I Z A Institute
of Labor Economics
Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 12264

Responding to Regulation: The Effects of Changes in Mandatory Retirement Laws on Firm-Provided Incentives

Anders Frederiksen
Colleen Flaherty Manchester

MARCH 2019

I Z A Institute
of Labor Economics

Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 12264

Responding to Regulation: The Effects of Changes in Mandatory Retirement Laws on Firm-Provided Incentives

Anders Frederiksen
Aarhus University and IZA

Colleen Flaherty Manchester
University of Minnesota

MARCH 2019

ISSN: 2365-9793

IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Responding to Regulation: The Effects of Changes in Mandatory Retirement Laws on Firm-Provided Incentives*

The Age Discrimination in Employment Act of 1978 expanded employee age protections to age 70, making the widespread practice by U.S. firms of mandating retirement at age 65 illegal. Building on the work of Lazear (1979), we propose that the law change not only weakened the long-term employment contract, but also contributed to the rise in pay-for-performance incentives. We model the firm's choice between offering long-term incentive contracts with low monitoring requirements and pay-for-performance (PFP) contracts with high monitoring requirements, showing how the law change increased the relative attractiveness of PFP contracts. We test the model's predictions using data from the Baker-Gibbs-Holmstrom firm, evaluating the effect of the law change on the slope of the age-pay profile, turnover rates, and the sensitivity of pay to performance. Further, we find direct evidence of strategic response to the law change by the firm, including the introduction of bonus payments, change in performance management system, and increase in the proportion of top managers. The setting also provides an opportunity to empirically investigate how firms navigate career incentives for employees.

JEL Classification: M51, M52

Keywords: incentive pay, pay for performance, long-term incentive contracts, promotions, slot constraints, career incentives

Corresponding author:
Anders Frederiksen
Aarhus University
Department of Business Development and Technology
Birk Center Park 15, 7400
Herning
Denmark
E-mail: afr@btech.au.dk

* We thank Mike Gibbs for providing the data. We would also like to thank Joel Waldfogel, Morris Kleiner, John Budd, Alan Benson, Avner Ben-Ner, Fabian Lange, Edward Lazear, Kathryn Shaw, Paul Oyer, Takao Kato, Hideo Owan, Aaron Sojourner, and seminar participants at Stanford University, Waseda University, Tinbergen Institute, Aarhus University, and Minnesota Population Center for their useful comments and suggestions. We acknowledge financial support from the University of Aarhus for a travel grant that helped support work on this project.

"An increasing fraction of jobs in the U.S. labor market explicitly pay workers for their performance using bonus pay, commissions, or piece-rate contracts." (p.1).
Thomas Lemieux, W. Bentley MacLeod, and Daniel Parent
Quarterly Journal of Economics, February 2009

Section I: Introduction

The practice of mandatory retirement by firms in the U.S. effectively ended in 1978 with the extension of the Age Discrimination in Employment Act (ADEA) that expanded the upper end of age projections from 65 to 70. With this law change, firm policies that mandated employee retirement at age 65 became illegal. At that time, approximately 40 percent of U.S. employees were subject to mandatory retirement policies at their employers; covered employees were more likely to be highly educated and in white-collar occupations relative to those not covered by these policies (von Watcher 2009). In 1986 mandatory retirement was abolished altogether for nearly all jobs in the U.S. Only small vestiges of this labor market institution remain in the U.S. today.[1]

Outside the U.S., mandatory retirement is a living institution. While some industrialized countries have eliminated mandatory retirement—including Australia, Canada, and the U.K.—it remains an active practice in other economies. In Japan most companies have a mandatory retirement policy; in 1986 the government incentivized employers to increase the retirement age to 60 to align with eligibility for the public pension, but mandatory retirement remains a fixture in Japan's labor market. In the European Union (EU) most firms can continue the practice of mandatory retirement at age 65 after overcoming a legal challenge in 2007, yet there is a movement toward an increase in the mandatory retirement age, and some EU countries, such as Denmark, have recently abolished mandatory retirement. Understanding the role that mandatory retirement policies play in the labor market remains a key issue for many economies across the globe.

The substantial weakening and eventual elimination of mandatory retirement policies in the U.S. was mostly an unsung policy change, in large part because its effects on

[1] While mandatory retirement is banned in the vast majority of U.S. jobs, it is still legal for the following occupations: pilots, air traffic controllers, firefighters, forest rangers, federal law enforcement, highly compensated employees at private firms (i.e., executive suite), and supreme court justices in a handful of states.

labor supply were expected to be minimal (Morrison 1988). With a handful of exceptions, economists have paid little attention to this particular law change. At the same time, research points to dramatic changes in the U.S. labor market since about the time of the law change, including a decline in long-term employment in the private sector (Farber 2010) and—as stated in the opening quote—increased prevalence of pay-for-performance compensation practices (Lemieux, McLeod & Parent 2009). When the ADEA extension was being considered, Lazear (1979) was among the few to connect mandatory retirement policies to aspects of the labor market outside of the labor supply of older employees. Namely, he proposed that mandatory retirement was a key part of long-term incentive contracts firms use to motivate employees to exert effort throughout their careers. This is the starting point for our paper.

We propose that the change in mandatory retirement law is a missing link in explaining the erosion of long-term employment and the increase in pay-for-performance contracts in the labor market since the early 1980s. We build on Lazear (1979) by developing a framework in which firms compare profitability under two incentive schemes: long-term incentive contracts and pay-for-performance contracts. Due to more intensive monitoring requirements, we show that pay-for-performance is a second-best alternative for incentivizing employee effort relative to long-term incentive contracts—characterized by an age-pay profile that is steeper than the age-productivity profile—for firms with sufficiently high monitoring costs. However, if the allowable mandatory retirement age is extended, then age-pay profile flattens, thereby weakening the long-term incentive contract and contributing to its unraveling (Proposition 1). This pushes firms toward greater use of pay-for-performance incentives for motivating employee effort (Proposition 2). We develop testable predictions from these two insights, including the flattening of the age-pay profile, increases in rate of employee separations, and increased sensitivity of pay to performance assessments following the law change.

We test these predictions using data from the well-known Baker-Gibbs-Holmstrom (BGH) firm, a large firm in the financial services industry. These data are particularly well suited for this analysis given that the available years of data (1970 to 1988) span the law change. In addition, while there is no available documentation of a mandatory retirement policy at the BGH firm, the data show strong evidence that the firm mandatorily retired

employees at age 65 prior to 1978 and abandoned this policy in 1979 with the law change. Further, administrative records on pay and performance rather than data from national surveys of employees are essential for evaluating possible changes in how firms incentivize worker effort following the law change.

We find evidence in the microdata consistent with our predictions. The slope of the age-pay profile flattens with the law change and persists at this lower gradient throughout the post-period. Employee separation is higher in the post-period relative to the pre-period. Performance is a stronger predictor of pay in the post-period relative to the pre-period. We also find direct evidence of a strategic response by the firm to the law change in the form of large-scale changes in personnel practices. First, the firm introduced performance-based bonuses in the post-period, representing a clear move toward a pay-for-performance incentive system. Second, we find evidence of an overhaul of the performance management system following the law change that resulted in greater dispersion in performance assessments across employees. Third, we see an increase in the proportion of the workforce allocated to upper management positions; this increase in the upper management ratio is consistent with using a more monitoring-intensive performance management system.

Further, we find evidence consistent with the firm considering and responding with multiple incentive levers. Importantly, the change in mandatory retirement law also imposed slot constraints on the firm, yet these had a disproportionate effect on employees based on their exposure to employees age 60+ in their promotion ladder. Therefore, the setting provides a credible source of identification to test key concepts in personnel economics. We find evidence that the firm tried to maintain employee career incentives as proposed by Gibbons and Murphy (1992) by offsetting lower promotion opportunities with higher promotion premiums for employees most affected by the law change. We find that this effect was transient, or a short-run response. Instead, the increase in the proportion of top managers appears to be in part due to the firm's long-term response, providing needed empirical evidence that organizational hierarchies flex to accommodate incentives (Gibbs 1994).

Was the firm responding to the change in mandatory retirement law, or something else? The 1970s and early 1980s was a dynamic macroeconomic environment in the U.S.,

marked by high inflation following the oil crises in 1973 and again 1979, as well as back-to-back recessions in 1980 and 1981–82. Yet, the marked changes we find tightly coincide with the change in mandatory retirement law as well with our expectations based on foundational theories in personnel economics, making credible the causal conclusion that the law change indeed affected the firm's decisions regarding incentives.

This paper contributes to the literature by connecting a seemingly small change in labor market regulations to dramatic changes in the landscape of firm-provided incentives. The framework and empirical findings fill an important gap in both the labor and personnel literatures by highlighting the mechanisms underlying the evolution of firm-provided incentives. To date, the specific factors that have contributed to the increase in use of pay-for-performance in the U.S. economy have largely been unknown; Lemieux, McLeod, and Parent (2009) speculate that improvements in monitoring technology and/or changes in the demand for "high productivity" employees may have pushed the cost-benefit scale in favor of pay-for-performance incentives. Our paper points to the weakening of mandatory retirement laws as a tipping point.

In terms of the role of mandatory retirement in facilitating long-term incentive contracts, there are a handful of studies testing the empirical relationship between mandatory retirement policies and steepness of the age-pay profile (Lazear 1979; Lazear and Moore 1984; Clark and Ogawa 1992). Those papers largely rely on observational data. In contrast, this paper uses a difference-in-difference strategy to evaluate the effect of mandatory retirement on the age-pay profile that uses the law change as a source of exogenous variation. While Neumark and Stock (1999) use state-level variation in the adoption of ADEA laws over time and data from the decennial census to test whether these laws facilitated long-term incentive contracts, the coarseness of the data used for the analysis (i.e., a 10-year gap between earnings data) opens up the possibility of reverse causality: states characterized by greater use of long-term incentive contracts are likely to face stronger lobbying efforts on the part of older employees to pass age protections given that these older employees stand to benefit most from these laws. In contrast, our approach uses administrative records from the years leading up to and following the policy change, allowing for accurate and timely measure of the effect of the federal regulation change on age-pay profiles.

Finally, this paper contributes to recent work on the use of multiple incentives by firms (Frederiksen and Takáts 2011; Ekinci et al. forthcoming) yet extends our understanding of firm use of incentives even further. Namely, it provides compelling empirical evidence that firms consider and use total incentives faced by employees (pay and promotion). It also highlights the interplay between incentives and organizational hierarchy, in terms of both how to adjust the hierarchy to create promotion opportunities and how the compensation system (long-term incentive contract versus pay-for-performance) has implications for hierarchical structure through monitoring requirements.

Section II: Theory

Employment relationships are subject to moral hazard problems because employers have limited information about employees' actions. To mitigate moral hazard, employers set up incentive systems. Such systems are not independent of the surrounding labor market conditions and regulations. For instance, Lazear (1979) argued that mandatory retirement made it possible for firms to motivate employees through long-term incentive contracts where the age-pay profile is steeper than the age-productivity profile. An alternative would be to link pay contemporaneously to productivity.

In this section, we provide an integrated framework to illustrate the relative merits of long-term incentive contracts and pay-for-performance contracts. Our analysis builds on the idea that long-term incentive contracts are "easy" because they rely on occasional monitoring and assessment against a benchmark, whereas pay for performance is "hard" as it requires continuous, precise monitoring of productivity. In fact, when both approaches are equally effective at incentivizing worker effort,[2] then the differences in monitoring costs will cause some companies to choose long-term incentive contracts over the alternative.

The notion that the monitoring requirements associated with pay for performance can make this type of contracts prohibitively expensive is commonly understood in the

[2] Lazear (1979) shows that contracts characterized by deferred compensation increase the productivity of employees over their career relative to those that pay employees their value of productivity on a per period basis.

literature (Lazear, 1986; Bishop, 1987; Lemieux, McLeod & Parent 2009). However, using this setup, we can show how an increase in the allowable mandatory retirement age reduces the relative attractiveness of long-term incentive contracts and provide predictions on when this incentive system is replaced by pay-for-performance incentives.

The Model

We explore long-term incentive contracts and pay-for-performance contracts in their simplest forms. To do so, we focus on a two-period model and risk-neutral agents. Productivity in period t is $y_t = e_i + \varepsilon_i$ where e_i is effort exerted by the employee and $\varepsilon_i \sim U(0,1)$ is a random component. The cost of effort function is $C(e_i) = \frac{1}{2}{e_i}^2$.

There are two types of monitoring costs: $\mu_j M$ and $\widetilde{M}$. $\mu_j M$ is the cost of monitoring employee productivity against a threshold, where M is general monitoring costs and μ_j reflects firm-specific costs. In contrast, $\widetilde{M}$ is the cost of assessing the *actual* productivity of an employee, which is the same across all firms. Clearly the resources used to precisely determine y_t exceed the resources required to determine if y_t exceeds some threshold. Hence, except for special cases, $\mu_j M << \widetilde{M}$. In what follows we separately solve for the worker and firm solution under long-term incentive contracting and under pay for performance, then compare the profit conditions to demonstrate how a firm's choice of incentive regime depends on $\mu_j M$, $\widetilde{M}$ and other parameters.

Long-Term Incentive Contracts

The essence of the long-term contracting models in Lazear (1979) and Lazear and Moore (1984) is to show that a contract with an age-pay profile steeper than the age-productivity profile can produce incentives for employees to put forth costly effort. For instance, in Lazear and Moore (1984) employees are potentially employed for two periods. If the employees do not shirk in the first period, then they will be retained and advance to the second period where wages are higher. All employees are mandatorily retired after the second period. The increasing age-wage profile and the risk of dismissal create incentives for employees.

We captured this idea in a simple two-period model.[3] In this setup employees are paid w_1 in the first period. The employer monitors the employees in the first period at the cost $\mu_j M$, and if $y_t > k$, where k is the threshold that productivity must exceed, they are retained and receive $w_2 > w_1$ in the second period; otherwise they are dismissed. Because employees are mandatorily retired after period 2, they will all shirk in the second period (i.e., $e_2 = 0$).

This setup implies that employees have expected utility:

$$EU = E[w_1 + w_2 P(y_1 > k) - C(e_1)]. \quad (1)$$

The participation constraint is:

$$E[w_1 + w_2 P(y_1 > k) - C(e_1)] \geq \bar{U}, \quad (2)$$

where $\bar{U}$ is the utility of the worker's best alternative outside the firm. It follows that expected firm profits are:

$$E\pi^{LT} = E\big[y_1 + y_2 P(y_1 > k) - \mu_j M - w_1 - w_2 P(y_1 > k)\big]. \quad (3)$$

Hence,

$$e_1^* = w_2;\ w_2^* = 1; E\pi^{LT} = ½ - \mu_j M - \bar{U}.^4 \quad (4)$$

From these results it is clear that monitoring costs $\mu_j M$ reduce firm profits; firms having especially high monitoring costs because μ_j is high have lower profits. It is also clear that first-period effort is determined by the magnitude of the second-period wage.

Pay-for-Performance Incentive Contracts

An alternative to long-term incentive contracting is paying employees commensurate with their productivity in each period, known as pay-for-performance. In each period employees

[3] Note that the theoretical setup used in Lazear and Moore (1984) is an implicit relational contract and thus richer than the simple framework presented here.

[4] First-period wages are $w_1 = k - \mu_j M - 1 < w_2$.

are paid according to their productivity: $w_t = by_t$. Hence, the firm has to accurately assess the employee's performance each period at cost $\widetilde{M}$.

It follows that employees have expected utility:

$$EU_t = E[by_t - C(e_t)], \quad (5)$$

they face the participation constraint:

$$E[by_t - C(e_t)] \geq \widetilde{U}, \quad (6)$$

where $\widetilde{U}$ is the best alternative to employment at the firm in each period t. It follows that firm profit in a given period is:

$$E\pi_t = E\left[y_t - \widetilde{M} - w_t\right]. \quad (7)$$

Employees have the possibility of working two periods, resulting in the following effort and wage decisions, and accumulated profits:

$$e_t^* = b = 1;\ w_t^* = y_t; E\pi^{PP} = 1 - 2\widetilde{M} - 2\widetilde{U}. \quad (8)$$

Similar to the long-term incentive contract, monitoring costs $\widetilde{M}$ reduce firm profits. In this contract, incentives follow from the pay for performance parameter b.

Comparing Incentive Systems

The firm will choose the incentive system with the highest profit. It follows that $E\pi^{LT} > E\pi^{PP}$ when:

$$\widetilde{M} > ½\mu_j M + B, \quad (9)$$

where B is a constant. Hence, higher monitoring costs in the performance pay system make the long-term contracting relatively more attractive. Namely, companies who find it easy (low cost) to assess employees against a threshold (i.e., relatively low μ_i) will choose long-term contracting.

The end of mandatory retirement

The end of mandatory retirement is a game changer—when the mandatory retirement age is extended and subsequently abolished, older employees can simply stay employed longer. This challenges long-term contracting because the high-wage period (i.e., when employee is older) is extended with no clear end date in the contract.

Proposition 1: An extension of the allowable mandatory retirement age weakens the long-term incentive contract; for a sufficiently large extension, the long-term contract unravels.

We model this situation by allowing the relative duration of the two time periods to depend on τ. Employees are now in period 2 for length of time τ and they are in period 1 for a length of time $(1-\tau)$. An extension of the mandatory retirement age or an abolishment of mandatory retirement altogether corresponds to an increase in τ (i.e., employees are in period 2 for a relatively longer period of time).

The equilibrium in the long-term incentive contract now becomes:

$$e_1^* = 1-\tau;\ w_2^* = \frac{1-\tau}{\tau}; E\pi^{LT} = F(\tau, M, \overline{U}). \tag{10}$$

An increase in τ following from changes in the mandatory retirement law influences effort, pay and profits. As $\tau \to 1$ we get:

$$e_1^* \to 0;\ w_2^* \to 0; E\pi^{LT} \to -M - \overline{U} < 0. \tag{11}$$

It follows from equation 10 that the wage profile will flatten with τ due to declining wages in the second period, which amounts to a weakening of long-term incentives. With τ sufficiently large, the long-term contract unravels (as shown in equation 11).

Proposition 2: An extension of the allowable mandatory retirement age increases the attractiveness of pay-for-performance incentives.

When employees are in the second period for a longer time, long-term contracting becomes less attractive for firms because the time during which employees provide effort becomes relatively short. Eventually (with τ sufficiently large) profits become negative, implying that the long-term contracting setup breaks down. Hence, firms offering long-

term contracts initially would need new ways to mitigate the moral hazard problem. The movement of the wage profile toward the productivity profile makes it straightforward for firms to base pay decisions on employee's per-period productivity—a system we know as pay-for-performance.

Implications

The theoretical framework provides an argument for why long-term incentive contracting was preferred for many firms (those with low μ_i) when mandatory retirement was allowed, and it gives direction for what is likely to happen when mandatory retirement is weakened and ultimately abolished. The framework produces the following predictions stemming from the change in law governing mandatory retirement policies.

First, the age-pay profile, which was set as steeper than the age-productivity profile under long-term incentive contracts, will flatten. Stated differently, there will be greater temporal alignment between productivity and pay. Second, this change will have implications for employee separation through two channels. Namely, the flattening of the age-pay profile reduces the deferred aspect of pay, which directly weakens incentives for continued employment. Further, the change in compensation structure will affect the type of employees employed at the firm (Lazear 2000). In particular, employees at firms with long-term incentive contracts accepted such contracts when others were available given that not all employees in the U.S. were covered by mandatory retirement policies in 1978. If a firm moves away from this incentive system, then its employees will re-optimize; those for whom the participation constraint is challenged will move firms. Employees who remain and those who sort into the firm under the new incentive scheme are likely to have higher discount rates and presumably higher separation tendencies (c.f. Manchester 2012).

Prediction 1: The change in mandatory retirement law will result in a) a flattening of the age-pay profile and b) higher rates of employee separation.

In addition, we expect that the change in law will increase use of performance-based pay such that performance will be a stronger predictor of contemporaneous pay decisions following the change in mandatory retirement law. In practice, this implies a movement

away from the firm making pay decisions based on seniority (which is commensurate with age in a long-term incentive contract) and toward one based more on performance. This will result in greater sensitivity of pay changes to performance following the law change and/or greater use of performance-based payments, such as bonuses, in the post-period.

Prediction 2: The change in mandatory retirement law will result in greater use of pay-for-performance incentives.

Section III: Data

In this section we introduce the BGH firm, establish the use of mandatory retirement by the firm prior to the law change, and present our empirical approach.

The BGH Firm

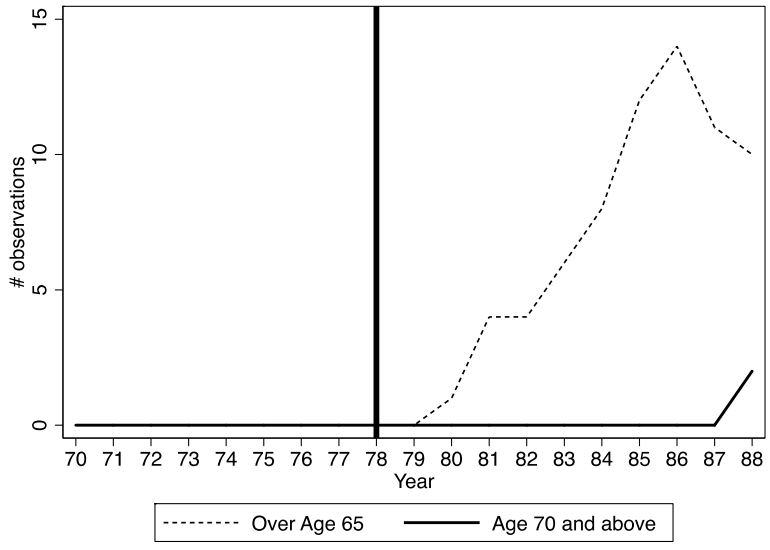
In our empirical analysis we use the BGH firm's data, which contains "confidential personnel records from all management employees of a medium-sized U.S. firm in a service industry over the years 1969–1988" (Baker, Gibbs & Holmstrom 1994a, p. 885). This dataset is described and analyzed in depth in two seminal papers on the internal working of firms (Baker, Gibbs & Holmstrom 1994a, 1994b), and has been used in numerous subsequent projects.[5] The data is well suited for the research at hand for several reasons. First, the amendment to the Age Discrimination in Employment Act (ADEA) in 1978, which extended the allowable age for mandatory retirement policies used by firms from 65 to 70 and was a precursor to the eventual abolishment of mandatory retirement in 1986, is conveniently located in the middle of the sample period. This gives us an empirical setup with balance between the pre-period (1970–1978)[6] and post-period (1979–1988). Second, because the data are administrative records, they contain information on compensation, performance, and hierarchical position, making it possible to evaluate how firm policies changed with the law.

[5] These projects focus on employer learning (Kahn and Lange 2014), performance management (Gibbs 1995; Gibbs and Hendricks 2004; Frederiksen et al. 2017), signaling (DeVaro and Waldman 2012), and the mix of incentives (Ekinci et al. forthcoming).

[6] We are omitting 1969 from our empirical analysis as the data are incomplete.

While mandatory retirement was widespread in the U.S. economy in 1978, it was not used by all firms.[7] Thus, to show the relevance of the change in mandatory retirement law for the BGH firm, we present the prevalence of employees over age 65 by year in the BGH firm in Figure I. Before the law change in 1978, the BGH firm had no employees above age 65. After the change in regulation, the number of employees above age 65 started to increase. Following 1986, when mandatory retirement at any age was abolished for most of the U.S. labor market,[8] we also start to see employees age 70 and above at the firm. Figure II shows the same phenomena from a different perspective by plotting the proportion of employees by age who separate from the firm in a given year (restricted to those age 55 and older). Prior to the policy change, 90 percent of employees aged 64 separated and 100 percent of those aged 65 separated from the firm; this pattern is not present in the post-period. Therefore, there is compelling evidence for the use of an age-65 mandatory retirement policy in the BGH firm before the law change as well as evidence of compliance with the law following the change.

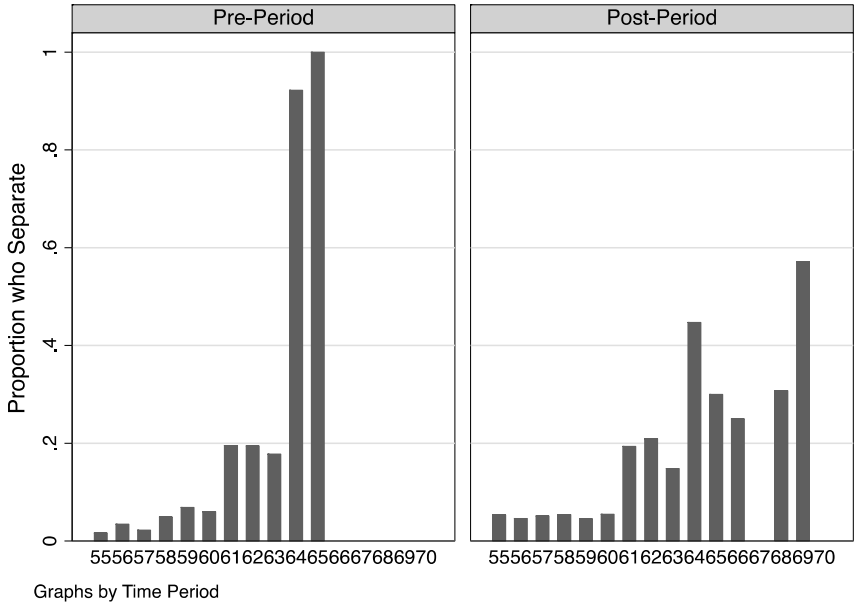
Figure I. Prevalence of Older Employees at the BGH Firm by Year



[7] von Wachter (2009) reports that approximately 40 percent of males in the U.S. labor market were covered by an age-65 mandatory retirement policy. Prevalence was higher among the more educated employees and those in white-collar occupations.

[8] Mandatory retirement is still allowable is some small subsets of the U.S. economy, such as air traffic control, forest rangers, and some state judicial systems.

Figure II. Separations from BGH Firm by Age Across Time Periods



Notes: Restricted to employees age 55 and over. Pre-period includes years 1970–1977, while post-period includes 1978 to 1987 given that separation measures those who leave the firm between time t and t+1 and the 1978 law change.

Descriptive Statistics

We have 56,863 employee-year observations available for analysis. In Table I, we present descriptive statistics for the full sample and for the pre-period and post-period. Overall, we find that the company is growing; the sample contains on average 1,903 employees per year in the pre-period and 3,974 employees per year in the post-period.

The average age of an employee in the sample is 39.22 years old. The vast majority of employees at the firm are white, and the proportion who are women is 0.25. The sample is well educated, with 26 percent holding advanced degrees, 37 percent having a bachelor's degree, and 19 percent with some college. These employee characteristics reflect that the sample comprises managerial employees in the BGH firm.

The management nature of the employees is also reflected in compensation, which has an annual average of $39,031 with a standard deviation of $23,033 (nominal).[9] Nominal wage growth is 11 percent, on average, with a standard deviation of 0.07.

[9] This is equivalent to an average salary of $53,575 in 1988 dollars, which is worth approximately $100,139 in 2018 dollars.

Information on bonuses is only available starting in 1981; while some employees may have received bonuses before this time, 1981 marks a change in utilization given bonuses became codified into personnel records at that point in time. In the years where bonus is available 24 percent receive a bonus. The average bonus is $2,274 (nominal) with a standard deviation of over $8,700. Among those receiving a non-zero bonus, the average bonus is $9,494 (nominal) with a standard deviation of $15,770.

Employee turnover from the firm is 10 percent per year, on average, with a significantly lower rate in the pre-period (7%) relative to the post-period (11%). As for promotion, the average annual promotion probability is 19 percent and there is not statistically significant difference by time period.

Table I: Descriptive statistics by time period

	All Years		*1970 to 1978*		*1979 to 1988*	
	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Salary (nominal)	39031	23033	25103	11533	45033	24129
Salary growth[a]	0.11	0.07	0.10	0.06	0.11	0.07
Annual bonus (nominal)	2274	8717	.	.	2274	8717
Received bonus	0.24	0.43	.	.	0.24	0.43
Separate from firm (t to t+1)[b]	0.10	0.30	0.07	0.26	0.11	0.32
Promoted (t to t+1)[b]	0.19	0.39	0.18	0.39	0.19	0.39
Performance rating[c]	4.13	0.71	4.23	0.68	4.08	0.73
Age	39.22	9.6	40.06	9.82	38.86	9.48
Female	0.25	0.43	0.10	0.30	0.31	0.46
White	0.89	0.31	0.95	0.22	0.87	0.34
Some college	0.19	0.39	0.25	0.43	0.17	0.37
Bachelor's degree	0.37	0.48	0.35	0.48	0.37	0.48
Advanced degree	0.26	0.44	0.25	0.44	0.27	0.44
High school	0.18	0.38	0.14	0.35	0.19	0.4
No. of employees (by year)	2993	275	1903	180	3974	191
Total observations	56,863		17,125		39,738	

Notes: [a] [Salary(t) – Salary (t-1)]/Salary(t-1). [b] Pre-period is 1970 to 1977 and post-period is 1978 to 1987 for this variable because events occur between t and t+1. [c] Performance data only available for 37,089 observations; a large portion of employees have missing data prior to 1974, and substantially more have missing data from 1980 to 1982.

The company has a performance management system for ratings its employees on an annual basis, which will be discussed in detail below. The company uses a performance scale ranging from 1 (low) to 5 (high) and the average performance is 4.13 with a standard

deviation of 0.71.[10] Across all years, 65.22 percent of employees receive a performance review, but prevalence varies substantially across years with some years having as low as 10 percent of employees with ratings, while in other years, over 90 percent of employees have ratings. This observation (and the data on bonus) plays a key role in our empirical analysis and serves as corroborating evidence that the firm altered its performance management system to support its new pay-for-performance incentive system. We return to this point later.

Empirical Approach and Identifying Assumptions

We evaluate the predictions stemming from our model by estimating the effect of the law change on features of the firm's compensation policy. To do this, we utilize a difference-in-differences approach. Important for identification is that there are no concurrent abrupt changes in the productive capacity of employees, such as those due to changes in education or use of technology, that may affect the relationship between employee age and pay or performance and pay. While we cannot test this assumption directly, we can examine it indirectly in several ways.

First, we assess if there is evidence of abrupt changes in features of the productive capacity of the workforce looking at demographics and human capital attainment over time. Figure III plots these employee characteristics over time, and we find evidence of smooth changes such as an increase in the proportion of employees who are female and who are black. We also find some variation in educational attainment over this time period, with a slow increase in the proportion of those with an Associate degree and non-monotonicity in the proportion of those with advanced and high school degrees. Thus, changes are present, but they appear to be slow moving and to not align with the 1978 law change.

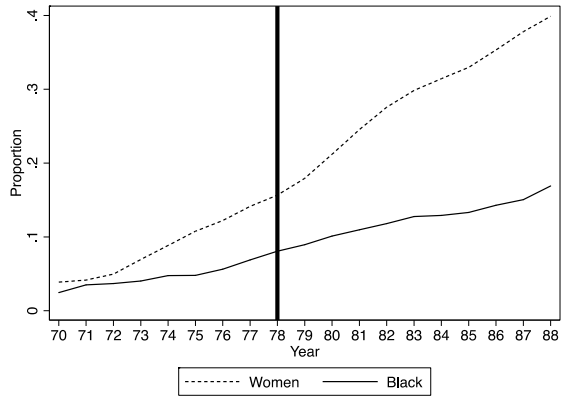
Second, in the analysis we employ placebo tests using the pre-period data to assess whether there is evidence of changes prior to the law change, in terms of both level differences (for separations) and changes in slope (for age-pay profile and for pay-

[10] In the original data, 1 was the highest and 5 was the lowest; we have recoded the values such that higher values correspond to higher performance.

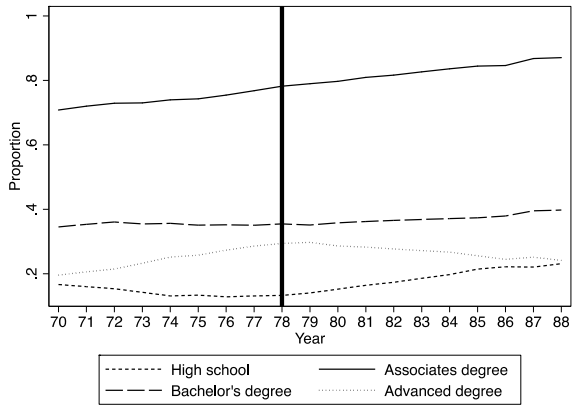
performance relationship). Further, we allow for year-by-year changes in slope (for age-pay profile and for pay-performance relationship) to evaluate if such changes align with the law change.

Figure III: Employee Characteristics Over Time

(a) Gender and race



b) Educational attainment



Section IV: The Unraveling of Long-Term Contracts

In Section II, we proposed that the law extending the mandatory retirement age from 65 to 70 weakened the long-term incentive contract and likely led to its unraveling (Proposition 1). In this section, we test the implied predictions (Prediction 1) that the age-pay profile will flatten and that employee separations will increase. Our empirical evidence is supportive of these predictions and show that the changes in the pay profile and separation patterns coincide with the timing of the law change.

The Age-Pay Profile Flattens

We estimate the change in the age-pay profile by regressing the natural log of nominal pay for salary and total earnings (salary plus bonus) on age and available demographic controls, including indicator variables for gender, race, educational attainment, and calendar year.[11] Columns 1 and 4 show a positive linear relationship between age and natural log of pay. When we include an interaction between age and the post-period

[11] We use nominal values of salary and earnings given this is the variable that firms can control; we report findings using real salary and real earnings in the appendix (Figures A.1 and A.2).

dummy in the model, shown in column 2 (column 5), we estimate a negative and statistically significant coefficient on the interaction term, which shows a reduction in the slope of the age-salary (age-earnings) profile in the post-period relative to the pre-period. We also consider a quadratic relationship between age and natural log of salary (earnings) and report the results in column 3 (column 6). For the age-salary profile, we estimate a negative coefficient on the linear interaction term (column 3), while we estimate a negative coefficient on the quadratic interaction term for the age-earnings profile (column 6). Figure IV plots the predicted effect on pay of the post-period (relative to the pre-period) by age using specifications shown in columns 3 and 6.

Table II: Changes in age-pay profile by time period

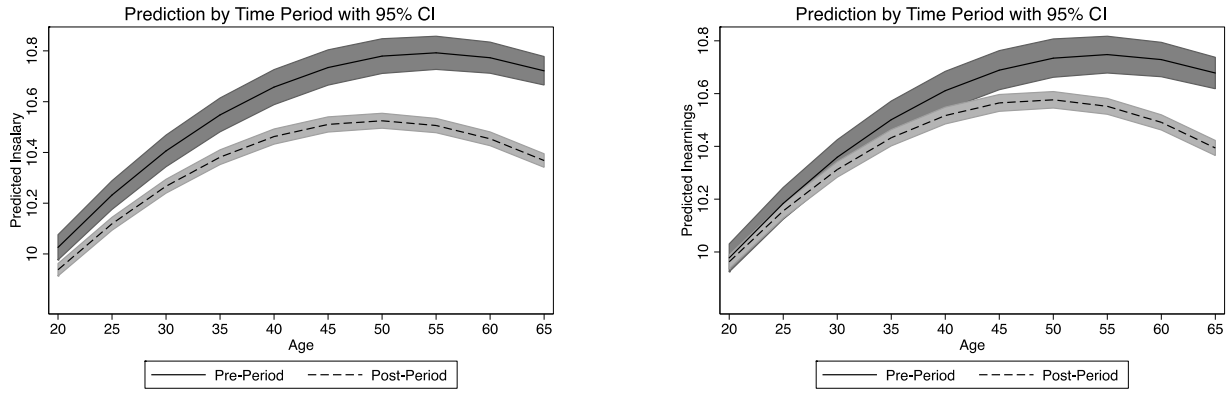
	Ln(salary)			Ln(earnings)		
	1	2	3	4	5	6
Age	0.0119**	0.0149**	0.0702**	0.0121**	0.0150**	0.0703**
	(0.0001)	(0.0002)	(0.0020)	(0.0002)	(0.0003)	(0.0021)
Age, squared			-0.0006**			-0.0006**
			(0.0000)			(0.0000)
Post-period x Age		-0.0044**	-0.0040+		-0.0044**	0.0009
		(0.0003)	(0.0023)		(0.0003)	(0.0025)
Post-period x Age, squared			0.0000			-0.0001**
			(0.0000)			(0.0000)
R-squared	0.585	0.586	0.605	0.569	0.571	0.590

Notes: Dependent variable in columns 1 to 3 is ln(salary) in time t; dependent variable in columns 4 to 6 is ln(salary + bonus) in time t. Note that bonus information is only available starting in 1981. Regressions include indicator controls for gender, race, highest degree obtained, and calendar year. Post equals 1 for years 1979 to 1988 and equals 0 otherwise. N=56,863.
+ p-value<0.10, * p-value < 0.05, ** p-value <0.01

To establish that the flattening in the age-pay profile is tied to the law change rather than to other changes happening inside or outside the firm, we conduct placebo tests using the pre-period (1970 to 1978) and sequentially pick each year as the placebo law change. The results are reported in Table III; we find no evidence of a negative coefficient on the interaction term between age and the placebo dummy in the pre-period. Instead, we find evidence of a statistically significant steepening of the slope in the pre-period. This shows

that the pre-period is characterized by a movement toward more deferred compensation, not less.[12]

Figure IV: Effect of Time Period on Age-Pay Profile



(a) Age-Ln(Salary) Profile (b) Age-Ln(Earnings) Profile

Notes: Predictions by period plotted from regression of natural log of pay on quadratic in age and interaction between post-period indicator and quadratic in age and indicators for gender, race, educational attainment, and calendar year. For coefficients, see Table II, columns 3 and 6.

Table III: Age-salary profile by time period (placebo)

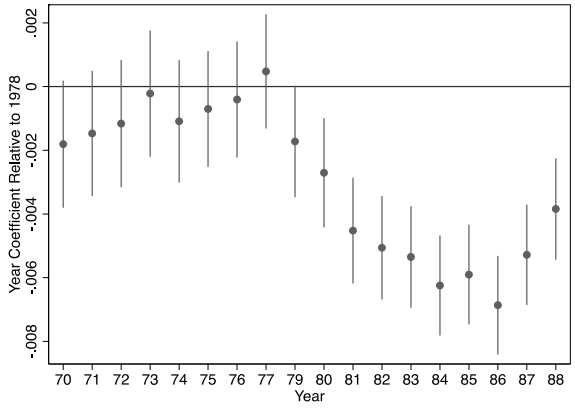
	Placebo Policy Year					
	1971	1972	1973	1974	1975	1976
Age	0.0138**	0.0139**	0.0140**	0.0143**	0.0143**	0.0143**
	(0.0007)	(0.0005)	(0.0004)	(0.0004)	(0.0003)	(0.0003)
Post-placebo x Age	0.0010	0.0010+	0.0009+	0.0006	0.0008+	0.0009*
	(0.0008)	(0.0006)	(0.0005)	(0.0005)	(0.0004)	(0.0004)
R-squared	0.397	0.397	0.397	0.397	0.397	0.397

Notes: Dependent variable is natural log of salary (note: salary is the only pay measure available in the pre-period). Regression includes indicator variables for gender, race, highest degree obtained, and calendar year. Sample restricted to 1970 to 1978. Year listed at top of each column is year placebo policy change is assigned (i.e., that year and all years after are assigned a value of 1; prior years are assigned a value of zero). N = 17,125. + p-value < 0.10; * p-value < 0.05; p-value < 0.01

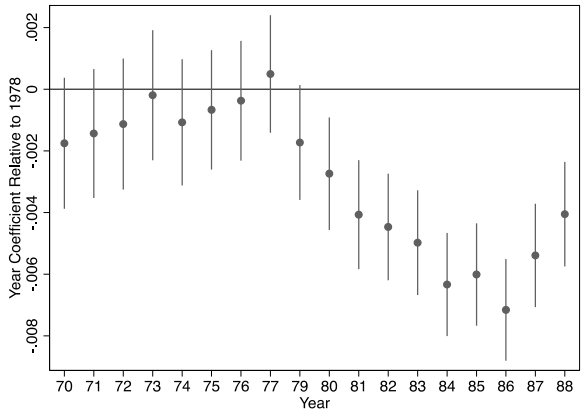
[12] The year 1973 is particularly interesting as it is the year of the first oil crisis; the second oil crisis is in 1979. If the oil crisis (and not the change in mandatory retirement law) is the driver for the changes in firm-provided incentives, then we should see evidence of the age-pay profile flattening following 1973, which we do not. Specifically, the placebo results show that, if anything, the profile is steepening in 1973 rather than flattening.

To provide additional evidence that the flattening of the age-pay profile coincides with the change in the law governing mandatory retirement policies, we estimate a specification that allows the slope between age and the natural log of pay to vary by calendar year. Figure V plots the coefficients on the age by calendar-year interaction terms from 1970 to 1988 relative to year 1978 using a linear specification for the relationship between age and the natural log of pay separately for salary and earnings. The plots clearly show that the flattening of the relationship coincides with the change in mandatory retirement law. Namely, the year 1979 shows a significant drop in the slope of the age-pay profile relative to the prior years followed by a continual decline in the slope, which is consistent with further weakening of the long-term incentive contract.

Figure V: Change in Slope of Age-Pay Profile by Year



(a) Age-Ln(Salary) Profile



(b) Age-Ln(Earnings) Profile

Notes: This shows the coefficient plot for age by calendar-year interaction terms (relative to 1979) from regression of ln(Salary) and ln(Earnings) on age, age by calendar year interaction terms, and indicator variables of gender, race, education dummies, and calendar year.

Employee Turnover

As described in Section II, we expect employee turnover to increase due to the weakening of the long-term incentive contract. While we cannot distinguish voluntary and non-voluntary separations in the data, our empirical evidence shows a sizable difference in separation rates by time period: separation is approximately 7 percent in the pre-period and increases to 12 percent in the post-period (Table I)—an increase of 71 percent. We use a regression framework to estimate the change in separation rate in the post-period relative to the pre-period and present the results in column 1 of Table IV. The coefficient of 0.0384 is statistically significant and economically meaningful (i.e., an increase of 3.84 percentage points relative to a mean of 7.10 percent in the pre-period).[13]

We present placebo regressions in columns 2 to 6, assigning the law change to years prior to the actual law change. With the exception of a marginally significant coefficient for 1971, all coefficients are statistically insignificant and small in magnitude. These placebo results show that the change in separation pattern did not occur prior to the law change.

Table IV: Separation rate in post-period versus pre-period and placebo regressions

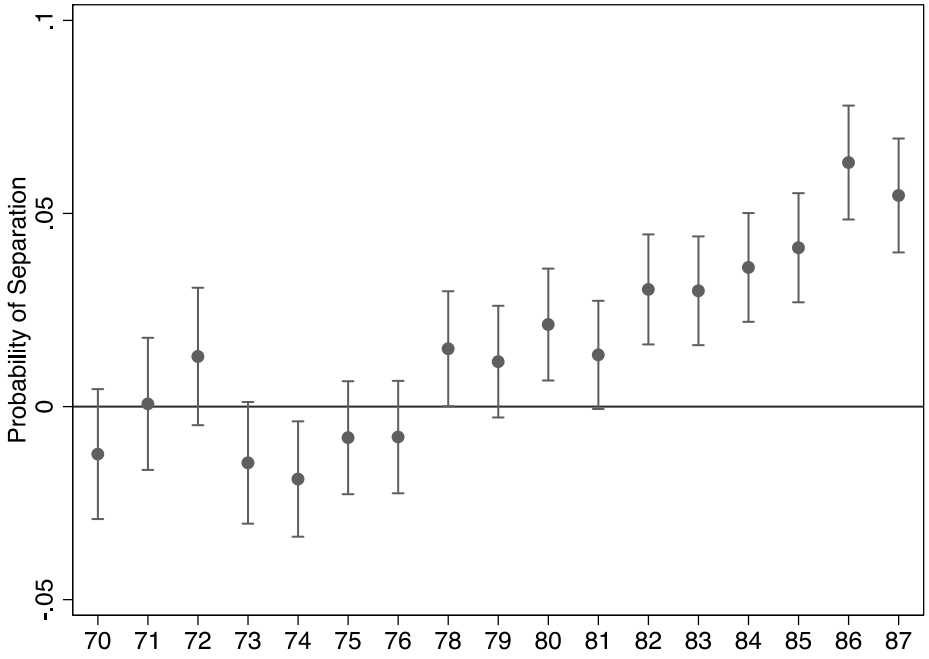
		Placebo Year				
	MR Law Change	1971	1972	1973	1974	1975
	1	2	3	4	5	6
Post-period	0.0384**					
	(0.0027)					
Post-placebo		0.0128+	0.0041	-0.0069	-0.0027	0.0031
		(0.0075)	(0.0056)	(0.0049)	(0.0047)	(0.0048)
R-squared	0.028	0.038	0.038	0.038	0.038	0.038
N	51,172	11,835	11,835	11,835	11,835	11,835

Notes: Dependent variable is separation between t and t+1, hence post-period starts in 1978 (instead of 1979) for these regressions. Regression includes indicator variables for gender, race, highest degree obtained, and calendar year. Sample restricted to 1970 to 1978. Year listed at top of each column is year placebo policy change is assigned (i.e., all years after that year are assigned a value of 1; prior years are assigned a value of zero). + p-value < 0.10; * p-value < 0.05; p-value < 0.01

[13] While we cannot separate voluntary from involuntary separations, we find evidence consistent with the firm more actively culling employees in the post-period based on performance in that low performance is more strongly associated with separations in the post-period relative to the pre-period (see Appendix Table A.1).

We plot the year coefficients estimated relative to 1977 in Figure VI given that separations are measured as leaving the firm between year t and t+1. The figure shows a rise in separation rates coinciding with the lead up to the first oil crisis in 1973, followed by a decline in separation rates. We also see a significant jump in separation rates in 1978 coinciding with the law change, and then a steady increase in separation rates throughout the post-period. Unlike the blip around the 1973 oil crisis, the change in 1978 marks a structural change in the pattern of employee separations. This change to higher separation rates is consistent with the weakening of—and even the unraveling of—the long-term incentive contract. This plot shows that the change in separation pattern coincides with the law change.

Figure VI: Separation Rates by Calendar Year



Notes: Plot of calendar year coefficients estimated relative to 1977 for OLS regression of employee separation between year t and t+1 on indicator variables for gender, race, highest degree obtained, and calendar year. Standard errors clustered at employee level. N = 51,172.

Section V: Movement Toward Pay-for-Performance Incentives

In Section II, we propose that extending the allowable mandatory retirement age increases the relative attractiveness of pay-for-performance incentive contracts (Proposition 2). The

implied consequence is that firms using long-term incentive contracts in the pre-period, such as the BGH firm, shifts towards a pay-for-performance incentive system (Prediction 2). We provide evidence for this prediction by first showing that the firm made a significant revision to its performance management system in the years just following the law change. We then provide direct evidence on greater use of pay-for-performance incentives by documenting the introduction of a widespread, performance-based bonus system following the law change. Finally, we provide evidence showing that the sensitivity of pay to ratings of performance was higher in the post-period relative to the pre-period.

The Performance Management System

In Section II we stressed the different monitoring requirements for long-term incentive contracts as compared to pay-for-performance incentives. The long-term incentive contracting setup simply required assessment of productivity—assessed as performance among professional and managerial employees—against a threshold to detect shirking; a pay-for-performance system requires close monitoring of employees in order to differentiate them (and pay them) based on their contribution to the firm. This requires a performance management system that is more precise and granular. Therefore, switching from a long-term incentive system to a pay-for-performance system is not a trivial choice from the perspective of the firm and likely requires substantial changes to how employees are assessed, which takes time and money.

The data provide evidence consistent with a marked change in the performance management system following the law change. The first piece of evidence is presented in Figure VII, which plots the proportion of employees who receive performance ratings by calendar year. It shows a dramatic drop in the prevalence of performance ratings following the law change. In the years preceding the change, more than 80 percent of employees received performance ratings. Then suddenly, in the few years after the law change (1980 to 1982), only 5 to 10 percent of employees had performance ratings. In 1983 the prevalence of performance ratings returned to 80 percent and stayed at this high level for the reminder of the sample period.

It is possible that this dramatic shift in the prevalence of performance ratings in the three years following the law change is a coincidental data issue (i.e., inadvertent omission

of performance ratings for these years in data collection). This is unlikely, however, because performance data are available for some employees in 1980 through 1982. A detailed look at the data reveals that in 1980, those employees with performance ratings are composed only of new hires; no incumbent employees have performance ratings in 1980. A small proportion of existing employees and new hires are rated on performance in 1981 and 1982.

Figure VII: Prevalence of Performance Ratings Over Time

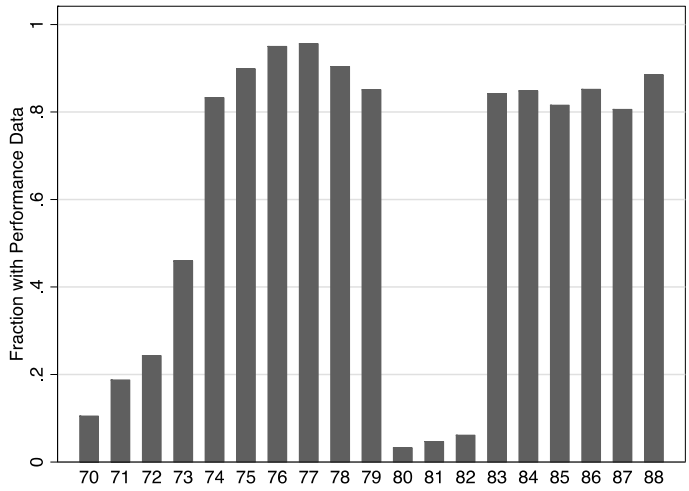
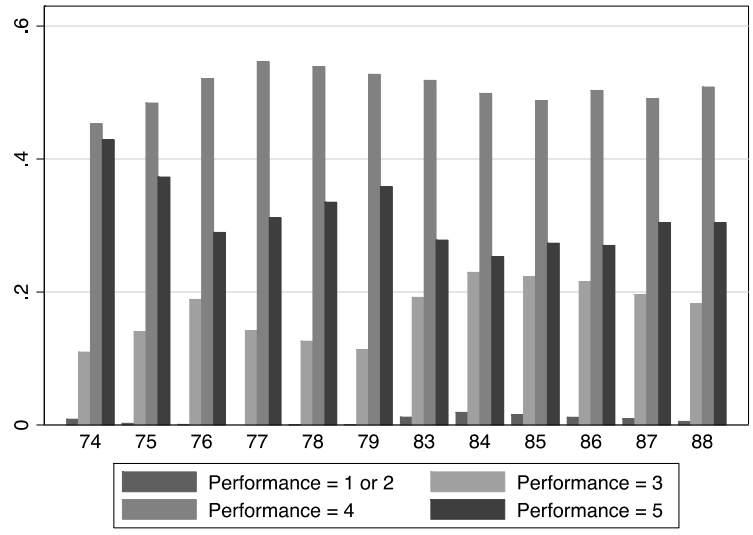
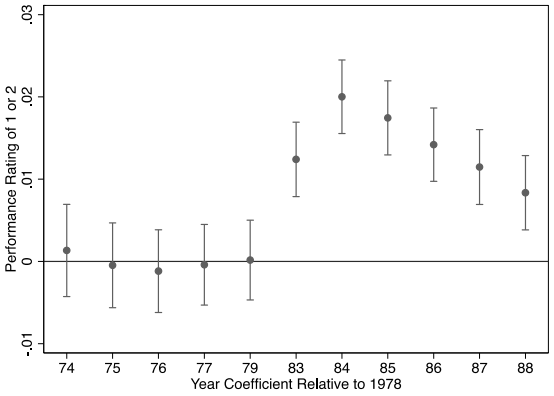


Figure VIII: Distribution of Performance Ratings Over Time

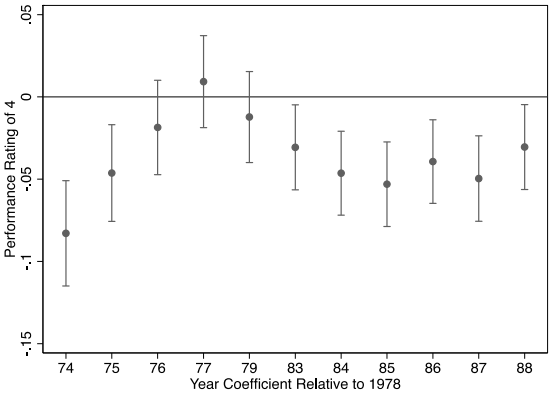


A second piece of evidence of a change in the performance management system is a change in the distribution of performance ratings following the law change.[14] As shown in Figure VIII, we see an increase in the use of low performance ratings (1s, 2s, and 3s) and reduction in use of high ratings (5s) when ratings again become widespread in the post-period (i.e., 1983 and after) relative to the pre-period.

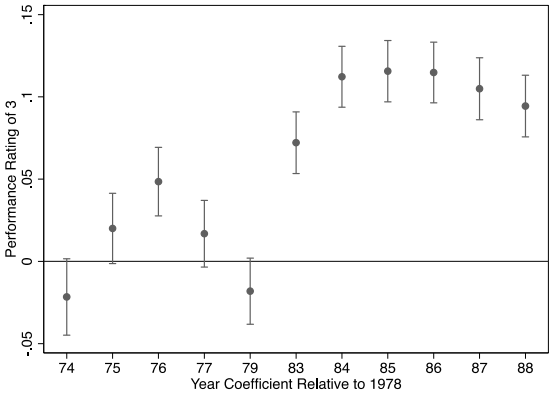
Figure IX: Change in Performance Ratings Over Time



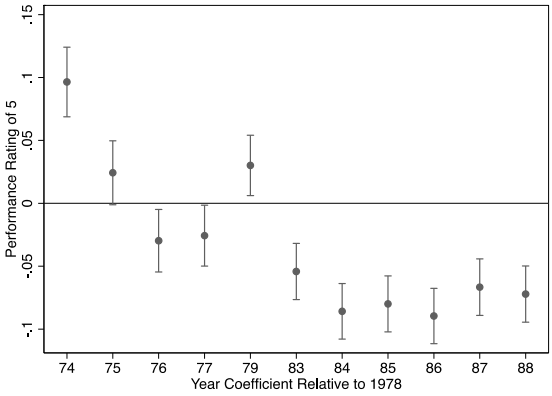
(a) Rating of 1 or 2



(c) Rating of 4



(b) Rating of 3



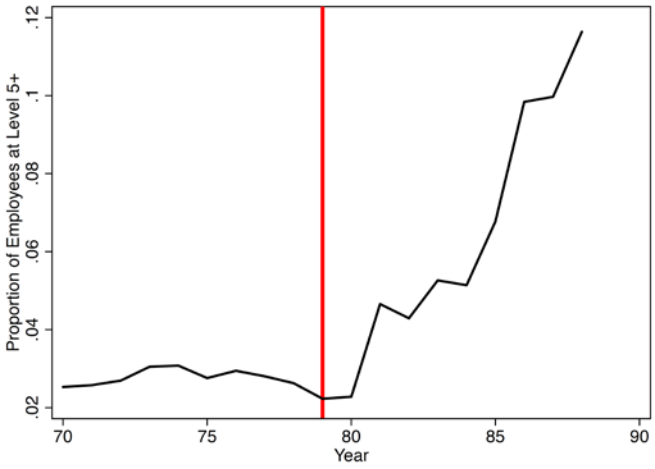
(d) Rating of 5

Notes: Calendar year coefficients estimate relative to 1978 from a regression of performance rating dummy on quadratic in age and indicator variables for gender, race, educational attainment, job level, new hire, and calendar year. Only includes years 1974 to 1979 and 1983 to 1988 due to substantial missing performance data in other years (see Figure VII).

[14] A Kolmogorov-Smirnov test for difference in distribution has a p-value of 0.000.

We formalize this finding using regression, predicting receipt of different performance ratings as a function of a quadratic in age and indicator variables for gender, race, educational attainment, job level, new hire, and calendar year. Figure IX plots the coefficients on the calendar year indicator variables estimated relative to 1978 for each performance rating. While the missing years for performance preclude discovering a sharp discontinuity in ratings between 1979 and 1980, a notable difference in ratings is present when comparing ratings on or before 1979 to 1983 and beyond. In particular, there is an increase in use of the very lowest ratings (1s and 2s) and moderate rating (3s) in the post-period relative to the pre-period. We also see that high ratings (5s) show evidence of decline starting in 1983.

Figure X: Top Managers Relative to Lower-Level Managers



Notes: Plots proportion of employees in levels 5 through 8 over time.

Our last piece of evidence for a reconfigured performance management system is presented in Figure X. The picture shows a steep increase in the proportion of employees who are top managers (in level 5 to 8).[15] The fact that this abrupt change in proportion of top managers coincides with the law change is intriguing and consistent with a more monitoring intensive performance management system in the post-period (i.e., requires

[15] Instead of addressing changes in the organizational structure by comparing employees at different organizational levels it would have been instructive to study changes in span of control. Unfortunately, the data only contains information about job level, not on who is the boss of whom.

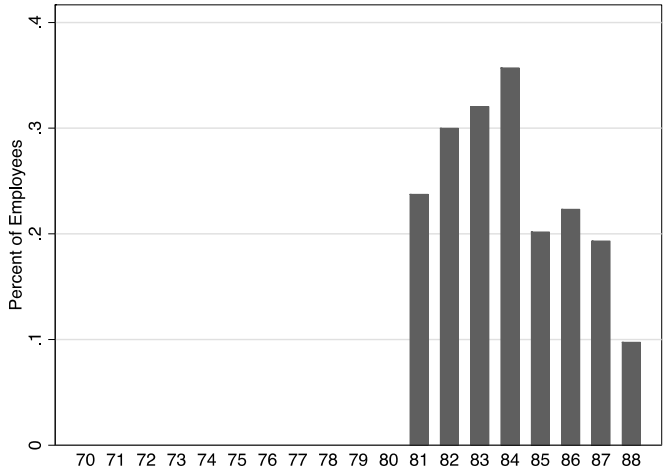
additional high-level managers to implement). We return to this point in Section VI when we consider how the firm may have responded to the law change through changes to its organizational hierarchy.

These three pieces of evidence point to a substantial change in the performance management system immediately following the law change. It is as if the firm hit pause on its performance management system following the law change, reinvested in a new system, which it then piloted before distributing it companywide three years later.

Bonus Payments

The introduction of bonus payments in the post-period shows seemingly direct evidence of movement toward a pay-for-performance system. In the pre-period, the data only contain information on salary, yet starting in 1981, the data include both salary and bonus payments.[16] Figure XI shows the percent of employees who receive a bonus by year. These bonus payments are not restricted to the highest-level employees. Figure XII shows how receipt of bonus varies by job level over time; even some employees at the lowest job level received a bonus payment.

Figure XI: Receipt of Bonus Pay Over Time

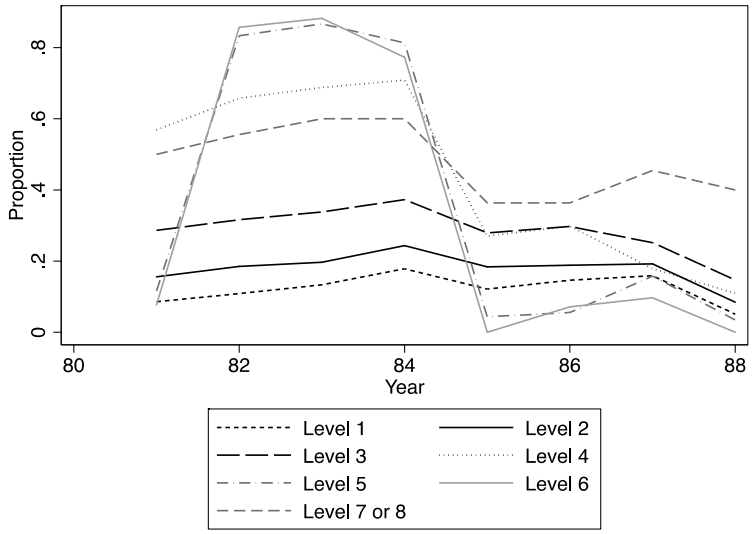


Notes: Bonus pay is not a recorded data field prior to 1981.

[16] While it is likely that the firm distributed bonuses to high-level executives prior to 1981, the scope of these payments does not appear to have been sufficient prior to 1981 to warrant inclusion in personnel records.

It could be that lack of data on bonus payments prior to 1981 is a missing variables issue (i.e., bonuses prior to 1981 was inadvertently left out of data collection). However, given that compensation was a focus of the initial analysis of these data (Baker, Gibbs & Holmstrom 1994a, 1994b), this occurrence seems unlikely. Further, we can rule out the possibility that bonus payments and salary were combined into one pay measure labeled salary prior to 1981 given that the data show evidence of bonus payments being added on top of salary (see Appendix Figure A.3).

Figure XII: Receipt of Bonus by Job Level Over Time



Introduction of bonus payments is not sufficient evidence of pay-for-performance incentives given that bonuses could be allocated in ways unrelated to performance, such as by seniority. For this reason, we relate receipt of bonus and bonus amount to performance ratings using regression analysis and present the findings in Table V. For both receipt and amount, we find that including performance information significantly improves the explanatory power of the model (column 2 versus 1 and column 5 versus 4). The likelihood of receiving a bonus increases substantially with performance ratings; receiving a one-point higher rating increases the likelihood of receiving a payment by 13.3 percentage points relative to a mean of 25.5 percent (column 2). The amount of bonus also substantially increases with one's performance rating such that those with a one-point higher rating receive nearly $7,000 more in bonus payments on average (column 5). Columns 3 and 6 show some evidence of non-linearity in the relationship between bonus

payments and performance such that higher ratings are rewarded disproportionately more. Overall, the evidence is strongly consistent with the firm using bonus payments as part of pay-for-performance incentives.

Table V: Bonus payments and performance ratings

	Received Any Bonus			Amount of Bonus		
	1	2	3	4	5	6
Performance rating		0.133**			6956**	
		(0.004)			(528)	
Performance = 1 or 2			-0.058**			-5129+
			(0.016)			(2868)
Performance = 4			0.127**			8749**
			(0.007)			(756)
Performance = 5			0.272**			14783**
			(0.009)			(1109)
R-squared	0.110	0.151	0.152			
log-likelihood				-66698	-66272	-66263

Notes: Columns 1 through 3 use receipt of bonus as the DV and estimate the coefficients using OLS regression, while the DV in columns 4 through 6 is dollar amount of bonus and is estimated using a tobit model with censoring at 0. Controls include quadratic in age and indicator variables for gender, race, educational attainment, job level, new hire, and calendar year. Sample is restricted to availability of performance and bonus data (i.e., years 1983 to 1988). N = 21.495. Standard errors clustered by employee.
+ p-value < 0.10; * p-value < 0.05; p-value < 0.01.

Raises

A movement toward pay-for-performance incentives can also be reflected in how the firm distributes annual pay raises. Namely, greater use of pay-for-performance incentives implies that pay changes will be closer aligned with performance in the post-period relative to the pre-period. Table VI shows a positive relation between performance and salary growth in column 1. In column 2 we introduce an interaction between performance ratings and a dummy for the post-period years and find a positive coefficient on the interaction term, which shows that performance is more closely linked to salary growth in the post-period relative to the pre-period. This pattern is also present when we use indicator variables for performance ratings values (columns 3 and 4) in that the pay change is

significantly lower for those who received 1s or 2s (relative to a rating of 3) in the post-period as compared to the pre-period, and significantly higher for those receiving 4s or 5s. In columns 5 and 6 we focus on the highest performers (those with a rating of 5) and confirm that they are rewarded even more in the post-period relative to the pre-period.

Overall, the empirical findings regarding changes in the drivers of pay in the post-period relative to the pre-period as well as corroborating direct evidence of changes in the performance management system are strongly consistent with the predictions stemming from our model. The collected evidence suggests, from multiple vantage points, that the BGH firm weakened its long-term incentive contract and strengthened its pay-for-performance incentive system following the change in law governing mandatory retirement policies.

Table VI: Raises and performance ratings by time period

	1	2	3	4	5	6
Performance rating	0.025**	0.019**				
	(0.000)	(0.001)				
Post x Performance		0.008**				
		(0.001)				
Performance = 1 or 2			-0.043**	0.013		
			(0.002)	(0.020)		
Post x Performance = 1 or 2				-0.058**		
				(0.020)		
Performance = 4			0.025**	0.018**		
			(0.001)	(0.001)		
Post x Performance = 4				0.009**		
				(0.001)		
Performance = 5			0.048**	0.037**	0.028**	0.022**
			(0.001)	(0.001)	(0.001)	(0.001)
Post x Performance = 5				0.014**		0.009**
				(0.002)		(0.001)
Constant	0.250**	0.275**	0.324**	0.331**	0.353**	0.356**
	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)
R-squared	0.329	0.331	0.33	0.332	0.298	0.299

Notes: LHS variable is $[\ln(\text{salary})_t - \ln(\text{salary})_{t-1}]/\ln(\text{salary})_{t-1}$. OLS regression that also includes quadratic in age and indicator variables for gender, race, educational attainment, job level, and calendar year. Only includes years 1974 to 1979 and 1983 to 1988 due to substantial missing performance data in other years. Standard errors clustered by employee. N=30,505. + p-value < 0.10; * p-value < 0.05; p-value < 0.01.

Section VI: Beyond the Model: Change in MR Law and Promotion Incentives

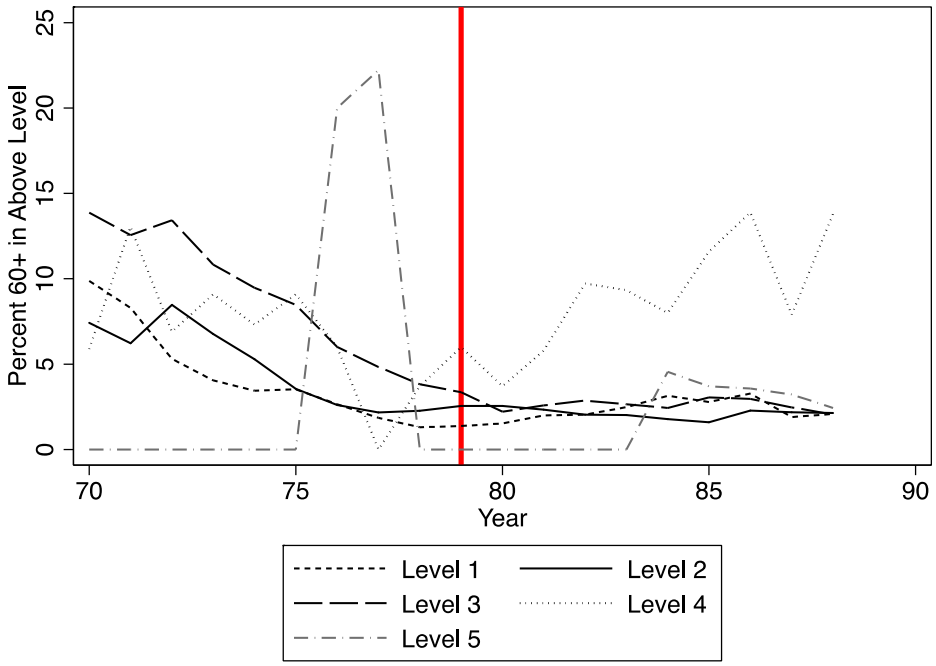
We find compelling evidence that extending the allowable mandatory retirement age contributed to the firm strengthening the role of employee performance ratings in pay decisions. However, a strict focus on pay practices may obscure other important dynamics in the firm regarding incentives. In particular, a direct implication of the law change is that (at least some) older employees are expected to stay longer in their jobs. Because older employees are disproportionately located in higher job levels due to their longer careers, they potentially impose slot constraints and hamper promotion incentives for younger employees.[17] If the firm seeks to keep total incentives constant (Gibbons and Murphy 1992), then the firm needs to actively implement policies to counteract these dampened incentives.

The elimination of mandatory retirement at age 65 provides a unique opportunity to assess whether firms simultaneously manage these two dimensions—pay and promotion—given that the law's effect on promotion opportunities varied across employees, i.e., based on whether there was a higher or lower proportion of older employees in one's promotion track.

To empirically address whether the firm actively manages these two incentive dimensions, we need a measure of heterogeneity across employees in terms of the effect of the law change on slot constraints (or fewer promotion opportunities). We construct a new variable called "60+ Above" that measures the percent of employees in the above job level aged 60 or older. When the mandatory retirement policy of age 65 was in effect, these employees would exit the firm in the next few years with certainty. When the law changed, this was no longer the case. Figure XIII plots the variable "60+ Above" by job level over time. The figure shows variation in the variable's value over time and by job level. In the pre-period, "60+ Above" is declining overall, while in the post-period it is relatively flat or increasing. In the post-period, job level 4 seems to have been most affected by the law change (i.e., a notable increase in "60+ Above" in post-period).

[17] Bianchi et al. (2018) consider how unexpected changes in pension eligibility in Italy affect wages and promotions of younger employees, finding evidence that the effect varies based on whether the firm is growing or contracting.

Figure XIII: Percent 60+ Above by Job Level and Calendar Year



Notes: 60+ Above is the percent of employees in the above job level who are age 60 or higher.

We evaluate promotions (rate and pay premium associated with promotions) taking into account this heterogeneity. Table VII shows statistically significant evidence of heterogeneity across employees in terms of promotion and promotion premium based on exposure to employees age 60+ in the above job level in the post-period relative to the pre-period. Namely, having greater exposure to age 60+ employees in one's promotion track is associated with a lower promotion likelihood in the post-period relative to the pre-period (column 2). At the same time, there is evidence of a higher pay premium associated with promotion in the post-period relative to the pre-period for those with greater exposure to older employees in their promotion track (positive coefficient on three-way interaction term in column 4).

Table VII: Promotion and promotion premium based on employees age 60+ in above job level

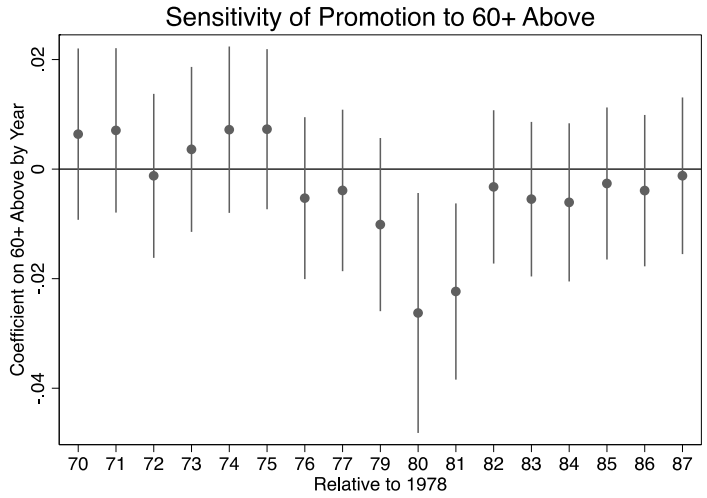
	Promotion		Salary Growth	
	1	2	3	4
Age 60+ above	0.0011	0.0039**	0.0001	-0.0005+
	(0.0007)	(0.0009)	(0.0001)	(0.0002)
Post x Age 60+ above		-0.0052*		0.0010*
		(0.0013)		(0.0003)
Post x Promoted				-0.0015
				(0.0022)
Post x Promoted x 60+ above				0.0018*
				(0.0005)
Promoted x 60+ above				-0.0008
				(0.0003)
Promoted			0.0454**	0.0461**
			(0.0007)	(0.0019)
R-squared	0.135	0.136	0.303	0.303

Notes: LHS variable varies by column. Columns 1 and 2 are an indicator for promotion; columns 3 and 4 are $[\ln(\text{salary})_{t+1} - \ln(\text{salary})_t]/\ln(\text{salary})_t$, OLS regression that also includes quadratic in age and indicator variables for gender, race, educational attainment, job level, and calendar year. Standard errors clustered by job level and year. + p-value < 0.10; * p-value < 0.05; p-value < 0.01

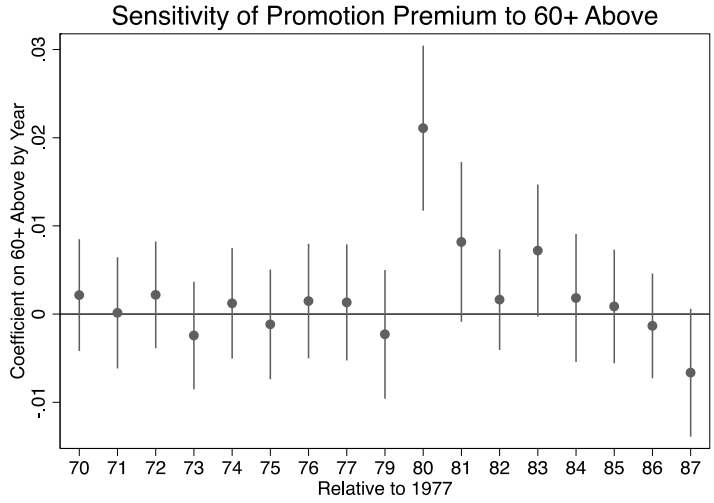
We allow the relationship between "60+ Above" and the promotion probability as well as the promotion pay premium to vary by year. We plot the findings in Figure XIV, which clearly shows that the two effects—promotion chances and promotion pay premium—are mirrors of each other. The transitory decline in the gradient between "60+ Above" and promotion rates in the post-period is paired with an increase in the gradient between "60+ Above" and promotion premium.

Why is the effect transitory? Perhaps the firm was able to neutralize the effect of the law change on promotion rates by changing its organizational structure. As such, this could be another reason for the increase in the proportion of employees in top manager positions following the law change as previously shown in Figure X.

Figure XIV: Variation in Promotion Rates and Promotion Prize by Exposure to Age 60+ Employees by Year



a) Promotion Rates



b) Promotion Premium (Salary Growth)

Notes: LHS variable for Figure XIVa is an indicator for promotion and for Figure XIVb is $[\ln(\text{salary})_{t+1} - \ln(\text{salary})_t]/\ln(\text{salary})t$. Plot of coefficients on year x 60+ Above interaction terms from OLS regression also include quadratic in age and indicator variables for gender, race, educational attainment, job level, and calendar year. Standard errors clustered by job level and year.

Overall, these findings provide evidence consistent with the firm addressing the change in promotion incentives induced by the law by increasing the pay premium associated with the promotion (at least temporarily). Hence, the firm seems to actively considering and balancing promotion incentives across employees.

Section VII: Conclusions

The expansion of age protections under ADEA in the late 1970s was intended to facilitate the labor supply of older workers in the U.S. We present a theoretical framework and compelling empirical evidence consistent with the law change serving as a catalyst for two major labor market trends that persist even today—a reduction in long-term employment and the increased use of pay-for-performance contracts. While these trends likely already had some footing in the labor market given that not all employees were covered by mandatory retirement policies at the time of the law change, our analysis reveals that the law change had the capacity to abruptly change the incentives used by firms as revealed by the response of the BGH firm.

Following the extension of the allowable mandatory retirement age, we find that the BGH firm weakened its long-term incentive contract by flattening the age-pay profile, effectively reducing the returns to tenure. At the same time, it strengthened its use of pay-for-performance incentives, including the introduction of performance-based bonuses and greater reliance on performance assessments in determining annual pay increases. This change was not costless. The data suggest that the firm invested in a multi-year change to its performance management system, resulting in a more granular distribution of performance ratings that is consistent with the greater monitoring requirement of pay-for-performance incentives. Changes in incentives were also accompanied by an increase in separation rates; some of this increase seems to be due to better culling of employees.

The law change also provides a novel opportunity for assessing whether firms consider and adjust to employees' career incentives. Because the law change imposed slot constraints by relaxing the employment constraint faced by older employees, the reduction in promotion opportunities varied across employees based on their exposure to older employees in their promotion track. We find that the firm responded in a manner consistent with considering the total incentives (pay and promotion) faced by employees. Those who experienced larger reductions in promotion opportunities where met with higher promotion pay premiums, at least in the short run. In the long run, the data are consistent with the firm expanding promotion opportunities through changes to the firm's hierarchical structure.

It is possible to consider the use of data from a single firm as a key limitation of the paper as such an approach limits the generalizability of the findings across firms. At the same time, having data from a single firm is a key aspect underlying the paper's contribution, namely taking a careful look at how the internal workings of the firm respond to changes in the legal environment. Detailed examination of incentives, performance assessment, and organizational structure would not be possible with national employee surveys. Further, the BGH firm provides proof of concept for key theories within personnel economics and illuminates a firm's strategic response in a way not yet examined.

References

Baker, George, Michael Gibbs, and Bengt Holmstrom, "The Internal Economics of The Firm: Evidence from Personnel Data," The Quarterly Journal of Economics, 109 (1994a), 881–919.

Baker, George, Michael Gibbs, and Bengt Holmstrom, "The Wage Policy of a Firm," The Quarterly Journal of Economics, 109 (1994b), 921–955.

Bianchi, Nicola, Giulia Bovini, Jin Li, Matteo Paradisi, and Michael Powell, "Chains of Opportunity Revisited," NBER Summer Institute, 2018.

Bishop, John, "The Recognition and Reward of Employee Performance," Journal of Labor Economics, 5 (1987), S36–S56.

Clark, Robert L., and Naohiro Ogawa, "The Effect of Mandatory Retirement on Earnings Profiles in Japan," Industrial and Labor Relations Review, 45 (1992), 258–266.

DeVaro, Jed, and Michael Waldman, "The Signaling Role of Promotions: Further Theory and Empirical Evidence," Journal of Labor Economics, 30 (2012), 91–147.

Ekinci, Emre, Antti M. Kauhanen, and Michael Waldman, "Bonuses and Promotion Tournaments: Theory and Evidence," Economic Journal, forthcoming.

Farber, Henry S., "Job Loss and the Decline in Job Security in the United States," in Labor in the New Economy, Katharine G. Abraham, James R. Spletzer, and Michael Harper, eds. (University of Chicago Press, 2010).

Frederiksen, Anders, Fabian Lange, and Ben Kriechel, "Subjective Performance Evaluations and Employee Careers," Journal of Economic Behavior and Organizations, 134 (2017), 408–429.

Frederiksen, Anders, and Elöd Takáts, "Promotions, Dismissals, and Employee Selection: Theory and Evidence," Journal of Law, Economics, & Organization, 27 (2011), 159–179.

Gibbs, Michael, "Testing Tournaments? An Appraisal of the Theory and Evidence," Labor Law Journal, 45 (1994), 493–500.

Gibbs, Michael, "Incentive Compensation in a Corporate Hierarchy," Journal of Accounting and Economics, 19 (1995), 247–277.

Gibbs, Michael, Wallace Hendricks, "Do Formal Salary Systems Really Matter?" Industrial and Labor Relations Review," 58 (2004), 71–93.

Gibbons, Robert, and Kevin J. Murphy, "Optimal Incentive Contracts in the Presence of Career Concerns: Theory and Evidence," Journal of Political Economy, 100 (1992), 468–505.

Kahn, Lisa B., and Fabian Lange, "Employer Learning, Productivity, and the Earnings Distribution: Evidence from Performance Measures," Review of Economic Studies, 81 (2014), 1575–1613.

Lazear, Edward P., "Why Is There Mandatory Retirement?" Journal of Political Economy, 87 (1979), 1261–1284.

Lazear, Edward P., "Salaries and Piece Rates," Journal of Business, 59 (1986), 405–431.

Lazear, Edward P., "Performance Pay and Productivity," The American Economic Review, 90 (2000), 1346–1361.

Lazear, Edward P., and Robert L. Moore, "Incentives, Productivity, and Labor Contracts," The Quarterly Journal of Economics, 99 (1984) 275–296.

Lemieux, Thomas, Bentley W. McLeod, and Daniel Parent, "Performance Pay and Wage Inequality," The Quarterly Journal of Economics, 124 (2009), 1–49.

Manchester, Colleen Flaherty, "General Skills and Employee Mobility: How Tuition Reimbursement Increases Retention through Sorting and Participation," Industrial and Labor Relations Review, 62 (2012), 952–974.

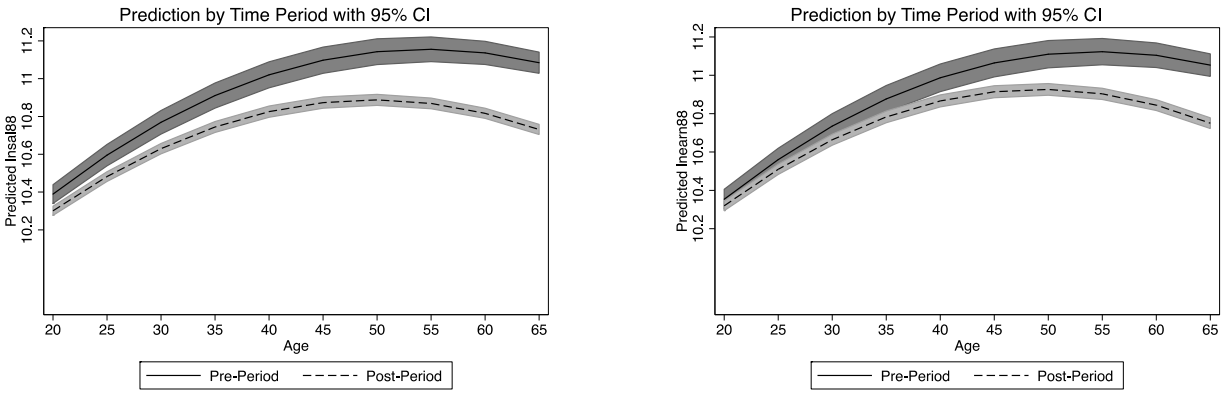
Morrison, Malcolm H., "Changes in the Legal Mandatory Retirement Age: Labor Force Participation Implications," in Issues in Contemporary Retirement, Rita Ricardo-Campbell and Edward P. Lazear, eds. (Hoover Institute Press, Stanford University, 1988).

Neumark, David and Wendy A. Stock, "Age Discrimination Laws and Labor Market Efficiency," Journal of Political Economy, 107 (1999), 1081–1125.

von Wachter, Till., "The End of Mandatory Retirement in the US: Effects on Retirement and Implicit Contracts" Center for Labor Economics Working Paper No. 49, University of California Berkeley, 2009.

Appendix

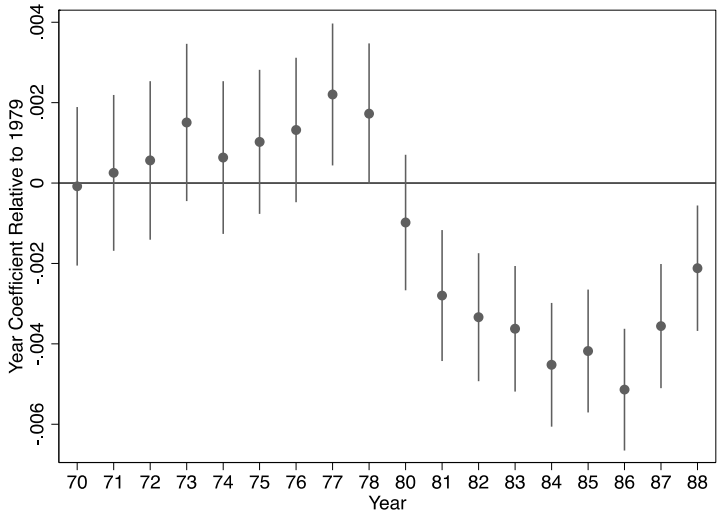
Figure A.1: Effect of Time Period on Age-Pay Profile Using Real Dollars



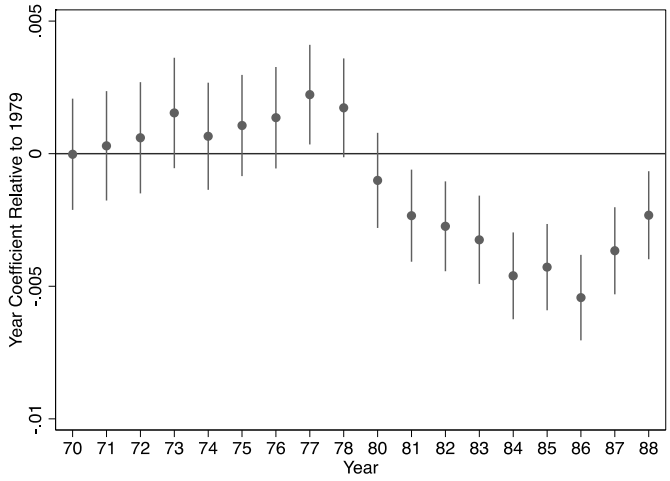
(a) Age-Ln(Salary) Profile (b) Age-Ln(Earnings) Profile

Notes: Predictions by post-period plotted from regression of pay (in 1988 dollars) on quadratic in age and interaction between post-period indicator and quadratic in age and indicators for gender, race, educational attainment, and calendar year.

Figure A.2: Change in Slope of Age-Pay Profile by Year Using Real Dollars



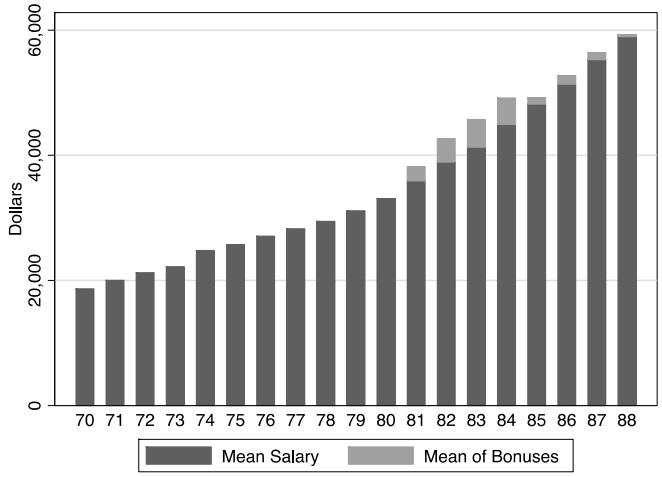
(c) Age-Ln(Salary) Profile



(d) Age-Ln(Earnings) Profile

Notes: This shows the coefficient plot for age by calendar-year interaction terms (relative to 1979) from regression of ln(Salary) in 1988 dollars and ln(Earnings) in 1988 dollars on age, age by calendar year interaction terms, and indicator variables of gender, race, education dummies, and calendar year.

Figure A.3: Average Salary and Bonus Over Time



Notes: This figure plots average salary and bonus payments by calendar year. The plot is consistent with bonus payments being added on top of salary.

Table A.1: Separation and performance ratings by time period

	1	2	3	4	5	6
Performance Rating	-0.035**	-0.019**				
	(0.003)	(0.004)				
Post x Performance		-0.022**				
		(0.005)				
Performance = 1 or 2			0.131**	-0.104**		
			(0.027)	(0.015)		
Post x Performance = 1 or 2				0.251**		
				(0.033)		
Performance = 4			-0.043**	-0.023**		
			(0.005)	(0.008)		
Post x Performance = 4				-0.025*		
				(0.010)		
Performance = 5			-0.066**	-0.041**	-0.033**	-0.020**
			(0.006)	(0.009)	(0.004)	(0.006)
Post x Performance = 5				-0.033**		-0.018**
				(0.011)		(0.007)
R-Squared	0.038	0.038	0.039	0.040	0.034	0.034

Notes: Regression of indicator for separated from firm between t and t+1 on reported variables and quadratic in age, and indicator variables for gender, race, educational attainment and job level. Post equals 0 in years 1970 to 1977; equal 1 in years 1978 to 1987 given that outcome occurs between t and t+1. Years excluded if performance data was missing for at least half the observations (excludes 1970-1973, 1980-1982). N = 27,452. + p-value < 0.10; * p-value < 0.05; p-value < 0.01.