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DELAYED VESTING AND PRIVATE PENSION BENEFITS:
A THEORETICAL FRAMEWORK FOR POLICY ANALYSIS[1]

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SUMMARY

Using a renewal theory approach to describe the employment termination process, and a reward function constructed to unify different plan types, we establish a number of fundamental functions in terms of vesting rules, mobility, plan types, and economic assumptions. These include the termination benefits function, the retirement benefits function, and the loss function due to delayed vesting. To demonstrate the use of the theory as a framework for policy decisions, these functions are then analyzed relative to the effects of delayed vesting on the ultimate benefit to be derived by a group of similar individuals from their career membership in pension plans. The results show that the impact of delayed vesting depends very much on the plan type. It is proved, for example, that in response to a change in the vesting rule, the marginal incremental change in termination benefits would be larger but the marginal relative change would be smaller in final-earnings plans than in career-average plans. It is also shown that the expected incremental benefits associated with a liberalization in vesting rules would be generally higher, and relative variability of termination benefits would be lower in money purchase plans than in defined benefit plans. These observations, coupled with the prospects of market response through changes in plan characteristics, raise some questions regarding the effectiveness of statutory vesting provisions as a primary regulatory instrument for the private pension system as a whole.

I. INTRODUCTION

Much of the recent discussion of private pension plans has centered around the anticipated impacts of changing policies and practices, especially in connection with the Employee Retirement Income Security Act (ERISA) of 1974. While the employers are primarily concerned with the magnitude and unpredictability of pension costs as a function of the payroll, issues of main importance to the employees have been the existence and value of private pension benefits. On the other hand, in addition to questions of distributional equity, the government is concerned with the overall well-being of the private pension system as a regulator and subsidizer.

Pension benefits are expected to increase substantially under ERISA with corresponding increases in pension costs. The incremental cost of liberalization is expected to be higher in money purchase plans than in defined benefit plans, and higher in the non-contributory than in the contributory defined benefit plans. Yet some observers maintain that the recent liberalization did not provide a satisfactory solution to the problem of benefit forfeitures and will not substantially decrease the proportion of retired persons with little or no private pension income (cf. [3]). It is also argued that earlier vesting might prove to be largely illusory for members of contributory defined benefit plans whose own contributions may purchase most of the benefits to which they become entitled during their younger years.

While such observations may be quite valid on intuitive grounds, they remain speculative in nature. An empirical base for verification is lacking because not enough time passed since the introduction of ERISA and long lead times are needed before the effects of changing policies and practices could be measured empirically. A theoretical base is therefore needed to provide a positive framework for policy analysis.

In this paper we present a stochastic model in continuous time to characterize the ultimate benefit to be derived by a group of similar workers from their career membership in pension plans. This characterization is in terms of termination rates, vesting rules, plan types and periods of employment. The employment termination pattern is represented by a renewal process and a reward function is introduced to unify different plan types. A number of basic functions are then deduced to represent termination benefits, retirement benefits and the loss due to delayed vesting. An analysis of these functions lead to a number of conclusions regarding the comparative effects of delayed vesting in different plans. It is proved, for example, that although the absolute marginal change in expected benefits induced by a change in the vesting rule is larger in final earnings plans than in career average plans, the relative marginal change is smaller. It is also shown that the relative variability of lifetime pension benefits would be smaller in defined contribution plans than in defined benefit plans. Numerical examples are presented to illustrate the proved behavior of the basic functions. Some comparative measures of performance are also constructed and analyzed in an effort to isolate the trade-offs between plan types, vesting rules, benefit and contribution levels, and termination rates.

II. THE MODEL

The theoretical model is based on two main assumptions: 1) completed lengths of service in different employments are independent, identically distributed random variables, 2) the vesting rule is uniform with service requirement s. The mobility of labor is taken as independent of the wage-pension mix and plan characteristics. Although there is some empirical evidence in support of this simplification, it is introduced primarily to avoid the estimation problems related to the extent to which varying plan parameters would affect labor mobility (the individual response) or cause compensating variations in wages (the market response). We show in section 3, however, that the model can be used as a normative tool to anticipate the trade-offs between mobility, vesting rules, and plan characteristics. In relation to the first assumption above, we also ignore unemployment and suppose that all the employments are covered by a pension plan. Full coverage and uniformity of vesting rules are approximated in industries characterized by large unionized firms where competition and the collective bargaining process require high rates of coverage and similar or identical vesting rules. These assumptions can be relaxed, however, to incorporate partial coverage, unemployment and portability (see [4]) within the framework of the basic model.

Let $F(x)$ and $f(x)$ denote, respectively, the distribution function and density of completed lengths of service of an individual in different employments. We take $F(x)$ to be time (age) invariant so that the implied rate of termination $\lambda(x) = f(x)/[1-F(x)]$ is strictly tenure-dependent. This simplification can also be removed to allow for time varying length-of-service distributions or fully select termination rates (see [1] and [5]). If X_n denotes the length of the n-th completed employment, then the sequence $\{X_1, X_2, \ldots\}$ forms a renewal process (cf. [2]) with interval distribution $F(x)$.

The related renewal density m(t) can be obtained by solving the integral equation

$$m(t) = f(t) + \int_0^t m(t-u)f(u)du \tag{1}$$

by one of a number of available techniques. We note that in the present context, m(t)dt is the probability that there is an employment termination during (t, t+dt]. The process is relevant over a finite interval (0,t], $t \leq T$, where 0 is the beginning of the working life, t is the end of the predictive period, and T is the time of retirement. A formal extension beyond T is needed for simplicity, however, so that the last employment that terminates with retirement is an incomplete interval (i.e., a backward recurrence time).

Next, we construct a reward function associated with a pensionable length of service. For this purpose, suppose that the related employment commences y time units before retirement, terminates y-u time units before retirement (i.e., it is of length u) with $u \geq s$. We denote by V(y,u) the resulting termination benefit. We also denote by W(x) the wage at x time units before retirement. Note that in both V(y,u) and W(x), time is measured backward from retirement. If T is the length of the working life, then W(T), for example, would be the wage at the beginning of the working life and W(0) the wage at retirement. We take the wage function as given, continuous, and normalized such that W(0)=1. The normalization is for the representation of V(y,t) and of pension benefits as a fraction of the wage at retirement (i.e., the replacement ratio).

The exact nature of the benefit function would depend on the plan type. As examples, we consider defined benefit plans based on career average earnings (CA), defined benefit plans based on final earnings (FE), and money purchase plans (MP). Also, by taking V(y,u)=u, we can investigate the accumulation of pensionable service (PS), or pension benefits in flat benefit plans (FB) up to a multiplicative constant. In these cases, the reward function can be expressed as:

$$(2) \qquad V(y,u) = \begin{cases} u & \text{(PS,FB)} \\ b \int_{y-u}^{y} W(x)dx & \text{(CA)} \\ buW(y-u) & \text{(FE)} \\ \frac{e}{a} \int_{y-t}^{y} e^{rx}\, W(x)dx & \text{(MP)} \end{cases}$$

Here, b is the benefit level, e is the contribution level (both expressed as percentages), a is the cost of unit annuity purchased at retirement and r is the investment rate of return. Since we are concerned with pension benefits rather than pension costs, contributory-noncontributory distinction is not relevant except in circumstances where in a defined benefit plan the accrued benefit is computed as the greater of that implied by the benefit formula or what the accumulated contributions would buy. Reward functions for this and other types of defined benefit plans can also be constructed. For our purposes, of main interest are the two extreme forms of defined benefit plans (CA and FE) and money purchase plans.

We can now represent the accumulation of pension benefits over time by integrating the employment termination process with the reward function. If we let B(t) denote the cumulative vested termination benefits over (0,T], we have:

$$(3) \qquad B(T) = \begin{cases} B(T-u) & \text{if } u < s \\ V(T,u) + B(T-u) & \text{if } u \geq s \end{cases}$$

where u is the duration of first employment. This relationship implies that

$$(4) \qquad E[e^{-\theta B(T)}] = e^{-\theta V(T,T)}[1-F(T)] + \int_0^s E[e^{-\theta B(T-u)}]\, f(u)du + \int_s^T e^{-\theta V(T,u)}\, E[e^{-\theta B(T-u)}]\, f(u)du, \quad T \geq s.$$

where E[.] stands for the expectation of [.]. These relations are based on the observation that if the first employment lasts until retirement (with probability 1-F(T)) then V(T,T) will accrue at time T (first term in (4)). If tenure in the first employment is less than s, then any pension accumulation would have to take place during T-u (second term). If the first employment terminates after s ($s \leq u < T$) then V(T,u) will accrue at time u and total pension at retirement will be V(T,u) plus additional accruals, if any, during T-u. If we now denote by $\mu^{(n)}(s,T)$ the n-th moment of B(T), we obtain

$$\mu^{(n)}(s,T) = (-1)^n \frac{d^n}{d\theta^n} E[e^{-\theta B(T)}]\Big|_{\theta=0}$$

$$(5) \qquad = [V(T,T)]^n[1-F(T)] + \int_0^T \mu^{(n)}(s,T-u)\, f(u)du + \sum_{m=1}^{n} \binom{n}{m} \int_s^T [V(T,u)]^m \mu^{(n-m)}(s,T-u)\, f(u)\, du$$

Given $\mu^{(m)}(s,T)$, m=1,2,...,n-1 ($\mu^{(0)}(s,T)\equiv 1$) (5) is an integral equation on $\mu^{(n)}(s,T)$. It has the solution

$$(6) \qquad \mu^{(n)}(s,T) = K_n(T) + \int_0^{T-s} K_n(t-u)m(u)du$$

where

$$K_n(T) = [V(T,T)]^n[1-F(T)] + \sum_{m=1}^{n} \binom{n}{m} \int_s^T [V(T,y)]^m \mu^{(n-m)}(s,T-u)\, f(u)du$$

and m(u) is the renewal density given by (1). This relation establishes all the moments of career pension benefits recursively.

Basic Functions

From the above result, the expected termination benefits can be expressed as:

$$\text{(7)} \quad \mu(s,T) = V(T,T)[1-F(T)] + \int_{s}^{T} V(u,u)[1-F(u)]m(t-u)du + \int_{y=s}^{T} f(y)[V(T,y) + \int_{u=y}^{T} V(u,y)m(t-u)du]dy$$

We call this function the termination benefits function. By construction, this function converts to pension benefits only those lengths of service that meet the vesting requirement. On the other hand, ERISA requires that an employee must be fully vested in his accrued benefit when he attains the normal or stated retirement age, regardless of the vesting rules in effect, if the eligibility requirements are met. To characterize total retirement benefits, the last employment that terminates with retirement must, therefore, be included irrespective of its length. $\mu(s,T)$ incorporates this employment only if it lasts at least s years.

To account fully for the contribution of the last employment, we let $\bar{B}(T)$ denote the total pension benefits at retirement. We also denote by $U(T)$ the duration of the last employment. As noted before, we regard $U(T)$ as the backward recurrence time at time T related to the renewal process of employment termination. We have that

$$\text{(8)} \qquad \bar{B}(T) = \begin{cases} B(T) + V(u,u) & \text{if } u-du \leq U(T) \leq u < s \\ B(T) & \text{otherwise} \end{cases}$$

On the other hand, from renewal theory we know that

$$\text{(9)} \qquad P[u-du \leq U(T) \leq u] = m(T-u)[1-F(u)]$$

If we now denote by $\bar{\mu}(s,T)$ the expected value of $\bar{B}(T)$, then on passing to expectation s in (8) and using (9) we obtain

$$\bar{\mu}(s,T) = \mu(s,T) + \int_0^s V(u,u)\ m(T-u)[1-F(u)]du$$

It follows by (7) that

$$(10) \qquad \bar{\mu}(s,T) = V(T,T)[1-F(T)] + \int_0^T V(u,u)[1-F(u)]m(T-u)du + \int_{y=s}^{T} f(y)[V(T,y) + \int_{u=y}^{T} V(u,y)m(T-u)du]dy$$

This function is called the retirement benefits function.

Evidently, both $\mu(s,T)$ and $\bar{\mu}(s,T)$ are decreasing functions of s and expected benefits are the highest under full and immediate vesting (s=0). To isolate the loss in benefits due to delayed vesting, we introduce a loss function defined as:

$$L(s,T) = \bar{\mu}(0,T) - \bar{\mu}(s,T)$$

This function turns out to be

$$(11) \qquad L(s,T) = \int_{y=0}^{s} f(y)[V(T,y) + \int_{u=y}^{T} V(u,y)m(T-u)du]dy$$

Higher moments of vested termination benefits could also be constructed from (6). In particular, the second moment is given by

$$(12) \qquad \mu^{(2)}(s,T) = K_2(T) + \int_0^{T-s} K_2(T-u)m(u)du$$

where

$$K_2(T) = V(T,T)]^2[1-F(T)] + \int_s^T \{[V(T,y)]^2 + 2V(T,y)\mu(s,T-y)\}\ f(y)dy$$

In the sequel, we use the related coefficient of variation given as:

$$(13) \qquad C(s,T) = \frac{\sqrt{\mu^{(2)}(s,T) - [\mu(s,T)]^2}}{\mu(s,T)}$$

This measure is independent of the benefit and contribution levels and therefore affords immediate comparisons of the variabilities of benefit under different plans.

III. DELAYED VESTING

In this section, we use the basic functions constructed in section 2 to investigate the effects of delayed vesting. We begin with a general comparison of CA and FE plans through functional analysis. Next, we construct and analyze some comparative measures in an attempt to isolate the trade-offs between vesting provisions, termination rates, plan characteristics and replacement objectives.

As noted earlier, both $\mu(s,T)$ and $\bar{\mu}(s,T)$ are decreasing functions of s while L(s,T) increases with s. This can be seen by forming the first derivatives (denoted by primes) in s; we have

(14) $$\mu'(s,T) = -V(s,s)[1-F(s)]m(T-s)-f(s)[V(T,s) + \int_s^T V(u,s)m(T-u)du]$$

(15) $$\bar{\mu}'(s,T) = -L'(s,T) = -f(s)[V(T,s) + \int_s^T V(u,s)m(T-u)du]$$

Magnitude of the right-hand-side in (14), for example, is the expected decrease (increase) in termination benefits corresponding to a unit increase (decrease) in the service requirement for vesting.

Because of the structural differences, basic functions under defined benefit plans are not directly comparable with their counterparts under money purchase plans. To compare CA and FE plans relative to the impact of delayed vesting, we first write out the basic functions in detail. We take b=1 without loss of generality and use the subscripts CA and FE to indicate the plan type. On substituting the reward function in the basic functions, we have for CA plans that:

(16) $$\mu_{CA}(s,T) = \bar{W}(T)[1-F(T)] + \int_s^T \bar{W}(u)[1-F(y)]m(T-y)dy + \int_{y=s}^T f(y)[\bar{W}(T)-\bar{W}(T-y) + \int_{u=y}^T [\bar{W}(u)-\bar{W}(u-y)]m(T-u)du]dy$$

(17) $$L_{CA}(s,T) = \int_{y=0}^s f(y)[\bar{W}(T)-\bar{W}(T-y) + \int_{u=y}^T [\bar{W}(u)-\bar{W}(u-y)]m(T-u)du]dy$$

where we wrote $\bar{W}(x) = \int_0^x W(u)du$. The expression for $\bar{\mu}_{CA}(s,T)$ would be similar to (16) with the lower limit s in the first integral replaced by 0. Likewise for FE plans we obtain:

$$(18) \qquad \mu_{FE}(s,T) = T[1-F(T)] + \int_s^T y[1-F(y)]m(t-y)dy + \int_{y=s}^{T} yf(y)[W(T-y) + \int_{u=y}^{T} W(u-y)m(T-u)du]dy$$

$$(19) \qquad L_{FE}(s,T) = \int_{y=0}^{s} yf(y)[W(T-y) + \int_{u=y}^{T} W(u-y)m(T-u)du]dy$$

It is safe to assume that W(x) is monotone non-increasing in x. (Recall that W(x) is the wage x time units before retirement and W(0)=1). Consequently, we have for every $t \geq y$:

$$\int_{t-y}^{t} W(x)dx = \bar{W}(t) - \bar{W}(t-y) \leq yW(t-y)$$

This implies immediately that

$$(20) \qquad \mu_{FE}(s,T) \geq \mu_{CA}(s,T) \;,\; \bar{\mu}_{FE}(s,T) \geq \bar{\mu}_{CA}(s,T) \;,\; L_{FE}(s,T) \geq L_{CA}(s,T)$$

For the same reason, we also obtain through (14) and (15) that

$$(21) \qquad |\mu'_{FE}(s,T)| \geq |\mu'_{CA}(s,T)| \;,\; |\bar{\mu}'_{FE}(s,T)| \geq |\mu'_{CA}(s,T)| \;,$$

$$L'_{FE}(s,T) \geq L'_{CA}(s,T)$$

The last set of observations indicate that FE plans are more sensitive to vesting provisions than CA plans in terms of marginal incremental benefits.

We now make the further assumption that $W(x) = e^{-\alpha x}$. This is a reasonable and simple way of representing the long term growth in wages and it leads to some interesting results in the present context. It is also the only wage function that produces the following decomposition:

$$\bar{W}(T) - \bar{W}(t-y) = W(T-y)\bar{W}(y)$$

Using this result in (14) and (15) we find that

$$(22) \qquad \frac{\mu'_{FE}(s,T)}{\mu'_{CA}(s,T)} = \frac{\bar{\mu}'_{FE}(s,T)}{\bar{\mu}'_{CA}(s,T)} = \frac{L'_{FE}(s,T)}{L'_{CA}(s,T)} = \frac{s}{\bar{W}(s)}$$

where $\bar{W}(s) = [1-e^{-\alpha s}]/\alpha$. This indicates that, with respect to all three measures being considered, marginal changes in FE plans induced by a change in the vesting rule would be $s/\bar{W}(s)$ times the corresponding changes in CA plans, irrespective of the period of accumulation.

The right-most equality in (22) implies:

$$L_{FE}(s,T) + C = \int_0^s \frac{u}{\bar{W}(u)} \, d_u L_{CA}(u,T)$$

where C is the integration constant. Since $L_{FE}(0,T)=0$, $C=0$, and, on integrating by parts, we get:

$$(23) \qquad L_{FE}(s,T) = \frac{sL_{CA}(s,T)}{\bar{W}(s)} - \int_0^s L_{CA}(u,T)\left[\frac{\bar{W}(u)-uW(u)}{\bar{W}(u)^2}\right] du$$

This relates the loss under CA plans to the loss under FE plans. It follows that

$$(24) \qquad 1 \leq \frac{L_{FE}(s,T)}{L_{CA}(s,T)} \leq \frac{s}{\bar{W}(s)}$$

where the upper bound is obtained from (23) on noting that $\bar{W}(u) - uW(u) \geq 0$. Further, if we compare (24) with (22), we find

$$(25) \qquad \frac{L'_{FE}(s,T)}{L_{FE}(s,T)} \geq \frac{L'_{CA}(s,T)}{L_{CA}(s,T)}$$

Thus the relative marginal increase in loss is also larger in FE plans.

For $W(x) = e^{-\alpha x}$, we also obtain from (22) the relation:

$$\mu_{FE}(s,T) + C = \int_0^s \frac{u}{\bar{W}(u)} \, d_u \, \mu_{CA}(u,T)$$

Using the initial conditions $\mu_{FE}(T,T) = T[1-F(T)]$, $\mu_{CA}(T,T) = \bar{W}(T)[1-F(T)]$, and integrating by parts, we find

$$C = -\mu_{CA}(0,T) - \int_0^T \mu_{CA}(u,T)\left[\frac{\bar{W}(u)-uW(u)}{\bar{W}(u)^2}\right] du$$

and, therefore,

$$\mu_{FE}(s,T) = \frac{s\mu_{CA}(s,T)}{\bar{W}(s)} + \int_s^T \mu_{CA}(u,T)\left[\frac{\bar{W}(u)-uW(u)}{\bar{W}(u)^2}\right] du \qquad (26)$$

Evidently,

$$\frac{\mu_{FE}(s,T)}{\mu_{CA}(s,T)} \geq \frac{s}{\bar{W}(s)} \qquad (27)$$

and, in view of (22):

$$\frac{|\mu'_{FE}(s,T)|}{\mu_{FE}(s,T)} \leq \frac{|\mu'_{CA}(s,T)|}{\mu_{CA}(s,T)} \qquad (28)$$

Equation (26) establishes the relation between the expected termination benefits under CA and FE plans, (27) provides a lower bound (>1) for the ratio of expected benefits, and (28) establishes the interesting fact that although the absolute marginal change in termination benefits is larger in FE plans, the relative marginal change is smaller. Retirement benefits functions under the two defined benefit plans can also be compared in the same vein.

The basic functions under different plans are plotted in Figure 1 against alternative vesting rules. As noted earlier, both benefits and the loss are expressed as a fraction of the wage at retirement. The length of the working life was taken as T=45 years and the rate of mobility was 0.154 which corresponds to a mean length of service of 6.5 years. Other parameters used in computations were: b=1%, e=6%, α=0.07, r=0.076 and a=9.47. Results under other values of b and e would be proportional to those in Figure 1. The effect of a also appears proportional through the reward function but this parameter depends on the retirement age which was taken as 65.

proved behavior of the basic functions can readily be observed in Figure 1. Using the same parameter values, coefficients of variation of termination benefits were also computed. These are listed in Table 1. As opposed to the means, these measures are independent of the parameters b, c and a. Therefore, they are immediately comparable under all plans. The results show that the relative variability would be the highest under final earnings plans. This conclusion remained the same under other values of the underlying parameters, and can be explained by the fact that in FE plans, benefits associated with a creditable year of service may vary substantially with the age (wage) at termination.

The analysis thus far shows that the impact of the vesting rule cannot be assessed independent of the plan type. A given liberalization in vesting provisions would clearly produce different incremental changes in different plans. More importantly, such changes could be compensated by corresponding changes in plan types and benefit levels. In this context, and given that any unification in plan types may not be forthcoming in the near future, it is of interest to define "equivalent" plans. One possibility is to use the benefit and contribution levels as control variables and expected retirement benefits as the criterion. For this purpose, we now define the following:

$$(29) \qquad b_{CA}^{(FE)}(s,T) = \frac{\bar{\mu}_{FE}(s,T)}{\bar{\mu}_{CA}(s,T)}, \quad b_{CA}^{(MP)}(s,T) = \frac{\bar{\mu}_{MP}(s,T)}{\bar{\mu}_{CA}(s,T)}, \quad b_{FE}^{(MP)}(s,T) = \frac{\bar{\mu}_{MP}(s,T)}{\bar{\mu}_{FE}(s,T)}$$

If we take b=1 in the reward function, the first measure above would characterize the benefit level needed in CA plans to yield the same expected retirement benefits as in unit-benefit FE plans. Similarly, the second and third ratios characterize the benefit levels needed in CA and FE plans to generate the same expected retirement benefits as in MP plans of a given contribution level (i.e., 6 percent).

Using the same parameter values as before, we computed these benefit levels as a function of the service requirement for vesting. The results are shown in Figure 2. It is seen that the benefit level needed in CA plans to generate the same expected retirement benefits as in unit-benefit FE plans is relatively insensitive to the vesting rule and varies in a narrow range. On the other hand, benefit levels needed in CA and FE plans to generate the same expectations as in MP plans of a given contribution level are decreasing functions of the service requirement for vesting with significant variations.

As another illustration of the use of the theory in assessing the impact of delayed vesting, we computed the benefit or contribution levels needed in different plans to generate a given replacement ratio. A frequent assumption regarding total retirement income goal, including Social Security, is half-salary after a career of 30-35 years. Sometimes, this goal is stated in graduated terms depending on the level of final pay. Such guidelines are frequently based, however, on highly idealized scenarios in which there is no job mobility (i.e., a single employer).

Perhaps a more useful approach is to compare disposable incomes before and after retirement. A 1972 Labor Department study shows that at low to moderate income levels, a preretirement income equivalency would be attained by a post-retirement income of about 75 percent of the preretirement total. The Social Security primary benefit can account for about 40 percent of the final earnings in these income groups, leaving 35 percent substantially to private pension benefits. We have therefore used, as reasonable expectations from the private pension system, the replacement ratios of 25, 35 and 45 percent of the final pay. Results under three different rates of mobility (.07, .154 and .290) are presented in Figures 3, 4 and 5 for CA, FE and MP plans, respectively. The replacement goal of 45% would apparently require extremely generous plans except under very liberal vesting provisions. In fact, since benefit levels in defined benefit plans have been usually under 2 percent and the contribution level in money purchase plans seldom exceeds 10 percent in practice, only a 25 percent replacement goal can be expected under the ERISA vesting rule of 10 years of service. Even this requires full coverage, as assumed, and a working life of 45 years.

IV. CONCLUDING REMARKS

From a general perspective, pension dynamics can be discussed as it relates to capital accumulation, mobility and efficient allocation of labor, and income distribution at retirement. The present effort encompasses mainly the last of these issues through a "zero-elasticity" approach. The mobility of labor is taken as independent of the wage-pension mix and plan characteristics. This avoids the estimation problems related to the extent to which varying plan parameters would affect labor mobility (the individual response) or cause compensating variations in wages (the market response).

Conceptually, higher pension benefits and costs induced by a given liberalization in vesting rules may result in higher employee mobility, lower real wages and/or benefit levels, and lower rates of coverage as some pension plans may be terminated. Although they are not allowed for at the outset, the proposed theory can be used as a normative tool to anticipate these important economic trade-offs. Some possibilities in this context have been explored in the paper. Figures 3, 4 and 5 demonstrate, for example, the trade-offs between vesting rules and benefit levels in different plans by identifying the alternative vesting rule-benefit level combinations that result in a given retirement benefit.

The comparative functional analysis in section 3 clearly shows that the impact of delayed vesting cannot be assessed independent of the plan type. It is proved, for example, that while the marginal incremental change in expected termination benefits would be larger in final earnings plans than in career average plans, the marginal relative change would be smaller in response to a change in the vesting rule. It is also shown that while the incremental benefits associated with a given liberalization in vesting rules would be generally higher, relative variability of termination benefits would be lower in money purchase plans than in defined benefit plans. These observations, coupled with the prospects of market response through changes in plan types and characteristics, raise serious questions regarding the desirability and effectiveness of statutory vesting provisions as a primary regulatory instrument for the private pension system as a whole. Regulatory practices should, perhaps, be based on a broader view of the system and provide guidelines for alternative structures that would result in reasonable replacement objectives.

The basic model presented in this paper could be extended to incorporate partial coverage and portability (see [4]). These generalities are important as pension coverage varies from one segment of the labor force to another, and intrasystem portability is typical of multi-employer plans which now involve 30 percent of all covered workers.

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s	CA	FE	MP
0	0.000	0.175	0.000
1	0.056	0.186	0.023
3	0.154	0.248	0.090
5	0.256	0.344	0.183
7	0.374	0.464	0.299
10	0.591	0.692	0.522
15	1.108	1.239	1.052
25	3.209	3.447	3.202

TABLE 1. Coefficients of Variation of Termination Benefits Under Different Plans as a Function of the Vesting Rule

FIGURE 1. Expected Benefits and Loss Under Different Plans as a Function of the Vesting Rule

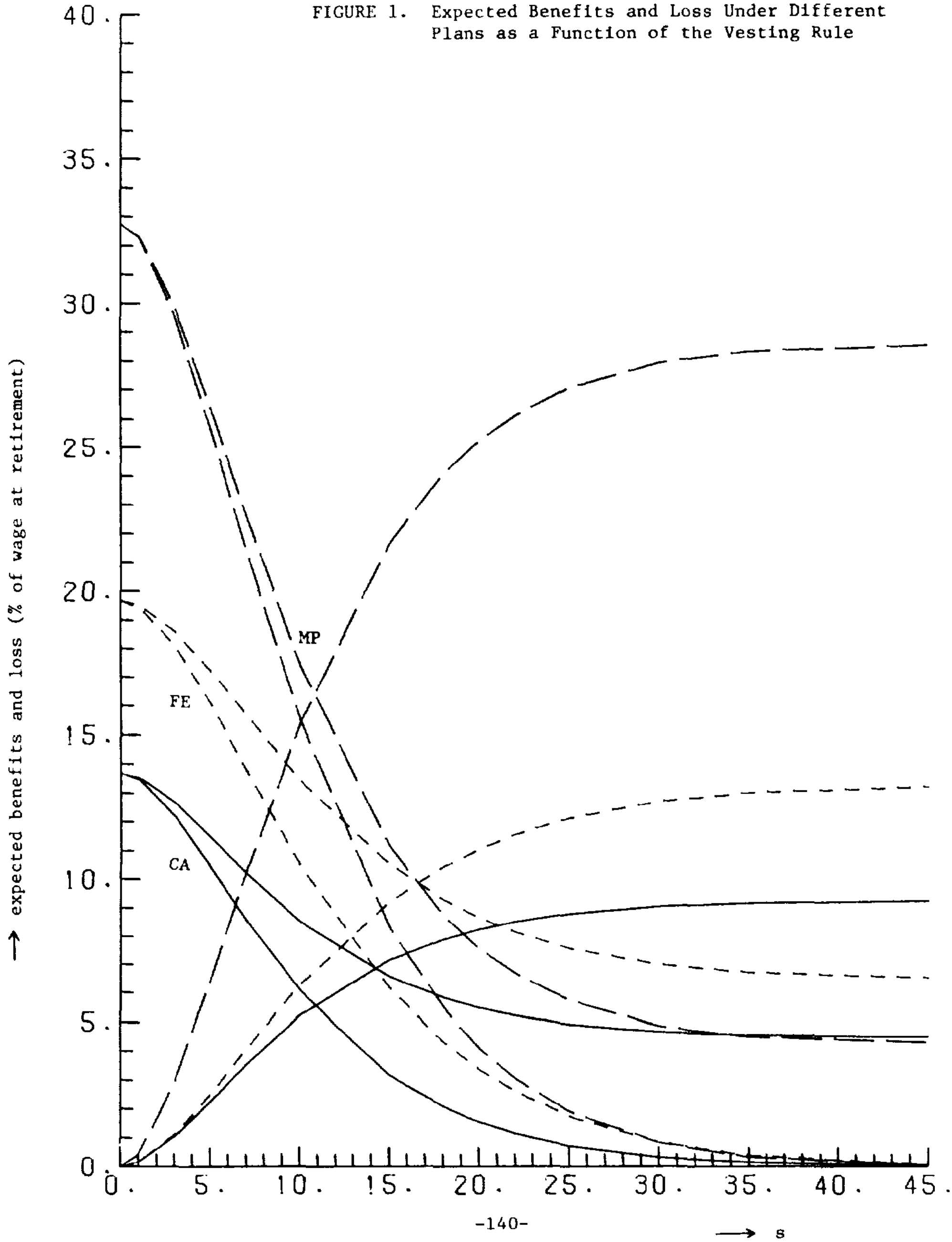

FIGURE 2. Benefit-level Ratio Curves as a Function of the Vesting Rule

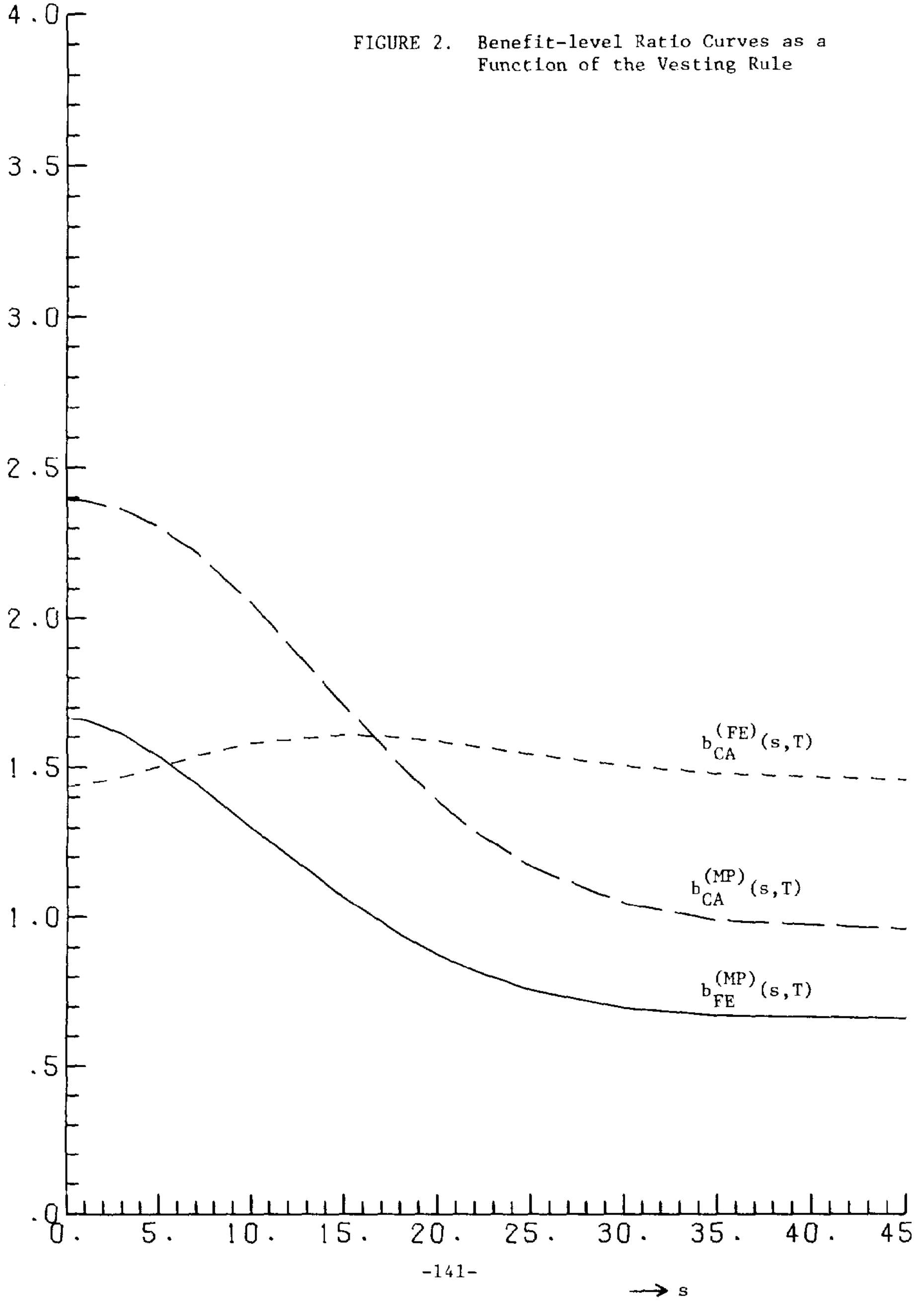

FIGURE 3. Benefit Levels Needed in CA Plans to Achieve Certain Replacement Objectives under Different Mobility Assumptions as a Function of the Vesting Rule

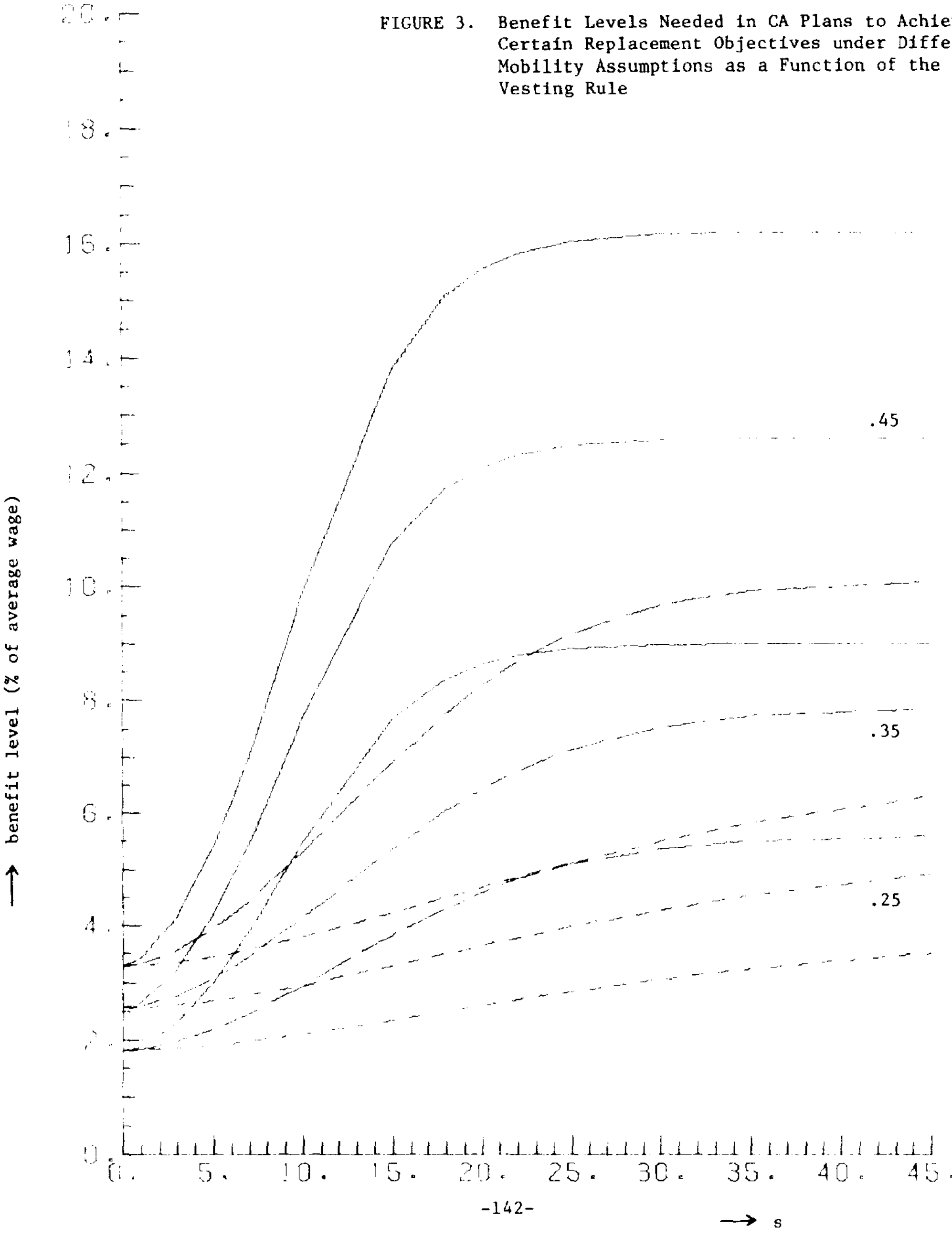

FIGURE 4. Benefit Levels Needed in FE Plans to Achieve Certain Replacement Objectives under Different Mobility Assumptions as a Function of the Vesting Rule

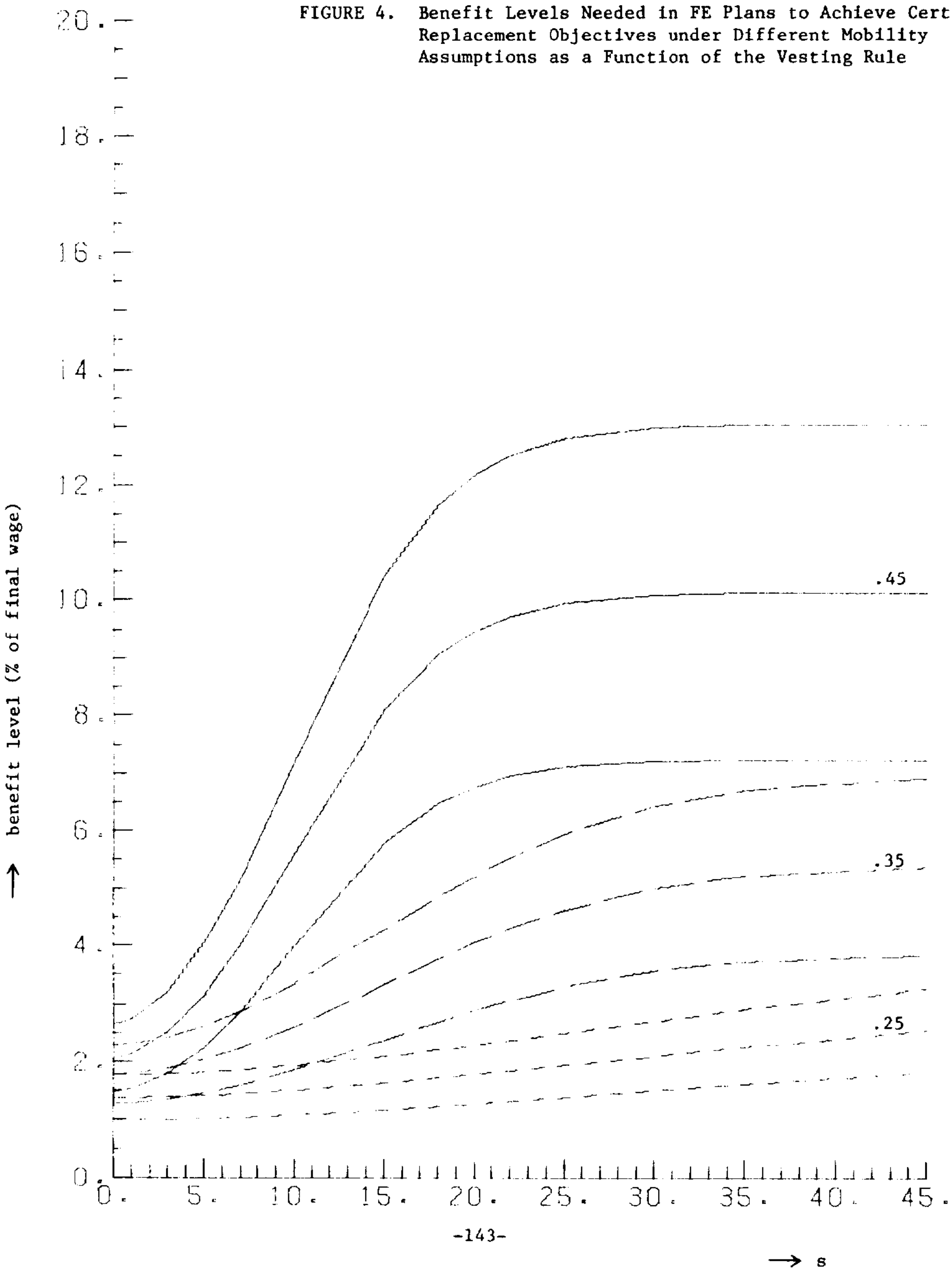

FIGURE 5. Contribution Levels Needed in MP Plans to Achieve Certain Replacement Objectives under Different Mobility Assumptions