[10] Our COMPUSTAT data are from the same provider (WRDS) as in recent work by Comin and Mulani (2006), Comin and Philippon (2005) and others.
[11] See McCue and Jarmin (2005) for details. We extend their methodology to include the whole period covered by the LBD.

Table 1 presents LBD and COMPUSTAT summary statistics for firm counts, employment and firm size in selected years. As of 2000, the LBD has almost five million firms with positive employment in the nonfarm private sector, of which we identify more than 7000 as publicly traded. Average LBD firm size in 2000 is about 18 employees, which is tiny compared to the average of 4,000 employees for publicly traded firms. Publicly traded firms account for a trivial fraction of all firms and less than one-third of nonfarm business employment during the period covered by the LBD. The highly skewed nature of the firm size distribution is also apparent in the enormous difference between average firm size and the employment-weighted mean firm size (the coworker mean). For example, the upper panel of Table 1 reports a coworker mean of 92,604 employees at publicly traded firms in the LBD in 2000, roughly 23 times larger than the simple mean of firm size. The highly skewed nature of the firm size distribution implies the potential for equally weighted and size-weighted measures of business volatility and dispersion to behave in dissimilar ways.

Comparisons between the upper and lower panels of Table 1 require some care, because the LBD and COMPUSTAT differ in how they define a firm and in how key variables are measured. LBD employment reflects the count of workers on the payroll during the pay period covering the 12$^{th}$ of March. The employment concept is all employees subject to U.S. payroll taxes. COMPUSTAT employment is the number of company workers reported to shareholders. It may be an average number of employees during the year or a year-end figure. More important, it includes all employees of consolidated subsidiaries, domestic and foreign. For this reason, discrepancies between the LBD and COMPUSTAT are likely to be greater for large multinationals and for foreign firms with U.S. operations (and listings on U.S. stock exchanges). Since the source data from annual reports can be incomplete, some COMPUSTAT firms have missing employment even when the firm has positive sales and a positive market value.

With these cautions in mind, consider the lower panel of Table 1 and its relationship to the upper panel. The lower panel provides information about the match rate in the LBD/COMPUSTAT Bridge. In 1990, for example, there are 6239 CUSIPs with positive COMPUSTAT employment. We match 5716 of these CUSIPs to firms in the LBD, which amounts to 92% of COMPUSTAT firms with positive employment and

92% of COMPUSTAT employment.[12] It is instructive to compare total employment, average firm size and the coworker mean between the upper and lower panels of Table 1 for the bridge cases. COMPUSTAT figures for these quantities exceed the corresponding LBD statistics by a very wide margin in all years. For example, among matched publicly traded firms in the Bridge file, the LBD employment figure (Panel A) is only 70.8 percent of COMPUSTAT employment (Panel B) in 1980, 72.2 percent in 1990, and 72.5 percent in 2000. These large discrepancies for matched cases reflect significant differences in the LBD and COMPUSTAT employment concepts, e.g., domestic versus global operations. See the Data Appendix for additional comparisons between the two data sources.

We can use the information reported in Table 1 to construct an estimate for the percentage of nonfarm business employment in publicly traded firms. First, adjust the COMPUSTAT employment totals for "Not Matched" cases in Panel B by multiplying by the ratio of LBD-to-COMPUSTAT employment for matched cases. Second, add the adjusted COMPUSTAT employment figure for "Not Matched" cases to LBD employment for "Publicly Traded (Bridge)" cases in Panel A, and then divide the sum by LBD nonfarm business employment. The resulting estimates imply that publicly traded firms account for 32.7 percent of nonfarm business employment in 1980, 27.2 percent in 1990 and 28.6 percent in 2000.

To sum up, the LBD provides data from 1976 to 2001 on the universe of firms and establishments with at least one employee in the U.S. private sector. We identify publicly traded firms in the LBD using our COMPUSTAT/LBD Bridge. The empirical analysis below focuses on the LBD, but we also carry out several exercises using COMPUSTAT data.

*B. Measuring Firm Growth, Volatility and Cross Sectional Dispersion*

[12] If we require that matches have positive COMPUSTAT employment *and* positive LBD employment in 1990, then the number of matched CUSIPs drops from 5716 to 5035. However, this requirement is overly restrictive in light of our previous remarks about missing COMPUSTAT employment observations, the inclusion of employment from foreign operations in COMPUSTAT, and timing differences between COMPUSTAT and the LBD. For instance, when we relax this requirement and instead allow CUSIPs with positive sales, price or employment to match to LBD firms with positive employment, then the number of matches exceeds 5700.

We focus on employment as our activity measure because of its ready availability in the LBD and COMPUSTAT. Recall from Figure 1 that volatility trends for employment and sales growth rates are similar in COMPUSTAT data. We use a growth rate measure that accommodates entry and exit. In particular, our time-*t* growth rate measure for firm or establishment *i* is

$$\gamma_{it} = \frac{x_{it} - x_{it-1}}{(x_{it} + x_{it-1})/2}. \qquad (4)$$

This growth rate measure has become standard in work on labor market flows, because it offers significant advantages relative to log changes and growth rates calculated on initial employment. In particular, it yields measures that are symmetric about zero and bounded, affording an integrated treatment of births, deaths and continuers. It also lends itself to consistent aggregation, and it is identical to log changes up to a second-order Taylor Series expansion. See Tornqvist, Vartia and Vartia (1985) and the appendix to Davis, Haltiwanger and Schuh (1996) for additional discussion.

To characterize the variability of business outcomes, we consider several measures of cross sectional *dispersion* in business growth rates and *volatility* in business growth rates. Our basic dispersion measure is the cross sectional standard deviation of the annul growth rates in (4), computed in an equal-weighted or size-weighted manner. Our basic volatility measure follows recent work by Comin and Mulani (2005, 2006) and Comin and Philippon (2005), among others. They measure volatility for firm *i* at *t* by

$$\sigma_{it} = \left[ \frac{1}{10} \sum_{\tau=-4}^{5} (\gamma_{i,t+\tau} - \overline{\gamma}_{it})^2 \right]^{1/2}, \qquad (5)$$

where $\overline{\gamma}_{it}$ is the simple mean growth rate for *i* from *t-4* to *t+5*. This measure requires ten consecutive observations on the firm's growth rates; hence, short-lived firms and entry and exit are not captured.[13]

Limiting the analysis to firms and establishments with ten consecutive years of positive activity is quite restrictive. Hence, we also consider a modified volatility

[13] When we implement (5) using LBD data, we permit the firm to enter or exit at the beginning or end of the ten-year window. This is a small difference in measurement procedures relative to Comin and Mulani (2005, 2006) and Comin and Philippon (2005). A more important difference is that our LBD-based calculations include the pre-public and post-public history of firms that are publicly traded at *t* but privately held before or after *t*. As a related point, we do not treat listing and de-listing in COMPUSTAT as firm entry and exit.

measure that incorporates entry and exit and short-lived business units. The modified measure differs from the basic measure in two main respects. First, we weight the squared deviation at *t* for firm *i* in proportion to its size at *t* relative to its average size in the ten-year window from *t-4* to *t+5*. Second, we apply a standard degrees-of-freedom correction to avoid the small-sample bias that otherwise arises for second moment estimates.[14] We ignored this issue in the basic volatility measure, following standard practice, because the correction is the same for all firms and would simply scale up the volatility magnitude by (10/9). However, the correction matters when some firms have much shorter intervals of positive activity than others. The degrees-of-freedom correction also enables us to obtain unbiased estimates for average volatility near the LBD and COMPUSTAT sample end points, which truncate the available window for estimating firm level volatility.

Here are the details for constructing our modified volatility measure. Let $z_{it} = .5(x_{it} + x_{it-1})$ denote the size of firm *i* at time *t,* and let $P_{it}$ denote the number of years from *t-4* to *t+5* for which $z_{it} > 0$. Define the scaling quantity, $K_{it} = P_{it} / \sum_{\tau=-4}^{5} z_{i,t+\tau}$, and the rescaled weights, $\tilde{z}_{it} = K_{it} z_{it}$. By construction, $\sum_{\tau=-4}^{5} \tilde{z}_{it} = P_{it}$. The modified firm volatility measure with degrees-of-freedom correction is given by

$$\tilde{\sigma}_{it} = \left[ \sum_{\tau=-4}^{5} \left( \frac{\tilde{z}_{i,t+\tau}}{P_{it} - 1} \right) (\gamma_{i,t+\tau} - \overline{\gamma}_{it}^{w})^2 \right]^{1/2}, \qquad (6)$$

where $\overline{\gamma}_{it}^{w}$ is firm *i*'s size-weighted mean growth rate from *t-4* to *t+5,* using the $z_{it}$ as weights. We construct this measure for all businesses in year *t* with a positive value for $z_{it}$. In other words, we compute (6) on the same set of firms as the contemporaneous dispersion measure.

The average magnitude of firm volatility at a point in time can be calculated using equal weights or weights proportional to business size. We prefer size-weighted volatility (and dispersion) measures for most purposes, but we also report some equal-

[14] We thank Eva Nagypal for drawing our attention to this issue.

weighted measures for comparison to previous work. In the size-weighted measures, the weight for business *i* at *t* is proportional to $z_{it}$.

Summing up, our dispersion measures reflect year-to-year, between-firm variation in growth rates. Our volatility measures reflect year-to-year, within-firm variation in growth rates. Some volatility measures restrict analysis to long-lived firms, but we also consider modified volatility measures defined over the same firms as contemporaneous dispersion measures. Volatility and dispersion measures have different properties, and they highlight different aspects of business growth rate behavior. Still, they are closely related concepts. For example, if business growth rates are drawn from stochastic processes with contemporaneously correlated movements in second moments, then the cross-sectional dispersion in business growth rates and the average volatility of business growth rates are likely to move together over longer periods of time.[15]

*C. Firm Volatility – Robustness to the Bridge Cases*

To assess whether our results are sensitive to the use of publicly traded firms in the LBD/COMPUSTAT Bridge, we compare firm volatility for the full COMPUSTAT to firm volatility for matched cases. We consider all CUSIPs that match to the LBD in any year during the LBD overlap from 1976 to 2001. Figure 3 displays the comparison. It shows that restricting attention to those publicly traded firms that we identify in the LBD/COMPUSTAT Bridge has no material effect on the volatility results. This result gives us confidence that our LBD-based comparisons below of publicly traded and privately held firms are not distorted by inadequacies in our matching algorithm.

## IV. Business Volatility and Dispersion Trends

*A. Results Using COMPUSTAT Data on Publicly Traded Firms*

We now compare the volatility and dispersion in business growth rates using COMPUSTAT data. At this point, we do not restrict attention to firms in the Bridge file.[16] Figure 4 shows the now-familiar pattern of rising firm volatility overlaid against a

[15] The shorter term response differs, however, as have verified in unreported numerical simulations. For example, a one-time permanent increase in the variance of the distribution of idiosyncratic shocks leads to a coincident permanent increase in the cross sectional dispersion of business growth rates, but it leads to a gradual rise in the average volatility that begins several years prior to the increase in the shock variance and continues for several years afterward.

[16] But we do exclude observations with growth rates of 2 and -2, because COMPUSTAT listing and de-listing typically do not reflect true entry and exit by firms. In the LBD-based analysis below, we include

similar trend for the cross sectional dispersion of firm growth rates. To ensure an apples-to-apples comparison, we calculate dispersion using only those firm-year observations for which we calculate firm volatility. While the volatility and dispersion measures capture different aspects of business dynamics, Figure 4 shows that they closely track each other over the longer term. Similar results obtain for sales-based volatility and dispersion measures and for dispersion measures calculated on all firm-year observations. However, dispersion is uniformly larger than average firm volatility. That is, between-firm variation in annual growth rates exceeds the average within-firm variation. The gap between the dispersion and volatility measures shown in Figure 4 expanded over time from about 4 percentage points in 1955 to 7 percentage points in 1999.

Figure 4 also shows that weighted measures are considerably smaller than the corresponding unweighted measures at all times. This pattern reflects the greater stability of growth rates at larger firms. The weighted measures also show a smaller and less steady upward trend than the unweighted measures, as we saw in Figure 1. The rest of paper reports weighted measures of dispersion and volatility, because we think they are more relevant for aggregate behavior. Moreover, on an unweighted basis, publicly traded firms have negligible effects on dispersion and volatility measures for the private sector as a whole, because they are so few in number.

*B. Results Using Firm Level Data in the Longitudinal Business Database*

A concern with COMPUSTAT-based results is whether they generalize to the entire economy. Figure 5 exploits LBD data to address this concern.[17] The figure shows large declines in the volatility and dispersion of firm growth rates for the whole nonfarm private sector and even larger declines among privately held firms. The dispersion in growth rates falls by about 13 percentage points from 1978 to 2000 in the private sector and by about 20 percentage points among privately held firms.[18] The average magnitude of firm volatility falls by about 10 percentage points from 1981 to 1996 in the private

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observations with growth rates of 2 and -2 (unless otherwise noted), because we can identify true entry and exit in the LBD.

[17] A comparison between Figures 4 and 5 reveals that the level of volatility among publicly traded firms is much greater in COMPUSTAT, perhaps because COMPUSTAT activity measures include the foreign operations of multinational firms.

[18] Recall that we use all firm-year observations with positive values of $z_{it}$ when computing our basic dispersion measure. That is, we include all continuing, entering and exiting firms. Below, we consider the effects of restricting the analysis to continuing firms only.

sector and by about 17 percentage points among privately held firms. The volatility decline in the private sector over this period is more than 40% of its 1981 value, a striking contrast to the rise in volatility among publicly traded firms over the same period.

The LBD-based results also show that privately held firms are much more volatile than publicly traded firms, and their growth rates show much greater dispersion. This pattern is not particularly surprising, because a bigger share of activity in the publicly traded sector is accounted for by older and larger firms that tend to be relatively stable. As Figure 5 shows, however, publicly traded and privately held firms are converging in terms of the volatility and dispersion of their growth rates. We return to this matter shortly.

The finding that firm volatility in the private sector falls over time is consistent with previous findings in the job flows literature (Figure 2). It is also consistent with previous research using the LBD. One of the earliest findings from the LBD is a steady decline in establishment entry rates (Foster, 2003 and Jarmin, Klimek and Miranda, 2003). Recent work also finds declining entry and exit rates in local retail markets for establishments and firms (Jarmin, Klimek and Miranda, 2005). Jarmin et al. stress the changing structure of retail trade as one factor underlying the decline in entry and exit. They document the increasing share of activity accounted for by large, national retail chains with many establishments.[19] This change in industry structure has a powerful effect, because entry and exit rates are substantially higher for small, single-unit firms than for large national chains. We return to the role of industry structure and business turnover in section V.

All volatility series displayed thus far are based on equation (5) and limited to firms with at least ten consecutive observations. This selection criterion is especially restrictive for privately held firms, most of which do not survive ten years. By and large, privately held firms are relatively volatile, and so are short-lived firms. If the objective is to examine the overall magnitude of firm volatility, then it is desirable to use datasets and statistics that capture the most volatile units in the economy. To do so, we now use LBD

[19] Foster, Haltiwanger and Krizan (2005) present related evidence using the Census of Retail Trade. They show that much of the increase in labor productivity in the 1990s in retail trade reflects the entry of relatively productive establishments owned by large national chains and the exit of less productive establishments owned by single-unit firms. See, also, McKinsey Global Institute (2001).

data to calculate modified volatility measures based on equation (6). Figure 6 shows the results for the employment-weighted modified volatility measure. As before, volatility is higher and falling for privately held business, lower and rising for publicly traded firms. Modified volatility for privately held firms falls from 0.60 in 1977 to 0.42 in 2001, with the entire fall occurring after 1987. Modified volatility for publicly traded firms rises from 0.16 in 1977 to 0.29 in 1999.

*C. Volatility Convergence across Major Industry Groups*

The most striking features of Figures 5 and 6 are the opposite trends for publicly traded and privately held firms and the dramatic convergence in their volatility levels. Table 2 shows that these two features hold in every major industry group. Among publicly traded firms, modified volatility rises for all industry groups, though by widely varying amounts. The biggest volatility gains among publicly traded firms occur in Transportation and Public Utilities, Wholesale, FIRE and Services. Among privately held firms, the modified volatility measure declines by 23 percent for FIRE and by 30 percent or more for all other industry groups. Overall volatility in the nonfarm business sector declines for every industry group, with drops of more than 30 percent in Construction, Wholesale, Retail and Services. The volatility convergence phenomenon is also present in every industry group. Between 1978 and 2001, the ratio of volatility among privately held firms to volatility among publicly traded firms fell from 3.2 to 1.7 in Manufacturing, from 6.3 to 1.8 in Transportation and Public Utilities, from 4.2 to 2.2 in Retail, from 3.3 to 1.3 in FIRE and from 2.3 to 1.1 in Services.

## V. Exploring and Refining the Main Results

*A. Establishment-Based Measures*

Trends in the volatility and dispersion of establishment growth rates can differ from trends for firm growth rates. In particular, a shift over time towards multi-unit firms yields declines in the volatility and dispersion of firm growth rates through a simple statistical aggregation effect. If two establishments with imperfectly correlated growth rates combine into a single firm, for example, then the volatility of the firm's growth rates is lower than the average volatility for the two establishments. As mentioned earlier, the Retail Trade sector has undergone a pronounced shift away from single-unit firms to

national chains. Motivated by these observations, Figure 7 shows the employment-weighted dispersion and volatility of establishment growth rates, calculated from LBD data. Publicly traded establishments are those owned by publicly trade firms. In line with the statistical aggregation effect, the levels of volatility and dispersion are substantially higher for publicly traded establishments than for publicly traded firms.

As seen in Figure 7, the basic patterns for establishment-based measures are the same as for firm-based measures. Dispersion and volatility fall for the privately held, and they rise for the publicly traded. As before, the overall trend for the nonfarm business sector is dominated by privately held businesses. Some differences between the firm-based and establishment-based results are also apparent. Rather remarkably, there is full volatility convergence between publicly traded and privately held establishments by the end of the LBD sample period. In sum, Figure 7 shows that our main results are not sensitive to the distinction between firms and establishments.

*B. The Role of Entry and Exit*

Figure 8 shows the dispersion and volatility of employment growth rates for continuing firms only. We calculate these measures on an employment-weighted basis from LBD data, after excluding entry-year and exit-year observations at the firm level. The exclusion of entry and exit mutes the downward trends for privately held firms and for the nonfarm sector as a whole. Indeed, the modified volatility measure for the nonfarm business sector is essentially flat from 1977 to 2001 when we restrict attention to continuers. This sample restriction also mutes the rise in volatility and dispersion for publicly traded firms. Not surprisingly, the levels of volatility and dispersion are also much lower when we exclude entry and exit. A comparison of Figures 5 and 8 reveals, for example, that the exclusion of entry and exit lowers the overall dispersion of firm growth rates by about one third.

Figure 9 provides direct evidence on the magnitude of entry and exit by ownership status for firms and establishments. The figure shows three-year moving averages of the employment-weighted sum of entry and exit, expressed as a percentage of employment. As seen in the figure, the volatility convergence phenomenon also holds for entry and exit rates, whether calculated for establishments or firms. Among privately held businesses, the sum of establishment entry and exit rates declines from 20.6 to 12.9

percent of employment over the period covered by the LBD. It rises from 8.1 to 12.3 percent of employment for publicly traded. Thus, there is essentially full volatility convergence by 2001 for establishment-based measures of business turnover.

On average, each publicly traded firm operates about 90 establishments, which implies considerable scope for statistical aggregation. This effect shows up in Figure 9 as a large gap between firm-based and establishment-based turnover among publicly traded businesses. In contrast, there are only 1.16 establishments per privately held firm, which implies much less scope for statistical aggregation. Indeed, the sum of entry and exit rates for privately held firms exceeds the corresponding establishment-based measure in the early years of the LBD. This feature of Figure 9 indicates that a portion of the firm entry and exit events identified in the LBD reflects ownership changes for continuing businesses, rather than complete firm shutdowns or de novo entry.[20] Since the gap between firm-based and establishment-based turnover narrows rapidly in the early years of the LBD, Figure 9 also suggests that we overstate the decline in firm-based measures of dispersion and volatility in the first few years.[21] Despite this concern, several observations give confidence that our main findings about volatility and dispersion trends and volatility convergence are not driven by ownership changes. First, the firm-establishment turnover gap is close to zero after 1984 (Figure 9). Second, the basic trends and volatility convergence results hold up strongly when we consider establishment-based measures (Figure 7). Third, our main results also hold when we restrict attention to continuing firms, which exclude improperly broken longitudinal links by construction (Figure 8).[22]

*C. The Role of Size, Age and Industry Composition*

We now investigate whether shifts in the size, age and industry composition of employment can account for the trends in firm volatility and dispersion. Shifts in the employment distribution along these dimensions have potentially large effects, because volatility and dispersion magnitudes vary by industry and especially by business size and

[20] While ownership changes can affect firm level longitudinal linkages in the LBD, they do not affect establishment level linkages. See the Data appendix for more discussion of linkage issues.
[21] While not a trivial task, we can use the LBD to separately identify and measure firm ownership change, de novo entry and complete firm shutdown. In future work, we plan to explore this decomposition.
[22] See the Data Appendix for details about the firm and establishment concepts used in the LBD and the construction of longitudinal links.

age.[23] To investigate this issue, Table 3 reports modified volatility measures in 1982 and 2001 alongside the volatility values implied by fixing the industry, age and/or size distribution of employment at 1982 shares while allowing category-specific volatilities to vary over time as in the data. We employ a cell-based shift-share methodology, where we compute the modified volatility measure for 448 size, age and industry cells per year. We use 1982 employment shares, because it is the earliest year for which we can identify seven distinct age categories in the LBD data – entrants, 1, 2, 3, 4, 5 and 6+ years of age, where firm age is identified as the age of the firm's oldest establishment. In addition to seven age categories, we consider eight size categories and the eight industry groups listed in Table 2.

Table 3 contains several noteworthy findings. Turning first to publicly traded firms, modified volatility rises by 21 percent from 0.21 in 1982 to 0.26 in 2001. The volatility rise among publicly traded firms is essentially unchanged when we control for shifts in the size and age distribution of employment. In contrast, when we fix the industry employment distribution at 1982 shares, the volatility rise among publicly traded firms is cut by half. To shed additional light on this result, Figure 10 shows the evolution of selected industry shares among publicly traded firms over the period covered by the LBD. The manufacturing employment share fell from almost 50 percent in the late 1970s to 23 percent in 2001, while the shares accounted for by FIRE, Services and Retail rose. As reported in Table 2, volatility among publicly traded Manufacturing and Retail firms is about one-fifth lower than overall volatility for publicly traded firms in 2001. In contrast, volatility among publicly traded firms in FIRE and Services is considerably greater. Thus, the large contribution of industry composition changes to the volatility rise among publicly traded firms is basically a story of shifts from Manufacturing to FIRE and Services. The coincident shift to Retail actually muted the rise in volatility among publicly traded firms.

Turning next to privately held firms, Table 3 reports that volatility fell by 31 percent from 0.60 in 1982 to 0.42 in 2001. In contrast to the story for publicly traded firms, shifts in the industry distribution play essentially no role in the volatility trend for privately held

[23] There is a vast literature on the relationship of business entry, exit and growth rates to business size and age. See Dunne, Roberts and Samuelson (1989), Sutton (1997), Caves (1998), Davis and Haltiwanger (1999), and Davis et al. (2005) for evidence, analysis and extensive references to related research.

firms. Size effects play a rather modest role. However, when we fix the age distribution of employment at 1982 shares, the volatility drop among privately held firms is cut by 27 percent. This 27 percent figure probably understates the contribution of shifts in the age distribution, because we cannot finely differentiate age among older firms in the early years covered by the LBD.

Table 4 provides additional information about the role of shifts in the age distribution among privately held firms. The table confirms that volatility declines steeply with firm age. Note, also, that the share of employment in firms at least 6 years old increases from 75.6 percent in 1982 to 83.6 percent in 2001, *and* that volatility drops much more sharply in the 6+ category than any other age category. Moreover, average volatility by age among privately held firms continues to decline through 25 years of age in 2001, as reported in the lower part of Table 4. These results are highly suggestive of unmeasured shifts from 1982 to 2001 in the age distribution of employment toward older, less volatile firms within the 6+ category. Hence, we conclude that shifts in the age distribution of employment among privately held firms probably account for more than the 27 percent figure suggested by Table 3.[24]

Turning last to the results for all firms, Table 3 implies that shifts in the age distribution of employment account for 29 percent of the volatility decline. Size effects alone account for 10 percent of the overall volatility decline. In unreported results that use a finer size breakdown, we find that a shift toward larger firms accounts for 25 percent of the volatility decline in Retail Trade.[25] These results are related to the decline in the employment-weighted entry and exit rates among privately held firms, documented in Figure 9. Since older and larger firm have lower exit rates, a shift of employment toward these firms leads to lower rates of firm turnover. Lastly, Table 3 implies that shifts in the industry mix of employment actually work against the overall volatility decline among nonfarm businesses.

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[24] The precise contribution of shifts in the age distribution to the volatility decline among privately held firms depends on exactly how we carry out the decomposition. Table 3, which evaluates volatilities at the 1982 age distribution, implies that the age distribution shift accounts for 27 percent of the volatility drop from 1982 to 2001. Table 4, which evaluates volatilities at the 2001 age distribution, reports that the age distribution shift accounts for 19.6 percent of the volatility drop. Both exercises are likely to understate the impact of shifts toward older privately held firms for reasons discussed in the text.

[25] The finer size classification breaks the 1000+ category into 1000-2499, 2500-4999, 5000-9999, and 10,000+ categories.

*D. Why the Rise in Volatility among Publicly Traded Firms?*

As discussed in Section II, there was a large upsurge in the number of newly listed firms after 1979. Fama and French (2004), among others, provide evidence that new listings are riskier than seasoned public firms, and that they became increasingly risky relative to seasoned firms after 1979. These pieces of evidence point to a significant change in the economic selection process governing entry into the set of publicly traded firms. They also suggest that much of the volatility and dispersion rise among publicly traded firms reflects a large influx of more volatile firms in later cohorts.

We now investigate this issue, focusing on the modified volatility concept for publicly traded firms. We rely on COMPUSTAT for this purpose, because it spans a much longer period than the LBD. The scope of COMPSUTAT expanded in certain years during our sample period, e.g., NASDAQ listings first became available as part of COMPUSTAT in 1973. Since COMPUSTAT does not accurately identify first listing year for firms that are added to COMPUSTAT because of changes in scope, we drop such firms from the data set for the present analysis.[26] As before, we intentionally exclude entry-year and exit-year observations in the COMPUSTAT data because listing and delisting typically do not reflect the birth or shutdown of the firm.

Figure 11 plots modified volatility time series for ten-year entry cohorts, defined by time of first listing. Volatility appears to be somewhat higher for the 1960s and 1970s cohort than earlier cohorts, and it is *much* higher still for the 1980s and 1990s cohorts.[27] To help understand how these cohort effects influence the evolution of overall volatility among publicly traded firms, Figure 12 displays cohort employment shares over the period covered by COMPUSTAT. This figure shows that cohort employment shares initially grow quite rapidly, and that this effect is especially strong for the 1990s cohort. By the latter part of the 1990s, firms that first listed in the 1980s or 1990s account for about 40 percent of employment among publicly traded firms. Taken together, Figures

[26] In unreported results, this sample selection requirement has little impact on the overall volatility trend in COMPUSTAT, but it does have an impact on the volatility trends for certain cohorts

[27] The modified volatility series in Figure 11 are employment weighted. We suppress the 1953 and 1954 values for the 1950s cohort, because they are calculated from only one or two firm level observations. In unreported results, the equal-weighted modified volatility series show a stronger pattern of greater volatility for later cohorts. So does the employment-weighted basic volatility measure.

11 and 12 suggest that cohort effects play a powerful role in the volatility rise among publicly traded firms.

Figure 13 quantifies the contribution of cohort effects to the evolution of volatility among publicly traded firms. For the sake of comparison, the figure also provides information about the contribution of size, age and industry effects. To construct Figure 13, we first fit employment-weighted regressions of firm volatility on year effects and other variables using COMPUSTAT data from 1951 to 2004. Our basic specification regresses firm volatility on year effects only. The fitted year effects in this basic specification yield the "No Controls" series plotted in Figure 13. Next, we expand the basic specification to include indicators for one-year entry cohorts. The fitted year effects in this expanded specification yield the "Cohort" series plotted in Figure 13. To isolate the impact of size, we expand the basic specification to include a quartic in log employment, which yields the "Size" series. Finally, we add the quartic in size, 1-digit industry controls and simple age controls (less than 5 years and 5+ years since listing) to the basic specification to obtain the "Size, Age and Industry" series in Figure 13..

The results in Figure 13 provide a powerful and simple explanation for the trend volatility rise among publicly traded firms. According to the figure, neither size effects alone nor the combination of size, age and industry effects account for much of the volatility rise.[28] In sharp contrast, simple cohort controls absorb most of the volatility rise for publicly traded firms. Table 5 quantifies this point by comparing the longer term change in fitted year effects with and without cohort controls. From 1978 to 1999, for example, the controls for entry cohort absorb 64 percent of the volatility rise among publicly traded firms. Over the 1978 to 2004 period, the trend change in volatility among publicly traded firms is actually negative once we control for entry cohort. In unreported results using LBD data, we find even stronger results – controls for entry cohort absorb 85 percent of the volatility rise among publicly traded firms from 1977 to 2001.

## VI. CONCLUDING REMARKS

[28] Industry effects play a substantially larger role in Table 3 (LBD data) than in Figure 13 (COMPUSTAT data). Unreported results show that much of the difference arises because of different sample periods. In particular, regardless of data set and whether we use a shift-share or regression-based method, industry effects play a substantially larger role from 1982 to 2001 than from 1977 to 2001. Differences between Table 3 and Figure 13 in method and data set play a smaller role.

Comprehensive micro data reveal that volatility and cross sectional dispersion in business growth rates declined in recent decades. Our preferred measure of firm volatility in employment growth rates (Figure 6) fell 23 percent from 1978 to 2001 and 29 percent from 1987 to 2001. Our most remarkable finding, however, is a striking difference in volatility and dispersion trends by business ownership status. Among privately held firms, volatility is relatively high but it fell by one third from 1978 to 2001. Among publicly traded firms, volatility is lower but it rose by three quarters from 1978 to 1999. This pattern of volatility convergence between publicly traded and privately held businesses prevails for every major industry group.

Our study also provides some proximate explanations for these strong patterns in the data. Employment shifts toward older businesses account for 27 percent or more of the volatility decline among privately held firms. In addition, shifts toward larger businesses played a role in certain industries, particularly Retail Trade. In line with the shifts toward older and larger businesses, the employment-weighted business turnover rate declined markedly after 1978. Finally, simple cohort effects that capture higher volatility among more recently listed firms account for most of the volatility rise among publicly traded firms.

These empirical results suggest a number of interesting questions and directions for future research. Consider, first, the connection between employer volatility and unemployment. Employer volatility can be interpreted as a rough proxy for the intensity of idiosyncratic shocks, a key parameter in unemployment models that stress search and matching frictions. A lower intensity of idiosyncratic shocks in these models leads to less job loss, fewer workers flowing through the unemployment pool, and less frictional unemployment. Motivated by these models, Figure 14 plots our employment-weighted modified volatility measure against annual averages of monthly unemployment inflow and outflow rates. The figure suggests that secular declines in the intensity of idiosyncratic shocks contributed to large declines in unemployment flows and frictional unemployment in recent decades. More study is clearly needed to confirm or disconfirm this view, and there is surely a role for other factors such as the aging of the workforce after 1980.

Another major development in U.S. labor markets since the early 1980s is a large rise in wage and earnings inequality.[29] One line of interpretation for this development stresses potential sources of increased wage and earnings flexibility: declines in the real minimum wage, a diminished role for private sector unionism and collective bargaining, intensified competitive pressures that undermined rigid compensation structures, the growth of employee leasing and temp workers, and the erosion of norms that had previously restrained wage differentials and prevented wage cuts. Greater wage (and hours) flexibility can produce smaller firm level employment responses to idiosyncratic shocks and smaller aggregate employment responses to common shocks. So, in principle, greater wage flexibility can provide a unified explanation for the rise in wage and earnings inequality *and* the declines in aggregate volatility, firm volatility and unemployment flows. We mention the role of wage flexibility because we think it merits investigation and may be a significant part of the story, not because we believe that greater wage flexibility or any single factor can explain all aspects of longer term developments in wage inequality, unemployment, firm volatility and aggregate volatility.

The potential role of greater wage flexibility is related to another question raised by our results. In particular, to what extent do trends in firm volatility reflect a change in the size and frequency of shocks, and to what extent do they reflect a change in shock response dynamics? One simple approach to this question is to fit statistical models that allow for nonstationarity in the size and frequency of business level innovations and in the response dynamics to the innovations. Another approach is to identify specific shocks, quantify their magnitude and investigate whether shock magnitudes and firm level responses to them have changed over time.

Several pieces of evidence point to a major shift in the selection process governing entry into the set of publicly traded firms. Figure 13 and Table 5 above indicate that more than half of the volatility rise among publicly traded firms in recent decades reflects an influx of more volatile firms in later cohorts. Other researchers find that later cohorts of publicly traded firms are riskier in terms of equity return variability, profit variability, time from IPO to profitability, and business age at time of first listing. The shift in the

[29] See Autor, Katz and Kearney (2005) for a recent contribution to this literature, a review of major competing hypotheses about the reasons for rising inequality and references to related research.

selection process for publicly traded firms is a major phenomenon, in our view, but it does not by itself explain the volatility convergence pattern we have documented or the overall downward trend in firm volatility and dispersion. To appreciate this point, consider a simple selection story that we sketch with the aid of Figure 15. The figure shows a hypothetical density function for firm level risk and a risk threshold that separates publicly traded from privately held firms. This figure captures, in a highly stylized manner, the notion that publicly traded firms are less risky than privately held ones. Suppose that the risk threshold moves to the right, so that a riskier class of firms now goes public. This shift yields an increase in average risk among publicly traded firms, but it also produces an increase in average risk among privately held firms and in the share of activity accounted for by publicly traded firms. The latter two implications are at odds with the evidence, at least when risk is measured by firm volatility and activity is measured by employment.

A richer story, with changing selection as one key element, is more consistent with the evidence. As discussed in Section II, smaller aggregate shocks can readily explain declines in macro volatility and the overall magnitude of firm volatility. In combination with a changing selection process, smaller aggregate shocks can rationalize the volatility convergence pattern we document and the declines in aggregate and average firm volatility. A shift of activity toward older and larger firms may have contributed to changes in the way firms respond to shocks. Shifts in the industry mix away from manufacturing and other industries that traditionally accounted for a large share of publicly traded firms help to explain why the share of employment in publicly traded firms has not risen.

Finally, our results also present something of a challenge to Schumpeterian theories of growth and development. In particular, the sizable decline in average firm volatility that we document coincided with a period of impressive productivity gains for the U.S. economy. This coincidence belies any close and simple positive relationship between productivity growth and the intensity of the creative destruction process, at least as measured by firm-based or establishment-based measures of volatility in employment growth rates. Perhaps there has been a large increase in the pace of restructuring, experimentation and adjustment activities within firms. Another possibility is that a more

intense creative destruction process among publicly traded firms, partly facilitated by easier access to public equity by high-risk firms, has been sufficient to generate the commercial innovations that fueled rapid productivity gains throughout the economy.

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## Data Appendix

*A. Additional Information about the LBD*

This appendix discusses improvements to the LBD that aided the analysis in this paper. The LBD is comprised of longitudinally linked Business Register (BR) files. The BR is updated continuously and a snapshot is taken once a year after the incorporation of survey data collections. The resulting files contain a longitudinal establishment identifier, the Permanent Plant Number (PPN). This identifier is designed to remain unchanged throughout the life of the establishment and regardless of reorganizations or ownership changes. However, there are known breaks in PPN linkages, and PPNs existed only for the manufacturing sector prior to 1982. Jarmin and Miranda (2002a) addressed these shortcomings in the BR files in creating the LBD. Their methodology employed existing numeric establishment identifiers to the greatest extent possible to repair and construct longitudinal establishment links. They further enhanced the linkages using commercially available statistical name and address matching software.

Construction of the longitudinal establishment links is relatively straightforward because they are one to one, and because establishments typically have well-defined physical locations. The construction of firm links requires additional work. Longitudinal linkages of firm identifiers can be broken by the expansion of single location firms to multi establishment entities and by merger and acquisition (M&A) activity. We address the first problem by assigning a unique firm identifier to firms that expand from single to multiple establishments. This process is straightforward because we can track establishments over time. The second problem is harder to resolve, because M&A activity can result in many-to-many matches, e.g., when a firm sells some establishments and acquires others in the same period. We do not directly address this issue in the current paper, but we recognize that it would be interesting to explore the role of M&A activity in greater depth, and we plan to do so in future work.

The combination and reconciliation of administrative and survey data sources in the LBD lead to a more serious problem that we have addressed in the current analysis. Early versions of the LBD contain a number of incorrectly timed establishment births and deaths. To see how this timing problem arises, recall that the LBD is a longitudinally linked version of the Business Register. Although the primary unit of observation in the

BR is a business establishment (physical location), administrative data are typically available at the taxpayer ID (EIN) level. As the vast majority of firms are single establishment entities, the EIN, firm and establishment levels of aggregation all refer to the same business entity. Business births typically enter the BR from administrative sources. Outside of Economic Census years, however, the Census Bureau directly surveys only large births, as measured by payroll. In Economic Census years, all establishments of "known" multi location firms are directly surveyed. A subset of larger single location businesses are canvassed as well.

The Census Bureau separately identifies the individual establishments of multi-establishment companies based on primary data collections from the Economic Census and certain annual surveys such as the Company Organization Survey and the Annual Survey of Manufactures. Since a much larger portion of firms and establishments are surveyed in Economic Census years (years ending in "2" and "7"), the Economic Census becomes the primary vehicle by which the Census Bureau learns about establishment entry and exit for smaller multi-unit firms. This information is then incorporated into the LBD. The implication is that the unadjusted LBD files show large spikes in establishment births and deaths for multi-unit firms in Economic Census years. Many of those births and deaths actually occurred in the previous four years.

We retime these incorrectly timed deaths and births following a two-phase methodology, described more fully in Jarmin and Miranda (2005). The first phase uses firm level information contained in the LBD to identify the correct birth and death years for as many establishments as possible. The second phase adapts an algorithm developed by Davis, Haltiwanger and Schuh (1996) to randomly assign a birth or death year for those case that cannot be resolved in phase one. The randomization procedure is constrained so that the temporal patterns of births and deaths for retimed cases match those for the accurately timed births and deaths that we observe directly in the data (single-unit births and establishment births in large multi-unit firms that are directly canvassed).[30]

[30] We construct birth and death retiming weights from accurate data on the timing of births and deaths using a conditional logit model. The model includes controls for state, metro and rural areas and job creation and destruction rates. The model is run separately by 2-digit SIC and for four different 5-year census cycles.

Finally, the LBD contains a substantial number of establishments that appear to become inactive for a period of time (Jarmin and Miranda, 2002b). That is, the establishment is active in period *t-1* and *t+1* but not in period *t*.[31] These gaps lead to possibly spurious startups and shutdowns. In this paper, we take a conservative approach by eliminating these establishment-year observations in the entry and exit computations. Our goal in doing so is to focus on true entry and exit.

*B. COMPUSTAT-LBD Employment Comparisons*

The top panel in Figure A.1 compares log employment levels between COMPUSTAT and the LBD data sources for a matched set of publicly traded firms. The lower panel compares five-year growth rates, calculated according to equation (4). Here, we restrict attention to matched firms that have positive employment in the LBD and COMPUSTAT. Much of the mass is concentrated along the 45 degree line in the top panel, but there are clearly many large discrepancies between the two data sources. The simple correlation of log employment levels is 0.89 on an unweighted basis and 0.83 on an employment-weighted basis. The standardized employment difference, measured as LBD employment minus COMPUSTAT employment divided by the average of the two, has an unweighted median value of -13 percent and an unweighted mean of -26 percent . The weighted values are -25 percent for the median -30 percent for the mean. The lower panel shows a weaker relationship for growth rates, with a correlation of 0.64 unweighted and 0.54 weighted. Lower values for the weighted correlations probably reflect bigger discrepancies for multi-national firms with significant global operations.

In short, the results in Figure 1 indicate that COMPUSTAT measures of firm level activity contain considerable measurement error, if the goal is to measure the U.S. domestic operations of publicly traded firms. Despite the large COMPUSTAT-LBD differences in employment levels and growth rates, the two data sources produce similar trends in firm volatility measures, as seen by comparing Figures 4, 5 and 7.

[31] There are between 40,000 and 120,000 cases each year. Work by Davis et. al. (2005) shows that business transitions between employer and non-employer status explains some of these cases.

**Figure A1: Comparisons of Employment levels (logs) and Employment Growth Rates for LBD and COMPUSTAT matched firms (pooled 1994-2001)**

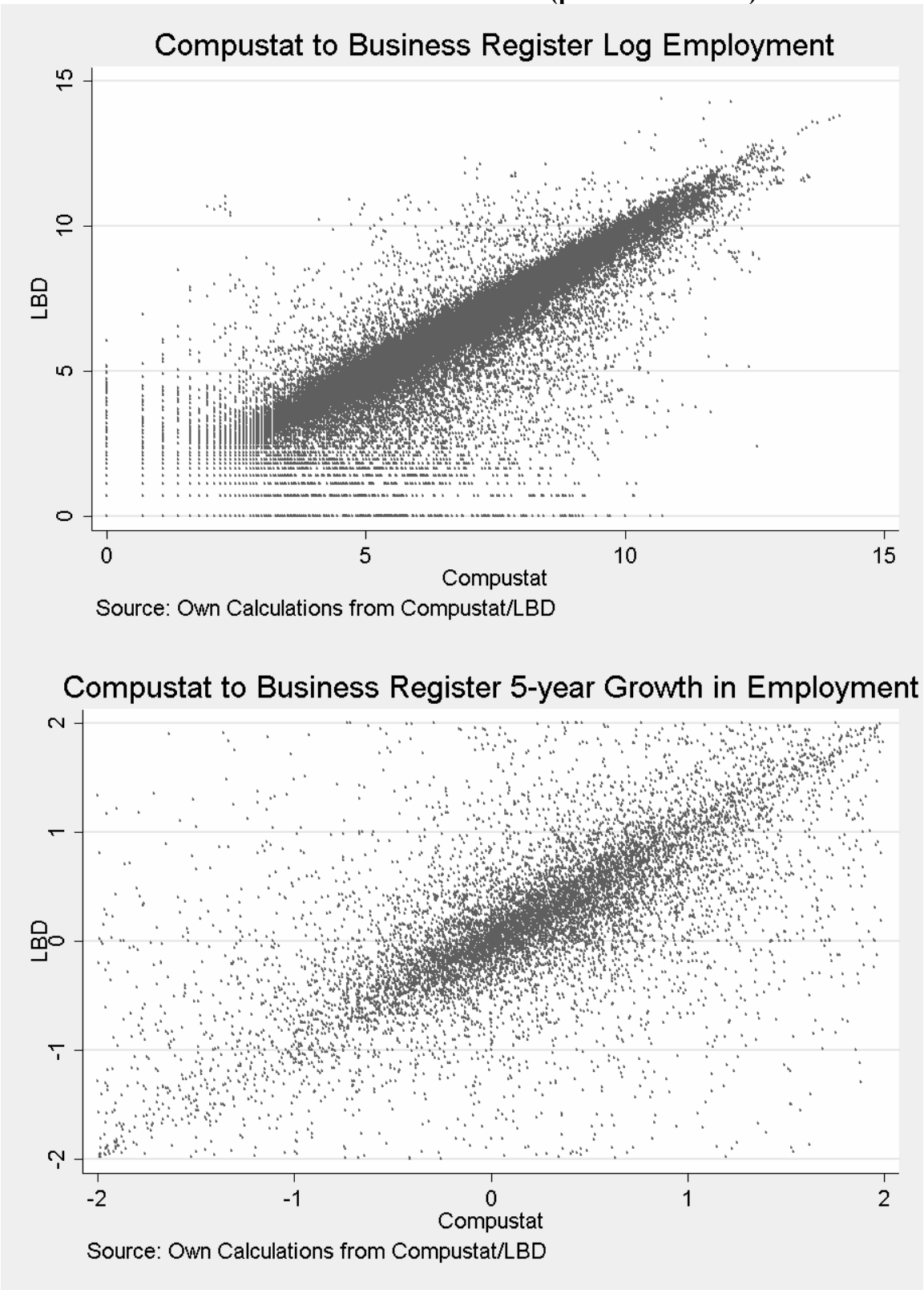


**Table 1: Summary Statistics for COMPUSTAT, LBD and Matched Data Sets**

***A. Summary Statistics for LBD Using LBD/COMPUSTAT Bridge***

| Year | | Number of Firms | Total Employment | Average Employment | Coworker Mean |
|---|---|---|---|---|---|
| 1980 | Privately Held | 3,530,307 | 51,622,693 | 14.6 | 2,736 |
| | Publicly Traded (Bridge) | 4,339 | 21,045,202 | 4,850.2 | 67,983 |
| | Total | 3,534,646 | 72,667,895 | 20.6 | 21,632 |
| 1990 | Privately Held | 4,222,385 | 68,896,957 | 16.3 | 4,235 |
| | Publicly Traded (Bridge) | 5,739 | 22,930,762 | 3,995.6 | 73,533 |
| | Total | 4,228,124 | 91,827,719 | 21.7 | 21,540 |
| 2000 | Privately Held | 4,744,020 | 83,845,864 | 17.7 | 4,761 |
| | Publicly Traded (Bridge) | 7,338 | 29,469,013 | 4,015.9 | 92,604 |
| | Total | 4,751,358 | 113,314,877 | 23.8 | 27,605 |

**B. Summary Statistics for COMPUSTAT Using LBD/COMPUSTAT Bridge**

| Year | | Number of CUSIPS with Positive Price | Number of CUSIPS with Positive Employment | Total Employment | Average Employ-ment | Coworker Mean |
|---|---|---|---|---|---|---|
| 1980 | LBD Match (Bridge) | 3,995 | 4,672 | 29,729,396 | 6,363 | 114,630 |
| | Not Matched | 835 | 880 | 3,841,700 | 4,366 | 39,050 |
| | Total | 4,830 | 5,552 | 33,571,096 | 6,047 | 105,981 |
| 1990 | LBD Match (Bridge) | 5,986 | 5,716 | 31,755,052 | 5,555 | 110,374 |
| | Not Matched | 847 | 523 | 2,793,759 | 5,342 | 72,865 |
| | Total | 6,833 | 6,239 | 34,548,811 | 5,538 | 107,341 |
| 2000 | LBD Match (Bridge) | 8,394 | 7,168 | 40,672,986 | 5,674 | 137,678 |
| | Not Matched | 2,063 | 1,306 | 4,090,947 | 3,132 | 53,033 |
| | Total | 10,457 | 8,474 | 44,763,932 | 5,283 | 137,570 |

Notes: In panel A, an LBD firm is identified as publicly traded if it appears in the LBD/COMPUSTAT Bridge and its COMPUSTAT CUSIP has a positive security price in the indicated year or in years that bracket the indicated year. In panel B, a COMPUSTAT firm is identified as an LBD match if the CUSIP appears in the LBD/COMPUSTAT Bridge. In panel B, we do not require the LBD match to have positive payroll in the current year. In both panels, average employment is the simple mean over firms, and the coworker mean is the employment-weighted mean firm size.

**Table 2: Firm Volatility Trends by Major Industry Group and Ownership Status**

| | All Firms | | | Publicly Traded Firms | | | Privately Held Firms | | | Volatility Ratio: Privately Held to Publicly Traded | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Industry | 1978 | 2001 | Percent Change | 1978 | 2001 | Percent Change | 1978 | 2001 | Percent Change | 1978 | 2001 | Change |
| Minerals | 0.54 | 0.41 | -24.2 | 0.25 | 0.28 | 10.9 | 0.74 | 0.52 | -29.8 | 3.0 | 1.9 | -1.1 |
| Construction | 0.78 | 0.51 | -34.5 | 0.33 | 0.34 | 1.3 | 0.82 | 0.52 | -36.6 | 2.5 | 1.5 | -0.9 |
| Manufacturing | 0.34 | 0.30 | -12.9 | 0.16 | 0.21 | 28.7 | 0.53 | 0.35 | -33.5 | 3.2 | 1.7 | -1.5 |
| TPU | 0.37 | 0.34 | -6.7 | 0.11 | 0.25 | 129.4 | 0.67 | 0.45 | -32.8 | 6.3 | 1.8 | -4.4 |
| Wholesale | 0.53 | 0.33 | -36.5 | 0.16 | 0.24 | 45.6 | 0.58 | 0.36 | -38.3 | 3.6 | 1.5 | -2.1 |
| Retail | 0.56 | 0.36 | -36.1 | 0.17 | 0.20 | 16.8 | 0.70 | 0.44 | -37.5 | 4.2 | 2.2 | -1.9 |
| FIRE | 0.44 | 0.39 | -13.1 | 0.17 | 0.33 | 96.4 | 0.54 | 0.42 | -22.6 | 3.3 | 1.3 | -2.0 |
| Services | 0.59 | 0.41 | -30.7 | 0.27 | 0.38 | 38.5 | 0.61 | 0.41 | -32.4 | 2.3 | 1.1 | -1.2 |
| All | 0.49 | 0.38 | -22.9 | 0.17 | 0.26 | 55.5 | 0.63 | 0.42 | -33.4 | 3.7 | 1.6 | -2.1 |

Notes: Modified firm volatility measures calculated according to equation (6) with LBD data. Average volatility across firms computed on an employment-weighted basis.

**Table 3: The Role of Shifts in the Size, Age and Industry Distribution of Employment**

| Fixing Employment Shares at 1982 Values for: | Average Volatility, All Firms | | | Average Volatility, Publicly Traded Firms | | | Average Volatility, Privately Held Firms | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1982 | 2001 | Percent Change | 1982 | 2001 | Percent Change | 1982 | 2001 | Percent Change |
| Size, Age and Industry | 0.49 | 0.40 | -17.7 | 0.21 | 0.24 | 10.5 | 0.60 | 0.47 | -22.7 |
| Industry | 0.49 | 0.36 | -25.6 | 0.21 | 0.24 | 11.2 | 0.60 | 0.41 | -31.5 |
| Age | 0.49 | 0.41 | -16.3 | 0.21 | 0.26 | 20.9 | 0.60 | 0.47 | -22.7 |
| Size | 0.49 | 0.39 | -20.7 | 0.21 | 0.26 | 21.5 | 0.60 | 0.43 | -28.1 |
| Actual Volatility | 0.49 | 0.38 | -23.0 | 0.21 | 0.26 | 21.4 | 0.60 | 0.42 | -31.1 |

Notes: Modified firm volatility measures calculated according to equation (6) with LBD data. Average volatility across firms computed on an employment-weighted basis. The bottom row shows the actual average volatility values in 1982 and 2001 and the percent change. Entries for 2001 in the other rows show the volatility values implied by fixing employment shares at the 1982 distribution over the indicated category variables, while allowing the average volatility within categories to vary as in the data. We use seven firm age categories (entrants, 1, 2, 3, 4, 5, and 6+ years), eight size categories (1-9, 10-19, 20-49, 50-99, 100-249, 500-999, and 1000+ employees), and the eight industries listed in Table 2. "Size, Age and Industry" refers to a fully interacted specification with $7 \times 8 \times 8 = 448$ distinct categories.

**Table 4: Employment Shares and Volatility by Firm Age, Privately Held Firms**

| | Percent of Employment | | Firm Volatility | | Percent Change In Volatility |
|---|---|---|---|---|---|
| Age in Years | 1982 | 2001 | 1982 | 1996 | 1982-1996 |
| Entrants | 1.6 | 1.2 | 1.47 | 1.63 | 11.0 |
| 1 | 3.4 | 2.6 | 1.36 | 1.37 | 1.3 |
| 2 | 4.3 | 3.4 | 1.21 | 1.14 | -5.2 |
| 3 | 4.8 | 3.3 | 1.00 | 0.90 | -9.5 |
| 4 | 4.3 | 3.0 | 0.84 | 0.79 | -5.9 |
| 5 | 6.0 | 3.0 | 0.66 | 0.65 | -1.2 |
| 6+ | 75.6 | 83.6 | 0.47 | 0.38 | -20.8 |
| Overall | | | 0.60 | 0.48 | -20.2 |
| 1982 Age-Specific Volatilities Evaluated at the 2001 Age Distribution of Employment | | | | 0.57 | |
| Percentage of 1982-2001 Volatility Decline Accounted for by Shift to Firms 6+ Years Old | | | | 19.6 | |

| Additional Statistics for 2001 | 6-9 years | 10-14 years | 15-19 years | 20-24 years | 25+ years |
|---|---|---|---|---|---|
| Percent of Employment | 10.2 | 11.1 | 11.6 | 10.2 | 40.5 |
| Firm Volatility | 0.45 | 0.37 | 0.32 | 0.30 | 0.28 |

Source: Own calculations on LBD data.

Notes: Modified firm volatility measures calculated according to equation (6). Average volatility across firms computed on an employment-weighted basis.

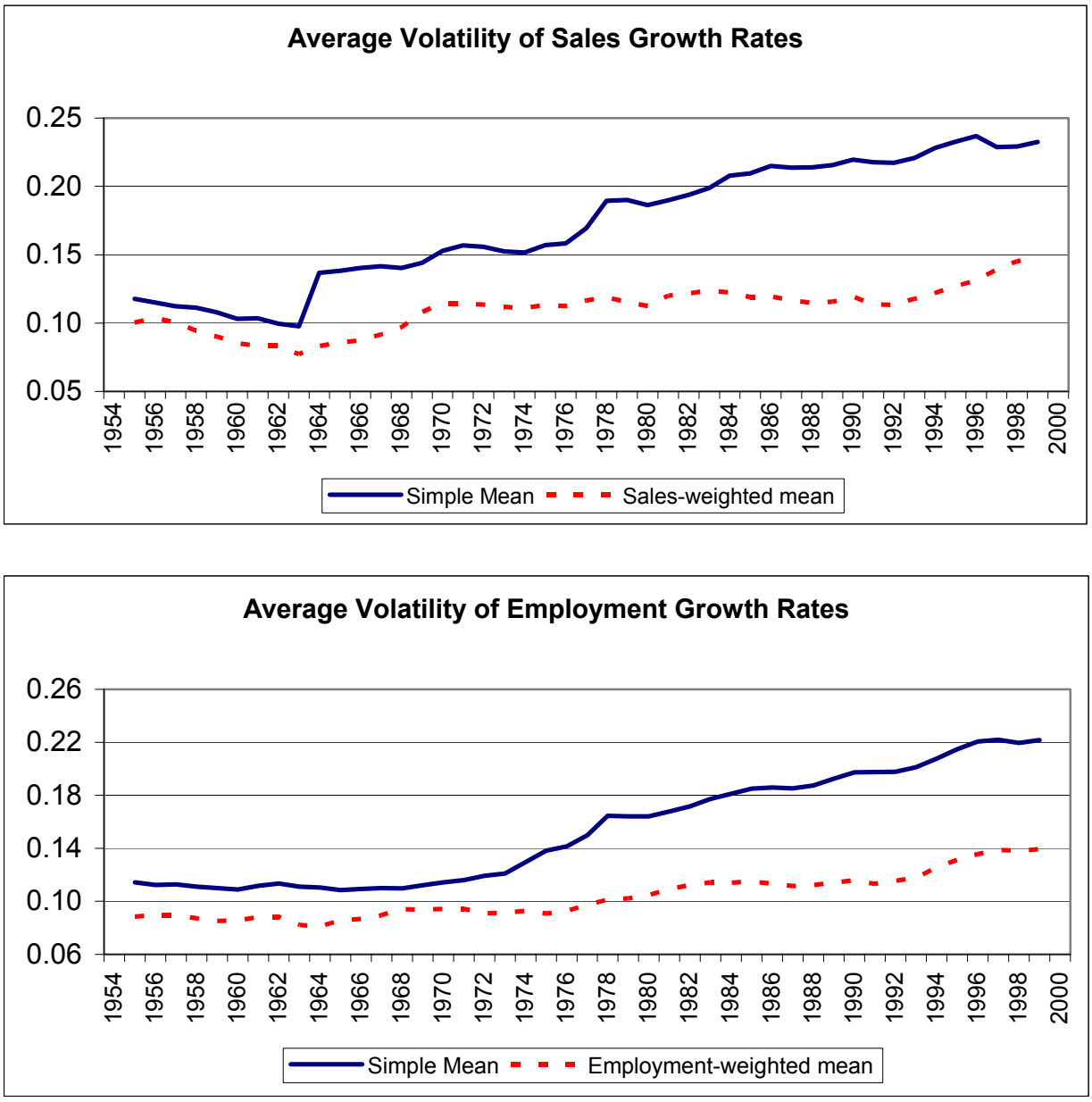
**Table 5: Cohort Effects in the Volatility Trend among Publicly Traded Firms, COMPUSTAT Data**

| Time Interval | Initial Volatility ×100 | Change in Volatility ×100 | Percentage of Volatility Change Accounted for by Cohort Effects |
|---|---|---|---|
| 1951-1978 | 8.87 | 2.03 | 49.1 |
| 1951-1999 | 8.87 | 7.14 | 59.4 |
| 1951-2004 | 8.87 | 4.55 | 90.0 |
| 1978-1999 | 10.89 | 5.11 | 63.5 |
| 1978-2001 | 10.89 | 4.67 | 67.4 |
| 1978-2004 | 10.89 | 2.52 | 122.9 |

Source: Own calculations on COMPUSTAT data.

Notes: "Initial Volatility" reports estimated year effects in a weighted least squares regression of modified volatility on year dummies, with weights proportional to firm size $(z_{it})$. The data set consists of an unbalanced panel of firm level observations from 1951 to 2004. "Change in Volatility" reports the change in the estimated year effects $(\Delta\hat{y})$ from the same regression. To quantify the percentage of the volatility change accounted for by cohort effects, we expand the regression to include one-year cohort dummies (year of first listing) and calculate the change in estimated year effects with cohort controls $\left(\Delta\hat{y}^{CC}\right)$. Lastly, we calculate the "Percentage of Volatility Change Accounted for by Cohort Effects" as $100\left(\Delta\hat{y}-\Delta\hat{y}^{CC}\right)/\Delta\hat{y}$.

**Figure 1: Firm Level Volatility for Publicly Traded Firms, COMPUSTAT Data**




Source: Own calculations on COMPUSTAT data.
Notes: Calculations exclude entry and exit. Firm-level volatility calculated according to equation (5).

**Figure 2a: Quarterly Excess Job Reallocation Rate, U.S. Manufacturing, 1947-2005**

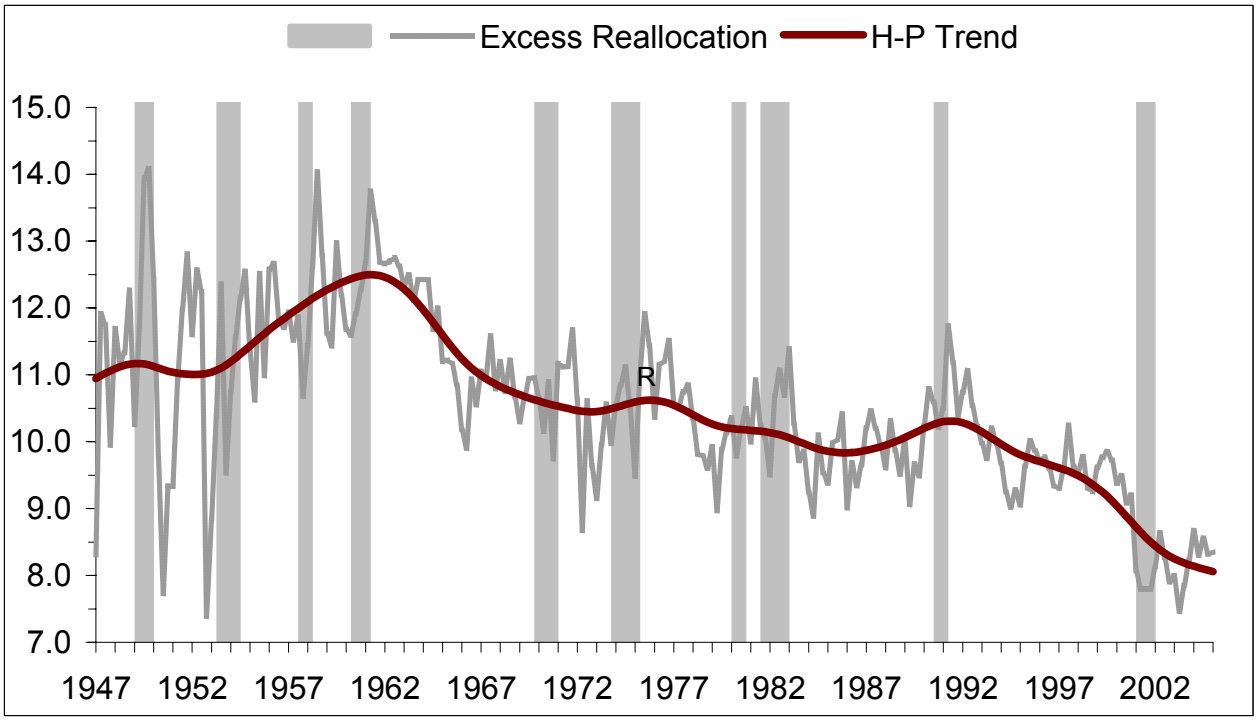
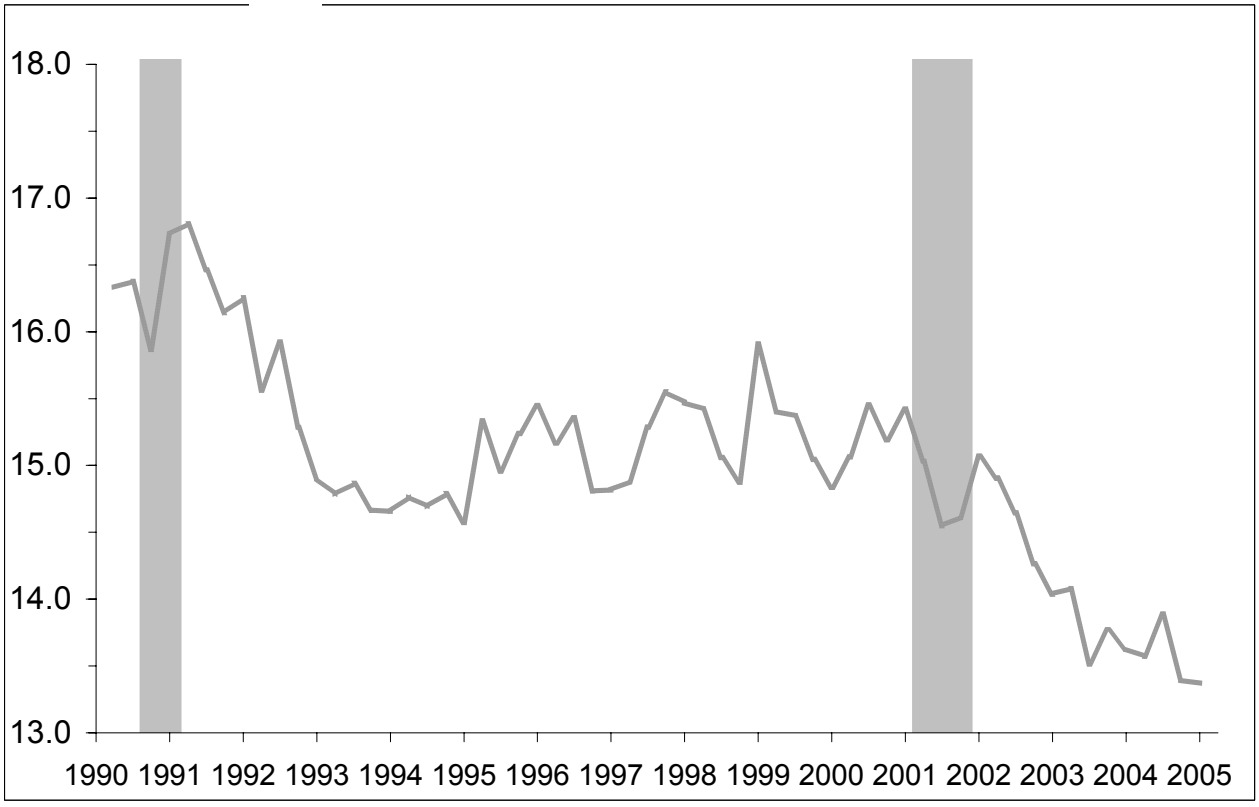
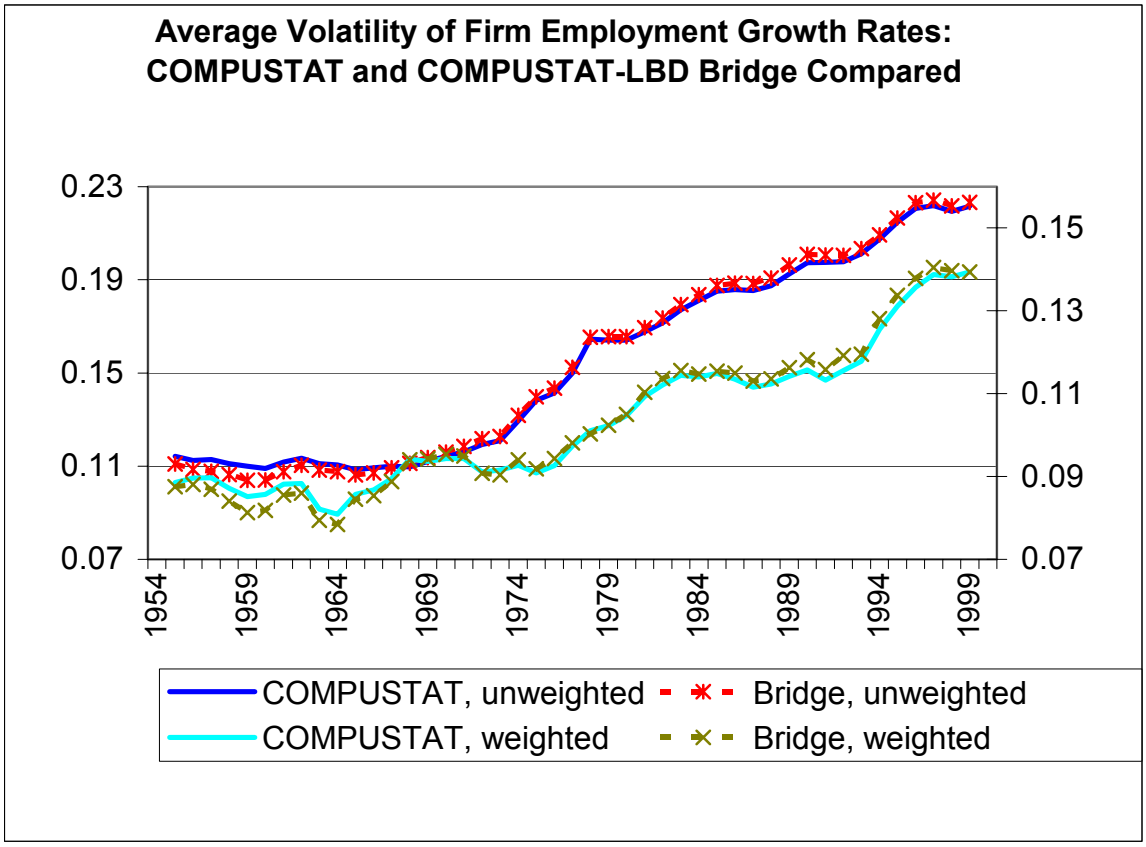



**Figure 2b: Quarterly Excess Job Reallocation Rate, U.S. Private Sector, 1990-2005**



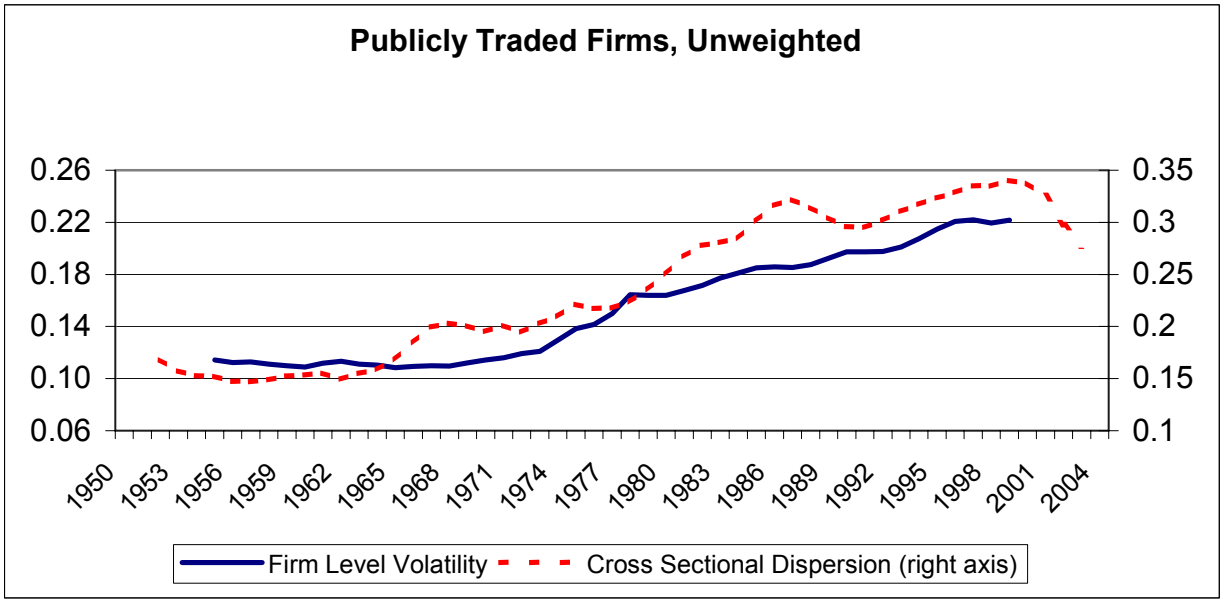

Source: Davis, Faberman and Haltiwanger (2006) and Faberman (2006)

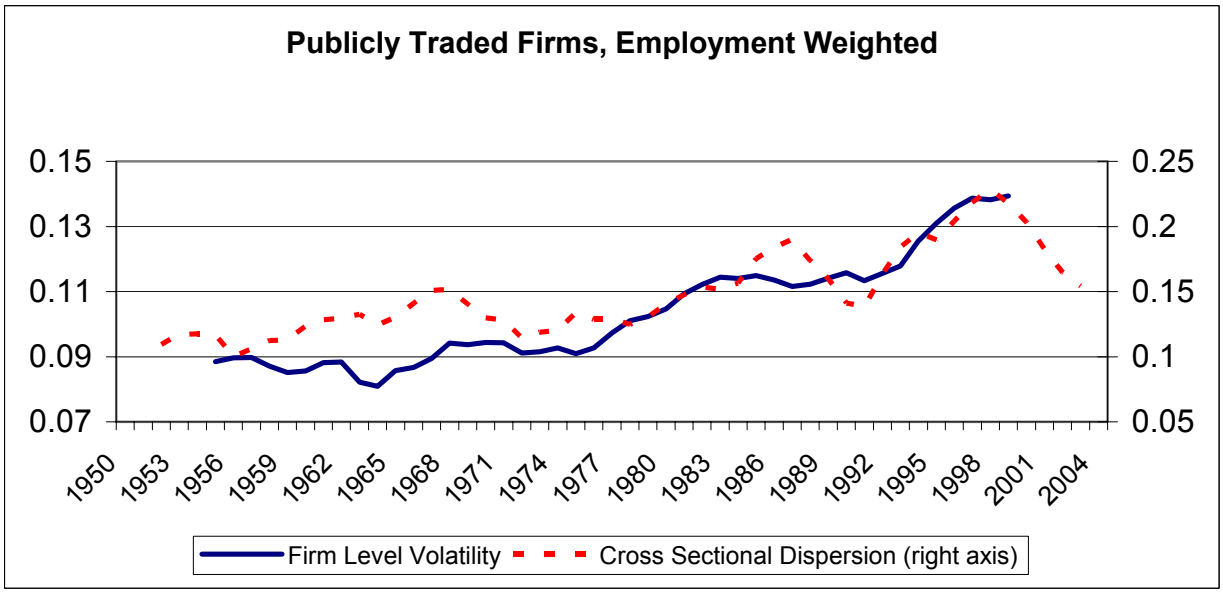
**Figure 3: Full COMPUSTAT Compared to COMPUSTAT-LBD Bridge File**




Source: Own calculations on COMPUSTAT data and COMPUSTAT-LBD Bridge file.
Notes: Calculations exclude COMPUSAT entry and exit. Firm volatility calculated according to equation (5).

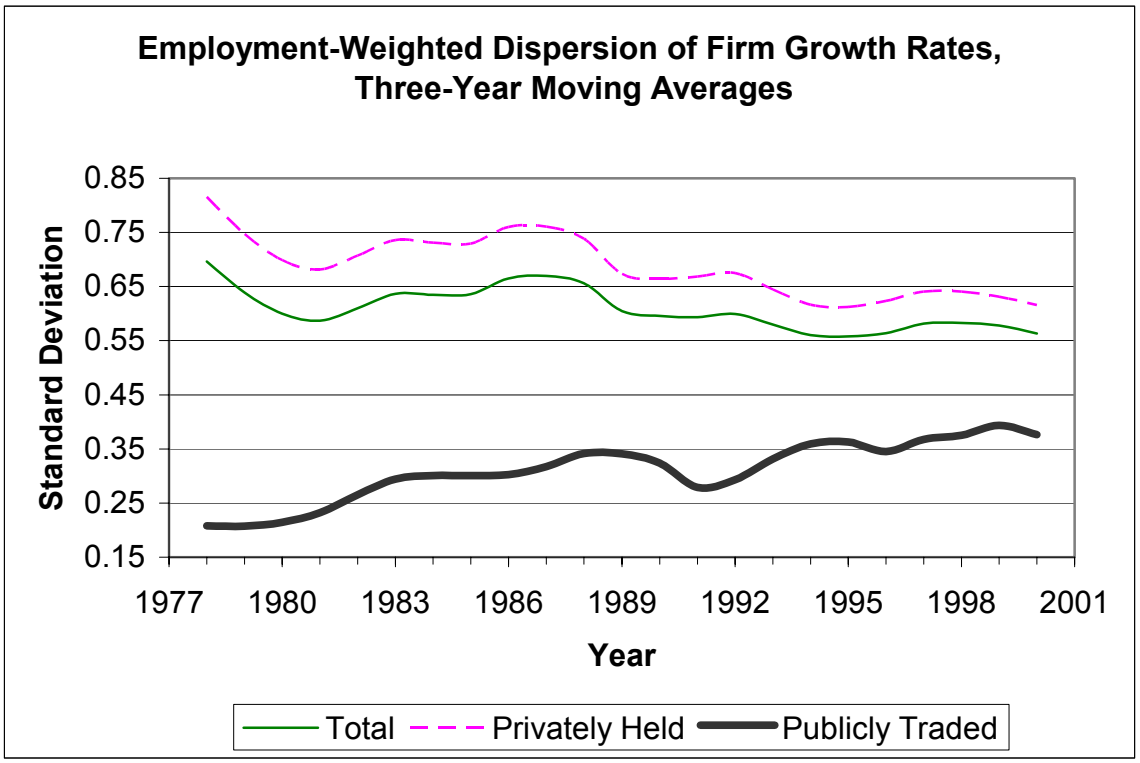
**Figure 4: Firm Volatility and Dispersion of Employment Growth Rates Compared, COMPUSTAT Data**

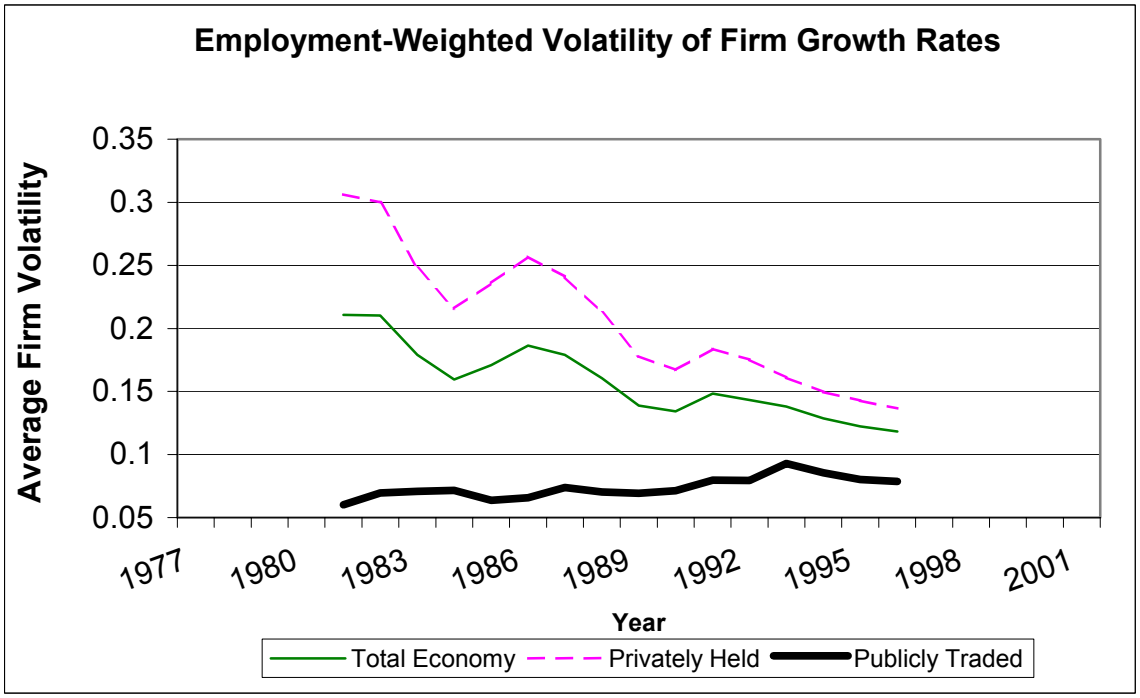



Source: Own calculations on COMPUSTAT data.
Notes: Calculations exclude COMPUSTAT entry and exit. Firm volatility calculated according to equation (5).

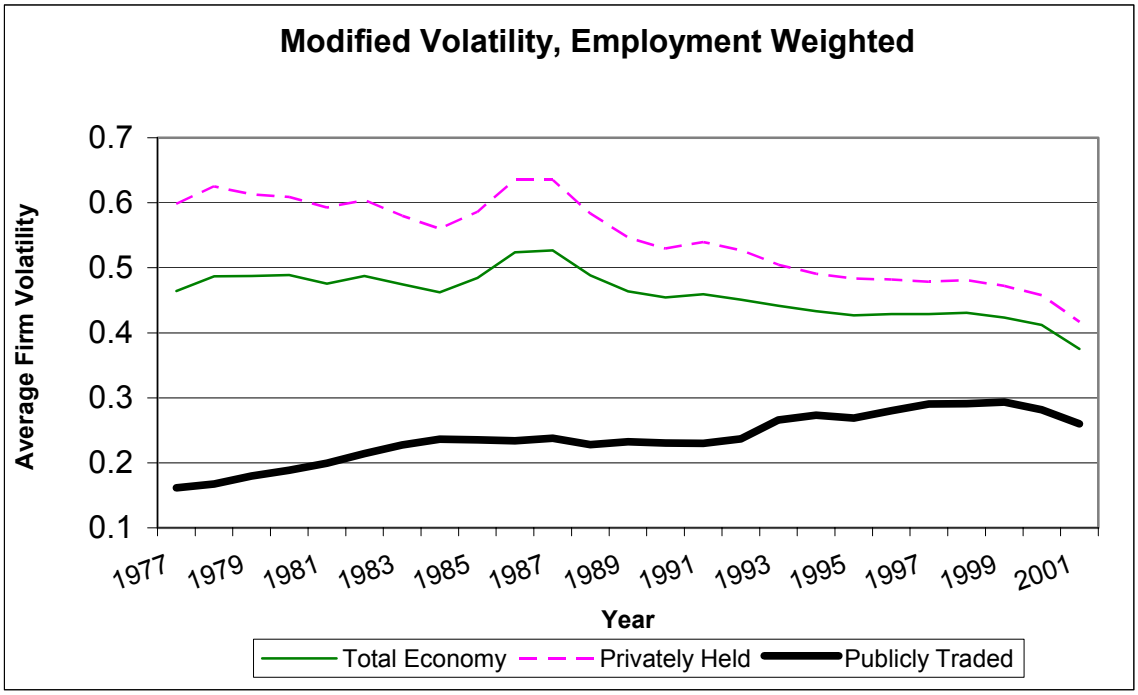
Figure 5: Dispersion and Volatility of Employment Growth Rates by Ownership Status, LBD Data



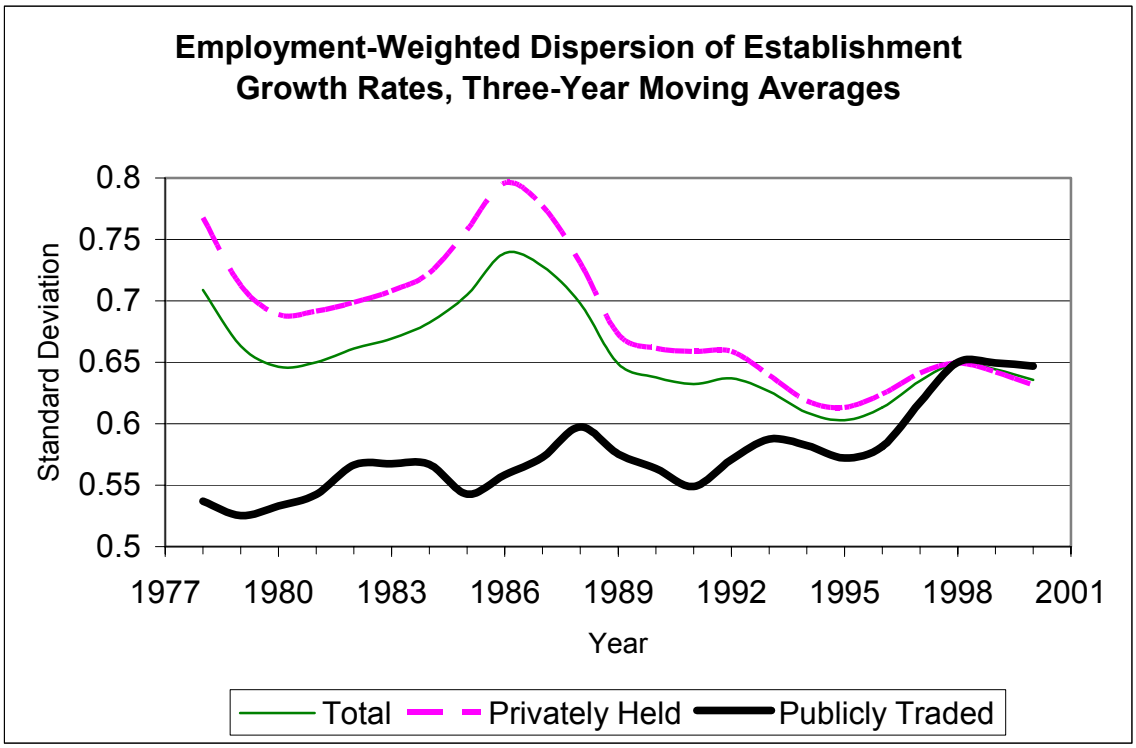

Source: Own calculations on LBD data.
Notes: Calculations in the top panel include entry and exit. Firm volatility in the bottom panel is calculated according to equation (5) and, hence, excludes short-lived firms.

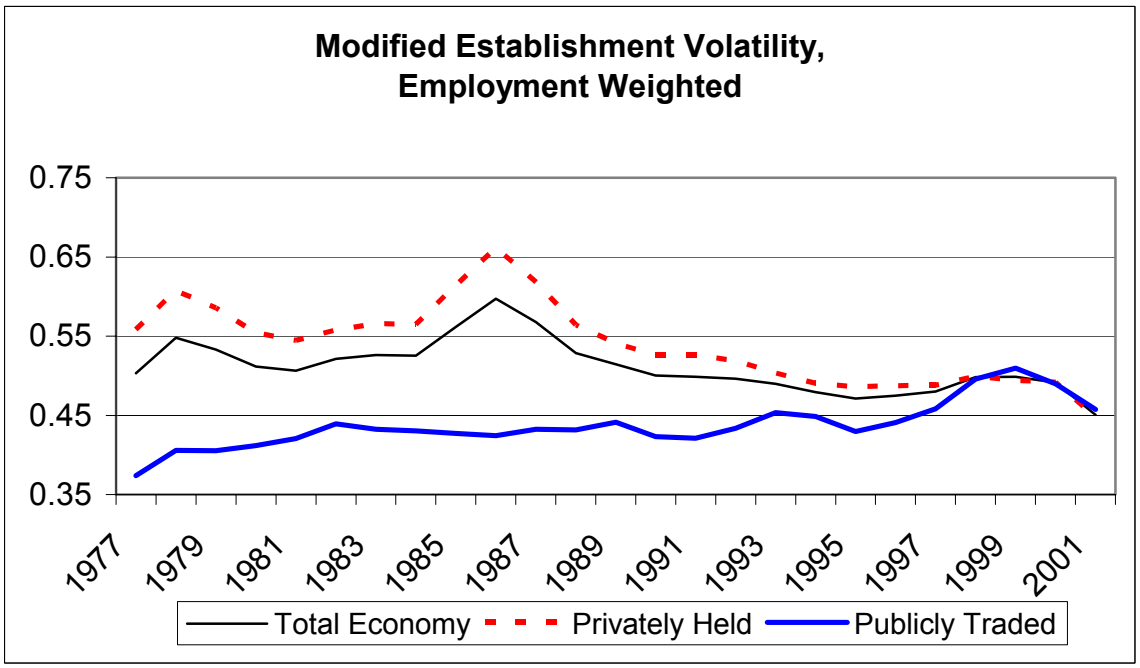
Figure 6: Modified Measure of Volatility in Firm Growth Rates, 1977-2001, LBD Data




Source: Own calculations on LBD data.
Notes: Calculations include entry and exit and short-lived firms. Firm volatility calculated according to equation (6).

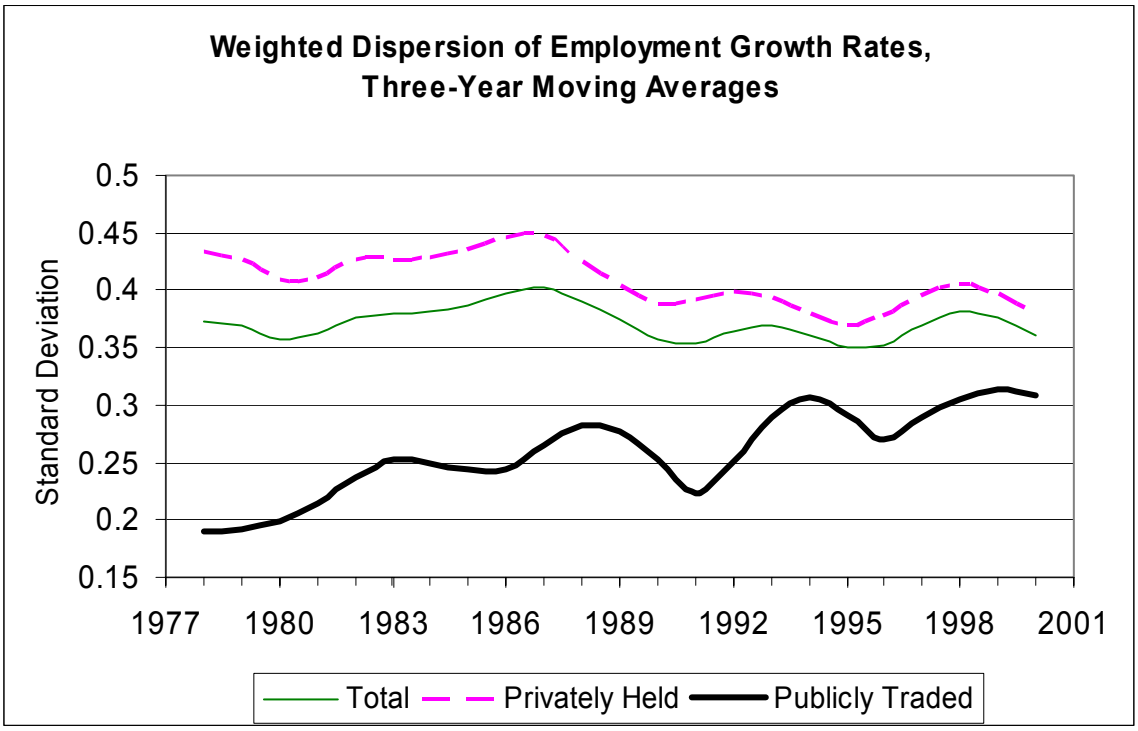
Figure 7: Dispersion and Volatility of Establishment Growth Rates, LBD Data

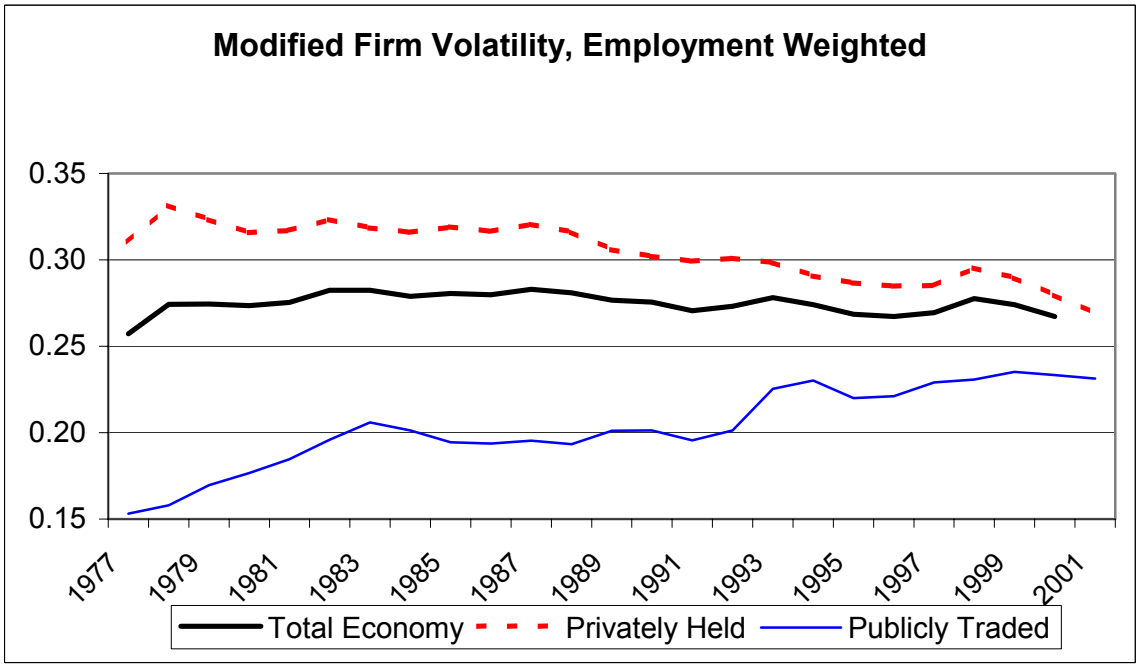



Source: Own calculations on LBD data.
Notes: Calculations include entry and exit and short-lived establishments. Modified establishment volatility calculated according to equation (6).

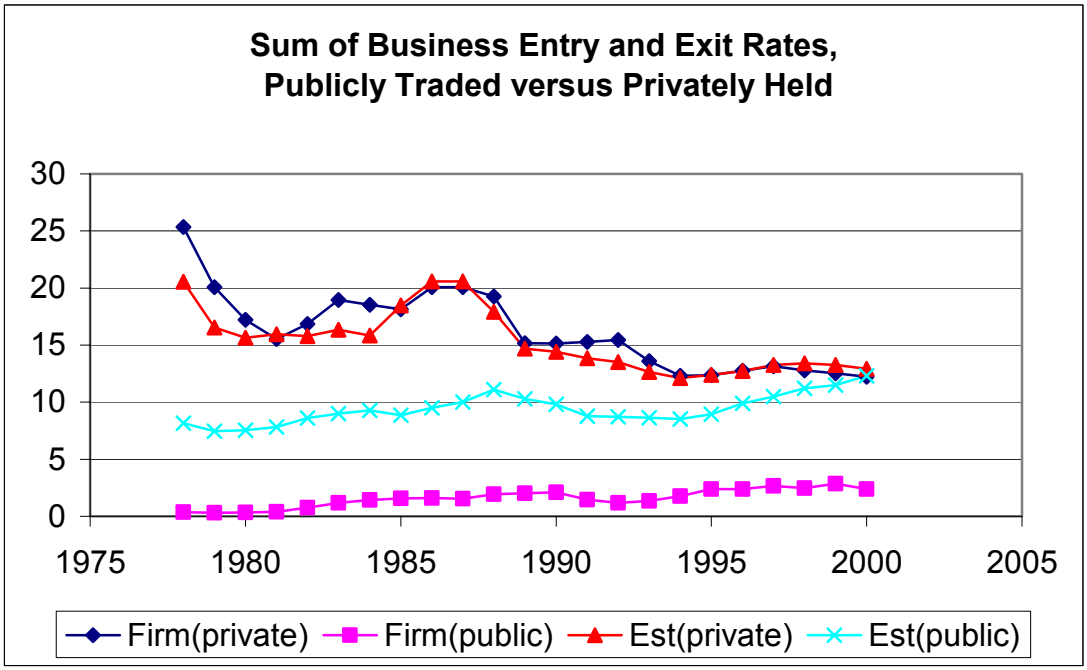
Figure 8: Dispersion and Volatility of Firm Growth Rates, Continuers Only, LBD Data



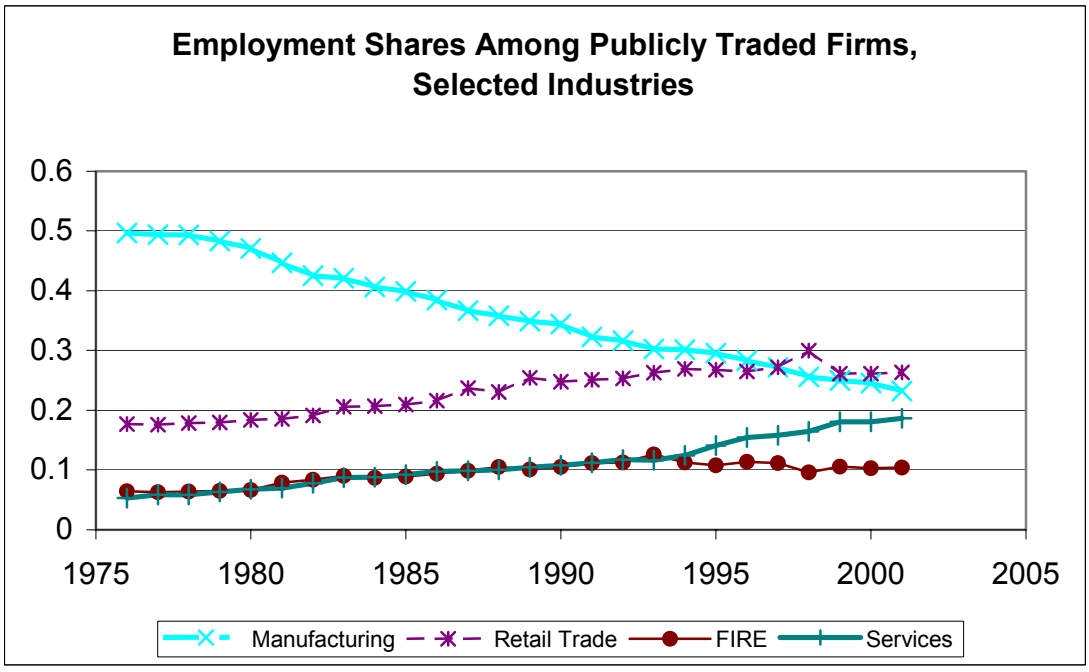

Source: Own calculations on LBD data.
Note: Calculations exclude entry and exit.

Figure 9: Employment-Weighted Sum of Entry and Exit Rates for Establishments and Firms by Ownership Status, Three-Year Moving Averages



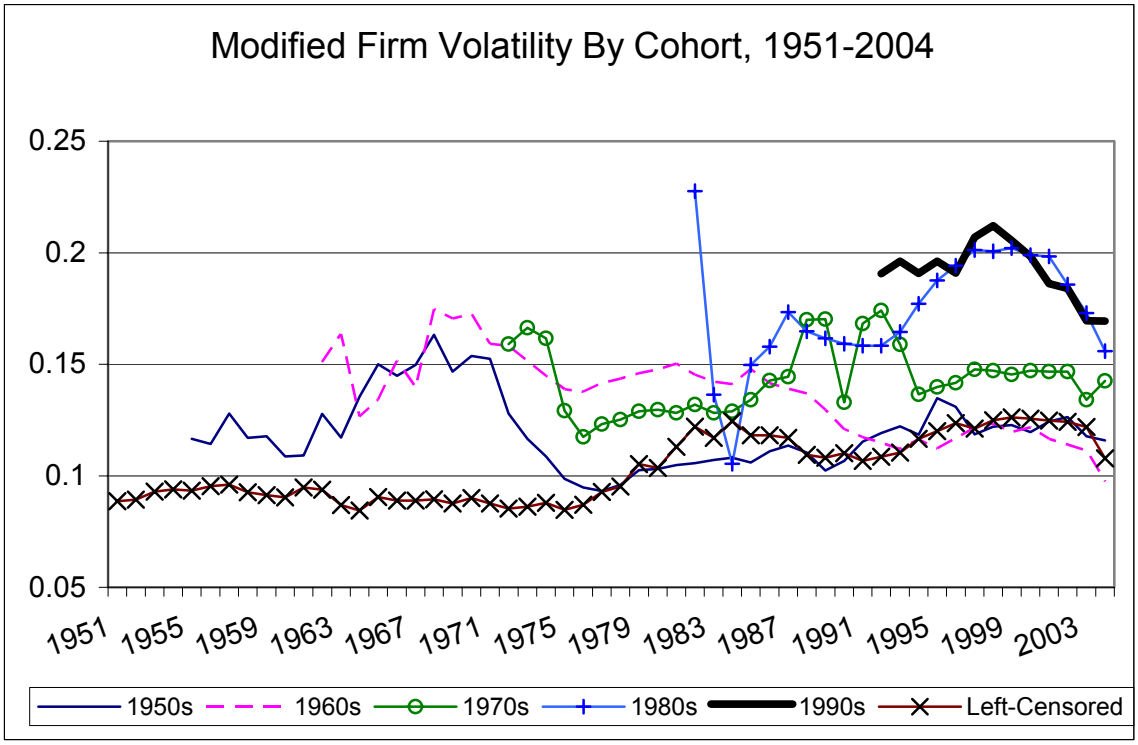

Source: Own calculations on LBD data.
Note: The employment-weighted sum of entry and exit rates at $t$ is expressed as a percentage of the simple average of employment in $t-1$ and $t$.

Figure 10: Industry Employment Shares among Publicly Traded Firms, 1976-2001



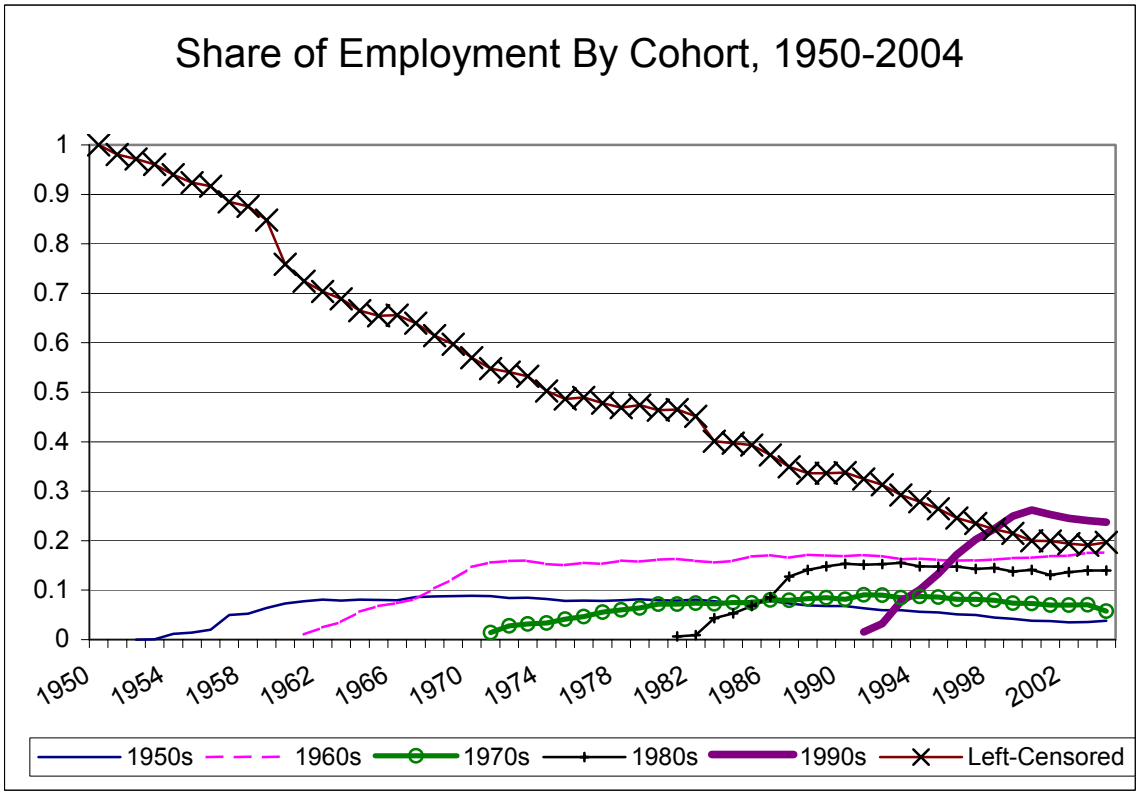

Source: Own calculations using LBD data and COMPUSTAT/LBD Bridge.

Figure 11: Modified Volatility by Cohort among Publicly Traded Firms



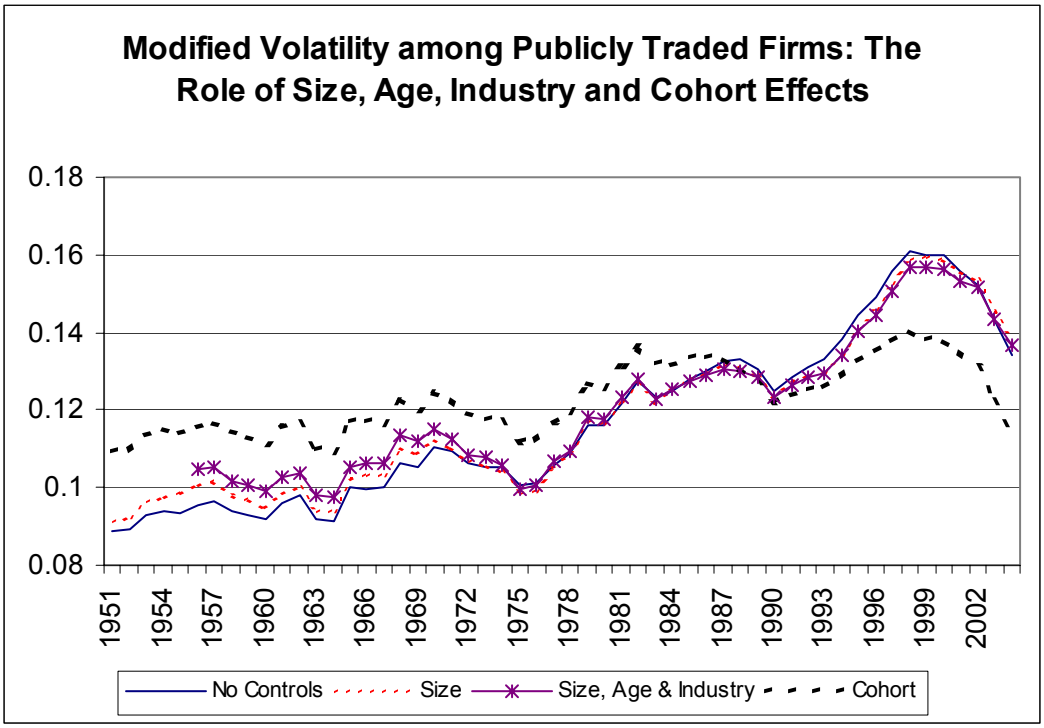

Source: Own calculations on COMPUSTAT data.
Notes: Calculations exclude entry and exit. Firm volatility calculated according to equation (6). Average volatility computed on an employment-weighted basis.

Figure 12: Employment Shares by Cohort, Publicly Traded Firms



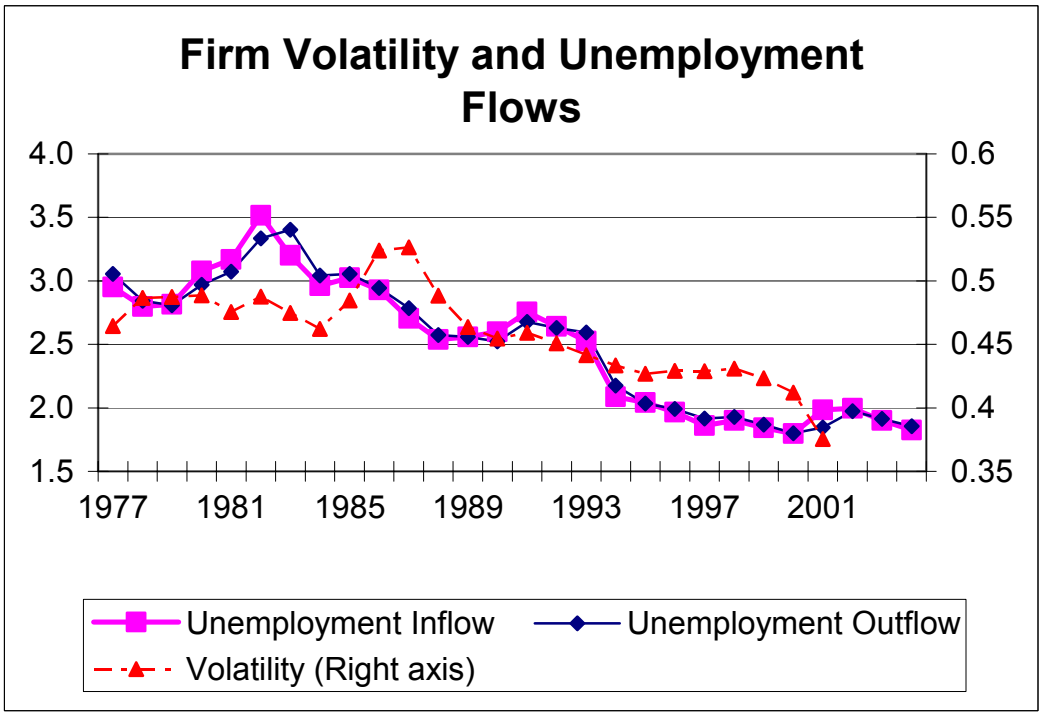

Source: Own calculations on COMPUSTAT data

Figure 13: The Role of Size, Age, Industry and Cohort Effects for Publicly Trade Firms




Source: Own calculations on COMPUSTAT data.
Notes: Calculations exclude entry and exit. Firm volatility calculated according to equation (6). Average volatility computed on an employment-weighted basis.

Figure 14: Firm Volatility Compared to Unemployment Inflows and Outflows




Source: Figure 6 for volatility measure and the Current Population Survey.
Notes: Unemployment flows are annual averages of monthly flows, expressed as a percentage of the labor force.

Figure 15: Selection on Risk and Firm Ownership Status

