The link between human capital, mass layoffs, and firm deaths
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1 Introduction

The fairly sizable economics literature on displaced workers has typically concentrated on the effects of displacement on worker outcomes (Anderson and Meyer, 1994; Bowlus and Vilhuber, 2002; Fallick, 1996; Jacobson et al., 1993; Kletzer, 1998; Kuhn and Sweetman, 1998; Ruhm, 1994; Schoeni and Dardia, 1996; Stephens Jr., 2002), which is also an important subject in the field of Human Resource Management (Davis et al., 2003; Grossman, 2002). The analysis typically occurs at the level of a single plant or a sample of workers, for whom the displacement event itself is a given. A mostly separate and distinct literature considers the causes of firm or plant exit (death), and reductions in employment levels (downsizing) (Audretsch, 1994; Bernard and Jensen, 2002; Davis et al., 1996; Dunne and Roberts, 1990; Dunne et al., 1988; Haltiwanger et al., 2000; McGuckin and

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Nguyen, 1995, 2001). The usual culprits for firm exits are size, age, innovations (Audretsch, 1994; Dunne et al., 1988), market structure and efficiency (Foster et al., 1998, 2002; Kletzer, 1998). Few authors explicitly link the micro-level movement of workers with death and downsizing at either the plant or firm level. Notable exceptions are Abowd et al. (1999a), Lengermann and Vilhuber (2002), and (Carneiro and Portugal, 2003), which we will describe shortly.

Mass layoffs are not only the result of firm or plant closures: in our dataset, 55 percent of firms that have one displacement event between 1993 and 1996 are still alive in 1997. Conversely, if the decline in size is gradual, a firm death may not result in a displacement event.

Abowd et al. (1999a) have previously investigated worker and job flows for establishments with declining employment, and Lengermann and Vilhuber (2002) considered the distribution of worker skill levels in flows out of firms prior to displacement events. Both find that there are changes in such flows relative to alternate establishments (establishments with stable or increasing employment, or the same establishments in prior periods), but neither address the point specifically as a potential latent cause of displacement.

In the absence of a direct measure of worker skills, the literature has used wages as both a proxy for skills and as a cost component. Dunne and Roberts (1990), Bernard and Jensen (2002), and Carneiro and Portugal (2003) consider the determination of wages and the effect on plant closures (Bernard and Jensen, 2002; Dunne and Roberts, 1990) or displacement events (Carneiro and Portugal, 2003). Dunne and Roberts (1990) find that higher-paying firms have a significant, but economically small increase in the likelihood of plant failure. One postulated explanation for this small effect is that plants with higher wages also have a more productive workforce. In contrast to Dunne and Roberts (1990), Bernard and Jensen (2002) found that plants paying above-average wages have a lower likelihood of exiting. Possibly, thus, above-average human capital is used by these firms. Our analysis directly addresses this issue, by deriving a measure of general (non-firm-specific) human capital, and using it instead of or in addition to wages.

Closest in spirit to our analyis is Carneiro and Portugal (2003), who estimate simultaneous plant failure and wage determination equations for Portugal. Their measures of human capital are the usual right-hand side variables to a Mincerian wage equation (education, age, tenure), but they do not include a measure of the physical capital of the firm. Furthermore, plant layoff is estimated as an event at the individual level. The distribution of human capital within the firm is not taken into account.

In this paper, we correlate firm-level measures of human and physical capital (capital intensity), as well as measures of efficiency (sales per worker) with displacement events. We differ from the literature in our use of a measure of human capital, rather than a direct measure of wages, and we consider the effect of the distribution of human capital within a firm on both displacement and firm-death outcomes.

Based on methods first developed in Abowd et al. (2002b), we estimate a measure of human capital, based on observed and unobserved worker ability. Firm-specific distributions are esti-

mated, which allows us to consider the impact of differences in the use of human capital across firms on outcome variables. We identify displacements from quarterly worker flows, and merge data on firm performance and capital from Ecomomic Censuses. Firms active in our data in 1992 are classified as survivors or exiters, depending on their activity in 1997. This set of companies is then cross-classified by whether or not they have experienced a single mass layoff, or multiple displacement events.

The paper is organized as follows. Section 2 lays out the basic definitions of human capital and displacement as used in our paper. Section 3 describes the data used, and Section 4 provides results. Section 5 concludes.

2 Definitions

The definitions of “human capital”, “economic activity,” and “mass layoff” are obviously crucial for our analysis. We will define these in turn.

Defining human capital

We provide a brief overview of our approach in this section, with a more complete definition of the within-firm human capital distribution, and of human capital itself available in Abowd et al. (2002b). Assume human capital H_{it} has a market-return (rental rate) r_t that is a function of the wage, where i indexes persons and t indexes time; $w_{it} = r_t H_{it}$. Assume as well that a person specific component and a general experience component are important factors that determine the accumulation of human capital; $\ln H_{it} = \theta_i + X_{it}\beta$. Using these two equations, we have the following model of earnings

$$\ln w_{it} = \ln r_t + \theta_i + X_{it}\beta \tag{1}$$

Following Abowd et al. (1999b), but using the procedures described in Abowd et al. (2002a), observed wage rates are then estimated as

$$\ln w_{it} = \theta_i + \psi_j + X_{it}\beta + \epsilon_{ijt} \tag{2}$$

where θ_i is the person effect, ψ_j is the firm effect, and X_{it} are time-varying person characteristics, such as experience, and ϵ_{ijt} is the statistical residual.

To compute a measure of a person’s human capital, we combine the estimated person effect $\hat{\theta}_i$, the remunerated experience components of person characteristics $X_{it}\hat{\beta}$, and the reference constant δ to compute

$$\hat{h}_{it} = \hat{\theta}_i + X_{it}\hat{\beta} + \delta \tag{3}$$

Because the fixed person effect absorbs all the usual "culprits," such as sex, education, and age at first entry, but also all factors, such as innate ability unobserved by the econometrician, h_{it} corresponds to the concept of "general human capital."

Once $\hat{h}_{it}$ is computed, firm-level kernel density estimates are calculated, yielding a firm-specific distribution of human capital $g_{jt}(\hat{h}_t)$, and

$$G_{jt}(\hat{h}) = \int_{\underline{H}}^{\hat{h}} g_{jt}(x)dx \tag{4}$$

where $\underline{H}$ and $\overline{H}$ define the support of $\hat{h}$. To obtain discrete measures, we partition $[\underline{H}, \overline{H}]$ into 4 subsets, and calculate the population quartiles q_k^* implicitly defined by

$$G(q_k^*) = \int_{\underline{H}}^{q_k^*} g(x)dx = k \cdot 0.25 \tag{5}$$

for $k = 0, 1, 2, 3, 4$. For each firm, we then calculate the proportion of workers who have human capital within the ranges defined by the overall population quartile boundaries q_k^* for for $k = 1, 2, 3, 4$.

$$\Gamma_{jt}(k) = G_{jt}(q_k^*) - G_{jt}(q_{k-1}^*) \tag{6}$$

These employer-level measures summarize the complete distribution of workers' human capital at the establishment. Similar measures $\Gamma(k)$ are computed for the experience ($X_{it}\hat{\beta}$) and person fixed effect (θ) distributions within the firm.

Defining mass layoffs

In keeping with the previous literature on the impact on workers of mass layoffs (Bowlus and Vilhuber, 2002; Jacobson et al., 1993; Schoeni and Dardia, 1996), we define a mass layoff in period t as a 30% single-period drop in employment from firm j's maximum employment level over the observed time period:

$$D_{jt} = 1 \text{ if } \frac{S_{jt}}{B_{jt}^*} > 0.3 \tag{7}$$

where $B_{jt}^* = \max_t B_{jq}$ over the time period that firm j is in the sample with positive employment. B_{jt} is firm j's beginning-of-quarter employment, a point-in-time measure derived by summing over workers employed at the firm in both period $t-1$ and t. S_{jt} are worker separations from firm j, i.e., workers that worked for the firm in period t but are no longer observed on the payroll in period $t+1$. Note that in our analysis, all firm deaths are classified as displacements. However, they may not involve mass layoffs. On the other hand, among survivors, some firms experienced mass layoffs, and some did not.

Due to some quirks and weaknesses in the administrative data used for this paper, a naïve use of the mass layoff equation above will overstate mass layoffs by some margin.[1] In order to reduce the impact of ”spurious” events, we take particular care to exclude firms that either change identity or who continue to operate, yet fail to file a firm report.

The firm identifier underlying all of our analysis is a state-specific account number, whose primary purpose is to facilitate the collection of premiums for a state's unemployment insurance system. These account numbers can and do change for reasons such as a simple change in legal form or a merger. In our analysis, the separation of a worker from a firm is identified by a change in the firm identifier on that worker's wage records. If a firm changes account numbers, but makes no other changes, the worker would seem to have left the original firm, when in fact his employment status remains unchanged. Thus, a simple change in account numbers would lead to the observation of a mass layoff at the firm associated with the original account number.

To identify such events, we track large worker movements between firms. Benedetto et al. (2003) provide an early analysis for one particular state of such an exercise. For this paper, if we observe 80% of a firm (the predecessor) moving to a single successor, then we eliminate the displacement event. The assumption is that such a movement is associated not with a layoff, but a reorganization, a takeover, or some similar event. Similarily, if we observe that 80% of a successor's employment stems from the same predecessor, then a displacement event is also eliminated.

A second, not uncommon event observed in adminstrative data is the failure of a firm to file a timely report. In general, such an absence will trigger a follow-up by the state administration, since tax payments are linked to the report. However, for multiple reasons, the corrected or late filing by the firm may not get entered into the database transmitted to LEHD. The result is a “hole” in the firm's activity.

Holes, however, are precisely what would also be observed if a firm laid off its entire workforce for more than a quarter – a mass layoff – and hired them or other workers back later. The approach we have taken to distinguish data-related holes from true layoffs is the following. Consider the different employment path of an individual i at some firm j. Define time t to be the elapsed fraction of a quarter T, $t \in [0, 1]$. If the individual left the firm at some point $0 < t < 1$, then observed earnings E_{iT} will be $E_{iT} = e_{iT} \cdot t$, where e_{iT} is the quarterly wage rate for individual i. If the individual worked for the entire quarter, then observed earnings will be $E_{iT} = e_i$. We do not observe t, but assume that quarterly wage rate is constant ($e_{iT} = e_{i0}$), where 0 is some baseline period, typically a prior quarter within the same job history. Compute $\Delta E_i = E_{iT}/E_{i0}$. Then $\Delta E_i = 1$ implies $t = 1$. On the other hand, if $\Delta E_i < 1$, then the worker left at some time $t < 1$.

Now compute the average $\Delta E_{\cdot}$ for all workers within a firm j, i.e., $\Delta E^j_T = \sum_{i \in J(i)} \Delta E_{iT}$, where $J(i)$ is a function mapping individual i to firm j (Abowd et al., 1999b). Now consider if

[1] Vilhuber (2004) provides an overview over several approaches to correcting the weaknesses of administrative datasets. Abowd and Vilhuber (2005) discuss one particular weakness, a corrective measure, and the impact it has on aggregate statistics, including on measures similar to the mass layoffs of interest in our paper.

$\Delta E^j_T = 1$, i.e., the *average* ratio of earnings is equal to unity. It is unlikely that all workers leave the firm at the same time, except, of course, if a mass layoff occurs. It is, however, even more unlikely, though not impossible, that that mass layoff occurs on the last day of the quarter - which is what $\Delta E^j_T = 1$ implies. Now consider further that no employment is observed at firm j in period $T+1$, but positive and large employment is observed in period $T+2$, with $\Delta E^j_{T+2} = 1$ as well. This 'hole' is very unlikely to occur under normal circumstances - it implies that *all* workers left the firm at the end of quarter T, and *all* workers started working again on the first day of quarter $T+2$. It *is*, however, the data pattern that is to be expected when a firm neglects to file all worker records for quarter $T+1$. We consider mass layoff events that are synchronous with such 'holes' to be data artifacts, not true events, and filter them out.

3 Data

To estimate the impact of displacement, we use data from three states, California, Illinois, and Maryland, covering the time period 1990-2003. The data used to estimate the human capital model and to identify firm displacement events is derived from the LEHD Infrastructure Files. The LEHD Infrastructure Files provide a worker's quarterly earnings history, basic demographic information, and most importantly identify a person's employer. The fact that we know the history of the firm and the employees at that firm over time allows us to estimate displacement events as well as provide a richer characterization of the employees at the firm.

The human capital estimates (Equation 2) are calculated using data from the LEHD infrastructure files for the 22 states available as of November 30, 2004. Once the estimates have been produced, we select workers employed in California, Maryland, and Illinois during 1992 and/or 1997. In order to get a snapshot or point-in-time measure of the human capital at the firm, we further restrict our analysis to workers employed at the end of quarter 1 (a date that roughly coincides with the collection of Economic Census data). Finally, we only keep workers between the ages of 18 and 70, with earnings during the quarter of greater than $250.00.

Additional information, such as a firm's sales and capital stock is gathered from the 1992 and 1997 Economic Census'. At the time we were preparing this version, the 2002 Economic Census was not available, although we expect to use this data in a later revision. Because of our desire to incorporate information from the Economic Census', we will only directly analyze individuals and firms during the period, 1992-1997, even though the human capital estimates are calculated using data for the full time period.

Due to the dynamic nature of the U.S. economy it is difficult to differentiate "normal" flows of employment from displacements for smaller firms. For example, a firm with 10 employees that has 3 workers leave during the quarter would be classified as having a displacement under our standard definition, even though 3 workers leaving a firm in the same quarter is not a particularly unusual event. In order to focus our analysis on "large" displacement events, we limit our sample

to firms that average at least 50 workers across the entire time period.

The firm-level displacement database contains indicators for all displacement events that occur during three time periods: 1992, 1993-1996, and 1997. We select a sample of firms that were active during 1992. Firms still present in 1997 are "survivors", otherwise firms are referred to as "exiters". This sample differs from Abowd et al. (2002b), where firms entering the sample between 1992 and 1997 were also included. We do not impose any restrictions on the incidence of displacement events during either 1992 or 1997, although the effect of this decision is worthy of further exploration. Firms are classified as to whether they experienced zero, one, or multiple displacement events in the years 1993-1996. Cross-classifying this grouping with exit status yields the six different types of firms we focus on in this paper.

4 Analysis

As shown in Table 1, about 70 percent of the nearly 50 thousand firms in our sample never experience a displacement event between 1993 and 1996. On the other hand, 15 percent experience multiple displacement events over the same period, with the remaining firms experiencing a single event over the period. These groups turn out to be fairly distinct, and although for parts of our analysis, we will concentrate on the comparison between firms experiencing zero and one displacement events, multiple-displacement firms are a group that remains of interest to this research.

[Table 1 here]

About 18 percent of firms die between 1992 and 1997 and in line with our intuition, firms experiencing a single displacement are much more likely to die, as shown by row 2 of Table 2. In this respect, firms with multiple displacements are very similar to firms that experience no displacement at all, suggesting that most firms with multiple displacements structure the firm with the expectation that a sequence of large demand shocks will occur. In general, firms with no displacement are bigger both in terms of their workforce as well as in terms of total sales and sales per worker (when available). Capital stock per worker is also the largest, but this variable is reported for a much smaller fraction of in-sample firms with multiple displacements (4.6%) than for single-displacements (14%) and firms with no displacement (20%). This may in part be due to the very different industry distribution of such firms.

Turning to the distribution of human capital, firms with displacement events have an above-average fraction of their workforce in the lower skill (θ) and human capital (h) distribution $\Gamma(1)$, at the expense of the upper tail of the distribution $\Gamma(4)$. This remains generally true at the lower tail for experience as well. At the upper tail, firms with a single displacement are much more similar to firms with no displacement.

[Table 2]

While firms with multiple displacements differ in their observable characteristics from firms in other categories, they do not seem to die as often as firms with singe displacements. In other words, they seem to be stable firms with highly volatile, possibly seasonal workforce fluctuations. Although it is worthwhile to further disentagle the correlates of the the highly volatile employment patterns, in the remainder of this paper, we will concentrate on firms with no or one displacement.

Table 3 contains descriptive statistics on the workers that worked for firms active in 1992, again separately by whether firms had no, one, or multiple displacements. This table gives a slightly different perspective, by focusing on the characteristics of the average worker rather than the average firm, thus giving greater weight to relatively large firms. Two things should be noted. Not all workers were in the sample in both periods. For instance, a worker will be included in our 1997 worker sample if he or she worked for a firm in our sample, regardless if that particular worker was in-sample in 1992. Such a situation can occur because the worker worked for an out-of-scope (small) firm in 1992, because the worker had not yet entered the labor market, or because the worker did not live in-state in 1992. Second, the human capital estimates do include workers not in our particular sample. Abowd et al. (2002b) provides more details on the sample selection for the estimation of the human capital components.

[Table 3 about here]

The exit probability for each of the three categories is roughly similar between Tables 2 and 3, although the rate does drop slightly, suggesting that larger firms may be less likely to experience a displacement event. The average size of the firm is clearly different from the firm and worker perspective. The average worker in the no displacement group works at a firm with about 7,000 employees, while the average firm in the same group has about 278 employees. However, from either perspective the size comparisons between groups are about the same, with firm size declining as the number of displacement events increases.

The sales and capital stock per worker variables show more significant changes when we move to the worker perspective. Interestingly, the average worker in a firm that experiences a single displacement has the highest productivity and capital intensity of any of the three categories. This suggests that the larger firms in the single displacement category tend to be relatively more productive and use more capital per worker than do the larger firms in the other two categories. Although the human capital variables look virtually the same, the industry distributions do change somewhat in Table 3, with relatively more workers in retail trade for the single displacement category and relatively more workers in services for the no-displacement group.

Simple probability models

From Table 2, it would appear that firms with a (single) displacement event are more likely to die, and have distinct observable characteristics even prior to the displacement event. To disaggregate some of the possible causes of displacement events, we specify a univariate probit model:

$$Pr(DW_j = 1|Y_j) = \Phi(\beta Y_j) \tag{8}$$

where DW_j is equal to one when firm j experienced a displacement event in the eligible period (in this paper, between 1993 and 1997). Y_j includes firm-level variables: measures of the firm's human and physical capital or capital intensity (if available), sales per worker (worker productivity), of firm structure (multi- or single-unit). Y_j also includes industry characteristics of firm j, such as the concentration index or industry dummies.

[no concentration index yet]

We estimate equation (8) for all firms active in 1992. Table 4 presents results.For sake of brevity, we only present results for the firm performance and human capital variables. Columns (1) through (6) report results for the sample of firms with complete sales and assets information is available. This specification is similar to others in the literature (Bernard and Jensen, 2002; Carneiro and Portugal, 2003; Dunne and Roberts, 1990), but it is not representative of all firms in our sample.

[Table 4 about here]

Column (1) is a simple specification that correlates sales and assets per worker to the likelihood of a displacement, conditional on industry and geography dummies. Both firm performance variables are significant. However, in Column (2), the addition of worker demographics reduces the effect of both variables. Not reported here are the coefficients on the included workforce characteristics. Firms with a predominantly male workforce, with more part-time workers, and with an older workforce are all more likely to have a displacement event. In Column (3), we replace the observable workforce characteristics with $\Gamma(1)$, $\Gamma(2)$, and $\Gamma(4)$. Note that the only significant variable is $\Gamma(1)$, a measure of how much of the workforce is in the lower tail of the skill distribution. A larger fraction of a firm's in the lower tail of the skill distribution in 1992 increases the likelihood of a displacement event in the next five years. This result remains robust to the introduction of observable workforce characteristics in Column (4). Thus, it would seem that the distribution of human capital captures a significant amount of the productivity factors that affect the incidence of mass layoffs.

However, as mentioned before, the sample of firms with complete sales and asset information is not representative of the full sample. Columns (5) and (6) test specifications that successively eliminate the sales and assets variables for the same sample as in Columns (1) and (4), and as is to be expected, given the insigificance of their coefficients, the impact on the coefficient on $\Gamma(1)$ is negligible. However, when estimating specification (5) on the larger sample in Column (7) that has

at least complete sales information, sales per worker again has a signficant impact on the incidence of displacement, and the effect of the lower tail of the human capital distribution is nearly halved, although still highly significant. Whether this result is due to a high degree of homogeneity in the smaller sample in the sales variable or some other factor remains to be explored.

Column (8) reports results from estimating (8) without sales or asset information. The coefficient on $\Gamma(1)$ is approximately the same as in (7), and all other results on the human capital variables also carry through.

While Equation (8) focusses on the likelihood of displacement, much of the interest in the literature has been on the likelihood of firm or plant closure:

$$Pr(D_j = 1|Y_j, DW_j) = \Phi(\beta_y Y_j + \beta_{DW} DW_j) \tag{9}$$

where D_j is equal to one if firm j exited the market (economy) between 1993 and 1997, and the other vectors are defined as before. Table 5 reports results comparable to the previous literature, with $\beta_{DW} = 0$, while Table 6 introduces the displacement dummy into the equation.

[Table 5 about here]

[Table 6 about here]

The specifications in Columns (1) through (8) mirror those in Table 4, except for the change in the dependent variable. Again, introducing observable workforce characteristics reduces the impact of sales and assets, and the introduction of the human capital distribution variables is robust to the presence of observable workforce characteristics. However, the introduction of the human capital distribution reveals a positive impact of the assets variable on the death likelihood. And contrary to the displacement likelihood, not only does the lower tail of the distribution matter for outcomes, but also in the upper end. A firm with an above-average fraction of its workforce in the upper skill distribution, or a below-average fraction of its workforce in the lower tail, has a significantly lower likelihood of exiting the market in the next five years.

This result remains robust to the elimination of the assets variable in Column (5) and (6), with no significant change in the estimated parameters. However, as before, when estimating (5) on the larger sample, the estimated parameters on $\Gamma(1)$ and now $\Gamma(4)$, while still highly significant, are signficantly reduced in magnitude, and the sales variable again has a distinct and significant impact on the likelihood of firm death.

Introducting DW_j into the regression changes little. The displacement indicator is strongly significant in all specifications and samples. Although this is to be expected based on the raw statistics from Table 2, it is nevertheless robust to the inclusion of detailed observable characteristics of the workforce, a full set of industry, geography, and firm structure dummies, as well as the three skill distribution variable. In fact, when considering Columns (6) and (8), and given the

strong correlation between displacement and $\Gamma(1)$ shown in Table 4, it is interesting to note that there is a signficant and additional effect of $\Gamma(1)$ even when including DW_j. Although the reduction in the level of $\Gamma(1)$ between Tables 5 and 6 in Column (8) is significant, both coefficient still have a strong and positive effect. on the likelihood of firm death. Not only does a firm with an above-average fraction of its workforce in the lower skill distribution have a higher likelihood of death directly, but the lower skill level of its workforce also increases the likelihood of a mass layoff, which in turn further increases the likelihood of death.

Changes in the distribution of human capital

If displacements are a direct consequence of a drastic change in production functions, then observable changes to the distribution of human capital within firms should be expected. Whether or not the change is positive or negative would depend on the type of technological change implemented. Figure 2 plots, for each group of firms among survivors, changes in the distribution of human capital $\hat{h}$.

[Table 7 about here]

Table 7 reports results from regressions of the human capital components on a set of dummies.representing the three groups and other control variables. We focus on the top and bottom tail separately. The first regression, which includes no further controls, shows significant differences between each group's changes. Firms experiencing either single or multiple displacement events both have a weaker reduction in the fraction of the workforce in the lowest quartile. This is robust to the inclusion of both industry and demographic controls. However, it should be noted that when disaggregating h into its component parts (θ and experience, not reported here), much of the difference between single displacement firms and non-displacing firms is driven by differences in the experience component, and less so by the θ component. For multi-displacement firms, both components are driving the differences with non-displacing firms.

A slightly different pattern emerges for the upper tail of the distributions. The results in Table 7 indicate no significant differences between firms with a single displacement event and firms with no displacements in the distribution of human capital. Firms with multiple displacements, on the other hand, are significantly different from non-displacing firms in the upper tail of the distribution as well.

In other words, the main difference between firms with a single displacement event and firms with no displacements is the distribution of experienced workers, not the distribution of unobserved abilities of its workforce, and the changes in the upper tail of the distribution are fairly similar. This is not true for firms with multiple displacements, where both components differ substantially relative to firms with no displacements.

Changes in the ratio of human capital to sales or physical capital

An alternate method of investigating changes to the production environment of the firm is to compute changes in the labor intensity, more precisely, the human-capital-to-physical-capital ratio HKR

$$HKR_{j,t} := H_{j,t}/K_{j,t} - H_{j,t+1}/K_{j,t+1} \tag{10}$$

or the θ-to-capital ratio TKR:

$$TKR_{j,t} := \theta_{j,t}/K_{j,t} - \theta_{j,t+1}/K_{j,t+1} \tag{11}$$

In both cases, the resulting statistic, averaged across categories, can be compared across categories. Table 8 reports results.

[Table8 about here]

5 Conclusion

Several caveats still apply to this preliminary analysis. Firm or plant survival obviously depends on more variables than the ones omitted from the analysis presented in this paper. Age of the firm (Dunne et al., 2003; Dunne and Roberts, 1990; Freeman and Kleiner, 1999), market share and measures of cost(Dunne and Roberts, 1990), industry characteristics such as Herfindahl indexes or import penetration rates (Freeman and Kleiner, 1999), unionization rates (Abowd, 1989; Carneiro and Portugal, 2003; Freeman and Kleiner, 1999), all matter and are not yet included in our analysis. The effect of previous displacement events on the probability of another displacement event occurring also needs to be taken into account, simultaneously with any persistence in the productivity measures of the firm. Some, but not all of these issues, will be addressed by incorporating data from the 2002 Economic Census.

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Table 1: Displacement and survival among 1992 firms

	Displacement events			
Firm type	0	1	Multiple	Total
Exiters	4575	3364	1098	9037
	50.63	37.22	12.15	18.65
	13.61	45.18	14.86	
Survivors	29045	4082	6291	39418
	73.68	10.36	15.96	81.35
	86.39	54.82	85.14	
Total	33620	7446	7389	48455
	69.38	15.37	15.25	100.00

Table 2: Characteristics of sample firms in 1992

	Displacement events		
Variable	0	1	Multiple
$N^{(A)}$	33620	7446	7389
Exiters	0.1360	0.4517	0.1485
	(0.3428)	(0.4977)	(0.3557)
Month 3 Employment	277.92	210.83	188.66
	(1371.33)	(757.27)	(519.69)
Max lifetime Beginning-of-period employment	432.80	314.75	358.21
	(1719.46)	(961.78)	(925.10)
Sales/Workers	232.7	166.2	91.1
(1000$)	(1243.6)	(553.2)	(178.1)
Cap stock/Worker	75.6	68.5	72.1
(1000$)	(142.5)	(122.3)	(191.2)
Total Receipts	47671.5	33927.8	15968.6
(1000$)	(283177.7)	(209670.7)	(68518.7)
$\Gamma(1)$ for h_{ij}	0.2454	0.2973	0.3685
	(0.1525)	(0.1719)	(0.1730)
$\Gamma(2)$ for h_{ij}	0.2422	0.2484	0.2527
	(0.0831)	(0.0808)	(0.0787)
$\Gamma(3) + \Gamma(4)$ for h_{ij}	0.5122	0.4541	0.3786
	(0.1938)	(0.2085)	(0.2063)
$\Gamma(4)$ for h_{ij}	0.2689	0.2288	0.1859
	(0.1590)	(0.1607)	(0.1573)

(cont.)

Table 2 (cont): Characteristics of sample firms in 1992

Variable	Displacement events 0	1	Multiple
$\Gamma(1)$ for experience	0.2551	0.2819	0.3460
	(0.1308)	(0.1491)	(0.1833)
$\Gamma(2)$ for experience	0.3009	0.2951	0.2775
	(0.0570)	(0.0600)	(0.0659)
$\Gamma(3) + \Gamma(4)$ for experience	0.4439	0.4228	0.3764
	(0.1332)	(0.1399)	(0.1527)
$\Gamma(4)$ for experience	0.2861	0.2755	0.2494
	(0.1016)	(0.1039)	(0.1102)
$\Gamma(1)$ for θ	0.2499	0.2945	0.3381
	(0.1521)	(0.1683)	(0.1621)
$\Gamma(2)$ for θ	0.2392	0.2407	0.2453
	(0.0809)	(0.0751)	(0.0715)
$\Gamma(3) + \Gamma(4)$ for θ	0.5108	0.4646	0.4165
	(0.1852)	(0.1944)	(0.1889)
$\Gamma(4)$ for θ	0.2688	0.2352	0.2060
	(0.1575)	(0.1542)	(0.1474)
Agriculture, Forestry, Fisheries, Mining	0.0199	0.0396	0.1050
	(0.1403)	(0.1960)	(0.3070)
Construction Industries	0.0431	0.0829	0.0814
	(0.2032)	(0.2758)	(0.2735)
Manufacturing	0.2315	0.1720	0.0581
	(0.4218)	(0.3774)	(0.2341)
Transportation, Communications, and Utilities	0.0516	0.0449	0.0249
	(0.2212)	(0.2072)	(0.1558)
Wholesale Trade	0.1027	0.0710	0.0274
	(0.3036)	(0.2569)	(0.1634)
Retail Trade	0.1160	0.1817	0.2722
	(0.3202)	(0.3856)	(0.4451)
Finance, Insurance, and Real Estate	0.0839	0.0564	0.0179
	(0.2773)	(0.2307)	(0.1329)
Service Industries	0.3257	0.3349	0.3920
	(0.4686)	(0.4720)	(0.4882)
Public Administration	0.0251	0.0161	0.0205
	(0.1566)	(0.1259)	(0.1419)

Note: (A) All cells correspond to the number of observations in line 1, except for “Sales per worker” (26273/5761/5473), “Capital stock per worker” (6720/1045/346), and “Total Receipts” (26353/5790/5493).

Table 3: Characteristics of in-sample workers in 1992

Variable	Displacement events 0	1	Multiple
Workers	8776710	1438614	1200130
Exiters	0.1113	0.4346	0.1284
	(0.3145)	*(0.4957)*	*(0.3345)*
Month 3 Employment	7115.65	2881.18	1556.18
	(14711.24)	*(5559.54)*	*(2647.47)*
Max lifetime Beginning-of-period employment	8534.54	3559.61	2522.59
	(16982.92)	*(6896.93)*	*(4189.09)*
Sales/Workers	249.5	312.3	89.8
(1000$)	*(1196.4)*	*(1666.3)*	*(207.1)*
Cap stock/Worker	116.6	130.7	95.6
(1000$)	*(169.0)*	*(224.8)*	*(149.5)*
Total Receipts	872958.0	354642.8	126396.1
(1000$)	*(2102754.5)*	*(944415.5)*	*(303838.7)*
$\Gamma(1)$ for h_{ij}	0.2247	0.2780	0.3829
	(0.1356)	*(0.1644)*	*(0.1633)*
$\Gamma(2)$ for h_{ij}	0.2368	0.2447	0.2565
	(0.0746)	*(0.0753)*	*(0.0729)*
$\Gamma(3) + \Gamma(4)$ for h_{ij}	0.5385	0.4773	0.3606
	(0.1748)	*(0.2041)*	*(0.1995)*
$\Gamma(4)$ for h_{ij}	0.2828	0.2456	0.1775
	(0.1417)	*(0.1605)*	*(0.1561)*
$\Gamma(1)$ for experience	0.2216	0.2703	0.3587
	(0.1225)	*(0.1412)*	*(0.1794)*
$\Gamma(2)$ for experience	0.2907	0.2913	0.2736
	(0.0483)	*(0.0500)*	*(0.0560)*
$\Gamma(3) + \Gamma(4)$ for experience	0.4877	0.4384	0.3677
	(0.1345)	*(0.1394)*	*(0.1505)*
$\Gamma(4)$ for experience	0.2815	0.2701	0.2318
	(0.1041)	*(0.1060)*	*(0.1064)*
$\Gamma(1)$ for θ	0.2350	0.2733	0.3413
	(0.1294)	*(0.1588)*	*(0.1514)*
$\Gamma(2)$ for θ	0.2389	0.2412	0.2511
	(0.0734)	*(0.0717)*	*(0.0667)*

(cont.)

Table 3 (cont): Characteristics of in-sample workers in 1992

	Displacement events		
Variable	0	1	Multiple
$\Gamma(3) + \Gamma(4)$ for θ	0.5260	0.4855	0.4076
	(0.1584)	*(0.1878)*	*(0.1798)*
$\Gamma(4)$ for θ	0.2715	0.2497	0.2007
	(0.1369)	*(0.1561)*	*(0.1460)*
Agriculture, Forestry, Fisheries, Mining	0.0097	0.0273	0.0768
	(0.0984)	*(0.1637)*	*(0.2666)*
Construction Industries	0.0157	0.0415	0.0462
	(0.1243)	*(0.1994)*	*(0.2100)*
Manufacturing	0.2164	0.1816	0.0527
	(0.4118)	*(0.3855)*	*(0.2235)*
Transportation, Communications, and Utilities	0.0747	0.0562	0.0206
	(0.2629)	*(0.2304)*	*(0.1421)*
Wholesale Trade	0.0520	0.0492	0.0145
	(0.2220)	*(0.2163)*	*(0.1193)*
Retail Trade	0.1133	0.2131	0.3012
	(0.3169)	*(0.4095)*	*(0.4588)*
Finance, Insurance, and Real Estate	0.0818	0.0543	0.0210
	(0.2741)	*(0.2266)*	*(0.1435)*
Service Industries	0.3670	0.3459	0.4411
	(0.4820)	*(0.4757)*	*(0.4965)*
Public Administration	0.0694	0.0309	0.0258
	(0.2542)	*(0.1731)*	*(0.1586)*

Note: (A) All cells correspond to the number of observations in line 1, except for “Sales per worker” (6016665/1076653/ 903019), “Capital stock per worker” (1711473/222702/ 60736), and “Total Receipts” (6041486/1079235/ 905270).

Table 4: Probability of displacement

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sales/worker	-0.0969 ***	-0.0375	0.0005	0.0142	0.0181		-0.0479 ***	
	(0.0270)	(0.0282)	(0.0289)	(0.0292)	(0.0285)		(0.0098)	
Assets/worker	-0.0314 **	-0.0024	0.0193	0.0116				
	(0.0159)	(0.0172)	(0.0174)	(0.0175)				
$\Gamma(1)$			1.4037 ***	2.0381 ***	1.9860 ***	1.9542 ***	1.0297 ***	1.0680 ***
			(0.2133)	(0.2914)	(0.2931)	(0.2887)	(0.1248)	(0.1072)
$\Gamma(2)$			0.1137	0.4762	0.4155	0.4058	-0.1166	-0.1208
			(0.3845)	(0.3997)	(0.4012)	(0.4010)	(0.2045)	(0.1762)
$\Gamma(4)$			-0.0731	0.3568	0.2810	0.2804	-0.0681	-0.0700
			(0.3278)	(0.3403)	(0.3420)	(0.3420)	(0.1490)	(0.1260)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Workforce characteristics	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Firm size	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7765	7765	7765	7765	7765	7765	32034	41066

Standard errors in parentheses. Sample excludes firms experiencing multiple displacement events. *** significant at 1% level, ** at 5% level, and * at 10% level. Industry dummies are at the SIC division level. All regressions include dummies for state, multi-state firms. Workforce characteristics are firm-average race (percentage white), sex (percentage male), full-time status (percentage full-time) and age.

Table 5: Probability of firm closure

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sales/worker	-0.0594 **	-0.0424	0.0046	0.0072	0.0272		-0.0713 ***	
	(0.0258)	(0.0269)	(0.0275)	(0.0277)	(0.0268)		(0.0094)	
Assets/worker	0.0131	0.0165	0.0398 **	0.0302 *				
	(0.0157)	(0.0168)	(0.0171)	(0.0172)				
$\Gamma(1)$			0.4421 **	1.1917 ***	1.2076 ***	1.1567 ***	0.7488 ***	0.9489 ***
			(0.1935)	(0.2725)	(0.2744)	(0.2697)	(0.1224)	(0.1051)
$\Gamma(2)$			-0.5605	-0.0673	-0.0651	-0.0816	0.0758	0.3259 *
			(0.3494)	(0.3646)	(0.3667)	(0.3664)	(0.1993)	(0.1708)
$\Gamma(4)$			-1.1580 ***	-0.8159 ***	-0.8157 ***	-0.8204 ***	-0.4146 ***	-0.5373 ***
			(0.2949)	(0.3083)	(0.3101)	(0.3100)	(0.1461)	(0.1242)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Workforce characteristics	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Firm size	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7765	7765	7765	7765	7765	7765	32034	41066

Standard errors in parentheses. Sample excludes firms experiencing multiple displacement events. *** significant at 1% level, ** at 5% level, and * at 10% level. Industry dummies are at the SIC division level. All regressions include dummies for state, multi-state firms. Workforce characteristics are firm-average race (percentage white), sex (percentage male), full-time status (percentage full-time) and age.

Table 6: Probability of firm closure conditional on displacement

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sales/worker	-0.0288	-0.0338	0.0046	0.0006	0.0200		-0.0640 ***	
	(0.0271)	(0.0282)	(0.0287)	(0.0290)	(0.0280)		(0.0097)	
Assets/worker	0.0264	0.0186	0.0359 **	0.0290				
	(0.0167)	(0.0178)	(0.0180)	(0.0181)				
$\Gamma(1)$			-0.0087	0.5496 *	0.5873 **	0.5493 *	0.4904 ***	0.7162 ***
			(0.2036)	(0.2861)	(0.2879)	(0.2829)	(0.1273)	(0.1087)
$\Gamma(2)$			-0.5951	-0.2107	-0.1810	-0.1935	0.1301	0.4001 **
			(0.3666)	(0.3827)	(0.3849)	(0.3845)	(0.2069)	(0.1766)
$\Gamma(4)$			-1.2134 ***	-1.0244 ***	-0.9924 ***	-0.9965 ***	-0.4304 ***	-0.5528 ***
			(0.3080)	(0.3225)	(0.3244)	(0.3243)	(0.1517)	(0.1284)
DW_j	1.2354 ***	1.2339 ***	1.2062 ***	1.2130 ***	1.2078 ***	1.2082 ***	1.0221 ***	0.9624 ***
	(0.0441)	(0.0446)	(0.0447)	(0.0450)	(0.0453)	(0.0453)	(0.0199)	(0.0175)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Workforce characteristics	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Firm size	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7765	7765	7765	7765	7765	7765	32034	41066

Standard errors in parentheses. Sample excludes firms experiencing multiple displacement events. *** significant at 1% level, ** at 5% level, and * at 10% level. Industry dummies are at the SIC division level. All regressions include dummies for state, multi-state firms. Workforce characteristics are firm-average race (percentage white), sex (percentage male), full-time status (percentage full-time) and age.

Table 7: Changes in the tails of firm distribution of human capital

Dependent Variable	Variable	Parameter Estimate	Standard Error	t Value	Pr$>|t|$
$\Delta\Gamma(1)$	Intercept	-0.0227	0.0003	-61.17	$<$.0001
	Single displacement	0.0074	0.0012	6.15	$<$.0001
	Multi displacement	0.0047	0.0010	4.37	$<$.0001
	Controls for SIC		No		
	Controls for Demo		No		
	Other Controls		No		
	Intercept	-0.0145	0.0009	-15.68	$<$.0001
	Single displacement	0.0052	0.0012	4.39	$<$.0001
	Multi displacement	-0.0002	0.0011	-0.19	0.8473
	Controls for SIC		Yes		
	Controls for Demo		No		
	Other Controls		No		
	Intercept	-0.0386	0.0018	-21.08	$<$.0001
	Single displacement	0.0067	0.0011	5.62	$<$.0001
	Multi displacement	0.0032	0.0011	2.89	0.0038
	Controls for SIC		Yes		
	Controls for Demo		Yes		
	Other Controls		Yes		
$\Delta\Gamma(4)$	Intercept	0.0050	0.0004	12.19	$<$.0001
	Single displacement	-0.0014	0.0013	-1.06	0.2870
	Multi displacement	0.0007	0.0012	0.62	0.5331
	Controls for SIC		No		
	Controls for Demo		No		
	Other Controls		No		
	Intercept	0.0061	0.0010	5.89	$<$.0001
	Single displacement	-0.0002	0.0013	-0.19	0.8460
	Multi displacement	0.0045	0.0012	3.65	0.0003
	Controls for SIC		Yes		
	Controls for Demo		No		
	Other Controls		No		
	Intercept	-0.0035	0.0020	-1.74	0.0826
	Single displacement	-0.0003513	0.0013	-0.26	0.7925
	Multi displacement	0.0052	0.0012	4.23	$<$.0001
	Controls for SIC		Yes		
	Controls for Demo		Yes		
	Other Controls		Yes		

Note: All regressions weighted by the number of employees with $6 < h < 14$. Demographic controls are the fraction of white workers and fraction of male workers. “Other controls” include state dummies, indicators for multi-state and multi-unit firms and for firm size. N=39148.

Table 8: Ratio comparisons

Group	Year	HKR	TKR
All	1992	1.1621	-0.0103
		(10.1148)	*(0.4590)*
	1997	1.1197	-0.0146
		(15.5366)	*(0.5154)*
By displacement incidence:			
No displacement	1992	1.1208	-0.0091
		(9.9209)	*(0.4838)*
	1997	1.0772	-0.0142
		(15.3750)	*(0.5459)*
Single displacement	1992	1.5783	-0.0091
		(13.7090)	*(0.1271)*
	1997	1.8899	-0.0182
		(21.0549)	*(0.1757)*
Multiple displacements	1992	1.2710	-0.0371
		(5.4912)	*(0.2754)*
	1997	0.6858	-0.0166
		(1.5525)	*(0.0626)*

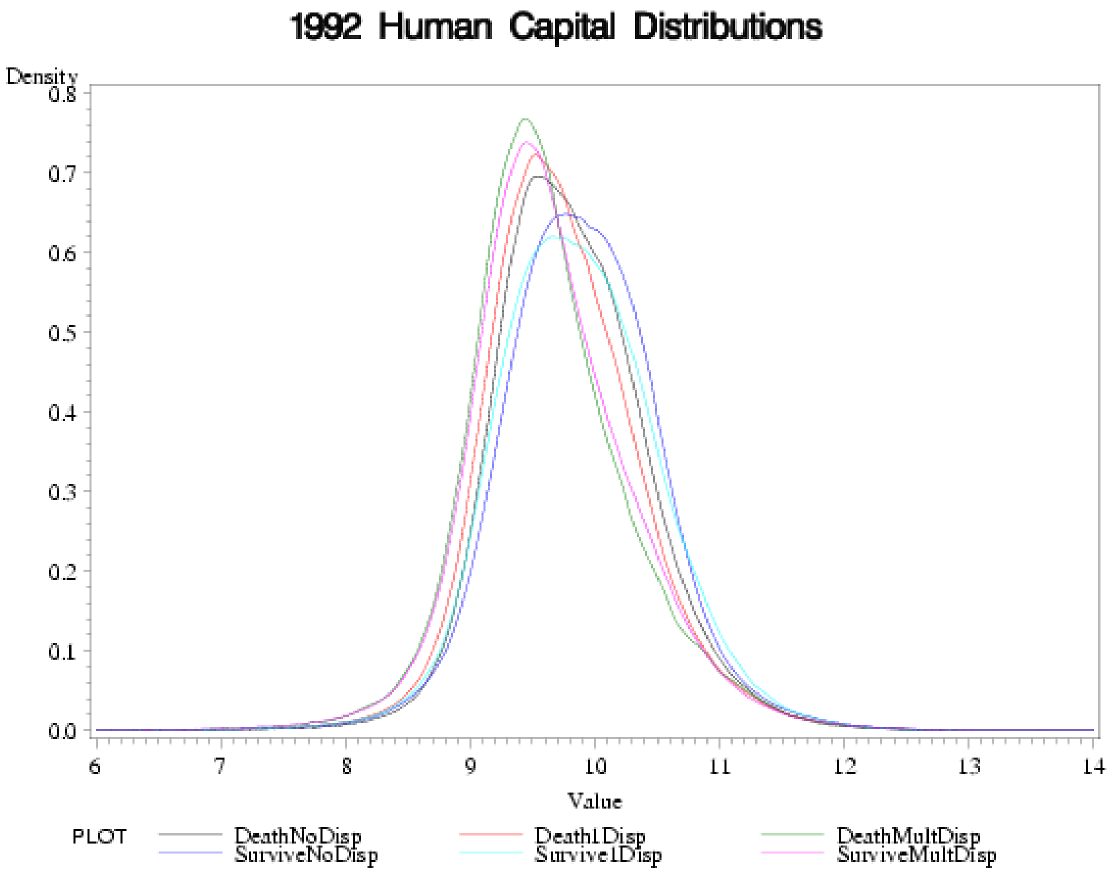

Figure 1: Distribution of human capital in 1992

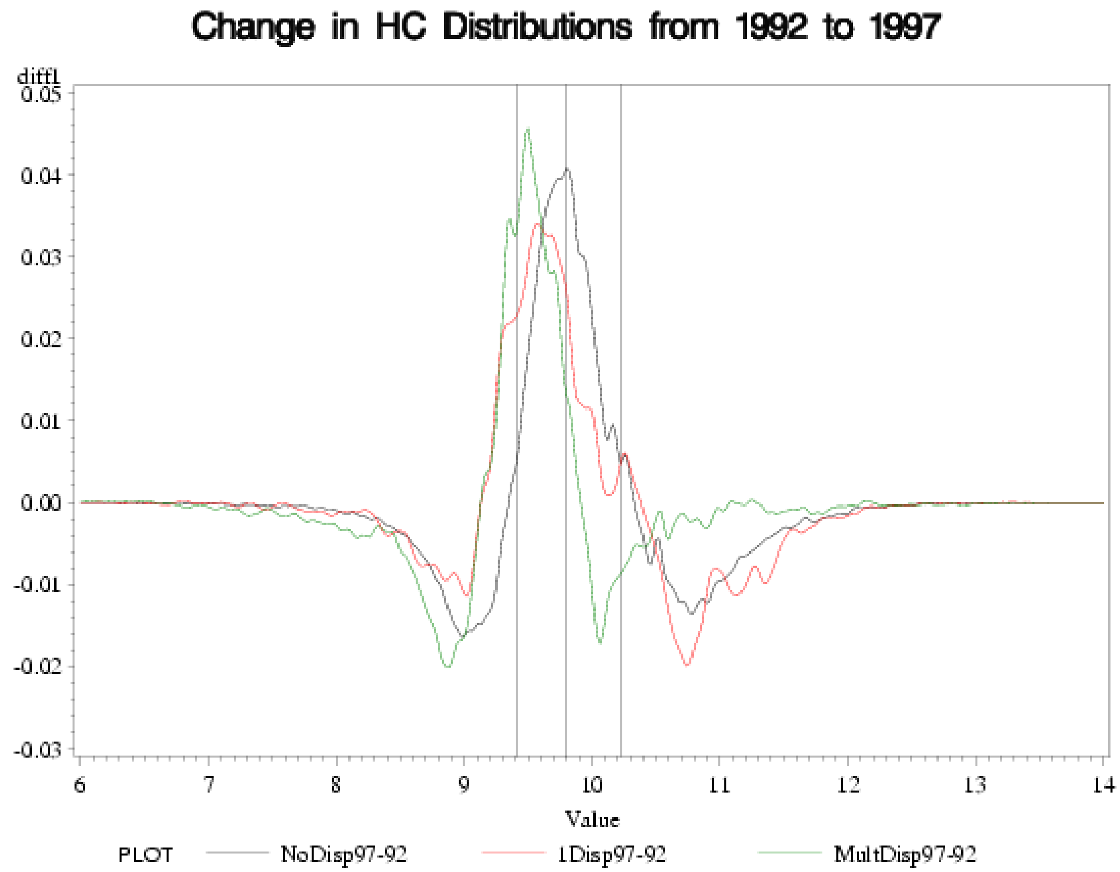

Figure 2: Changes in distributions of human capital between 1992 and 1997 for survivors