A Appendix: Standard Errors

There are several issues concerning computing standard errors for the pooled specification in equation (2). First, insofar as there is heterogeneity in the displaced worker earnings losses, then we expect there to be serial correlation in the standard errors at the individual level. This concern arises even in specification (1). We address this concern by clustering at the person level. Second, a given person-quarter observation might appear several times. For example, if a person continues in a job for several quarters and then loses their job in a mass displacement, then a particular calendar quarter of earnings would show up in two different calendar times. This specification with a given observation potentially appearing multiple times is formally identical to the preferred specification in Dube, Lester, and Reich (2010), and we adopt their solution of clustering at the level of aggregation at which a given observation might appear multiple times.[19]

To summarize, our standard errors have the following structure: $E[u^y_{ik} u^{y'}_{i'k'}] \neq 0$ if $i = i'$ or $k + y = k' + y'$. As a result, we use the Cameron, Gelbach, and Miller (2011) two-way clustered standard errors where we cluster at the person level and calendar time level. They show that the variance matrix is then $V^{IT} = V^I + V^T - V^{I \cap T}$ where the right hand side are variance matrices from one-way clustering and I is the set of individuals and T is the set of calendar-time periods.[20]

B Appendix: Propensity Score Reweighting

The basic idea of propensity score reweighting is to make the control group "look like" the treatment group. That is, we are interested in estimating the average treatment on the treated (ATT). To operationalize this reweighting, we estimate a propensity score, $\hat{p}$, to be in the treated group including all of the covariates in Table 2. We use a logit functional form. We construct a weight, $\frac{\hat{p}}{1-\hat{p}}$, to be in the control group. We then re-estimate equation (2) using these weights.

The literature has emphasized three implementation issues in propensity score reweighting: normalization, common support and "large weights." Busso, DiNardo, and McCrary (2014) emphasize in their finite-sample Monte Carlo results that it is important to normalize the weights. We normalize the weights so that the number of units in the control group is the same as before reweighting (i.e. the average weight is 1). Common support refers to whether there is overlap in the propensity score distributions between the treatment and control groups. Conceptually, if there is not overlap then the control group is very different from the treated group, and it is harder to imagine that these are randomly assigned. For each comparison, we verify that there is common support. Heuristically, this means that there are not (near) perfect predictors of being displaced. Finally, a concern emphasized by Crump et al. (2014) is that for propensity scores close to 1 the weights blow-up and in the bias-variance trade-off a researcher is better off dropping some observations.[21] In practice, the events that we study are relatively rare and so we do not have estimated propensity scores close to 1.

[19] Davis and von Wachter (2011) implicitly have this issue in that their year-by-year estimates are not independent samples.

[20] In our application, we have over 30 clusters in the time dimension and over 30,000 dimensions in the person dimension.

[21] They are interested in the average treatment effect (ATE), and so have weights that look like $\frac{p}{1-p}$ and $\frac{1-p}{p}$ and so they recommend trimming weights both at the top and the bottom. We are interested in the average treatment on the treated (ATT) and so only have weights that look like $\frac{p}{1-p}$ and so their approach would only suggest trimming at the top.

C Appendix: Matching Procedure, Properties of the Match and Variables

C.1 Separators

We match jobs in the SIPP to those in the LEHD in the following manner.

In the SIPP, we start with the universe of jobs with 12 months or more of tenure based on question TSJDATE: "When did ... start this job?". We assign the separations, which are monthly, to the relevant quarter.

In the LEHD, we create a universe of jobs among workers also in the SIPP based on the following three criteria:

- We impose a tenure requirement by restricting attention to jobs with positive earnings in quarter t for which the worker also had positive earnings in quarter $t-3$, $t-2$ and $t-1$;
- We impose a "full-time" earnings requirement by restricting attention to quarters with earnings that exceed 70% of 480 hours of work at \$4.25 (in 1991 dollars, the Federal minimum wage);
- We match the notion of separation by restricting attention to jobs where the last quarter of positive earnings is quarter t and the worker has earnings below the threshold described in the previous bullet from the same employer in quarters $t+1$, $t+2$, $t+3$ and $t+4$.

This generates two lists of jobs. We then combine them in the following way:

- If a worker had a SIPP job that ended in quarter t that met our criteria, we examined all LEHD jobs for that worker that ended in quarter $t-1$, t, or $t+1$.
- If the previous step generated multiple LEHD jobs per SIPP job, then we selected a unique job in the following order of priority:
  - If a given SIPP job generated multiple matches, we prioritized the match that was exact in terms of timing;
  - If there were two jobs that met our criteria, we picked the one with the highest earnings in the quarter before the separation;
  - It is possible to have two jobs that both match inexactly and have the same earnings. In this case we took one at random.
  - If a given LEHD job matched to both a separating job and a continuing job then we kept the separating job (this can happen if in the first month of the quarter a worker is employed, and then separates in the third month—in the second month this job would be reported as continuing while in the third it would be reported as separating);
  - For remaining duplicates, we picked a job at random.

Table A5 provides more details on the matching process and match rates. We start with 22,700 separations in the SIPP and are able to match 10,100 of them to the LEHD.

C.2 Non-separators

For the sample of non-separators, we impose a tenure requirement in an identical manner. Of course, we do not impose a separation requirement. The other difference is that to generate the list of candidate jobs in the LEHD we require that the job match in the exact quarter, rather than in a two quarter window.

Table A5 provides further details. We start with 525,900 job-quarters in the SIPP and are able to match 348,100 of them to the LEHD.

C.3 Other Variables

C.3.1 Worker-Level Variables

Among the set of workers that we match, we construct the following variables in the LEHD:

- Total earnings in quarter t: we take the sum across all jobs in the LEHD (not just those passing the earnings test). We winsorize (topcode) at the 99th percentile of earnings in that quarter.[22]
- For workers who separate, we keep track of whether they have any earnings from their pre-separation employer in every quarter following the separation. We also record whether their pre-separation employer is their source of maximum earnings in a particular quarter.

C.3.2 Establishment-Level Variables

We restrict attention to workers earnings at least 35% of 480 hours at the 1991 minimum wage. We then create the following variables at the SEIN quarter level:

- Employment counts in quarter t: the number of workers with earnings above our threshold.

D Appendix: Cleaning Employer IDs

We might record a mass layoff when an employer shuts down, when in fact the employer identification number has just changed. Following Schoeni and Dardia (1996) and Benedetto et al. (2007), we use worker flows across establishments to correct longitudinal linkages.[23]

Table A6 presents a simplified version of Table 3 in Benedetto et al. (2007), which summarizes how we use worker flows to edit longitudinal linkages. The basic idea is that if most workers from an employer move to the same employer and then make up the majority of the new employer then this probably reflects an ID change. If most workers from an employer move to the same employer but make up a smaller share of the new employer, then this is more plausibly an acquisition/merger in which the new ID number swallowed the old ID number. The only difference from Benedetto et al. (2007) is that we use a 70% threshold rather than an 80%. The reason to do this is to be more conservative. It also aligns with Jacobson, LaLonde, and Sullivan (1993) definition of a displacement more tightly so that we know that the JLS mass layoffs are never associated with large flows of workers to a common employer.

[22] Couch and Placzek (2010, Web appendix A) topcode at $155,000 in 2000 dollars.

[23] Davis and von Wachter (2011) use an alternative strategy to mitigate concerns about measurement error in employer IDS: they alter their definition of displacement to exclude all cases where the ID disappears.

When we observe an ID change or a merger/acquisition we go back and change the ID so that we have a consistent ID series. This correction allows us to compute employer level outcomes.

E Alternative Ways of Identifying Economic Distress

The literature and some government programs contain other ways of attempting to measure separations due to firm distress.

E.1 Government Programs

Some US Federal government programs use definitions of mass displacements. These definitions are also displayed in Table A2. In general, these definitions focus on the number of separations (e.g. 50 or more worker separations), rather than the change in employer size (e.g. 30% contraction) as in the definitions in the economics literature. The BLS Mass Layoff definition has been used in academic research (e.g. Ananat et al. (2011)). The BLS Mass Layoff Program has been discontinued due to budget cuts, which serves to reinforce the value of alternative measures of displacements in administrative data.

E.2 Unemployment Insurance

While UI collection is not commonly used to measure the nature of worker separations, both Jacobson, LaLonde, and Sullivan (1993) and Couch and Placzek (2010) report estimates of long-term earnings losses on the subset of workers who collect UI. Some papers also use unconditional UI collection as a measure of displacement: Jacobson, Lalonde, and Sullivan (2005) and Hilger (2012), which uses state UI records and tax records respectively.

The goal of this measurement is to isolate separations that are not due to workers being fired for cause. A disadvantage of this approach, however, is that it conditions on future outcomes since it selects those workers who do not find jobs immediately.

E.3 Media Reports

A final alternative measure worth noting is one based on what the media covers as mass layoffs. Hallock (1998) is an outstanding example of this approach.[24] He looks at media reports of mass layoffs at public companies from 1987-1995.[25] An interesting feature of this data is that these layoffs are small compared to that reflected in economic studies. Chen et al. (2001, Table 3) replicate Hallock (1998) for 1990-1995 and report that the average share of the workforce involved in a layoff identified in this matter is 8.74%, while the median is 4.55%. One interpretation of this fact is that even though a large number of separations is required to attract media attention, public companies are large so this makes up a small share of their size.

[24] See Farber and Hallock (2009) for additional references.

[25] He searches the *Wall Street Journal* for article abstracts containing the following words: layoff, laid off, downsize, plant closing, or downsizing.

Table A1. Survey Measures of Displacement

Survey	Involuntary Job Loss Reasons	Papers
Displaced Worker Survey (DWS) (question wording and recall window changed in 1994)	i) Plant or company closed down or moved; ii) Plant or company operating but lost or left job because of insufficient work; iii) Plant or company operating but lost or left job because position or shift abolished	Kletzer (1989) [reasons i) and iii)]; Topel (1990) [all reasons]; Neal (1995) [reason i)]; Farber (1993) [all reasons]; Gibbons and Katz (1991) [compare i) to(ii) and iii))]
Panel Study of Income Dynamics (PSID)	plant or business closing or due to being laid off or fired (excludes temporary jobs)	Topel (1990), Ruhm (1991), Stevens (1997), Stephens (2001), Stephens (2002), Charles and Stephens (2004), Lindo (2010), Lindo (2011), Krolikowski (2013)
Health and Retirement Study (HRS)	business closed, or laid off	Couch (1998), Chan and Stevens (1999), Stevens and Chan (2001)
National Longitudinal Study of Youth (NLSY)	plant closing or layoff (exclude people subsequently reemployed)	Kletzer and Fairlie (2003), Krashinsky (2002)
Survey of Income and Program Participation (SIPP)	layoff, slack work, or employer bankruptcy, or because the employer sold the business	Johnson and Mommaerts (2011), Flaaen, Shapiro and Sorkin (2015) [this paper]

The PSID coding, at least for 1969-1970, was based on an open-ended question: "What happened with that job—Did the company go out of business, were you laid off, did you quit, or what?" Boisjoly, Duncan, and Smeeding (1998, pg. 212 n. 5) examine a sample of the original coding and find that approximately 16% of respondents who were coded as "layoff, fired" in 1969-1970 reported being fired. The BLS Job Opening and Labor Turnover Survey (JOLTS) also does not distinguish between "laid off" and "fired" as it has a single category for "layoffs and discharges." In the SIPP, the ratio of discharged/fired to separations we classify as distress as well as discharged/fired is 27% ($\frac{329}{329+892}$). See Table 1.

Table A2. Administrative Measures of Displacement

Paper	Dataset	Definition
Jacobson, LaLonde, and Sullivan (1993)	Pennsylvania UI records (1974-1986)	in 1979 50 or more employees; employment in year following the separation is 30% below 1970's peak;
Schoeni and Dardia (1996)	California UI Records (1989:I-1994:III)	in 1989:I 50 or more employees; 1994:III employment is less than 1989:I employment
Bowlus and Vilhuber (2002)	LEHD (1990-1999, 2 states)	average from 1990-1999 is 50 or more employees; number of *separators* from $t-1$ to t (quarters) is at least 30% of average employment
Lengermann and Vilhuber (2002)	Maryland (1985:II - 1997:II)	for period they are in the data, employer averages 25 or more employees; reduction in employment of 30% from one quarter to the next
Dustmann and Meghir (2005)	German Social Security	Establishment Closing
Abowd, McKinney, and Vilhuber (2009)	LEHD	Reduction in employment from quarter to quarter is at least 30% of max employment from 1992 to 1997; fewer than 80% of workers move to a common other employer
Couch and Placzek (2010)	Connecticut UI Records	employer has 50 or more employees (not sure on when); separate within a year (before or after) of a 30% drop in employment below maximum employment from 1993 to 1998
Davis and von Wachter (2011)	U.S. Social Security Records	a separation in year t (positive earnings in $t-1$ and zero earnings in t) is a mass displacement if: i) employment in $t-2$ is greater than 50; ii) employment in t is between 1% and 70% of period $t-2$ employment; iii) employment in $t-2$ is less than 130% of $t-3$ employment; iv) employment in $t+1$ is less than 90% of $t-2$ employment
Andersson et al. (2011)	LEHD	25 or more workers in quarter t and a 4-quarter contraction of at least 30%
von Wachter, Handwerker, and Hildreth (2012)	California UI Records (1990-2000)	in 1990:I 50 or more employees; 30% contraction below maximum level at the beginning of the sample period; [robustness exercises with quarter to quarter drops, and plant closings]
Flaaen, Shapiro and Sorkin (2015) [this paper]	LEHD	50 or more workers in quarter $t-3$ and a 4 quarter contraction of 30%, or a 4 quarter gross flow measure of 20% or less
Government Program		**Defintion**
Mass Layoff Program		50 or more workers *filing* for unemployment insurance and not recalled within 31 days; at state UI account level
Worker Adjustment and Retraining Notification Act (WARN)		50-499 workers laid off when laid-off workers are at least 33% of the workforce; or all layoffs involving 500 or more workers at a physical location

Table A3. Sample Selection Restrictions on Worker Side in Administrative Measures

Paper	Dataset	Sample Selection
Jacobson, LaLonde, and Sullivan (1993)	Pennsylvania UI records (1974-1986)	6 or more years of tenure and 31-50 in 1980; men and women; positive earnings in each calendar year between 1974-1986;
Schoeni and Dardia (1996)	California UI Records (1989:I-1994:III)	all workers employed in aerospace in 1989:I (all ages, tenure, and men and women); positive earnings in each calendar year in the dataset;
Bowlus and Vilhuber (2002)	LEHD (1990-1999, 2 states)	full quarter employment 4 quarters before displacement, continually employed until displacement; in full quarter employment 4 quarters after the displacement (implicitly no zeros); 5 years of experience; men
Lengermann and Vilhuber (2002)	Maryland (1985:II - 1997:II)	full-quarter employment; all workers; zeros unclear (some specifications in logs)
Dustmann and Meghir (2005)	German Social Security	oldest worker is 35; "observe from labor force entry onwards"
Abowd, McKinney, and Vilhuber (2009)	LEHD	male and female workers between the ages of 18 and 70, with earnings during the quarter of greater than $250.00.
Couch and Placzek (2010)	Connecticut UI Records	workers born between 1949 and 1979 (19-49 in 1998); six years of continuous employment with the same employer from 1993 through the end of 1998; positive earnings in each year of the panel from 1993 through 2004
Davis and von Wachter (2011)	U.S. Social Security Records	3 years of tenure; 50 or younger; include years with zeros; men only
Andersson et al. (2011)	LEHD	4 quarters of employment prior to separation; no restriction on post-displacement earnings; all workers with earnings in a particular range
von Wachter, Handwerker, and Hildreth (2012)	California UI Records (1990-2000)	4 years of tenure; no post-displacement earnings restrictions; all ages; men and women;
Flaaen, Shapiro and Sorkin (2015) [this paper]	LEHD	25-74 years old in quarter of separation; 1 year of tenure; positive earnings in up to 4 calendar years following separation

Table A4. Illustration of Methodology using Fictional Earnings Record

(1) Earnings	(2) Employer ID	(3) Calendar Time	(4) Event Time 1	(5) Event Time 2	(6) Event Time 3
10000	3653	2000:I	-3		
10000	3653	2000:II	-2	-3	
10000	3653	2000:III	-1	-2	
10000	3653	2000:IV	0	-1	
9500	3653	2001:I	1	0	
0	NA	2001:II	2	1	
8000	4511	2001:III	3	2	
9000	5205	2001:IV	4	3	-3
9000	5205	2002:I	5	4	-2
9000	5205	2002:II	6	5	-1
9000	5205	2002:III	7	6	0
9000	5205	2002:IV	8	7	1
Event			Continue	Sep.	Continue

Table A5. Properties of the SIPP-LEHD Match

	Continuers	Separators
SIPP person-quarters	525,900	22,700
Positive LEHD earnings	499,800	22,000
4 quarters of LEHD earnings	488,000	21,500
4 quarters of LEHD earnings and pass earnings test	473,600	20,100
Matched	348,100	10,100
Number of quarters	27	27

Table A6. Successor/predeccessor flow and firm birth/death combinations

Link description	70% of successor comes from predecessor	less than 70% of successor from predecessor
70% of predecessor moves to successor and predecessor exits	ID Change	Acquisition/merger
70% of predecessor moves to successor and predecessor lives on	ID Change	Acquisition/merger

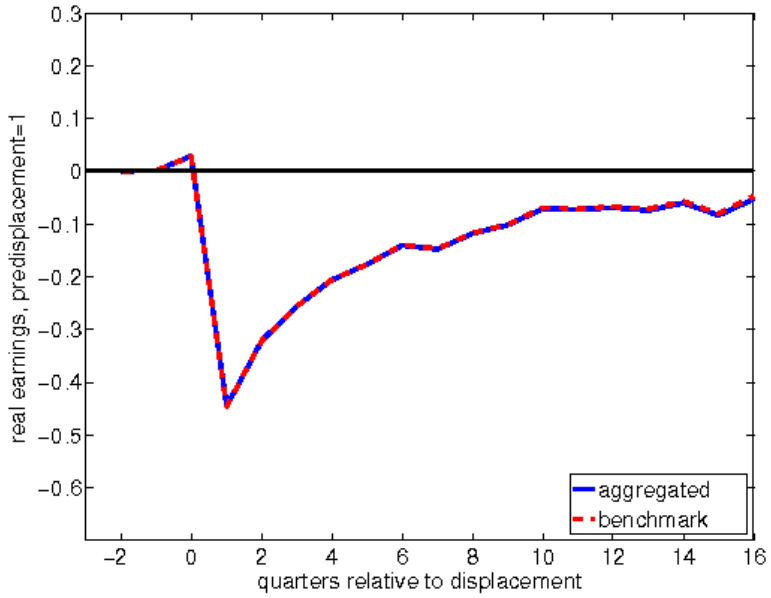
Note: this table is based on Table 3 in Benedetto et al. (2007).

Table A7. Latent Firm Contribution to Survey Reports (unweighted)

	Survey reason (s)		
	Distress	Quit	Other
$\Pr(\text{Separation}_s$ — ML)	0.055	0.021	0.026
$\Pr(\text{Separation}_s$ — No growth)	0.001	0.006	0.006
$\Pr(\text{ML}_s^*\|\text{ML}_s) = \pi_s$	0.974	0.726	0.767
$\omega_s = \text{Share}_s\|\text{ML}$	0.54	0.20	0.25
$\omega_s^* = \text{Share}_s\|\text{ML}^*$	0.61	0.17	0.22

Source: SIPP-LEHD as explained in text.
This table reports the unweighted version of Table A7.

Figure A1. Mass layoff: benchmark and aggregated



Source: SIPP-LEHD as explained in text.
This figure plots earnings changes from administrative mass layoffs computed in two different ways. The first way is from equation 2, which is also plotted in Panel A of Figure 3. The second way is from equation (3) in section 4, where we have estimated the earnings changes associated with each of the survey responses separately. This line is also plotted in Figure 6. Confidence intervals are suppressed for the sake of clarity. See equation (2) in the text.