The Human Capital Costs of Financial Constraint

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Abstract

This paper explores the link between external financing constraints and firm-level employment decisions. I introduce new data on the occupations of workers affected in mass layoff instances, which allows me to examine layoff behavior as well as the type of human capital dismissed. To isolate the effect of financial constraints on employment decisions, I exploit firm-level variation in the amount of debt coming due at the onset of the 2007-2009 financial crisis. I find that financially constrained firms reduced total employment by more than otherwise similar, unconstrained firms, and were significantly more likely to make a mass layoff. Among firms that made a mass layoff, I find that financially constrained firms laid off high human capital employees, contradicting theoretical labor economics predictions that firms lay off workers in inverse order of the degree of human capital. In looking at stock returns following mass layoff announcements, I find 3-day cumulative abnormal returns to be negatively related to the degree of human capital laid off. These results combine to suggest that financing constraints have a significant impact on firm-level employment outcomes and, in particular, on the type of human capital dismissed.

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1. Introduction

Do financial frictions affect firm-level employment decisions? This question has been asked with piqued interest following the 2007-2009 financial crisis. The crisis led to a sharp contraction in non-financial corporate lending, representing potentially severe external financing constraints for firms. At the same time, the labor market in the United States witnessed significant increases in unemployment: from a low of 4.4% in May 2007 to a high of 10.0% in October 2009. How are these outcomes related? The relationship between the availability of external finance and firm-level expenditure has been studied extensively; though labor is a large share of expenditure, comparatively little is known about how the availability of external finance impacts labor outcomes.

This paper examines how external financing constraints affect both the quantity of labor a firm chooses to employ as well as the quality. I introduce new, hand-collected data on the occupations of workers affected in mass layoff instances in California between 2006 and 2011, which allows me to assess the quality of dismissed workers using proxy measures of human capital. An exploration of these relationships is key aspect of an understanding of firm behavior as well as variation in employment over the business cycles.

Theoretically, the availability of external financing should affect employment decisions for several reasons. I first examine the impact on the quantity of labor. External financing constraints may affect employment indirectly through an impact on the level investment (labor and capital being complements in the production function). In the face of high external finance premiums, employment will shrink alongside reductions in capital expenditures. Alternatively, in the context of liquidity constraints, payments to labor may exceed cash flow generation. Firms that finance labor activity using working capital will be forced to reduce payroll costs as working capital deteriorates. Finally, particularly in crisis environments, firms may reduce employment as a means to preemptively reduce their dependence on external financing from unstable or weak banks.

I next examine the impact of external financing constraints on the quality of labor (i.e. the degree of human capital) affected in mass layoff instances. Theoretical predictions from labor economics hold that, given a layoff decision, firms will sort workers in inverse order of firm-specific

human capital and begin dismissing workers at the bottom. This is driven by the result that workers with more firm-specific skills contribute more to a firm's profitability. Though a more cursory explanation, this behavior is also consistent with a "last in, first out" pecking order. I explore how this theoretical pecking order is affected by financing constraints.

Next, how do we capture these effects? The literature has so far been limited by a lack of data on firm-level employment outcomes that includes occupational detail. I introduce new, hand-collected data on mass layoffs in California between 2006 and 2011, which includes detail on the occupations affected in each layoff instance. This allows me to investigate firms' propensity for mass layoffs during the financial crisis as well as their human capital choices in the face of a mass layoff.

Testing for a causal effect of financial constraints on firm employment decisions is complicated by identification concerns of endogeneity. In particular, variables measuring firms' financial health are also correlated with their demand for labor. To address this, I use the onset of the 2007-2009 financial crisis provides an identification tool. The crisis led to a significant contraction in non-financial corporate lending, representing potentially severe external financing constraints for firms. Firms that faced the need to rollover existing long-term corporate debt obligations at the onset of the crisis encountered sudden and unexpected difficulty. This contraction in lending arguably provides a shock to the supply of external financing that is unrelated to the weakening of corporate business fundamentals. To isolate the effect of financial constraints on employment decisions, I exploit firm-level variation in the amount of debt coming due at the onset of the 2007-2009 financial crisis, following Almeida et al. (2012). I examine whether firms with large fractions of long-term debt maturing at the onset of the crisis adjust their employment behavior in ways that are more pronounced than otherwise similar firms that did not face a need to refinance their long-term debt at that time. To the extent that these refinancing effects are large, they imply that the terms of financial contracting (i.e. contract maturity) affect employment outcomes.

Long-term debt is typically publicly-held and difficult to renegotiate on short notice (Bolton and Scharfstein (1996)). Because cumulative, hard-to-reverse decisions made several years in the past affect current long-term debt maturity structures, it is hard to argue that firms are at their optimal

debt maturities at all times. Therefore, whether a firm had to refinance a significant portion of its long-term debt right after August 2007 is plausibly exogenous to the firm's performance in the aftermath of the shock. I exploit this maturity-structure discontinuity, using the portion of long-term debt pre-set to mature right after fall of 2007 to gauge how firms' employment decisions are affected by financing constraints. While my analysis treats variation in the fraction of long-term debt that comes due right after August 2007 as exogenous to firm outcomes, it is plausible that other sources of firm heterogeneity could underlie these relationships. To alleviate this concern, I use a difference-in-difference matching estimation approach that incorporates observable firm characteristics and accounts for unobservable, idiosyncratic firm effects. The tests match firms that should be more susceptible to the negative effects of refinancing constraints (firms that had a large fraction of their long-term debt coming due when the crisis hit) with firms that did not face a need to rollover their debt, allowing me to compare otherwise similar firms that differ only in their profiles of long-term debt maturity. The tests account for time-invariant heterogeneity by comparing within-firm changes in outcome variables from the period that precedes the 2007 credit shock to the period that follows.

My findings are as follows. I first verify pronounced cross-firm variation in long-term debt maturity structure at the onset of the 2007 crisis. Cross-sectional variation in long-term debt maturity is persistent over time, with similar dispersion patterns observed in the years preceding the crisis. I isolate a sizable pool of firms with a large fraction of long-term debt maturing right after the crisis (financially constrained firms) that are virtually identical to other firms whose debt happens to mature in later years (financially unconstrained firms). I show that these two groups of firms are similar across all characteristics except for the share of long-term debt due at the onset of the crisis.

I then show that whether a firm faced financing constraints due to impending debt maturity has important consequences for post-crisis employment outcomes. While the growth rate of total employment declined for both financially constrained and unconstrained firms, it declined 5.07% more among the financially constrained. In order to verify that the employment behavior differences between the two groups are particular to an environment in which credit is tight, I replicate my experiment over a number of non-crisis years. In non-crisis years, debt coming due is less likely to

induce financial constraint; consistent with this, the effects of financing constraints due to impending debt maturity hold only for the 2007 environment of tight credit.

Having shown that financial constraints cause firms to reduce employment, I then turn to understand how adjustments are made. In particular, do firms lay off workers or simply slow hiring? Using data on layoff instances, I repeat the analysis on changes in total employment using an indicator variable of firm-level mass layoffs. I find that the likelihood of a mass layoff increased 6.77% between 2007 and 2008 among financially constrained firms, though it barely changed at all among unconstrained firms. Overall, firms facing external financing constraints were 6.89% more likely to make a mass layoff than otherwise similar but unconstrained firms. The effect of financing constraints on the likelihood of mass layoff instances is insignificant in subsequent years.

Following evidence that external financing constraints affect the level of total employment as well as firms' layoff behavior, what about the quality of layoffs? Do financing constraints influence the degree of human capital of workers affected in a layoff event? I restrict my attention to the subset of firms that made a mass layoff and examine the quality of layoff instances using proxies for human capital by occupation. I find that external financing constraints have important consequences for the degree of human capital laid off. Financially constrained firms laid off workers with higher average annual salaries following the onset of the crisis. The difference-in-difference estimate implies that financially constrained firms laid off workers earning $12,617 more relative to financially unconstrained firms and relative to the pre-crisis period. I do not find a significant difference in the average annual salary of workers laid off by financially unconstrained firms and the difference between salaries of laid off workers across constrained and unconstrained firms does not persist in later years. These results are robust to alternative measures of human capital (educational attainment, work experience and on-the-job training).

From measures of salary, educational attainment, work experience and on-the-job training, it appears that financially constrained firms laid off higher human capital workers following the onset of the crisis relative to unconstrained firms. It is encouraging that the outcomes tend in the same direction. Overall, the results point to destruction of the firm-worker match in a sort of human

capital fire sale brought on by financial constraint. This may reflect a strategic decision to lay off relatively more expensive employees in a struggle to conserve cash holdings.

In a follow-up exercise, I note that many firms in my dataset laid off workers in multiple instances. I look into how the average level of human capital of laid off workers varies within firms by layoff instance. I find that financially healthy firms laid off workers in order of human capital, laying off low human capital workers first and escalating to high human capital workers in later layoff instances. However, financially distressed firms behave in the opposite manner, laying off high human capital workers in early layoff instances and deescalating to low human capital workers later on. This result contradicts theoretical predictions concerning firms' investment in human capital.

Finally, I consider stock market reactions to mass layoff announcements. A valuation-based understanding of layoff announcements should provide additional context in which to interpret the results described above. I find 3-day cumulative abnormal returns to be slightly negative following a mass layoff announcement. This is consistent with Farber and Hallock (2008), who document negative returns among firms with layoff announcements reported in the Wall Street Journal between 1970 and 1999. In addition, I find a negative relationship between 3-day cumulative abnormal returns and the degree of human capital laid off. These results indicate that valuations decline upon destruction of the value created in worker-employer relationships. Moreover, the decline is particularly pronounced for high human capital worker-employer relationships, suggesting that the market accounts for the type of workers being laid off.

The rest of the paper is organized as follows. Section 2 outlines theory underlying firms' employment decisions and the impact of credit constraints on real firm-level outcomes. Section 3 describes the data sources, data selection and the construction of the main variables. Section 4 discusses the 2007-2009 crisis and the maturity structure of long-term corporate debt. Section 5 presents the empirical design. Section 6 discusses the results and implications. Section 7 concludes.

2. Underlying Economic Theory

The link between financial constraint and firm employment decisions is analogous to the link between financial constraint and firm expenditures, a well-worn question in corporate finance. I begin by describing that literature in order to highlight useful parallels and distinctions for thinking about employment. Modigliani and Miller (1958) predict that, in perfect markets, a firm's financial structure will not affect its market value. Thus, real firm decisions, motivated by the maximization of shareholders' claims, are independent of financial factors. Applied to firms' capital investment, this prediction provided a foundation for the neoclassical theory of investment (Hall and Jorgenson (1967), Jorgenson and Siebert (1968) and Elliot (1973)), in which a firm's inter-temporal optimization problem could be solved without reference to a firm's financial condition.

Stepping away from a Modigliani-Miller world, the cost of external finance may exceed the cost of internal finance (due to information asymmetries, agency costs, incomplete contracting or the tax system), in which case the two are not perfect substitutes. The central prediction is that, where the cost of external finance exceeds the cost of internal finance (also known as a positive external finance premium), firms will respond by decreasing capital expenditures (Fazzari, Hubbard, and Petersen (1988, 2000), Kaplan and Zingales (1997, 2000), Lamont (1997) and Rauh (2006)). While this literature is interested the impact of financial constraints on real outcomes in general, it has little to say about labor outcomes. Yet labor is a very large share of firm expenditure. This paper fits into a burgeoning literature that is concerned instead with the impact of financial constraints on firm employment.

Theoretically, the cost and availability of external debt financing should affect employment decisions for several reasons. Labor and capital being complements in the production function, the availability of external finance may affect employment indirectly through its impact on the level investment. In the face of high external finance premiums, employment will shrink naturally alongside reductions in capital expenditures. Alternatively, in the context of liquidity constraints, payments to labor may exceed cash flow generation. Firms that finance labor activity using working capital will be forced to reduce payroll costs as working capital deteriorates (Greenwald and Stiglitz

(1988)). Finally, firms may also reduce employment in a push to preemptively reduce their dependence on debt financing from unstable or weak banks. The link between financial constraints and employment is also explored in Benmelech, Bergman and Seru (2011), which uses a set of quasi-experiments to suggest that financial constraints and the availability of credit play an important role in determining firm employment levels as well as aggregate unemployment. This paper uses observations on layoff instances in addition to data on total employment by firm, as well as information on the human capital of affected workers.

Concerning the human capital of affected workers, I am interested in whether financial constraints also impact employment quality, i.e. the degree of human capital that a firm chooses to employ. Economic theory on firm investment in human capital is rooted in the classic papers of Becker (1962) and Oi (1962). They wrote about the distinction between general and firm-specific training of workers. By definition, firm-specific knowledge is useful only in the firms providing it, whereas general knowledge is translatable to other firms. Accordingly, firms are predicted to pay for specific knowledge but leave the costs of general training to be borne by the workers. This helps explain why workers with highly firm-specific skills are less likely to quit their jobs. It also suggests that they are the last to be laid off during business downturns; we should expect layoffs to affect workers with high degrees of firm-specific human capital disproportionately less and workers with low degrees of firm-specific human capital disproportionately more. What about general human capital? More recent papers have broadened the theories laid down by Becker (1962) and Oi (1962) by weakening the certain assumptions, such as that of perfectly competitive labor markets. Acemoglu and Pischke (1998, 1999)[1] and Kessler and Lülfesmann (2006) suggest that firms have an interest in general human capital in addition to specific and are indeed willing to pay for it. This may be due to labor market imperfections, to firms' desires to gather superior information on workers' abilities, or complementarities between specific and general training. While the explanations are varied, there is strong evidence that firms are invested in levels of general human capital in addition

[1] Acemoglu and Pischke (1998) note the familiar example of employers sending workers to college, certificate or MBA programs offering general skills.

to levels of specific human capital. This leads to a view that layoffs affect workers with high degrees of general human capital disproportionately less as well, and workers with low degrees of general human capital disproportionately more.

The layoff data that I rely on reflects mass layoff instances in particular. Employers use mass layoffs for a host of strategic reasons: change of location, outsourcing of labor, productivity gains that render some functions superfluous or the elimination of an unviable business line. In these examples, mass layoffs are a planned, strategic management choice and may be unrelated to financing constraints. Yet they are also commonly related to financial distress. Abowd, McKinney and Vilhuber (2005) relate mass layoff events to firm closures, finding that mass layoffs increase the probability of a closure. They also find that layoffs occur disproportionately more often in firms that employ workers in the lowest quartile of the human capital distribution and disproportionately less often in firms that employ workers in the highest quartile of the human capital distribution. This makes sense: firms are more willing to lay off employees that can be easily trained. Conditioning their analysis the level of human capital within each firm, they find that firms that employ a disproportionate fraction of workers in the highest quartile of the human capital distribution are less likely to close even given a layoff event. High human capital appears to protect the firm from closure.

Research on the effects of layoffs on short-run stock prices is extensive. The key paper on the topic is Farber and Hallock (2008), which uses an event study methodology to analyze the stock price reactions to 5,353 Fortune 500 company layoff announcements collected from the *Wall Street Journal* from 1970-2007. The paper finds three-day cumulative abnormal returns surrounding the publication of layoff events to be negative (and gradually less negative over time). The authors also analyze the stock price reaction conditional on the reported reasons for the layoffs. They find positive cumulative abnormal returns for reasons such as "reorganization" and "plant closing" but negative cumulative abnormal returns for "demand slump" and "cost." The signs of these reactions make good sense. Reorganizations and plant closings are byproducts of strategic change within the company. Layoffs attributed to these reasons are more likely to be seen as management's good

stewardship, causing stock prices to rise. The opposite is true for layoffs attributed to a demand slump or the need for cost cutting: as symptoms of poor stewardship, it is intuitive that these layoff events would prompt a fall in stock prices. They find negative returns to be largely associated with demand slumps yet, the financial crisis having induced an economy-wide demand slump, layoffs motivated by reduced demand may have been assessed differently between 2007 and 2009. It may also have been the case that firms had excess labor leading up to the crisis, in which case mass layoffs may have enhanced value.

My results complement research documenting that layoffs are more prevalent among financially constrained firms, whose management faces greater pressure to reorganize (Denis and Kruse (2000), Kahl (2002) and Powell and Yawson (2009)). The paper also adds to a large literature documenting layoff characteristics (Itkin and Salmon (2011), Guthrie and Datta (2008), Pagano and Volpin (2005), and Cappelli (2000)).

3. Data

This paper introduces new data on firm-level mass layoffs in California from 2006-2011. The dataset is built around firm-level mass layoff instances. Since my analysis also requires additional worker and firm characteristics, I combine the following four datasets into one: (1) firm-level mass layoff data available as a result of the WARN Act; (2) proxies of human capital by occupation (salary, educational attainment, work experience, and on-the-job training) from the Bureau of Labor Statistics (BLS); (3) quarterly and annual firm fundamentals as well as credit ratings from Compustat; and (4) stock price and market return data from CRSP. The final, combine dataset consists of 412 unique, public firms having made 824 mass layoffs in California between 2006 and 2011. This section describes each source, data selection and variable construction.

3.1. Firm-Level Mass Layoff Data

Firm-level data on mass layoffs is available as a result of the Worker Adjustment and Retraining Notification (WARN) Act,[2] passed federally in 1989. The WARN Act requires firms with more than 100 full-time employees to provide 60-day advanced notice of impending mass layoff events, defined by the BLS as affecting 50 or more employees of a single company in a given location. Notice must be given in writing to: (1) the employees' representative or, if there is no representative, to each affected employee; (2) the state dislocated worker unit; and (3) the local government where the plant is located.

Implementation of the WARN Act having been left to states, the availability of WARN data varies widely. Compliance with the Act, the variables collected, the time span over which they have been collected, as well as public access to the records, depending on the state. The non-standard nature of the reporting makes it difficult to imagine a national dataset. Many states would be missing, there would be few data fields in common, and the time series would be short. As a result, I have chosen to focus on a single state, California. In addition to being a large economy, California has enforced thorough WARN reporting and has made the records relatively easily accessible. It is also the only state to require firms to report the occupations affected in a mass layoff, which is important to my analysis. Californian WARN notices require the following information: company name; address of layoff location; layoff date; date notice received; number of employees affected; layoff or closure; severance; union representation; bumping rights; and occupations of affected employees. To my knowledge, this research is the first to describe and analyze firm-level layoffs beyond a case study of a single firm.

Figure 1 presents a geographic scatter plot of all mass layoff instances in California between 2006 and 2011. Unsurprisingly, they are clustered in the urban areas surrounding San Francisco and Los Angeles, corresponding to the locations of most large firms, retail stores, and production facilities. Figure 2 presents a scatter plot of layoff instances over this period. The raw data consists

[2] I compiled the data from over 3,000 PDF pages of notices available to the public from the State of California's Employment Development Department: http://www.edd.ca.gov/jobs_and_training/layoff_services_warn.htm.

of 4,335 layoff events among 1,274 unique public and private firms, affecting a total of 260,100 workers. The average layoff event in this period affected 110 workers. Several major layoff events stand out. The largest and third largest layoff events belong to Macy's, which laid off 2,053 workers on September 1st, 2006 and 1,501 workers on May 1st, 2009. The second largest layoff event belongs to United Airlines, which laid off 1,549 workers on October 5th, 2008. The fourth largest layoff belongs to Circuit City, which laid off 1,163 workers on March 21st, 2009. The fifth largest layoff belongs to Washington Mutual, which laid off 1,153 workers on June 30th, 2008.

I compared the WARN series to both initial unemployment claims from the BLS and an estimate of mass layoffs derived from BLS data in order to get a sense for the completeness of the WARN data. Initial claims are only a partial description of layoffs in California, as not all those laid off apply for unemployment assistance. Nevertheless, initial claims offer a more complete picture of layoffs than the WARN data, as an unemployment assistance claim can be initiated by any laid off worker, not just those affected by a mass layoff. I find that the WARN data represents approximately 20% of initial claims. In another attempt to assess the completeness of the WARN data, I estimate the minimum amount of mass layoffs in California using Mass Layoff Statistics (MLS) from the BLS. The MLS program does not report the number of employees affected by mass layoffs, but it does report the number of monthly mass layoff incidents in the state. California defines a mass layoff as a layoff incident affecting at least 35 workers. Thus, I assume that a minimum of 35 workers are affected in each mass layoff incident and simply multiply the number of mass layoff events by 35 in order to arrive at a minimum estimate. I find that the WARN data represents 60% of estimated mass layoffs. This leads me to believe that some firms are simply not reporting mass layoff events as they are required to by state and federal law. This is unsurprising, as there is slight or no enforcement of the WARN Act in California. Non-reporting firms are likely to be less well-run administratively rather than intentionally flouting the state disclosure requirement; I do not believe that the omission of these firms biases the data in a predictable direction.

Table 1 presents a tabulation of mass layoff events by industry and Table 2 tabulates the employers having fired the greatest numbers of workers. Financial firms (including Wells Fargo,

Washington Mutual, Fleetwood, Indymac, Citigroup) made a large number of mass layoffs, as did major retail firms (including Macy's, Mervyn's, Circuit City, Target, JC Penney's). The airline and aerospace industry (including United, American, ATA, Boeing), persistently beleaguered, cut many jobs as well. The mix of occupations affected in each mass layoff depends to some extent on the firm. For example, the WARN data reveals that aerospace engineers and flight attendants were laid off by United Airlines, whereas marketing managers and sales personnel were laid off by Macy's. However, each mass layoff notice pertains to a variety of occupations and those occupations tend to be repeated among firms within the same industry.

It is common for firms to engage in multiple rounds of mass layoffs as opposed to all at once; sometimes the layoff events are separated by years, sometimes merely by several weeks. Thus, firms behave as though WARN notice filings carry either no market signal or at least not a negative market signal. It may be that press releases lead the WARN announcements, in effect nullifying the information that they contain for financial markets. Multiple mass layoffs may be a sign of ongoing financial constraint.

3.2. Constructing Proxies for Human Capital By Occupation From the BLS

In order to construct measured of human capital by occupation, the job titles reported in the WARN data had to be unified by occupation. I unified WARN job titles by hand using the standard occupation classification (SOC) system available from the BLS. Once WARN job titles were matched to SOC occupations they were also linked to SOC codes, which allowed me to connect to other occupational data tracked by the BLS. This data is the basis of four human capital proxies: annual salary, educational attainment, work experience and on-the-job training.

Annual salary is available by occupation (840 unique occupation classifications) and by metropolitan statistical area (24 unique areas within California). To take an example, this allows me to estimate that a typical chemical engineer in the San Diego-Carlsbad-San Marcos area earns an annual salary of $86,490. In the absence of a direct measure of worker skill, the literature has commonly used wages as a proxy. Examples include Bernard and Jensen (2002) and Dunne and

Roberts (1990), who consider the determinants of wages and the effects of wages on plant closures and Carneiro and Portugal (2003), who consider the link between wages and displacement events.

Next, SOC codes link to estimates of educational attainment, work experience and on-the-job training for each occupation. Occupations receive designations in three categories:

1) Entry-level education: doctoral/professional degree; master's; bachelor's; associate's; postsecondary; some college; high school; less than high school
2) Related work experience: > 5 years; 1-5 years; < 1 year; none
3) On-the-job training: internship; apprenticeship; long-term (> 1 year); moderate (1-12 months); short-term (< 1 month); none

To take an example, a typical judge has a doctoral or professional degree, more than 5 years of work experience and short-term on-the-job training. Layoffs in California between 2006 and 2011 are summarized according to these four human capital proxies in Table 3.

A worker's human capital can be thought of in two pieces: firm-specific and general. The proxies described above are each indicators of a worker's general human capital. Ideally, I would have data on firm-level investment in specific skills, i.e. those that do not easily translate to other firms or context, by occupation. Tenure at a firm would be a rough but reasonable proxy, as firm-specific knowledge naturally increases with tenure. However, lacking data on tenure or potential other proxies, I use the four general human capital proxies as though they are representative of firm-specific human capital and interpret the results with this caveat.

3.3. Compustat Annual Fundamental Data

I consider the entire universe of firms from the Compustat Annual and Quarterly Fundamental Files between 2000 and 2011. In addition to balance sheet and income statement information, Compustat also reports the number of workers employed by a firm. The main independent variables are size (represented as the log value of total assets), Tobin's Q (proxied by the market-to-book ratio), cash flow, cash balance, and long-term debt normalized by total assets. Variable definitions

and constructions are detailed in Appendix A. Finally, I use four-digit SIC codes in order to map each firm's industry into Fama-French 12 and Fama-French 48 industry classifications.

3.4. CRSP Stock Price and Market Return Data

I use value-weighted return and market return data from the Center for Research in Security Prices (CRSP) to calculate 3-day cumulative abnormal returns for each firm surrounding each layoff event. The CRSP data was merged using CUSIP and stock tickers.

4. The 2007 Credit Shock and the Maturity Structure of Corporate Debt

I begin my overview of the credit crisis by describing changes in 3-month LIBOR and commercial paper rates – both common sources of short-term financing – in August 2007.[3] Spreads between LIBOR and commercial paper and comparable-maturity Treasuries were low in the period between 2001 and the early part of 2007 (around 0.5%) but spiked in August 2007 (around 1.5%). The re-pricing of credit instruments spread from short-term bank financing to longer-term instruments quickly, highlighting the interdependence of financial market segments. Current research on the crisis suggests that spreads on long-term corporate bonds increased sharply. Adrian, Colla and Shin (2012) find that spreads relative to comparable-maturity Treasuries tripled during the financial crisis, from 156 basis points in the second quarter of 2007 to 436 basis points in the second quarter of 2009. This evidence supports the conjecture that there was a substantial increase in the cost of short- and long-term bond financing. This environment of tight corporate credit provides a unique opportunity to identify the effects of supply contractions on corporate policies.

My identification strategy also requires variation in long-term debt maturity across firms. In particular, it relies on an adequate group of firms with long-term debt maturing right after the onset of the crisis. While one might expect firms to have well-diversified maturity structures, protecting against the need to repay or refinance significant amounts of debt in any particular year, this would

[3] I defer to Gorton (2008) and Brunnermeir (2009) for broader summaries of the roots of the crisis.

hamper the proposed strategy. Fortunately, a literature on capital market frictions outlines evidence that it is difficult for firms to maintain their optimal capital structures.[4]

Almeida et al. (2012) investigated the distribution of debt maturities for their Compustat sample of firms. For each firm in the third quarter of 2007, they collected information on the amount of long-term debt maturing in the subsequent five years and report these amounts as a fraction of total long-term debt (between 0% and 100%). They find that while a significant number of firms have long-term debt maturing largely in 2008 (some firms with nearly 100% of their long-term debt maturing that year), many firms do not have any significant amount of long-term debt maturing in 2008. Other years exhibit similar variation. Debt maturity commonly concentrates in a particular year, but not necessarily in 2008. Further, the distributions of long-term debt maturing in the individual years beyond 2008 (2009 through 2012) look fairly similar to the distribution of long-term debt maturing in 2008. This suggests that firms may not always try to renegotiate in advance to prolong debt maturities. They also examine the distributions of debt maturities in years prior to 2007 and find that they look very similar to years following 2008.

5. Empirical Design

This section describes the basic empirical design, including the matching methodology to construct a comparison group and difference-in-difference regression specifications. My empirical strategy uses variation in long-term debt maturity at the onset of the 2007 crisis as a tool to identify the effect of credit supply shocks on corporate policies. In a frictionless capital markets, debt maturity is irrelevant. Firms can always refinance and re-contract their way around the potential effects of a balloon debt payment. The 2007 crisis is a unique context because financial markets contain more friction in a crisis environment. Maturing debt was not as easy to rollover and, at the same time, firms found it difficult to substitute across alternative funding sources. As a result, firms that had large portions of debt maturing at the onset of the 2007 crisis may be expected to face tighter financing constraints than firms that did not have a large portion of debt coming due.

[4] This can be thought of as due to transaction costs, as in Fischer, Heinkel and Zechner (1989), or due to market-timing strategies, as in Baker and Wurgler (2002) and Welch (2004).

5.1. Matching Methodology

I want to test whether the employment decisions of firms needing to rollover their long-term debt obligations at the onset of the credit crisis differed from those of firms that did not face such a need. My identification strategy resembles an experiment: the firm's long-term debt maturity structure and developments in the financial markets coincide such that the firm needs to refinance a large fraction of its debt in the midst of a credit contraction. If debt maturity was randomly assigned across firms, then it would suffice to compare the outcomes of firms that had significant debt maturing around the time of the crisis with firms whose debt happened to mature at a later date. However, the data in this study is non-experimental. The challenge is to gauge firms' outcomes had they not been caught between a credit crisis and the need to refinance their debt. One way to tackle this issue is to estimate differences between plausibly counterfactual outcomes and those that are observed in the data. Under this approach, a standard method is to use a parametric regression where the group of interest is identified by a dummy variable. Outcome differences are then estimated by the coefficient on the group dummy.

This strategy is closely related to the design-based test described by Angrist and Pischke (2010). Within the natural experiment framework, I add the use of matching estimators, which aim to isolate "treated" observations (firms with debt maturing during the crisis). Next, from the population of "non-treated" observations, I look for control observations that best match the treated ones according to a set of firm characteristics. In this framework, the set of counterfactuals are restricted to the matched controls. In other words, it is assumed that in the absence of the treatment, the treated group would have behaved similarly to the control group. The matches are made so as to ensure that treated and control observations have identical distributions along each and every one of the firm characteristic covariates chosen (firm size, profitability, leverage and credit rating). Inferences about the treatment of interest (refinancing constraints) are based on differences in the post-treatment outcomes of treated and control groups. I rely on the Abadie and Imbens (2006) estimator, as implemented by Abadie, Drukker, Herr, and Imbens (2004). The Abadie-Imbens matching estimator minimizes the distance (i.e., the Mahalanobis distance) between a vector of

observed covariates across treated and non-treated firms, finding controls based on matches for which the distance between vectors is smallest. I select one matched control for each treated firm. The estimator produces heteroskedastic-robust standard errors.

Matching aims to account for variables that may influence the selection into treatment and observed outcomes. The outcome variables here relate to employment. It is important to include only covariates for which one could make a reasonable case for simultaneity in the treatment—outcome relation. Categorical variables include firms' industrial classification codes (Fama-French SIC-12 and SIC-48 classification codes) and the credit rating of public bonds. Non-categorical variables include size (the log of total assets), Q, cash flow, cash balance and the ratio of long-term debt to total assets. It is commonly accepted that these covariates capture a lot of otherwise unobserved firm heterogeneity. The estimations implicitly account for all possible interactions between the included covariates. I estimate Abadie-Imbens' average effect of the treatment on the treated (ATT) and then model the outcomes in differenced form using difference-in-differences estimations.

5.2. Difference-in-Difference Specifications

I compare changes in employment behavior between financially constrained and unconstrained firms (denoted $Constrained$ and $Unconstrained$) and before and after the onset of the financial crisis (denoted Pre and $Post$). The logic is that employment decisions may be different preceding and following the crisis, in which case the inferences may be biased by uncontrolled firm-specific differences. I estimate the following difference-in-difference specification for each outcome variable:

$$y = \beta_0 + \beta_1 * Constrained + \delta_0 * Post + \delta_1 * Constrained \times Post + \varepsilon$$

The coefficient of interest is δ_1, the coefficient on the interaction term $Constrained \times Post$. In this equation, β_0 is the baseline average, β_1 represents the time trend in the financially constrained group, δ_0 represents the difference between financially constrained and unconstrained groups in the period before the crisis and δ_1 represents the difference in the changes over time. Assuming that both

groups face the same credit conditions over time, this specification controls for a possible time trend, allowing me to isolate the impact of financial constraints on employment outcomes.

Some of the outcome variables that I consider, such as the mass layoff indicator as well as educational attainment, work experience and on-the-job training indicators, are binary. I estimate these outcome variables using a linear probability model rather than logit or probit regressions due to the difficulty comparing outcomes among groups in these models (see Norton and Ai (2003) and Norton, Wang, Ai (2004)). Angrist and Pischke (2009) show linear probability models to be good options for certain dependent variables. Given an interest in the average effect of some variable upon some outcome, Hellevik (2009) also makes a compelling case for choosing a linear probability model of over logit.

6. Results

This section first presents a comparison of financially constrained and unconstrained firms using summary statistics of main variables. I then present evidence on the employment effects of the 2007 credit crisis and evidence on the human capital effects of the 2007 credit crisis. Last, I present results on the stock market reaction following a mass layoff announcement.

6.1. Summary Statistics

Summary statistics of the main variables are presented in Table 4 for financially constrained and financially unconstrained firms (both full and matched samples) at the end of 2007. Recall that financially constrained firms are defined as those for which the percentage of long-term debt maturing within one year is greater than 20 percent, while unconstrained firms are those for which this percentage is less than or equal to 20 percent. The overall sample consists of 844 firms. The treated sample consists of 119, the non-treated of 725, and the control sample of 119 firms using one-to-one matching. Looking at differences between financially constrained firms and financially unconstrained firms in the full sample, I observe that financially constrained firms are smaller in size,

have lower long-term leverage, high interest coverage ratios, higher KZ Index values, slightly higher Q values, as well as higher cash flow and higher cash balances.

These sample differences are not unexpected. The goal of matching techniques is to control for these distributional differences, as they may affect whether a firm becomes financially constrained as well as post-crisis outcomes. The set of unconstrained firms in the matched sample is a subset of unconstrained firms in the full sample, where matching is based on the following set of firm characteristics: size (log of total assets), market-to-book, cash flow, cash balance, long-term debt normalized by assets and Fama-French 12 industry indicators. This approach allows me to compare otherwise similar firms, with the only difference being the profile of their long-term debt maturity. Upon matching, I have 119 firms in the financially constrained group and 119 firms in the matched, financially unconstrained group. Importantly, I find no statistical differences between the main variables across the two groups after matching.

6.2. Employment Effects of the 2007 Credit Crisis

I examine the employment behavior of financially constrained and matched, financially unconstrained firms around the 2007 credit crisis. I first consider changes in total firm employment, seeking to understand whether reductions in employment during the crisis were more pronounced for financially constrained firms. In Table 5, the first row of Panel A shows that both financially constrained and unconstrained firms were growing total employment (7.03% for financially constrained firms versus 6.45% for financially unconstrained firms) between 2006 and 2007. The difference is economically and statistically insignificant after matching. Examining the differences in total employment changes between 2007 and 2008, I find that employment decisions of financially constrained firms differed from those of unconstrained firms. While average annual employment among financially constrained firms fell by 1.23%, average annual employment among financially unconstrained firms continued to grow by 3.08%. My estimates imply that annual changes in employment among financially constrained firms were reduced by -4.90% relative to financially

unconstrained firms following the onset of the crisis. The Abadie-Imbens estimate of the difference-in-difference coefficient is -5.07%.

Panel B presents the difference-in-difference coefficient estimates and Abadie-Imbens estimates across non-crisis years (total employment changes from 2000-2001 through 2005-2006). My identification strategy argues that financial constraint is brought on by the perfect storm of debt coming due in a credit crisis. In non-crisis years, debt coming due is less likely to induce financial constraint. Consistent with this, I find that the effects of financing constraints due to impending debt maturity hold only for the 2007 environment of tight credit. Difference-in-difference estimates in non-crisis years are economically and statistically insignificant.

Having shown that financial constraints cause firms to reduce employment, I next turn to understand how adjustments are made. This analysis draws on data on mass layoff instances in California between 2006 and 2011, represented by an indicator variable equal to one in the event of a mass layoff and zero otherwise. I estimate a difference-in-difference regression of a mass layoff indicator variable using a linear probability model, which yields coefficients that describe a firm's mass layoff propensity. Panel A of Table 6 presents the main results. The set of financially constrained firms and the matched set of unconstrained firms both exhibited a mass layoff propensity of 1.69% preceding the crisis. The likelihood of a mass layoff among financially constrained firms increased dramatically between 2007 and 2008, reaching 8.46% following the onset of the crisis but barely changing for unconstrained firms. Looking at the difference-in-difference estimate, I find that firms facing external financing constraints were 6.50% more likely to make a mass layoff compared to otherwise similar but unconstrained firms. The Abadie-Imbens estimate of the difference-in-difference mass layoff likelihood is 6.89%.

Panel B of Table 6 contains difference-in-difference coefficient estimates and Abadie-Imbens estimates for subsequent years (from 2008-2009 through 2010-2011). I consider subsequent years rather than preceding non-crisis years for these placebo tests because my layoff indicator variable is available beginning in 2006. I find the effect of financing constraints on the likelihood of mass layoff instances to be insignificant in subsequent years, holding only for the 2007 period. It is somewhat

surprising that the difference between mass layoff propensities does not last between 2008 and 2009. I would have expected mass layoffs to be prevalent among financially constrained firms in across these years as well, perhaps tapering off between 2009 and 2010. This indicates that the propensity for mass layoffs was concentrated early on in the crisis. Evidence that firms prefer to cluster the timing of layoff instances with firms in their industries seems to support this result (see Agarwal and Kolev (2012)).

6.3. Human Capital Effects of the 2007 Credit Crisis

Following evidence that external financing constraints affect the level of total employment, do financing constraints influence the degree of human capital of workers affected in a layoff event? This analysis draws on the subset of firms that made a mass layoff between 2006 and 2011, i.e. the intensive margin. I compare the degree of human capital of workers laid off among financially constrained firms to the degree of human capital of workers laid off among unconstrained firms, using annual average salary, educational attainment, work experience and on-the-job training as proxies.

Results for average annual salary are presented in Table 7. I find that financially constrained firms laid off workers with higher average annual salaries following the onset of the crisis. The first row of Panel A indicates that financially constrained firms laid off workers with an average annual salary of $66,151 preceding the crisis, while unconstrained firms laid off workers with an average annual salary of $63,357. Following the onset of the crisis, the average annual salary of workers affected in a mass layoff rose $13,175 to $77,326 (or nearly 20%). In contrast, the average annual salary of workers affected in a mass layoff by unconstrained firms rose less than 2%, from $63,357 to $64,488. The difference-in-difference estimate implies that financially constrained firms laid off workers earning $12,044 more relative to financially unconstrained firms and relative to the pre-crisis period. The Abadie-Imbens estimate of the difference-in-difference coefficient is $12,617. Panel B indicates that the difference between salaries of laid off workers across constrained and unconstrained firms does not persist in later years but is specific to the 2007-2008 period. Following

the result that the propensity for mass layoffs was much reduced in subsequent periods, this result is unsurprising.

Similar results also hold for the other three proxies of human capital: educational attainment, work experience and on-the-job training. The results for educational attainment by occupation are presented in Table 8. I consider employment decisions affecting workers with high levels of educational attainment (having a bachelor's degree or greater). Looking at the first row of Panel A, I find that financially constrained firms laid off 10.15% of their share of highly educated workers in the pre-crisis period, compared to 9.82% for unconstrained firms. Following the onset of the crisis, this portion increases to 38.27% for financially constrained firms, or 28.12%. The increase in the portion of highly educated workers fired is economically and statistically insignificant among unconstrained firms. The difference-in-difference estimate implies that financially constrained firms laid off 27.90% more highly educated workers relative to financially unconstrained firms and relative to the pre-crisis period. The Abadie-Imbens estimate of the difference-in-difference coefficient is 28.25%. Panel B reports that this difference is significant for the comparison between 2007 and 2008, but not in subsequent years. These agree with the results on the average salary discussed above. , as we expect salary and educational attainment to be highly correlated.

The results for work experience by occupation are presented in Table 9. As with educational attainment, I consider employment decisions affecting workers with high levels of work experience (at least five years). Looking at the first row of Panel A, I find that financially constrained firms laid off 7.25% of their share of workers with substantial work experience in the pre-crisis period, compared to 7.03% for unconstrained firms. Following the onset of the crisis, this portion increases to 35.61% for financially constrained firms, or 28.36%. The increase in the portion of workers with substantial work experience is economically and statistically insignificant among unconstrained firms. The difference-in-difference estimate implies that financially constrained firms laid off 26.67% more highly experienced workers relative to financially unconstrained firms and relative to the pre-crisis period. The Abadie-Imbens estimate of the difference-in-difference coefficient is 26.14%. We

see from Panel B that this difference is significant for the comparison between 2007 and 2008 but is insignificant in subsequent years.

Finally, I consider the differences in layoff decisions concerning workers' levels of on-the-job training. The results are presented in Table 10. I consider employment decisions affecting workers with high levels of on-the-training (at least one year). I find that, in comparison to unconstrained firms, financially constrained firms laid off a greater fraction of workers with high levels of on-the-job training. Looking at the first row of Panel A, I find that financially constrained firms laid off 22.45% of their share of highly trained workers in the pre-crisis period, compared to 20.74% for unconstrained firms. Following the onset of the crisis, this portion increased to 45.80% for financially constrained firms, or 23.35%. The increase in the portion of highly trained workers fired is economically and statistically insignificant among unconstrained firms. The difference-in-difference estimate implies that financially constrained firms laid off 19.54% more highly trained workers relative to financially unconstrained firms and relative to the pre-crisis period. The Abadie-Imbens estimate of the difference-in-difference coefficient is 21.17%.

From measures of salary, educational attainment, work experience and on-the-job training, it appears that financially constrained firms laid off higher human capital workers following the onset of the crisis relative to unconstrained firms. Though these measures are approximate, it is encouraging that the outcomes tend in the same direction. What can we infer from the differing magnitudes? The greatest gap between the human capital of workers laid off by financially constrained firms relative to unconstrained firms shows up for educational attainment (28.25%), followed by work experience (26.14%) and then followed by on-the-job training (21.17%). On-the job training seems to be the best proxy for firm-specific human capital as opposed to general human capital, as it reflects training specific to a firm. However, because this variable is an estimate by occupation and not actual on-the-job training reported by firms in WARN filings, there is no way of knowing whether the amount of on-the-job training was acquired at the firm that made the mass layoff. Thus, it makes little sense to read to closely into the magnitudes of each estimate.

Next, I am interested in the evolution of human capital affected across multiple mass layoff instances. I split the subset of firms that have made a mass layoff into two sub-samples: firms with KZ Index values in bottom quartile (which I designate as financially healthy) and firms with KZ Index values in the top quartile (which I designate as financially distressed). I then estimate a regression relating the number of layoff instances within a firm to the degree of human capital laid off. I find the degree of human capital laid off to be positively related to the number of layoff instances among financially health firms, but negatively related to the number of layoff instances among financially distressed firms.

6.4. Stock Market Reactions to Mass Layoffs Announcements

Finally, I consider stock market reactions to mass layoff announcements. A valuation-based understanding of layoff announcements should provide additional context in which to interpret the results described above. I find 3-day cumulative abnormal returns to be slightly negative following a mass layoff announcement. This is consistent with Farber and Hallock (2008), who document negative returns among firms with layoff announcements reported in the *Wall Street Journal* between 1970 and 1999. In addition, I find a negative relationship between 3-day cumulative abnormal returns and the degree of human capital laid off. These results indicate that valuations decline upon destruction of the value created in worker-employer relationships, and that the decline is particularly pronounced for high human capital worker-employer relationships.

One concern is how market participants observe the degree of human capital affected. WARN notifications containing the job titles of affected workers are made public with a lag. It is more likely that market participants are simply responding to their knowledge of whether a given firm is a low or high capital employer, for example, a manufacturer or a biotech firm.

7. Conclusion

I use the August 2007 credit panic to assess the effect of financial contracting on employment outcomes. In particular, I consider whether firms with a significant portion of long-term debt maturing at the onset of the crisis experienced more pronounced outcomes than otherwise similar

firms that did not face a need to rollover a significant portion of debt during the crisis. My empirical methodology replicates an experiment-like test that controls for observed and time-invariant unobserved firm heterogeneity using a difference-in-difference matching estimator.

My results indicate that debt maturity structure can have significant implications for firms' employment decisions when they face a credit shock. Firms whose long-term debt was largely maturing right after the third quarter of 2007 reduced their total employment by 5.07% more than otherwise similar firms whose debt was due following the onset of the crisis and were 6.89% more likely to make a mass layoff.

Examining the quality of layoffs, I find that financially constrained firms lay off greater portions of high human capital workers relative to financially unconstrained firms. These specifications rely on a variety of human capital proxies – salary, educational attainment, work experience and on-the-job training. Given multiple layoff instances, I find that financially healthy firms began laying off low human capital workers, escalating to high human capital workers in later layoff instances. In contrast, financially distressed firms laid off high human capital workers in early layoff instances, deescalating to low human capital workers later on. The pecking order of layoffs that I observe among financially distressed firms contradicts labor economics theory predicting that, given a layoff event, firms will sort workers in inverse order of firm-specific human capital and begin laying off at the low end.

Finally, I consider stock market reactions to mass layoff announcements. I find 3-day cumulative abnormal returns to be slightly negative following a mass layoff announcement. In addition, I find a negative relationship between 3-day cumulative abnormal returns and the degree of human capital laid off. These results indicate that valuations decline upon destruction of the value created in worker-employer relationships, and that the decline is particularly pronounced for high human capital relationships.

My results contribute to the literature in a number of ways. My results point to the importance of maturity structure for flexible maintenance of labor. This highlights the extra attention firm managers should pay to the maturity profile of their firms' debt. Second, my results provide

evidence that the 2007 credit crisis had significant real effects on labor decisions in 2008. Third, I present new evidence on human capital choices within layoff instances, which underscores the attention that firm managers should pay to the cost and contribution of each occupation, both in the near and long terms. Broadly, my findings suggest that financing constraints have a significant impact on firm-level employment outcomes and, in particular, on the type of human capital dismissed in layoffs induced by financial constraint.

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Appendix

Table A.1: Computat Sample Selection

The sample consists of all firms in the Compustat Annual and Quarterly Fundamentals Files in 2007. Following Almeida et al. (2012) as well as Almeida, Compello and Weisback (2004) and Frank and Goyal (2003) before them, I apply the following screens. Additionally, I remove small firms (those with fewer than 500 employees), following Benmelech, Bergman and Seru (2011). This reduces an inital sample of 9,395 firms with Compustat data to a final sample of 844 firms with Compustat data.

Number of firms in fiscal year 2007	9,395
Drop firms with:	
SIC 6000s	-2,008
SIC 8000s	-191
SIC 9000s	-28
Total employees < 500	-3,456
Total assets < $100 million	-90
Negative sales	-1
Missing sales	-410
Cash greater than assets	0
PPE greater than assets	-1
Total debt (DD1+DLTT) greater than assets	-95
Missing DD1 or missing DLTT	-1
Notes payable over assets > 1%	-842
DLTT < (DD2+DD3+DD4+DD5)	-524
Fiscal year end months 2, 3, 4, 5, 6, 7, 8	-278
DLTT / assets > 5%	-469
Missing outcome and control variables	-157
Number of firms after sample selection screens	844

Variable Construction

This section documents the definitions of the variables used in the empirical analysis. Variable names in parentheses are from the Compustat Annual Fundamental files, unless noted.

Market-to-book: total book value of assets (AT) plus the market value of equity (AT+CSHO*PRCC_F) minus the book value of equity deferred taxes (CEQ+TXDB), all over total assets (AT*0.9) plus the market value of assets (MKVALT*0.1)

Long-term leverage: total debt (DLTT+DLC+DCLO) divided by total assets (AT)

Profitability: EBITDA (OIBDP) divided by beginning-of-period total assets (AT)

Interest coverage: operating income before depreciation (OIBDP) divided by interest and related expenses (XINT)

Cash flow: net income (IB) plus depreciation and amortization (DP) over the lag of property, plant and equipment (PPENT)

Cash balance: the ratio of cash and short-term investments (CHE) to total assets (AT)

Dividends: common dividend (DVC) plus preferred dividend (DVP) over lagged total assets (AT)

KZ Index: index of financial constraint, calculated following Lamont, Polk, and Saa-Requejo (2001) as follows:

$$KZ\ Index(t) = -1.002 * Cash\ Flow(t) + 0.283 * Market - to - Book(t) + 3.139 * Debt\ Portion(t) - 39.368 * Dividends(t) - 1.315 * Cash\ Balance(t)$$

Investment: capital expenditures (CAPX) divided by the lag of property, plant and equipment (PPENT)

% Δ investment: percentage change in investment from $t-1$ to t

% Δ employment: percentage change in the number of employees (EMP) from $t-1$ to t

% Δ capital expenditure: percentage change in capital expenditure (CAPX) from $t-1$ to t

Figures and Tables

Figure 1: Geographic Dispersion of Mass Layoffs in California, 2006-2011

Figure 2: Number of Workers Affected by Mass Layoffs in California

The figure below shows layoff instances in California between 2006 and 2011. Each point represents a layoff event, with the y-axis indicating the number of employees affected.

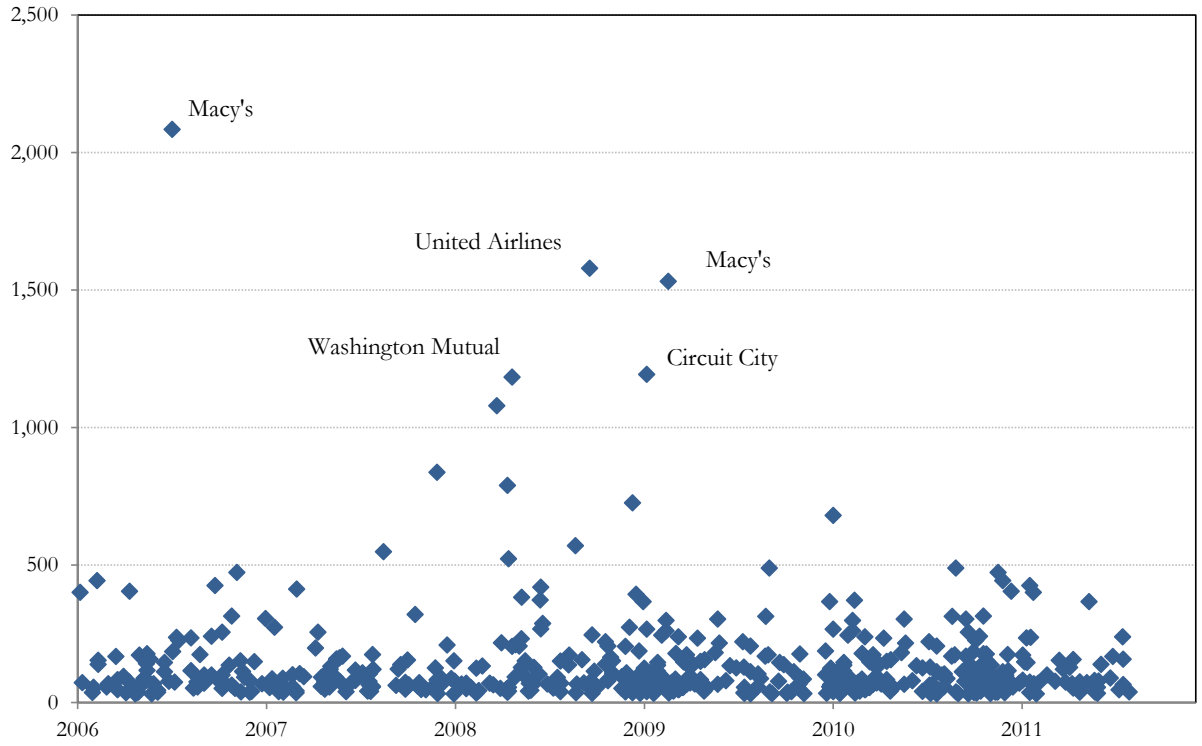

Table 1: Layoff Firms by Industry

Fama-French 12 Industry Classifications	# Firms
Finance	357
Business Equipment	165
Other	145
Healthcare, Medical Equipment, and Drugs	136
Wholesale, Retail	111
Manufacturing	107
Utilities	60
Consumer Non-Durables	58
Telephone and Television	45
Oil, Gas, and Coal Extraction and Products	36
Consumer Durables	29
Chemicals and Allied Products	26
	1,274

Table 2: Layoffs by Employers Having Laid Off the Most Workers

Company	# of Employees Affected	Company	# of Employees Affected
Macy's	3,554	JC Penney	337
United Airlines	2,095	Owens Corning	328
Circuit City	1,526	Medtronic	323
General Electric	1,319	Conagra Foods	322
Intel	1,292	Marriot	311
Target	1,161	Siemens	311
Washington Mutual	1,153	Cardinal Health	291
Boeing	1,069	TTM Technologies	283
Applebee's	1,049	Cisco Systems	275
American Airlines	971	Zebra Technologies	268
AT&T	949	Adobe Systems	263
Abbott Vascular	867	Smurfit Stone	261
KLA Tencor	770	Electronic Arts	255
Fleetwood	729	Quiksilver	244
Citigroup	678	Xyratex International	243
Intuit	638	Callaway Golf	240
Lockheed Martin	489	Hewlett Packard	237
Oracle	413	Albertson's	231
Technicolor Home Entertainment	402	Northrop Grunman	230
Wells Fargo	376	JP Morgan Chase	230

Table 3: Measures of the Human Capital of Laid Off Workers

This table summarizes the human capital of workers laid off in mass layoff instances in California between 2006 and 2011 using the following four proxies available from the BLS: annual average salary by occupation, estimated educational attainment by occupation, recommended related work experience and estimated on-the-job training. A total of 260,100 workers were affected in mass layoffs over this period. The panels of the table shows the distribution of layoffs by proxy.

Average Annual Salary	# Laid Off	% of Layoffs
> $150,000	24,267	9%
$125,000 - $150,000	19,097	7%
$100,000 - $125,000	19,305	7%
$75,000 - $100,000	63,956	25%
$50,000 - $75,000	54,959	21%
$25,000 - $50,000	29,557	11%
< $25,000	48,959	19%
Total	260,100	

Educational Attainment	# Laid Off	% of Total Laid Off
Doctoral/Professional Degree	4,446	2%
Master's Degree	16,065	6%
Bachelor's Degree	50,124	19%
Associate's Degree	24,650	9%
Post-Secondary Vocational Award	13,305	5%
Some College	41,810	16%
High School	52,628	20%
Less than High School	57,072	22%
Total	260,100	

Related Work Experience	# Laid Off	% of Total Laid Off
> 5 Years	66,843	26%
1-5 Years	103,550	40%
< 1 Year	35,067	13%
None	54,640	21%
Total	260,100	

On-the-Job Training	# Laid Off	% of Total Laid Off
> 1 year	61,126	24%
1-12 Months	101,179	39%
< 1 Month	42,193	16%
None	55,601	21%
Total	260,100	

Table 4: A Comparison of Financially Constrained and Unconstrained Firm Characteristics Using a Matching Methodology

This table compares financially constrained and unconstrained groups (in the full sample and in the matched sample) across several dimensions at the end of 2007. Financially constrained firms are defined as those for which the percentage of long-term debt maturing within one year (DD1/DLTT) is greater than 20 percent; unconstrained firms are those for which this percentage is less than or equal to 20 percent. The set of unconstrained firms in the matched sample is a subset of unconstrained firms in the full sample. To construct it, I match unconstrained firms to constrained firms using the following set of firm characteristics: size (log of total assets), market-to-book, cash flow, cash balance, long-term debt normalized by assets and Fama-French 12 industry indicators. The overall sample consists of 844 firms. The treated sample consists of 119, the non-treated of 725, and the control sample of 119 firms using one-to-one matching. See Appendix for variable definitions.

	Financially	Full Sample		Matched Sample	
	Constrained	Unconstrained	Difference	Unconstrained	Difference
Total Assets ($mm)	$2,694	$10,438	-$7,744 ***	$2,577	$117
Total Revenue ($mm)	$251	$1,156	-$905 ***	$272	-$21
Total Employees	1,363	4,805	-3,442 ***	1,442	-79
Long-Term Leverage	$774	$3,712	-$2,938 ***	$548	$226
Profitability	0.029	0.026	0.003	0.024	0.005
Interest Coverage	21.257	5.000	4.421 ***	4.842	16.415
Kaplan-Zingales Index	1.277	0.877	0.400 **	1.540	-0.264
Market-to-Book	2.694	2.499	0.195 **	2.587	0.107
Cash Flow	0.128	0.088	0.039 ***	0.120	0.008
Cash Balance	0.150	0.103	0.047 *	0.132	0.019
Dividends	0.008	0.011	-0.003	0.013	-0.004
Debt Portion	0.370	0.484	-0.114 ***	0.320	0.050
% Changes					
Investment	-16.55%	5.59%	-22.14%	21.51%	-38.06%
Employment	7.36%	5.36%	2.00%	2.73%	4.64%
Capital Expenditure	27.76%	14.27%	13.485% ***	19.77%	7.98%
Number of Firms	119	725		119	

Table 5: Difference-in-Difference Comparisons of Total Employment Before and After the Onset of the 2007 Credit Crisis

This table reports evidence on how total firm employment was affected by the fall 2007 credit crisis. Firms with a large portion of long-term debt maturing right after the third quarter of 2007 (financially constrained firms) reduced annual employment by 5.07% more than otherwise similar firms whose debt was scheduled to mature after 2008 (unconstrained firms). Panel A compares changes in total employment between 2006 and 2007 to changes in total employment between 2007 and 2008. The financially constrained set is defined as firms with at least 20% of long-term debt maturing in 2008 (with the onset of the financial crisis), while the unconstrained set is defined as those with less than or equal to 20% of long-term debt maturing in that period. There are 119 financially constrained firms and 119 unconstrained firms. The set of unconstrained firms is constructed by matching on Q, cash flow, size, cash holdings, long-term debt normalized by assets, SIC 12 industry classifications and credit rating category. Panel B compares annual changes in total employment between non-crisis years. Heteroskedasticity-consistent standard errors are in parentheses.

Panel A: Percentage Changes in Total Annual Employment Before and After the Fall 2007 Credit Crisis

	Constrained	Unconstrained	Difference (Constrained - Unconstrained)
2007-2006	7.03% ***	6.45% ***	0.49%
	(0.03)	(0.02)	(0.04)
2008-2007	-1.23% ***	3.08% ***	-4.31% ***
	(0.00)	(0.00)	(0.01)
Difference (2008/07 - 2007/06)	-8.27% ***	-3.37%	-4.90% ***
	(0.02)	(0.03)	(0.02)
Matching Estimator (ATT)			-5.07% ***
			(0.03)

Panel B: Placebo Tests	Difference in Employment Changes Between Financially Constrained and	Matching Estimator (ATT)
2002/01 - 2001/00	0.28%	0.33%
	(0.03)	(0.03)
2003/02 - 2002/01	0.21%	0.30%
	(0.02)	(0.02)
2004/03 - 2003/02	0.28%	0.30%
	(0.03)	(0.04)
2005/04 - 2004/03	0.61%	0.60%
	(0.04)	(0.03)
2006/05 - 2005/04	0.38%	0.39%
	(0.02)	(0.03)
2007/06 - 2006/05	0.45%	0.48%
	(0.04)	(0.04)
2008/07 - 2007/06	-3.80% ***	-4.07% ***
	(0.04)	(0.04)

Table 6: Difference-in-Difference Comparisons of Mass Layoff Propensity Before and After the Onset of the 2007 Credit Crisis

This table reports evidence on the likelihood of a mass layoff among financially constrained and unconstrained firms in the fall 2007 credit crisis. Firms with a large portion of long-term debt maturing right after the third quarter of 2007 (financially constrained firms) were 6.9% more likely to make a mass layoff than otherwise similar firms whose debt was scheduled to mature after 2008 (financially unconstrained firms). There is no significant difference in the mass layoff propensities of financially constrained and unconstrained firms in the years following 2008. The table presents the likelihood of a mass layoff in percentage points. Panel A compares the likelihood between 2006 and 2007 to the likelihood between 2007 and 2008. The financially constrained set is defined as firms with at least 20% of long-term debt maturing in 2008 (with the onset of the financial crisis), while the unconstrained set is defined as those with less than or equal to 20% of long-term debt maturiting. There are 119 financially constrained firms and 119 financially unconstrained firms. The set of unconstrained firms is constructed by propensity score matching on the following firm characteristics: Q, cash flow, size, cash holdings, long-term debt normalized by assets, SIC 12 industry classifications and credit rating category. As a placebo test, Panel B compares the mass layoff propensities across years following 2008. The only significant difference in mass layoff propensities among financially constrained and unconstrained firms occured between 2007 and 2008. Heteroskedasticity-consistent standard errors are in parentheses.

Panel A: Propensity for Mass Layoffs Before and After the Fall 2007 Credit Crisis

	Constrained	Unconstrained	Difference (Constrained - Unconstrained)
2007	1.69% ***	1.69% ***	0.00%
	(0.003)	(0.002)	(0.002)
2008	8.46% ***	1.97% ***	6.49% ***
	(0.006)	(0.002)	(0.007)
Difference (2008 - 2007)	6.77% ***	0.27%	6.50% ***
	(0.005)	(0.002)	(0.006)
Matching Estimator (ATT)			6.89% ***
			(0.007)

Panel B: Placebo Tests	Difference in the Propensity for Mass Layoffs Between Financially	Matching Estimator (ATT)
2008 - 2007	6.50% ***	6.89% ***
	(0.006)	(0.007)
2009 - 2008	0.34%	0.36%
	(0.002)	(0.002)
2010 - 2009	0.27%	0.31%
	(0.003)	(0.004)
2011 - 2010	0.11%	0.13%
	(0.004)	(0.004)

Table 7: Difference-in-Difference Comparisons of the Annual Salaries of Workers Affected by Mass Layoffs

This table reports evidence on the salaries of workers affected by mass layoff events in the fall 2007 credit crisis. Firms with a large portion of long-term debt maturing right after the third quarter of 2007 (financially constrained firms) laid off workers with higher average annual salaries of $12,617 compared to otherwise similar firms whose debt was scheduled to mature after 2008 (financially unconstrained firms). There is no significant difference in the salaries of laid off workers between financially constrained and unconstrained firms across non-crisis years. The table presents the average annual salaries of laid off workers in dollars. Panel A compares the salaries in 2007 to the salaries in 2008. The financially constrained set is defined as firms with at least 20% of long-term debt maturing in 2008 (with the onset of the financial crisis), while the unconstrained set is defined as those with less than or equal to 20% of long-term debt maturiting in that period. There are 68 financially constrained firms and 68 financially unconstrained firms. The set of unconstrained firms is constructed by matching on the following set of firm characteristics: Q, cash flow, size, cash holdings, long-term debt normalized by assets, SIC 12 industry classifications and credit rating category. As a placebo test, Panel B compares annual average salaries of laid off workers for the years that follow. The only significant salary difference of laid off workers between financially constrained firms above financially unconstrained firms occured between 2007 and 2008. Heteroskedasticity-consistent standard errors are in parentheses.

Panel A: Propensity for Mass Layoffs Before and After the Fall 2007 Credit Crisis

	Constrained	Unconstrained	Difference (Constrained - Unconstrained)
2007	$64,151 ***	$63,357 ***	$794
	($3,705)	($3,354)	($487)
2008	$77,326 ***	$64,488 ***	$12,838 ***
	($3,893)	($3,875)	($572)
Difference (2008 - 2007)	$13,175 ***	$1,131	$12,044 ***
	($878)	($675)	($633)
Matching Estimator (ATT)			$12,617 ***
			($714)

Panel B: Placebo Tests	Difference in Salaries of Laid Off Workers Between Financially Constrained and Unconstrained Firms	Matching Estimator (ATT)
2008 - 2007	$12,044 ***	$12,617 ***
	($633)	($714)
2009 - 2008	$1,094	$1,102
	($669)	($714)
2010 - 2009	$955	$967
	($713)	($722)
2011 - 2010	$728	$773
	($624)	($660)

Table 8: Difference-in-Difference Comparisons of the Education Levels of Workers Affected by Mass Layoffs

This table reports evidence on the education levels of workers affected by mass layoff events in the fall 2007 credit crisis. Firms with a large portion of long-term debt maturing right after the third quarter of 2007 (financially constrained firms) laid off a greater portion of highly educated workers compared to otherwise similar firms whose debt was scheduled to mature after 2008 (financially unconstrained firms). The table summarizes indicator variables representing the fraction of mass layoffs that affected workers with higher education. Panel A compares the fraction of highly educated workers affected by mass layoffs in 2007 to that in 2008. The financially constrained set is defined as firms with at least 20% of long-term debt maturing in 2008 (with the onset of the financial crisis), while the unconstrained set is defined as those with less than or equal to 20% of long-term debt maturiting in that period. There are 68 financially constrained firms and 68 financially unconstrained firms. The set of unconstrained firms is constructed by matching on Q, cash flow, size, cash holdings, long-term debt normalized by assets, SIC 12 industry classifications and credit rating category. As a placebo test, Panel B compares the fraction of highly educated workers affected by mass layoffs for the years that follow. The only significant difference between financially constrained firms above financially unconstrained firms occured between 2007 and 2008. Heteroskedasticity-consistent standard errors are in parentheses.

Panel A: Fraction of Employees with Higher Education Affected in Mass Layoffs

	Constrained	Unconstrained	Difference (Constrained - Unconstrained)
2007	10.15% ***	9.82% ***	0.33%
	(0.034)	(0.032)	(0.003)
2008	38.27% ***	10.04% ***	28.23% ***
	(0.032)	(0.020)	(0.027)
Difference (2008 - 2007)	28.12% ***	0.22%	27.90% ***
	(0.025)	(0.002)	(0.076)
Matching Estimator (ATT)			28.25% ***
			(0.060)

Panel B: Placebo Tests	Difference in the Fraction of Higher Education Mass Layoffs Between Financially Constrained and Unconstrained Firms	Matching Estimator (ATT)
2008 - 2007	27.90% ***	28.25% ***
	(0.076)	(0.060)
2009 - 2008	3.99%	4.05%
	(0.069)	(0.072)
2010 - 2009	3.46%	3.58%
	(0.062)	(0.065)
2011 - 2010	5.62%	4.77%
	(0.066)	(0.075)

Table 9: Difference-in-Difference Comparisons of Work Experience of Workers Affected by Mass Layoffs

This table reports evidence on the work experience of workers affected by mass layoff events in the fall 2007 credit crisis. Firms with a large portion of long-term debt maturing right after the third quarter of 2007 (financially constrained firms) laid off workers with greater work experience compared to otherwise similar firms whose debt was scheduled to mature after 2008 (financially unconstrained firms). The table summarizes indicator variables representing the fraction of mass layoffs that affected workers with at least five years of work experience. Panel A compares the fraction of workers with high work experience affected by mass layoffs in 2007 to that in 2008. The financially constrained set is defined as firms with at least 20% of long-term debt maturing in 2008 (with the onset of the financial crisis), while the unconstrained set is defined as those with less than or equal to 20% of long-term debt maturiting in that period. There are 68 financially constrained firms and 68 financially unconstrained firms. The set of unconstrained firms is constructed by matching on Q, cash flow, size, cash holdings, long-term debt normalized by assets, SIC 12 industry classifications and credit rating category. As a placebo test, Panel B compares the fraction of high work experience mass layoffs for the years that follow. The only significant difference between financially constrained firms above financially unconstrained firms occured between 2007 and 2008. Heteroskedasticity-consistent standard errors are in parentheses.

Panel A: Fraction of High Work Experience Employees Affected in Mass Layoffs

	Constrained	Unconstrained	Difference (Constrained - Unconstrained)
2007	7.25% ***	7.03% ***	0.22%
	(0.024)	(0.023)	(0.002)
2008	35.61% ***	8.72% ***	26.89% ***
	(0.030)	(0.017)	(0.026)
Difference (2008 - 2007)	28.36% ***	1.69%	26.67% ***
	(0.025)	(0.015)	(0.073)
Matching Estimator (ATT)			26.14% ***
			(0.049)

Panel B: Placebo Tests	Difference in the Fraction of High Work Experience Mass Layoffs Between Financially Constrained and Unconstrained Firms	Matching Estimator (ATT)
2008 - 2007	26.67% ***	26.14% ***
	(0.073)	(0.049)
2009 - 2008	5.21%	4.94%
	(0.068)	(0.065)
2010 - 2009	5.09%	4.88%
	(0.065)	(0.055)
2011 - 2010	5.13%	4.89%
	(0.052)	(0.052)

Table 10: Difference-in-Difference Comparisons of On-the-Job Training of Workers Affected by Mass Layoffs

This table reports evidence on the levels of on-the-job training of workers affected by mass layoff events in the fall 2007 credit crisis. Firms with a large portion of long-term debt maturing right after the third quarter of 2007 (financially constrained firms) laid off workers with greater levels of on-the-job training compared to otherwise similar firms whose debt was scheduled to mature after 2008 (unconstrained firms). The table summarizes indicator variables representing the fraction of mass layoffs that affected workers with at least one year of on-the-job training. Panel A compares the fraction of workers with high on-the-job training affected by mass layoffs in 2007 to that in 2008. The financially constrained set is defined as firms with at least 20% of long-term debt maturing in 2008 (with the onset of the financial crisis), while the unconstrained set is defined as those with less than or equal to 20% of long-term debt maturiting in that period. There are 68 financially constrained firms and 68 financially unconstrained firms. The set of unconstrained firms is constructed by matching on Q, cash flow, size, cash holdings, long-term debt normalized by assets, SIC 12 industry classifications and credit rating category. As a placebo test, Panel B compares the fraction of high on-the-job training mass layoffs for the years that follow. The only significant difference between financially constrained firms above financially unconstrained firms occured between 2007 and 2008. Heteroskedasticity-consistent standard errors are in parentheses.

Panel A: Fraction of High On-the-Job Training Employees Affected in Mass Layoffs

	Constrained	Unconstrained	Difference (Constrained - Unconstrained)
2007	22.45% ***	20.74% ***	1.71%
	(0.076)	(0.068)	(0.017)
2008	45.80% ***	24.55% ***	21.25% ***
	(0.038)	(0.049)	(0.020)
Difference (2008 - 2007)	23.35% ***	3.81%	19.54% ***
	(0.021)	(0.033)	(0.054)
Matching Estimator (ATT)			21.17% ***
			(0.054)

Panel B: Placebo Tests	Difference in the Fraction of High On-the-Job Mass Layoffs Between Financially Constrained and Unconstrained Firms	Matching Estimator (ATT)
2008 - 2007	19.54% ***	21.17% ***
	(0.054)	(0.054)
2009 - 2008	3.36%	3.87%
	(0.058)	(0.063)
2010 - 2009	4.13%	4.39%
	(0.067)	(0.066)
2011 - 2010	4.22%	4.40%
	(0.075)	(0.077)

Table 11: The Relationship Between the Number of Layoff Instances and the Degree of Human Capital Laid Off

This tables presents evidence on the relationship between the number of layoff instances within firms and the degree of human capital laid off. I split the set of firms having made at least one mass layoff into two groups: firms with KZ Index values in the bottom quartile (financially healthy) and firms with KZ Index values in the top quartile (financially distressed firms). The number of layoff instances varies from one to eight in the period between 2006 and 2011. The average annual salary is the weighted average salary of workers laid off in a given layoff instance. I find the degree of human capital laid off to be positively related to the number of layoff instances among financially health firms, but negatively related to the number of layoff instances among financially distressed firms. I include industry and firm fixed effects. Robust standard errors in parentheses.

	Average Annual Salary of Workers Laid Off By Financially Healthy Firms	Average Annual Salary of Workers Laid Off By Distressed Firms
Total Employment	-0.104	0.167
	(0.100)	(0.191)
Q	-0.158 **	-0.097 **
	(0.061)	(0.048)
# of Layoff Instances	0.660 ***	-0.823 ***
	(0.233)	(0.243)
Constant	0.474 ***	-0.542 ***
	(0.104)	(0.163)
R-Squared	0.17	0.21
Adjusted R-Squared	0.11	0.16
Fixed Effects		
Fama-French SIC-12 Industry	Yes	Yes
Year	Yes	Yes
Number of Observations	206	206

Table 12: Stock Market Reactions Following Mass Layoff Announcements

This table reports coefficient estimates for regressions on cumulative abnormal returns in the [-3, +3] day window surrounding mass layoff announcements. Announcemnt dates are the dates which firms reported as layoff notice dates in the WARN data and then adjusted by hand after looking up the first occurence of the layoff news in Factset media sources. Robust standard errors in parentheses.

	3-day Cumulative Abnormal Return	3-day Cumulative Abnormal Return
Log of Average Annual Salary	-5.38% ***	-5.23% ***
	(0.004)	(0.004)
Higher Education Dummy	-1.24% **	-1.11% **
	(0.007)	(0.005)
Work Experience Dummy	-1.94% **	-1.75% ***
	(0.004)	(0.003)
On-the-Job Training Dummy	-1.74% ***	-1.75% ***
	(0.003)	(0.003)
Fraction of Total Employment Affected		-2.18% ***
		(0.004)
R-Squared	0.090	0.137
Year Fixed Effects	Yes	Yes
Number of Observations	802	802