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AMERICAN ENTERPRISE INSTITUTE

# Do volatile firms pay volatile earnings?

Evidence using linked worker-firm data

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# DO VOLATILE FIRMS PAY VOLATILE EARNINGS? EVIDENCE USING LINKED WORKER-FIRM DATA

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## **Abstract**

The instability of labor earnings in the United States contributes to earnings inequality and may diminish household welfare. Despite the importance of earnings instability little is known about its correlates or causes. This paper seeks to better understand earnings instability by studying whether volatile firms pay volatile earnings. I am the first to directly test the relationship between earnings instability and firm employment instability using linked employer-employee data. I find a positive and statistically significant relationship between the two that remains when the effect is estimated using only within-firm variation. This suggests that the effect is a feature of the way workers are being paid by their employer. The size of the effect varies by a worker's position in the earnings distribution: low-earning workers are passed a greater share of firm employment instability than higher-earning workers. Survey data from the NLSY79 confirm that lower-skill workers have relatively less stable earnings. I find significant heterogeneity in the magnitude and significance of the effect across industries and explore how the competitiveness of an industry relates to the size of the industry-specific effect.

## I. Introduction

The earnings of American workers have grown significantly more volatile since the 1970s. This *earnings instability* — the fluctuations over time in a worker's earnings — plays an important role in earnings inequality: the rise in earnings instability accounts for nearly one-third of the increase in earnings inequality from 1970 to 2004 (Moffitt and Gottschalk, 2008). Earnings instability lowers household welfare because risk averse households prefer stable to unstable earnings, even if average earnings are the same. There is evidence that households have trouble smoothing consumption in the face of earnings instability (Dynarski and Gruber, 1997 and Gorbachev, 2011). Households of lesser means may only be able to partially insure their consumption against transitory income shocks (Blundell *et al.*, 2008). Income volatility is associated with volatile food consumption, particularly for traditionally-vulnerable households (Gorbachev, 2011).

Despite the importance of earnings instability, little empirical evidence has been documented on its causes and correlates.<sup>1</sup> With this paper I add to our understanding of earnings instability by studying whether workers who are employed by volatile firms are paid volatile earnings. Specifically, I investigate the relationship between earnings instability and an important firm characteristic: the instability of firm employment. Firm employment is a natural measure of the scope of economic activity undertaken by the firm, and firm employment instability is a natural measure of fluctuations in the scope of economic activity. To carry out this investigation I use linked employer-employee data for the U.S.

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<sup>1</sup> Most of the research to date has focused on documenting the trends in aggregate earnings instability. There have been some studies in this literature which do not focus on the trends, however. For example, changing jobs does affect the stability of a worker's earnings, but the trends found in the data remain even when only workers who do not change jobs are studied (Gottschalk and Moffitt, 1994). Job instability has been linked to earnings instability — displaced workers experienced substantially increased earnings instability in the years following the loss of their job (Huff Stevens, 2001).

labor market — the first time linked data have been used to estimate this relationship. Having established the baseline results, I further study whether the relationship between earnings instability and the instability of the worker's employing firm varies across worker type and across industry.

Models of perfect competition predict that a worker's earnings are unrelated to firm performance: the price of labor is set in the market, and both firms and workers take the price of labor as given. Other models — including contract models, bargaining models, and monopsony models — predict that firms have some control over the earnings they pay their workers, and suggest a link between the market outcomes of a firm and the earnings dynamics of the firm's employees. The core of this issue is the motivation behind implicit contracts: Do firms insure the earnings of their risk-averse workers from shocks by smoothing the earnings of their workers from period to period?

Bertrand (2004) finds that a firm may decide to reduce the protection from external labor market conditions which it provides to its workers' earnings when competition from imports increases. This suggests a possible link between firm instability and earnings instability: firms which operate in increasingly hostile markets are less willing to insure the earnings of their workers from shocks. To my knowledge, Comin *et al.* (2009) provide the only direct test of whether firms pass volatility onto workers' earnings. Using COMPUSTAT data on publicly traded firms, they find a robust relationship between the instability of sales and employment of a firm and the instability of the average earnings paid by that firm, implying that firms may be passing instability onto workers in the form of more volatile earnings.

To study the relationship between firm employment instability and worker earnings instability I use worker-level earnings linked to firm-level variables. The linked employer-employee data I use come from the LEHD program of the U.S. Census Bureau. These linked employer-employee data provide me with the

ability to directly investigate the question at hand because I have information about individual workers and the firms in which they are employed, and the extensive coverage of the dataset allows me to study whether the effect varies across worker type and firm industry.

I present three main findings on the effect of firm employment instability on earnings instability. (1) I find a positive relationship between the instability of a firm's employment and the instability of the earnings of workers in that firm. This result is robust to a number of demographic and firm controls and remains when estimated using within-firm variation, suggesting that the effect is a feature of the way workers are being paid by firms. (2) I find that low-earning workers are being passed more than twice as much instability as high-earning workers — the size of the effect decreases over earnings quintile. Using survey data, I confirm that workers of lower-skill have relatively less stable earnings. And (3), I find significant heterogeneity in the magnitude and statistical significance of the effect across industries.

The third finding is particularly interesting. In the canonical implicit contract model, the fully-insured wage enjoyed by the worker is driven by the assumption that firms are risk neutral and workers risk averse. Is an increasingly competitive economy introducing risk aversion into firms' utility over profits? Does increasing competition drive down corporate profits, and thus weaken the ability of a firm to honor implicit contracts? If so, then variation across industries in competitive pressure may explain the variation across industries in the magnitude of the effect. At the same time, variation across industries in the power of firms to affect the earnings of their workers may also shed some light on the inter-industry heterogeneity of the effect. I present preliminary evidence of a relationship between the magnitude of the pass-through effect and the competitiveness of the industry.

This paper proceeds as follows. The next section will discuss earnings instability with more rigor, and specify the measure used in this paper. To motivate the results, Section III will discuss the relationship between earnings instability and firm instability. Section IV will discuss the LEHD data. Section V will present the baseline analysis of the effect of firm employment instability on earnings instability. The sixth section will examine whether the effect varies across worker type, and the results of the linked worker-firm regressions will be supported by evidence from survey data. The seventh section will examine whether the effect varies across industry, and the eighth section will conclude.

## **II. Earnings Instability: Motivation & Measurement**

At least since Milton Friedman (1957), economists have found it natural to think of a worker's earnings as consisting of a time-invariant permanent component and a time-varying transitory component. The transitory component can be thought of as a "random" shock to earnings, causing earnings to be unstable over time. Attempting to better understand this *earnings instability* is the focus of this paper.

To help build intuition, think of these transitory shocks in a number of labor market settings. Among high-skill workers, a lawyer who wins a once-in-a-decade case or a corporate vice president who receives an unusually generous annual bonus has received a positive transitory shock to her permanent earnings, and a hedge fund manager who makes a bad investment decision and earns no bonus in a given year can be thought of as experiencing a negative transitory shock. Among low-skill workers, a negative transitory shock to earnings could come in the form of a factory layoff, a business slowdown that results in weekly hours being temporarily cut from forty to thirty, or an unusually slow summer in a landscaping occupation. In each case, the worker's average or permanent



earnings are being hit by a shock which dies out quickly — which would not be expected to affect earnings into the future.

Earnings instability is an important component of many interesting economic questions. It is a critical component of cross-sectional earnings inequality. Assuming that transitory shocks to earnings are a random process which is uncorrelated with permanent earnings, the cross-sectional variance of earnings at any point in time is simply the sum of the cross-sectional variance of permanent earnings and the cross-sectional variance of transitory earnings.

A conceptual example helps to clarify this point. Imagine that you observe the distribution over earnings at two points in time,  $t$  and  $t'$ . At  $t$  all workers earn exactly the same amount of money. There is no spread in the earnings distribution, and thus there is no earnings inequality. At  $t'$ , one worker receives a random shock to his earnings, causing him to earn more than the other workers in the distribution. All other workers retain the same earnings as in  $t$ . Now, at  $t'$ , there is non-zero variance in the distribution, and we conclude that earnings inequality has increased from  $t$  to  $t'$ , though nothing in the structure of the labor market has actually changed.

Peter Gottschalk and Robert Moffitt have studied the trends in earnings instability in a series of papers (1994, 2002, 2008, and 2009). Using the Michigan Panel Study of Income Dynamics, they find that the rise in transitory earnings variance accounts for 31 percent of the total rise in cross-sectional earnings variance from 1970 to 2004 (Moffitt and Gottschalk, 2008). Standard explanations of increasing earnings inequality — increasing demand for high-skill workers, increasing supply of low-skill workers, and structural changes such as a decrease in union membership — apply to permanent earnings, but we would not expect them to affect transitory shocks. Supply and demand factors evolve slowly over time, and while a gradual increase in the demand for college-educated workers would be expected to raise the average wage of a college-educated

worker over time, it seems less likely that this change in demand would affect deviations from the worker's average wage. To better understand earnings inequality, then, we must better understand earnings instability.

Earnings instability also plays a significant role in consumer welfare. Abstract away from savings behavior and assume that a household consumes all of its earnings in the form of goods and services. For households with a concave utility function — a standard assumption — we know that the utility of the expected value of earnings is greater than the expected utility of the gamble:  $u(\delta y + (1 - \delta)y') \geq \delta u(y) + (1 - \delta)u(y')$ , where  $\delta \in (0,1)$ . If  $y = y'$  — if the household has perfectly stable earnings — then the two expressions are equivalent. But if not, household welfare is higher in the scenario to the left of the inequality, when the household income is not uncertain.<sup>2</sup>

Household welfare may also be affected by earnings instability as it relates to consumption smoothing. Dynarski and Gruber (1997) find that households may have trouble smoothing in the face of earnings instability, particularly with respect to durable goods. Blundell *et al.* (2008) find that low-wealth households are only able to partially insure their consumption against transitory income shocks. Similarly, Gorbachev (2011) finds that income volatility is associated with volatile consumption of food, particularly for traditionally-vulnerable households.

Instability of earnings also has a clear relationship with earnings mobility; depending on the size of the transitory shock, a worker's relative position in the earnings distribution could change. Finally, earnings dynamics are interesting in

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<sup>2</sup> In addition to preferring the expected value of the gamble to the gamble, it is the case that the household prefers smaller variance in expected earnings to larger variance. Let  $y$  be a random level of earnings for a given year, with  $\mu_y = E[y]$  and  $\sigma_y = var(y) > 0$ . Let  $U$  be utility over earnings, with  $U''(y) < 0$ . Consider  $y' = y + w$ , where  $w$  is a mean-zero random variable which is independent of  $y$ , such that  $cov(y, w) = 0$ . Then  $E[y'] = E[y] = \mu_y$ , but  $var(y') = \sigma_y + \sigma_w > \sigma_y$ . It is a well known result that  $E[U(y)] > E[U(y')]$ .

and of themselves, and earnings instability plays a clear role in the path of earnings over time.

The decomposition of annual earnings into a permanent and transitory component can be summarized by the following equation:

$$y_{it} = u_i + v_{it},$$

where  $y_{it}$  is annual earnings for person  $i$  in year  $t$ ,  $u_i$  is a time-invariant component specific to individual  $i$ , and  $v_{it}$  is the transitory shock experienced by worker  $i$  in year  $t$ . The dynamics of  $v_{it}$  cause annual earnings to change from year to year, introducing instability.

The canonical model can be further developed. For example, it is natural to think that permanent earnings may change over time — investments in human capital surely affect permanent earnings, or changes in occupation and industry due to a layoff, or a severe illness. We also might expect a transitory shock to linger for more than one period. Permanent earnings are probably not unchanging over an entire career — they may most accurately be thought of as approximating time invariance over, say, a five or ten year period. Permanent earnings are also most likely subject to shocks — say, from an unexpected layoff which requires the worker to change industries, or from an investment in human capital.

Because this paper measures worker-level earnings instability and firm-level employment instability, and not macro trends, the method used to calculate instability — also used, for example, in Gottschalk and Moffitt (1994) and Comin *et al.* (2009) — is to compute a rolling variance window of the following form:

$$instability(y_{it}) = \frac{1}{a + b - 1} \sum_{j=-a}^{j=b} (y_{i,t+j} - \bar{y}_{i,[t-a,t+b]})^2.$$

Here,  $y_{it}$  is log annual earnings for worker  $i$  in year  $t$ . The parameters  $a$  and  $b$  represent years before and after year  $t$ , respectively.  $\bar{y}_{i,[t-a,t+b]}$  is the average earnings for worker  $i$  during the time interval defined by  $a$  and  $b$ .

To measure the instability of worker  $i$ 's earnings in year  $t$  using, say, a nine-year window, compute the variance of his log annual earnings over the nine-year period starting four years before  $t$  and ending four years after  $t$  ( $a = b = 4$ ). The permanent component of earnings during that nine-year window is simply the average earnings during the window, and the transitory component for each year is the deviation from the average. This method is attractive because it allows the permanent component of earnings to evolve over time, as it likely does for workers, but to evolve much more slowly than transitory earnings. And it consequently measures transitory earnings in a straight-forward and intuitive manner. Computing this measure for every worker  $i$  in every year  $t$  generates a time series of earnings instability for each worker.

The length of the time window is very important in this calculation. Following the previous literature, I use windows of two lengths: nine years, and five years. Five years allows the permanent component to shift frequently, and captures very high-frequency variation in earnings (Comin *et al.*, 2009). Nine years is the original length suggested by Gottschalk and Moffitt (1994). The results in this paper are substantively the same regardless of which window is used.

### **III. Earnings Instability & Firm Instability**

In the perfectly competitive model of the labor market firms take the price of labor as given. The price of labor is set at the market level, and responds to *market level* demand and supply conditions. The firm faces a perfectly elastic

labor supply curve, pays the going rate for labor, and derives its labor demand from profit maximization.

In this model of the labor market, the firm does not have the option to pass volatility onto its workers, or to protect workers from volatile economic conditions. The firm enters the labor market as a price taker facing a perfectly elastic labor supply curve. If the firm pays above the market price it will earn negative profits and go out of business. If the firm pays below the market price then it will lose all its workers and shut down. A firm experiencing volatility would have to adjust along margins other than the price of labor, and a firm wishing to shield its workers from external conditions would be unable to do so.

Other models of the labor market offer different predictions. Perhaps the simplest model is one in which a firm's profits or output are distributed among its workers in each period. If profits or outputs experience time series variation, then so too will worker's earnings. As another simple exercise, consider a general equilibrium economy with one worker and one firm. The worker supplies one unit of labor to the firm, irrespective of his earnings. The firm produces output according to  $f(N) = N_t^{\gamma_t}$ , where  $N_t$  is labor input and  $0 < \gamma_t < 1$ . Interpret the parameter  $\gamma_t$  as the firm's time-varying technology which converts labor into output. The firm maximizes profit, taking the price of labor as given, and demands labor according to the following function:  $N_t^d = (\gamma_t/w_t)^{1/(1-\gamma_t)}$ . In this model, the equilibrium wage will be a function of the time-varying technology parameter. So the introduction of new technology to the firm (say, computers) will affect the earnings of workers in that firm.

Richer models also suggest that the firm will pass volatility onto its workers. Consider a firm-employee negotiation. Both firm and worker know that the firm will experience shocks. The firm and worker want to write a contract which specifies both the wage the worker will receive and the hours the worker

will work in each state of the world. Call the shock  $\alpha$ . Call the contract  $C(\alpha) = \{w(\alpha), h(\alpha)\}$ , where  $h(\alpha)$  are the hours worked conditional on  $\alpha$  and  $w(\alpha)$  is the wage paid conditional on  $\alpha$ . Suppose that both the firm and the worker have concave utility, the firm over profits and the worker over the wage and leisure. Suppose that the worker is endowed with one unit of time.

The prospective employee must be induced to work at the firm — at the time the contract is signed, the expected utility of the contract must exceed the workers opportunity cost. Let the worker's next-best offer be summarized by  $\bar{U}$ . Then the contract ensures the survival of both the firm and the worker by satisfying the following:

$$\max_{C(\alpha)} EV[\pi(\alpha)] \quad s. t. \quad EU[w(\alpha), 1 - h(\alpha)] \geq \bar{U}.$$

The contract maximizes the expected utility of profit for the firm  $EV[\pi(\alpha)]$  subject to the participation constraint of the worker.

Let the worker's utility function be  $\log w(\alpha) + \log(1 - h(\alpha))$ . A first order condition for the maximization problem is  $V'[\pi(\alpha)] = \lambda/w(\alpha)$ , where  $\lambda$  is the Lagrange multiplier. For state of the world  $z$  and  $z'$ , we have the following result:

$$\frac{V'[\pi(z)]}{V'[\pi(z')]} = \frac{w(z')}{w(z)}.$$

It is evident that the firm and the worker share the risk associated with the shock. Specifically, if  $z' \neq z$  then  $w(z') \neq w(z)$ . The shock  $\alpha$  which hits the firm will be absorbed partly by the firm, but the firm will pass some of this risk onto the worker, inducing time series variation in the worker's wage.<sup>3</sup>

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<sup>3</sup> See Sherwin Rosen (1985) for a survey of the implicit contracts literature. If the firm in this example were risk neutral — i.e., if it did not have concave utility over profits — then the model would result in a constant wage for the worker. However, the firm would still adjust hours in response to the shock, which would cause time-series variation in labor earnings, the variable of interest in this paper. The example also assumes that workers face prohibitive costs in switching firms, as the only parameter which matters in writing the contract is the opportunity cost at the

In bargaining models, increasing firm performance is correlated with higher wages for workers — the time series variance of firm performance is positively correlated with the time series variance of worker earnings. Finally, in models of monopsony, the monopsonistic firm faces the upward sloping, market level labor supply curve, inducing a positive correlation between firm size and worker earnings.

Empirically, there is evidence that firms have some measure of control over the earnings of their workers — that firms are not pure price takers in the labor market. The existence of sizable firm effects in earnings regressions using linked employer-employee data is evidence in favor of the hypothesis that firms have some discretion in the compensation of their workers (Abowd *et al.*, 1999; Goux and Maurin, 1999). Recent research by Brummund (2011) and Webber (2011) finds a distribution over market power at the firm level, implying that variance exists over the ability of firms to influence the earnings of their workers. If firms do have this ability, then some may choose to vary worker earnings with firm performance.

Bertrand (2004) studies the extent to which product market competition influences a firm's decision to shield its workers from external labor market conditions. Specifically, she studies whether increased competition from imports induced by globalization increases the sensitivity of workers' earnings to the current unemployment rate and decreases the sensitivity of workers' earnings to the unemployment rate at the time of hire. She finds evidence of both effects, and concludes that the labor market is more like a spot market than it used to be.

While Bertrand (2004) does not specifically study the relationship between the instability of firm performance and the instability of worker earnings,

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time the contract is written. For an implicit contract model with costly mobility see Beaudry and DiNardo (1991). For empirical investigations of contract models, see Card (1986), Abowd and Card (1987), and Ham and Reilly (2002).

her results imply that the correlation may exist: if increasing foreign competition makes firms less likely to shield workers from external conditions, then the earnings of those workers will be characterized by an increase in time series variation. Provided that increasing foreign competition makes the product market riskier for firms, the two may be correlated. To my knowledge, Comin *et al.* (2009) provide the only direct test of whether firms pass volatility onto workers' earnings. Using COMPUSTAT data on publicly traded firms, they study whether the instability of the average wage paid by a firm is correlated with the instability of firm sales and employment. They find a robust relationship between the two, implying that firms are passing instability onto workers in the form of more volatile earnings.

While Comin *et al.* (2009) has compelling results, the paper is not without limitations. The sample of firms is restricted to publicly traded firms. It has been shown that firm instability follows very different patterns for privately-held firms than for publicly traded firms (Davis *et al.*, 2006). In addition, since Comin *et al.* (2009) do not have linked data, they study the instability of *average* earnings at a firm-year, and not the instability of *worker-level* earnings. Furthermore, Comin *et al.* (2009) use a noisy measure of average earnings — they divide the firms total annual wage bill by total employment, and are not able to control for the entry and exit of workers. Finally, only twenty percent of COMPUSTAT firms report their wage bill, and those which do report have less firm volatility than those which do not.

Linked employer-employee data are needed for a more complete investigation of the question at hand. In this paper, I investigate the relationship between firm employment instability and earnings instability using data from the



Longitudinal Employer-Household Dynamics (LEHD) program of the U.S. Census Bureau.<sup>4</sup> In the next section, I describe the data.

## IV. LEHD Data & Sample

The LEHD program is a federal-state partnership between the U.S. Census Bureau and all fifty states.<sup>5</sup> The states supply LEHD with Unemployment Insurance (UI) administrative files, providing LEHD with a report of worker-level UI-covered quarterly earnings. UI records cover approximately ninety-eight percent of wage and salary payments in private, non-farm jobs. Each earnings record is associated with a state UI account number which identifies the employing entity of the worker. In addition, the states supply an extract of their ES-202 report, providing LEHD with information on the firms in which the workers are employed, including employment and industry.

The UI and ES-202 files are the core of the LEHD data. The UI records are a worker-employer link — a job. So the LEHD data are a job frame. The unique person identifier for each record allows for the workers' demographic characteristics to be linked from other administrative and survey records. Demographic information in the LEHD data now includes sex, date and place of birth, citizenship status, race, ethnicity, and education. The unique identifiers for workers and firms allow for the study of a wide variety of topics, including job-to-job transitions, worker earnings histories, and coworker characteristics.

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<sup>4</sup> The LEHD data have been used to study earnings instability topics prior to this paper. Gottschalk, McEntarfer, and Moffitt (2008) estimate the trend in earnings instability from 1991 to 2003 in the LEHD data and compare it to the estimated trend in the PSID. They find that the trend is very similar in the two data sets. (They also find that the cross-sectional variance of earnings is quite different.) Celik *et al.* (2009) use LEHD data to study the importance of employment fluctuations and job changes in explaining the trends in earnings instability.

<sup>5</sup> LEHD currently has data for every state except Massachusetts, the most recent state to join.

Abowd *et al.* (2009) provides a comprehensive overview and description of the LEHD data.<sup>6</sup>

## Sample

The sample of LEHD data on which the earnings and firm employment instability measures were computed consists of all male long-form Census 2000 records, an (approximately) random one-in-six sample of the U.S. population, from the states of California, Colorado, Idaho, Illinois, Indiana, Kansas, North Carolina, Oregon, Washington, and Wisconsin, for the years 1992 through 2009.<sup>7</sup> Workers younger than twenty-five and older than sixty-five are dropped in order to avoid the time series variation in earnings associated with beginning and ending a career. To ensure that outliers are not driving the regression results, worker-years with earnings in the first and ninety-ninth percentile of the earnings distribution are dropped. For each worker, only the dominant job in each quarter is studied. Quarterly earnings from dominant jobs are summed to create annual earnings, which are then logged. The earnings instability measure is calculated on log annual earnings as previously described.

The nine-year earnings instability measure for year  $t$  requires four years of data on each side of  $t$ . With earnings data starting in 1992, the earliest year for which a worker's earnings instability could be calculated is thus 1996. Likewise, the last year for which the worker's earnings instability could be calculated is

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<sup>6</sup> Interested researchers can access these data through the network of Census Research Data Centers. There are currently twelve Census RDCs in the United States. The RDC network is part of the Center for Economic Studies of the U.S. Census Bureau. The RDCs are Census Bureau facilities housed in partner institutions. For more information on conducting research using the LEHD data (or other data) in a Census RDC, please see this website: <http://www.census.gov/ces/rdcresearch/index.html>.

<sup>7</sup> The LEHD data are relatively new, and many states do not start until later in the 1990s. These states were chosen because their data begin in either 1991 or 1992, and because many of them are large and representative. Gottschalk, McEntarfer, and Moffitt (2008) use the LEHD data to study earnings instability, and use a subset of the states in this paper. Celik *et al.* (2009) use a similar set of states.

2005. This leaves a baseline sample of approximately five million worker-years composed of approximately one million unique workers and 250,000 unique firms running from 1996 through 2005, and from the states listed previously.<sup>8</sup>

This sample of workers is characterized by very strong labor market and employer attachment. To have earnings instability calculated for a given year, the worker must have worked for the same employer for four years before and four years after the year in question. These workers may be among the most stable employed by their respective firms. Studying them will go a long way towards eliminating the concern that a relationship between earnings and firm stability is being driven by workers changing jobs, or workers entering and leaving employment, or workers who are not strongly committed to the labor market. We can be reasonably confident, then, that the relationship between earnings and firm employment instability calculated on this sample of workers reflects a feature of the way workers are paid, and is not driven by other factors.

Tables 1 presents summary statistics from the regression sample. Firm employment instability is measured using log annual employment, and is calculated in exactly the same way as earnings instability. Employment is a natural measure of the scope of economic activity taking place at the firm, and it is intuitive to think that a firm with relatively greater time series variance in employment — in economic activity — is in some sense relatively less stable.

Table 1 presents the distributions for the sample over North American Industry Classification System (NAICS) sector, race, state, and education categories. Over one-quarter of the observations come from the manufacturing sector. Over ten percent come from public administration, with an additional ten percent from educational services. Construction, wholesale trade, retail trade, and transportation and warehousing are the remaining industries which constitute over

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<sup>8</sup> Observation numbers are rounded for confidentiality protection.

five percent of the sample. The sample is 83.3 percent white. Interestingly, the number of observations with an African American worker is roughly the same as the number with an Asian worker. Over sixty percent of the sample have at least some college education.

## V. Empirical Strategies & Baseline Regression Results

To investigate the relationship between the instability of firm employment and the instability of the earnings of the firm's workers, the following equation, Eq. 1, is estimated:

$$instability(y_{ift}) = \alpha + \varphi instability(e_{ft}) + X_{ift}\delta + \varepsilon_{ift}, \quad (1)$$

where  $y_{ift}$  is the earnings of worker  $i$  employed by firm  $f$  in year  $t$ ;  $e_{ft}$  is employment of firm  $f$  which employs worker  $i$  in year  $t$ ;  $X_{ift}$  is a matrix of firm and worker characteristics, and includes controls for industry, race, education category, age and age squared, year, and state. Because the size of the firm may have an effect on the volatility of the earnings it pays its workers, the log of employment is included in  $X_{ift}$  as well.  $\varepsilon_{ift}$  is the error term, and  $\delta$  and  $\alpha$  are parameters. The parameter of interest is  $\varphi$ , which measures the effect of firm employment instability on earnings instability.

Columns 1 through 8 of Table 2 report the results. The odd-numbered columns use the five-year instability measure for both earnings and firm employment instability, and the even-numbered columns use the nine-year measure. The first two columns are estimated with no control variables. They show a positive and statistically significant relationship between earnings instability and firm employment instability. Columns 3 and 4 add a control for firm size. The coefficient is negative and statistically significant, suggesting that

larger firms pay more stable earnings to their workers. The sign and statistical significance of the coefficient on firm employment instability,  $\varphi$ , is robust to this control. Columns 5 through 8 add controls for workers and firms, described above. Columns 5 and 6 do not include the firm-size control, though it is returned in Columns 7 and 8. As before, the sign and significance of  $\varphi$  is robust to these controls. Across the four specifications, the five-year firm employment instability coefficient  $\varphi$  ranges in size from 0.138 to 0.152. The nine-year coefficient ranges from 0.178 to 0.189. Its magnitude is largely unaffected by the inclusion of the controls.

Consider two states of the world for a given firm. The firm experiences greater time series variance in employment in the first state, and less in the second state. The thought experiment of interest here is whether, *ceteris paribus*, the firm's workers will experience less stable earnings in the first state of the world than in the second. This line of thinking suggests including a firm fixed effect in Eq. 1, allowing us to estimate  $\varphi$  using within-firm variation. Call this Eq. 2:

$$instability(y_{ift}) = \alpha + \varphi instability(e_{ft}) + X_{ift}\delta + \theta_f + \varepsilon_{ift}, \quad (2)$$

where everything is as in Eq. 1 except  $\theta_f$ , a firm effect. This firm effect controls for persistent, time-invariant features of firms, including compensation practices, other HR practices, preferences over worker characteristics, occupational composition, and other factors which may be of importance to both earnings and employment instability.

Columns 9 and 10 of Table 2 report estimates of Eq. 2. The coefficient retains its statistical significance and positive sign in both regressions. The five-year regression sees the coefficient's magnitude nearly cut in half, suggesting that the estimates of Eq. 1 were driven in part by between-firm comovements in

earnings and employment instability. The coefficient on the nine-year coefficient is reduced in magnitude, but not nearly as much as the five-year coefficient.

A potential concern with the interpretation that firms are passing instability onto workers earnings is reverse causality. As Comin *et al.* (2009) argue, reverse causality — that unstable earnings of workers are causing their employer to experience unstable employment — is unlikely here. Earnings are determined by the supply of and demand for labor. Changes in labor supply are usually gradual, driven by population growth and other factors. At the frequencies studied in this paper, it is unlikely that unstable labor supply causes unstable earnings, which in turn cause unstable employment levels of employing firms. Volatile labor demand may influence earnings volatility, but labor demand is not determined by earnings — rather, the opposite is true. (I attempt to control for these aggregate factors by including year effects and industry effects in the regressions.) Finally, it is unlikely that the worker's *personal* demand for the products of the firm influences the size of the firm, so earnings instability almost surely does not induce employment instability along this margin.

The weight of the evidence presented in Table 2 suggests that firms are passing instability in the scope of undertaken economic activity onto their workers in the form of less stable earnings. While I want to stress that these findings do not rise to the level of causal, it is the case that the finding is robust to a host of control variables, including demographic controls of workers, industry effects which control for aggregate, industry-level conditions, year effects, and firm size. In addition, the effect exists when estimated using within-firm variation, providing strong support for the hypothesis that what is being estimated is a feature of the way workers are paid by their employers.

## VI. Results By Earnings Quintile

Workers of different type experience the labor market very differently. It is of interest to see if the effect of firm employment instability on earnings instability is different for workers of different skill. To this end, I group each worker-year into an earnings quintile and estimate Eq. 2 separately on each quintile.

Table 3 reports the results. Each regression in the table is an estimate of Eq. 2 — the model with full worker and firm controls, and firm effects. The odd-numbered columns estimate firm and earnings instability using the five-year measure, and the even-numbered columns use the nine-year measure. Columns 1 and 2 report results estimated on the first earnings quintile, Columns 3 and 4 on the second earnings quintile, and so on.

The results are interesting. In each regression, the coefficient on firm employment instability is positive and statistically significant. The coefficient magnitude is considerably larger for the lowest earnings workers than for the highest. For the nine-year measure, the coefficient  $\varphi$  strictly decreases over earnings quintile. The magnitude of the coefficient estimated on the lowest quintile of earnings (0.230) is over double the magnitude of  $\varphi$  estimated for the highest earnings quintile. For the five-year measure, except for a slight increase between the second and third quintile, the coefficient magnitude decreases over earnings quintile as well. The magnitude of the first earnings quintile's coefficient is over 3.5 times as large as the magnitude of the highest earnings quintile.

These results strongly suggest that low-earnings workers have more instability passed to them from their employers than do high-earnings workers.

## **NLSY Investigation**

If low-skill workers are being passed relatively more volatility by their employing firms, then survey data should show that low-skill workers have less stable earnings than workers of other skill group. To investigate this, I turn to the National Longitudinal Survey of Youth 1979 (NLSY79). The NLSY79 contains person-level data on earnings and a plausibly exogenous measure of skill, which I will now discuss.

The NLSY79 follows a cohort of American youths aged fourteen to twenty-one at the time of first interview in 1979 and records detailed information about their labor market outcomes. The cohort is interviewed every year from 1979 through 1994, and every other year thereafter. The NLSY79 oversampled Hispanic, black, and economically-disadvantaged whites, so sample weights are used in this analysis

The annual earnings variable used is the log of total income from wages and salaries. The respondent is asked to recall his total earnings for the previous year from working, which includes wages, salaries, commissions, and tips from all jobs, before taxes or other deductions.

The “skill” variable in the NLSY79 used in this paper is a worker’s AFQT score. In the summer and fall of 1980, the Armed Services Vocational Aptitude Battery — the standardized aptitude test used by the military to assist in assigning service members to jobs — was administered to the NLSY79 cohort, and was completed by approximately ninety-four percent of the sample. The AFQT score is calculated using the arithmetic reasoning, word knowledge, paragraph comprehension, and numerical operations components of the ASVAB, and is frequently used in labor economics to proxy for unobserved ability or skill (see, for example, Heckman and LaFontaine, 2006). A benefit of using this particular measure of unobserved skill is that it is plausibly exogenous to future labor market experiences — i.e., workers are not choosing their AFQT score in order to



affect their earnings and earnings dynamics. In addition, there is no reason to be concerned that a worker's earnings are causing the worker's AFQT score.

A unit of observation is a worker-year, and the analysis sample consists of males older than twenty-five years of age who are not enrolled in school and who have positive earnings for the year, and runs from 1979 through 2008. The data are annual, and males are studied to avoid confounding labor supply issues. Workers older than twenty-five are studied to avoid the confounding volatility which may be associated with beginning a career. Students are excluded because their labor supply patterns are likely quite different than non-students. Workers with positive earnings are studied because they are the observations in the sample which are being paid by a firm, and the primary purpose of this paper is to study the instability of labor income — to see if the instability of earnings paid to workers by firms is related to the skill level of workers.

Earnings are deflated using the CPI-U. Following the literature, I delete worker-years in the bottom one percent and the top one percent of the log earnings distribution. This is done to eliminate reporting errors, to deal with the problem of top-coding, and to ensure that outliers are not driving the regression results. When interpreting the results, note that they only apply to the middle ninety-eight percent of the log earnings distribution.

Earnings instability is computed in the same way as in using the LEHD data, with one difference. An issue with using the NLSY79 is that after 1994 the respondents cease being surveyed annually and are instead surveyed every other year. For odd-numbered years following 1994 there are no data on earnings. Following Comin *et al.* (2009), I deal with this issue by modifying the earnings instability measure by calculating it only on every other year of data. (Comin *et al.* refer to this as a “skipping years” methodology.) To ensure consistency, I use the skipping years methodology on the entire sample. All results use this methodology. Summary statistics are presented in Panel A of Table 4.

To gain an understanding of the shape of the relationship between earnings instability and workers skill in the NLSY79, I create AFQT quintile indicator variables. AFQT20 equals 1 if the worker has an AFQT percentile score less than or equal to twenty, and 0 otherwise. AFQT40 equals 1 if the worker’s score is both greater than twenty and less than or equal to forty, and 0 otherwise. AFQT60, AFQT80, and AFQT100 are analogously defined. The empirical specification is presented below as Eq. 3:

$$\begin{aligned}
 \text{instability}(y_{it}) &= \alpha + \sum_{k \in \psi} \beta_k \text{AFQT}_k + X_{it} \delta + \varepsilon_{it}, \\
 \psi &\stackrel{\text{def}}{=} \{20, 40, 80, 100\},
 \end{aligned}
 \tag{3}$$

where the dependent variable is the instability of the log of total labor earnings for worker  $i$  in the window centered on year  $t$ ,  $\alpha$  is a constant,  $\varepsilon_{it}$  is the residual,  $\delta$  is a parameter vector, and  $X_{it}$  is a matrix of control variables. The symbol  $\psi$  signifies the four-element set  $\{20, 40, 80, 100\}$ , so  $\beta_k$  is the coefficient on each of the four AFQT categorical variables. Standard errors are robust, and the regressions are weighted. AFQT60 is omitted and used as the comparison group.

Before turning to the regression results, it is helpful to examine the average level of earnings instability for each AFQT group. Panel B of Table 4 reports the means by AFQT quintile for total labor earnings. The quintile with the least stable earnings is the lowest quintile. Interestingly, the quintile with the *most* stable earnings is the middle quintile, AFQT60.

These quintile-specific means imply that the lowest-skill workers have the least stable earnings — for the five-year subsample, for example, the average earnings instability for AFQT20 is approximately 57 percent larger than the

average earnings instability for AFQT60.<sup>9</sup> This is what we would expect based on the LEHD worker-firm regressions — if low-skill workers are being passed more volatility from their employing firms, then their earnings in the survey data should be more volatile than workers in other skill groups.

To control for other economic and demographic factors, I now turn to regression estimates of this relationship. Table 5 reports the results from these regressions. The first five columns of the table report results using the five-year window, and the last five columns report results using the nine-year window. For each subsample, the first regression is uncontrolled. The second regression includes a control for the log of hours worked. Earnings instability could be driven by hours variation, so this is an important control to consider. The third regression removes the hours control, and adds controls for years of schooling, experience and its square, and indicator variables for race, region of residence, marital status, urban residence, and year. The fourth regression returns the hours control to the estimating equation. And the fifth regression adds controls for industry and occupation.

The excluded AFQT category in the regressions is AFQT60 — AFQT scores between 40 and 60. The coefficients on AFQT20 are statistically significant and positive in all five regressions, and the coefficients on AFQT40 are statistically significant and positive in all but one, implying that low-skill workers experience greater earnings instability than middle-skill workers.

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<sup>9</sup> The magnitude of the difference is economically significant. Consider two workers, each of whom earns 22,000 dollars in year  $t$ , which is approximately the mean inflation-adjusted value of earnings in the regression samples. Between years  $t - 2$  and  $t + 2$ , the first worker starts at 26,000 dollars, suffers a 2,000 dollar pay cut each year, and so is earning 18,000 dollars in the last year of the five-year window. The second worker receives a pay cut of 4,000 dollars per year, starts at 30,000 dollars in year  $t - 2$ , and finishes at 14,000 dollars in year  $t + 2$ . The earnings instability measure for the second worker is larger than the earnings instability measure for the first worker by a magnitude of 0.07. This difference of 0.07 is the same as the difference for the five-year subsample between the middle AFQT quintile and the lowest AFQT quintile.

The results from the analysis of worker-firm data suggest that relatively volatile firms pay more volatile earnings, and that, within firm, lower-skill workers are paid more volatile earnings than workers of other skill level. This result seems to be confirmed using NLSY79 survey data, which shows that lower skill workers may have less stable earnings than workers of higher skill level.

## VII. Results By Industry

We now return to the analysis of the relationship between firm volatility and worker volatility using linked worker-firm LEHD data. Due to across-industry variation in competition, monitoring technology, and a host of factors, we may expect that the magnitude of  $\varphi$  — the amount of firm employment instability passed to employees in the form of earnings instability — may vary across industries. I compute estimates of Eq. 2 — the fully controlled model with firm effects — for each North American Industry Classification System (NAICS) sector using both the five- and nine-year measures and report the estimates of  $\varphi$  in Table 6.

There is significant heterogeneity in the statistical significance and magnitude of the coefficient  $\varphi$ .<sup>10</sup> Using the five-year measure, the construction industry has the largest coefficient, equal to 0.187, while transportation and warehousing has the smallest (precisely estimated) coefficient, which is less than one-third the magnitude of construction. Utilities, manufacturing, administrative, and construction have large estimates of  $\varphi$ , while mining, management, accommodation and food service, and education have small or imprecise estimates of  $\varphi$ .

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<sup>10</sup> There is also significant heterogeneity in the number of observations in each sector-specific regression. The sector with the largest number of observations is the manufacturing sector, with approximately 1.3 million records. The smallest sector is mining, with approximately 27,000 records. For the number of records in a regression, refer to Table 8b for the distribution over industries.

As discussed previously, Bertrand (2004) finds that firms which experience greater import competition employ workers whose wages are more sensitive to current labor market conditions. She interprets this as evidence that firms in increasingly competitive markets are providing less shielding to workers' earnings from external conditions. If so, then we may expect that the size of the coefficient  $\varphi$  would be positively correlated with the amount of competition in an industry — greater competition leads to less shielding, which leads to a stronger relationship between firm and earnings instability. On the other hand, classes of models which assume that firms have market power allow for firms to control the earnings of their workers. Under this framework, we may expect that the coefficient  $\varphi$  is negatively correlated with competition — less competitive industries may have larger values of  $\varphi$ .

To conclude the investigation of the effect of firm employment instability on the instability of worker earnings, I offer a preliminary test of the relationship between the magnitude of the *subsector-specific* pass-through coefficient  $\varphi$  and the competitiveness of the industry. I estimate Eq. 2 for each NAICS subsector (often referred to as three-digit NAICS) and collect the subsector-specific estimates of the  $\varphi$  coefficients. I measure subsector competitiveness as the ratio of receipts, revenue, sales, or value added of the top N firms in a subsector to the total receipts, revenue, sales, or value added of that subsector. N equals four, eight, twenty, or fifty. The concentration ratio data come from the 2002 Economic Census. *Sector-level* concentration ratios are reported in Table 7; *subsector-level* concentration ratios are used in the analysis.

A major caveat is in order. First, there is no concentration ratio data available for the following five sectors: management, mining, public administration, agriculture, and construction. In addition, there are a small number of other NAICS subsectors for which there are no data. This leaves data on concentration ratios available for 77 of the 100 NAICS subsectors. The

concentration ratios for these 77 subsectors were matched to their respective subsector-specific  $\varphi$  coefficient. Two of the 77  $\varphi$  coefficients could not be used in the analysis due to Census Bureau disclosure avoidance rules — the two subsectors were too small, and so statistical output relating to those subsectors could not be released. These leaves 75  $\varphi$ -concentration ratio matches.

Using the five-year measure, 32 of the 75 estimates of  $\varphi$  are statistically significant, demonstrating that the sector-level heterogeneity reported in Table 6 is also present at the subsector level. Fifty-three of the 75 estimates of  $\varphi$  are statistically significant using the nine-year measure.

The question at hand is whether the level of competition in a subsector, as measured by the concentration ratio, is predictive of the size of the coefficient  $\varphi$  for that subsector. To that end, I plot  $\varphi$  against the four concentration ratios. I only use those coefficients with associated  $t$ -statistics greater than two, as those are the coefficients estimated with precision, so the five-year plots have 32 observations, and the nine-year plots have 53.

Figures 1 and 2 present the scatter plots of the subsector-specific estimate of  $\varphi$  against the corresponding subsector's concentration ratio. Figure 1 plots the coefficients estimated using the five-year measure. The line of best fit is upward sloping, suggesting that the amount of firm employment instability passed to employees in the form of earnings instability is increasing in the share of the market accounted for by the top firms. I regress  $\varphi$  against the concentration ratio to learn more about the relationship. The coefficient on the concentration ratio is statistically significant when the concentration ratio is measured using  $N = 8$  and  $N = 20$ . Figure 2 plots the coefficients estimated using the nine-year measure against the concentration ratios. Unlike the plots with the five-year measures, the line of best fit here is negative, not positive. However, in a regression of  $\varphi$  using

the nine-year measure against the concentration ratios, the coefficient on the concentration ratio is statistically insignificant in all four regressions.

To conclude, there is significant heterogeneity in the size and significance of  $\varphi$  across both NAICS subsectors and NAICS sectors. I present preliminary evidence that the level of competition in an industry as measured by concentration ratios is predictive of the size of  $\varphi$ . In ongoing research I am attempting to come to a better understanding of the size of  $\varphi$  — of the amount of firm employment instability passed to employees in the form of earnings instability.

## **VIII. Conclusion**

Earnings instability affects earnings inequality, may lower household welfare, and impacts other important economic phenomena, yet little evidence has been documented on its causes and correlates. This paper adds to our understanding of earnings instability by studying whether volatile firms pay volatile earnings, and, if so, whether the effect differs across worker type and industry of employment.

Models of the labor market offer different predictions as to whether firms can affect the volatility of their workers' earnings. This paper is the first to directly test the relationship between firm employment instability and earnings instability using linked worker-firm data. The data are created by the Longitudinal Employer-Household Dynamics (LEHD) program of the U.S. Census Bureau. LEHD earnings data come from unemployment insurance earnings records, and firm data come from ES-202 reports. Firm employment instability is defined as the instability of employment, as employment is a natural measure of the scope of economic activity undertaken by the firm.

Three main findings are presented in this paper. First, the effect of firm employment instability on the instability of its workers' earnings is positive,

statistically significant, robust to a number of firm and worker controls, and remains when estimated using within-firm variation. This suggests that the effect is a feature of the way workers are being paid by firms. Second, the effect is much stronger for low-earning workers than it is for high-earning workers — lower-skill workers are being passed significantly more volatility from their employing firms than are workers of other skill levels. Survey data from the NLSY79 are used to validate the finding that lower-skill workers have less stable earnings. Finally, I find significant heterogeneity in the magnitude and statistical significance of the effect across NAICS sectors. I present preliminary evidence of the relationship between the competitiveness of the industry and the size of the effect, which suggests that the presence of large firms in an industry is positively associated with the amount of firm employment instability passed to employees in the form of earnings instability.



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**Table 1: LEHD sample summary statistics**

<u>Distribution over NAICS sector</u>		<u>Variable</u>	<u>Mean</u>	<u>Std. Dev.</u>
	Percent			
Agriculture (11)	1.85	Log annual earnings	10.132	0.601
Mining (21)	0.54	Firm size	4540.987	12561.390
Utilities (22)	2.41			
Construction (23)	7.14	<u>Earnings instability</u>		
Manufacturing (31-33)	26.03	Nine-year	0.100	0.275
Wholesale Trade (42)	6.27	Five-year	0.042	0.192
Retail Trade (44-45)	7.84			
Transportation and Warehousing (48-49)	5.13	<u>Firm instability</u>		
Information (51)	2.42	Nine-year	0.044	0.134
Finance and Insurance (52)	2.26	Five-year	0.023	0.092
Real Estate (53)	0.94			
Professional Services (54)	3.7			
Management (55)	1.04			
Administrative (56)	1.84			
Educational Services (61)	10.3	<u>Distribution over race</u>		
Health Care and Social Assistance (62)	3.99	Percent		
Arts, Entertainment, and Recreation (71)	1.03	White	83.3	
Accommodation and Food Services (72)	1.8	Black	4.47	
Other Services (81)	2.24	U.S. Indian or Alaskan Native	0.91	
Public Administration (92)	11.23	Asian	4.55	
		Pacific Islander	0.18	
		Two or more	6.6	
<u>Distribution over education categories</u>		<u>Distribution over state</u>		
	Percent	Percent		
No school	1.02	California	31.6	
Nursery to 4th grade	0.57	Colorado	4.7	
5th or 6th grade	1.64	Idaho	1.83	
7th or 8th grade	1.17	Illinois	19.02	
9th grade	1.18	Indiana	3.65	
10th grade	1.41	Kansas	4.78	
11th grade	1.56	North Carolina	7.73	
12th grade, no diploma	2.72	Oregon	4.61	
High school graduate	26.22	Washington	7.28	
< 1 year of college	7.77	Wisconsin	14.81	
1+ years of college	16.55			
Associate degree	8.61			
Bachelor's degree	18.64			
Master's degree	7.27			
Professional degree	1.89			
Doctorate degree	1.79			

**Table 2: Earnings instability and firm instability**

The table reports estimates of Eq. 1 and Eq. 2. The dependent variable for each regression is the earnings instability measure using either a nine-year or five-year rolling window. The odd-numbered columns use the five-year window, and the even use the nine-year window. (See text for details.) Firm and worker controls include race, education category, industry, year, and state dummies, and age and age squared. Standard errors are clustered on firm.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Firm instability (Five-year)	0.152*** [0.007]		0.143*** [0.008]		0.142*** [0.007]		0.138*** [0.007]		0.074*** [0.008]	
Firm instability (Nine-year)		0.189*** [0.007]		0.183*** [0.007]		0.180*** [0.007]		0.178*** [0.007]		0.148*** [0.010]
Log number of employees			-0.003*** [0.001]	-0.002*** [0.001]			-0.002*** [0.001]	-0.001 [0.001]	-0.008*** [0.004]	0.005 [0.004]
Constant	0.038*** [0.001]	0.092*** [0.001]	0.053*** [0.003]	0.106*** [0.004]	0.259*** [0.013]	0.740*** [0.016]	0.264*** [0.015]	0.744*** [0.018]	0.303*** [0.034]	0.765*** [0.034]
Firm fixed effects	No	No	No	No	No	No	No	No	Yes	Yes
Firm and worker controls	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Observations	~5000000	~5000000	~5000000	~5000000	~5000000	~5000000	~5000000	~5000000	~5000000	~5000000
R-squared	0.005	0.009	0.006	0.009	0.012	0.029	0.012	0.03	0.222	0.197

Standard errors in brackets. \*\*\* signifies statistical significance at the one-percent level, \*\* signifies the five-percent level, and \* the one-percent level.

**Table 3: Earnings instability and firm instability by earnings quintile**

The table reports estimates of Eq. 2. The dependent variable for each regression is the earnings instability measure using either a nine-year or five-year rolling window. The odd-numbered columns use the five-year window, and the even use the nine-year window. (See text for details.) Firm and worker controls include race, education category, industry, year, and state dummies, and age and age squared. Standard errors are clustered on firm. Regressions estimated separately by earnings quintile.

	Quintile 1		Quintile 2		Quintile 3		Quintile 4		Quintile 5	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Firm instability (Five-year)	0.157*** [0.016]		0.057*** [0.008]		0.059*** [0.015]		0.050*** [0.018]		0.044*** [0.008]	
Firm instability (Nine-year)		0.230*** [0.018]		0.169*** [0.018]		0.159*** [0.018]		0.134*** [0.022]		0.114*** [0.012]
Log number of employees	-0.007** [0.003]	0.001 [0.003]	0 [0.003]	0.008*** [0.003]	0.007 [0.009]	0.020** [0.008]	0.006 [0.011]	0.020* [0.012]	-0.004 [0.003]	0.011*** [0.004]
Constant	0.306*** [0.029]	0.651*** [0.030]	0.161*** [0.023]	0.532*** [0.025]	0.141** [0.067]	0.601*** [0.063]	0.135 [0.087]	0.699*** [0.100]	0.280*** [0.026]	0.908*** [0.046]
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm and worker controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	~1000000	~1000000	~1000000	~1000000	~1000000	~1000000	~1000000	~1000000	~1000000	~1000000
R-squared	0.426	0.417	0.292	0.279	0.238	0.231	0.184	0.191	0.252	0.203

Standard errors in brackets. \*\*\* signifies statistical significance at the one-percent level, \*\* signifies the five-percent level, and \* the one-percent level.

**Table 4: NLSY79 summary statistics**

## Panel A: Summary statistics, overall

	Five-year window		Nine-year window	
	Mean	Std. Dev.	Mean	Std. Dev.
Earnings instability	0.146	0.390	0.136	0.287
Labor earnings	21674.84	13221.70	22556.19	12822.70
Total income	34605.28	52108.02	35327.36	49085.83
AFQT	0.433	0.295	0.443	0.291
Years of school	13.047	2.383	13.086	2.308
Percent Hispanic	17.930		17.670	
Percent black	25.690		24.550	
Observations	25287		13515	

## Panel B: Average instability by skill level

	Five-year window		Nine-year window	
	Mean	Std. Dev.	Mean	Std. Dev.
$0 < \text{AFQT} \leq 20$	0.186		0.161	
$20 < \text{AFQT} \leq 40$	0.150		0.138	
$40 < \text{AFQT} \leq 60$	0.118		0.118	
$60 < \text{AFQT} \leq 80$	0.118		0.121	
$80 < \text{AFQT} \leq 100$	0.126		0.124	

**Table 5: Earnings instability on AFQT indicator variables, using the NLSY79**

The table reports estimates of Eq. 3. The dependent variable for each regression is the earnings instability measure using either a nine-year or five-year rolling window. (See text for details.) In addition to the control variables shown in the table, regressions which are labeled as including demographic controls include dummies for year, race, region of residence, marital status, and urban residence. Regressions are weighted. Standard errors are robust. The AFQT indicators equal 1 if the worker's AFQT score falls within the specified interval, otherwise 0.

	Five-year window measure/subsample					Nine-year window measure/subsample				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
0 < AFQT ≤ 20 Indicator	0.051*** [0.008]	0.040*** [0.008]	0.029*** [0.009]	0.024*** [0.008]	0.020** [0.009]	0.030*** [0.008]	0.027*** [0.008]	0.012 [0.009]	0.014 [0.008]	0.009 [0.009]
20 < AFQT ≤ 40 Indicator	0.033*** [0.009]	0.027*** [0.009]	0.021** [0.009]	0.018** [0.009]	0.013 [0.010]	0.026*** [0.009]	0.023** [0.009]	0.016* [0.009]	0.016* [0.009]	0.013 [0.010]
60 < AFQT ≤ 80 Indicator	0.002 [0.008]	0.005 [0.008]	0.009 [0.008]	0.009 [0.008]	0.013 [0.008]	0.003 [0.008]	0.006 [0.008]	0.01 [0.008]	0.011 [0.008]	0.015 [0.009]
80 < AFQT ≤ 100 Indicator	0.007 [0.009]	0.007 [0.008]	0.022** [0.009]	0.018** [0.009]	0.021** [0.009]	0.001 [0.009]	0.003 [0.008]	0.013 [0.009]	0.012 [0.009]	0.018* [0.010]
Log hours worked		-0.140*** [0.014]		-0.123*** [0.014]	-0.114*** [0.013]		-0.088*** [0.011]		-0.077*** [0.011]	-0.074*** [0.012]
Years of school			-0.007*** [0.002]	-0.005** [0.002]	-0.005* [0.002]			-0.009*** [0.002]	-0.008*** [0.002]	-0.007** [0.003]
Experience			-0.004 [0.003]	-0.005 [0.003]	-0.008** [0.004]			-0.016*** [0.004]	-0.017*** [0.004]	-0.019*** [0.005]
Experience squared			0.000 [0.000]	0.000 [0.000]	0.000* [0.000]			0.000** [0.000]	0.000*** [0.000]	0.000*** [0.000]
Constant	0.113*** [0.005]	1.192*** [0.106]	0.298*** [0.065]	1.222*** [0.127]	1.125*** [0.138]	0.115*** [0.006]	0.793*** [0.089]	0.486*** [0.060]	1.056*** [0.109]	0.926*** [0.140]
Demographic controls	No	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Occ and industry controls	No	No	No	No	Yes	No	No	No	No	Yes
Adjusted R-squared	0.003	0.021	0.02	0.033	0.125	0.002	0.016	0.024	0.034	0.175
Number of observations	25287	24850	25029	24599	24446	13515	13292	13432	13210	13122

Standard errors in brackets. \*\*\* signifies statistical significance at the one-percent level, \*\* signifies the five-percent level, and \* the one-percent level.

**Table 6: Earnings instability and firm instability by industry**

This table reports the coefficient on firm instability estimated from Eq. 2, by industry. The dependent variable in each regression is the earnings instability measure using either a nine-year or five-year rolling window. (See text for details.) Each regression controls for race, education category, industry, year, age and age squared, and includes a firm fixed effect. Standard errors are clustered on firm. Regressions estimated separately by industry.

<u>NAICS sector</u>	<u>Firm instability</u>	
	<u>Five-year</u>	<u>Nine-year</u>
Agriculture (11)	0.059***	0.111***
Mining (21)	0.021	0.050
Utilities (22)	0.152**	0.158
Construction (23)	0.187***	0.326***
Manufacturing (31-33)	0.059***	0.167***
Wholesale Trade (42)	0.075***	0.154***
Retail Trade (44-45)	0.074***	0.103***
Transportation and Warehousing (48-49)	0.056***	0.131***
Information (51)	0.085*	0.097***
Finance and Insurance (52)	0.061**	0.146***
Real Estate (53)	0.080**	0.130***
Professional Services (54)	0.138***	0.185***
Management (55)	0.015	0.041***
Administrative (56)	0.092***	0.225***
Educational Services (61)	0.025	0.043
Health Care and Social Assistance (62)	0.071***	0.133***
Arts, Entertainment, and Recreation (71)	0.104	0.132***
Accommodation and Food Services (72)	0.057***	0.096***
Other Services (81)	0.082**	0.181***
Public Administration (92)	0.03	0.054*

\*\*\* signifies statistical significance at the one-percent level, \*\* signifies the five-percent level, and \* the one-percent level.



**Table 7: Concentration ratios by NAICS sector, 2002 Economic Census**

This table contains concentration ratios for each NAICS sector from the 2002 Economic Census. There are four concentration ratios for each industry. Each represents the percent of sector-level revenue, sales, or receipts accounted for by the N largest firms, where N = 4, 8, 20, or 50.

NAICS sector	Percent of total industry receipts accounted for by N largest firms, where N = ...			
	<u>Four</u>	<u>Eight</u>	<u>Twenty</u>	<u>Fifty</u>
Management (55)	N/A	N/A	N/A	N/A
Mining (21)	N/A	N/A	N/A	N/A
Educational Services (61)	6.5	10.6	15.6	21.4
Public Administration (92)	N/A	N/A	N/A	N/A
Transportation and Warehousing (48-49)	14.8	18.3	25.2	33
Accommodation and Food Services (72)	5.1	8.9	16.5	23.1
Agriculture (11)	N/A	N/A	N/A	N/A
Manufacturing (31-33)	N/A	N/A	N/A	N/A
Finance and Insurance (52)	9.9	16.1	28.2	44.9
Health Care and Social Assistance (62)	3.9	5.4	9	14.7
Retail Trade (44-45)	11	15.3	23.9	31.7
Wholesale Trade (42)	7.5	11.6	18.7	27.2
Real Estate (53)	6.5	10.4	17.1	24.4
Other Services (81)	N/A	N/A	7.1	11.2
Information (51)	23.2	34.4	48.5	62
Administrative (56)	6	9	14.9	21.9
Arts, Entertainment, and Recreation (71)	5.4	7.7	12.4	19.6
Professional Services (54)	3.9	6.4	11.1	16.2
Utilities (22)	13.4	24.6	44.9	69
Construction (23)	N/A	N/A	N/A	N/A

These data can be found at <http://www.census.gov/econ/concentration.html>

Figure 1: Estimated phi against subsector concentration ratio

Five-year measure

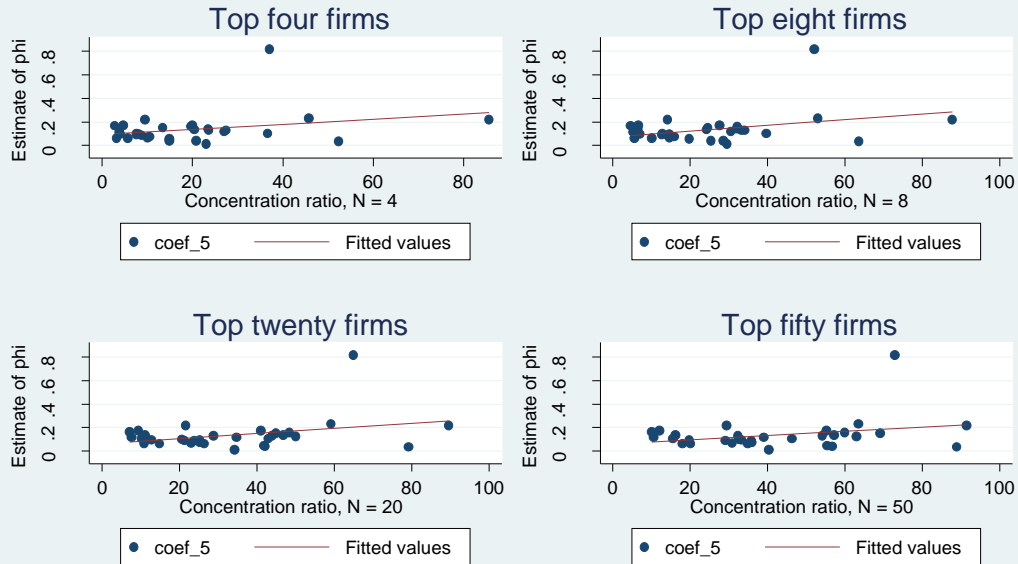


Figure 2: Estimated phi against subsector concentration ratio

Nine-year measure

