Are layoff decisions of American corporations efficient?*

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Abstract: We propose a novel measure of layoff efficiency which compares actual layoff size with the abnormal level of hiring prior to layoff announcements. Based on 749 layoff announcements hand-collected from corporate disclosures in Form 8-K over the period 2004 to 2012, we find that layoff decisions in the U.S. are on average inefficient. Specifically, an average layoff firm's level of hiring already falls short of the optimal level of hiring (i.e., under-hiring) even before the layoff so that the layoff further exacerbates the extent of the under-hiring from -1.5% to -11.9%, relative to its optimal level of hiring. We further find that abnormal stock returns surrounding layoff announcements increase with layoff efficiency, suggesting that the stock market understands the performance implication of layoff efficiency. The difference in the abnormal stock returns between the lowest and the highest layoff efficiency deciles is 2.8% and economically significant.

Keywords: Layoff; Measuring layoff efficiency; Restructuring; Downsizing; Form 8-K

JEL Classification: E24, G34, J53, J63, M41, M51, M54

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1. Introduction

Corporate restructuring involves various downsizing programs such as asset sales, plant closures, and large-scale employee layoffs. Compared to other types of restructuring plans, employee layoffs draw more keen public attention as they often create severe political and social tensions. However, prior research on layoffs has remained sparse even after the most recent financial crisis in 2008, albeit Cameron (1994) once claimed that 'downsizing is probably the most pervasive yet understudied phenomenon in the business world'.

The key to understanding the value implication of corporate layoffs is to assess whether, and to what extent, a layoff pushes an excessive labor force down to the optimal level, which we call *layoff efficiency* in this paper. Earlier studies investigate stock market reactions to layoff announcements by implicitly assuming that stock prices fully incorporate such layoff efficiency. However, previous empirical findings are largely mixed and thus do not clearly indicate whether the stock market fully appreciates layoff efficiency. For instance, some studies (e.g., Worrell et al. 1991; Hillier et al. 2007) document negative stock market reaction to layoff announcements, while others (e.g., Berger and Ofek 1999; Marshall et al. 2012) report positive stock market reaction to layoff announcements.

Several researchers attempt to reconcile these mixed results in stock market reactions by exploring underlying reasons for layoffs. For example, Worrell et al. (1991) find that while the stock market generally reacts negatively to layoff announcements, it reacts much more negatively to those effects attributable to financial reasons. They conclude that it is important to consider the strategic implications of layoffs in understanding the stock market reaction. However, unlike Worrell et al. (1991), Chalos and Chen (2002) report a positive market reaction to layoff announcements, particularly when layoffs relate to refocusing lines of business. Furthermore, Palmon et al. (1997) show that while the stock market reacts negatively to

layoffs attributable to declining demands, it reacts positively to those purporting efficiency enhancement.[1] Other researchers instead consider layoff size (i.e., the number of dismissed employees) but find that the market reaction to layoff size ranges from highly positive to insignificant (e.g., Nixon et al. 2004; Hiller et al. 2007).

In this study, we address two research questions: (1) whether layoff decisions are efficiently rendered and (2) whether the stock market incorporates the performance implication of layoff efficiency in its responses to layoff announcements. We collect information on layoff announcements by reading Form 8-K filed with the US Securities and Exchange Commission (SEC). Effective on August 2004, the US SEC has mandated firms to report costs associated with exit or disposal activities on the 8-K report (Item 2.05). The form contains detailed layoff information such as layoff announcement date, layoff size, and the reasons of employee termination. Our sample collection based on Form 8-K is superior to conventional media search widely used in prior studies because all the public companies in the US must file the report within four business days after their layoff announcements. Compared to the news media search that is prone to cover large firms selectively, our approach overcomes such a visibility bias against smaller firms.

We first investigate whether layoffs of US firms are, on average, efficient. Unlike prior studies that rely on stock price reactions to layoff news, we directly gauge layoff efficiency by examining whether layoffs reduce the extent of over-hiring or aggravate that of under-hiring. On the one hand, if a layoff occurs when a firm is already over-hiring before the layoff event, the layoff will cut superfluous employees, thus mitigating hiring inefficiency. On the other hand, if a layoff occurs when the level of current hiring already falls short of the optimal level (i.e., already under-hiring before the layoff event), the layoff will exacerbate the extent of under-hiring, thus further worsening hiring inefficiency. We expect such identification of the pre-layoff hiring inefficiency and the subsequent measurement of layoff efficiency to be indicative of why

[1] Some studies do not find that stock market reactions vary with layoff reasons (e.g., Hillier et al. 2007; Farber and Hallock 2009). We conjecture that the result might be attributable to the difficulty of researchers to correctly identify a key claim for layoffs. Our reading of Form 8-K reveals that managers often provide multiple reasons for layoffs or sometimes they do not provide any reason for layoffs.

the stock market reacts differentially to layoff news. Thus, our measure of layoff efficiency helps to explain the mixed findings in prior studies.

To examine whether a firm is over-hiring or under-hiring before layoffs, we first estimate the optimal level of hiring, based on the recent literature. In particular, following Pinnuck and Lillis (2007) and Jung et al. (2014), we regress a change in the number of employees on various fundamental variables, which affect managers' hiring decisions, such as sales growth, leverage, liquidity, and profitability. If a firm hires more (less) than the optimal level predicted by fundamental variables, we consider it as over- (under-) hiring. That is, we define pre-layoff hiring inefficiency as the difference between the actual level of hiring and the optimal level of hiring fitted by fundamental variables. We then compare the extent of pre-layoff hiring inefficiency with layoff size. That is, our measure of layoff efficiency is defined as the absolute difference between the extent of pre-layoff hiring inefficiency and layoff size. We multiply it by negative one so that the larger value indicates more efficient layoffs – that is, its maximum value is zero. For instance, as layoff size becomes closer to the extent of over-hiring, layoff efficiency increases since the negative absolute difference between layoff size and the extent of over-hiring gets larger (i.e., becomes closer to zero).

Using 749 layoff announcements over the period from 2004 to 2012, we find that an average layoff firm in our sample is already under-hiring even before its layoff announcement; thus its layoff procedure further aggravates under-hiring. In particular, the extent of under-hiring before (after) layoffs is on average -0.015 (-0.119), indicating that layoffs increase the magnitude of under-hiring by about 8 times [based on Pinnuck and Lillis (2007) model]. Note that when measuring the extent of under-hiring based on the Pinnuck and Lillis model, we already control for various profitability measures (e.g., current year ROA, and ROA changes in the current and preceding years) and sales growth measures (e.g., sales growths in the current and preceding years). This suggests that we already take into account the effect of declines in sales or profitability on our measure of hiring inefficiency. Our results that layoffs aggravate the extent of under-hiring are consistent with the literature (e.g., Worrell et al. 1991) that generally documents negative stock market reaction to layoff announcements. We also report that larger layoffs make the under-hiring problem

more severe, suggesting that large-scale layoffs are, on average, value-destroying. The results offer an explanation for the findings in some prior studies (e.g., Nixon et al. 2004) that layoff size is significantly negatively related to stock market reaction.

Next, to investigate whether stock investors understand the differential implications of layoff decisions as they relate to layoff efficiency, we examine the relation between our measure of layoff efficiency and stock market reaction to layoff announcements. We measure stock market reaction as the sum of three-day abnormal returns around the layoff announcement, where abnormal returns are the difference between raw returns for each firm and value-weighted market returns.[2] We find that, on average, investors react negatively to layoff announcements, suggesting that the value-destroying implication of aggravating under-hiring problems dominates the value-creating implication of mitigating over-hiring problems. More importantly, we find that more efficient layoffs result in higher stock market reaction around layoff announcements, suggesting that stock investors appear to understand the value implication of layoff efficiency.

Our results may be driven by firm-, industry-, or macro-level characteristics associated with the likelihood of layoffs. To mitigate this concern, we perform a series of subsample analyses. We first examine whether our results may be driven by certain firms with or without labor unions and find that the stock market reaction is positively related to layoff efficiency regardless of the existence of labor unions. We also examine whether our results are robust to the effect of the financial crisis since managers' layoff motivations may vary with macroeconomic conditions. We perform the sub-sample analysis between the 2008 financial crisis and non-financial crisis periods and find that the positive relation between layoff efficiency and stock market reaction exists in both periods. Lastly, we find that the positive stock market reaction to layoff efficiency is not concentrated in high or low technology industries, suggesting that labor skill or labor

[2] We also measure market reaction using abnormal returns which are computed as the difference between raw returns and expected returns based on the market model estimated over 255 trading days, ending 45 trading days before the layoff announcement date. The results based on this alternative measure are similar to those based on our primary market reaction measure (untabulated).

entrenchment does not affect our results.

As an additional test, we examine the effect of layoff efficiency on future operating performance. We document that firms with more efficient layoff decisions tend to experience higher ROA in the following year, suggesting that efficient layoffs improve future operating performance and corroborating our evidence on the positive relation between layoff efficiency and the stock market reaction.

Our layoff efficiency measure based on Pinnuck and Lillis (2007) model may suffer from measurement error in the estimation of the optimal level of hiring. To address this concern, we also consider the industry median (i.e., industry norm) of the change in the number of employees as the optimal level of hiring following the literature (e.g., Cella 2014; Jung et al. 2014). Similar to our first measure of layoff efficiency, if each firm's actual net hiring is greater (lower) than the industry median of net hiring, the firm is considered as over-hiring (under-hiring). Again, to construct layoff efficiency, we compare the extent of over-hiring (or under-hiring) with layoff size. Our results with this alternative measure are qualitatively similar to those with our primary measure based on the Pinnuck and Lillis model. We also modify the Pinnuck and Lillis model in two ways. First, when measuring the optimal level of hiring, we include additional indicator variables such as the existence of labor unions, high technology industry and the 2008 financial crisis - in the Pinnuck and Lillis model, since these variables may affect managers' hiring decisions. Second, following the spirit of Biddle et al. (2009), we use only sales growth measures to estimate the optimal level of hiring. We find that our results continue to hold when we use these alternative layoff efficiency measures.

Our study makes several important contributions to the literature. First, to the best of our knowledge, our paper is the first to document that layoff efficiency is an important determinant of investors' reactions to layoff announcements. Second, despite the prevalence of layoffs in US corporations, particularly during the global financial crisis in 2008, it is still unanswered as to whether layoff decisions are efficiently rendered. Prior studies on stock market reaction to layoff announcements address this question indirectly by assuming that stock investors should react positively to efficient layoffs. Instead of relying on the market efficiency hypothesis, we directly construct a measure of layoff efficiency and show

that layoffs, on average, are not efficient in the US. Our findings further reveal that layoff firms in the US are generally under-hiring relative to the optimal level even prior to layoffs, implying that adjustment of slack labor forces is not a primary purpose of layoffs. These results contradict managers' justification of layoff procedures.

2. Related research and hypothesis

Because no extant study directly examines the efficiency of layoffs, we are confined to review prior studies on stock market reactions to layoff announcements. Further, since our first research question of whether layoffs at US firms are efficient is descriptive in nature, we develop a formal hypothesis only on the second research question about the relation between layoff efficiency and stock market reaction around layoff announcements.

2.1. The stock market reaction to layoff announcements

A number of prior studies document negative stock market reactions to layoff announcements. Worrell et al. (1991) examine 194 layoff announcements published in the *Wall Street Journal* between 1979 and 1987 and find that cumulative stock market returns (*CAR*) over the three-day window (-1, +1) around the announcement is, on average, -0.41 percent. Elayan et al. (1998) examine 646 layoff announcements published in the *Wall Street Journal* between 1979 and 1991 and find that *CAR* is -0.64 percent over the two-day window (-1, 0). Chen et al. (2001) examine 349 layoff announcements published in the *Wall Street Journal* between 1990 and 1995 and find that *CAR* over the two-day window is, on average, -1.20 percent. Other studies examine layoffs outside the US: For example, using 322 layoff announcements in the UK between 1990 and 2000, Hilllier et al. (2007) report the mean *CAR* of -0.81 percent over the three-day event window (-1, 1).

Recently, Farber and Hallock (2009) examine whether there exists a shift in the market reaction to layoff announcements over time. They report that the mean *CAR* for layoff announcements changes from -0.59 percent for the period 1970-1979 to -0.06 percent for the period 1990-1999, suggesting that the negative impact of layoff announcements on stock price became weaker over time. Follow-up studies

further provide evidence on the shift in stock market reaction to layoff announcements. Marshall et al. (2012) show that the three-day *CAR* over layoff announcements is, on average, 0.51 percent and that it is significantly positive during 2005-2006. Berger and Ofek (1999) also report 1.90 percent of mean *CAR,* using 404 refocusing events between 1984 and 1993.

In sum, research on the market reaction to layoff announcements generally documents negative stock market responses, although the magnitude varies with sample period and countries. However, several recent studies report positive or insignificant market reaction to layoff announcements.

2.2. Determinants of stock market reaction to layoff announcements

To explain the mixed findings in previous studies on the market reaction to layoff announcements, some researchers investigate the reasons for corporate layoffs: e.g., financial distress owing to declining sales or money loss versus restructuring or consolidation (Worrell et al. 1991); declining demand versus efficiency enhancement (Palmon et al. 1997). Other researchers further add labor management dispute (Eleyan et al. 1998) and plant closure (Chalos and Chen 2002) as layoff reasons. Hillier et al. (2007) outline the most detailed classification of layoff reasons: Reorganization; plant closure; poor performance; fall in demand; cost cutting; and mergers and acquisitions.

Palmon et al. (1997) find that while the stock market reacts positively to proactive layoffs such as restructuring and consolidation, it reacts negatively to reactive layoffs such as cost cutting and declining demand. However, on the contrary to Palmon et al. (1997), Hillier et al. (2007) find that the stock market reaction is negative regardless of layoff reasons, implying that stock investors may not discern layoff reasons when responding to layoff announcements.

Researchers also examine whether layoff size affects stock price reaction to layoff announcements. Palmon et al. (1997) and Chalos and Chen (2002) show that layoff size is significantly positively associated with *CAR*, but the association is conditional on layoff reasons. Nixon et al. (2004) suggest that the stock market return has a negative curvilinear relationship with layoff size, implying that the effect of layoffs on the stock market reaction becomes increasingly negative as layoff size increases. However, Chen et al. (2001) and Hillier et al. (2007) report that, when conducting multivariate analysis with controls for various

firm characteristics and layoff reasons, the relation between layoff size and stock market reaction is rather insignificant. Lastly, recent studies investigate whether financial crisis influences the stock price reaction to layoff announcements. Capelle-Blancard and Tatu (2012) and Marshall et al. (2012) report that the stock market reacts more negatively to layoff announcements after the 2008 global financial crisis, based on layoffs in the European countries.

Overall, extant studies suggest several factors that may affect stock market reaction to layoff announcements. However, the results are mixed. While layoff size and stated layoff reasons appear somewhat associated with stock returns, how the stock market assesses value implication of layoffs is still inconclusive. For example, layoff reasons stated by managers are not always straightforward. In many cases, managers provide multiple reasons for a given layoff. As such, it is challenging for stock investors to distinguish a true reason for a layoff and for researchers to choose a primary reason for a layoff. Further, prior studies do not provide the benchmark to measure the efficiency of layoff size. To fill this void, we attempt to construct more explicit measures of layoff efficiency based on the recent development in the hiring inefficiency literature (Pinnuck and Lillis 2007 and Jung et al. 2014), and then we examine how stock investors assess layoff efficiency. More details on this measure follow in the next section.

2.3. Hiring inefficiency and layoff efficiency

Pinnuck and Lillis (2007) predict managers' hiring decisions based on various firm characteristics such as sales growth, liquidity, profitability, and accounting loss occurrence. Jung et al. (2014) measure hiring inefficiency by comparing the actual level and the estimated normal (or optimal) level of hiring based on the Pinnuck and Lillis model. We further their work by attempting to measure layoff efficiency - i.e., we compare layoff size with the optimal level of hiring prior to layoff announcements, following Jung et al.'s approach. For example, if a layoff event reduces the degree of over-hiring close to zero, we consider the layoff as efficient. If a layoff drives the degree of under-hiring to further deviate from the optimum, we consider the layoff as inefficient. In sum, we propose a reasonable benchmark for layoff size and thereby develop a measure of layoff efficiency. To address our first research question, we examine this layoff

efficiency at the time of layoff announcements.

Our second research question is whether the stock market reflects layoff efficiency into its price reaction to layoff announcements. If investors understand the differential implications of layoff decisions as they relate to layoff efficiency, then they will respond positively to efficient layoffs, but negatively to inefficient layoffs. However, as Hillier et al. (2007) find that the stock market reaction is negative regardless of layoff reasons, investors may not understand the performance implication of layoff decisions. Accordingly, the association between layoff efficiency and stock price reaction to layoff announcement is an empirical question, which leads to the following hypothesis (in null form):

Hypothesis: Stock returns around layoff announcements are not related to the extent of layoff efficiency.

3. Sample and research design

3.1. Data on Layoff Announcements

Prior studies obtain information on layoff announcements by searching either the financial press such as *Wall Street Journal* (Worrell et al. 1991; Palmon et al. 1997; Nixon et al. 2004) or electronic sources such as *FT Extel* Company Research and *Lexis-Nexis* (Chalos and Chen 2002; Hillier et al. 2007). Unlike the extant literature, we collect detailed layoff information from Form 8-K, which firms are required to file with the SEC when announcing major corporate events. After August, 2004, firms disclose costs associated with exit or disposal activities on the 8-K report as Item 2.05. In particular, if a firm plans to engage in exit or disposal activities, dispose of long-lived assets, or terminate employees or contracts, it needs to disclose related information: the date of commitment to the course of action and a description of the course of action. We focus on the information associated with employee termination. Several examples of Item 2.05 are illustrated in Appendix 1, Panel A. Our sample selection from Form 8-K is more complete than the extant literature because the SEC mandates all the publicly traded firms to file the information on layoff announcements. Manual media search used by prior studies may omit announcements by small and relatively less popular firms because news media is usually less likely to cover those firms.

From Form 8-K, we first identify filing date, company name, and Central Index Key (CIK) as firm identifier. This initial procedure collects 4,083 observations of 8-K disclosures regarding corporate exit or disposal activities. We then exclude observations not associated with employee termination and collect the detailed layoff information including the date of layoff announcement (*AnnounceDate*), percentage of employee termination (*LAYOFF_SIZE*)[3], and the reason of employee termination. Following prior studies (e.g., Chalos and Chen 2002; Hillier et al. 2007), we classify layoffs into four categories: *DISTRESS*, *CLOSE*, *M&A*, and *RESTRUCT* based on the reason of employee termination. If the layoff event is due to financial distress, declining demand, or bad economic situation, we label it as *DISTRESS*. If the event is due to sale, closure, or discontinuance of operation, we label it as *CLOSE*. The event due to M&A activities is categorized as *M&A* while the event due to restructuring or consolidation of operations is classified as *RESTRUCT*. Our dataset of layoff announcements consists of 3,519 observations from 2004 to 2012.

3.2. Sample Construction

We merge our layoff announcement dataset with the Compustat and CRSP databases to obtain financial data and stock price information. First, we eliminate observations if they lack financial information or detailed layoff information. Second, we retain only one announcement per year for a firm. If multiple announcements are reported within a year, we select the first announcement. Third, we remove financial firms for which SIC codes are between 6000 and 6999. After the above data screenings, our final sample consists of 749 layoff announcements for 498 unique firms from 2004 to 2012 (see Appendix 2 for layoff data attribution process).[4]

Table 1, Panel A reports the distribution of layoff announcements by year. As expected, layoff announcements occur most frequently during the financial crisis between 2008 and 2009 and then become less frequent after 2009. Specifically, the numbers of layoffs in 2008 and 2009 are 119 and 147, respectively.

[3] If *LAYOFF_SIZE* is not specified, we divide the number of employees laid off by total number of employees before layoff is announced.

[4] If we do not require *UNION* variable, the sample size increases to 958 layoff announcements. Our results also hold with this increased sample.

In 2010, the number of layoffs sharply drops down to 57. Panel B reports the distribution of layoff announcements by industry. Layoffs occur most frequently in the following industries: business equipment; manufacturing; and healthcare, medical equipment and drugs industries. For example, the proportion of layoff firms in the business equipment industry is 42.19% in our sample while the industry only represents 2.89% of the CSRP-Compustat universe. In contrast, layoffs occur rarely in the following industries: telephone and television transmission; utilities; and oil, gas, and coal extraction and products industries.

3.3. Measuring layoff efficiency

We define layoff efficiency as the distance between the abnormal (i.e., inefficient) level of hiring just before layoff announcements and the size of the layoff announced by managers. The abnormal level of hiring prior to layoff announcement (i.e., pre-layoff hiring inefficiency) is the difference between actual hiring (i.e., a change in the number of employees) and the expected (i.e., optimal) level of hiring in the fiscal year preceding the layoff. To estimate the expected level of net hiring, we use two measures: one based on the model developed by Pinnuck and Lillis (2007) and the other based on the industry median, which is considered as industry norm. Pinnuck and Lillis (2007) estimate the following equation (1) that regresses the change in the number of employees on various fundamental variables which affect managers' hiring decisions:

$$\begin{aligned} HIRE_t = {} & SALES\_GROWTH_t + SALES\_GROWTH_{t-1} + \Delta ROA_t + \Delta ROA_{t-1} + ROA_t \\ & + STOCK\_RETURN_t + SIZE\_R_{t-1} + QUICK_{t-1} + \Delta QUICK_{t-1} + \Delta QUICK_t \\ & + LEV_{t-1} + LOSS\_BINX_{t-1} + \text{Industry fixed effects} + \varepsilon, \end{aligned} \quad (1)$$

where *HIRE* is the percentage change in the number of employees; *SALES_GROWTH* is the percentage change in sales; *ROA* is computed as net income scaled by total assets; *STOCK_RETURN* is the annual stock return for fiscal year *t*; *SIZE_R* indicates firm size, computed as the percentile rank of the market value of equity; *QUICK* is the quick ratio, computed as the ratio of cash and short-term investments plus receivables to current liabilities; *LEV* is the ratio of long-term debt to total asset; and *LOSSBINX* (*LOSSBIN1* through *LOSSBIN5*) are loss indicator variables which equal one if prior-year *ROA* is between -0.005*X and -0.005*(X-1) and 0 otherwise. For example, *LOSSBIN1* = 1 if prior-year *ROA* is between -

0.005 and 0, and 0 otherwise; *LOSSBIN2* = 1 if prior-year *ROA* is between -0.01 and -0.005, and 0 otherwise; and *LOSSBIN3*, *LOSSBIN4*, and *LOSSBIN5* are defined in similar ways. We also include industry fixed effects in equation (1) to control for the variation in hiring practices across industries.[5]

Hiring inefficiency is defined as how much the actual level of hiring deviates from the expected level of hiring. To measure pre-layoff hiring inefficiency (i.e., abnormal hiring), we use the residual estimated from the equation (1) before layoff announcements (*AB_HIRE_PL*). To define layoff efficiency (*LAYOFF_EFF_PL*), we compute the absolute difference between pre-layoff hiring inefficiency (*AB_HIRE_PL*) and layoff size (*LAYOFF_SIZE*). We then multiply it by negative one so that the larger value of *LAYOFF_EFF_PL* indicates that managers' layoff decisions are more efficient. Lastly, to reduce the estimation error of *LAYOFF_EFF_PL* measure, we decile-rank it.[6]

Panel A of Table 2 presents descriptive statistics for variables used to estimate equation (1). The sample consists of 31,015 firm-year observations from 2004 to 2012.[7] We find that the distribution of each variable is comparable to that of prior research. For example, the mean (median) percentage change in the number of employees (*HIRE*) is 6.4% (2.5%), similar to 5.4 % (1.6 %) reported in Pinnuck and Lillis (2007) and 5.9% (2.0%) reported in Jung et al. (2014). The mean (median) of sales growth in the current year is 14.4% (8.7%). The mean (median) change in *ROA* for the current year is 0.3% (0.2%). The average firm in our sample is not profitable – the mean value of *ROA* is negative (-0.9%). Lastly, the mean value of *LEV* is 20.0%, suggesting that the average sample firm holds about 20% of total assets as debt.

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[5] Following Pinnuck and Lillis (2007), we also include *PROFIT_BIN* indicator variables in equation (1). *PROFIT_BIN* indicator variables are defined as similar to *LOSS_BIN* indicator variables. Specifically, *PROFIT_BIN1* is a dummy variable which equals 1 if 0 <= *ROA* <= 0.005. *PROFIT_BIN2* equals 1 if 0.005 < *ROA* <= 0.01. *PROFIT_BIN3*, *PROFIT_BIN4*, and *PROFIT_BIN5* are defined similarly. Pinnuck and Lillis (2007) show that the coefficients on the *PROFIT_BIN* indicator variables are not significant (Table 3 of Pinnuck and Lillis 2007). We also find that those coefficients are not significant in our sample (untabulated). All of our results are qualitatively similar when we include the *PROFIT_BIN* indicator variables in the model (1).

[6] We also use raw values of our layoff efficiency measures without decile-ranking them. We find that our results (untabulated) based on raw values are qualitatively similar to those reported in tables.

[7] To estimate the expected level of hiring more accurately, we estimate equation (1) with all the observations in the Compustat dataset during our sample period. As a robustness test, we re-estimate equation (1) only with the sample of layoff announcements. The results based on the layoff sample are qualitatively similar to those reported.

Panel B of Table 2 shows results of estimating equation (1). The results are generally consistent with prior research. The coefficients on sales growth variables are significantly positive, suggesting that managers of firms with higher sales growth tend to hire more employees. The coefficient on ROA_t is significantly positive, suggesting that more profitable firms hire more employees. In contrast, the coefficients on ΔROA_t and ΔROA_{t-1} are significantly negative. The negative coefficient on ΔROA_t is consistent with Jung et al. (2014) who argue that the relation between ΔROA_t and *HIRE* is negative since an increase in hiring mechanically leads to an increase in labor expense and thus decreases ΔROA_t. The coefficients on $STOCK\_RETURN_t$, $SIZE\_R_t$, $QUICK_{t-1}$, and $\Delta QUICK_{t-1}$ (LEV_{t-1}) are significantly positive (negative), suggesting that firms with more positive stock returns, as well as larger firms, and firms with higher quick ratio (firms with higher leverage) tend to hire more (fewer) employees. The negative coefficient on $\Delta QUICK_t$ is consistent with Jung et al. (2014) who claim that the negative relation is due to the mechanical relation between more employment and lower quick ratio – hiring more employees requires firms to spend more cash and thus to decrease quick ratio.

Following the literature (e.g., Cella 2014; Jung et al. 2014), we also use the industry median as the expected (or normal) level of hiring. Thus, the level of abnormal hiring prior to layoffs (*AB_HIRE_IM*) is computed as the difference between each firm's actual hiring and its industry median level of hiring before layoffs. When measuring the industry median level, we employ the 12 industry classification scheme of Fama and French (1997). Similar to layoff efficiency measure based on Pinnuck and Lillis model (i.e., *LAYOFF_EFF_PL*), we compute the absolute difference between abnormal hiring (*AB_HIRE_IM*) and layoff size (*LAYOFF_SIZE*). We then multiply it by negative one so that the larger value of *LAYOFF_EFF_IM* indicates more efficient layoffs.

3.4. Stock market reaction to layoff announcements

To test the stock market reaction to layoff announcements, we estimate the following equation (2):

$$\begin{aligned} CAR = {} & LAYOFF\_EFF + DISTRESS + CLOSE + M\&A + RESTRUCT \\ & + F\_SIZE + MB + ROA + UNION + LAYOFF\_SIZE \\ & + Year\ fixed\ effects + Industry\ fixed\ effects + \varepsilon, \end{aligned} \quad (2)$$

where *CAR* indicates stock market reaction to layoff announcement, measured as the sum of the abnormal returns from one day before the layoff announcement to one day after the layoff announcement, where abnormal returns are the difference between raw returns for each observation and the value-weighted market return; *LAYOFF_EFF* is the measure of layoff efficiency; *DISTRESS* is an indicator variable that equals one for layoff due to financial distress, declining demand, or bad economic situation; *CLOSE* equals one for layoff due to discontinuance of operation; *M&A* equals one for layoff due to M&A activities; *RESTRUCT* equals one for layoff due to restructuring or consolidation; *F_SIZE* indicates firm size; *MB* is market to book ratio; *ROA* is return on assets prior to layoff announcements; *UNION* is an indicator variable that equals one if a firm has labor union and zero otherwise; *LAYOFF_SIZE* is the number of employees laid off divided by the total number of employees before layoff.

If stock investors understand the value implication of layoff efficiency, *LAYOFF_EFF* will be positively related to *CAR* variable. We include several control variables such as firm size, growth, firm performance prior to layoffs, and the existence of labor unions. Firm size is defined as the natural logarithm of market value of equity at the beginning of the layoff year (*F_SIZE*). The market to book ratio represents growth opportunities and is computed as the ratio of market value of equity to book value of equity at the beginning of the layoff year (*MB*). We use return on assets at the beginning of the layoff year (*ROA)* as a proxy for firm performance. To measure the existence of labor union (*UNION*), following Hamm et al. (2015), we hand-collect Form 10-Ks for all our layoff firms from DirectEdgar. We read Items 1 and 1A for a subsample of firms and extract several keywords and phrases pertaining to the existence or non-existence of a unionized workforce. We then run keywords and phrases in a search for 10-Ks for all the sample firms. *UNION* is set to 1 if we confirm the existence of unionized workers, and 0 if we find phrases that explicitly state that none of the workers is unionized. If none of the keywords or phrases is found, we consider there exists no clue of the unionization of employees in the 10-K. We thus assume that the employees are not unionized and set *UNION* to 0. Prior literature provides evidence that layoff size (*LAYOFF_SIZE*) also affects stock market reactions (e.g., Palmon et al. 1997; Chalos and Chen 2002; Nixon et al. 2004) although empirical results are mixed and inconclusive. Finally, we include both industry and year fixed effects to

control for the variations in the stock market reaction to layoff announcements across industries and over time, respectively. All continuous variables are winsorized at the 1% and 99% levels to mitigate the effect of outliers on the results. Standard errors are clustered by firm to account for intra-group correlations of residuals within a firm (Petersen 2009).

3.5. Real-life cases of layoff

In this subsection, we discuss two real-life cases of layoff announcements in our sample to help understand our measure of layoff efficiency and illustrate the hypothesis of whether the stock market understands layoff efficiency or not.

On May 24, 2006, Sun Microsystems, Inc. announced its plan to reduce its workforce by approximately 4,000 to 5,000 employees (see Item 2.05 in the firm's Form 8-K in Panel A of Appendix 1). At the beginning of FY 2005, Sun had a total of 32,600 employees and, during the FY 2005, the firm further reduced 1,600 employees, thus resulting in a total of 31,000 employees at the end of FY 2005 (see Panel B of Appendix 1). According to our hiring inefficiency estimation based on Pinnuck and Lillis (2007) model, Sun was expected to hire 49 employees additionally in FY2005. However, the firm in fact fired 1,600 employees in FY 2005. Thus, our pre-layoff hiring inefficiency measure (*AB_HIRE_PL*) indicates that Sun was already under-hiring by -5.06% (=1,649/32,600) even before the layoff announcement in 2006. That is, Sun began FY 2006 with a shortage of 1,649 employees, compared to the optimal level of labor size (32,649 = 32,600+49) at the beginning of FY 2006. The layoff plan of 4,500 (i.e., the median value of the range between 4,000 and 5,000) employees announced on May 24, 2006 is 14.5% of the firm's total employees (=4,500/31,000, *LAYOFF_SIZE*). Thus, Sun's layoff efficiency (i.e., *-1*|AB_HIRE_PL – LAYOFF_SIZE|*) is computed as -19.58% (= -1*| -5.06% - 14.52% |). Panel C of Appendix 1 depicts Sun's layoff decision which further exacerbated the extent of the under-hiring from -5.06% to -19.58%. The three-day cumulative abnormal return around the layoff announcement was -5.45% which is a noticeably negative.

Next, on November 21, 2006, Alcoa Inc. announced its layoff plan to eliminate approximately 6,700 employees (i.e., *LAYOFF_SIZE* = 5.19% or 6,700/129,000). Alcoa had a total of 119,000 employees

at the beginning of FY 2005, and the firm additionally hired 10,000 employees, thus resulting in a total number of 129,000 employees at the end of FY 2005. Its actual hiring (10,000 employees) in FY 2005 is considerably larger than the expected level of hiring (4,450 employees) estimated using Pinnuck and Lillis (2007) model, thus resulting in 4.66% (=5,550/119,000) of hiring inefficiency before the layoff announcement (*AB_HIRE_PL*). Alcoa's layoff efficiency (*-1*|AB_HIRE_PL – LAYOFF_SIZE|*) is computed as -0.53% (= -1*|-4.66% - 5.19%|). That is, Alcoa's layoff announcement on November 21, 2006 mitigates the hiring inefficiency from 4.66 % (i.e., over-hiring) to -0.53% (i.e., slightly under-hiring or near optimal) by reducing 5.19% (=6,700/129,000) of its total workforce. Panel C of Appendix 1 depicts Alcoa's layoff decision which reduces its pre-layoff hiring inefficiency to be closer to the optimal level of hiring. The three-day cumulative abnormal return was 7.06%, which is noticeably positive.

4. Empirical Results

4.1. Are US managers' layoff decisions efficient?

In Table 3, pre-layoff hiring inefficiency measures (i.e., *AB_HIRE_PL* and *AB_HIRE_IM*) represent the extent of hiring inefficiency prior to layoff announcements based on the Pinnuck and Lillis (2007) model and the industry median. The positive (negative) values of *AB_HIRE_PL* and *AB_HIRE_IM* measures indicate that a firm over-hires (under-hires) its employees prior to layoff announcements. We find that both mean and median values of *AB_HIRE_PL* are significantly negative (-0.015 and -0.030), suggesting that an average layoff firm already under-hires by 1.5%, compared to its optimal (i.e., expected) level of hiring prior to layoff announcements. About 36.2% of layoff firms (i.e., 271 layoff firms) over-hire while 63.8% of layoff firms (i.e., 478 layoff firms) under-hire before layoff announcements (untabulated). When we use the industry median as the expected (i.e., optimal) level of net hiring, we find that the mean value of *AB_HIRE_IM* is positive (0.8%) whereas its median value is negative (-0.8%). Both mean and median values are close to zero. In addition, the mean value is not statistically significantly different from zero. Based on *AB_HIRE_IM*, about 45% (55%) of layoff firms over-hire (under-hire). The mean (median) value of *LAYOFF_SIZE* is 10.2% (7.0%), which is relatively larger than those values based on UK firms

between 1990 and 2000 reported in Hillier et al. (2007) and on US firms between 1990 and 1995 reported in Chen et al. (2001).

Next, post-layoff hiring inefficiency measures (i.e., *AB_HIRE_PL – LAYOFF_SIZE* and *AB_HIRE_IM – LAYOFF_SIZE*) represent the extent of over- or under-hiring after layoffs and directly address to our first research question of whether managers' layoff decisions are efficient. We rely on *t*-test to examine post-layoff hiring inefficiency. The mean and median values of (*AB_HIRE_PL – LAYOFF_SIZE*) are -0.119 and -0.102, respectively, indicating that layoff firms, as a consequence of the layoff, under-hire by about 11.9% relative to their optimal level of hiring. The extent of under hiring is smaller based on (*AB_HIRE_IM – LAYOFF_SIZE*), but the inference from the results remains unchanged. We also find that when (*AB_HIRE_PL – LAYOFF_SIZE*) is used, about 18.4% (81.6%) of layoff firms are in the over-hiring (under-hiring) case (untabulated), suggesting that most layoff firms are suffering from severe under-hiring problems after layoffs. When (*AB_HIRE_IM – LAYOFF_SIZE*) is used, about 23.0% (77.0%) of layoff firms are in the over-hiring (under-hiring) case.

Our layoff efficiency measures (i.e., *LAYOFF_EFF_PL* and *LAYOFF_EFF_IM*) are the negative absolute values of the difference between abnormal hiring and layoff size (-1*|*AB_HIRE_PL – LAYOFF_SIZE*| and -1*|*AB_HIRE_IM – LAYOFF_SIZE*|). We use the absolute values of the difference since both over-hiring and under-hiring reduce layoff efficiency. If the value of *LAYOFF_EFF* is significantly different from zero, it indicates that the size of layoff is significantly deviated from the level of abnormal hiring, suggesting the layoff is inefficient. Our results show that the mean values of layoff efficiency measures are significantly different from zero (-0.187 for *LAYOFF_EFF_PL* and -0.174 for *LAYOFF_EFF_IM*), indicating that a layoff decision of our average sample firm is inefficient.

As to other firm characteristics, both mean and median values of *ROA* are negative, suggesting that an average layoff firm reports poor profitability in the preceding year. The mean value of *UNION* is 0.350, indicating that about 35.0% of our sample firms are unionized. Lastly in Table 3, the mean (median)

value of *CAR* is -1.0% (-0.5%) and is significantly different from zero (p-value = <0.001).[8] The negative market reaction to layoff announcements indicates that stock investors, on average, evaluate corporate layoff decisions negatively (i.e., layoff decisions are inefficient).

In Table 4, we further examine whether layoff efficiency of the US firms is affected by certain factors related to managers' layoff decisions such as the existence of labor unions, the financial crisis, and industry membership. In Panel A, we compare layoff efficiency between firms with and without labor unions. The number of layoffs of firms with labor unions (without labor unions) is 262 (487). Firms with labor unions execute the smaller scale of layoffs, compared to firms without labor unions (0.069 vs. 0.120), consistent with the notion that large-scale layoffs are less likely to occur in unionized firms (Pouder et al. 2004). We do not find any evidence that pre-layoff hiring inefficiency is significantly different between layoff firms with and without labor unions. The mean value of *LAYOFF_EFF_PL* is greater for firms with unions than for firms without unions (-0.144 vs. -0.211, respectively), suggesting that firms with labor unions are likely to execute relatively more efficient layoffs, compared to firms without unions. But post-layoff hiring inefficiency of both groups of firms, regardless of the existence of unions, becomes further deteriorated after layoffs: i.e., layoffs further aggravate the degree of pre-existing under-hiring problems from -0.006 to -0.077 for firms with unions; from -0.019 to -0.142 for firms without unions.

In Panel B of Table 4, we compare layoff efficiency between the financial crisis and non-crisis periods. Following the National Bureau of Economic Research's (NBER) definition, the financial crisis starts from 4th quarter 2007 and ends in 2nd quarter 2009.[9] While the median layoff size is higher during the financial crisis period than non-financial crisis period, the mean value of layoff size is not statistically different between the two periods. The differences in the mean values of both layoff efficiency measures (*LAYOFF_EFF_PL* and *LAYOFF_EFF_IM*) between the financial crisis period and non-crisis period are

[8] We also extend the three-day window of *CAR* to five days before and after the announcement date to incorporate information leakage of layoff announcement. In untabulated results, we find that the results based on this extended announcement period are similar to those based on our main measure, 3-day *CAR*. The mean (median) stock market reaction to layoff announcement is -2.5% (-1.4%) and both are significantly different from the zero.
[9] See http://www.nber.org/cycles.html

marginally significant, and the median values of layoff efficiency are not statistically different between the two periods. The results suggest that layoff efficiency does not vary with macro-economic conditions, specifically, the financial crisis.

In Panel C, we compare layoff efficiency between firms in high and low technology industries. The extent of employee entrenchment (employee immobility) is generally severe in low technology firms (Chemmanur et al. 2013). Thus, managers' layoff decisions are likely to be different between high and low technology firms.[10] We find that the median values of layoff efficiency are smaller for high technology firms, but their mean values are not statistically different between two groups. The results suggest that layoff inefficiency is not concentrated in either high or low technology industries.

In sum, the results in Table 4 indicate that there exists some difference in terms of layoff efficiency between firms with and without labor unions. However, layoff efficiency does not vary with either macroeconomic condition or industry membership.

Layoffs result in the inefficient hiring situation either (1) because they do not completely reduce pre-existing over-hiring or (2) because they further exacerbate pre-existing under-hiring problems prior to layoffs. To examine which of the two drives our results, we first divide our layoff sample into five groups based on the extent of over-hiring prior to layoffs. Then we compare hiring inefficiency between before and after layoffs. Figure 1 shows that layoffs mitigate hiring inefficiency only in the 5th quintile group where firms are already over-hiring prior to layoffs although the layoffs do not completely eliminate the over-hiring problem. In all the other groups, layoffs result in more severely inefficient hiring: In particular, the

[10] Following Loughran and Ritter (2004), if a firm belongs to such industries as computer hardware (SIC codes of 3571, 3572, 3575, 3577, 3578), communications equipment (3661, 3663, 3669), electronics (3674), navigation equipment (3812), measuring and controlling devices (3823, 3825, 3826, 3827, 3829), medical instruments (3841, 3845), telephone equipment (4812, 4813), communications services (4899), or software (7370, 7371, 7372, 7373, 7374, 7375, 7378, 7379), it is considered as a high technology firm. All other firms are defined as low technology firms.

layoffs exacerbate the pre-existing under-hiring problem.[11]

4.2. The effect of layoff efficiency on stock price reaction to layoff announcement

Table 5 reports correlation coefficients among variables used for stock market reaction tests. Consistent with our hypothesis, *CAR* is positively correlated with both layoff efficiency measures, *LAYOFF_EFF_PL* and *LAYOFF_EFF_IM* – those correlation coefficients range from 0.131 to 0.127. *CAR* is negatively correlated with *LAYOFF_SIZE*, suggesting that the larger layoffs generate the more negative stock market reactions. The positive correlations between layoff efficiency measures and *DISTRESS* suggest that managers execute layoffs more efficiently when they attribute the layoffs to financial distress, declining demand, or bad economic situation. In contrast, *CLOSE*, *M&A*, and *RESTRUCT* are not significantly correlated with layoff efficiency measures. *CAR* is not significantly correlated with managers' stated layoff reasons, suggesting that stock investors do not respond to layoff reasons disclosed by managers. Layoff size is negatively (positively) correlated with *DISTRESS* and *CLOSE* (*RESTRUCT*), indicating that layoff size tend to be larger when firms execute layoffs with restructuring reasons, but smaller when firms execute with reasons related to financial-distress or the sale, closure, or discontinuation of operations.

Table 6 reports results of estimating equation (2). In models 1 and 2, we regress *CAR* on only layoff efficiency measures with industry and year fixed effects. We find that the coefficients on both *LAYOFF_EFF_PL* and *LAYOFF_EFF_IM* are significantly positive, suggesting that the stock market responds positively to layoff efficiency. In models 3 and 4, we control for layoff reason indicator variables (i.e., *DISTRESS*, *CLOSE*, *M&A*, and *RESTRUCT*), firm size (*F_SIZE*), market to book ratio (*MB*), firm performance (*ROA*), the existence of union (*UNION*) and layoff size (*LAYOFF_SIZE*). We continue to find

[11] We also perform the same analysis after splitting the sample into the above three categories: (1) firms with labor unions versus firms without labor unions; (2) layoffs during the financial crisis period versus layoffs during non-crisis period; (3) high technology firms versus low technology firms. Results show similar patterns to those in Figure 1, indicating that the overall trend that layoffs aggravate hiring inefficiency by intensifying the pre-existing under-hiring problem is ubiquitous.

that the stock market positively reacts to layoff efficiency after including all the control variables identified in the literature. The effect of layoff efficiency on the stock market reaction also appears to be economically significant: the magnitude of the coefficient on *LAYOFF_EFF_PL* is 0.028, indicating that the difference in the three-day stock returns around layoff announcements between the lowest and the highest layoff efficiency deciles is about 2.8%.

As to the control variables, we find that the coefficients on layoff reason indicator variables (i.e., *DISTRESS*, *CLOSE*, *M&A*, and *RESTURCT*) are insignificant, suggesting that stock market reaction is not related to layoff reasons stated by managers in our sample. While the coefficients on layoff efficiency measures are significantly positive, the coefficient on *LAYOFF_SIZE* is insignificant both in models 3 and 4. This suggests that investors put more weight on layoff efficiency than layoff size when evaluating managers' layoff decisions.

In Table 7, we further investigate whether the impact of layoff efficiency on stock market reaction varies with the following factors: the existence of labor unions, the financial crisis, and high technology firms. First, to examine whether the existence of labor unions affects the relation between layoff efficiency and stock market reaction, we add to equation (2) a dummy variable indicating the existence of labor unions, and we interact it with layoff efficiency variables. In Panel A of Table 7, we find that the coefficient on the interaction term between *LAYOFF_EFF_PL* and *UNION* is insignificant, indicating that the positive relation between layoff efficiency and stock market reaction is not affected by the existence of labor unions. The results based on *LAYOFF_EFF_IM* are qualitatively similar. In Panel B, we also examine whether the stock market response to layoff efficiency is affected by macroeconomic conditions such as the financial crisis between 2008 and 2009. Marshall et al. (2012) show that the stock market reaction to layoff announcements is generally negative during the 2008 financial crisis and argue that managers' layoff decisions are likely to signal poor investment opportunities in the future during the financial crisis. During the financial crisis, the default risk becomes much higher and thus investors are more unfavorable to the over-investment in labor than they are during a non-crisis period. Thus, it is plausible that the relation between stock market reaction and layoff efficiency is more pronounced during the financial crisis. If this

is the case, our main result may be driven by layoff announcements during the financial crisis. To examine this possibility, we add to equation (2) a dummy variable, *CRISIS* indicating layoffs during the financial crisis and interact it with layoff efficiency measures. Results in Panel B show the coefficient on the interaction term between layoff efficiency and *CRISIS* is insignificant, suggesting that our results are not driven by layoff announcements during the financial crisis.

Finally, we examine whether the effect of layoff efficiency on stock market reaction is driven by high technology firms. Anderson et al. (2000) and Chemmanur et al. (2013) suggest that employees working for high technology firms are generally less entrenched and more skillful. Thus, it is plausible that layoff efficiency of high-technology firms is more important for stock investors, compared to that of low technology firms. To test whether our results are driven by high-technology firms, we add to equation (2) a dummy variable, *HIGHTECH* indicating firms in high-technology industries (Loughran and Ritter 2004) and interact it with layoff efficiency measures. Results are presented in Panel C. We find that the coefficient on the interacted variable between *LAYOFF_EFF_PL* (*LAYOFF_EFF_IM*) and *HIGHTECH* is insignificant, suggesting that our results on the positive relation between layoff efficiency and stock market reaction are not driven by high-technology firms.

In sum, we find that the positive relation between layoff efficiency and stock market reaction around layoff announcement is not affected by the existence of labor unions, financial crisis, and high technology firms.

5. Additional tests

5.1. Layoff efficiency and future operating performance

In this section, we further investigate whether efficient layoffs help firms to improve future operating performance. This supplementary analysis will corroborate our results on the positive relation between stock market reaction and layoff efficiency since the stock market reflects expected changes in

future operating performance. [12] Using future ROA change as a proxy for future performance improvement, we estimate the following equation (3):

$$\Delta ROA_{t+1} = LAYOFF\_EFF + DISTRESS + CLOSE + M\&A + RESTRUCT + F\_SIZE + MB + ROA_t + \Delta ROA_t + UNION + LAYOFF\_SIZE + Year\ fixed\ effects + Industry\ fixed\ effects + \varepsilon, \quad (3)$$

Table 8 reports results of estimating equation (3). The coefficients on layoff efficiency measures (i.e., *LAYOFF_EFF_PL* and *LAYOFF_EFF_IM*) are significantly positive, suggesting that efficient layoffs lead to an improvement in future operating performance for the subsequent year. Turning to control variables, both coefficients on *MB* and *F_SIZE* are significantly positive, indicating that firms with higher market-to-book ratio and larger firms are more likely to experience an improvement in future *ROA* change, respectively. Both ROA_t and ΔROA_t are generally negative, reflecting earnings autocorrelation and mean reversion in earnings (Nissim and Ziv 2001; Grullon et al. 2005). In sum, we find the positive relation between layoff efficiency and future ROA change, consistent with positive stock market reactions to layoff efficiency.

5.2. Alternative measures of hiring inefficiency and layoff efficiency

In our study, measuring the optimal (normal) level of hiring is critical. Although the model developed by Pinnuck and Lillis (2007) fits well with our sample firms (Adjusted R^2 = 21.74%), it is still possible that the model may be misspecified. To mitigate this concern, we modify the Pinnuck and Lillis model in two ways. First, following the spirit of Biddle et al. (2009), we regress *NET_HIRE* only on sales growth measures. Second, we further add the following variables: *UNION, HIGHTECH,* and *CRISIS* to the original Pinnuck and Lillis model, since these variables also may affect managers' hiring decisions. In

[12] While (changes in) *ROA* is a reasonable gauge of firm performance, we believe that stock market reaction is a better gauge for the following two reasons. First, ROA change is measured for a year after layoff announcements and thus there may be confounding effects on the measurement. In addition, there may be a mechanical increase in *ROA* as layoffs reduce labor costs such as salaries and wages. Stock market reaction around layoff announcements can avoid such concerns.

untabulated results, we find that the coefficients on *UNION* and *CRISIS* (*HIGHTECH*) are significantly negative (positive), suggesting that hiring growth is lower (higher) for firms with labor unions and during the financial crisis (for high technology firms).[13] We find that results (untabulated) using the above alternative layoff efficiency measures are qualitatively similar to those tabulated.

5.3. Why are under-staffed firms involved in layoff activities?

We show that an average layoff firm announces its layoff plan even when they are not over-hiring. We also document that stock investors negatively react to layoff announcements by firms which are already under-hiring prior to layoffs. Further, firms conducting inefficient layoffs experience poor future operating performance. It remains puzzling why under-staffed firms get involved in layoffs even though it will further aggravate their hiring inefficiency and harm firm value. In this section, we investigate whether under-staffed layoff firms use layoffs as a means of big bath (i.e., taking a large, non-recurring charge to make poor results look even worse in the current year and enhance net income in the subsequent year). Prior literature suggests that some managers incur restructuring charge to reduce net income (e.g., Francis et al. 1996; Haggard et al. 2015). Thus, it is possible that layoffs can be exploited as a means of big bath for under-staffed firms. Using the amount of special items as a proxy for big bath (Haggard et al. 2015), we estimate the following Tobit model (4):

$$BIG\_BATH = UNDER\_HIRE + RET1 + RET5 + \Delta MB + MB + F\_SIZE + REVENUE + ROA + \Delta ROA + UNION + Year\ fixed\ effects + Industry\ fixed\ effects + \varepsilon, \quad (4)$$

where *BIG_BATH* is a censored variable, which is the amount of special items divided by total assets. We multiply the ratio of special items to total assets by negative one, so that the larger value of *BIG_BATH* indicates more severe big bath activities. Following Haggard et al. (2015), if the ratio of special items to total assets is smaller than 1%, we set the value of *BIG_BATH* to be 0, indicating no big bath occurrence.[14]

[13] Results that include *CRISIS*, *UNION*, and *HIGHTECH* are available upon request.
[14] The results are similar when we censor the ratio at 0.

UNDER_HIRE equals one if a firm is already in the under-hiring situation prior to layoff announcements and 0 otherwise; *RET1* is cumulative abnormal return computed over the year preceding the announcement of the layoffs; *RET5* is the cumulative abnormal return computed over the period beginning five years prior to a layoff announcement date and ending one year prior; *REVENUE* is the amount of revenue divided by total assets.

Table 9 presents results of estimating equation (4). When the Pinnuck and Lillis (2007) model is used to measure hiring inefficiency, the coefficient on *UNDER_HIRE_PL* is significantly positive, suggesting that, among layoff firms, those who are under-hiring prior to layoff announcements are more likely to incur large, non-recurring charges compared to over-hiring firms. When the industry median is used to measure hiring inefficiency, the coefficient on *UNDER_HIRE_IM* is also positive, yet marginally significant (p-value = 0.10). Consistent with prior literature (e.g., Francis et al. 1996; Haggard et al. 2015), the coefficients on *RET1*, *MB*, and *REVENUE* are significantly negative, indicating that well-performing firms are less likely to incur big bath. In sum, our results suggest that it is plausible that under-staffed firms may be involved in layoffs due to big bath motivation.

6. Conclusion

Employee layoff is one of most prevalent means of corporate restructuring and often sparks a bitter controversy over its validity and legitimacy within corporations, in the stock market and amongst the general public. However, academic research on layoff efficiency and the impact of layoffs on stock market reactions remains inconclusive, mainly due to the difficulty of gauging the efficiency of layoffs. To fill this void in the literature, we introduce a novel measure of layoff efficiency. Based on hand-collected data of 749 layoff announcements in the US during the period 2004 to 2012, we document that layoff firms are on average short of labor even before the layoff events and the shortfall is further aggravated by the layoff activities, suggesting that layoff decisions are, on average, inefficient in the US. We also find that stock market reactions to layoff announcements increase in the efficiency of layoffs, suggesting that investors understand the implications of layoff efficiency in firm values. We further corroborate our findings by

linking layoff efficiency to subsequent operating performance. In sum, by taking into consideration that not all layoffs are equally efficient, we pave a way for assessing the efficiency of layoff decisions and provide empirical evidence that helps reconcile the inconsistent stock market reactions documented in prior studies.

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Appendix 1
Two real-life cases of layoffs in our sample

Panel A: Examples of Item 2.05. in Form 8-K

Example 1: On May 24, 2006, the Board of Directors of **Sun Microsystems, Inc.** ("Sun" or the "Company") approved a plan to further rationalize and consolidate Sun's property portfolio and to reduce its workforce by approximately 4,000 to 5,000 employees in order to better align the Company's resources with its strategic business objectives (the "Restructuring Plan"). The Company expects to incur total charges ranging from $340 million to $500 million over the next several quarters in connection with the Restructuring Plan, the majority of which will be incurred in the fiscal quarter ended June 30, 2006. The Restructuring Plan includes (i) an expected non-cash charge ranging from $60 million to $110 million related to Sun's previously announced disposition of its campus in Newark, California, (ii) expected charges ranging from $10 million to $40 million related to exiting the Newark campus, the majority of which relate to cash costs and (iii) an expected charge ranging from $270 million to $350 million related to cash severance costs. In addition, we expect to incur acquisition-related cash severance costs, which are expected to range between $40 million and $60 million and which will be adjusted against goodwill. The Company is also evaluating its other facilities including those acquired through its recent acquisitions. Any near term decisions regarding dispositions of acquired properties would result in an adjustment to the purchase price allocation and goodwill.

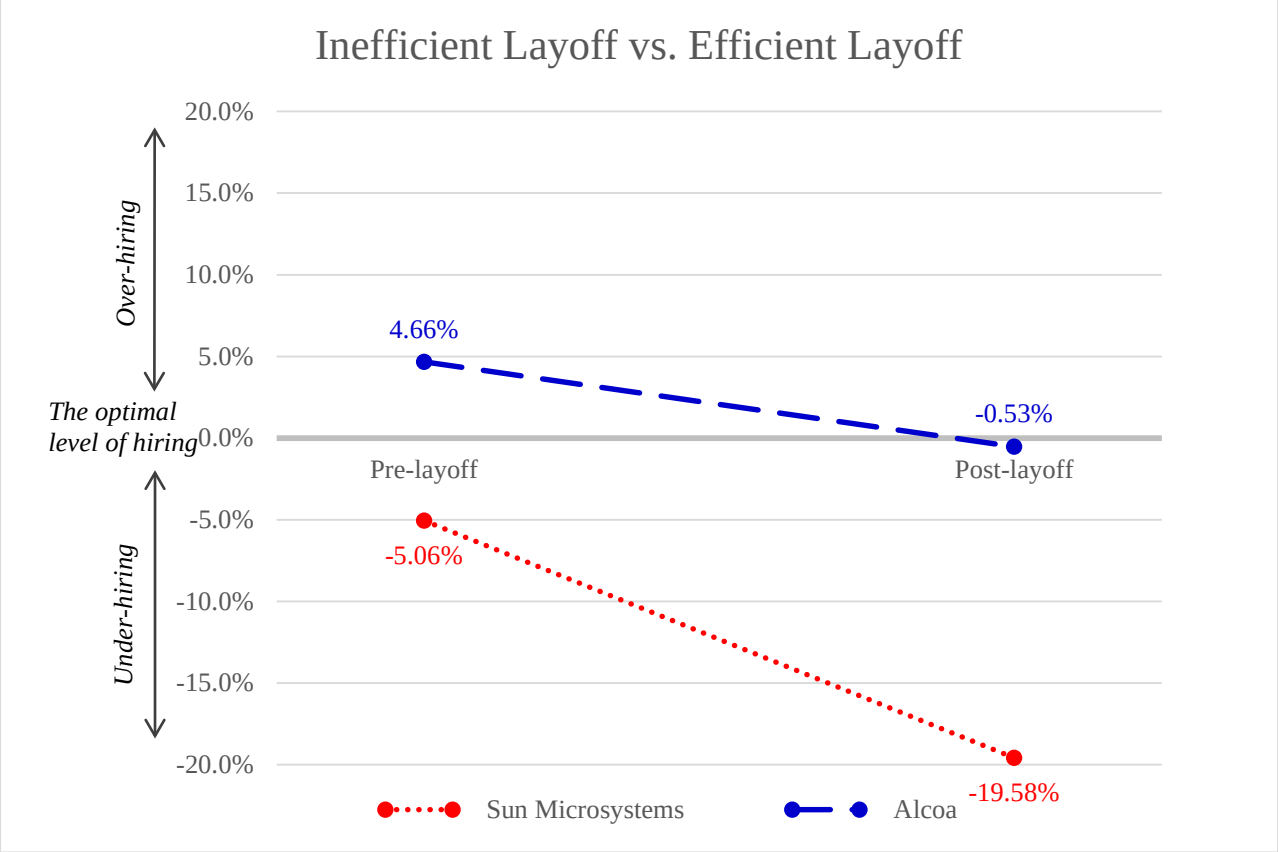
Example 2: On November 21, 2006, **Alcoa Inc.** ("Alcoa" or the "company") announced that it has committed to re-positioning several of its downstream operations in order to further improve returns and profitability through a targeted restructuring of operations, and the creation of a soft alloy extrusion joint venture with the intention of eventually offering the venture to the public markets through an IPO. The company expects to record after-tax restructuring charges of $175 to $195 million in the fourth quarter of 2006 as part of its plan to streamline operations. In addition, Alcoa expects to record after-tax restructuring charges of $25 to $30 million in 2007 related to the fourth quarter restructuring program. The restructuring program will encompass plant closings and consolidations, and will lead to the elimination of approximately 6,700 positions across the company's global businesses during the next year. This program is expected to save approximately $125 million before taxes on an annualized basis. … Approximately half of the charges associated with the restructuring program will be in the form of cash payments, primarily for employee severance costs, and the remainder are for non-cash charges associated with plant closings and asset impairments.

Panel B: Information to measure layoff efficiency for Sun Microsystems Inc. and Alcoa Inc.

Firm Name	Sun Microsystems Inc.	Alcoa Inc.
Announce Date	2006.05.24	2006.11.21
FY	2006	2006
The number of employees at the beginning of FY 2005	32,600	119,000
The number of employees at the beginning of FY 2006	31,000	129,000
Actual change in the number of employees in FY 2005	-1,600	+10,000
Expected (or optimal) change in the number of employees during FY 2005, based on the Pinnuck and Lillis model	+49	+4,450

Pre-layoff hiring inefficiency	Under-hiring by 1,649 (= -1,600 - 49) ➔ **-5.06%** of total employees	Over-hiring by 5,550 (= 10,000 - 4,450) ➔ **4.66%** of total employees
Layoff size announced in FY 2006	**14.52%** (-4,500 employees)	**5.19%** (-6,700 employees)
The effect of layoff on hiring efficiency	Layoff exacerbates hiring inefficiency ➔ The extent of under-hiring increases to 6,149 (= -1,649-4,500)	Layoff mitigates hiring inefficiency ➔ Hiring inefficiency is reduced from the over-hiring of 5,550 to the slight under-hiring of 1,150 employees.

Panel C: Graphical illustration



Appendix 2
Sample selection

Data Attribution Process		*No. of observations*
Number of Item 2.05 reported on Form 8-K for the period 2004-2012		4,083
Less: Events that are not associated with employee termination	(564)	
The number of layoff announcements reported on Form 8-K		3,519
Less: Observations without GVKEY (firm identifier) and financial data	(1,319)	
Less: Observations without detailed layoff data (i.e., layoff size and reasons)	(1,082)	
Less: Firms in financial industries	(8)	
Less: Firms with multiple layoff announcements	(152)	
Less: Observations without unionization information	(209)	
The number of layoff announcements in the final sample		749

Appendix 3

Variable definitions

Pinnuck and Lillis (2007) model estimation	
HIRE	Percentage change in the number of employees.
SALES_GROWTH	Percentage change in sales.
ROA	Return on assets, computed as net income scaled by total assets.
ΔROA	Change in return on assets.
STOCK_RETURN	Total stock return.
F_SIZE	Natural log of market value of equity.
SIZE_R	Percentile rank of *F_SIZE*.
QUICK	Quick ratio, computed as cash and short-term investments plus receivables divided by current liabilities.
$\Delta QUICK$	Percentage change in the quick ratio.
LEV	Leverage, measured as the sum of debt in current liabilities and long-term debt, divided by total assets.
LOSSBINX	There are five separate loss bins to indicate each 0.005 interval of ROA from 0 to -0.025 in period *t-1* for firm *i*. For example, LOSSBIN1 is equal to 1 if ROA ranges from -0.005 to 0. LOSSBIN2 is equal to 1 if ROA is between -0.005 and -0.010. LOSSBIN3, LOSSBIN4, and LOSSBIN5 are defined similarly.
Stock market reaction tests	
AnnounceDate	Date of the layoff announcement goes public.
LAYOFF_SIZE	The number of employees laid off divided by the total number of employees before layoff.
DISTRESS	A dummy variable that equals 1 if layoff is due to financial distress, declining demand, or bad economic situation, and 0 otherwise.
CLOSURE	A dummy variable that equals 1 if layoff is due to sale, closure, or discontinuance of operation, and 0 otherwise.
M&A	A dummy variable that equals 1 if layoff is due to M&A activities, and 0 otherwise.
RESTRUCT	A dummy variable that equals 1 if layoff is due to restructuring or consolidation of operations, and 0 otherwise.
AB_HIRE_PL	A proxy of abnormal level of hiring, measured as the residual of estimating the following regression: $HIRE = SALES\_GROWTH_t + SALES\_GROWTH_{t-1} + \Delta ROA_t + \Delta ROA_{t-1} + ROA_t + STOCK\_RETURN_t + SIZE\_R_{t-1} + QUICK_{t-1} + \Delta QUICK_{t-1} + \Delta QUICK_t + LEV_{t-1} + LOSS\_BINX_{t-1}$ + Industry fixed effects
AB_HIRE_IM	A proxy of abnormal level of hiring, measured as the difference between the actual and industry median level of *HIRE*.
LAYOFF_EFF_PL	A proxy of layoff efficiency, measured as the decile rank of -1*|*LAYOFF_SIZE* - *AB_HIRE_PL*|.
LAYOFF_EFF_IM	A proxy of layoff efficiency, measured as the decile rank of -1*|*LAYOFF_SIZE* - *AB_HIRE_IM*|.
F_SIZE	Natural log of market value of equity.

MB	Market-to-book ratio, computed as market value of equity divided by the book value of equity.
ROA	Return on assets, computed as net income scaled by total assets.
UNION	A dummy variable that equals 1 if firm has a labor union, and 0 otherwise.
CAR	Cumulative abnormal returns over the event window from 1 day before to 1 day after the layoff announcement. It is measured as the difference between the raw return of layoff firms and value-weighted market return.
Additional Tests	
CRISIS	An indicator variable that equals 1 if the announcement date is in the recession period that is between 4th quarter, 2007 and 2nd quarter, 2009, and 0 otherwise. The recession period is designated by National Bureau of Economic Research (NBER). http://www.nber.org/cycles.html
HIGHTECH	An indicator variable that equals 1 if SIC code is 3571, 3572, 3575, 3577, 3578 (computer hardware), 3661, 3663, 3669 (communications equipment), 3674 (electronics), 3812 (navigation equipment), 3823, 3825, 3826, 3827, 3829 (measuring and controlling devices), 3841, 3845 (medical instruments), 4812, 4813 (telephone equipment), 4899 (communications services), and 7370, 7371, 7372, 7373, 7374, 7375, 7378, or 7379 (software).
BIG_BATH	A proxy of big bath, measured as -1*(special items divided by total assets), where it is larger than 0.01, and 0 otherwise.
UNDER_HIRE_PL	An indicator variable that equals 1 if pre-layoff hiring inefficiency (*AB_HIRE_PL*) is negative, and 0 otherwise.
UNDER_HIRE_IM	An indicator variable that equals 1 if pre-layoff hiring inefficiency (*AB_HIRE_IM*) is negative, and 0 otherwise.
RET1	Cumulative abnormal return computed over the year preceding the announcement of the layoffs.
RET5	Cumulative abnormal return computed over the period beginning five years prior to layoff announcement date and ending one year prior.
ΔMB	Change in market-to-book ratio.
REVENUE	Total revenue divided by total assets.

Table 1
Sample distribution over time and across industry

Panel A. Sample distribution by year

Year	No. of Obs.
2004	35
2005	99
2006	99
2007	85
2008	119
2009	147
2010	57
2011	55
2012	53
Total	749

Panel B. Sample distribution by industry

Fama and French 12 industry classification	N	Proportion of firms in each industry in the sample	Proportion of firms in each industry in the CRSP-Compustat dataset
Top 3 industries			
Business Equipment	316	42.19%	2.89%
Manufacturing	100	13.35%	1.93%
Healthcare, Medical Equipment and Drugs	96	12.82%	1.59%
Bottom 3 industries			
Telephone and Television Transmission	12	1.60%	0.55%
Utilities	11	1.47%	0.43%
Oil, Gas, and Coal Extraction and Products	2	0.27%	0.07%

Note: This table documents sample distribution for our sample during the period 2004–2012. The sample used in our main tests consists of 749 firm-year observations. Panel A presents the sample distribution by year while Panel B reports the sample distribution by industry.

Table 2
Estimation of the optimal level of net hiring (*AB_HIRE_PL*)

Panel A: Descriptive statistics (N=31,015)

Variable	Mean	Std Dev	Median	25th	75th
$HIRE_t$	0.064	0.253	0.025	-0.044	0.125
$SALES\_GROWTH_t$	0.144	0.397	0.087	-0.020	0.222
$SALES\_GROWTH_{t-1}$	0.170	0.493	0.086	-0.025	0.232
ΔROA_t	0.003	0.170	0.002	-0.040	0.041
ΔROA_{t-1}	0.008	0.193	0.003	-0.040	0.045
ROA_t	-0.009	0.209	0.037	-0.035	0.089
$STOCK\_RETURN_t$	0.190	0.700	0.080	-0.219	0.409
$SIZE\_R_{t-1}$	62.232	24.987	66.000	43.000	84.000
$QUICK_{t-1}$	2.147	2.379	1.330	0.812	2.463
$\Delta QUICK_{t-1}$	0.154	0.748	0.009	-0.191	0.247
$\Delta QUICK_t$	0.097	0.593	-0.003	-0.200	0.221
LEV_{t-1}	0.200	0.205	0.156	0.007	0.321

Panel B: Estimation results

Dep Var. = $\boldsymbol{HIRE_t}$	Predicted sign	Coeff	p-value
Intercept	?	-0.0506	0.20
$SALES\_GROWTH_t$	+	0.2514	0.00
$SALES\_GROWTH_{t-1}$	+	0.0407	0.00
ΔROA_t	-	-0.1799	0.00
ΔROA_{t-1}	+	-0.0400	0.00
ROA_t	+	0.1217	0.00
$STOCK\_RETURN_t$	+	0.0272	0.00
$SIZE\_R_{t-1}$	+	0.0005	0.00
$QUICK_{t-1}$	+	0.0050	0.00
$\Delta QUICK_{t-1}$	+	0.0286	0.00
$\Delta QUICK_t$	+/-	-0.0293	0.00
LEV_{t-1}	+/-	-0.0440	0.00
$LOSSBIN1_{t-1}$	-	-0.0175	0.08
$LOSSBIN2_{t-1}$	-	-0.0090	0.35
$LOSSBIN3_{t-1}$	-	-0.0132	0.22
$LOSSBIN4_{t-1}$	-	0.0016	0.90
$LOSSBIN5_{t-1}$	-	-0.0127	0.30
Industry Fixed Effects		Yes	
Adj. R2		21.74%	
N		31,015	

Note: This table presents the regression results of estimating the optimal level of net hiring based on Pinnuck and Lillis (2007) and Jung et al. (2014). The sample period for this estimation is from 2004 to 2012. See Appendix 3 and Section 3.3 for variable definitions.

Table 3
Results: Are managers' layoff decisions efficient?

Variable	Mean	Standard Deviation	Median	25th	75th.
Pre-layoff hiring inefficiency:					
Abnormal (over- or under-) hiring prior to layoff announcements					
AB_HIRE_PL	-0.015 (0.06 *)	0.216	-0.030 (0.00***)	-0.091	0.034
AB_HIRE_IM	0.008 (0.34)	0.216	-0.008 (0.09*)	-0.070	0.053
Layoff size announced by managers					
LAYOFF_SIZE	0.102 (0.00***)	0.101	0.07 (0.00***)	0.031	0.134
Post-layoff hiring inefficiency:					
Abnormal hiring – layoff size					
AB_HIRE_PL - LAYOFF_SIZE	-0.119 (0.00 ***)	0.227	-0.102 (0.00***)	-0.203	-0.029
AB_HIRE_IM - LAYOFF_SIZE	-0.097 (0.00 ***)	0.229	-0.081 (0.00***)	-0.178	-0.008
Layoff efficiency:					
-1*|*Abnormal hiring – layoff size*|					
LAYOFF_EFF_PL[†]	-0.187 (0.00***)	0.196	-0.132 (0.00***)	-0.231	-0.06
LAYOFF_EFF_IM[†]	-0.174 (0.00***)	0.197	-0.106 (0.00***)	-0.224	-0.05
Firm characteristics					
F_SIZE	6.631	1.817	6.552	5.413	7.821
MB	3.055	4.909	1.957	1.302	3.029
ROA	-0.034	0.189	0.023	-0.057	0.068
UNION	0.350	0.477	0	0	1
Stock market reaction to layoff announcements					
CAR	-0.010 (0.00***)	0.088	-0.005 (0.00***)	-0.042	0.027

Note: This table provides descriptive statistics for our sample during the period 2004–2012. The sample used in our main tests consists of 749 firm-year observations. See Appendix 3 and Section 3.4 for variable definitions.

[†] We multiply the absolute value by negative one so that the larger value of layoff efficiency indicates more efficient layoffs.

Table 4
Cross-sectional variation in layoff efficiency
Panel A: The existence of labor union and layoff efficiency

	Layoff size		Pre-layoff hiring inefficiency				Post-layoff hiring inefficiency				Layoff efficiency			
	LAYOFF_SIZE		*AB_HIRE_PL*		*AB_HIRE_IM*		*AB_HIRE_PL - LAYOFF_SIZE*		*AB_HIRE_IM - LAYOFF_SIZE*		*LAYOFF_EFF_PL*		*LAYOFF_EFF_IM*	
	Mean	Med.	Mean	Med.	Mean	Med.	Mean	Med.	Mean	Med.	Mean	Med.	Mean	Med.
With Union (N =262)	0.069	0.045	-0.006	-0.023	0.017	-0.005	-0.077	-0.077	-0.054	-0.054	-0.144	-0.094	-0.132	-0.083
Without Union (N= 487)	0.120	0.090	-0.019	-0.034	0.003	-0.011	-0.142	-0.127	-0.119	-0.098	-0.211	-0.147	-0.197	-0.123
DIFF (p-value)	***0.00***	***0.00***	0.37	0.12	0.36	0.17	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***

Panel B: Financial crisis and layoff efficiency

	LAYOFF_SIZE		*AB_HIRE_PL*		*AB_HIRE_IM*		*AB_HIRE_PL - LAYOFF_SIZE*		*AB_HIRE_IM - LAYOFF_SIZE*		*LAYOFF_EFF_PL*		*LAYOFF_EFF_IM*	
	Mean	Med.	Mean	Med.	Mean	Med.	Mean	Med.	Mean	Med.	Mean	Med.	Mean	Med.
Crisis (N = 265)	0.101	0.077	-0.027	-0.030	-0.002	-0.007	-0.128	-0.011	-0.103	-0.086	-0.172	-0.127	-0.157	-0.104
Non-Crisis (N=484)	0.103	0.066	-0.008	-0.030	0.013	-0.009	-0.115	-0.097	-0.093	-0.079	-0.196	-0.114	-0.184	-0.110
DIFF (p-value)	0.84	*0.09*	0.21	0.83	0.33	0.50	0.41	0.69	0.56	0.94	*0.08*	0.55	**0.05**	0.62

Panel C: High-tech firms and layoff efficiency

	LAYOFF_SIZE		*AB_HIRE_PL*		*AB_HIRE_IM*		*AB_HIRE_PL - LAYOFF_SIZE*		*AB_HIRE_IM -LAYOFF_SIZE*		*LAYOFF_EFF_PL*		*LAYOFF_EFF_IM*	
	Mean	Med.	Mean	Med.	Mean	Med.	Mean	Med.	Mean	Med.	Mean	Med.	Mean	Med.
High-tech (N =246)	0.102	0.087	0.006	-0.027	0.029	-0.008	-0.100	-0.129	-0.077	-0.099	-0.193	-0.153	-0.180	-0.134
Low-tech (N = 503)	0.102	0.061	-0.025	-0.032	-0.003	-0.008	-0.129	-0.092	-0.106	-0.073	-0.185	-0.114	-0.172	-0.095
DIFF (p-value)	0.97	***0.00***	*0.07*	0.45	0.06	0.49	*0.10*	0.42	*0.10*	0.37	0.58	***0.01***	0.56	***0.00***

Note: *Italic* indicates 10% level significance. **Bold** indicates 5% level significance while ***italic and bold*** indicates 1% level significance.

Table 5
Correlation Matrix (N = 749)

	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	*UNION*
[1] CAR	*0.069*	*0.071*	0.047	0.005	0.044	-0.050	***0.131***	***0.127***	***-0.151***	***0.104***	0.020	***0.130***	0.021
[2] AB_HIRE_PL		***0.997***	-0.010	-0.002	0.060	-0.011	-0.001	-0.049	***-0.134***	***0.116***	-0.053	***0.125***	0.030
[3] AB_HIRE_IM			-0.003	-0.007	0.059	-0.014	0.004	-0.041	***-0.139***	***0.111***	*-0.061*	***0.122***	0.031
[4] DISTRESS				-0.039	**-0.079**	***-0.475***	**0.084**	**0.090**	*-0.066*	-0.017	*-0.063*	***0.126***	0.034
[5] CLOSE					0.003	***-0.159***	0.030	0.023	***-0.111***	-0.011	-0.054	0.026	***0.139***
[6] M&A						-0.041	-0.049	-0.060	-0.012	-0.001	-0.026	0.017	0.006
[7] RESTRUCT							-0.049	-0.051	**0.088**	-0.037	0.054	**-0.087**	**-0.086**
[8] LAYOFF_EFF_PL								***0.993***	***-0.613***	***0.240***	-0.047	***0.342***	***0.164***
[9] LAYOFF_EFF_IM									***-0.596***	***0.233***	-0.047	***0.333***	***0.157***
[10] LAYOFF_SIZE										***-0.358***	*0.070*	***-0.436***	***-0.237***
[11] F_SIZE											***0.170***	***0.417***	***0.144***
[12] MB												-0.055	*-0.068*
[13] ROA													0.160

Note: This table presents the Pearson correlation matrix for the variables used in our analyses. See Appendix 3 and Section 3.4 for variable definitions. *Italic* indicates 10% level significance. **Bold** indicates 5% level significance while ***italic and bold*** indicates 1% level significance.

Table 6
Layoff efficiency and stock market reaction to layoff announcements

	Model 1		Model 2		Model 3		Model 4	
Dependent variable = ***CAR***	Coeff.	p- value	Coeff.	p- value	Coeff.	p- value	Coeff.	p- value
Intercept	-0.017	0.25	-0.016	0.28	-0.040	0.11	-0.039	0.11
***LAYOFF_EFF_PL* (+)**	**0.029**	**0.01**			**0.028**	**0.04**		
***LAYOFF_EFF_IM* (+)**			**0.029**	**0.01**			**0.027**	**0.04**
DISTRESS					0.002	0.79	0.002	0.79
CLOSE					0.003	0.66	0.003	0.68
M&A					0.022	0.11	0.022	0.10
RESTRUCT					-0.006	0.46	-0.006	0.46
F_SIZE					0.003	0.12	0.003	0.13
MB					0.001	0.30	0.001	0.30
ROA					0.032	0.23	0.032	0.23
UNION					-0.003	0.69	-0.002	0.72
LAYOFF_SIZE					0.011	0.43	0.010	0.44
Year Fixed Effects	Yes		Yes		Yes		Yes	
Industry Fixed Effects	Yes		Yes		Yes		Yes	
Clustered by firm	Yes		Yes		Yes		Yes	
Adj. R2	0.99%		0.97%		1.30%		1.28%	
N	749		749		749		749	

Note: This table presents the results from the OLS regression of stock market reaction (i.e., *CAR*) on layoff efficiency. Standard errors are clustered by firm. See Appendix 3 and Section 3.4 for variable definitions.

Table 7
Sensitivity analysis

Panel A: Labor union

Dependent variable = ***CAR***	When *LAYOFF_EFF = LAYOFF_EFF_PL*		When *LAYOFF_EFF = LAYOFF_EFF_IM*	
	Coeff	p-value	Coeff	p-value
LAYOFF_EFF	**0.035**	**0.02**	**0.033**	**0.02**
UNION	0.008	0.50	0.006	0.61
LAYOFF_EFF*UNION	**-0.020**	**0.35**	**-0.016**	**0.45**
Control variables	Yes		Yes	
Year Fixed Effects	Yes		Yes	
Industry Fixed Effects	Yes		Yes	
Clustered by firm	Yes		Yes	
Adj. R2	1.28%		1.21%	
N	749		749	

Panel B: Financial crisis

Dependent variable = ***CAR***	When *LAYOFF_EFF = LAYOFF_EFF_PL*		When *LAYOFF_EFF = LAYOFF_EFF_IM*	
	Coeff	p-value	Coeff	p-value
LAYOFF_EFF	**0.024**	**0.08**	**0.026**	**0.04**
CRISIS	-0.013	0.58	-0.008	0.72
LAYOFF_EFF*CRISIS	**0.010**	**0.73**	**0.002**	**0.95**
Control variables	Yes		Yes	
Year Fixed Effects	Yes		Yes	
Industry Fixed Effects	Yes		Yes	
Clustered by firm	Yes		Yes	
Adj. R2	1.09%		1.04%	
N	749		749	

Panel C: High vs. low technology firms

Dependent variable = ***CAR***	When *LAYOFF_EFF = LAYOFF_EFF_PL*		When *LAYOFF_EFF = LAYOFF_EFF_IM*	
	Coeff	p-value	Coeff	p-value
LAYOFF_EFF	**0.027**	**0.12**	**0.031**	**0.06**
HIGHTECH	0.002	0.90	0.007	0.58
LAYOFF_EFF*HIGHTECH	**0.001**	**0.96**	**-0.010**	**0.64**
Control variables	Yes		Yes	
Year Fixed Effects	Yes		Yes	
Industry Fixed Effects	Yes		Yes	
Clustered by firm	Yes		Yes	
Adj. R2	1.03%		1.03%	
N	749		749	

Note: This table presents the results from the sensitivity analysis examining whether labor union, financial crisis, and tech-industry drives the effect of layoff efficiency on stock market reaction. Standard errors are clustered by firm. See Appendix 3 and Section 3.4 for variable definitions.

Table 8
Layoff efficiency and future operating performance

Dependent variable = ΔROA_{t+1}	Model 1		Model 2	
	Coeff.	p- value	Coeff.	p- value
Intercept	-0.190	0.00	-0.192	0.00
***LAYOFF_EFF_PL* (+)**	**0.065**	**0.02**		
***LAYOFF_EFF_IM* (+)**			**0.070**	**0.01**
DISTRESS	0.018	0.30	0.018	0.29
CLOSE	0.061	0.00	0.061	0.00
M&A	0.097	0.00	0.099	0.00
RESTRUCT	0.009	0.60	0.009	0.59
ROA	-0.425	0.00	-0.425	0.00
ΔROA	-0.081	0.21	-0.081	0.21
F_SIZE	0.021	0.00	0.021	0.00
MB	0.005	0.01	0.005	0.01
UNION	0.006	0.70	0.006	0.69
LAYOFF_SIZE	-0.132	0.00	-0.130	0.00
Year Fixed Effects	Yes		Yes	
Industry Fixed Effects	Yes		Yes	
Clustered by firm	Yes		Yes	
Adj. R2	20.31%		20.43%	
N	719		719	

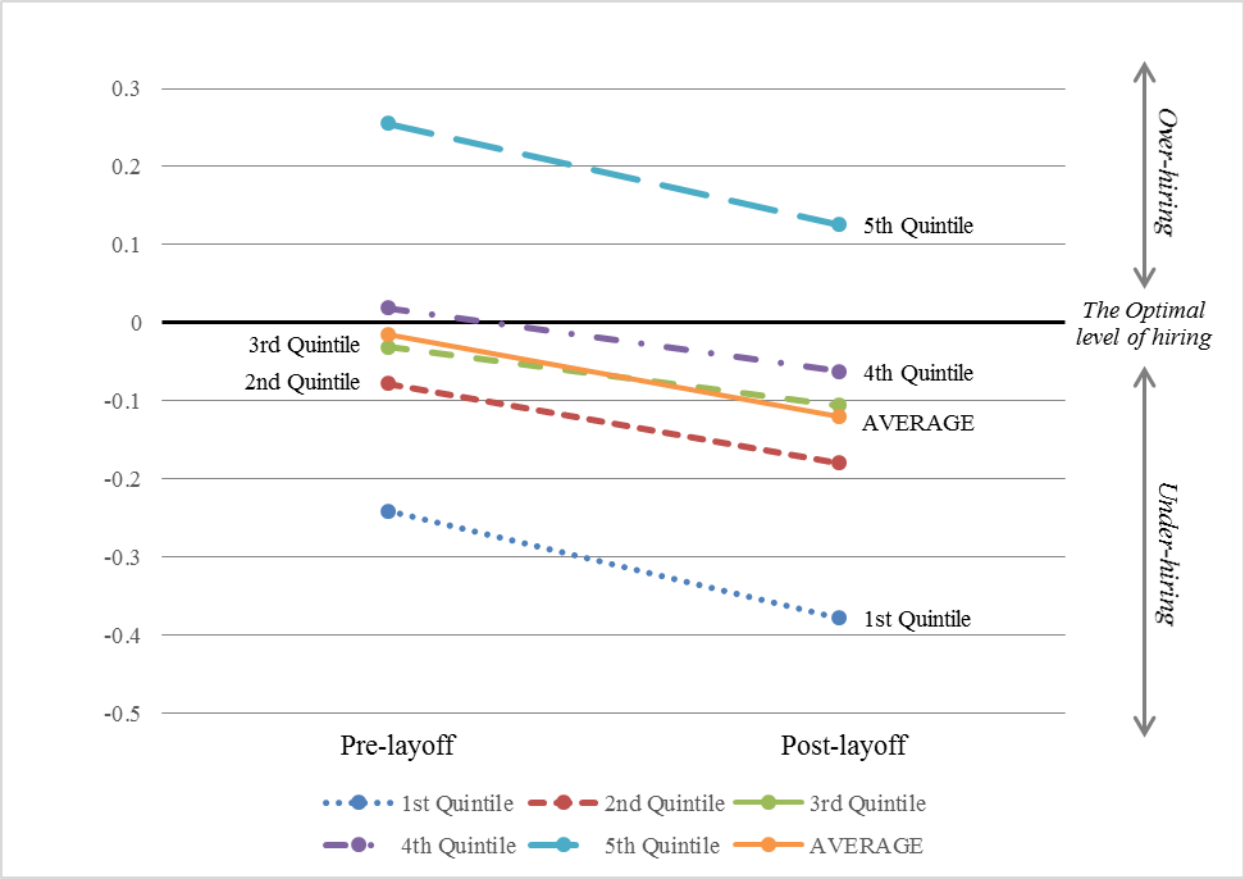
Note: This table presents the results from the OLS regression of future firm performance (i.e., ΔROA_{t+1}) on layoff efficiency. Standard errors are clustered by firm. See Appendix 3 and Section 3.4 for variable definitions.

Table 9
Pre-layoff hiring inefficiency and big bath activities

Dependent variable = ***BIG_BATH***	Model 1		Model 2	
	Coeff.	p- value	Coeff.	p- value
Intercept	0.126	0.00	0.123	0.00
UNDER_HIRE_PL	**0.028**	**0.02**		
UNDER_HIRE_IM			**0.019**	**0.10**
RET1	-0.091	0.00	-0.090	0.00
RET5	-0.004	0.52	-0.005	0.41
ΔMB	-0.002	0.35	-0.002	0.41
MB	-0.001	0.28	-0.001	0.26
F_SIZE	-0.013	0.00	-0.013	0.00
REVENUE	-0.029	0.03	-0.029	0.03
Year Fixed Effects	Yes		Yes	
Industry Fixed Effects	Yes		Yes	
Clustered by firm	Yes		Yes	
Pseudo R2	14.20%		13.73%	
N	732		732	

Note: This table presents the results from the Tobit regression of big bath (large, non-recurring charges) on pre-layoff hiring inefficiency. Standard errors are clustered by firm. See Appendix 3 and Section 5.3 for variable definitions.

Figure 1
Changes in hiring inefficiency before-and-after layoffs



Note: We split the entire sample into five groups depending on the extent of under-hiring prior to layoff announcements. The first group (1st Quintile) consists of firms which under-hire the most prior to layoff announcements while the last group (5th Quintile) consists of firms which over-hire the most. Then we examine how the average hiring in each group changes after layoff announcements.