A TEST OF LAZEAR’S MANDATORY RETIREMENT MODEL

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ABSTRACT

This chapter discusses several testable implications of Lazear’s (1979) model of mandatory retirement and tests whether they are consistent with the data, using a sample from the National Longitudinal Survey of Mature Men. Empirical evidence on the close association between firm pension programs and mandatory retirement programs can be interpreted to lend support to Lazear’s model. However, estimates from an econometric model of retirement behavior reject an important implication of the model concerning the relationship between mandatory retirement and the propensity to retire early.

INTRODUCTION

Until it was prohibited by law, mandatory retirement was a prevalent institution in the United States. It is still prevalent in Japan, although its characteristics differ from that which existed in the U.S. A few theories have been proposed to explain why mandatory retirement is a feature of labor market contracts. Lazear (1979) shows how mandatory retirement can provide a solution to the so-called ‘shirking problem’, whereby workers have an incentive to cheat on the job imposing losses on the firm. Cheating can be thought of as stealing or destroying a piece of capital. In Lazear’s model, a mandatory retirement date is part of an optimal labor market contract that minimizes the incidence of...
cheating. This suggests that mandatory retirement is part of an optimal arrangement between a firm and its workers and should not be illegal. Furthermore, the model suggests that, since mandatory retirement is part of a lifetime contract agreed when workers are young, it is not really discriminatory against older workers. Lazear’s model is the most influential and widely accepted explanation for the existence of mandatory retirement.2

Before modeling mandatory retirement, one must define it. The most reasonable definition is that age at which the firm refuses to pay its worker any wage. No model explains why a firm would create such an employment rule. Lazear’s model explains a different but possibly observationally equivalent rule. He defines mandatory retirement as that age when: (1) the firm requires a discrete decrease in the wage rate of its worker even though the worker’s productivity does not discretely fall, and (2) the worker is no longer willing to work at the wage the firm is willing to pay.

There have been some attempts to empirically test Lazear’s model, but they mostly rely upon testing an implication of Lazear’s model that is not directly observable. Namely, they measure wage slopes to test the prediction that the wage curve will be steeper than the productivity curve (see e.g. Lazear (1979), Medoff and Abraham (1981), Lazear and Moore (1984), Hutchens (1987) and Kotlikoff (1992)). Without a measure of productivity, this implication of the model is difficult to test.

There are, however, two other testable implications of the model that should also be consistent with the data, regardless of whether the wage-slope hypothesis is correct. First, Lazear’s model predicts that all mandatory retirement programs should include a pension program with early retirement benefits. The pension is necessary to prevent workers from cheating arbitrarily close to the mandatory retirement age. Early retirement benefits are needed to adjust for unanticipated superior opportunities outside of the firm. Lazear (1979) discusses this implication of the model.

A second implication of the model, not discussed by Lazear, is that those workers who face mandatory retirement should be no more likely to retire before the mandatory retirement age than those who are not subject to mandatory retirement. The details of the reasoning behind this implication rely on the existence of an efficient pension plan and on the reason why some workers are not subject to mandatory retirement. For a large class of reasons, this implication is true while the wage growth implication in Lazear (1979) is not always true.3 The next section discusses this point in detail. Rees and Smith (1991) find in a small sample of university professors that workers subject to mandatory retirement do not retire earlier than workers not subject to mandatory retirement. An alternative test, found in Kahn and Lang (1992,
1995), uses implications of the model for worker preferences for hours in a way similar to this chapter. These tests, however, rely on wages being greater than marginal product near the mandatory retirement age. This is discussed more below as well.

This work tests the two implications of Lazear’s mandatory retirement model about the existence of efficient pension programs and about early retirement behavior. For the first, we present empirical evidence from aggregate historical data on whether mandatory retirement programs are accompanied by efficient pension programs. We test the second implication by estimating a model for the date of retirement using data from the National Longitudinal Survey of Mature Men (NLS).

The study develops in the following way. Section 2 describes Lazear’s model and discusses the implications and testable hypotheses of the model. Section 3 presents empirical evidence on the first hypothesis concerning pension programs. Section 4 describes the econometric framework for testing the second hypothesis regarding the likelihood of early retirement. Section 5 presents the empirical results, some of which prove to be inconsistent with the predictions of Lazear’s model, and Section 6 summarizes the findings.

THE LAZEAR MODEL AND TESTABLE IMPLICATIONS OF THE MODEL

The basic idea of Lazear’s model can be explained in terms of the graph in Fig. 1. Let $t$ index time spent at the firm, $V^*(t)$ be the marginal product of the worker, and $W(t)$ the reservation wage. Workers cheat or shirk when it is in their interest to do so. When a worker cheats, the worker gains $\theta$ where $\theta \sim \phi(0)$ with support $(0, \theta]$, the firm loses a discrete amount, and the worker is immediately fired. Lazear also suggests that this model is equivalent to a model in which the return to cheating is a flow and it takes a finite time for the firm to observe cheating. Cheating is similar to turnover in that there is a discrete loss to the firm and a discrete gain to the worker. However, the distribution of gains to turnover would decline over the worker’s life contrary to Lazear’s assumptions.

The firm chooses a wage schedule $W^*(t)$ that minimizes the incidence of cheating. Lazear argues that the optimal wage schedule will be increasing relative to the marginal product over the worker’s lifetime. The advantage of such a wage schedule is that it makes the present job more valuable than alternative jobs at all $t > 0$ and prevents cheating, except at $t = 0$. However, this schedule implies that there exists a $t^*$ such that $W^*(t) > V^*(t)$ for all $t > t^*$. The firm cannot employ a worker under such a contract indefinitely because it will
be losing profits for all \( t > t^* \). Thus, at some point, the firm must force the worker to take a lower wage or to retire. Lazear argues that the optimal strategy is for the firm to lower the worker’s wage from \( W^*(t) > V^*(t) \) to \( W^*(t) = V^*(t) \) at the point \( t \) where the value of the match becomes negative; where \( V^*(t) = \tilde{W}(t) \) for all \( t > T \). Thus mandatory retirement at \( T \) is equivalent to the required wage reduction at \( T \).

Let \( R(t) \) be the present discounted value of remaining at the firm at time \( t \),

\[
R(t) = \int_t^T \left[ \int_s^t e^{-\gamma \tau} (W^*(s) - \tilde{W}(s)) ds \right] g(\tau) d\tau + [1 - G(T)] e^{-\gamma T - \eta} P \quad (1)
\]

where \( g(.) \) is the density of exit times for reasons other than cheating, \( T \) is the mandatory retirement date and \( P \) is the pension paid at mandatory retirement. The wage schedule (including the pension) is constructed so that \( R(t) \) is always greater than \( \tilde{\theta} \). Actually, this does not require a rising wage schedule (see Becker & Stigler, 1974), but it does require a pension. If there were no discrete amount due at time \( T \), then \( R(t) \) would approach zero as \( t \) approached \( T \). Therefore, there would occur a time \( t < T \) where \( R(t) < \tilde{\theta} \) for all \( \theta \in (0, \tilde{\theta}] \);

**Fig. 1.**
everyone would eventually cheat. A pension worth more than \( \bar{p} \) prevents cheating near \( T \). In fact, historical references concerning the establishment of pensions (rather than mandatory retirement) use Lazear’s shirking argument to explain their existence, especially in regard to preventing strikes.6 Thus, one implication of the model is that all mandatory retirement programs should have an attached pension program.

Next, we need to compare workers subject to mandatory retirement to workers not subject to mandatory retirement. According to Lazear’s model, a properly constructed wage schedule benefits both the firm and worker. The firm reduces cheating and the workers earn more over their lifetime at a firm with mandatory retirement than they would at other firms without. In fact, for all \( V^*, W, \) and \( g \), there exists a long term contract with a mandatory retirement age that benefits the firm and worker. Thus it seems that all firm-worker relationships should have a mandatory retirement age.

Firms may not have mandatory retirement either because there is no shirking problem or because there is another solution to the shirking problem. If there is no shirking problem, then the retirement behavior of workers subject to mandatory retirement should not differ from that of workers not subject to mandatory retirement (as long as an efficient pension plan exists at the firm with mandatory retirement). If there is a shirking problem, then other possible solutions are Becker and Stigler’s bonds, which can be accomplished with pensions or with wage-productivity wedges caused by firm-specific human capital. If firms without mandatory retirement schedules use bonding, then they should also offer efficient early retirement schedules and retirement behavior should not vary between firms using and not using mandatory retirement.

Another possibility might be that workers subject to mandatory retirement have a different exogenous exit density \( g(t) \) than workers not subject to mandatory retirement. However, since workers subject to mandatory retirement know they will lose lifetime rents if they retire early, it is likely that they would have \( g(t) \) densities implying later retirement dates than for workers not subject to mandatory retirement. Anticipating results, we find that workers subject to mandatory retirement retire faster than workers not subject to mandatory retirement; thus we can ignore this issue.

The other possibility is that some firms require much job specific human capital and others do not. Those with more specific human capital create a natural wedge between the wage and productivity at an alternative firm. This gives a worker an incentive not to cheat. Those firms that do not require much job specific human capital cannot use this natural wedge. They might instead institute a Lazear wage schedule with a mandatory retirement age.7 If this is the reason that some firms do not have mandatory retirement, then retirement
behavior should still not differ greatly between workers who are and are not subject to mandatory retirement as long as there is not a severe selection problem of workers into both types of jobs with respect to productivity $V^*(t)$, reservation wages $\bar{W}(t)$, or exogenous exit rates $g(t)$. We assume that, conditional on some observed variables, workers who are or are not subject to mandatory retirement do not differ in terms of the distributions of $V^*(t)$, $\bar{W}(t)$, and $g(t)$.

In Fig. 2, consider the effect of an unanticipated increase in the reservation wage at $t^*$ from $\bar{W}_1$ to $\bar{W}_2$ (say due to an unanticipated disability incurred at $t^*$). Without an early retirement program, the worker would remain at the firm because $W^*(t^*) > \bar{W}_2(t^*)$. This is inefficient though because the firm would offer the worker an early retirement benefit (or severance pay) equal to

$$E(t^*) = \int_{t^*}^{T} \left[ \int_{t^*}^{s} e^{-\kappa(t'-t')}(W^*(s) - V^*(s))ds \right] g(t)dt' + [1 - G(T)]e^{-\kappa(T-t')}P.$$

Fig. 2.
In Fig. 2, this is equal to the area between $W^*$ and $V^*$ from $t^*$ to $T$. The firm is willing to offer $E(t^*)$ because it represents the loss of profits the firm expects from the worker if he stays. The worker is better off by

$$B(t) = \int_{t^*}^{T} \int_{t^*}^{s} e^{-\alpha(t-s)} (W^*(s) - V^*(s)) ds d\tau,$$

the shaded area in Fig. 2. Thus, a second implication of the model is that pension programs be efficient. More formally, we examine the following hypothesis to see if there is empirical support for Lazear’s model:

H1. Mandatory retirement programs should include pension programs as part of the plan and they should be efficient.

Lazear (1983) also makes this point. The early retirement benefits must be paid only to workers who retire early for a reason other than shirking, or the effect of the pension in decreasing the incentive to shirk close to the retirement date is lost.

Finally, consider in Fig. 2 a worker who is not subject to mandatory retirement and is paid his marginal product $V^*$. If his reservation wage increased at $t^*$ to $\tilde{W}^*$, then the value of retiring would be $B(t)$ in equation 2. Thus a worker subject to mandatory retirement (with an efficient early retirement program) should be equally as likely to retire early as a worker not subject to mandatory retirement. Similarly, if the reservation wage falls, he would be willing to work beyond $T$ at a wage equal to $V^*$ for as long as he would have had he not been subject to mandatory retirement. Thus, he would be just as likely to retire late as a worker not subject to mandatory retirement.

Before comparing workers who are and are not subject to mandatory retirement, it is useful to ask why there are workers who are not subject to mandatory retirement. Thus, a test of Lazear’s model that focuses on comparing the retirement behavior of workers is still feasible. This second hypothesis that we test in the paper is

H2. Workers subject to mandatory retirement should be no more likely to retire early than workers not subject to mandatory retirement.

However, the specific human capital explanation for why certain firms do not adopt mandatory retirement practices poses some problems in testing the implication of Lazear’s model concerning relative wage and productivity slopes. Workers at jobs with specific human capital may exhibit wage growth beyond alternate productivity growth. Thus, one could no longer test the
implication of Lazear’s model that the wage growth is steeper than the growth in marginal product using wage growth data.

The empirical evidence suggests that mandatory retirement is not more prevalent in firms that have less job specific human capital. Instead, there seems to be a high correlation between specific human capital and mandatory retirement. Firms that are likely to have more job specific human capital (large firms, for example) frequently had mandatory retirement.

**EVIDENCE FROM AGGREGATE HISTORICAL DATA ON PENSION PLANS**

The first implication of the model that we examine, using aggregate historical data, is whether firms with mandatory retirement plans offer efficient pension plans. Kotlikoff and Smith (1983, p. 29) report that pension coverage increased from 23.8% of private wage and salary employees in 1950 to 44.9% in 1970. Since approximately 80% of those workers subject to mandatory retirement received pensions, approximately at most 55% of the work force was subject to mandatory retirement. Reno (1976) reports that 33% of newly entitled social security beneficiaries were subject to mandatory retirement on their last job. The NLS data used in the next section also has 33% coverage by mandatory retirement.

There is a high correlation between having a pension and being subject to mandatory retirement. Lazear (1979) and Burkhauser and Quinn (1983) find a high correlation between pensions and mandatory retirement using the Retirement History Data. Also, most early pension plans include a mandatory retirement age, and very few mandatory retirement plans were created without a pension. Reno (1976) reports that 80% of newly entitled social security beneficiaries who were still working and who were subject to mandatory retirement were eligible for a pension and 60% of those eligible for a pension were subject to mandatory retirement. It is up to the reader to decide whether this evidence is supportive of Lazear’s model.

We do not know of any historical data on whether pension plans in the 1970s were efficient. Lazear (1983) provides some evidence that pensions provided incentives to retire early, but he can not determine whether they were efficient. To determine whether a plan was efficient would require knowing details of both the firm’s plan and its wage schedule. Thus we can not directly test this part of H1. We also know of no data on whether severance payments could be withheld for malfeasance.
AN ECONOMETRIC MODEL OF RETIREMENT

In this section, we describe the econometric framework used to test hypothesis H2. Under this implication, the existence of a mandatory retirement program should not significantly alter a worker’s retirement behavior. We estimate a model for the hazard rate into retirement. It controls for observable differences among workers, which will mitigate a selection problem into types of jobs if there is one. The model allows for duration dependence and for unobserved heterogeneity.

Let $F(t)$ be the distribution of retirement ages $t$, $f(t)$ the corresponding density function, and $S(t)$ the survival function which represents the probability of staying in a job until age $t$. The continuous time hazard function is $h^*(t) = f(t)/(1 - F(t))$. The derivative $h^*(t)dt$ is the probability of leaving in the interval $(t, t + dt)$ conditional of having stayed until age $t$. The survival function can be expressed in terms of the hazard function as $S(t) = \exp\left(- \int_0^t h^*(s)ds\right)$.

Because we observe individuals only once each year, we write $h^*(t)$ as a stepwise function denoted by $h(t)$, which imposes the restriction that $h^*(t)$ be constant over each interval $(t, t+1)$ and that $\int_{t-1}^t h^*(s)ds = h(t)$. Thus $S(t) = \exp\left(- \sum_{s=t}^{t-1} h^*(s)\right)$. We assume a very general form of a discrete hazard function:

$$h(t) = \exp(X\beta + b(t) + av).$$

The term $X\beta$ accounts for observed differences across individuals, $b(t)$ allows for duration dependence, and $v$ accounts for unobserved heterogeneity. We use the Heckman and Singer (1984) specification for unobserved heterogeneity. In particular, we consider a discrete density with a fixed number of mass points and let the number of mass points increase as the sample size increases. Our results condition on there being two mass points, which implies that $v \sim \text{Bernoulli}(p)$. $a$ and $p$ are parameters to be estimated. We also tried increasing the number of mass points with no significant increase in the likelihood function or change in the parameter estimates. Our results in this respect are similar to Trussell and Richards (1985), Ham and Rea (1987) and Lynch (1989) who found only two points or less were significant in a wide
range of empirical problems. Including the Bernoulli variable in the hazard function yields the survival function

\[ S(t) = \sum_{s=0}^{1} \exp \left( - \sum_{j=1}^{t} h(s, v)(pv + (1 - p)(1 - v)) \right). \]

It has been shown that restricting \( b(t) \) to a functional form can bias estimates of other parameters (Meyer, 1990). Therefore, we estimate \( b(t) \) semi-parametrically by including unrestricted indicator variables for each time period. The usual procedure would be to estimate a value of \( b_t \) for each time \( t \) in the job spell. However, individuals in the sample typically have been in their job for many years, and we would not expect the number of years to have a great effect on the hazard function. We therefore define \( b_t \) in terms of the number of years (0 to 5+) away from a typical retirement age, which we chose to be age 67 (i.e. as \( b_{67-} \)). The hazard function can be written as

\[ h(t, v) = \exp \{ X\beta + b_{67-} + av \}. \]

The probability that a censored individual stays in his job until time \( t \) is

\[ S(t) = 1 - F(t) = \sum_{i=0}^{1} \exp \left\{ - \sum_{j=1}^{t} h(s, v) \right\} (pv + (1 - p)(1 - v)). \]  \hspace{1cm} (3)

The probability that an uncensored individual leaves his job between \( t - 1 \) and \( t \) is

\[ S(t - 1) - S(t) = \sum_{i=0}^{1} \exp \left\{ - \sum_{j=1}^{t-1} h(s, v) \right\} \{ 1 - \exp ( - h(t, v) ) \} \times (pv + (1 - p)(1 - v)). \]  \hspace{1cm} (4)

We estimate model parameters by maximum likelihood. Using equations (3) and (4) and letting \( \alpha \) represent the vector of parameters to be estimated, the likelihood function for an individual is written as

\[ L_i = \sum_{i=0}^{1} [1 - \exp \{ - h(t + 1, v)\alpha \}]^{1-c_i} \]

\[ \times \exp \left\{ - \sum_{j=1}^{t} h(s, v) \{ pv + (1 - p)(1 - v) \} \right\} \]

where
We calculate the covariance matrix (assuming the likelihood function is correctly specified) using the Berndt, Hall, Hall and Hausman (1974) method

$$\text{cov}(\hat{\alpha}) = \frac{1}{N} \left[ \sum_{i=1}^{N} \left( \frac{\partial \log L_i}{\partial \alpha} \frac{\partial \log L_i}{\partial \alpha'} \right) \right]^{-1}$$

where $N$ is the number of observations.

The expected age of retirement, the age at which individuals say they expect to retire, is of particular interest to our model. The Lazear model assumes that there are no sudden events that cause an individual to adjust the date of retirement. The expected age of retirement is a better variable than the actual age to isolate the effects of such sudden changes and to focus on the mandatory retirement age for which workers would contract. Unfortunately, the data on the expected age of retirement is not as reliable as that on the actual age. Individuals tend to give expected retirement ages of 60, 62, 65, or 67. This makes survival analysis methods difficult to use in that dummy variables associated with years when no one expects to retire diverge to $-\infty$. Instead, we just present disaggregated (by mandatory retirement status) Kaplan–Meier hazard functions and survival functions. These should be viewed as descriptive rather than as providing any precise statistical information.

**EMPIRICAL RESULTS**

The model described in the previous section was estimated using a subsample of the National Longitudinal Survey of Mature Men (NLS) used in Berkovec and Stern (1991). The NLS data set contains observations on 5020 men between the ages of 45 and 59 in 1966. These individuals are followed from 1966 until 1983 with interviews conducted approximately every other year. From the original NLS data, a sample of 2497 observations with complete job histories was constructed. A complete job history contains information on job status and individual characteristics for each year in the sample. Job status and individual characteristics were imputed for non-interview years using information in adjacent interview years. Those without complete job histories were deleted from the sample. Each complete job history contains up to 17 years of data. Censored observations were kept up until the point they were censored. We then limited our sample to observations where the respondent was at least
55 years old in 1966. This provided us with 1982 observations observed for 11.6 years on average. In Berkovec and Stern (1991), potential states for each period are full-time work, part-time work, and retirement. For this analysis, full-time and part-time work are aggregated, and the retirement date is the first period of no work. Brief periods of not working surrounded by adjacent periods of work at the same firm are counted as work to distinguish between short-term periods of nonemployment and retirement.

The health variable is constructed from answers to ‘limits’ questions asked each year of the form, “Does your health limit the kind or amount of work you can do?” and “Does your health prevent you from working?” ‘Limits’ questions may have subjective answers, but they are the only health related questions asked in every interview. Health is coded as 0 if the individual is healthy, 2 if unhealthy and 1 if health status is uncertain. In non-interview years, if the individual had the same health status in both adjacent years, it was assumed he had the same status in the noninterview year. Health status is coded as uncertain in noninterview years where the health status in adjacent years is different or for interview years where there is conflicting information.13

Table 1 displays sample moments of the variables used in the retirement model. The mean age in 1966 is 57, 21% of the sample is black, and approximately 28% of periods are spent disabled. Thirty-three percent of the sample is subject to a mandatory retirement clause in their job in 1966. We could not allow for variation in being subject to mandatory retirement over time.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>56.99</td>
<td>5.63</td>
</tr>
<tr>
<td>Black</td>
<td>0.209</td>
<td>0.407</td>
</tr>
<tr>
<td>Disabled</td>
<td>0.552</td>
<td>0.849</td>
</tr>
<tr>
<td>Assets</td>
<td>25.96</td>
<td>43.02</td>
</tr>
<tr>
<td>Married</td>
<td>0.882</td>
<td>0.323</td>
</tr>
<tr>
<td>Mandatory Retirement</td>
<td>0.331</td>
<td>0.470</td>
</tr>
<tr>
<td>Expected Retirement</td>
<td>70.58</td>
<td>14.55</td>
</tr>
<tr>
<td>Retirement Age (included censored observations)</td>
<td>62.31</td>
<td>5.16</td>
</tr>
<tr>
<td>Retirement Age (excluding censored observations)</td>
<td>70.58</td>
<td>14.55</td>
</tr>
</tbody>
</table>

Notes
(1) There are 1982 observations with 11.62 retirement decisions per person.
(2) Disabled is defined as 0 if not disabled, 2 if disabled and 1 if in an intermediate year.
(3) Assets are measured in $1000’s.
(4) Men who say they never expect to retire are included as expecting to retire at age 100.
within in person because a) the mandatory retirement question was not asked every year and b) we were more concerned about being subject to mandatory retirement being endogenous if it was allowed to vary over time than if it was attached to the job one had at the beginning of the sample.

We also include a sequence of five dummy variables measuring the number of years away from the mandatory retirement age. We include these because we think that maybe early retirement provisions of firm policy (possibly tied to pensions) are tied to the firm’s mandatory retirement age. The other explanatory variables are self-explanatory.

Six specifications of the model were estimated, one with b’s and one without, using three samples: (1) the whole sample, (2) the subset of people who were at some point subject to mandatory retirement, and (3) the subset of people who were never subject to mandatory retirement. The appropriate sums of the log likelihoods for the disaggregated (by mandatory retirement) sample are not significantly less than the log likelihoods for the full sample, so we only report coefficient estimates for the full sample in Table 2. Under all specifications, the existence of mandatory retirement significantly increases the hazard rate into retirement. This is seen most easily in Figs 3 and 4. Figure 3 graphs the survival curves (conditional on working at age 55) from ages 55 through 74 for individuals with and without mandatory retirement under both specifications of the model using the joint sample. Figure 4 graphs survival curves (conditional on working at age 55) for the disaggregated samples. Both figures show that workers subject to mandatory retirement retire earlier than those not subject to mandatory retirement. These results are consistent with those in Gustman and Steinmeier (1984).

Three possible explanations for these findings are (a) firms with mandatory retirement policies are more likely to have pensions, and it is the pension that causes workers to retire early (see Burkhauser and Quinn, 1983, for some empirical evidence), (b) there is a set of unobserved variables correlated with the existence of mandatory retirement and the length of work relationships that cause a bias, or (c) workers at firms with mandatory retirement are a select group with higher lifetime marginal products, are paid more, and therefore retire earlier (assuming leisure is a normal good). Argument (a) cannot be tested using NLS data, because the pension data is not usable. In particular, since no pension question is asked in every year, it is impossible to determine whether each individual had a pension. Deleting observations because of missing pension data would certainly cause bias. However, a pension in itself should not cause a worker to retire early. Early retirement incentives of a pension might. Section 2 showed that firms with mandatory retirement should
Table 2. Estimates of Coefficients from Retirement Model with and without Allowing for Duration Dependence

<table>
<thead>
<tr>
<th>Variable</th>
<th>No Duration Dependence (without b’s)</th>
<th>With Duration Dependence (with b’s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>–26.50 (3.98)</td>
<td>–11.87 (8.21)</td>
</tr>
<tr>
<td>Education</td>
<td>–0.033 (0.012)</td>
<td>–0.035 (0.011)</td>
</tr>
<tr>
<td>Age</td>
<td>0.501 (0.139)</td>
<td>0.240 (0.251)</td>
</tr>
<tr>
<td>Age*Age/100</td>
<td>–0.214 (0.118)</td>
<td>–0.179 (0.193)</td>
</tr>
<tr>
<td>Black</td>
<td>–0.271 (0.100)</td>
<td>–0.243 (0.103)</td>
</tr>
<tr>
<td>Disabled</td>
<td>0.525 (0.038)</td>
<td>0.528 (0.040)</td>
</tr>
<tr>
<td>Assets/1000</td>
<td>–0.004 (0.001)</td>
<td>–0.004 (0.001)</td>
</tr>
<tr>
<td>Married</td>
<td>–0.537 (0.090)</td>
<td>–0.538 (0.089)</td>
</tr>
<tr>
<td>Mandatory Retirement</td>
<td>0.870 (0.095)</td>
<td>1.053 (0.099)</td>
</tr>
<tr>
<td>Mandatory Age –1</td>
<td>1.896 (0.181)</td>
<td>1.279 (.208)</td>
</tr>
<tr>
<td>Mandatory Age –2</td>
<td>0.842 (0.191)</td>
<td>0.960 (0.155)</td>
</tr>
<tr>
<td>Mandatory Age –3</td>
<td>0.117 (0.199)</td>
<td>–0.205 (0.223)</td>
</tr>
<tr>
<td>Mandatory Age –4</td>
<td>0.381 (0.165)</td>
<td>–0.060 (0.179)</td>
</tr>
<tr>
<td>Mandatory Age –5</td>
<td>0.192 (0.165)</td>
<td>0.114 (0.199)</td>
</tr>
<tr>
<td>A</td>
<td>1.947 (0.394)</td>
<td>1.669 (0.337)</td>
</tr>
<tr>
<td>Probability</td>
<td>0.712 (0.008)</td>
<td>0.524 (0.016)</td>
</tr>
<tr>
<td>Log Likelihood</td>
<td>–3891.6</td>
<td>–3827.2</td>
</tr>
</tbody>
</table>

Notes
1. Numbers in parentheses are standard errors.
2. There are 1982 individuals with 11.62 retirement decisions per person.
3. ‘Mandatory Age – n’ for n = 1,2, . . . , 5 are dummies measuring number of years away from the mandatory retirement age.
4. ‘A’ and ‘Probability’ are the unobserved heterogeneity parameters.
5. Duration dummies $b_{31}$. were estimated but are not reported.
provide workers with an incentive to retire early only at the same rate as workers not subject to mandatory retirement.

Lazear (1979, p. 1276) suggests that, for example, unions are correlated with mandatory retirement because they increase job tenure. Since we do not include a ‘union’ variable, maybe it causes a bias that explains the results. To see why this argument does not work, consider a simple model,

\[ t_i = X_i\alpha + U_i\zeta + e_i \]

where \( t_i \) is job tenure, \( U_i \) is (unobserved) union status, and \( X_i \) is a set of other explanatory variables including mandatory retirement. The bias on the OLS estimate of \( \alpha \) is \( (X'X)^{-1}X'U\zeta \). Lazear (1979) argues that \( \zeta > 0 \) and mandatory retirement and union status are positively correlated. Thus, the omission of ‘union’ cannot explain the empirical results. The same argument applies to any variable that increases the likelihood of mandatory retirement by increasing expected job tenure.

**Fig. 3.**
Argument (c) would imply that the mandatory retirement age should be earlier than the ‘normal retirement age’ (because the optimality condition for the mandatory retirement age requires that $V^*(T) = \tilde{W}(T)$). Furthermore, one should wonder why those firms without mandatory retirement do not institute a mandatory retirement age. For example, neither the existence of firms without a shirking program nor the existence of firms with significant specific human capital imply (c).

It may be that workers subject to mandatory retirement are not really being paid more than their marginal product. In fact, Kahn and Lang (1992, 1995) provide evidence that workers with twenty or more years of tenure are more likely to want to work fewer hours than to work more hours. This suggests that they are more likely to receive less than their marginal utility of leisure than to receive more than their marginal utility of leisure; under an optimal contract, marginal utility of leisure is set equal to marginal product.

When the dependent variable is the expected retirement age, the maximum likelihood estimation procedure does not work because there are some ages

Fig. 4.
when no one says they expect to retire. Instead we nonparametrically estimate the survival function using a Kaplan–Meier estimator on a smaller sample of 930 observations. The graphs in Fig. 5 show that workers subject to mandatory retirement expect to retire earlier than those not subject to mandatory retirement. We thought a possible explanation for this is that workers subject to mandatory retirement expected to retire when they reached the mandatory retirement age. Figure 6 shows that only at age 65 is a significant amount of retirement due to reaching the mandatory retirement age.

**CONCLUSIONS**

Lazear’s model offers one possible explanation for how wage slopes, pension plans, and retirement dates are jointly determined in the labor market. The model has several implications, some of which can be empirically tested. Our inability to accurately measure productivity slopes makes it difficult to test the implication that wage growth will be steeper than productivity growth. But there are several other implications that can be tested concerning the existence
of pension plans, the efficiency of pension plans, and dates of retirement. Our paper shows how these implications follow from Lazear’s model and examines whether there is empirical support for them. It also entertains other possible explanations that can account for observed patterns.

Section 2 showed that a mandatory retirement program implemented to discourage shirking should include an efficient pension program. The empirical evidence indicates a high positive correlation between the existence of pension plans and mandatory retirement programs, possibly lending support to this prediction of Lazear’s model. We cannot, however, determine whether existing pension programs are efficient because of data limitations.

A second implication of the model that we test is that workers subject to mandatory retirement should be no more likely to retire early than workers not subject to mandatory retirement. We estimate a model for retirement behavior and contrast results for workers who are and are not subject to mandatory retirement programs. Results indicate that workers subject to mandatory retirement are more likely to retire early than those who are not, even at ages well before the mandatory retirement age. This evidence rejects an important prediction of Lazear’s model and suggests that it does not capture the whole

![Hazard Rates for Expected Retirement Date](image)

*Fig. 6.*
story in explaining the mandatory retirement phenomenon. Further investigation is needed to determine whether the model can be revised so that its predictions are more consistent with the data or whether a new approach would be more successful. One might wonder what rejection of Lazear’s model implies about other long-term contract models. Since we are not presenting an alternative explanation for mandatory retirement, it is not yet appropriate for us to conjecture how other models might change. It may be the case that mandatory retirement is caused by some phenomenon independent of the length of a contract. For example, post-doctorates and assistant professorships at the very best economics departments are characterized by an institution very similar to mandatory retirement without having a long-term relationship. We think that research into other causes of mandatory retirement would be worthwhile.

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NOTES

1. Relevant legislation are the amendments to the Age Discrimination in Employment Act in 1978 and 1986.
2. Other explanations rely on declining productivity, morale problems, providing young workers with promotion opportunities, and bringing in ‘new blood’ to the firm. Lazear (1979) criticizes the first two motivations persuasively. The promotion opportunity argument is analyzed by Stern (1987) and was found not to lead to mandatory retirement. However, the last has not received any formal analysis.
3. The model in Lazear and Moore (1984) does not depend upon the reason why some firms do not have mandatory retirement.
4. The notation is slightly different from Lazear’s. The main difference is that pensions are explicitly included.
5. If the wage schedule were flat as in Becker and Stigler (1974), no mandatory retirement age would be necessary. For the remainder of the paper we assume a rising wage schedule to focus on the other implications of the model.
7. The wedge caused by specific human capital accumulation fails to prevent cheating at the retirement date just as Lazear’s wage schedule does. Nevertheless, to the degree that the wedge helps to prevent cheating prior to the retirement date, it plays the same role as Lazear’s wage schedule which was the cause of the mandatory retirement rule.
9. See Fox (1952) or Haber (1978).
10. See Fox (1952), Gordon (1961) or Slavick (1966).
11. Other papers, including Card and Sullivan (1988), Butler, Anderson and Burkhauser (1989), Gunderson and Melino (1990), and Gritz (1993) have used more than two points. A large proportion of researchers, including Heckman and Walker (1990), Behrman, Sickels and Taubman (1990), Johnson and Ondrich (1990) and Light and Ureta (1992) use two points without any reported attempts to try more points.
12. Stern (1989) suggests that a ‘limits’ question does as well as any other health status measure in predicting labor force participation and that it is reasonable to treat it as exogenous.
13. There is some data on duration of disability which can cause conflicts with ‘limits’ questions from prior years.
14. This would cause the dummy variable associated with age to diverge to $-\infty$.

REFERENCES

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