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Uncovering the Differences among Displaced Workers: Evidence from Canadian Job Separation Records*

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Abstract

We revisit the measurement of the sources and consequences of job displacement using Canadian job separation records. To circumvent administrative data limitations, conventional approaches address selection by identifying displacement effects through mass-layoff separations, which are interpreted as involuntary. We refine this procedure and find that only a quarter of mass-layoff separations are indeed layoffs. Isolating mass-layoff separations that reflect involuntary displacement, we find twice the earnings losses relative to existing estimates. We uncover heterogeneity in losses for separations with different reason and timing, ranging from 15 percent for quits after a mass layoff to 60 percent for layoffs before it.

Keywords: Job displacement, Earnings losses, Layoffs vs quits, Employer effects
JEL Codes: E24, E32, J31, J63, J65

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1 Introduction

A large and active literature pursues estimates of the magnitude and sources of earnings losses following a job displacement. Estimates of displacement outcomes are of foremost empirical interest, as they shed light on outcomes upon involuntary job separation; they are also pivotal inputs to quantitative models used for macroeconomic and policy analysis. To arrive at these estimates, the literature has often relied on employer-employee-matched administrative data, where a job separation is detected by a change in a worker's employer identifier from one period to another. Thus far, a common strategy adopted to address selection and capture involuntary separations is to focus on separations of long-tenure workers during large employment contractions within a particular employer, events labeled as "mass layoffs" (Jacobson, LaLonde, and Sullivan 1993; Couch and Placzek 2010; Davis and von Wachter 2011; Lachowska, Mas, and Woodbury 2020; Schmieder, von Wachter, and Heining 2023, among others).[1] While this strategy is plausible, relying on employer identifier changes during mass layoffs alone to capture involuntary separations introduces new challenges. For instance, it is not clear that all separations during employer contractions are involuntary, as some workers may quit during such episodes. Further, the protracted nature of employer distress implies that estimates may depend heavily on how systematic decisions by employers and workers shape the composition of separations.

In this paper, we exploit employer-employee-matched administrative data from Canada that distinctly contain information on the reason and exact timing of a separation. In particular, we use the Canadian Employer-Employee Dynamics Database (CEEDD), an annual employer-employee-matched data that link various individual-, employer-, and job-level tax forms, covering the universe of individual and corporate tax filers in Canada. Crucially, we merge this database with Record of Employment (ROE) data, forms which employers are legally obligated to issue during separations and are primarily used to determine eligibility for transfer programs, such as employment insurance (EI). The ROE contains information on the beginning and end dates of employment and the reason for separation. We emphasize that Canada's regulatory environment lends itself naturally to accurate reporting on the ROE. First, in contrast to the U.S., employers' payroll taxes for funding EI are not subject to experience rating. Second, verification mechanisms through employment laws exist for rare cases when an employee and employer disagree with ROE information. Overall, our database therefore allows us to (i) evaluate the efficacy of the existing strategy in identifying involuntary separations, (ii) distinguish separations that conform to the notion of involuntarily displaced workers—the very people of interest in the literature, and (iii) shed light on outcomes of different types of mass-layoff separations. We provide four main findings that advance our understanding of outcomes upon involuntary job separations.

First, existing mass-layoff identification strategies used to detect involuntary job losses mix

[1] Survey data that are often useful in providing the reason for job separation at a higher frequency suffer from small sample sizes, are subject to measurement errors, and are unable to match workers with their employers.

separations that arise from a variety of reasons. We find that only a *quarter* of mass-layoff separations are actual layoffs, while 45 percent are not even actual job losses but are employer identifier changes due to reorganization (e.g., changes in business ownership or name, merger and acquisition) and the rest are quits or separations that occur for idiosyncratic reasons (e.g., parental leave, illness, retirement). While data limitations force the hands of researchers to implement this identification strategy, our results demonstrate the shortcomings of identifying involuntary separations without utilizing the exact reason for separation.

Second, the average earnings loss in the year following the separation for *all* mass-layoff separators is 28 percent in the Canadian data, which is well within the range of available estimates obtained using administrative data from the U.S. and European countries (18–46 percent).[2] However, utilizing ROE information on the reason for separation in our data, we document that involuntary mass-layoff separators experience a substantially larger loss of 54 percent. As such, we offer more accurate estimates on earnings losses for involuntary job separators that existing studies could not fully capture because of data limitations. Beyond its intrinsic empirical value, this finding is relevant for quantitative models that take earnings loss estimates as key inputs to discipline parameters, analyze mechanisms behind these losses, and evaluate policy (Huckfeldt 2022; Jarosch 2023; Braxton, Herkenhoff, and Phillips 2023, among others). For instance, using the smaller estimates for all mass-layoff separators understates the role of the job ladder in explaining earnings losses (as discussed below) and the insurance benefits of fiscal transfers.

Third, we show that the magnitude and sources of earnings losses greatly differ across separations with different reasons. We find that earnings and employer-specific premium (á la Abowd, Kramarz, and Margolis 1999, henceforth AKM) losses are larger and more persistent for layoffs than for quits. In the year following a mass-layoff separation during the Great Recession, the average earnings loss is 54 percent for layoffs but only 22 percent for quits. Six years after the separation, earnings remain 20 percent lower for layoffs but only 5 percent lower for quits when compared with job stayers. We also show that employer effects are important in explaining earnings losses for layoffs but not for quits. For layoffs, the loss of employer-specific premium accounts for 25 (60) percent of short-term (long-term) earnings losses. For quits, the average employer-specific premium does not change upon separation and becomes 4 percent higher six years after the separation when compared with stayers. We conjecture that this finding may help explain divergent results on the role of lost employer effects in explaining earnings losses obtained using data from Washington state (Lachowska, Mas, and Woodbury, 2020) vs Germany (Schmieder, von Wachter, and Heining, 2023). Since employer effects are important only for layoffs, country-specific compositional differences between layoffs and quits influence the overall role of employer effects. Another key implication of this finding is that the AKM model with

[2]On the other hand, available estimates on average earnings losses in the year following the separation according to survey data from the U.S. are even lower. These estimates are between 14 and 30 percent.

additive worker and employer effects explains earnings changes better for layoffs than for quits.

Finally, using ROE information on the exact separation date, we analyze the second key dimension of heterogeneity in separations that has been understudied in the literature: timing. We first document that employers experience substantial employment losses several months before the mass-layoff month: Around half of quits and a quarter of layoffs occur before that month. Next, to understand whether the timing of separation matters for its consequences, we estimate the dynamics of earnings and employer effects for separations before and after the mass-layoff month, separately for layoffs and quits. Overall, we uncover sizable heterogeneity in short-term earnings losses for separations with different reason and timing, ranging from 15 percent for quits six months after the mass-layoff month to 60 percent for layoffs six months before the mass-layoff month. Among layoffs, earnings and employer premium losses are larger for those who are laid off before the mass-layoff month than for those who are laid off after. In terms of worker characteristics, we find that workers who are laid off before the mass-layoff month have lower worker fixed effects, pre-separation earnings, and positions within the original employer's earnings distribution. Taken as a whole, these findings suggest that employers lay off less-productive workers first during a severe contraction. Among quits, earnings losses are also larger for workers who quit before the mass-layoff month than for those who quit after, but the employer premium changes between the two groups are similar. Importantly, we do not find any evidence that more-productive workers quit and "jump ship" in anticipation of the mass layoff. Instead, workers who quit early tend to have lower pre-separation earnings and worker fixed effects. This can be rationalized by the fact that workers who can retain their jobs throughout the contract enjoy sufficient time to sample job offers, wait for favorable job opportunities, and bargain better contracts. A key implication of these results is that the pool of separators is not random but instead is an outcome of strategic decisions made by employers and workers.

Related literature. This paper contributes to a large literature that analyzes the consequences of a job displacement using administrative data from various countries (Jacobson, LaLonde, and Sullivan 1993; Couch and Placzek 2010; Davis and von Wachter 2011; Lachowska, Mas, and Woodbury 2020; Schmieder, von Wachter, and Heining 2023; Bertheau et al. 2023, among others) and survey data from the U.S. (Ruhm 1991; Stevens 1997; Stephens 2002; Krolikowski 2017; Birinci 2021, among others). To the best of our knowledge, our paper is the first to study how earnings losses and their sources differ based on the reason and timing of separation during mass layoffs, using administrative employer-employee-matched data from Canada that provide records of job separations together with their underlying reasons and exact date of separation.[3] More importantly, our data allow us to revisit the measurement of a central question in the

[3]The information contained in Canadian job separation records has been used for other applications. Nakamura et al. (2019) and Nakamura et al. (2020) use the ROE to measure gross worker flows in Canada more accurately without a time-aggregation bias. Related to our work, Bowlus et al. (2022) use the ROE to compare short-run earnings growth distribution of stayers, laid-off separators, and non-laid-off separators.

literature: the extent to which job loss translates to adverse outcomes among workers. In particular, we reveal the limitations of the existing strategy used in the literature to identify involuntary separations, offer estimates that reflect outcomes of involuntary separations, and uncover differences in outcomes of separators when distinguished by reason and timing.

A closely related paper to our work is Flaaen, Shapiro, and Sorkin (2019), which combines administrative and survey data to distinguish between layoffs and quits during mass layoffs in the U.S. Similar to our results, they show that earnings losses are larger and more persistent following separations due to distress (covering layoffs, employer distress, and slack work conditions) than quits. Relative to this paper, our data allow us to link employees to their employers for *all* separations, not just those that appear in the survey data and provide a response to the survey question on the reason for separation. We document not only the differential magnitudes of earnings losses between layoffs and quits but also differences in the underlying sources behind these losses. We uncover drastically different roles of employer effects in explaining earnings losses for layoffs and quits, and show that the AKM model with additive worker and employer effects explain earnings changes better for layoffs than for quits. Finally, we provide novel findings on how worker characteristics and outcomes differ by timing of separation and argue that the pool of mass-layoff separators is a result of strategic decisions made by employers and workers.

The rest of the paper is organized as follows. Section 2 explains our data and empirical methodology. Section 3 provides results when we differentiate mass-layoff separations based on the reason for separation, and Section 4 documents results when we group them based on timing of separation around mass layoffs. Section 5 provides concluding remarks.

2 Data and empirical methodology

In this section, we provide details about our database, focusing on its novel aspects and how it allows us to differentiate separations during mass layoffs based on their reason and timing; provide details about our sample; and present sample descriptive statistics. We then discuss our empirical methodology in estimating the magnitude of earnings losses upon job separations during mass layoffs and in decomposing the sources behind these losses. Appendix A provides additional details about the underlying administrative forms used to construct the database.

2.1 Canadian Employer-Employee Dynamics Database

Data. We utilize the 2001-2016 Canadian Employer-Employee Dynamics Database (CEEDD), an annual employer-employee matched, longitudinal administrative record of the universe of yearly Canadian income tax filings for both individuals and employers, with a separate form that provides detailed information in relation to job separations. In particular, the CEEDD links *individual*-level information from T1 returns, *employer*-level information from the National Accounts Longitudinal Microdata File (NALMF) using various employer tax returns, and *job*-

level information from T4 slips and Records of Employment (ROE).[4]

On the worker side, the CEEDD provides information on worker demographics recorded from the T1 (e.g. age, gender, and province), as well as earnings from *all* jobs reported from all T4s.[5] We define earnings as total annual pre-tax earnings received from employment.[6] Importantly, each worker is linked to each employer from which they derive employment income using employer identifiers in their T4. As such, individual and employer identifiers along with the panel nature of the administrative records allow us to identify a worker's tenure at an employer. On the employer side, employer characteristics contained in the CEEDD include employer size, industry, legal status, and a wide range of income statement and balance sheet variables. Of note is the manner by which employer size is calculated. Employer size information is obtained from monthly payroll remittance forms (PD7), which provide information on the total number of employees an employer renumerated each month. Our measure of employer size is calculated as an annual average of the number of employees reported on this form for each month of the year.

Of particular importance to this study is the ROE form, as it contains detailed information that allows us to study how the circumstances surrounding a job separation influence worker outcomes. By law, employers are required to issue an ROE whenever there is an "interruption in earnings." These include cases when the worker does not receive any payment for at least seven consecutive days or when the worker's salary falls below 60 percent of regular weekly earnings. Therefore, an ROE must be issued after all job separations. However, an ROE may be issued, even without an interruption in earnings, because of changes in pay period type, payroll account number, business ownership, or business name.

The ROE contains information on a worker's employment history with a particular employer. Specifically, it provides information on employer and worker identifiers, exact hiring and separation dates, and detailed reasons behind a job separation. It is important to note that this information is available only when an ROE is issued (i.e., an interruption in earnings or other changes discussed above). As such, when an individual separates from an employer and finds a new job, we can obtain information on the exact beginning date of the new job only if the new employer issues an ROE because, for example, the individual also separates from the new job.[7]

In this paper, we focus on two key dimensions of job separations: reason and timing. First, using information on the reason for separation, we can separately identify quits and layoffs within

[4]T1 returns and T4 slips are similar to the individual-level 1040 form and job-level W2 form in the U.S., respectively. The NALMF is a longitudinal database of Canadian enterprises constructed from Statistics Canada's Business Register (BR), corporate tax returns (T2), payroll forms (PD7), and statements of renumeration (T4). As such, the NALMF covers all incorporated businesses as they are required to submit T2 forms, and unincorporated businesses with a least one employee as they are required to submit T4 and PD7 forms. A more detailed discussion about these forms can be found in Appendix A.

[5]As is typical in administrative datasets, our dataset does not contain information on hours worked.

[6]Earnings are converted to constant 2010 Canadian dollars (CAD) using the Consumer Price Index (all items).

[7]An implication of this limitation is that we can calculate the duration of non-employment after a separation only for those who find a new job and also separate from the new job.

and outside of severe employer contractions, i.e., mass layoffs (defined below). These mass-layoff events are widely used to identify unexpected job separations when estimating scarring effects of displacements. ROE codes cover detailed separation reasons, wherein we focus on two primary reasons—layoff and quit.[8] Second, information on the exact separation dates allows us to determine the proximity of a separation from the height of a mass layoff. Timing information allows us to treat episodes of employer contraction as protracted events wherein workers separate over time and potentially in a systematic manner that is related to worker characteristics.

Institutional details. In Canada, separating workers need the ROE form to provide authorities with information to assess eligibility for Employment Insurance (EI), as well as the benefit amount and duration they are entitled to. These workers are ineligible for regular EI benefits and severance payments based on years of service if they quit the job without just cause. As such, a potential concern with the accuracy of information provided by employers in the ROE form is that employers may have incentives to disguise or misreport a layoff as a quit. This would be especially concerning if the EI program in Canada featured experience rating as in the U.S., where an employer's payroll tax rate would rise with the number of previous employees receiving EI benefits. Facing such consequences, employers possess incentives to reduce the likelihood that their ex-employees' EI applications succeed (Lachowska, Sorkin, and Woodbury, 2022). In the context of submitting the ROE, disguising a layoff as a quit may prevent a worker from receiving EI. Reassuringly, employer EI contributions in Canada have not featured experience rating since 2001, unlike the U.S. system.[9] As such, an employer has less of a motive to misreport a layoff as a quit in the ROE form to undermine the EI claim of its previous employee. However, this does not mean that employers can fill the reason of separation section of the ROE form without paying much attention to it, given that the receipt of severance payments or other transfers (e.g., disability, parental leave, and retirement) by previous employees depends on the reason of job separation.[10] Overall, the information provided in the CEEDD with merged ROE data obtained within the context of a favorable institutional environment provide an ideal setup to study differences among workers who lose their jobs during mass layoffs.

We use the Canadian administrative records described above in two steps. First, we estimate earnings losses upon job separations during mass layoffs and decompose the sources of these losses, where we also conduct an Abowd et al. (1999) ("AKM") analysis to estimate the

[8]ROE includes codes for shortage of work (layoff), strike or lockout, return to school, illness or injury, quit, maternity leave, retirement, work-sharing, apprentice training, dismissal or suspension, leave of absence, parental, compassionate care/family caregiver, and other.

[9]The EI program in Canada has been financed by contributions shared by employees and employers since 1990. EI premiums are deducted from an employee's insurable earnings and an employer contributes 1.4 times the employee's contributions. The federal government briefly experimented with a form of experience rating in the 1990s; the reforms were implemented in 1996 but were ultimately repealed in 2001.

[10]Furthermore, if an employer misreports a layoff as a quit in the ROE form or forces an employee to resign involuntarily in order to avoid paying severance, the employee is able to appeal to this and is typically protected by employment laws that require the employer to provide severance payments to the employee.

contribution of employer fixed effects to earnings. Second, we use the data to understand the extent of heterogeneity in earnings losses upon job separation when we are able to distinguish job separations by reason and by proximity in time from a mass layoff.

In the rest of this section, we first describe our samples, explain how we identify mass-layoff events following the strategy used in the existing literature without using ROE data, and then we uncover differences among displaced workers within mass layoffs utilizing the ROE data.

Sample selection. In what follows, we describe the criteria used to construct our worker sample and to identify separations associated with mass layoffs. These criteria are chosen in a way that is consistent with those adopted by previous studies (Jacobson, LaLonde, and Sullivan 1993 and Lachowska, Mas, and Woodbury 2020, among others). This is an important step as it allows us to establish a baseline comparison with previous work using a similar sample before utilizing new information surrounding separations from the ROE data.

We restrict our sample to the working age population who are at most 50 years old in 2010.[11] As in Jacobson et al. (1993), we focus on long-tenure workers defined as those reporting positive earnings and being continuously employed by the same primary employer for six years. For workers with multiple jobs recorded during the tax year, we define the primary employer as that which accounts for the highest share of earnings for that individual during the year.[12] Similar to Jacobson et al. (1993), we further restrict the sample to individuals who reported positive earnings from 2002–2014 and for whom an employer identifier is always available. As such, the estimates on earnings losses following job separations should be interpreted as effects of separations on workers who remain attached to the labor force.[13] On the employer side, we restrict attention to employers with at least 50 employees in at least one year in 2002–2007, with positive employment in 2006 and 2007, and with non-missing industry code in 2007.[14]

Conventional mass-layoff identification. We now proceed to identifying mass layoffs in the data. In doing so, we closely follow the literature and use the same set of criteria that rely only on changes in the size of an employer over time. Following Lachowska et al. (2020), we define a *separator* to be a long-tenure worker who is separated from her primary employer at any point in time during 2008–2010.[15] Further, a separator is classified as a *mass-layoff separator* if the

[11] We also restrict our sample to individuals who are at least 21 years old in 2008, implying that they would have been in the working-age population in 2002. We also restrict our main sample to focus on years between 2002 and 2014 because of an oil price shock in 2015 in Canada that induced highly sector-specific job separations.

[12] We have explored excluding all multiple job-holders for robustness, finding no appreciable difference in main results, as shown in Appendix B.4.

[13] Workers who drop out of the labor force, work in the informal economy, and workers who move out of Canada or immigrate to Canada during the period of the sample will not be included in this sample.

[14] As discussed below, because mass layoffs are defined by percentage changes in employment, a small absolute change in employment may be considered a mass layoff for employers with few employees. As such, we focus on employers with at least 50 employees, as in the literature.

[15] We use the job flow exclusion methodology employed by Benedetto et al. (2007) to partially filter out employer identifier changes associated with merger and acquisition, changes in legal structure and name, as well as other

separation occurs in a year during which her primary employer experiences a mass layoff.[16] For the years between 2008 and 2010, a mass-layoff event occurs when (i) an employer experiences an employment drop of 30 percent or more relative to its 2007 employment level and (ii) its 2007 employment does not exceed 130 percent of 2006 employment. The second condition is used to reduce the chances that employers experiencing temporary employment fluctuations are classified as undergoing a mass layoff (Davis and von Wachter, 2011).[17]

We define a *stayer* to be a worker who remains attached with the same primary employer between 2002–2014. In our analysis, the control group consists of these long-tenure workers in 2008 who remain attached to their primary employer after 2008.[18] As such, the comparison will be between outcomes of long-tenure workers who separated from their job and long-tenure workers who retain employment with the same primary employer for another seven years.[19]

Utilizing ROE data. We now proceed to utilize additional information from the ROE data regarding the reason for job separation. Using the ROE forms for all mass-layoff separators in our sample, we first calculate the fraction of mass-layoff separators across different reasons for separation. The first column of Table 1 strikingly shows that 44.3 percent of mass-layoff separations in our sample are in fact employer identifier changes without an ROE. The last two columns of Table 1 present evidence to support the idea that mass-layoff separations with no ROE are more likely to be spurious separations (not related to actual job losses). The values in the column "Outflow" are constructed as follows. For a given mass-layoff separator moving from employer A to employer B, we compute the ratio of total number of individuals who move from employer A *and* to employer B to the total number of employees at the origin employer A. The values reported are the average of ratios across all separators of a given reason for job separation. The column "Inflow" presents statistics for when the ratio's denominator is the total number of employees at employer B. To interpret, among mass-layoff separators without an ROE, an average of 53.9 percent of all employees from the origin employer move to the same destination employer. Further, on average, workers originating from the same employer as the separator represent 49.8 percent of all employees at the destination employer. Thus, Table 1 shows that separations with missing ROE information are disproportionately associated with large employment flows from one employer to another. This indicates that separations without an

movements across establishments within a large parent organization.

[16]The group we label *mass-layoff separators* tend to be what the literature labels as *displaced workers*, defined as workers who experience an involuntary job separation. We retain this distinction throughout this paper as the ROE reveals that not all mass-layoff separators are laid-off workers. We provide more details on this below.

[17]Without restricting separations to be within the 2008–2010 period, we also consider an alternative sample restriction as well as alternative definitions of long-tenure workers and mass-layoff events as in Davis and von Wachter (2011). We present the results for this alternative specification in Section B.4.

[18]Specifically, the control group incorporates all job stayers and separators 6 years prior to the separation as in Lachowska et al. (2020).

[19]We also provide our main results when the control group focuses on stayers *within* the same employer from which mass-layoff separators separate. Appendix B.4 provides results for this alternative specification.

Table 1: Mass-layoff separations by reason for separation: Summary statistics

ROE reasons	Share (%)	Share (%) of ROE	Average fraction (%)	
			Outflow	Inflow
Layoff	25.3	45.5	5.8	8.3
Quit	11.9	21.4	2.0	4.7
Other	18.4	33.1	18.1	17.4
Missing	44.3	-	53.9	49.8

Note: This table presents ROE summary statistics for the mass-layoff separator sample. The first column presents a breakdown of separations by reason for separation, while the second column presents the same breakdown but conditional on the separation being associated with non-missing ROE. The third and fourth columns present differences in the extent to which different types of separations are associated with concentrated flows. The values in the column "Outflow" are constructed as follows. For a given separator moving from employer A to employer B, we compute the ratio of total number of individuals who move from employer A to employer B to the total number of employees at the origin employer A. The values reported are the average of ratios across all separators of a given reason for job separation. The column "Inflow" presents statistics for when the ratio's denominator is the total number of employees at the destination employer instead.

ROE have a significantly higher likelihood of being associated with employer merger, acquisition, and reorganization activities, which would ideally be excluded from the analysis. Importantly, the spurious nature of separations with missing ROE is further supported by the negligible change in the trend of average earnings for mass-layoff separators with a missing ROE after 2008 (Figure A1) and the small fraction of mass-layoff separators with a missing ROE receiving EI (Table A1). These results highlight that despite the efforts in the literature to exclude highly concentrated flows from the analysis of mass-layoff separators, as in Benedetto et al. (2007) and implemented in Section 2.1, this method is unable to capture all highly concentrated flows. Overall, these findings reveal the shortcomings of the existing strategy used to identify involuntary separations in mass layoffs without taking into account the exact reason behind each separation.

Having shown that separations with missing ROEs are unlikely to be relevant separations for this study, we narrow our attention to mass-layoff separations associated with an ROE. 25.3 percent of all mass-layoff separations, which corresponds to 45.5 percent of all mass-layoff separations with an ROE, are recorded as actual layoffs, while more than half of mass-layoff separations with ROE are actually quits or separations that occur because of other reasons. We note that our sample of *mass-layoff separators* is what Jacobson et al. (1993) and subsequent studies would label as the displacement sample, the set of workers who experienced a separation during mass layoffs. This implies that, even when focusing on non-spurious separations with ROE, the method of identifying involuntary job losses using separations that occur during large employer contractions, i.e., "mass layoffs," as in previous studies in the literature, actually captures a large number of voluntary separations. Given the presence of ROE information in our data, we are able to identify which separations conform better to the definition of *displaced* workers—employees who are laid off during mass layoffs. We argue that a more convincing measure of the consequences of involuntary job separations should focus on separation outcomes

associated with this group of workers. Importantly, in Section 3, we show that this distinction is relevant as we find that estimated earnings and employer-pay premium losses greatly differ across separations with different reasons for separation in mass layoffs.

For the remainder of the paper, we focus on analyzing differences between layoffs and quits in mass layoffs for two reasons. First, separations with missing ROE are often not actual job losses, as evidenced by concentrated flows of workers, and negligible change in average earnings and EI receipt around these events. Second, we also find that separations that we group under "Other" in Table 1 are less likely to be actual separations. This is because around 80 percent of separations in this group are coded under a category that is primarily used when an ROE is issued without an interruption in earnings.[20] Other major categories in this group cover many idiosyncratic reasons (e.g., pregnancy (6 percent), injury/illness (5 percent), going back to school (3 percent), and retirement (2 percent)), which we do not intend to differentiate in this paper.

Summary statistics. Before moving to discuss our approach to estimating the consequences of mass-layoff separations because of layoffs or quits, Table 2 presents descriptive statistics for mass-layoff separators with different reasons for separation (layoff, quit, or average across layoffs and quits) and compare them with stayers. We document several differences across the two groups within the mass-layoff separator sample. First, laid-off workers had around $5,000$ CAD lower average earnings than stayers between 2002 and 2005, while the average earnings of those who quit were much closer to that of stayers. Second, in terms of demographics, laid-off workers are less likely to be female and older than are workers who quit. Third, the fraction of individuals who receive EI transfers after the separation, as well as the average amount of EI receipt, are much higher for laid-off workers than for workers who quit.[21] Fourth, the primary employers of laid-off workers are much smaller in size than those of workers who quit. Finally, layoffs are highly concentrated within manufacturing, while quits are concentrated within manufacturing; trade and transpiration; and information, finance, and professional services.

2.2 Estimating the consequences of job separation

We now discuss our methodology to estimate earnings losses upon separations during mass layoffs. We then explain how we use the AKM model to estimate the importance of employer and match effects in driving these earnings losses following separations.

To estimate the scarring effects of job separation on earnings, we follow Jacobson et al. (1993)

[20] In particular, employers often use "code K" in the ROE form when there is no interruption in earnings. We find that 80 percent of separations that we group under "Other" in Table 1 are recorded under this code.

[21] As discussed earlier, while workers who quit their job without just cause are ineligible for EI transfers, those who had a just cause (e.g., harassment, discrimination, significant change in work duties) to quit may qualify for EI. In our sample, around one-third of mass-layoff separators who quit their job receive EI transfers. Furthermore, individuals who are working part-time can also collect EI. In our sample, 16 percent of stayers receive EI.

Table 2: Sample descriptive statistics

	Mass-layoff separators			Stayers
	Average	Layoff	Quit	
Worker characteristics				
Average earnings 2002–2005 (2010 CAD)	52,500	51,400	54,800	56,500
Female (proportions)	0.326	0.298	0.386	0.522
Age in 2007 (years)	39.14	40.02	37.29	40.74
	(6.78)	(6.58)	(6.83)	(6.17)
Fraction received EI	0.64	0.79	0.32	0.16
Average EI among recipients (2010 CAD)	12,132	13,800	8,600	8,600
Employer characteristics in 2007				
Employer size (number of workers)	3,755	1,805	7,899	9,575
	(10,744)	(4,219)	(17,253)	(22,469)
One-digit NAICS Industry (proportions)				
1 agriculture, forestry, fishing	0.021	0.027	0.009	0.003
2 mining, utilities, construction	0.041	0.041	0.040	0.040
3 manufacturing	0.620	0.712	0.425	0.189
4 trade, transportation	0.126	0.081	0.221	0.159
5 information, finance, prof. services	0.128	0.085	0.220	0.126
6 educational and health care services	0.015	0.012	0.021	0.364
7 arts, recreation, hospitality services	0.035	0.036	0.034	0.019
8 other services	0.005	0.004	0.008	0.015
9 public administration and unclassified	0.009	0.002	0.023	0.085
Number of employers (pre- and post-separation)	20,780	15,065	8,775	12,825
Number of workers	19,410	13,185	6,225	774,075

Note: This table presents descriptive statistics for workers who separate from their jobs during a mass layoff between 2008 and 2010 because of a layoff or quit (or the average across the two reasons) and stayers who remain attached to the same primary employer between 2002 and 2014. Standard deviations are provided in parentheses. Fraction received EI and average EI amount among recipients are calculated from the year of separation and the year following the separation for mass-layoff separators, while they are calculated from between 2008 and 2009 for stayers. Because of confidentiality, dollar values are rounded to the nearest 100 CAD and counts are rounded to the nearest 5.

and Lachowska et al. (2020) and use the following distributed lag regression:

$$y_{i,t} = \alpha_i + \zeta_t + \beta x_{i,t} + \sum_{s \in S} \sum_{k=-4}^{6} d^s_{i,t,k} \times \gamma^s_k + \varepsilon_{i,t}. \tag{1}$$

Here, $y_{i,t}$ denotes the logarithm of annual earnings of individual i reported in year t, while α_i and ζ_t capture individual and time fixed effects, respectively. Further, $x_{i,t}$ represents a vector of individual and primary employer characteristics including a quadratic on individual's age, interactions between gender and age, interactions between year dummies and worker's average earnings (over 2005–2007), as well as primary employer size in 2007 and its one-digit employment industry (NAICS) code.[22] The vector of dummy variables $d^s_{i,t,k}$ indicates that the worker at year t is observed k years before, on, or after a separation. For example, $d^s_{i,t,3} = 1$ if year t is three

[22]Controlling for pre-displacement average earnings was also employed by Davis and von Wachter (2011) and Lachowska et al. (2020) and aims to capture differential trends in earnings for mass-layoff separators and stayers.

years after a mass-layoff separation for individual i and zero otherwise.

Our main interest lies in the estimates of γ_k^s, which are estimated percent differences in annual earnings between mass-layoff separators and stayers for the four years preceding the separation ($k = -4, -3, -2, -1$), for the year of the separation ($k = 0$), and for every year until six years after the separation ($k = 1, 2, ..., 6$).[23] Under the assumption that, absent separation, average earnings of mass-layoff separators would be parallel to those of stayers, estimated γ_k^s is interpreted as the causal effect of separations. In Appendix B.4, we relax the parallel trends assumption by modifying Equation (1) to allow for worker-specific linear time trends. We find that this does not materially change our main findings and thus provides additional reassurance that the pre-displacement earnings of mass-layoff separators and stayers moved in parallel.

In our analysis, the set S can take several forms. In the absence of ROE information, $d_{i,t,k}^s$ would simply refer to the occurrence of a mass-layoff separation. In this case, the estimated coefficients-of-interest γ_k^s would reduce to γ_k and represent regression-implied differences in earnings outcomes between mass-layoff separators and stayers. Such estimates would be comparable to those estimated in the existing literature, such as Jacobson et al. (1993) and Lachowska et al. (2020). However, unlike previous studies, we separately estimate differences in outcomes between separators and stayers depending on reasons or timing of the separation. In particular, ROE information allows us to determine differences within mass-layoff separations characterized by a layoff and quit. Moreover, we also divide mass-layoff separations into alternative groupings based on the proximity of time of the separation to the exact date of mass layoff. As such, when earnings loss coefficients differ by subgroup s, we interact separation dummies, along with their leads and lags, with dummies indicating membership in $s \in S$.

Finally, the changes in earnings upon job separation can then be decomposed into three main components as in Lachowska et al. (2020): those that arise from changes in employer-specific pay premium, match effect, and a residual (direct) effect. Below, we explain how to estimate the first two components following the literature.

Employer-specific pay premium. There is a rich literature analyzing the role of employers in affecting earnings differences across individuals (Abowd, Kramarz, and Margolis, 1999; Card, Heining, and Kline, 2013; Card, Cardoso, and Kline, 2016; Sorkin, 2018; Song et al., 2019). Following this literature, we estimate an AKM model of earnings using our data. We then use the resulting estimated employer fixed effects to measure the fraction of earnings losses of mass-layoff separators accounted for by working for post-displacement employers that differ from the pre-displacement employer in terms of policies affecting average earnings.

We identify employer-specific time-invariant effects on earnings, which we term "employer-

[23] For each separator during a mass layoff, we assume that separation happens a year prior to an employer identifier change for that individual. This assumption is not important for estimates presented throughout the paper; it only shifts estimates one year before and after separations.

specific pay premium," using the following regression based upon Abowd et al. (1999) (AKM):

$$y_{i,t} = \kappa_i + \psi_{j(i,t)} + \lambda_t + v_{i,t}. \tag{2}$$

We regress the logarithm of annual earnings $y_{i,t}$ of individual i in year t on individual fixed effects κ_i, time fixed effects λ_t, and employer fixed effects $\psi_j(i,t)$, where the function $j(i,t)$ indexes the primary employer j of individual i in year t. For this regression, following the literature, we use a different sample, restricting the full database of earnings between 2001 and 2016 to exclude (i) stayers and all separators, including the mass-layoff separators as defined above, (ii) earnings in the first or last year of an employment spell, (iii) earnings below 400 times the national average minimum hourly wage, and (iv) employers with less than 5 employees in that year.[24]

Estimation of Equation (2) yields a vector of employer-specific premiums $\widehat{\psi}_j$ for log of earnings, which represent time-invariant employer characteristics such as compensation policy that shape earnings. Put differently, following the interpretation of Card et al. (2013), $\widehat{\psi}_j$ represents a measure of pay advantages associated with being employed by a particular employer j.[25]

We use the estimated employer effects $\widehat{\psi}_j$ as outcomes of job separations. In particular, we use them to estimate the fraction of earnings losses upon separations that can be accounted for by reemployment of a separated worker at an employer with a different $\widehat{\psi}_j$ than the employer from which the worker was separated. To do so, we assign $\widehat{\psi}_j$ of the primary employer to each worker-year observation in the data whenever possible.[26] We then use these data to estimate the role of employer-specific premium in explaining earnings dynamics following a worker's separation, by type of separation $s \in S$, in a very similar way to total earnings as in Equation (1) above:

$$\widehat{\psi}_{j(i,t)} = \alpha_i + \zeta_t + \beta x_{i,t} + \sum_{s \in S} \sum_{k=-4}^{6} d^s_{i,t,k} \times \gamma^s_k + \varepsilon_{i,t}, \tag{3}$$

where variables in the right-hand side of this equation are identical to those in Equation (1). Here, estimated negative (positive) γ^s_k values represent evidence of lost (gained) employer-specific premiums following separations.

[24] These sample restrictions are similar to those made in Card et al. (2013), Sorkin (2018), Song et al. (2019), and Lachowska et al. (2020) among others. The first restriction is imposed to avoid a mechanical relationship between employer effects and earnings losses of mass-layoff separators that would potentially overstate the role of employer effects. The second restriction is imposed to eliminate non-full-year earnings from an employer. Finally, the last two restrictions are imposed to drop workers with very little earnings so that we do not incorporate logarithm of very small amounts in our observations and employers with few workers so that employer effects are estimated for a reasonably-sized employers.

[25] Although we do not focus on variance-covariance estimates from the AKM specification, in Appendix B.3, we report results in relation to worker mobility in Canada to mitigate concerns on limited worker mobility bias.

[26] We cannot assign employer effects when, for example, a separated worker is reemployed by an employer that does not belong to the "connected set" used to estimate employer effects or that has less than 5 employees. However, the fraction of such cases among all observations is less than 0.1 percent.

Match effects. We also estimate match effects as a time-invariant worker-employer fixed effect. These match effects can be interpreted as changes in a worker's productivity when the worker is employed by different employers due to differences in work arrangements that affect the worker's productivity. We estimate match effects for earnings and then use them to understand the fraction of earnings losses upon separations that can be accounted for by loss of match effects.

Following Woodcock (2015) and Lachowska et al. (2020), we estimate match effects as follows. First, we calculate the average log of earnings $\overline{y_{ij}}$ for each worker-employer pair (i, j) in the sample over the duration of the match.[27] Second, average earnings are regressed on worker θ_i and employer $\xi_{j(i,t)}$ fixed effects, where the regression is weighted by match duration. Formally,

$$\overline{y_{ij}} = \theta_i + \xi_{j(i,t)} + \mu_{ij},$$

where the error μ_{ij} is assumed to be orthogonal to the worker and employer fixed effects. The residuals $\widehat{\mu}_{ij}$ represent the component of earnings accounted for by time-invariant worker-employer match effects, averaged over the period the match is observed, after accounting for worker and employer effects.[28]

We estimate match effects from this equation using our sample to estimate the AKM model described above except that we keep stayers and all separators because the match effects are individual-specific. We then estimate the impact of separations on estimated match effects where we use $\widehat{\mu}_{ij}$ as a dependent variable similar to that in Equation (3).

3 Earnings losses upon separations: the role of reason

In this section, we first document how earnings and employer effects evolve upon all mass-layoff separations. This step allows us to benchmark our results with previously documented estimates in the literature. Next, we estimate earnings losses following layoffs and quits and compare how the magnitude and sources of earnings losses due to employer, match, and direct effects differ between these two types of separations *within* the mass-layoff separator sample. This step presents novel results when compared with existing studies, as we document that earnings and employer-effect dynamics greatly differ across layoffs vs. quits.

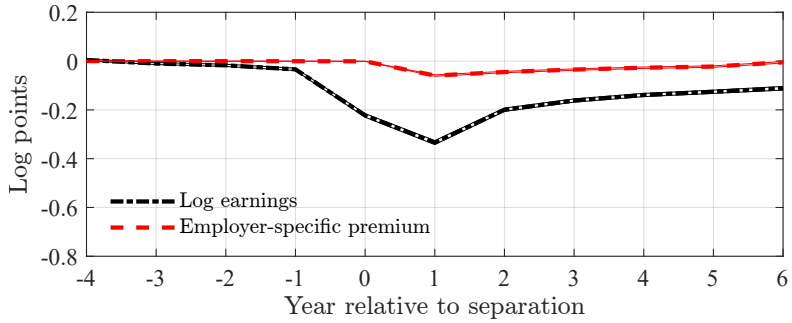
3.1 Earnings losses without accounting for reason of separation

We start by estimating the effects of a separation during mass layoffs on log earnings from Equation (1) and on employer-specific pay premium from Equation (3). The objective of this

[27] Following Lachowska et al. (2020), we net out year and tenure effects from the average of log earnings $\overline{y_{ij}}$. We do so by first removing year effects from the outcome variable, and then regressing this adjusted outcome variable on years of job tenure and worker-employer match indicators. Next, we subtract the contribution of job tenure from the outcome variable and calculate within-match averages of the outcome variable.

[28] Because worker and employer effects are constant over time and $\widehat{\mu}_{ij}$ is constant for each match, some individual-level variation in earnings remains after accounting for worker, employer, and match effects.

Figure 1: Effects of job separation among mass-layoff separators



Note: This figure plots estimates for earnings and employer-specific pay premium losses upon job separations during mass layoffs. The dashed-dotted-black line shows estimated γ_k values (along with 95 percent confidence intervals given by solid-black lines) without taking into account the type of separation s in Equation (1). The dashed-red line presents estimated γ_k values (along with 95 percent confidence intervals given by solid-red lines) without taking into account the type of separation s in Equation (3).

exercise is to establish a consistent benchmark with the literature by retaining the same approach used in identifying mass layoffs, without utilizing new information (reason or timing) from the ROE. As a result, in Section 3.1, S contains only one element: the mass-layoff separator sample.[29]

The black line in Figure 1 plots the estimated effects of mass-layoff separations on earnings, i.e., the estimated γ_k values, along with 95 percent confidence intervals, which are narrow because of the large sample size. We find that the average earnings of mass-layoff separators start declining one year before the separation, consistent with the findings in the literature.[30] We also find that the average earnings loss in the year following a mass-layoff separation was 28 percent ($\exp(-0.33) - 1 = -0.28$ or 33 log points) during the 2008–2010 episode in Canada. This loss was also persistent: The earnings of mass-layoff separators remain 11 percent lower even after six years past the job separation when compared with the earnings of job stayers.[31]

These results are comparable to previous estimates in the literature using U.S. national- and state-level administrative data and European administrative data.[32] Jacobson et al. (1993) use data from Pennsylvania and estimate an average of 40 percent earnings loss for mass-layoff separators in the year of separation. The earnings of mass-layoff separators stay around 25 percent lower six years after the separation. Couch and Placzek (2010) use administrative data from Connecticut and find that the average earnings loss is 32 percent for mass-layoff separators in the year of separation and that the earnings of these workers remain lower by 12 percent

[29]Recall that this sample covers all mass-layoff separations including those with or without an ROE.

[30]This result is often called the "Ashenfelter's dip," which refers to the fact that the earnings and hours worked of separators decline even before the separation. In addition, in Section 4, we will show that a sizable fraction of separations occur prior to the year of mass-layoff, leading to a decline in the average earnings of mass-layoff separators even before the mass layoff.

[31]Figure A2 in Appendix B.2 presents estimated earnings losses upon separations in mass layoffs in 2010 CAD. The average earnings of all mass-layoff separators drop by around 7,800 CAD in the year following the separation and remain around 5,000 CAD lower six years after the separation.

[32]The similarity of estimates found in the Canadian data to those found in U.S. national- and state-level data and European data provides some reassurance that the substantial heterogeneity documented in Section 3.2 do not simply arise from differences in the source of data.

six years after the separation. Davis and von Wachter (2011) use administrative data from the U.S. to study the cyclicality of earnings losses following mass-layoff separations. They find that earnings drop by 39 (20) percent following such separations during recessions (expansions), and that these negative effects are persistent. Lachowska et al. (2020) use administrative data from Washington and find an average earnings loss upon a mass-layoff separation of 43 percent during the Great Recession.[33] Schmieder et al. (2023) use administrative data from Germany to study the cyclicality of earnings losses. They estimate that the average earnings loss in the year of separation during a mass layoff is 27 percent and find that this loss is long-lasting, remaining depressed by 12 percent even after six years. Finally, Bertheau et al. (2023) measure magnitudes of earnings losses across seven European countries using administrative datasets. They document that the average earnings loss is between 18 percent and 46 percent in the year of separation and between around 10 percent and 30 percent five years after the separation across countries.

There is a growing literature that studies the role of employer-specific pay premiums in explaining the magnitude and persistence of earnings losses following separations upon a mass layoff. Lachowska et al. (2020) find that 6 percent of all earnings losses in the quarter following separations in mass layoffs is due to reemployment with an employer that pays less on average. In terms of long-term effects, they show that employer effects account for 9 percent and 17 percent of all earnings and wage rate losses, respectively, five years after separations in mass layoffs. On the other hand, Schmieder et al. (2023) estimate much larger employer effects in explaining wage losses. They find that 75 percent of wage losses are explained by employer effects.

Our results from Canadian data indicate that the change in employer effects are in between these two estimates, as shown by the red dashed line in Figure 1 which presents the estimated dynamics of employer-specific pay premium, i.e., estimated γ_k values from Equation (3). We find that lost employer effects explain 18 percent of the average earnings loss in the year following separations: 6 log points of the average earnings loss of 33 log points are due to reemployment with an employer that pays less on average. However, we also find that employer effects almost fully recover six years after the separation and the loss of employer effects accounts for only 4.5 percent of earnings loss six years after the separation.[34]

[33] Multiple studies measure earnings losses upon mass-layoff separations using survey data from the U.S. Estimates obtained from these survey data are often smaller in magnitude than estimates obtained from administrative data. For instance, Topel (1990) use Displaced Workers Survey and estimate an average of 17 percent earnings loss in the year of separation, while Ruhm (1991) and Stevens (1997) use the Panel Study of Income Dynamics and estimate an average of 14 percent and 30 percent earnings loss, respectively, in the year of separation.

[34] In general, employers play an important role in shaping earnings inequality in Canada. Gee et al. (2020) document that around 40 percent of the total earnings variance in Canada is explained by between-firm earnings variance. In addition, in a decomposition of the total earnings variance over time (Figure 4), they show that between-firm earnings variance is constant after 2000 in Canada. Based on the AKM regression, Li et al. (2020) report that employer effects explain 11 percent of log earnings variance for both men and women in Canada.

3.2 Uncovering the differences in outcomes among layoffs vs quits

Earnings and employer-effect dynamics. Having presented our benchmark estimates of the consequences of job separation, we now investigate the extent to which this average estimate might mask differential scarring effects of job displacement for those who are laid off vs those who quit. To this end, we present the estimated effects of mass-layoff separations on log earnings from Equation (1) and on the employer-specific pay premium from Equation (3) for separations with different reasons within our mass-layoff separator sample. As such, in Section 3.2, the set of groups within the mass-layoff separator sample $S = \{\text{layoff, quit}\}$.

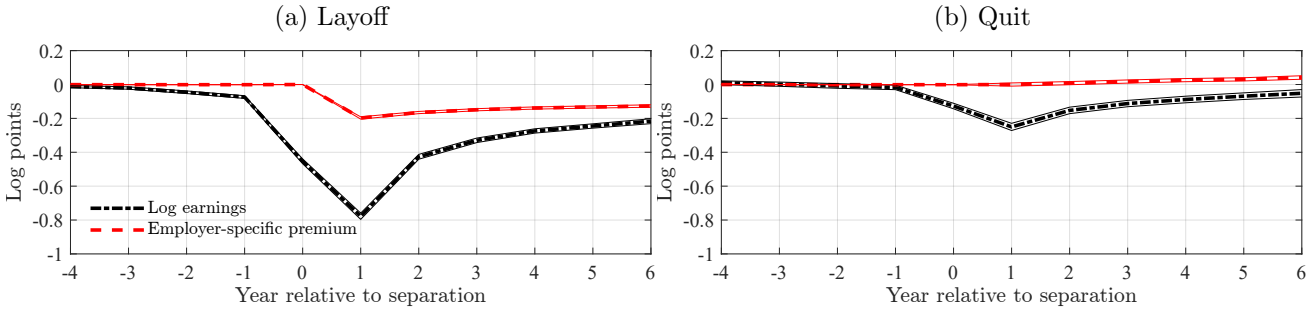
The dashed-dotted-black lines in Panels (a) and (b) of Figure 2 plot earnings dynamics for individuals who are laid off from employers with a mass layoff and individuals who quit from such employers, respectively. We find significant differences in earnings losses between the two groups. In the year following a separation during the Great Recession, individuals who are laid off experience an average earnings loss of 78 log points, while individuals who quit experience an average earnings loss of only 25 log points. Six years after these separations, the former group's average earnings stay 22 log points lower, while the latter group's average earnings is only 5 log points lower.[35] Thus, we find that involuntary job separators during mass layoffs—the true group of interest—experience substantially larger and more persistent earnings losses than what is implied by estimates in both the literature and in Section 3.1 that mix a variety of separations arise from layoffs, quits, or other idiosyncratic reasons, as well as non-separation events that result in employer identifier changes but are not actual job losses. As a result, our analysis is able to offer more accurate estimates on earnings losses for involuntary job separators that existing studies could not fully capture due to data limitations.

We further show that the dynamics of employer-specific pay premium are also drastically different for these two types of separations within the mass-layoff separators sample. While individuals who are laid off experience a large and persistent loss in employer-specific premium, individuals who quit their job face virtually *no* short-term decline in employer-specific premium and in fact experience a positive long-term *gain* in employer-specific premium. These results are shown by red-dashed lines in Panels (a) and (b) of Figure 2.

Starting with individuals who are laid off, we find that the average employer-specific premium for these workers is 20 log points lower in the year following the layoff and 13 log points lower six years after the layoff. These imply that, for this group, the loss of employer-specific premium accounts for 26 percent (20/78) of earnings losses in the short term and 59 percent (13/22) in the long term. On the other hand, the average employer-specific premium does not change in

[35] Figure A2 in Appendix B.2 presents these earnings loss estimates in levels of 2010 CAD. For quits, the average earnings drop by about 7,300 CAD in the year following the separation and remain around 1,800 CAD lower six years after the separation. For layoffs, the average earnings decline by 21,600 CAD in the year following the separation and stay 9,900 CAD lower six years after the separation.

Figure 2: Effects of job separation by reason for separation



Note: This figure plots estimates for earnings and employer-specific pay premium dynamics upon job separation by reason of separation during mass layoffs. Panel (a) presents estimates for separations due to layoff during mass layoffs and Panel (b) presents estimates for separations due to quit during mass layoffs. Dashed-dotted-black lines show estimated γ_k^s values (along with 95 percent confidence intervals given by solid-black lines) in Equation (1), and dashed-red lines present estimated γ_k^s values (along with 95 percent confidence intervals given by solid-red lines) in Equation (3).

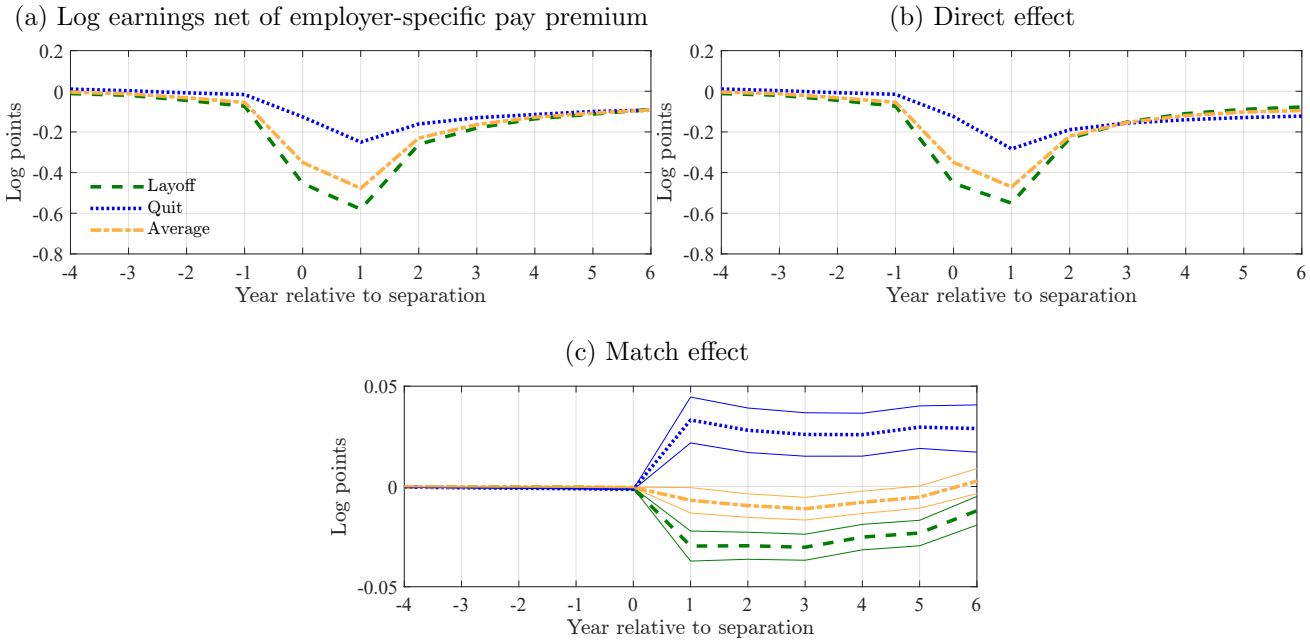
the year following the separation for individuals who quit during mass layoffs. In fact, six years after the quit, it increases by 4 log points for these individuals.[36]

A growing literature (see, among others, Card et al., 2013; Card et al., 2016; Barth et al., 2016; Sorkin, 2018; and Song et al., 2019) has established that employer effects are important in explaining earnings dynamics in general. More recently, focusing on mass-layoff separators, Lachowska et al. (2020) estimated a limited role of employer effects in explaining earnings losses of separators in Washington state, while Schmieder et al. (2023) estimated that lost employer effects play a significant role in explaining the losses of mass-layoff separators in Germany. We document novel evidence that the role of changes in employer-specific premium in explaining earnings losses upon mass-layoff separations is drastically different for individuals who are laid off than for those who quit. For the former group, the loss of employer-specific premium accounts for a quarter of their short-term earnings loss and close to two-thirds of their long-term earnings losses. For the latter group, changes in employer-specific premium have no role in explaining their earnings losses.[37] As such, our results suggest that the overall importance of employer effects depends on whether the job separation is voluntary or not. This finding might help explain the differential importance of employer effects obtained using data from Washington state vs Germany: The composition of layoffs and quits across these two datasets may be different.

[36]In Appendix B.4, we provide robustness checks for the results in Figure 2 under alternative specifications and samples. Specifically, Figures A3 to A7 repeat the results in this section using a sample of single-job holders (excluding multiple-job holders), focusing only on mass-layoff events due to employer closures, implementing an alternative definition of mass-layoff events as in Davis and von Wachter (2011), comparing outcomes of mass-layoff separators to stayers within the same employer, and incorporating heterogeneous (worker-specific) trends in Equation (1). Overall, our main results remain mostly similar across all these exercises.

[37]In Appendix B.7, we repeat our analysis of earnings and employer premium outcomes for separations that occur outside a mass layoff event. Our findings point to important interactions between worker and employer outcomes. For both layoffs and quits, average earnings and employer premium outcomes arising from a non-mass layoff separation are less severe when compared with those arising from separations during mass layoffs. In addition, the gap in outcomes documented between workers who are laid off and those who quit also narrows when restricting the analysis to non-mass layoff separations.

Figure 3: Underlying reasons behind differences in earnings losses upon layoffs and quits



Note: This figure plots estimates for dynamics of log earnings net of employer-specific pay premium (Panel (a)) as well as direct effects (Panel (b)) and match effects (Panel (c)) of separations by reason of separation in mass layoffs. Dashed-green lines present these estimates for separations due to layoffs in mass layoffs, dotted-blue lines represent these estimates for separations due to quits in mass layoffs, and the dashed-dotted-orange lines represents the average of estimates for the two separation types. 95 percent confidence intervals are given by solid lines in Panel (c).

Sources of earnings losses. To better understand the reasons behind differences in earnings losses upon layoffs and quits within mass-layoff separators, we first present the dynamics of log earnings net of employer-specific premium in Panel (a) of Figure 3. It shows that changes in log earnings net of employer effects for layoffs and quits become nearly identical four years after the separation, implying that differences in long-term earnings losses between the two groups are almost entirely driven by differences in employer effects.[38] In terms of the gap in the year following the separation, employer effects account for 20 log points of the total 53 log points gap ($78 - 25 = 53$), given that the gap in log earnings net of employer effects between the two groups is 33 log points ($58 - 25 = 33$). Put differently, 38 percent of the total earnings gap in the year following the separation is due to the difference in employer effects.

Panel (b) shows that, in the year following the separation, the earnings loss decline attributable to direct effects is 55 log points for layoffs and 28 log points for quits, implying that the difference in direct effects accounts for 27 log points of the total 53-log-point gap between earnings losses for layoffs and quits after the separation (or, equivalently, 51 percent of the short-term earnings gap is due to the difference in direct effects). We also find that the difference in direct effects between layoffs and quits disappears two years after the separation. Because direct

[38]Notice that, in the long run, the magnitude of the direct effect loss is slightly larger for quits, while the match effect is slightly positive for quits and negative for layoffs. As a result, in the long run, these small differences in direct and match effects between the two groups cancel out each other.

effects capture scarring effects and loss of time-varying features of the former worker-employer relationship, our results imply that such effects of separation are only important in driving the difference in earnings losses between the two groups in the short term but not in the long term.

Finally, Panel (c) shows that match effects lead to a 3-log-point increase in average earnings for individuals with quits, while they lead to 3-log-point decline in average earnings for individuals with layoffs. This result implies that, following a separation in mass layoffs, individuals with quits gain time-invariant worker-employer match effects, while individuals with layoffs lose such effects. Overall, the remaining 6 log points (or, equivalently, 11 percent) in the total gap between earnings losses in the short term is explained by the difference in match effects.[39]

Taking stock. We estimate much larger and more persistent earnings losses upon involuntary job separations during mass layoffs when compared with estimates in the literature, as our data allow us to distinguish separations because of layoffs from separations because of quits, reorganization related employer identifier changes, and idiosyncratic reasons. We also show that lost employer effects are important in explaining earnings losses for layoffs but not important for quits. In terms of underlying sources of the difference in earnings losses between the two groups, we find that the short-term gap in earnings losses is driven by differences in direct and employer effects, while the long-term gap is almost entirely explained by the difference in employer effects. On the other hand, match effects are negative for layoffs but positive for quits, but they are relatively small for both groups in magnitude.

3.3 Cross-sectional earnings loss differences upon layoff vs quit

Overview. In this section, we investigate the reasons behind the gaps along the cross-section in post-separation outcomes between workers who are laid off and workers who quit during mass layoffs. Section 3.2 established that employer effects play an important role in explaining the difference in earnings losses between the two groups, both upon impact and especially over longer horizons. The following discussion provides further insights on the gap in outcomes of workers who are laid off and who quit when separators are subdivided into different segments of the employer premium ladder. In particular, we assign each employer into employer-specific pay premium quintiles based on their AKM estimates.[40] We then assign each separation into one of 25 quintile-to-quintile transitions using the respective employer-effect quintiles of the separator's origin and destination employers. In doing so, we compare outcomes between one year before and three years after the separation, similar to Card et al. (2013) and Lachowska et al. (2020). This allows us to calculate the average change in earnings and underlying changes in employer, match, and direct effects for each of the 25 quintile-to-quintile transitions for all separations as

[39]Focusing on the sources of earnings losses within each group, Figure A8 in Appendix B.5 presents a complete decomposition for the sources of earnings losses upon layoffs and quits.

[40]Thresholds for the quintiles are obtained by sorting on individual-year observations.

Table 3: Below-, on-, and above-diagonal sums and averages

	Below diagonal	On diagonal	Above diagonal
(a) Layoff			
Share of separators	0.468	0.370	0.164
Average change in log earnings	-0.332	-0.017	0.159
Average change in employer effect	-0.414	-0.002	0.303
Average change in match effect	0.037	-0.050	-0.167
Average direct effect	0.046	0.034	0.023
(b) Quit			
Share of separators	0.288	0.380	0.335
Average change in log earnings	-0.097	0.139	0.277
Average change in employer effect	-0.360	0.017	0.365
Average change in match effect	0.191	0.048	-0.130
Average direct effect	0.073	0.074	0.042
(c) Average			
Share of separators	0.410	0.373	0.219
Average change in log earnings	-0.279	0.034	0.217
Average change in employer effect	-0.402	0.004	0.334
Average change in match effect	0.071	-0.018	-0.149
Average direct effect	0.052	0.047	0.033

Note: This table presents five rows for separations with a different reason (layoff, quit, or average across layoffs and quits) with below-diagonal, on-diagonal, and above-diagonal transitions: (i) the fraction of separators, (ii) average change in log earnings, (iii) average change in employer effects, (iv) average change in match effects, and (v) average direct effects of the transition. Below-diagonal transitions represent moves to an employer with a lower-quintile employer effects, on-diagonal and above-diagonal transitions represent moves to a same-quintile employer and to a higher-quintile employer, respectively. Values are based on a comparison of outcomes between one year before and three years after separation.

well as separately for individuals who are laid off and individuals who quit during mass layoffs.

In the remainder of this section, we document results using this analysis. Table 3 summarizes the main differences in quintile-to-quintile transitions between layoffs and quits by focusing on below-diagonal, on-diagonal, and above-diagonal transitions. Next, in Figures 4, 5, and 6, we document more detailed results across quintile-to-quintile transitions regarding distributions, earnings losses, and the sources of these losses upon transitions across origin and destination employer-effect quintiles. These figures demonstrate main insights from Tables A2, A3, and A4 in Appendix B.6, which present the full results for each of the 25 quintile-to-quintile transitions for all separations in mass layoffs, as well as separately for layoffs and quits, respectively.

Below-, on-, and above-diagonal transitions. Table 3 presents results for below-, on-, and above-diagonal transitions. Below-diagonal transitions represent moves to a destination employer in a lower employer-effects quintile; on-diagonal and above-diagonal transitions represent moves to a same-quintile employer and to a higher-quintile employer, respectively. Table 3 presents five statistics (rows) conditional on separations differentiated by reason (layoff, quit, or average across layoffs and quits) and by the type of transition (below-, on-, or above): (i) the fraction

of separators, (ii) average change in log earnings, (iii) average change in employer effects, (iv) average change in match effects, and (v) average direct effects of the transition. For instance, among all individuals who are laid off in our mass-layoff separators sample, 46.8 percent found reemployment with an employer whose employer effect is in a lower quintile than the employer-effect quintile of the worker's origin employer. These individuals experienced an average of 33.2 log points earnings loss, and this loss was largely driven by a loss of employer effects (41.4 log points) but partially mitigated by gains of match effects and direct effects (3.7 and 4.6 log points, respectively).[41] We emphasize the following three main observations from Table 3.

First, workers who are laid-off (Panel (a)) are more likely to transition into lower employer-premium quintiles compared with those who quit (Panel (b)). Almost half of those laid-off move to lower-paying employers, while this fraction is less than 30 percent among those who quit. Since laid-off workers account for a disproportionately large fraction of below-diagonal transitions, when simply looking at average earnings losses for below-diagonal transitions (Panel (c)), changes in earnings and its subcomponents more closely mirror this group. In contrast, the average earnings changes of above-diagonal transitions are closer to those who quit than those who are laid-off, given that the fraction of workers who move to employers with higher employer-premium quintiles is much higher for quits (33 percent) than layoffs (16 percent).

Second, conditional on falling into lower employer-premium quintiles, workers who are laid-off experience much larger declines in earnings than those who quit (33.2 vs. 9.7 log points). Importantly, we find that losses of employer effects are comparable for layoffs and quits with a below-diagonal transition (41.4 vs. 36.0 log points) and that the smaller loss in earnings for quits is mostly driven by a larger average gain in match effects (3.7 vs 19.1 log points), mitigating lost employer effects. This means that when individuals who quit their job in a mass layoff find reemployment at an employer with lower pay on average, they often obtain valuable specific worker-employer matches, which may be because of better fits for their skill sets at destination employers or better contracts from destination employers that increase their productivity.

Finally, conditional on rising along employer-premium quintiles, relative to laid-off workers, those who quit experience larger increases in earnings (15.9 vs. 27.7 log points), although the earnings-gain gap between layoffs and quits is smaller in this case relative to the earnings-loss gap for below-diagonal transitions. For above-diagonal transitions, workers experience a substantial gain in employer effects and a sizable loss in match effects, where gains of employer effects are slightly larger and losses of match effects are slightly smaller for quits than layoffs. These results imply that, after a quit or layoff during a mass layoff, moving to a higher-paying employer is often associated with a loss of valuable specific worker-employer matches.

Analyzing outcomes conditional on transitions across employer-effect quintiles also turns out

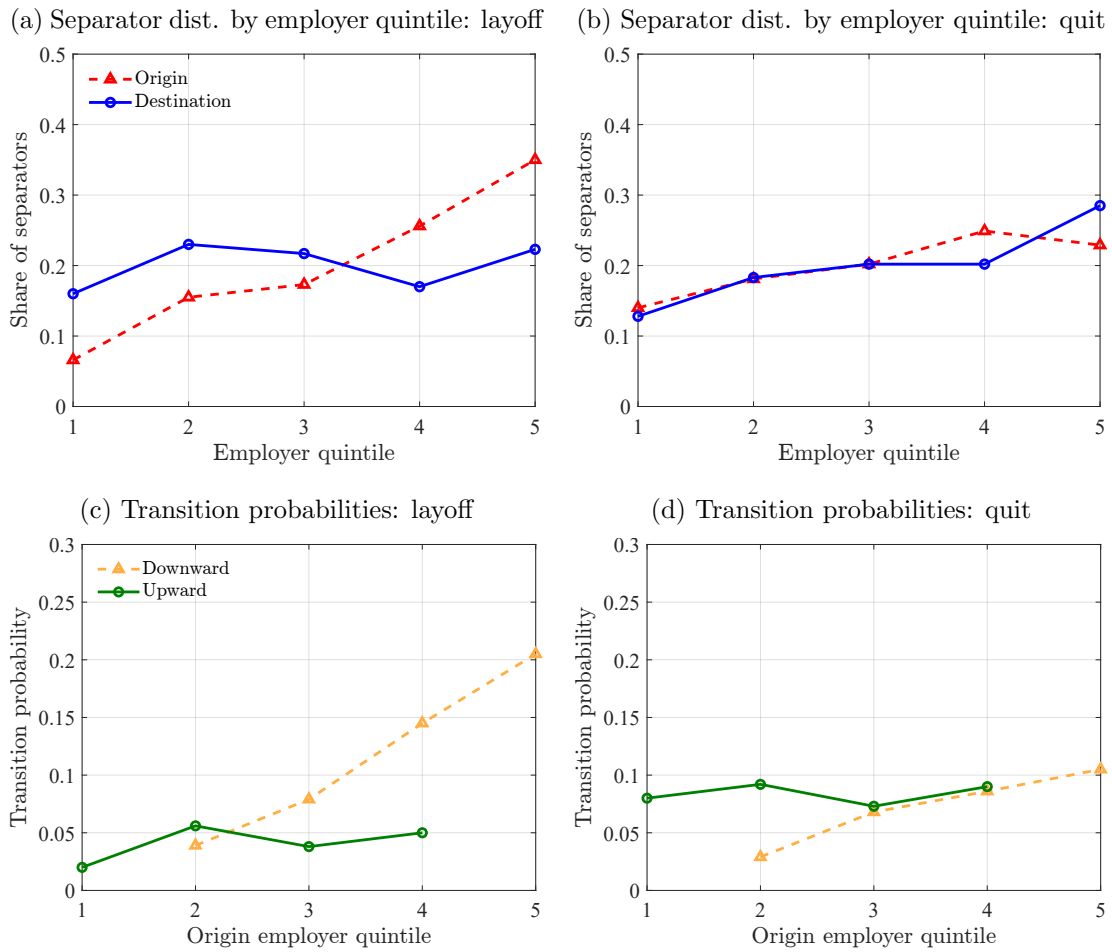
[41] We note that these estimates may not necessarily match our regression estimates presented in Figures 2 and 3. This is because the estimates presented in this section are simple averages and not obtained from regression estimates where stayers are the control group.

to be relevant for understanding the average of outcomes for layoffs and quits presented in Figures 2 and 3 previously. We highlight two important results regarding this conclusion. First, while Figure 2 shows that employer effects are small on average for those who quit, Table 3 documents that this result masks substantial heterogeneity in changes in employer effects for transitions across employer-effect quintiles. Workers who quit experience a large decline in employer effects (36.0 log points) if they transition into employers in a lower employer-effect quintile, while they experience a large increase in employer effects (36.5 log points) if they transition into employers in a higher employer-effect quintile. Second, recall from our results in Figure 3 that match effects on average are positive for quits and negative for layoffs but small in magnitude. Results in Table 3 reveal substantial heterogeneity in match effects for both layoffs and quits based on transitions across employer-effect quintiles. Workers experiencing a below-diagonal transition gain match effects, while those experiencing an above-diagonal transition lose match effects.

Positional dynamics. We further investigate the asymmetries in employer premium dynamics between workers who are laid-off and workers who quit in Figure 4. Panels (a) and (b) present the distribution of separations by origin (dashed-red lines) and destination (solid-blue lines) quintiles for both layoffs and quits in mass layoffs, respectively. Comparing origin-quintile distributions (dashed-red lines in Panels (a) and (b)), laid-off workers are more likely to originate from high employer-premium quintiles, whereas the same distribution is more even for those who quit. For example, while 35 percent of all layoffs in mass layoffs originate from employers in the fifth quintile of employer effect distribution, only 7 percent of them originate from employers in the bottom quintile. On the other hand, these shares are 23 percent and 14 percent for quits, indicating much less heterogeneity along the origin-quintile distributions for quits than for layoffs. Moreover, Panel (a) documents that there is strong asymmetry between the origin quintile and destination quintile distributions among laid-off workers (dashed-red lines and solid-blue lines in Panel (a)). While layoffs are more prevalent in higher origin quintiles, the fraction of workers transitioning toward higher destination quintiles is much lower, implying that, for individuals who are laid off in mass layoffs, the distribution of employer effects shifts leftward upon separations and that these workers experience a substantial *net* decline in employer premium position. In contrast, workers who quit face similar origin and destination distributions, with slightly higher probabilities of transitioning into top quintiles (dashed-red lines and solid-blue lines in Panel (b)). This implies that, for individuals who quit, the distribution of employer effects remains largely unchanged.

Panels (c) and (d) present downward and upward transition probabilities by origin employee quintiles for layoffs and quits in mass layoffs, respectively. Specifically, dashed-orange lines represent the probability that upon separation in a mass layoff, a worker finds reemployment with an employer whose employer effect is in a lower quintile than the employer-effect quintile of the worker's origin employer, conditional on the origin-employer quintile. The solid-green lines, on the other hand, represent the probability that the worker moves to a destination employer that

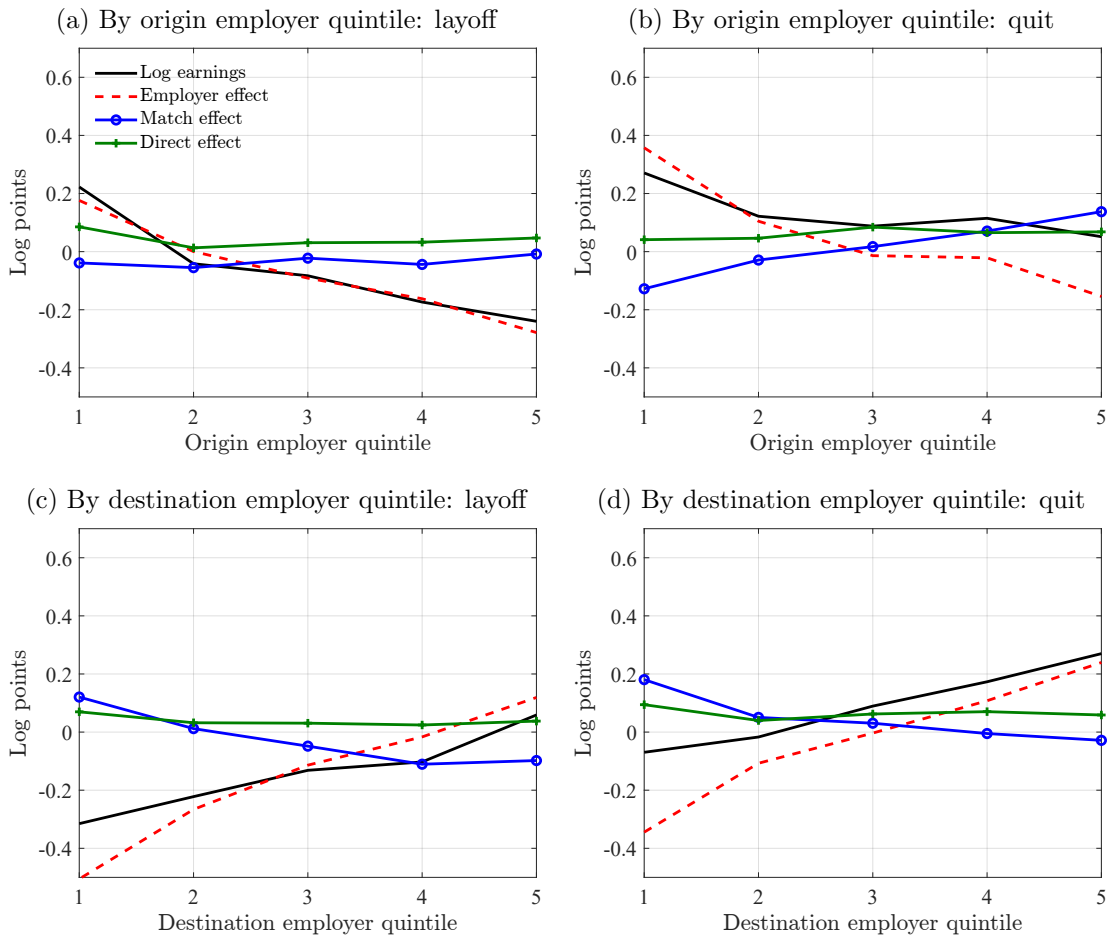
Figure 4: Transitions across employer effect distribution



Note: Panels (a) and (b) present the distribution of separations by origin (dashed-red lines) and destination (solid-blue lines) employer effect quintiles for both layoffs and quits in mass layoffs, respectively. Panels (c) and (d) present upward (solid-green lines) and downward (dashed-orange lines) transition probabilities by origin employer effects quintiles for layoffs and quits in mass layoffs, respectively. Values are based on a comparison of outcomes between one year before and three years after separation.

belongs to a higher employer-premium quintile than that of the origin employer, conditional on the origin-employer quintile. Comparing layoffs and quits, we note two key takeaways. First, downward transition probabilities are larger for laid-off workers, especially when the origin employer is in the fourth and fifth employer-effect quintiles (dashed-orange lines in Panel (c) and (d)). Upward transition probabilities, on the other hand, are around twice as large for workers who quit, regardless of origin-employer quintile (solid-green lines in Panel (c) and (d)). Second, downward transition probabilities increase rapidly with the origin-employer quintile for layoffs but exhibit a much flatter profile for quits. These results document the underlying reason behind the larger average loss of employer effects for laid-off workers in mass layoffs: The laid-off workers are much more likely to come from employers with high pay premium and the likelihood of experiencing a transition into a new employer with a lower pay premium than the previous

Figure 5: Earnings changes by origin and destination employer quintile



Note: The top (bottom) panels present average changes in log earnings by origin (destination) employer premium quintile among workers who are laid off and workers who quit in mass layoffs. These changes are further decomposed into changes in employer, match, and direct effects. These results are obtained by comparing outcomes between one year before and three years after separation.

employer is much higher when the origin-employer quintile is high.[42]

Earnings outcomes. Thus far, we have focused on differences in employer premium *positional* dynamics faced by workers who are laid off and workers who quit during mass layoffs. In Figure 5, we now present average changes in log earnings separately by origin and destination employer-premium quintiles for layoffs and quits within the mass-layoff separator sample. These earnings losses are also further decomposed into changes in employer, match, and direct effects.

Starting with the results by origin employer-effect quintiles in Panels (a) and (b), we note several key takeaways. First, regardless of origin-employer quintile, laid-off workers experience a larger decline (or smaller increase) in earnings and employer effects versus those who quit. Second, laid-off workers from low-paying employers tend to experience an increase in earnings,

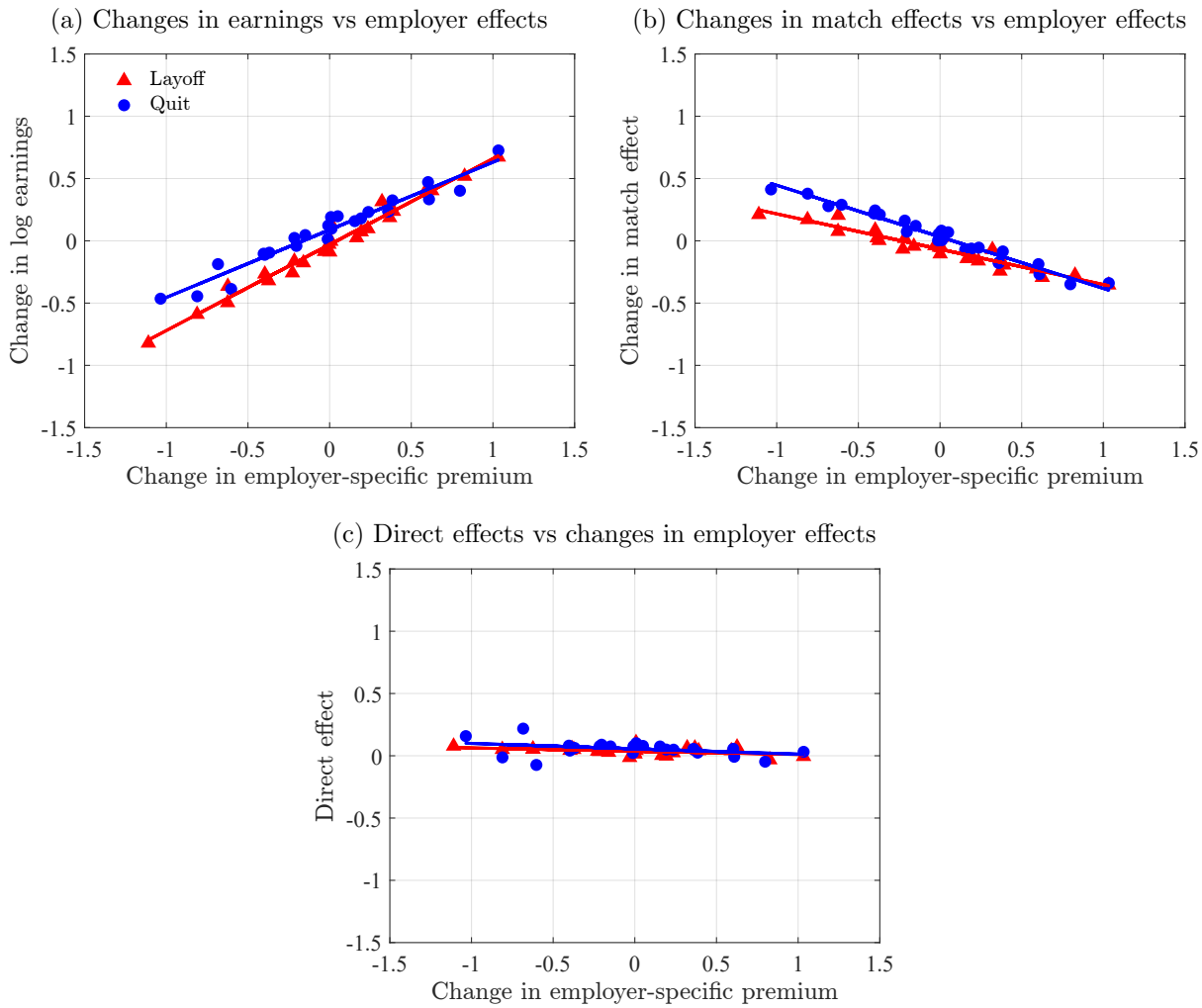
[42]In Appendix B.7, we present results on the employer premium dynamics of separations associated with non-mass layoffs. The equivalent results for Table 3 and Figure 4 show that workers who separate because of layoff or quit during non-mass layoffs face lower probabilities of falling the employer premium ladder.

most of which is explained by increases in employer effects. Meanwhile, those who quit from low-paying employers also enjoy an increase in earnings, but this change arises from a large increase in employer effects that is offset by a decline in match effects. Third, laid-off workers from high-paying employers—the group that constitutes a large fraction of laid-off workers and thus drives most of the results presented in Section 3.2—experience a large decrease in earnings, which is almost wholly explained by the decline in employer effects. As for workers who quit from high-paying employers, they tend to experience a small positive change in earnings because of a trade-off between a loss in employer effects that is offset by a gain in match effects. Overall, laid-off workers' earnings losses closely track changes in employer premiums, while this is not true for workers who quit due to a stronger trade-off between employer and match effects.

Moving to the results by destination employer-effect quintiles in Panels (c) and (d), we find that laid-off workers' earnings losses vary significantly depending on the employer-effect quintile of the destination employer. Laid-off workers who transition to employers in the lowest employer-effects quintile experience a large decline in earnings (32 log points), while those who transition to the highest-paying employers experience a small increase in earnings (6 log points). For these workers, while the magnitude of the lost employer effects significantly declines (and eventually becomes a gain) as the destination employer's quintile increases, match effects change in the opposite direction across the quintiles of the destination employer effects. As a result, larger earnings losses (gains) in the bottom (top) quintile due to changes in employer effects are mitigated by gains (losses) in match effects. For quits, reemployment with the lowest-paying employers translates to a smaller earnings loss (7 log points) because of a smaller decline in employer effects and a larger increase in match effects. Meanwhile, unlike laid-off workers, those who quit into the highest-paying employers enjoy a substantial increase in earnings (27 log points), which is almost wholly driven by an increase in employer effects.

Finally, Figure 6 plots interquintile changes in log earnings, match effects, and direct effects against changes in employer effects. As a result, each panel contains a scatter plot of 25 points, one for each origin-destination combination of employer-effect quintiles. As such, this exercise allows us to document differences in changes in earnings, match effects, and direct effects between layoffs and quits conditional on experiencing the same interquintile change in employer effects. Panel (a) shows that, for the same change in employer effects, workers who quit in the mass-layoff separator sample enjoy better earnings outcomes than their laid-off counterparts. This gap is especially prominent in transitions that involve a decline in employer premiums. Note that since the change in employer premium is the same for any given point in the x-axis and changes in direct effects are roughly zero (Panel (c)), the gap in log earnings changes between those laid-off and those who quit will be largely explained by differences in match effects between the two groups. Indeed, this is documented in Panel (b), which shows that among those laid-off and those who quit that experience the same decline in employer effects, workers who quit are

Figure 6: Interquintile changes in earnings, match effects, and direct effects vs employer effects



Note: This figure plots interquintile changes in log earnings, match effects, and direct effects against changes in employer effects separately for layoffs and quits in mass layoffs. Each panel contains a scatter plot of 25 points, one for each origin-destination combination of employer-effect quintiles. These results are obtained by comparing outcomes between one year before and three after separation. The table below summarizes outcomes from linear regressions of changes in log earnings, match effects, and direct effects on changes in employer effects, respectively, for layoffs and quits in mass layoffs.

	(a) Changes in log earnings		(b) Changes in match effects		(c) Direct effects	
	Layoff	Quit	Layoff	Quit	Layoff	Quit
Constant	-0.030	0.088	-0.067	0.032	0.037	0.056
	(0.011)	(0.013)	(0.009)	(0.008)	(0.006)	(0.011)
Changes in employer effects	0.690	0.543	-0.283	-0.414	-0.026	-0.043
	(0.023)	(0.027)	(0.019)	(0.017)	(0.011)	(0.023)
R-squared	0.975	0.945	0.910	0.964	0.185	0.137
Root Mean Squared Error	0.058	0.067	0.046	0.041	0.029	0.056
Observations	25	25	25	25	25	25

compensated by a larger increase in match effects. This result suggests that workers who quit into lower-paying employers may be doing so strategically in pursuit of a better match for their skills or a better contract that increases their productivity. In contrast, laid-off workers may

have little choice but to accept lower compensation in pursuit of reemployment.

Looking at the relationship between changes in employer effects against changes in log earnings in Panel (a) also reveals that the role of employer effects in explaining earnings dynamics is stronger for layoffs than quits, a result that is in line with our previous findings in Section 3.2. As the table below Figure 6 shows, a regression of changes in log earnings on changes in employer effects yields a stronger estimate of the slope for layoffs than for quits (0.690 vs 0.543), which is associated with a stronger relationship between changes in employer and match effects for quits than for layoffs (as shown by a similar regression that yields slope coefficients of -0.283 and -0.414 for layoffs and quits, respectively). This result implies that the AKM model with additive worker and employer effects explains earnings changes better for layoffs than for quits.

Taking stock. Laid-off workers are more likely to originate from high-paying employers and transition to low-paying employers. Further, those who are laid off from high-paying employers experience much larger earnings and employer premium losses when compared with quitting workers who originate from higher-paying employers. Finally, workers who quit and experience drops in employer premium are often compensated by better match effects, resulting in smaller changes in earnings despite downward transitions along the employer premium ladder.

4 Earnings losses upon separations: the role of timing

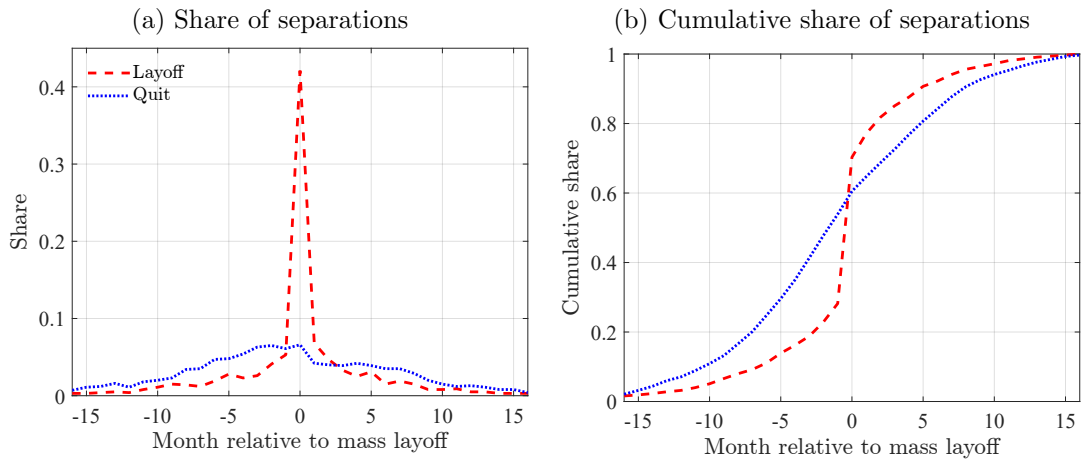
The previous section studied the role of accounting for the reason for separation on understanding the consequences of job separations. In this section, we utilize another important piece of information provided by the ROE forms, which allows us to analyze the second key dimension of heterogeneity in separations that has been understudied in the literature: timing. We first provide novel evidence to demonstrate that episodes of employer contraction are protracted in nature in that a large share of separations occur several months before the height of the mass-layoff event. We then investigate the extent to which the timing of separation matters for the consequences of job separations and whether the timing of separation is systematically related to observable worker characteristics.

4.1 Accounting for the timing of separation during mass layoffs

The date-of-separation information from the ROE serves two purposes. First, it allows us to classify the exact month during which the height of a mass layoff occurred. For each employer experiencing a mass layoff, the mass-layoff month is identified as the month during which the largest number of ROE layoffs are recorded.[43] Second, it allows us to group mass-layoff separators

[43]To account for the possibility that distressed employers may suffer from multiple mass layoffs, we allow for the reference month of the mass layoff to be worker-specific. Consider an employer that experienced a mass layoff in 2008 and another one in 2009. If a worker from the employer is observed to be employed with a new main employer in 2009 (2010), then we assign the mass-layoff month of the employer to be the month with the largest ROE layoffs recorded between 2008 and 2009 (2009 and 2010). Results are robust to alternative specifications.

Figure 7: Distribution of separations around a mass-layoff based on timing



Note: This figure plots the distribution of separations (separately for layoffs and quits) in terms of their proximity to the mass-layoff month. For each employer experiencing a mass-layoff, the mass-layoff month is identified as the month during which the largest number of ROE layoffs are recorded. To calculate the distribution, for each mass-layoff separator in our sample, we use ROE job end-dates to calculate the distance of a separation from the mass-layoff month.

based on the proximity of their *own* separation to the mass-layoff month. Specifically, for each mass-layoff separator, because we know the exact date of the separation, we can determine how far this date was from the peak of their origin employer's mass-layoff event. This step allows us to study sources and consequences of separations based on the timing of separation.

Figure 7 presents the distribution of separations in our mass-layoff separator sample in terms of proximity to the mass-layoff month, for both layoffs and quits. Panel (a) shows that quits occur more gradually before and after the mass-layoff month, whereas layoffs are more concentrated within that month. For example, 42 percent of layoffs occur at the exact month of the mass layoff, while only 7 percent of quits are observed at that month. Panel (b) presents the cumulative share of these separations, for both layoff and quits, and shows that 53 percent of quits and 27 percent of layoffs occur before the mass-layoff month.[44]

These results suggest that the timing of separation might be associated with worker characteristics as well as consequences of separations through strategic decisions of workers and employers. For instance, the large presence of quits prior to the mass-layoff month may suggest the presence of strategic decisions made by workers to find employment elsewhere. Similarly, employers may strategically choose which employees to lay off based on productivity to reduce labor costs prior to mass layoff. On the other hand, the large presence of quits after the mass-layoff month may imply that workers who survive mass layoffs have incentives to leave a distressed employer once

[44]Canadian regulation requires employers in federally regulated industries (e.g., utilities, transportation, and financial services) to give a notice at least 16 weeks before laying off 50 or more employees within any four-week period. In other industries, the length of the advance notice period varies by province. For example, in Ontario and Quebec, it is between 8 and 16 weeks depending on the size of layoff. Thus, some workers may start searching for jobs when they receive the advance notice and decide to quit before the mass-layoff month.

a suitable new employer is found. In Section 4.3, we provide results in relation to worker characteristics of those who quit and those who are laid off before and after the mass-layoff month in order to distinguish these different and potential selection mechanisms around mass layoffs. Before doing so, in Section 4.2, we first analyze whether the timing of separation matters for its consequences in terms of earnings and employer-specific premium dynamics.

4.2 Earnings and employer effects upon separations based on timing

To understand whether the timing of separation matters for its consequences, we estimate the dynamics of earnings and employer-specific pay premium for separations before and after the mass-layoff month, separately for layoffs and quits. Thus, in Sections 4.2 and 4.3, the set of groups within the mass-layoff separator sample is $S = \{\text{layoff, quit}\} \times V$, where V is a set of groups that divide mass-layoff separators by proximity (in months) to the mass-layoff month.[45]

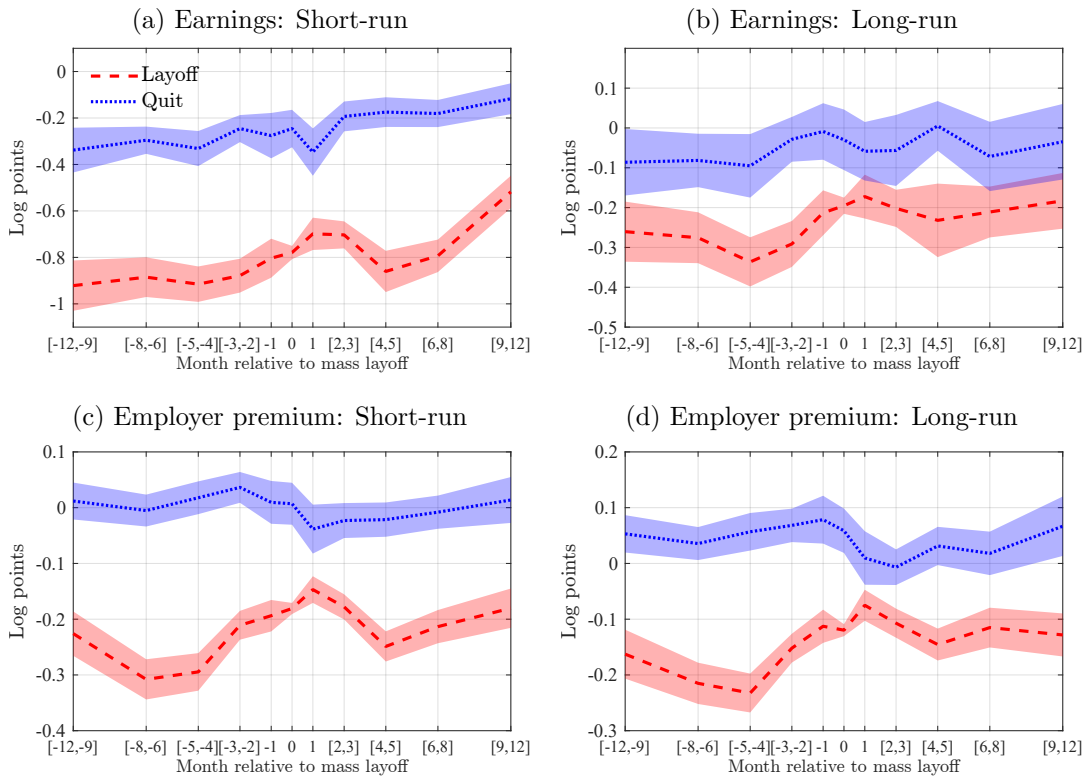
Earnings and employer effect dynamics. Panels (a) and (b) of Figure 8 present estimates for earnings losses upon separations across layoffs and quits when they are also grouped by their proximity to the mass-layoff month. Importantly, we uncover substantial heterogeneity in earnings losses across the timing of separation.

Starting with short-term (one year after the separation) earnings losses (Panel (a)), those who experience a layoff prior to the mass-layoff month incur even larger earnings losses than those who are laid off at that month. For instance, while those who are laid off between 9 to 12 months before the mass-layoff month experience a 92-log-point earnings loss in the year following the separation, those who are laid off at the month of mass layoff incur a 78-log-point earnings loss. On the other hand, the short-term earnings losses are typically smaller for those who experience a layoff after the mass-layoff month when compared with the earnings losses of those who are laid off at the mass-layoff month. Albeit to a lesser degree, similar results are also obtained for those who quit during mass layoffs: Short-term earnings losses are smaller, especially for those who quit two months (or later) after the mass-layoff month. Moving to long-term (six years after the separation) earnings losses (Panel (b)), we find that while the resulting point estimates on earnings losses are typically larger for those who experience a separation (both layoffs and quits) prior to the mass-layoff month relative to earnings losses for those who experience a separation after the mass-layoff month, the degree of heterogeneity in the magnitudes of earnings losses by timing of separation is smaller in the long-run than in the short-run.

The result that workers who are laid off prior to the mass-layoff month typically experience larger earnings losses than those who are laid off after the mass-layoff month signals that employers may be selecting less-productive workers to layoff first. These workers may be those who potentially face more difficulties in finding reemployment with a comparable employer. On the other hand, smaller earnings losses among workers who quit after the mass-layoff month

[45] Specifically, the groups in V are $\{[-12,-9],[-8,-6],[-5,-4],[-3,-2],-1,0,1,[2,3],[4,5],[6,8],[9,12]\}$.

Figure 8: Earnings and employer effect dynamics upon separation, by proximity to mass layoff



Note: Top (bottom) panels present estimates for earnings losses (employer premium dynamics) upon separations across layoffs and quits when they are also grouped by their proximity to the mass-layoff month. Panel (a) and (c) present estimated outcomes one year after separation (short-run), while Panel (b) and (d) present estimates for six years after separation (long-run). For each employer experiencing a mass layoff, the mass-layoff month is identified as the month during which the largest number of ROE layoffs are recorded. 95 percent confidence intervals are given by the shaded regions.

relative to those who quit before that month suggest that the former group may have been able to secure better reemployment outcomes given that a job search was conducted in less desperate conditions as they were able to retain their jobs in spite of the large contraction their employer experienced. Furthermore, the smaller gap in earnings losses between separators before and after the mass-layoff month for quits than layoffs implies that workers who quit are able to optimally time their separation based on their individual labor market opportunities.[46]

Why are earnings losses larger for separators prior to the mass-layoff month? To answer this question, Panels (c) and (d) of Figure 8 present estimates for employer-specific pay premium dynamics upon separations across layoffs and quits when they are also grouped by their proximity to the mass-layoff month. We find that, among those who are laid off, employer premium losses are much larger for separators whose jobs are dissolved relatively early into the mass-layoff event.

[46] As mentioned previously, advance notices may affect workers' job search behavior and ultimately estimates of earnings losses around mass layoffs. If advance notices allow workers to search intensively before the mass layoff and mitigate their earnings losses, then earnings losses among workers who separate before the mass layoff would have been even larger in the absence of these notices. As such, even without advance notices, we would still conclude that average earnings losses are larger among workers who separate before the mass layoff.

The short-term gap (Panel (c)) in employer premium losses between those who are laid off prior to the mass-layoff month and those who are laid off after that month is sizable and sustained over the long-term (Panel (d)). Thus, employer pay premium losses largely contribute to the gap in earnings losses observed between those who are laid off prior to the mass-layoff month and those who are laid off after that month. In contrast, for quits, there is a smaller gap in earnings losses between the two groups based on the timing of separation. This is consistent with similar employer effects dynamics between the two groups both in the short run and in the long run. As such, employer effect dynamics are unimportant not only for explaining the average earnings loss for workers who quit in mass layoffs (as discussed in Section 3.2), but also for accounting for the cross-sectional difference in earnings losses upon quits based on timing of separation.

Below-, on-, and above-diagonal transitions. We continue exploring cross-sectional heterogeneity in the magnitudes of earnings losses upon layoffs and quits by the timing of separations as well as the underlying differences in the sources of these earnings losses by comparing outcomes for below-diagonal, on-diagonal, and above-diagonal transitions between employer-effects quintiles as in Section 3.3. Table 4 repeats our analysis in Table 3 for separations before (Panel A), around (Panel B), and after (Panel C) the mass-layoff month.[47]

Starting with the outcomes of laid-off workers, we highlight three results. First, close to half of layoffs lead to a below-diagonal transition independent of the timing of separation, indicating that even workers who are laid off after the mass-layoff month typically find reemployment with employers in lower quintiles of the employer effects distribution. Second, consistent with our results in Figure 8, for such below-diagonal transitions, earnings losses are much smaller for those who experience a layoff after the mass-layoff month when compared with earnings losses for those who are laid off before that month. On the other hand, for on- and above-diagonal transitions, changes in earnings upon layoffs are mostly similar across the timing of separation. Finally, changes in earnings closely track changes in employer effects independent of the type of transition across employer-premium quintiles and the timing of separation, implying that employer effects are important in understanding earnings changes for those who are laid off even among subgroups of laid-off workers based on the type of the transition and timing of separation.

Moving to results for workers who quit, we also emphasize three main findings. First, the shares of quits across the types of transition between employer-effects quintiles are almost equally distributed, and this is independent of the timing of separation. Thus, the incidence of quits to higher or lower employer-premium quintiles is almost equally likely across quits with different timing of separation. Second, earnings losses among below-diagonal transitions are very similar for quits before or after the mass-layoff month, while earnings gains among above-diagonal tran-

[47] In this exercise, separations before (after) the mass-layoff month cover separations occurring 8 to 23 months before (after) the mass-layoff month, while separations around mass-layoff month cover separations one month before, at, and one month after the mass-layoff month.

Table 4: Below-, on-, and above-diagonal sums and averages, by timing of separation

	Below diagonal	On diagonal	Above diagonal
A. Separations before mass-layoff month			
(a) Layoff			
Share of separators	0.499	0.307	0.194
Average change in log earnings	-0.458	-0.100	0.211
Average change in employer effect	-0.489	-0.008	0.320
Average change in match effect	-0.003	-0.052	-0.147
Average direct effect	0.033	-0.040	0.038
(b) Quit			
Share of separators	0.275	0.373	0.353
Average change in log earnings	-0.063	0.116	0.215
Average change in employer effect	-0.345	0.007	0.328
Average change in match effect	0.212	0.055	-0.164
Average direct effect	0.069	0.055	0.051
B. Separations around mass-layoff month			
(a) Layoff			
Share of separators	0.451	0.375	0.174
Average change in log earnings	-0.305	0.005	0.168
Average change in employer effect	-0.390	0.004	0.300
Average change in match effect	0.033	-0.044	-0.167
Average direct effect	0.052	0.045	0.036
(b) Quit			
Share of separators	0.288	0.344	0.368
Average change in log earnings	-0.130	0.152	0.240
Average change in employer effect	-0.361	0.010	0.357
Average change in match effect	0.132	0.058	-0.118
Average direct effect	0.099	0.084	0.001
C. Separations after mass-layoff month			
(a) Layoff			
Share of separators	0.475	0.378	0.147
Average change in log earnings	-0.277	0.027	0.206
Average change in employer effect	-0.341	0.007	0.340
Average change in match effect	0.037	-0.040	-0.165
Average direct effect	0.028	0.059	0.031
(b) Quit			
Share of separators	0.304	0.390	0.306
Average change in log earnings	-0.043	0.160	0.348
Average change in employer effect	-0.324	0.042	0.383
Average change in match effect	0.217	0.025	-0.111
Average direct effect	0.064	0.094	0.076

Note: This table presents five rows for separations with a different timing (separations before the mass-layoff month (Panel A), around that month (Panel B), and after that month (Panel C)) and reason (layoff and quit) with below-diagonal, on-diagonal, and above-diagonal transitions: (i) the fraction of separators, (ii) average change in log earnings, (iii) average change in employer effect, (iv) average change in match effect, and (v) average direct effect of the transition. Below-diagonal transitions represent moves to an employer with a lower-quintile employer effects, on-diagonal (above-diagonal) transitions represent moves to a same-quintile (higher-quintile) employer. Values are based on a comparison of employment one year before and three years after separation.

sitions are larger for quits after the mass-layoff month. Finally, for below-diagonal transitions, independent of timing of separation, changes in employer effects and match effects move in opposite directions and thus offset each other, suggesting that the tradeoff between finding a job at an employer with higher average pay and forming a more valuable match is present even across subpopulations based on the timing of separation. On the other hand, for above-diagonal transi-

tions, those who quit after the mass-layoff month experience not only a larger average increase in employer effects but also also a smaller decline in match effects, supporting the possibility that those who are able to remain attached to their employers during large employment contractions are more likely to find a new job at employers with better average pay and form more valuable specific worker-employer matches than those who quit before the mass-layoff month.

4.3 Characteristics of mass-layoff separators: role of timing

In this section, we provide results in relation to worker characteristics of those who quit or are laid-off before and after the mass-layoff month in order to understand whether observable characteristics of these workers are systematically related to the timing of separation. To do so, we estimate the following cross-sectional regression:

$$y_i = \alpha_{j(i)} + x_i\beta + \sum_{s \in S} d_i^s \xi^s + \epsilon_i, \tag{4}$$

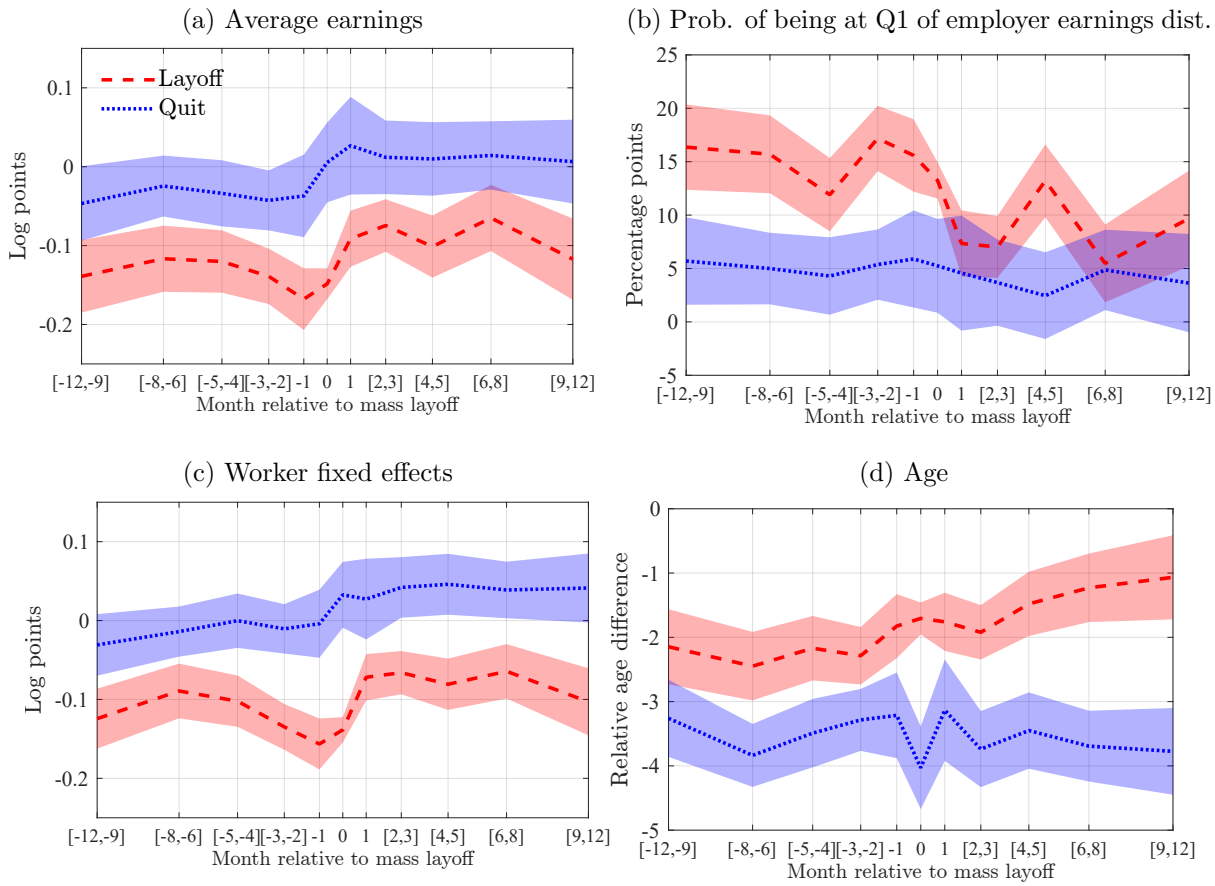
where the outcome variable y_i can be the log average earnings (over 2002–2005), a dummy variable indicating being in the bottom quintile of the within-employer earnings distribution in 2007 (i.e., the earnings distribution at the origin employer for separators and at the current employer for stayers), the worker's fixed effects component of log earnings obtained from the AKM estimation in Equation (2), or the worker's age.[48] The dummy variable d_i^s equals to 1 if the individual i is a mass-layoff separator with reason and timing subgroup s. The vector x_i consists of a worker's observable characteristics. Finally, $\alpha_{j(i)}$ controls for the employer j of worker i in 2007. Thus, estimated outcomes are interpreted as differences between separators and stayers associated with the same employer. The coefficient of interest ξ^s measures the estimated difference in the outcome variable between a given subgroup of separators versus stayers.

Panel (a) in Figure 9 measures the log points difference in average earnings (over 2002–2005) for workers in the mass-layoff separator sample (prior to separation, i.e., at the origin employer) relative to average earnings of stayers by timing of separation, separately for layoffs and quits in our mass layoff separator sample. As expected, while the average pre-separation earnings of laid-off workers in the mass-layoff separators sample is much lower than the average earnings of stayers, the average pre-separation earnings of those who quit are similar to that of stayers. Importantly, focusing on subpopulations within the mass-layoff separators sample based on the timing of separation, our results indicate that the average pre-separation earnings is around 5 log points lower among those who separate before the mass-layoff month than among those who separate after that month, for both layoffs and quits.[49] Because the composition of separators

[48] Here, our sample to estimate the specification in Equation (4) consists of the sample used to estimate the AKM model in Equation (2) except that we keep stayers and all separators, as we need to estimate their individual fixed effects. As such, the sample used here is the same sample we used to estimate match effects.

[49] For layoffs (quits), the average of point estimates for separations before the mass-layoff month is −14 (−4)

Figure 9: Characteristics of mass-layoff separators by timing of separation relative to stayers



Note: This figure plots differences in worker characteristics for mass-layoff separators grouped by reason and timing of separations relative to stayers, as outlined in Equation (4). Panel (a) measures the log points difference in average earnings (over 2002–2005) for workers in the mass-layoff separator sample (prior to separation, i.e., at the origin employer) relative to average earnings of stayers. Panel (b) measures the percentage points difference in the probability of being in the first quintile of the within-employer earnings distribution in 2007 for workers in the mass-layoff separator sample (prior to separation, i.e., at the origin employer) relative to that of stayers in 2007. Panel (c) provides the log points difference between the worker fixed effects for workers in the mass-layoff separator sample and that for stayers. Panel (d) provides the age difference between workers in the mass-layoff separator sample and that for stayers. These estimates are provided for separations with different reason (layoff in dashed-red lines and quit in dotted-blue lines) and different timing (as measured by horizontal axis in each panel). 95 percent confidence intervals are given by the shaded regions.

closer to the mass-layoff month is increasingly dominated by layoffs and less by quits, as shown in Figure 7, if we were to mix layoffs and quits in Panel (a) of Figure 9, the average pre-separation earnings for separators at the mass-layoff month would seem to be substantially lower than that for those who separate before that month. As such, this compositional change within the mass-layoff separator sample would lead to a false conclusion that high-paid workers separate from their employer first, highlighting the importance of accounting for the reason for separation.

Panel (b) presents the percentage points difference in the probability of being in the first quintile of the within-employer earnings distribution in 2007 for mass-layoff separators (prior to separation, i.e., at the origin employer) relative to that of stayers in 2007 by timing of separation, separately for layoffs and quits in our mass-layoff separator sample. We highlight two main

log points, while the average of point estimates for separations after the mass-layoff month is -9 (1) log points.

results. First, we find that the probability of being in the bottom quintile of the distribution is between 5 and 16 percentage points higher (depending on the timing of separation) for those who are laid off in our mass-layoff separators sample relative to stayers, while it is between 2 and 6 percentage points higher for quits relative to stayers. Second, focusing on how the timing of separation varies with the probability of being in the bottom quintile of the distribution, we find that while this probability is around 6 percentage points higher on average for those who are laid off before the mass-layoff month than for those who are laid off after that month, it does not change much for those who quit across timing of separation.[50] Taken together, these results complement our findings in Section 3.3. While our previous findings in Figure 4 document that layoffs mostly originate from employers with high-employer effects, Panel (b) in Figure 9 suggests that workers who are laid off from these employers are more likely to be those who are in the bottom quintile of the within-employer earnings distribution, even more so when they experience the separation prior to the mass-layoff month.

Next, Panel (c) provides the log points difference between the average of worker fixed effects for workers in the mass-layoff separator sample and that for stayers by timing of separation, separately for layoffs and quits. Relative to stayers, workers who are laid-off have worker fixed effects that are on average 10 log points lower, while workers who quit have worker fixed effects that are no different or slightly higher than their stayer counterparts. Focusing on the effects of timing of separation on the average of worker fixed effects for mass-layoff separators, we find that, for both layoffs and quits, those who separate prior to the mass-layoff month have a lower average relative to those who separate after that month.

Finally, Panel (d) presents the relative age differences between mass-layoff separators and stayers, by timing and reason for separation. We find that laid-off workers are on average older than quitting workers, regardless of the timing of separation. Moreover, workers who are laid off before the mass-layoff month are slightly younger than those who are laid off after that month.

Overall, workers who are laid off before the mass-layoff month are likely to be less productive than those who are laid off after that month, given that the former group consists of separators with lower pre-separation average earnings, higher likelihood of being in the bottom quintile of the within-employer earnings distribution, and lower average worker fixed effects. These patterns suggest that employers make strategic decisions to lay off less-productive workers first during a period of severe contraction. For quits, we do not find any evidence to support the hypothesis that more-productive workers quit their jobs before the mass layoff. Instead, we find that workers who quit after the mass-layoff month have higher average pre-separation earnings and worker fixed effects than those who quit before that month. This suggest that separators in the former group—who are potentially more productive—are typically valuable to the employer

[50]The 6-percentage-point gap is obtained by comparing the average of point estimates for layoffs after the mass-layoff month and before the mass-layoff month.

and are thus not laid-off even during a period of contraction. This allows them sufficient time to search for favorable employment opportunities. Potentially, a job search that is conducted in less desperate conditions helps them to bargain better contracts compared with less-productive workers who quit a couple of months before the mass-layoff month to avoid being laid off.

5 Conclusion

This paper uses Canadian administrative employer-employee matched data to revisit the measurement of earnings losses upon job displacement. Our database is advantageous in that it provides reliable information on the reason and timing of separations, thus allowing for better detection of involuntary job losses without relying solely on identifying mass-layoff events through changes in employer identifiers as implemented in the literature. We advance the literature along four key dimensions. First, we reveal the shortcomings of existing approaches that use separation outcomes during mass layoffs to approximate the consequences of job displacement. When we employ the same mass-layoff identification strategy, we find that only a quarter of separations are actual layoffs, while close to half are not actual job losses but are employer identifier changes due to reorganization activities. Second, we find substantially larger and more persistent earnings losses upon involuntary job separations than what would be implied by estimates obtained from the conventional mass-layoff identification strategy widely adopted by the literature. This is because existing estimates represent the averaged outcomes of a mix of separations that arise from layoffs, quits, or other idiosyncratic reasons, as well as events that result in employer identifier changes but are not actual job losses. Third, we document substantial heterogeneity in earnings and employer pay premium dynamics faced by workers who are laid off and workers who quit. The earnings losses of workers laid off during a mass layoff are significantly worse than those of workers who quit during the same episode. Further, the loss of employer effects is an important driver of earnings losses for layoffs but not for quits, implying that the AKM model with additive worker and employer effects explains earnings dynamics better for layoffs than for quits. Finally, we exploit the exact time of separation contained in the ROE to demonstrate that mass layoffs are protracted and systematic. We find that among employers that underwent a mass layoff, substantial employment losses from layoffs and quits begin several months before the most severe month of employment contraction. Workers who are laid off before the mass-layoff month experience more severe earnings and employer premium losses. They also have lower worker fixed effects, are more likely to be in the bottom of the earnings distribution of their employer before separation, and earn less on average. These findings suggest that employers are systematic in the sequencing of layoffs during large employment contractions: less-productive workers are the first to be let go. In contrast, among workers who quit, we do not find any evidence to support the hypothesis that highly-productive workers "jump ship" early into a mass-layoff event. Instead, workers who quit after the mass-layoff month have higher average pre-separation earnings and

worker fixed effects than those who quit before that month.

Our findings have important implications for quantitative models. While estimates of displacement outcomes obtained from microeconometric studies are often used to discipline these models, both strands of literature have not yet seriously distinguished between layoffs and quits. Our results reveal large heterogeneity in earnings and employer effects dynamics between these two types of separation, underscoring the need for separately modeling layoffs and quits in quantitative models. Furthermore, our results indicate that layoffs are concentrated within certain episodes of protracted employment contractions, while quits are more gradual, with most of them occurring before the peak of mass layoffs. The protracted and systematic nature of these employment contractions requires careful modeling of selection mechanisms where employers lay off less-productive workers first, whereas more-productive workers decide on the optimal timing of quitting depending on their individual-level job search outcomes and aggregate conditions. Ultimately, a model that takes into account heterogeneity in separations depending on the reason for and timing of separation would be a useful framework to study the implications of different labor market policies jointly. For instance, payroll subsidies may be useful in preventing financially constrained employers from laying off long-tenure workers who would have otherwise been optimal to retain, while the unemployment insurance system may be reconfigured to facilitate the dissolution of less-productive matches via quits to ease workers' climb up the job ladder.

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Appendix

A Data

In this section, we provide additional details on our database.

A.1 The Canadian Employer-Employee Dynamics Database (CEEDD)

The Canadian Employer-Employee Dynamics Database (CEEDD) is an employer-employee matched database which covers the universe of individual and corporate tax filers in Canada. It is maintained by Statistics Canada and is a linked collection of administrative data from Statistics Canada, Canada Revenue Agency (CRA), Employment and Social Development Canada (ESDC), and Immigration, Refugees, and Citizenship Canada (IRCC). This paper utilizes a subset of the tax and administrative forms used to construct the CEEDD. Information from the following forms contained in the CEEDD are used in our analysis:

- Individual-level tax files: This is obtained from the T1 Income Tax and Benefit Return, the main tax return used by individuals to file annual personal income taxes. It consolidates information on income earned from all sources, among which include those derived from employment, businesses, and investments. It also contains detailed demographic and other financial information about the individual.

- Employer-level tax files: The National Accounts Longitudinal Microdata File (NALMF) combines tax and administrative forms submitted by employers, including the T2 Corporation Income Tax Return, T4, Payroll Account Deductions (PD7), and Goods and Services tax/Harmonized Sales tax (GST/HST)). Any enterprise the files at least one of these forms will be included in the NALMF. As a result, the NALMF would include all corporate tax filers and unincorporated businesses with at least one employee are included but would exclude non-employer businesses.

- Job-level tax files: Employers are required to submit the T4 Statement of Remuneration Paid for all their employees. The T4 contains information on various forms of compensation, among which includes wages and salaries, tips or gratuities, bonuses, taxable benefits, and commissions. Amounts reported on the T4 are based on when the income was paid, and not when the services were rendered. Individuals who received compensation from multiple employers during the year would have multiple T4s as well. As discussed in Section 2.1, the ROE is a form that employers must issue to employees whenever an interruption in earnings occurs. An interruption in earnings occurs when at least one of the following two conditions are met. First, an employee experiences seven consecutive calendar days with no work and no insurable earnings from the employer. This condition covers separations associated with a layoff, quit, or termination. Second, the employee's salary from

the employer falls below 60 percent of their regular weekly earnings and the interruption is caused by reasons such as illness, injury, maternity/parental leave, child/compassionate care among others. The ROE contains information on the worker's employment history and is primarily used for the determination of EI eligibility.

Each T1 form features an individual identifier, while each NALMF record features an employer identifier. The T4 job-level records contain *both* individual (the employee) and the employer level identifiers and allow for linkages between T1 individual demographics and financials with NALMF employer characteristics.

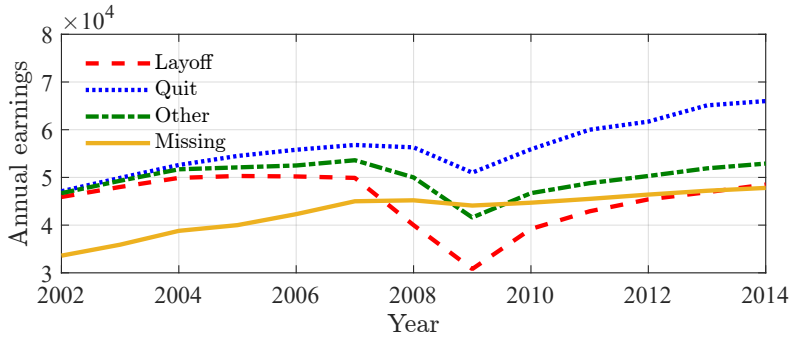
B Additional results

In this section, we provide additional results to supplement our discussions in the main text.

B.1 Outcomes of separators with missing ROE

Before moving to additional results used in Section 3, we first provide two results discussed in Section 2.1 to understand characteristics of mass-layoff separators with missing ROE data.

Figure A1: Average annual earnings: Separators by ROE reason



Note: This figure shows average annual earnings over time for workers who separate from their job in 2008 for different reasons when their employer is experiencing a mass layoff in 2008–2009. Earnings are denominated in 2010 CAD and are rounded to the nearest 100 CAD because of confidentiality.

First, Figure A1 presents average annual earnings over time for workers who separate from their job in 2008 for different reasons when their employer is experiencing a mass layoff in 2008–2009. We find that while the average earnings of workers who are laid off, who quit, and who separated because of other reasons during mass layoffs in 2008–2009 declines in 2009, it remains nearly unchanged in 2009 for separators with missing ROE data.

Second, Table A1 shows the fraction of individuals who received employment insurance (EI) benefits and average amount of total annual EI benefits received among those who receive EI during a two-year period. For stayers, the two-year period is 2008–2009. For mass layoff separators, it is the separation year and the following year. We find that less than only 10 percent of workers with missing ROE data within the mass-layoff separators sample actually received EI benefits in the year of job separation or the year after.

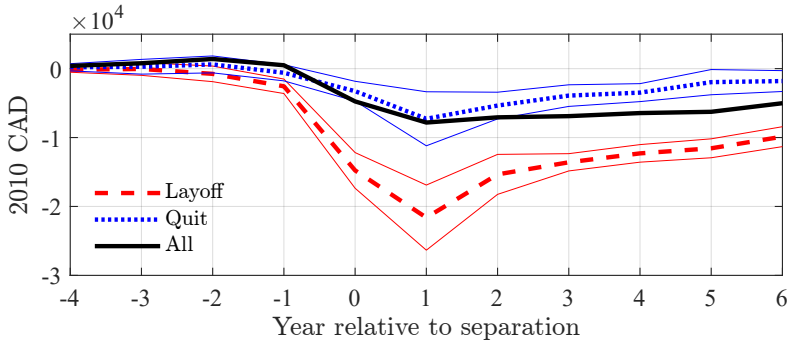
Table A1: Statistics on employment insurance (EI) benefits

	Stayers	Mass layoff separators			
		Layoff	Quit	Other	Missing
Fraction received EI benefit	0.164	0.789	0.316	0.450	0.093
Average amount of total EI benefit received (among those received positive amount)	8,600	13,800	8,600	10,900	10,600

Note: This table provides the fraction of individuals received employment insurance (EI) benefits and average amount of total annual EI benefits received among those who receive EI during a two-year period. For stayers, the two-year period is 2008–2009. For mass-layoff separators, it is the separation year and the following year. Earnings are denominated in 2010 CAD and are rounded to the nearest 100 CAD because of confidentiality.

B.2 Earnings losses upon separations: level changes

Figure A2: Effects of job separation by reason for separation: level changes in earnings



Note: This figure plots estimates for earnings losses in levels (2010 CAD) upon job separation by reason of separation during mass layoffs. Dashed-red and dotted-blue lines (along with 95 percent confidence intervals in solid lines) show estimated earnings losses for layoffs and quits, respectively, while solid-black line presents these losses for all mass-layoff separators (layoffs, quits, other, and missing ROE).

Figure A2 plots estimates for earnings losses in levels (2010 CAD) upon separation by reason of separation during mass layoffs. Dashed-red and dotted-blue lines show estimated earnings losses for layoffs and quits, respectively, while the solid-black line presents estimated earnings losses for all mass-layoff separators (layoffs, quits, other, and missing ROE). We find that, for layoffs (quits), the average earnings decline by $21,600$ CAD ($7,300$ CAD) in the year following the separation and stay $9,900$ CAD ($1,800$ CAD) lower six years after the separation.

B.3 Worker mobility in Canadian data

The employer-specific fixed effects in Equation (2) are identified by workers' transitions between employers. As such, limited worker mobility in the data yields to biased AKM estimates for the variance of employer effects, as shown by Abowd et al. (2003) and Andrews et al. (2012), leading to a misleading variance decomposition of $y_{i,t}$ into individual effects, employer effects, and sorting of individuals to employers. Although we do not focus on variance-covariance estimates from the AKM specification in our paper, in this section, we briefly summarize results

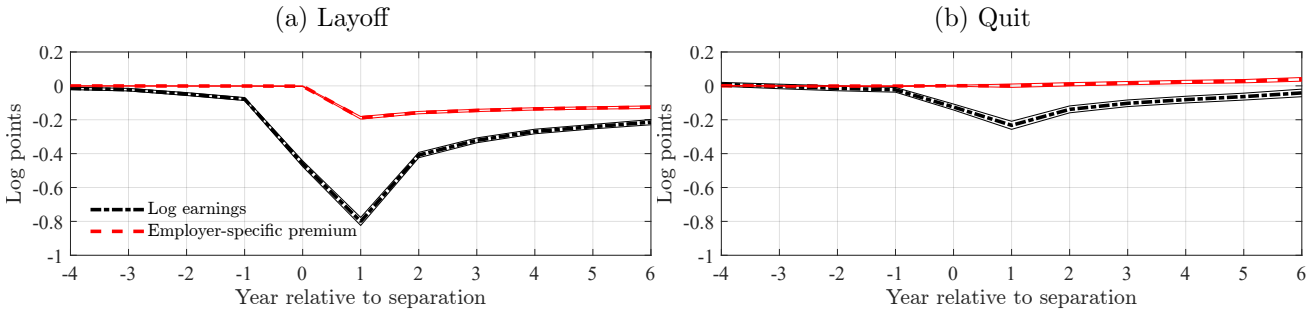
in relation to worker mobility in Canada to mitigate these concerns on limited worker mobility bias. First, worker mobility in Canada is quite high as in the U.S. Between 2002 and 2014, the average monthly job-separation, job-finding, and job-to-job transition rates in Canada are 1.5 percent, 24.7 percent, and 0.73 percent, respectively.[51] Second, the average number of movers per employer in the AKM sample is around 14, which is larger than the value of 10 reported in Lachowska et al. (2020) and also above the value of 6, below which limited mobility poses a problem according to Andrews et al. (2012). The number of moves per person in our data is 0.533, while the number of moves per person-year is 0.084. This is in line with values calculated from the Washington data in Lachowska et al. (2020), which are 0.63 and 0.097, respectively. Lachowska et al. (2020) also calculate implied mobility rates from the German administrative data used by Card et al. (2013), Fackler et al. (2021), and Schmieder et al. (2023). They find moves per person and moves per person-year to be 0.19 and 0.03, respectively.

B.4 Main results under alternative specifications and samples

In this section, we repeat our main result in Figure 2 of Section 3.2 under alternative specifications and samples.

Excluding multiple job holders. Our main sample includes workers holding multiple jobs in a year. For these workers, we define the primary employer as the employer that accounts for the highest share of earnings for a worker during the year. Here, we repeat our main exercise in Figure 2 by excluding individuals with multiple job records in a given year.

Figure A3: Effects of job separation by reason for separation: Single-job holders



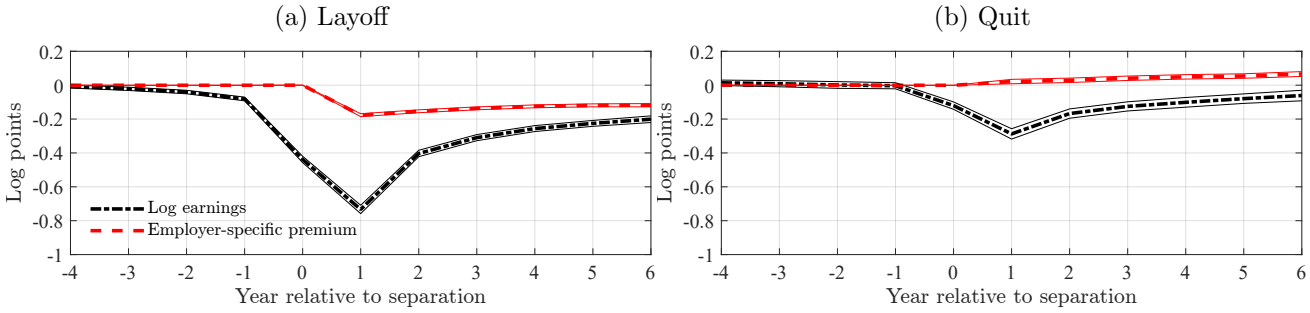
Note: This figure plots estimates for earnings and employer-specific pay premium losses upon job separation by reason of separation during mass layoffs. Panel (a) presents estimates for separations due to layoff and Panel (b) presents estimates for separations due to quit. Dashed-dotted-black lines show estimated γ_k^s values (along with 95 percent confidence intervals given by solid-black lines) in Equation (1), and dashed-red lines present estimated γ_k^s values (along with 95 percent confidence intervals given by solid-red lines) in Equation (3). In this figure, we drop individuals with multiple job records in a year in our sample.

Figure A3 presents estimates for the dynamics of earnings and employer effects for layoffs and quits. It shows that our main findings remain nearly identical when compared with those presented in Figure 2.

[51] These values are obtained from the monthly Labour Force Survey published by Statistics Canada.

Focusing on employer closures. As we discussed in Section 2 of the main text, the literature identifies mass-layoff events from large employment contractions experienced by an employer. Such employment contractions can potentially occur for reasons that keep the employer in the business (e.g., reorganization and restructuring) or result in a complete closure of the business. Recall that in Figure 2, we do not take any stance on the underlying reasons behind large employment contractions. As an alternative specification, we consider a subset of the mass-layoff separations that occur between 2008 to 2010 as defined in Section 2.1 that only includes separations associated with employer closures. Formally, these closures are defined as employers that experience a mass layoff and either register zero employment or drop out from the sample for some given year, without ever returning to positive employment until the end of the sample period. Given our long-tenure sample restriction that workers must be attached to the same main employer from 2002 through 2007, no plant closures occur before 2008. To illustrate, a mass-layoff separation that occurs in 2009 from an employer that eventually disappears permanently from 2013 onward would be considered a separation associated with an employer closure. The results in this case are presented in Figure A4. Restricting attention to employer closures retains the key message that laid-off workers suffer much larger earnings losses than quitting workers. However, compared with our baseline estimates, we note that earnings losses are slightly lower for the layoffs that coincide with an employer closure (73 vs. 78 log points) and slightly higher for quits (29 vs. 25 log points). This can be rationalized by the fact that mass layoffs may involve some discretion by employers in terms of selecting who to lay off and by workers in terms of deciding when to quit to join a new employer. An employer closure dilutes the negative selection for layoffs and the strategic opportunities for workers to time their quits. These findings are broadly in line with those documented in Gibbons and Katz (1991) and in Section 4.3.

Figure A4: Effects of job separation by reason for separation: Separators from employer closures



Note: This figure plots estimates for earnings and employer-specific pay premium losses upon job separation by reason of separation during mass layoffs. Panel (a) presents estimates for separations due to layoff and Panel (b) presents estimates for separations due to quit. Dashed-dotted-black lines show estimated γ_k^s values (along with 95 percent confidence intervals given by solid-black lines) in Equation (1), and dashed-red lines present estimated γ_k^s values (along with 95 percent confidence intervals given by solid-red lines) in Equation (3). Here, we focus only on employer closures when identifying mass-layoff events in our sample.

Implementing an alternative mass-layoff identification. In Section 2, we identify a mass-layoff event between 2008 and 2010 when an employer experiences (i) an employment drop of

30 percent or more relative to 2007 employment levels and (ii) employment in 2007 that did not exceed 130 percent of 2006 levels. Here, without restricting separations to be within the 2008–2010 period, we also consider an alternative sample restriction, as well as definitions of long-tenure workers and mass-layoff events as in Davis and von Wachter (2011). Consider a reference year t. A mass layoff occurs in year t when: (i) employment drops more than 30 percent between $t-2$ and t, (ii) employment in $t-2$ is not more than 130 percent of employment in $t-3$ and (iii) employment in $t+1$ is less than 90 percent of employment in $t-2$. We restrict our sample to individuals who are 50 years or younger and who have been employed with the same main employer for at least three years. Similar to Davis and von Wachter (2011), we define a mass-layoff separator in year t to be an individual who separates from their main employer in year t while the employer is identified as having experienced a mass layoff in year t or $t+1$.[52] The tenure requirement implies that a separator at t must have been employed by the employer at $t-2$, $t-1$, and t. In our analysis, we also restrict attention to all observations two years before and six years after the reference separation year t. For any given year t, this implies a panel with at most nine observations for each worker, with the earliest observation for all workers being $t-2$. Importantly, this restriction allows us to exclude situations where an individual meets the three-year tenure requirement with their main employer in year t but was attached to a different employer more than two years prior. To maintain the consistency of this restriction, we are left with reference years t from 2003 to 2010. Under this restriction, for any given nine-year window for a reference year t, a stayer is defined as an individual who maintains positive earnings with the same main employer from $t-2$ to $t+6$. Finally, employer effects are estimated repeatedly for each reference year t following the methodology outlined in Section 2.2. Unique to this procedure is that the exclusion of stayers and mass-layoff separators is specific to the sample in each reference year t.

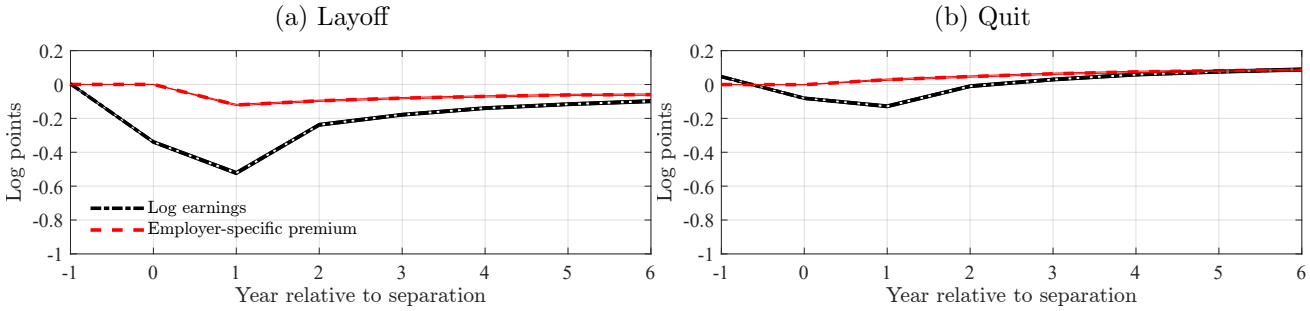
Using the 2001 to 2016 data, we identify mass layoffs, mass-layoff separators, and stayers for each reference year t from 2003 to 2010. We then estimate the regression in Equation (1) using pooled data from each panel constructed using each reference year t. We note that as in Davis and von Wachter (2011), our controls include an interaction of year dummies with a worker's average earnings (over $t-2$ to t).

Figure A5 presents results in this exercise.[53] In this case, we find that magnitudes of earnings and employer effects losses are smaller for both layoffs and quits when compared with our estimates in Figure 2. However, our main conclusions still remain similar: Gaps in earnings and employer effects losses between layoffs and quits are still large and employer effects account for earnings losses especially in the long-run for layoffs but they do not explain earnings losses for quits.

[52] We also drop separations associated with concentrated flows, following the job flow exclusion methodology described in Section 2.1.

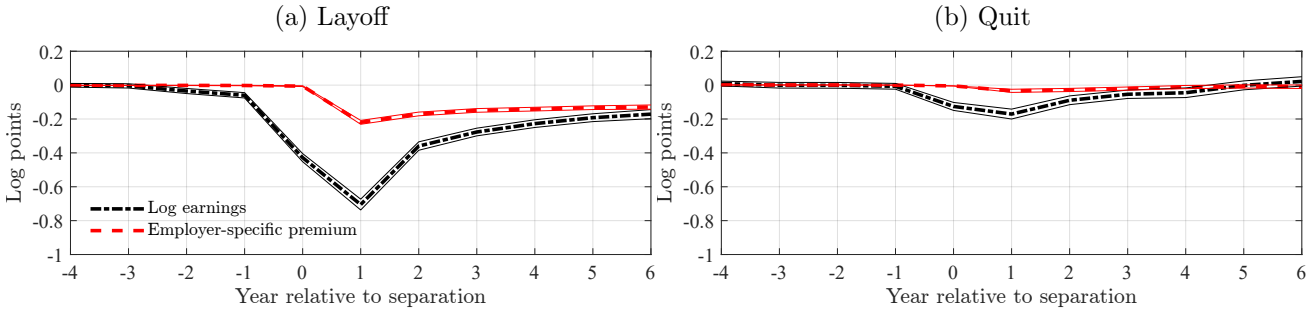
[53] The shorter horizon of pre-displacement estimates arises from the shorter tenure requirement of three years.

Figure A5: Effects of job separation by reason for separation: Alternative identification



Note: This figure plots estimates for earnings and employer-specific pay premium losses upon job separation by reason of separation during mass layoffs. Panel (a) presents estimates for separations due to layoff and Panel (b) presents estimates for separations due to quit. Dashed-dotted-black lines show estimated γ_k^s values (along with 95 percent confidence intervals given by solid-black lines) in Equation (1), and dashed-red lines present estimated γ_k^s values (along with 95 percent confidence intervals given by solid-red lines) in Equation (3). Here, without restricting separations to be within the 2008–2010 period, we also consider an alternative sample restriction, and definitions of long-tenure workers and mass layoff as in Davis and von Wachter (2011). In this case, a mass layoff occurs when: (i) employment drops more than 30 percent between $t-2$ and t, (ii) employment in $t-2$ is not more than 130 percent of employment in $t-3$ and (iii) employment in $t+1$ is less than 90 percent of employment in $t-2$.

Figure A6: Effects of job separation by reason for separation: Within-employer comparison



Note: This figure plots estimates for earnings and employer-specific pay premium losses upon job separation by reason of separation during mass layoffs. Panel (a) presents estimates for separations due to layoff and Panel (b) presents estimates for separations due to quit. Dashed-dotted-black lines show estimated γ_k^s values (along with 95 percent confidence intervals given by solid-black lines) in Equation (A1), and dashed-red lines present estimated γ_k^s values (along with 95 percent confidence intervals given by solid-red lines) in Equation (3). Here, we compare outcomes between mass-layoff separators and stayers from the same employer.

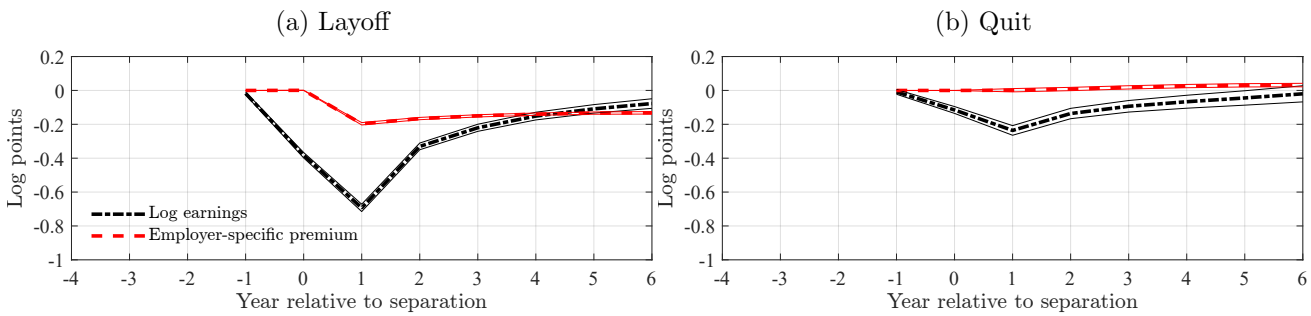
Comparing separators and within-employer stayers. In our main results, when estimating the effects of mass-layoff separations on worker outcomes, we compare outcomes of long-tenure workers in the mass-layoff separator sample with outcomes of long-tenure workers who retain employment with the same primary employer for another seven years. We now redefine the control group to be the colleagues of mass-layoff separators who remain with their employers. As such, the comparison is now between mass-layoff separators and stayers from the same employer. To do this, we implement the following specification as in Jacobson et al. (1993):

$$y_{i,t} = \alpha_{i,j} + \zeta_t + \beta x_{i,t} + \sum_{s \in S} \sum_{k=-4}^{6} d_{i,t,k}^s \times \gamma_k^s + \varepsilon_{i,t}. \tag{A1}$$

The noticeable difference between this specification when compared with Equation (1) is that fixed effects $\alpha_{i,j}$ are conditional upon employer affiliation j, such that the estimated outcomes translate to differences between separators and stayers at the *same* employer. When stayers at an employer experiencing a mass layoff also systematically experience earnings losses, the magnitude of estimated coefficients γ_k^s in Equation (A1) will be smaller than those estimated in Equation (1). Moreover, by construction, this specification excludes all separators whose previous employer goes out of business or otherwise disappears from the sample, which is another reason to expect lower earnings losses in this case relative to the baseline estimates.

As expected, Figure A6 shows that earnings and employer premium losses are slightly less severe in this case for both layoffs and quits relative to those in Figure 2. Apart from this slight difference, our main conclusions remain similar.

Figure A7: Effects of job separation by reason for separation: Heterogeneous worker time trends



Note: This figure plots estimates for earnings and employer-specific pay premium losses upon job separation by reason of separation during mass layoffs. Panel (a) presents estimates for separations due to layoff and Panel (b) presents estimates for separations due to quit. Dashed-dotted-black lines show estimated γ_k^s values (along with 95 percent confidence intervals given by solid-black lines) in Equation (A2), and dashed-red lines present estimated γ_k^s values (along with 95 percent confidence intervals given by solid-red lines) in Equation (3). Here, we estimate a version of Equation (1) with heterogeneous (worker-specific) trends, as in Equation (A2).

Incorporating heterogeneous time trends. Estimates of the effects of mass-layoff separations from the main regression specification in Equation (1) may be biased if there are worker fixed effects in earnings growth (in addition to the fixed effects in earnings level). For example, if those with lower lifetime earnings growth are more likely to be laid off, then the earnings losses estimated from Equation (1) may be overstated. To address this potential source of bias, we estimate a version of Equation (1) with worker-specific linear time trends. Specifically, the new specification now becomes:

$$y_{i,t} = \alpha_i + \xi_i t + \zeta_t + \beta x_{i,t} + \sum_{s \in S} \sum_{k=-1}^{6} d_{i,t,k}^s \times \gamma_k^s + \varepsilon_{i,t}, \tag{A2}$$

where ξ_i is the worker fixed effects in growth. Notice that we do not estimate the effects of separation for two, three, and four years before the separation. This is to ensure that the worker-specific linear time trends are well identified based on these three additional years of observations. With

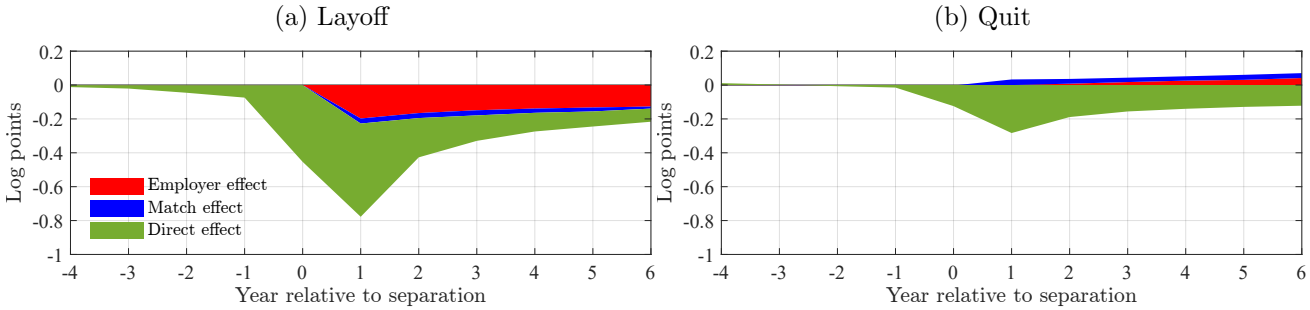
the inclusion of worker-specific trends, the estimates of γ_k^s now reflect the effect of a mass-layoff separation relative to stayers, controlling for differences in workers' unobserved characteristics that lead to differences in level as well as growth of worker outcomes.

Figure A7 presents results for this case. Again, we find that the magnitudes of earnings and employer effect losses remain similar to those in Figure 2. This provides reassurance that differential trends in earnings growth do *not* significantly bias the estimated effects of mass-layoff separations in our baseline specification.

B.5 Decomposition of sources of earnings losses

In this section, we provide results to complement our discussions in Section 3.3. Figure A8 presents a complete decomposition for the sources of earnings losses upon separations during mass layoffs for workers who are laid off (Panel (a)) and who quit (Panel (b)).

Figure A8: Decomposition of sources of earnings losses upon separations during mass layoffs



Note: This figure presents a decomposition of earnings losses upon job separation by reason of separation, as indicated in the ROE, from employers experiencing a mass layoff. Earnings losses are decomposed into those attributable to changes in employer premium, match, and direct effects. Panels (a) and (b) present estimates for separations due to layoff and quit, respectively.

Results in Panels (a) and (b) reveal that how employer effects contribute to explaining earnings losses substantially differ between layoffs and quits. Furthermore, match effects and employer effects are both positive and thus mitigate the decline in earnings due to a decline in direct effects for quits. For layoffs, match effects are negative but small, while direct effects decline largely, especially in the short run. Quantitatively, for layoffs (quits), we find that employer, match, and direct effects are -20 (0), -3 (3), and -55 (-28) log points lower relative to stayers in the year following the separation, while these effects are -13 (4), -1 (3), and -8 (-12) log points lower relative to stayers, respectively, six years after the separation.

B.6 Cross-sectional earnings loss differences between layoffs and quits

Here, we provide additional results regarding the cross-sectional differences in earnings losses and their sources (employer, match, and direct effects). These additional results supplement our main findings in Figures 4, 5, and 6. In particular, Tables A2, A3, and A4 present full results for each of the 25 quintile-to-quintile transitions across employer effects for separations in mass layoffs due to layoffs and quits, as well as separately for layoffs and quits, respectively.

Table A2: Interquintile employer transitions and changes for mass-layoff separators

	Destination employer quintile					
Origin employer quintile	1	2	3	4	5	All
1						
Share of separators in cell	0.050	0.017	0.008	0.008	0.006	0.090
Average change in log earnings	0.133	0.268	0.355	0.441	0.713	0.247
Average change in employer effect	0.001	0.343	0.614	0.807	1.033	0.267
Average change in match effect	0.037	-0.134	-0.276	-0.324	-0.343	-0.083
Average direct effect	0.095	0.059	0.017	-0.042	0.023	0.063
2						
Share of separators in cell	0.036	0.061	0.035	0.019	0.014	0.163
Average change in log earnings	-0.224	-0.054	0.112	0.212	0.438	0.016
Average change in employer effect	-0.399	-0.025	0.193	0.364	0.597	0.037
Average change in match effect	0.121	-0.026	-0.098	-0.208	-0.207	-0.046
Average direct effect	0.053	-0.002	0.017	0.056	0.048	0.025
3						
Share of separators in cell	0.020	0.055	0.058	0.028	0.021	0.182
Average change in log earnings	-0.314	-0.128	0.015	0.083	0.283	-0.022
Average change in employer effect	-0.641	-0.212	0.001	0.160	0.388	-0.064
Average change in match effect	0.226	0.034	-0.032	-0.111	-0.137	-0.008
Average direct effect	0.101	0.050	0.046	0.034	0.032	0.050
4						
Share of separators in cell	0.023	0.045	0.058	0.065	0.063	0.254
Average change in log earnings	-0.564	-0.269	-0.118	0.011	0.159	-0.083
Average change in employer effect	-0.811	-0.387	-0.157	0.004	0.236	-0.118
Average change in match effect	0.208	0.063	0.000	-0.038	-0.113	-0.008
Average direct effect	0.039	0.055	0.040	0.045	0.036	0.043
5						
Share of separators in cell	0.022	0.037	0.053	0.060	0.139	0.311
Average change in log earnings	-0.774	-0.481	-0.273	-0.192	0.054	-0.171
Average change in employer effect	-1.100	-0.621	-0.373	-0.225	0.020	-0.249
Average change in match effect	0.237	0.107	0.046	-0.013	-0.019	0.026
Average direct effect	0.088	0.034	0.053	0.046	0.053	0.052
All						
Share of separators in cell	0.150	0.215	0.212	0.180	0.243	
Average change in log earnings	-0.248	-0.166	-0.064	-0.004	0.138	
Average change in employer effect	-0.461	-0.223	-0.080	0.028	0.164	
Average change in match effect	0.137	0.022	-0.024	-0.073	-0.072	
Average direct effect	0.076	0.034	0.040	0.041	0.046	

Note: This table presents five rows for mass-layoff separations due to layoff or quit for each quintile to quintile transition between origin (rows) and destination (columns) employer effects: (i) the fraction of separators, (ii) average change in log earnings, (iii) average change in employer effects, (iv) average change in match effects, and (v) average direct effects of the transition. Values are based on a comparison of outcomes between one year before and three years after separation.

Table A3: Interquintile employer transitions and changes for mass-layoff separators: layoff

	Destination employer quintile					
Origin employer quintile	1	2	3	4	5	All
1						
Share of separators in cell	0.046	0.010	0.004	0.004	0.002	0.066
Average change in log earnings	0.140	0.314	0.402	0.518	0.672	0.223
Average change in employer effect	0.007	0.321	0.626	0.827	1.033	0.176
Average change in match effect	0.026	-0.070	-0.294	-0.276	-0.355	-0.039
Average direct effect	0.106	0.064	0.070	-0.033	-0.006	0.085
2						
Share of separators in cell	0.039	0.061	0.032	0.014	0.010	0.155
Average change in log earnings	-0.267	-0.086	0.072	0.186	0.405	-0.042
Average change in employer effect	-0.397	-0.032	0.193	0.368	0.591	0.000
Average change in match effect	0.087	-0.040	-0.119	-0.243	-0.226	-0.055
Average direct effect	0.043	-0.014	-0.002	0.062	0.040	0.013
3						
Share of separators in cell	0.021	0.058	0.056	0.023	0.015	0.173
Average change in log earnings	-0.365	-0.163	-0.028	0.025	0.237	-0.083
Average change in employer effect	-0.623	-0.216	-0.004	0.165	0.391	-0.091
Average change in match effect	0.205	0.018	-0.051	-0.143	-0.194	-0.022
Average direct effect	0.054	0.034	0.028	0.003	0.040	0.031
4						
Share of separators in cell	0.028	0.054	0.063	0.061	0.050	0.256
Average change in log earnings	-0.590	-0.303	-0.176	-0.090	0.097	-0.174
Average change in employer effect	-0.811	-0.385	-0.160	0.001	0.235	-0.162
Average change in match effect	0.170	0.024	-0.044	-0.105	-0.162	-0.044
Average direct effect	0.051	0.058	0.028	0.014	0.024	0.033
5						
Share of separators in cell	0.028	0.047	0.062	0.068	0.146	0.350
Average change in log earnings	-0.821	-0.497	-0.321	-0.257	-0.004	-0.240
Average change in employer effect	-1.110	-0.624	-0.374	-0.228	0.007	-0.279
Average change in match effect	0.211	0.075	0.002	-0.067	-0.054	-0.008
Average direct effect	0.077	0.052	0.051	0.037	0.043	0.047
All						
Share of separators in cell	0.160	0.230	0.217	0.170	0.223	
Average change in log earnings	-0.315	-0.222	-0.132	-0.103	0.059	
Average change in employer effect	-0.505	-0.266	-0.114	-0.017	0.119	
Average change in match effect	0.121	0.012	-0.048	-0.111	-0.098	
Average direct effect	0.070	0.032	0.031	0.024	0.038	

Note: This table presents five rows for all layoffs within the mass-layoff separators sample for each quintile to quintile transition between origin (rows) and destination (columns) employer effects: (i) the fraction of separators, (ii) average change in log earnings, (iii) average change in employer effects, (iv) average change in match effects, and (v) average direct effects of the transition. Values are based on a comparison of outcomes between one year before and three years after separation.

Table A4: Interquintile employer transitions and changes for mass-layoff separators: quit

	Destination employer quintile					
Origin employer quintile	1	2	3	4	5	All
1						
Share of separators in cell	0.060	0.031	0.018	0.017	0.014	0.140
Average change in log earnings	0.123	0.236	0.333	0.402	0.726	0.271
Average change in employer effect	-0.008	0.359	0.609	0.798	1.034	0.357
Average change in match effect	0.055	-0.178	-0.267	-0.349	-0.340	-0.128
Average direct effect	0.077	0.055	-0.008	-0.047	0.032	0.041
2						
Share of separators in cell	0.029	0.061	0.040	0.031	0.021	0.181
Average change in log earnings	-0.103	0.014	0.180	0.236	0.471	0.122
Average change in employer effect	-0.404	-0.012	0.192	0.361	0.603	0.105
Average change in match effect	0.219	0.004	-0.062	-0.175	-0.187	-0.029
Average direct effect	0.081	0.022	0.050	0.050	0.056	0.046
3						
Share of separators in cell	0.018	0.050	0.061	0.038	0.035	0.202
Average change in log earnings	-0.187	-0.041	0.098	0.158	0.325	0.088
Average change in employer effect	-0.684	-0.203	0.012	0.154	0.385	-0.014
Average change in match effect	0.278	0.074	0.005	-0.071	-0.085	0.017
Average direct effect	0.218	0.089	0.081	0.075	0.025	0.084
4						
Share of separators in cell	0.013	0.025	0.048	0.073	0.090	0.249
Average change in log earnings	-0.445	-0.112	0.046	0.191	0.231	0.115
Average change in employer effect	-0.811	-0.398	-0.149	0.009	0.237	-0.021
Average change in match effect	0.378	0.244	0.120	0.081	-0.055	0.071
Average direct effect	-0.013	0.042	0.075	0.101	0.049	0.065
5						
Share of separators in cell	0.009	0.017	0.035	0.044	0.125	0.229
Average change in log earnings	-0.465	-0.387	-0.095	0.023	0.197	0.051
Average change in employer effect	-1.035	-0.603	-0.369	-0.216	0.050	-0.154
Average change in match effect	0.412	0.290	0.211	0.162	0.068	0.138
Average direct effect	0.158	-0.074	0.063	0.077	0.079	0.068
All						
Share of separators in cell	0.128	0.183	0.202	0.202	0.285	
Average change in log earnings	-0.070	-0.017	0.089	0.173	0.270	
Average change in employer effect	-0.344	-0.107	-0.003	0.108	0.239	
Average change in match effect	0.181	0.051	0.031	-0.005	-0.028	
Average direct effect	0.094	0.040	0.062	0.070	0.059	

Note: This table presents five rows for all quits within the mass-layoff separators sample for each quintile to quintile transition between origin (rows) and destination (columns) employer effects: (i) the fraction of separators, (ii) average change in log earnings, (iii) average change in employer effects, (iv) average change in match effects, and (v) average direct effects of the transition. Values are based on a comparison of outcomes between one year before and three years after separation.

Table A3 shows that, among workers who are laid-off, the share of layoffs sharply increases with origin quintile. At the same time, the probability of below-diagonal transitions and earnings and employer premium drops also increase with origin quintile. Combined, a substantial fraction of layoffs are associated with higher-paying employers whose workers have more to lose upon separation. In contrast, the distribution of separations is more even across origin quintiles among workers who quit, as seen in Table A4.

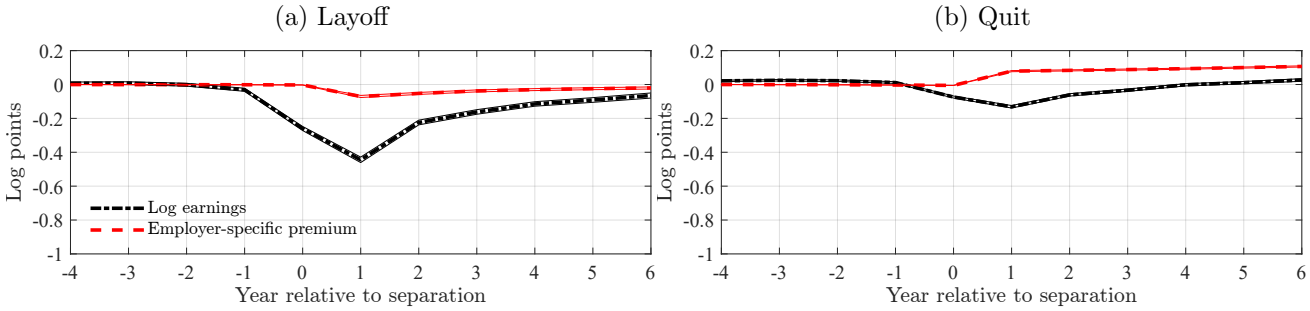
B.7 Interaction between worker and employer outcomes

The results shown in Section 3.2 demonstrate that earnings losses upon job separations and the underlying sources of such losses differ greatly for individuals who are laid-off and who quit from employers with a mass layoff. We now show that employer outcomes also influence outcomes of a worker upon a separation. In particular, we document that both the composition and the impact of separations largely vary between distressed employers undergoing mass layoffs and employers that are *not* experiencing mass layoffs. These findings are relevant for two reasons. First, they demonstrate that one cannot treat worker separation outcomes as distinct and isolated from employer outcomes. Second, these results provide further evidence for why the literature has documented worse outcomes for workers who separate from their employers during recessions, during which mass layoffs are much more prevalent, as we discuss below.

Distribution of separations. Before delving into earnings outcomes of non-mass-layoff separators, we first document differences in the composition of separations compared with a mass-layoff event. Based on ROE reasons, a majority of non-mass-layoff separations are because of quits. In particular, among all non-mass-layoff separations (all non-mass-layoff separations with non-missing ROE information), 45 percent (55 percent) are quits, while only 14 percent (18 percent) are layoffs. This is very different than the composition of mass-layoff separations where layoffs are much more prevalent than quits, as shown in Table 1.

Earnings outcomes. Next, we provide estimated earnings and employer-specific pay premium losses separately by reason for separations that do not occur during a mass layoff. The results from this exercise are shown in Figure A9. When comparing the estimates for separations originating from mass layoffs presented in Figure 2, we highlight two results. First, earnings losses associated with a separation outside a mass layoff are much smaller and less persistent. Declines in earnings in the year following layoffs and quits are much smaller for non-mass-layoff separations (45 log points and 13 log points) when compared with declines in earnings upon layoffs and quits for mass-layoff separations (78 log points and 25 log points). In addition, for non-mass-layoff separations, earnings upon quits fully recover three years after the separation and earnings upon layoffs remain only 7 log points lower six years following the separation. Overall, the gap between earnings losses upon layoffs and quits for non-mass-layoff separations

Figure A9: Effects of job separation by reason for separation: Non-mass-layoff separations



Note: This figure plots estimates for earnings and employer-specific pay premium losses upon job separation by reason of separation from employers that are *not* experiencing mass layoffs. Panel (a) presents estimates for separations due to layoff and Panel (b) presents estimates for separations due to quit. Dashed-dotted-black lines show estimated γ_k^s values (along with 95 percent confidence intervals given by solid-black lines) in Equation (1), and dashed-red lines present estimated γ_k^s values (along with 95 percent confidence intervals given by solid-red lines) in Equation (3).

is much smaller than that for mass-layoff separations both in the short run and in the long run. Second, non-mass-layoff separations are also associated with a smaller and less-persistent decline in employer-specific pay premium for laid-off workers and a much larger increase in employer-specific pay premium for workers who quit. In particular, employer premium declines by only 7 log points in the year following the layoff and almost fully recovers six years after the layoff. In fact, workers who quit experience a long-lasting 11-log-point gain in their employer premium. As such, when a worker quits from an employer not undergoing a mass layoff, the worker experiences a temporary small decline in earnings but typically finds reemployment with an employer that pays more on average.

Cross-sectional earnings loss differences between layoffs and quits. To understand the underlying reasons behind these results, we now turn to cross-sectional differences in the consequences of non-mass-layoff separations, as in Section 3.3.

Table A5 presents fractions of separations, average changes in earnings, underlying reasons behind these changes in earnings (employer, match, and direct effects) based on below-, on-, and above-diagonal transitions between origin and destination employer-specific pay premium quintiles. Starting with the share of separators, workers who are laid-off during non-mass layoffs are less likely to find reemployment with employers in a lower quintile of the employer-specific pay premium distribution relative to workers who are laid-off during mass layoffs, as shown in Table 3 (34.3 percent vs 46.8 percent). Workers who quit during non-mass layoffs are also less likely to fall to lower quintiles and more likely to climb to higher quintiles of the distribution relative to workers quit who during mass layoffs (22.3 percent vs 28.8 percent for below-diagonal transitions and 41.3 percent vs 33.5 percent for above diagonal transitions). Moving to average changes in earnings, relative to laid-off workers in mass layoffs (Table 3), laid-off workers in non-mass layoffs experience smaller average earnings losses when their destination employer is in a lower quintile of the employer-specific pay premium distribution (-16.2 percent vs -33.2 percent) and larger

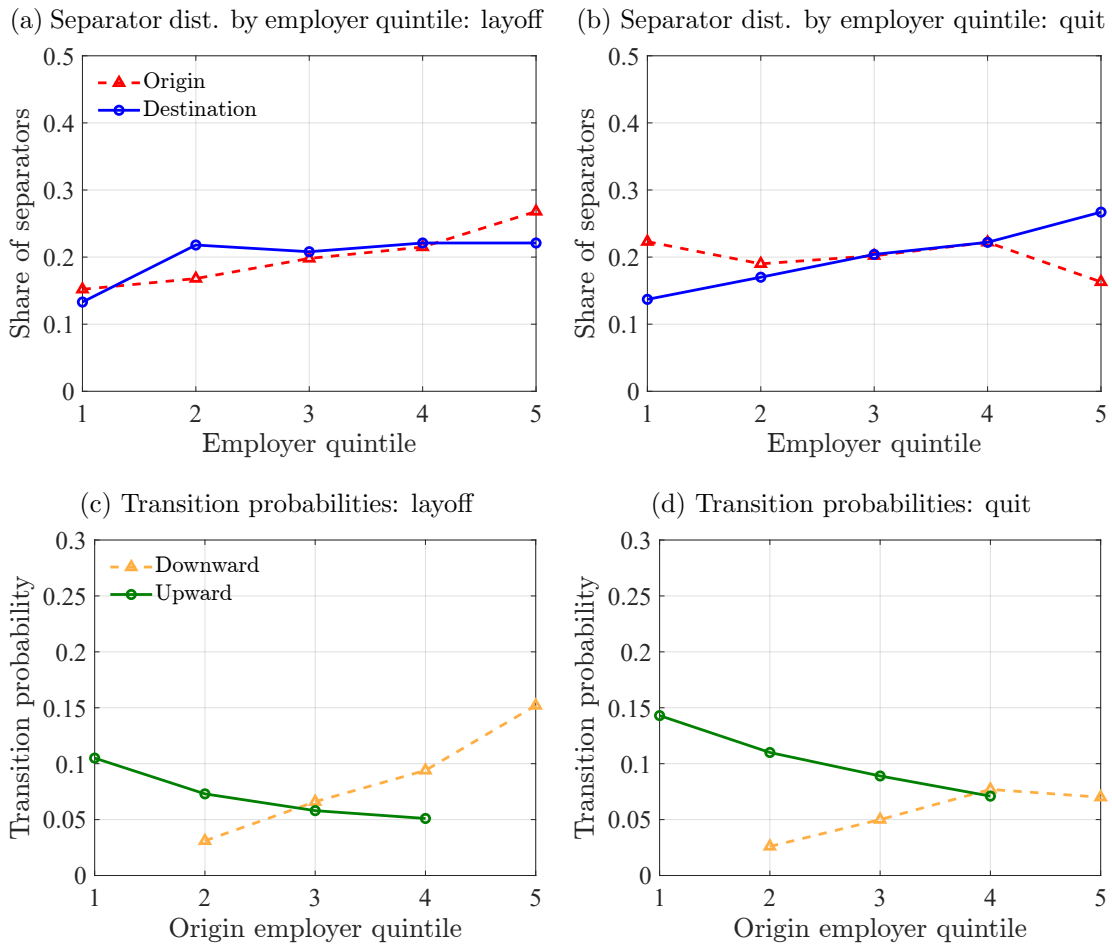
Table A5: Below-, on-, and above-diagonal sums and averages: non-mass-layoff separations

	Below diagonal	On diagonal	Above diagonal
(a) Layoff			
Share of separators	0.343	0.369	0.287
Average change in log earnings	-0.162	0.075	0.308
Average change in employer effect	-0.367	0.003	0.352
Average change in match effect	0.167	0.023	-0.075
Average direct effect	0.038	0.049	0.030
(b) Quit			
Share of separators	0.223	0.360	0.413
Average change in log earnings	0.018	0.185	0.381
Average change in employer effect	-0.335	0.014	0.424
Average change in match effect	0.298	0.115	-0.080
Average direct effect	0.056	0.056	0.037
(c) Average			
Share of separators	0.252	0.362	0.383
Average change in log earnings	-0.041	0.158	0.368
Average change in employer effect	-0.346	0.011	0.411
Average change in match effect	0.255	0.093	-0.079
Average direct effect	0.050	0.054	0.035

Note: This table presents five rows for non-mass-layoff separations with a different reason (layoff, quit, or average across layoffs and quits) with below-diagonal, on-diagonal, and above-diagonal transitions: (i) the fraction of separators, (ii) average change in log earnings, (iii) average change in employer effects, (iv) average change in match effects, and (v) average direct effects of the transition. Below-diagonal transitions represent moves to an employer with a lower-quintile employer effects, on-diagonal and above-diagonal transitions represent moves to a same-quintile employer and to a higher-quintile employer, respectively. Values are based on a comparison of outcomes between one year before and three years after separation.

average earnings gains when their destination employer is in a higher quintile of the distribution (30.8 percent vs 15.9 percent). We find that these differences in earnings changes between laid-off workers in non-mass layoffs and mass layoffs are mostly accounted for by differences in average changes in match effects (16.7 percent vs 3.7 percent for below diagonal transitions and -7.5 percent vs -16.7 percent for above diagonal transitions). On the other hand, workers who quit during non-mass layoffs on average do not experience losses in earnings when they find reemployment with employers in lower quintiles but experience large gains (38.1 percent) in earnings when they are reemployed at employers with higher quintiles. These results are different for workers who quit during mass layoffs: They experience close to a 10 percent decline in earnings when they fall in the employer-premium quintile upon separation and experience a smaller increase (27.7 percent) in earnings when they climb in the distribution upon separation. These differences in changes in average earnings of workers who quit in non-mass layoffs relative to workers who quit in mass layoffs are again mostly driven by differences in average changes in match effects (29.8 percent vs 19.1 percent for below-diagonal transitions and -8 percent vs -13 percent for above-diagonal transitions).

Figure A10: Transitions across employer effect distribution: non-mass-layoff separations



Note: Panels (a) and (b) present the distribution of separations by origin (dashed-red lines) and destination (solid-blue lines) quintiles for both layoffs and quits that do not occur during a mass layoff, respectively. Panels (c) and (d) present upward (solid-green lines) and downward (dashed-orange lines) transition probabilities by origin employer effects quintiles for layoffs and quits that do not occur during a mass layoff, respectively. Values are based on a comparison of outcomes between one year before and three years after separation.

Finally, Figure A10 presents more-detailed results on shares and transition probabilities across quintiles of the employer-specific pay premium distribution for non-mass-layoff separators who are laid-off (Panel (a) and Panel (c)) and workers who quit (Panel (b) and Panel (d))). Relative to the same moments documented in Figure 4, we highlight the following differences. First, while the incidence of layoffs increase in employer-effects quintile of the origin employer for both non-mass-layoff and mass-layoff separations, this profile is much flatter for the former group. In particular, the red-dashed line in Panel (a) shows that 15 and 27 percent of all layoffs originate from the bottom and top quintiles for non-mass-layoff separations, respectively, while these fractions are 7 percent and 35 percent for mass-layoff separations. Second, because the distributions of layoffs among non-mass-layoff separations across origin and destination employer effects quintiles closely track each other (red-dashed and solid-blue lines in Panel (a)), the overall distribution of employer effects remains largely unchanged following layoffs during non-mass

layoffs. This is very different from layoffs during mass layoffs, where the distribution of employer effects shifts leftward upon separations, leading to a substantial net decline in employer premium position. Third, dashed-orange and solid-green lines in Panel (c) show that downward transition probabilities are smaller and upward transition probabilities are larger for layoffs during non-mass layoffs regardless of the employer effect quintile of the origin employer when compared with those probabilities for layoffs during mass layoffs. Fourth, moving to quits, the dashed-red line in Panel (b) shows that the fraction of all separations that originate from workers separating from employers in the bottom quintile is higher for non-mass-layoff separations than for mass-layoff separations (22 percent vs 14 percent). Finally, we find that the upward transition probability is typically higher for workers who quit during non-mass layoffs (solid-green line in Panel (d)) than for workers who quit during mass layoffs, while the downward transition probabilities are mostly similar across the distribution for these two groups. Importantly, among those who work at employers in the bottom quintile of the distribution, the upward transition probability is around double for workers who quit during non-mass layoffs than for workers who quit during mass layoffs (14 percent vs 8 percent).