NBER WORKING PAPER SERIES

LAYOFFS, LEMONS, RACE, AND GENDER

Luojia Hu
Christopher Taber

Working Paper 11481
http://www.nber.org/papers/w11481

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
June 2005

We thank Joe Altonji, Gadi Barlevy, Hank Farber, Bruce Meyer, Espen Moen and seminar participants at the Chicago Federal Reserve Bank for helpful comments. All errors remain our own. The views expressed herein are those of the author(s) and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 11481
July 2005
JEL No. J6, J7

ABSTRACT

This paper expands on Gibbons and Katz (1991) by looking at how the difference in wage losses across plant closing and layoff varies with race and gender. We find that the difference between white males and other groups are striking and complex. The lemons effect of layoffs for white males as in Gibbons and Katz, but not for the other three demographic groups (white females, black females, and black males). These three all experience a greater decline in earnings at plant closings than at layoffs. This result form two reinforcing effects. First, plant closings have substantially more negative effects on minorities than on whites. Second, layoffs seem to have more negative consequences for white men than the other groups. We also find that the relative wage losses of blacks following layoffs increased after the Civil Rights Act of 1991 which we take as suggestive of an informational effect of layoffs as in Gibbons and Katz. The results are suggestive that the large losses that African Americans experience at plant closing could result from heterogeneity in taste discrimination across firms.

Luojia Hu
Department of Economics
Northwestern University
2003 Sheridan Road
Evanston, IL 60208-2600
luojiahu@northwestern.edu

Christopher Taber
Department of Economics
Northwestern University
2003 Sheridan Road
Evanston, IL 60208-2600
and NBER
ctaber@northwestern.edu

1 Introduction

The role of asymmetric information in labor market outcomes has long been of interest to labor economists (e.g. Akerlof, 1976, Spence, 1973 and Greenwald, 1986). Empirical studies on this topic, however, have been scarce. In a seminal paper, Gibbons and Katz (1991; hereafter GK) construct a model of asymmetric information in the labor market. They use their model to argue that if firms have discretion as to which workers to lay off, a layoff provides a signal to the outside market that a worker is of low quality. In contrast, virtually all workers lose their jobs when their plant closes so it does not provide a negative signal. GK test for asymmetric information by looking at changes in wages for white collar workers.[1] Since a layoff provides a negative signal about ability, one would expect wages to fall more following a layoff than for a plant closing. They confirm this prediction in the data showing that wage penalties are substantially higher for layoffs than for plant closings.

In this paper, we take advantage of the fact that we have many more years of displaced workers data to expand on GK by looking at how the difference in wage losses across plant closing and layoff varies with race and gender. Statistical discrimination against African Americans or women occurs when employers use race and gender as a predictor for productivity.[2] If this is the case, then one would expect the information contained in a layoff to vary across racial and gender groups. Empirically, we find that the differences between white males and the other groups are striking and complex. We show that the relative wage loss at layoff is substantially larger for white males than for the other groups. This is consistent with the GK model if being laid off is a relatively more negative signal for white males than for other demographic groups – a result that seems quite likely. However, interpretation of our results is not quite this straightforward. In fact, we find that this result is driven by the fact that for three of our four demographic groups (white females, black females, and black males) workers actually experience a greater decline in earnings at plant closings than

[1] They use white collar workers because they argue that blue-collar jobs are much more likely to be covered by collective bargaining agreements. In that case seniority is typically the main determinant of lay off decisions so that a layoff will not necessarily convey negative information.

[2] The theory of statistical discrimination was introduced by Phelps (1972) and Arrow (1973) and subsequently developed by, among others, Aigner and Cain (1977), Lundberg and Startz (1983), and Coate and Loury (1993). Empirical studies of statistical discrimination are still scarce. A notable exception is Altonji and Pierret (2001). Altonji and Blank (1999) presents a survey on this topic.

at layoffs. This means that the simple GK prediction holds for only one of the four groups. This results from two reinforcing effects. First, that plant closings have substantially more negative effects on minorities than on whites. Second, layoffs seem to have more negative consequences for white men than the other groups.

Does this mean that we should discard the GK model? We think clearly not. However, the simple model is not sufficient to explain all of the data. We propose three different "theories" for these empirical findings. First, in Section 2, we propose a model of heterogenous human capital in which different types of firms hire different types of workers. We model layoffs and plant closings as resulting when shocks hit firms in which they work. Severe shocks lead the plants to cease operation (plant closings) while less severe shocks lead them to reduce the size of their workforce (layoffs). In general plant closings will differ from layoffs, but which effect leads to larger wage declines depends on the correlation structure of the shock across firms. This model is consistent with the data when different demographic groups posses different types of human capital and when shocks affect different types of workers differently. The second possibility is that both asymmetric information and heterogenous human capital are present. On one hand, plant closing can be more devastating than layoff because it is associated with larger negative shock to the human capital of a particular worker. On the other hand, layoff can send a bad signal to the market and thus have additional negative consequences on the worker. If layoff is a substantially more negative signal for white males than for other groups, this could lead the information hit for layoff to dominate for white males while the human capital aspect dominates for the other groups. A third possibility is that the stronger negative consequences of plant closing for minority groups could be explained if some firms discriminate against minorities more than others as in the taste discrimination model of Becker (1971). Minority workers are likely to match with nondiscriminatory firms. As a result, plant closings are likely to have strong negative impacts on these workers. In contrast, if some firms are discriminatory then minorities who experience layoffs may be more likely to be laid off by a discriminatory firm.

Our data is not rich enough to precisely distinguish between these three different hypotheses that have very different interpretations for how one views the labor market. However, we provide some additional evidence that is suggestive that the second two explanations are important. In support of the third explanation we demonstrate that the racial effect at plant closing is surprisingly robust to inclusion of region, industry, and occupation dummies. We argue that this would seem unlikely if heterogeneous human capital were the whole story. To look at asymmetric information we make use of the Civil Rights Act of 1991 which induced employers to layoff "protected" workers in mass layoffs rather than fire them for cause. As a result, layoff should become a relatively more negative signal for blacks after 1991 than prior. Thus, if asymmetric information is important, one would expect the relative wage losses of blacks following layoffs to increase after 1991 which is precisely what we find. So while we can not formally reject the pure heterogenous human capital model, we show that our results are consistent with the view that two sources of discrimination are present, statistical discrimination in the second "theory" and taste discrimination in the third.

The remainder of the paper is organized as follows. Section 2 presents a theoretical framework for heterogenous human capital. Section 3 describes the data. Empirical results are reported in Section 4. Finally, Section 5 discusses the results.

2 Conceptual Framework for Heterogenous Human Capital

As we describe in the introduction, our data are inconsistent with the basic model presented in GK. Our goal in this section is to present an alternative model of plant closings and layoffs which is consistent with the data. The key difference is that we allow for heterogenous human capital. We use the model to show that the relative wage loss associated with plant closings and layoffs depends very much on the underlying source of the shocks and could easily go in either direction. We should point out that we do not view this heterogenous human capital model as a substitute for a model of asymmetric information, but rather as a complement to it. Not only is it feasible that heterogenous human capital and asymmetric information coexist in the labor market, but it is almost obvious that both are present.

We allow for a finite number of different sectors in a particular labor market, $j = 1, ..., J$. Within each sector, many identical firms can potentially enter so the labor market is competitive with free entry. Thus free entry guarantees that for each sector that participates in the market, profit for each firm is zero.

A key to the model is that human capital is heterogeneous. In particular we allow L different types of human capital with $\ell = 1, ..., L$. Assume that production for a firm from sector j depends on the CES production function

$$\left(\sum_{\ell=1}^{L}\alpha_{j\ell t}H_{j\ell t}^{\rho}\right)^{\frac{1}{\rho}}$$

where $H_{j\ell t}$ is the amount of human capital of type ℓ employed by firms of type j at time t. Since the production function is constant returns to scale it is not important to determine relative sizes of firms within a sector. We allow $\alpha_{j\ell t}$ to be zero for some firms and worker types.

In equilibrium there will be a single wage for each type of human capital that clears the market. We define that as $w_{\ell t}$. Since the labor market is competitive, each firm type that participates in the market for workers of type ℓ maximizes profit by setting

$$\left(\sum_{\ell=1}^{L}\alpha_{j\ell t}H_{j\ell t}^{\rho}\right)^{\frac{1}{\rho}-1}\alpha_{j\ell t}H_{j\ell t}^{\rho-1}=w_{\ell t}. \tag{1}$$

Since there is free entry for firms of type j, we know that profit must be zero for each firm of type j who enters the market during time period t. Let P_{jt} be a dummy variable indicating whether firms of type j participate in the market at time t and define $\overline{\ell}_{jt}$ to be some value of ℓ_{jt} for which $\alpha_{j\ell t}>0$. It is straightforward to show that the free market condition implies in equilibrium that

$$\left(\sum_{\ell=1}^{L}\alpha_{j\ell t}\left(\frac{w_{\ell t}\alpha_{\overline{\ell}_{jt}t}}{w_{\overline{\ell}_{jt}t}\alpha_{\ell t}}\right)^{\frac{\rho}{\rho-1}}\right)^{\frac{1}{\rho}}-\sum_{\ell=1}^{L}w_{\ell t}\left(\frac{w_{\ell t}\alpha_{\overline{\ell}_{jt}t}}{w_{\overline{\ell}_{jt}t}\alpha_{\ell t}}\right)^{\frac{1}{\rho-1}} = 0 \text{ for } P_{jt}=1 \tag{2}$$

$$\left(\sum_{\ell=1}^{L}\alpha_{j\ell t}\left(\frac{w_{\ell t}\alpha_{\overline{\ell}_{jt}t}}{w_{\overline{\ell}_{jt}t}\alpha_{\ell t}}\right)^{\frac{\rho}{\rho-1}}\right)^{\frac{1}{\rho}}-\sum_{\ell=1}^{L}w_{\ell t}\left(\frac{w_{\ell t}\alpha_{\overline{\ell}_{jt}t}}{w_{\overline{\ell}_{jt}t}\alpha_{\ell t}}\right)^{\frac{1}{\rho-1}} < 0 \text{ for } P_{jt}=0. \tag{3}$$

Finally we assume that labor of type ℓ is supplied inelastically at level $\overline{H}_{\ell}$. So the labor market clears when for each ℓ,

$$\sum_{j=1}^{J}P_{jt}H_{j\ell t}=\overline{H}_{\ell}. \tag{4}$$

Thus the conditions (1), (2), (3), and (4) characterize the equilibrium. Generally we expect the total number of sectors that participate to be no larger than the number of human capital types (i.e. $\sum_{j=1}^{J}P_{jt}\leq L$).[3]

[3]Generally we expect $\sum_{j=1}^{J}P_{jt}\leq L$ because with L different wages, it is unlikely that profit could be

Our goal is to use this model to understand displacement which occurs when the production parameters ($\alpha_{j\ell t}$) for a sector change over time. A layoff occurs when a sector reacts to the parameter change by laying off some, but not all, of its workers. A plant closing occurs when a sector leaves the market completely. If the decline in productivity occurred to a single firm, no effect would result since no one firm affects the market equilibrium. Thus the interesting case occurs when the productivity shocks are correlated across firms.

We will show that the model does not have strong predictions about the relative wage losses associated with layoffs versus plant closings. They will tend to differ depending on the correlation structure of the productivity shocks. One type of productivity shock occurs when a sector wide shock hits all firms of type j (sector specific shocks). A negative shock of this type will lead the sector to shrink in size. Since sectors will tend to specialize in certain types of workers, workers of this type will be particularly hurt by the shock. If the shock is large enough, the sector will shut down and plants will close. An example of such a shock is a decrease in demand for a good produced by this sector.[4] In this case, workers will tend to be hurt more by plant closings than by layoffs.

As another case, consider technology shocks which are specific to human capital types (factor specific shocks). That is, suppose that for a specific ℓ^*, $\alpha_{j\ell^* t}$ falls for all firms $j = 1, ..., J$. This will tend to lead some firms to lay off workers of type j. These workers will be particularly hurt by the production shock since their value in all sectors fall. An example of this type of shock is a technological discovery that is substitutable with type j workers (such as the improvement of word processing software for typists). Thus the nature of the shock determines which workers are likely to be harmed the most.

As an example consider a plant that manufactures a specific type of car. If the demand for that type of car falls, some of the workers in the plant will be laid off. If demand falls enough, the plant will close. In this case both types of displacement lead to a loss in earnings, but the loss will be greater in the plant closing place because the demand for this type of worker has fallen more severely. By contrast, consider a different type of layoff. Suppose it is initiated not from a change in demand for the product, but rather a technological change

identically zero for more than L types of firms. That is since there are only L variables, it is only by coincidence that equation (2) would hold for more than L sectors. If one type of firm is considerably more productive than the others, it may easily be the case that $\sum_{j=1}^{J} P_{jt} < L$.

[4] Since we are measuring productivity in terms of dollar values, this will show up as a proportional decline of $\alpha_{j\ell t}$ for all ℓ employed in sector j.

in how cars are produced. As a specific example, suppose a technology develops in which all welding can be done by robotics. This would lead the plant to lay off all of its welders (but presumably none of its other workers). This is a potentially much more severe shock to welders. Their value in their current plant has fallen, but if all other automotive plants use the same new technology their value at all other plants has fallen as well and we might see enormous losses for them. To put it in a different way, if most human capital is "occupation specific" and plant closings result from "industry specific" shocks while layoffs tend to result from "occupation specific" shocks then layoffs could have more severe consequences than plant closings. We demonstrate this result with an example.

In order to gain an understanding into the manner in which these effects may operate we present a numerical example with two sectors and two factors (i.e. $J = 2$ and $L = 2$). We then consider the change in equilibrium from an initial period ($t = 0$) to a new equilibrium ($t = 1$). The results of the simulation are presented in Table 1. We consider a version of the model with the elasticity parameter $\rho = 0.5$. For base case take $\alpha_{110} = 0.6$ and $\alpha_{120} = 0.4$ for the first sector. We make the model symmetric by taking $\alpha_{210} = 0.4$ and $\alpha_{220} = 0.6$ for the second. We use unity supply of each type $\overline{H}_1 = \overline{H}_2 = 1$. Solving for the equilibrium one can show that the wages of each type are the same (at level $w_{10} = w_{20} = 0.520$) with sector 1 employing 69.2% of the type one workers and 30.8% of the type two workers. The other sector is symmetric with 30.8% of the type one workers and 69.2% of the type two workers.

As a first simulation we model a "layoff" in which sector 2 is hit by a productivity shock which lowers productivity by 5% for any given set of inputs (i.e. $\alpha_{211} = 0.38$ and $\alpha_{221} = 0.57$). We see that this relatively small shock leads to a large change in employment in which sector 2 goes from employing 50% of the labor force to only 20%. The average wage change for the workers who switch sectors is -0.035 which combines wage gains for the type one workers and considerable wage losses for the type two workers.

To simulate a plant closing, we impose a productivity shock large enough to lead sector two to close (e.g. $\alpha_{211} = \alpha_{221} = 0$, but much less severe shocks can lead the sector to shut down). These results are shown in Table 1 under Simulation 2. As predicted this leads to a more severe fall in wages for the plant closing workers than in the previous simulation.

Finally we simulate a layoff resulting from factor specific shock by keeping the share parameter for factor 1 constant (i.e. $\alpha_{j11} = \alpha_{j10}$), but allowing α_{j21} to fall by 20%. Once again this leads to considerable layoffs of both types of workers from the sector 2 firms.

Wages of type 1 workers do not change,[5] but type two workers experience large wage losses and we see that the average wage loss is large.

In summary, we interpret simulation 2 as representing a plant closing while simulations 1 and 3 represent two different types of layoffs. In one case the wage loss is greater for layoffs than for plant closing while in another case it is smaller, so the model has no strong prediction about the relative size of layoffs versus plant closings.

Again, it is important to point out that we do not view this model as at odds with asymmetric information. One could easily allow for asymmetric information of the form of GK and place it into this model. In that case, one would expect layoff to have an additional negative impact on wages through the lemon effect. One would not see the same effect for plant closings.

3 Data

We use data from the biennial Displaced Workers Surveys (DWSs) Supplement to the Current Population Survey (CPS) between 1984 and 2002. The DWSs were conducted as part of the January CPSs in 1984, 1986, 1988, 1990, 1992 and 2002 and the February CPSs in 1994, 1996, 1998 and 2000. Each of the supplements from 1984-1992 asks workers if they lost a job at any time in the previous 5-year period, and each supplement from 1994-2002 asks this question but for the previous 3-year period.[6] Displacement is defined as involuntary separation based on operating decisions of the employer such as plant closing, employer going out of business, layoff from which the worker was not recalled. Other events including quits and being fired for cause were not considered displacement. Thus, the supplement is designed to focus on the loss of jobs that results from business decisions of firms unrelated to the performance of particular workers. If the response to the job loss question is positive, the respondent is then asked about the reason of job loss: 1) plant closing, 2) slack work, 3) position or shift abolished, 4) seasonal jobs ended, 5) self-employment failed, and 6) other. The data have information on workers' demographics, tenure on pre-displacement job, occupation, industry

[5] The fact that these wages do not change at all comes from our choice of $\rho = 0.5$.

[6] The DWSs ask and collect information on at most one job loss for each individual. If the respondent lost more than one job in the reference period, she/he is asked about information only for the longest job lost.

and weekly earnings, weeks of joblessness after displacement and current weekly earnings.[7]

We restrict the sample to workers aged 20-64 who lost a job in the private sector in the preceding 3-year period due to plant closing, slack work or position or shift abolished, and are reemployed in the private sector at the survey date. We only focus on workers who made full time to full time job transitions (i.e. lost a full-time job and are re-employed on a full-time job).[8] We exclude workers who have re-employment weekly real earnings under $40. Earnings are deflated by the 1982-84=100 consumer price index (CPI). As in GK we distinguish between blue- and white-collar workers. The white collar sample consists of workers with pre-displacement jobs as managers and administrators, professional and technical workers, clerical workers, and sales workers while the blue collar sample consists of workers with pre-displacement jobs as craft and kindred workers, operatives, laborers, transport operatives, or service workers. We exclude workers in agriculture and construction industries.

Descriptive statistics of the sample are reported in Tables 2A and 2B. We divide the data into sixteen different groups, classifying by gender, race, blue/white collar, and layoff/plant closing. Sample means and standard deviations for all of the variables are displayed in the cells.

4 Empirical Analysis

4.1 Basic Results

The main focus of our empirical work is on the wage losses associated with plant closings and layoffs for various demographic groups. To a large extent our main results can all be seen from our summary statistics in Table 2A. Note that we have a much longer history of data than Gibbons and Katz who only used 1984-1986. Since we can now extend the data until 2002, our sample size is large enough to condition on specific demographic groups. The key

[7] In 1994 and later DWSs, individuals who report a job loss for the reasons other than the first three are not asked follow-up questions about the lost job.

[8] We restrict to the sample to full time jobs (at least 35 hours per week) because the DWSs only provided information on usual weekly earnings (and not hourly earnings) and the full/part time status of the worker's old job. By limiting our sample to full time workers we attempt to control for hours of work on the old job.

variable is the change in the logarithm of the real wage which is shown in the third row. First, focusing on white males one can see that the main prediction of the Gibbons and Katz model holds up. White men lose approximately 6% of their wages at plant closings, but this rises to around 10% at layoffs. This can be interpreted as evidence that asymmetric information is important.[9] However, for the other three demographic groups the point estimates actually go in the wrong direction. In particular, for African American males and females the difference is huge with substantially larger wage losses associated with plant closings than with layoffs. Both of these effects are statistically significant.[10] In Table 2B we present results for blue collar workers, and like Gibbons and Katz, we find that wage losses are similar for plant closing as for layoff. This result holds approximately for all four demographic groups.

A key question is why the relative losses at plant closing and layoff vary so much across the demographic groups in Table 2A. Is it because the losses at plant closing are larger, or is it that the losses at layoffs are smaller? To add control variables and formally test for differences, we set up the model in a regression framework. The main results for white collar workers are presented in Table 3A. The key dependent variable is the change in log wages. We regress that variable on black and female dummy variables interacted with layoff and plant closing. Note that this specification is not completely free in that we do not interact race with gender so that the gender effect is constrained to be the same for the two different races.[11] One can see that the results described above depend on differences at both layoff and plant closing. In particular, blacks experience both smaller wage losses at layoff and larger losses at plant closing. However, the plant closing effect seems to be the larger of the two and the layoff effect is not statistically significant at conventional levels. A particularly striking aspect of the results is the robustness of the plant closing/black interaction to inclusion of control variables. In particular it is surprising to us that occupation, industry, and region controls seem to make little difference in the final result. To show that this is not just a result

[9] Krashinsky (2002) provides an alternative explanation and attributes the differences in wage losses between workers displaced by plant closings and layoffs to differences in firm size of pre-displacement employers. He argues that small firms are more likely to close down when facing adverse economic shocks, while larger firms are more likely to reduce their workforce. Therefore laid-off workers tend to lose any wage premium or rents they earned from working at large firms.

[10] The t-stat for men is 1.93 so falls barely below the 5% convention, but is well above the 10% level. For women, the t-stat is well above 1.96.

[11] We do this to increase the precision of the results.

of noisy controls, in Table 4A we run the same regressions using the log of wage levels prior to displacement as the dependent variable. The parameters change substantially as we add more control variables (i.e. looking across columns). In particular the plant closing/black interaction that we focused on in Table 3A falls by over 40%. This strongly suggests that the extra wage loss accompanying plant closing for African American workers is not simply due to differences in the sector of the economy in which they were employed. One explanation for this result is that there is heterogeneity in employer taste discrimination across firms. When a nondiscriminatory plant exits the market, black workers are particularly hurt.

For women the story portrayed in Table 3A is quite different. We see virtually no difference at plant closing between men and women, but women experience much smaller wage declines following a layoff. This can be explained by a model in which in the absence of information, losses at plant closing are larger than for layoff. However, asymmetric information counteracts this effect. It seems quite feasible that the human capital effect could dominate for white women while the lemons effect dominates for men.

In Table 3B we present results for blue collar workers. The interactions are virtually all smaller in absolute value than those in Table 3A, and none of the interactions are statistically significant at conventional levels.

4.2 Extensions

4.2.1 Employment Discrimination Legislation

The GK model assumes that firms maximize profits and rationally decide whom to dismiss. It also assumes that the only way for an employer to dismiss low quality workers is through a layoff. In reality, firms can also let go workers by firing them for cause. It is plausible that firms can fire the lowest quality workers in the initial period, and when facing a shock, lay off the next lowest quality workers in a later period. Non-economic factors, such as concerns about discrimination lawsuits, can lead employers to alter their methods of dismissal. For example, if workers are more likely to sue for wrongful termination when fired than when dismissed as a part of layoff (see for example, Donohue and Siegelman (1993)), then increases in the expected costs to firms should induce substitution toward layoffs and away from individual firings (i.e. lowering cutoff in the initial screen for those who are more likely to sue).

A recent paper by Oyer and Schaefer (2000) tests the hypothesis by exploring the passage of the Civil Rights Act of 1991 (CRA91), which increases the expected costs to firms of displacing "protected" employees (such as blacks and females).[12] Using data from the 1987-1993 SIPP, they find that, relative to whites, rates of overall involuntary job loss (including both layoff and firing) of black men were unaffected by CRA91.[13] However, while black men were significantly more likely to be fired than white men in the pre-CRA91 period, this difference disappeared in the post-CRA91 period. Since we are examining layoffs rather than firings, their results imply that a layoff would become a more negative signal of the productivity of black workers after the CRA91. As a result, we would expect wages to fall more dramatically at layoffs for blacks relative to whites after 1991 than before.[14]

The DWSs data contain information about the year in which workers lost their jobs, by which we divide the sample into two sub-periods: 1981-1991 and 1992-2001. In Table 5 we repeat the specification of Table 3A except we interact all of the main coefficients with a dummy variable for post 1991. The point estimates tell a strong story. That conforms with our prediction if signalling is important. Relative to whites, the wage hit associated with a layoff is substantially larger after 1991. To put it more literally, prior to 1991 whites had much larger wage declines at layoff than blacks, but that difference essentially disappeared after the CRA91. Further evidence that this is not just sporadic comes from examining the other coefficients. None substantially differ before and after the civil rights act. It is important to keep in mind that the confidence interval for the key interaction found in the

[12] While previous federal employment discrimination legislation typically limited plaintiff recovery to lost wages, CRA91 allows employees to sue for intentional gender and race discrimination up to $300,000 in punitive damages; furthermore, CRA91 allows employees to claim unlawful termination on the basis of *race* to sue for unlimited punitive damages. (See Oyer and Schaefer for more details of the law.)

[13] The data used in Oyer and Shaefer (2000) can not separately identify job losses due to plant closing from the other forms of layoffs (selective downsizings such as abolished positions).

[14] There might be other reasons for worrying about changes over time in general. It is widely believed that there has been an increase in the number of layoffs (selective downsizings, in which some workers are discontinued and others stay at the firm), especially from white collar jobs in some large corporations, in the early to mid-1990s. Findings in Farber (1997 and 2003) lead support to this belief. He finds that although the overall involuntary job loss rate did not change substantially from the 1980s to 1990s, there was a decade-long increase in the rate of job loss due to position abolished. If mass layoffs occur increasingly frequently, then the event layoff might become less informative about individual worker's productivity. Therefore we would expect the difference in wage losses between layoffs and plant closings to become smaller over time.

first row of Table 5 is wide. It is significant at the 10% level (or 5% one-sided level) with a large point estimate. At the very least, we find these results highly suggestive that layoff appears to be a relatively more negative signal of quality for African American workers after the CRA91.

4.2.2 Length of Unemployment

Our results to this point have focused only on wages. However, an obvious selection problem arises since we focus only on workers who have been subsequently hired. We are also interested in the overall well being of these individuals which depends not only on the wage impact of displacement, but also the length of the subsequent unemployment spell.

To examine this, we follow GK and use a Weibull proportional hazard model to analyze a sample of first spells of joblessness.[15] The hazard can be specified as

$$\gamma t^{\gamma-1} e^{X_i'\beta}$$

where X_i is observable covariates, t is duration and (γ, β) are parameters. The nice aspect of the Weibull model is that the expected value of the log duration is linear so that if T_i represents the duration of unemployment for individual i,

$$\frac{\partial E(\log(T_i))}{\partial X_i} = -\frac{\beta}{\gamma}.$$

In Table 6 we report estimates of our model using a specification analogous to Table 3. We report the coefficients in terms of change in average log duration $(-\beta/\gamma)$. For clarity, a positive number means that the average unemployment spell would be longer.

The basic results in Table 6 are quite similar to those found in Table 3. First one can see that for white collar workers, layoff is associated with significantly longer unemployment spells, while the results for blue collar workers are mirkier. (In their smaller sample Gibbons

[15] The DWS data contain information about total weeks of joblessness since displacement, and starting 1986, they also provide information on the number of jobs held by a worker since displacement. These two variables allow us to determine the length of the initial spell of joblessness for those employed in their first job at the survey date and the censored length of the initial spell for those who had not worked since displacement. We then construct a sample of first spells of joblessness subject to the following additional restrictions: workers aged 20-64 who were displaced in previous three years from full-time, private sector jobs not in agriculture and construction industries and had weekly wage no less than $40.

and Katz did not find this.) We also again see that plant closing has a much more negative impact on African Americans than on white workers.

Other results are somewhat different in that we find that layoffs are associated with longer unemployment spells for women and blacks than for white males. We do not find this result surprising since the employment effect we are looking at here is about the level while the wage effect in Table 3 is about the change. They do not necessarily contradict each other. Another result that tells a somewhat different story than before is that in Table 3A we found that white males are the only group for which layoff is worse than plant closing. In terms of unemployment spells white women seem to look similar to white men in the sense that unemployment spells are longer following a layoff. For blacks, there is little difference between plant closing and layoff while the wage hit associated with plant closings was much larger than that associated with layoff.

Overall, we view these results as telling a story similar to those in Table 3. Relative to layoffs, plant closings are associated with much longer spells of unemployments for blacks than for whites.

5 Discussion

To summarize our basic results, we find that plant closings have substantially more negative effects on minorities than on whites. In contrast we find that layoffs seem to have more negative consequences for white men than the other groups. For three of our four demographic groups (black men, black women, and white women) we find the opposite of the Gibbons and Katz prediction; plant closings lead to more negative consequences than do layoffs. In this discussion we propose three different "theories" for why this might be true.

1. The first comes directly from our model in Section 2. One possibility is just that different demographic groups possess different quantities of human capital types and that shocks affect different workers differently.

2. The second possibility is to incorporate the Gibbons and Katz asymmetric information into our model of heterogenous human capital. It is quite possible that in the absence of information issues, plant closing is more devastating than lay off because it is associated with a stronger negative shock for the human capital of a particular worker.

At the same time, as a counteracting effect, layoff may reveal lemons so one would expect an additional negative impact for them. Which effect is larger would depend on the relative size of the signal. It seems quite plausible to us that a layoff may be a substantially more negative signal for white males than for the other groups. This could lead the information effect to dominate for white males while the human capital aspect dominates for the other groups which could explain our results.

3. An intriguing aspect of our empirical results is that the negative consequences of plant closing are much worse for African Americans. One explanation for this result is that some firms discriminate against minorities more than others as in Becker (1971). Minority workers would be likely to match with nondiscriminatory firms. The closing of these nondiscriminatory plants is likely to have strong negative consequences for these workers. In contrast, if some firms are discriminatory then minorities who experience layoffs may be more likely to be laid off by a discriminatory firm. If this is the case, one would not expect to see such an effect in layoffs. Incorporating this possibility into our model would be straightforward by allowing different sectors to have different levels of taste discrimination against minority workers.

Our data are not rich enough to precisely distinguish between these three different (but not mutually exclusive) hypotheses that have very different interpretations for how one views the labor market. However, we think our results are suggestive that explanation 2 and 3 are important. In support of explanation 3, we find it striking how little the results are affected by including industry and occupation dummies (Table 3A). If the model in section 2 were correct, one would expect these controls to be very important – and they are when one looks at wage levels (Table 4A).

We think the strongest evidence in favor of asymmetric information can be found in Table 5. Oyer and Schaefer (2000) provide evidence suggesting that the Civil Rights Act of 1991 induced employers to lay off “protected” workers in mass layoffs rather than fire them for cause. As a result, layoff should become a relatively more negative signal for blacks after 1991 than prior. Thus, if asymmetric information is important, one would expect the relative wage losses of blacks following layoffs to increase after 1991 which is precisely what we find.

Ultimately, we find these results interesting and intriguing, but not definitive. We hope that alternative data sources can be found which will shed more light on these important issues.

References

[1] Aigner, Dennis and Glen Cain (1977): "Statistical Discrimination in Labor Markets," *Industrial and Labor Relations Review*, 30, 175-187.

[2] Akerlof, George (1976):"The Economics of Caste and of the Rat Race and Other Woeful Tales," *Quarterly Journal of Economics*, 90, 599-617.

[3] Altonji, Joseph and Rebecca Blank (1999): "Race and Gender in the Labor Market," in Orley Ashenfelter and David Card eds., *Handbook of Labor Economics*, Volume 3C, Chapter 48. Elsevier Science, North-Holland.

[4] Altonji, Joseph and Charles Pierret (2001): "Employer Learning and Statistical Discrimination," *Quarterly Journal of Economics*, 116, 313-350.

[5] Arrows, Kenneth (1973): "The Theory of Discrimination," in *Discrimination in Labor Markets*, ed. by O. Ashenfelter and A. Rees, 3-33. Princeton University Press.

[6] Becker, Gary (1971): *The Economics of Discrimination*, 2nd Edition. The University of Chicago Press.

[7] Coate, Stephen and Glenn Loury (1993): " Will Affirmation-action Policies eliminate Negative Stereotypes?," *American Economic Review*, 83, 1220-1240.

[8] Farber, Henry (1997): "Has the Rate of Job Loss Increased in the Nineties?" *Brookings Papers on Economic Activity: Microeconomics*, 55-128.

[9] Farber, Henry (2003): "Job Loss in the United States, 1981-2001," Working Paper No. 471, Industrial Relations Section, Princeton University.

[10] Gibbons, Robert and Lawrence Katz (1991): "Layoffs and Lemons," *Journal of Labor Economics*, 9, 351-380.

[11] Greenwald, Bruce (1986): "Adverse Selection in the Labor Market," *Review of Economic Studies*, 53, 325-347.

[12] Krashinsky, Harry (2002): "Evidence on Adverse Selection and Establishment Size In the Labor Market," *Industrial and Labor Relations Review*, 56, 84-96.

[13] Lundberg, Shelly and Richard Startz (1983): "Private Discrimination and Social Intervention in Competitive Labor Markets," *American Economic Review*, 73, 340-347.

[14] Oyer, Paul and Scott Schaefer (2000): "Layoff and Litigation," *Rand Journal of Economics*, 31, 345-358.

[15] Phelps, Edmund (1972): " The Statistical Theory of Racism and Sexism," *American Economic Review*, 62, 659-661.

[16] Spence, Michael (1973): "Job Market Signalling," *Quarterly Journal of Economics*, 87, 355-374.

Table 1: Simulation Results

	Base Case	Simulation 1	Simulation 2	Simulation 3
Parameters:				
ρ	0.500	0.500	0.500	0.500
α_{11}	0.600	0.600	0.600	0.600
α_{12}	0.400	0.400	0.400	0.320
α_{21}	0.400	0.380	0.000	0.400
α_{22}	0.600	0.570	0.000	0.480
Results:				
w_1	0.520	0.569	0.600	0.520
w_2	0.520	0.435	0.400	0.333
H_{11}	0.692	0.922	1.000	0.892
H_{12}	0.308	0.700	1.000	0.619
Δwage		-0.035	-0.059	-0.114

Note: This table presents results from simulation of the model outlined in Section 2 of the paper. We first present the basic parameters for the simulations and then show the equilibrium wages and labor force allocation. The last row, Δ wage, presents the average change in wages for the displaced workers from the base case.

Table 2A: DWS 1984-2002
(White Collar)

Descriptive Statistics

	Male White		Male Black		Female White		Female Black	
	Plant Closing	Layoff	Plant Closing	Layoff	Plant Closing	Layoff	Plant Closing	Layoff
Log pre-displacement real wage	6.059 (0.565)	6.126 (0.573)	5.713 (0.467)	5.811 (0.544)	5.664 (0.525)	5.694 (0.544)	5.593 (0.449)	5.526 (0.490)
Log post-displacement real wage	5.981 (0.565)	6.015 (0.572)	5.610 (0.588)	5.810 (0.464)	5.601 (0.496)	5.650 (0.502)	5.462 (0.458)	5.495 (0.444)
Change in log real wage	-0.063 (0.431)	-0.099 (0.448)	-0.108 (0.439)	0.022 (0.420)	-0.049 (0.416)	-0.033 (0.420)	-0.143 (0.385)	-0.023 (0.445)
Tenure on previous job	5.407 (6.948)	4.300 (5.953)	5.747 (7.678)	3.711 (4.858)	4.122 (5.504)	3.571 (5.009)	4.913 (6.152)	3.337 (4.907)
Age	38.69 (10.36)	38.71 (10.32)	36.52 (9.908)	34.69 (8.12)	36.50 (10.52)	37.04 (10.24)	35.42 (9.613)	34.50 (9.63)
Married	0.706 (0.456)	0.701 (0.458)	0.576 (0.497)	0.484 (0.502)	0.522 (0.500)	0.496 (0.500)	0.395 (0.490)	0.388 (0.489)
High school dropout	0.034 (0.182)	0.023 (0.149)	0.065 (0.248)	0.033 (0.180)	0.037 (0.188)	0.019 (0.137)	0.043 (0.204)	0.036 (0.188)
High school graduate	0.268 (0.443)	0.210 (0.407)	0.348 (0.479)	0.231 (0.424)	0.400 (0.490)	0.326 (0.469)	0.333 (0.473)	0.248 (0.433)
Some College	0.302 (0.459)	0.295 (0.456)	0.348 (0.479)	0.341 (0.477)	0.353 (0.478)	0.362 (0.481)	0.500 (0.502)	0.521 (0.501)
College graduate or above	0.396 (0.489)	0.473 (0.499)	0.239 (0.429)	0.396 (0.492)	0.210 (0.408)	0.293 (0.455)	0.123 (0.330)	0.194 (0.397)
No. obs	1,670	2,170	92	91	1,741	1,841	162	165

Sample selections: (1) White collar workers aged 20-64; (2) lost job for 3 reasons: plant closing, position abolished or slack work; (3) lost a job in previous 3 years; (4) re-employed at survey date; (5) full time to full time transition; (6) private sector to private sector; (7) delete if re-employment weekly wage<$40; (8) delete agriculture and construction.
Note: Standard deviations are in parentheses.

Table 2B: DWS 1984-2002
(Blue Collar)

Descriptive Statistics

	Male White		Male Black		Female White		Female Black	
	Plant Closing	Layoff	Plant Closing	Layoff	Plant Closing	Layoff	Plant Closing	Layoff
Log pre-displacement real wage	5.727 (0.517)	5.679 (0.525)	5.560 (0.506)	5.486 (0.433)	5.288 (0.443)	5.323 (0.447)	5.215 (0.373)	5.252 (0.467)
Log post-displacement real wage	5.646 (0.480)	5.603 (0.486)	5.470 (0.482)	5.416 (0.424)	5.231 (0.428)	5.255 (0.396)	5.107 (0.418)	5.120 (0.450)
Change in log real wage	-0.089 (0.457)	-0.082 (0.478)	-0.072 (0.450)	-0.067 (0.416)	-0.068 (0.427)	-0.075 (0.412)	-0.099 (0.359)	-0.143 (0.406)
Tenure on previous job	5.500 (6.997)	3.375 (5.180)	5.916 (7.563)	3.212 (5.011)	4.744 (6.023)	2.905 (4.591)	6.629 (7.380)	3.037 (4.567)
Age	36.32 (10.73)	34.55 (10.25)	35.70 (9.89)	33.76 (9.82)	38.18 (10.94)	35.95 (10.91)	38.01 (10.07)	34.03 (8.81)
Married	0.705 (0.456)	0.659 (0.474)	0.573 (0.496)	0.438 (0.497)	0.536 (0.499)	0.485 (0.500)	0.331 (0.472)	0.309 (0.464)
High school dropout	0.207 (0.405)	0.176 (0.381)	0.228 (0.421)	0.179 (0.384)	0.273 (0.446)	0.174 (0.380)	0.296 (0.458)	0.236 (0.427)
High school graduate	0.520 (0.500)	0.529 (0.499)	0.515 (0.501)	0.502 (0.501)	0.515 (0.500)	0.563 (0.496)	0.542 (0.500)	0.482 (0.502)
Some College	0.229 (0.420)	0.236 (0.425)	0.218 (0.414)	0.279 (0.449)	0.172 (0.377)	0.205 (0.404)	0.162 (0.370)	0.273 (0.447)
College graduate or above	0.044 (0.205)	0.058 (0.235)	0.038 (0.194)	0.040 (0.196)	0.041 (0.198)	0.057 (0.232)	0.000 (0.000)	0.009 (0.095)
No. obs	2,108	2,515	206	201	763	682	142	110

Sample selections: (1) Blue collar workers aged 20-64; (2) lost job for 3 reasons: plant closing, position abolished or slack work; (3) lost a job in previous 3 years; (4) re-employed at survey date; (5) full time to full time transition; (6) private sector to private sector; (7) delete if re-employment weekly wage<$40; (8) delete agriculture and construction.
Note: Standard deviations are in parentheses.

Table 3A: DWS 1984-2002
(White Collar)

Dep Var: *Change* in Log wage

	(1)	(2)	(3)	(4)
Layoff*Black	0.052	0.029	0.028	0.031
	(0.030)	(0.029)	(0.029)	(0.029)
Layoff*Female	0.059	0.053	0.050	0.054
	(0.014)	(0.014)	(0.014)	(0.014)
Layoff	-0.034	-0.049	-0.046	-0.050
	(0.015)	(0.015)	(0.015)	(0.015)
Plant Closing*Black	-0.075	-0.080	-0.077	-0.080
	(0.031)	(0.030)	(0.030)	(0.030)
Plant Closing *Female	0.011	-0.002	-0.003	-0.001
	(0.015)	(0.015)	(0.015)	(0.016)
Constant	-0.062	Y	Y	Y
	(0.011)			
Married, Age, Age2, Education	--	Y	Y	Y
Yr dummies, Yrs since disp, Region	--	Y	Y	Y
Pre-displacement tenure (1-3, 3-5,5-10,10+, omitted <1))	--	Y	Y	Y
Industry	--	--	Y	Y
Occupation	--	--	--	Y
N	6,981	6,981	6,978	6,978

Sample selections: See Table 2A.

Table 3B: DWS 1984-2002
(Blue Collar)

Dep Var: *Change* in Log wage

	(1)	(2)	(3)	(4)
Layoff*Black	-0.015	-0.025	-0.035	-0.035
	(0.030)	(0.030)	(0.030)	(0.030)
Layoff*Female	-0.002	-0.002	-0.018	-0.020
	(0.019)	(0.019)	(0.019)	(0.020)
Layoff	0.007	-0.021	-0.020	-0.019
	(0.014)	(0.014)	(0.014)	(0.014)
Plant Closing*Black	-0.002	0.003	-0.012	-0.012
	(0.028)	(0.028)	(0.028)	(0.028)
Plant Closing *Female	0.015	0.019	0.000	-0.001
	(0.019)	(0.019)	(0.019)	(0.019)
Constant	-0.087	Y	Y	Y
	(0.010)			
Married, Age, Age2, Education	--	Y	Y	Y
Yr dummies, Yrs since disp, Region	--	Y	Y	Y
Pre-displacement tenure (1-3, 3-5,5-10,10+, omitted <1))	--	Y	Y	Y
Industry	--	--	Y	Y
Occupation	--	--	--	Y
N	5,926	5,926	5,885	5,875

Sample selections: See Table 2B.

Table 4A: DWS 1984-2002
(White Collar)

Dep Var: Log Pre-displacement Wage

	(1)	(2)	(3)	(4)
Layoff*Black	-0.223	-0.154	-0.161	-0.143
	(0.038)	(0.033)	(0.032)	(0.032)
Layoff*Female	-0.424	-0.319	-0.327	-0.301
	(0.018)	(0.016)	(0.016)	(0.016)
Layoff	0.072	0.062	0.044	0.043
	(0.019)	(0.016)	(0.016)	(0.016)
Plant Closing*Black	-0.176	-0.120	-0.123	-0.102
	(0.039)	(0.034)	(0.033)	(0.033)
Plant Closing *Female	-0.377	-0.243	-0.257	-0.240
	(0.020)	(0.017)	(0.017)	(0.017)
Constant	6.050	Y	Y	Y
	(0.014)			
Married, Age, Age2, Education	--	Y	Y	Y
Yr dummies, Yrs since disp, Region	--	Y	Y	Y
Pre-displacement tenure (1-3, 3-5,5-10,10+, omitted <1))	--	Y	Y	Y
Industry	--	--	Y	Y
Occupation	--	--	--	Y
N	6,982	6,982	6,979	6,979

Sample selections: See Table 2A.

Table 4B: DWS 1984-2002
(Blue Collar)

Dep Var: Log Pre-displacement Wage

	(1)	(2)	(3)	(4)
Layoff*Black	-0.149	-0.096	-0.076	-0.073
	(0.033)	(0.030)	(0.030)	(0.029)
Layoff*Female	-0.343	-0.318	-0.282	-0.263
	(0.021)	(0.019)	(0.019)	(0.019)
Layoff	-0.047	0.007	0.007	0.001
	(0.015)	(0.014)	(0.014)	(0.014)
Plant Closing*Black	-0.131	-0.095	-0.075	-0.072
	(0.031)	(0.028)	(0.027)	(0.027)
Plant Closing *Female	-0.427	-0.390	-0.345	-0.327
	(0.021)	(0.019)	(0.019)	(0.019)
Constant	5.724	Y	Y	Y
	(0.011)			
Married, Age, Age2, Education	--	Y	Y	Y
Yr dummies, Yrs since disp, Region	--	Y	Y	Y
Pre-displacement tenure (1-3, 3-5,5-10,10+, omitted <1))	--	Y	Y	Y
Industry	--	--	Y	Y
Occupation	--	--	--	Y
N	5,926	5,926	5,885	5,875

Sample selections: See Table 2B.

Table 5: DWS 1984-2002
(White Collar Only)

Dep Var: *Change* in Log wage

	(1)	(2)
Post91* Layoff*Black	-0.097	-0.102
	(0.060)	(0.059)
Post91* Layoff*Female	0.003	0.015
	(0.028)	(0.028)
Post91* Layoff	0.004	0.020
	(0.030)	(0.029)
Post91* Plant Closing* Black	-0.012	-0.044
	(0.061)	(0.060)
Post91* Plant Closing* Female	-0.016	-0.005
	(0.031)	(0.030)
Post91	0.035	0.028
	(0.023)	(0.039)
Layoff*Black	0.107	0.090
	(0.046)	(0.045)
Layoff*Female	0.055	0.044
	(0.021)	(0.020)
Layoff	-0.039	-0.059
	(0.020)	(0.020)
Plant Closing* Black	-0.070	-0.057
	(0.043)	(0.042)
Plant Closing* Female	0.017	0.002
	(0.020)	(0.020)
Constant	-0.076	Y
	(0.015)	
Married, Age, Age2, Education	--	Y
Pre-displacement tenure (1-3, 3-5,5-10,10+, omitted <1))	--	Y
Yrs since disp., Yr dummies, Regions	--	Y
Industry, Occupation	--	Y
N	6,981	6,978

Sample selections: See Table 2A.

Table 6: DWS 1986-2002
Effects on Duration of the First Spell of Joblessness since Displacement
Dependent Variable: Log (Weeks of Joblessness)
MLE Estimates from Weibull Duration Model

	White Collar			Blue Collar		
	(1)	(2)	(3)	(1')	(2')	(3')
Layoff*Black	0.049	0.112	0.130	0.333	0.238	0.259
	(0.088)	(0.083)	(0.088)	(0.096)	(0.089)	(0.094)
Layoff*Female	0.058	0.102	0.054	0.255	0.139	0.135
	(0.046)	(0.044)	(0.048)	(0.068)	(0.063)	(0.068)
Layoff	0.128	0.227	0.246	-0.045	0.108	0.089
	(0.051)	(0.047)	(0.051)	(0.054)	(0.049)	(0.052)
Plant Closing*Black	0.339	0.324	0.302	0.413	0.299	0.246
	(0.105)	(0.097)	(0.103)	(0.099)	(0.090)	(0.095)
Plant Closing*Female	0.142	0.138	0.115	0.291	0.242	0.248
	(0.053)	(0.050)	(0.055)	(0.068)	(0.063)	(0.068)
Married, Age, Age2	--	Y	Y	--	Y	Y
Education	--	Y	Y	--	Y	Y
Pre-displacement tenure (1-3, 3-5,5-10,10+, omitted <1))	--	Y	Y	--	Y	Y
Yr dummies, Yrs since disp, Regions	--	Y	Y	--	Y	Y
Industry, Occupation	--	Y	Y	--	Y	Y
Log Pre-displacement wage	--	--	-0.054	--	--	0.003
			(0.037)			(0.049)
Weibull scale parameter	1.156	1.046	1.036	1.251	1.093	1.091
	(0.013)	(0.012)	(0.013)	(0.017)	(0.015)	(0.016)
N	5,244	5,227	4,613	4,433	4,348	3,952

Sample selections: (1) workers aged 20-64; (2) lost job for 3 reasons: plant closing, position abolished or slack work; (3) lost a job in previous 3 years; (4) had 0 or 1 job after displacement (5) displaced from full time jobs; (6) displaced from private sector jobs; (7) delete if pre-displacement weekly wage<$40; (8) not displaced from agriculture and construction.
Note: Standard errors are in parentheses.