Labor Market Rigidities and Unemployment: The Case of Severance Costs

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ABSTRACT

It is frequently alleged that the persistent, high rates of unemployment in many European countries are due, at least in part, to various labor market rigidities. One of these rigidities is the high cost of firing workers, compared with the cost in the United States, or in Europe in the early 1960s.

This paper assesses the empirical importance of severance costs on labor demand. A partial equilibrium model of the firm's employment decision in the presence of significant severance costs is formulated and solved. The theoretical section of the paper identifies the following determinants of the impact of severance costs on labor demand: (1) the size of the required severance payments, (2) the variability and persistence of shocks to labor demand, (3) the expected rate of growth of labor demand, (4) the rate at which workers voluntarily leave the firm to retire or take other jobs, (5) the wage elasticity of labor demand, and (6) the firm's discount rate.

The analytical framework is then used to evaluate the impact of severance costs on the expected cost of hiring a worker, and hence on labor demand. These costs are evaluated for a plausible base case, and the sensitivity of the conclusions to alternative assumptions is investigated.

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by

Michael K. Gavin*

I. Introduction:

The proposition that the current unemployment problem in Europe is largely or even entirely due to excessive real wages has become, if not the conventional wisdom, then at least the working hypothesis of choice for many analysts and, especially, policy advisors. Under this hypothesis employment is determined by labor demand; consequently, much of the recent empirical research on unemployment has focused on the determinants of labor demand. With the resultant estimates of a labor demand schedule, analysts have estimated the real wage consistent with full employment, and have attributed the existing unemployment to the calculated "real wage gap."[1]

These studies use as the firm's cost of employing labor the measured real product wage, including labor taxes paid by the firm. However, many observers have argued that nonwage labor costs resulting from various social policies and labor market rigidities have significantly depressed labor demand in many European economies. (See Balassa (1984) for a rather emphatic attribution of European unemployment to various social policies, many of which fall under the general rubric of "labor market rigidities.") Thus, previous studies on the European real wage problem may well underestimate the impact of excessive labor costs, broadly defined, on the European unemployment problem.

A form of labor market rigidity that is often mentioned in this context is the high cost of firing workers in Europe, compared both with the cost in the United States, and with the European situation in the early 1960's.[2/] There is little doubt that it is much more expensive and difficult to fire workers in Europe than in the United States. This is established, for example, in Kaufman (1979), which documents separation costs in Europe in some detail, showing that they are substantially higher than in the United States. Although Kaufman actually argued that these severance costs were a reason for supposing that unemployment should be <u>lower</u> in Europe than in the United States, the recent situation in Europe has led many observers to argue that the inability to fire workers in future recessions would make firms reluctant to expand employment during years of normal or high demand, thus reducing labor demand and, in a context of rigid real wages, increasing unemployment. Thurow (1985) expresses a typical view:

> [in America, firms] can easily fire unneeded workers. Advance notice need not be given; severance pay need not be paid. Workers can be hired with the knowledge that if they are not needed they can easily be fired. . . . In Europe firings range from difficult and expensive to impossible. This makes it much riskier and expensive to go into business. What is a reasonable risk in America where labour is a variable cost becomes an unreasonable risk in Europe where it is an overhead fixed cost.

These concerns have led to policy responses in some countries. For example, in a 1985 White Paper on employment, the government of the

United Kingdom proposed that the adverse effects of employment protection legislation be reduced by raising the qualifying period for protection against unfair dismissal from six months to two years of tenure with a firm.

However, even if there were consensus on the direction of the impact of severance costs on employment, there is little evidence on its magnitude. Especially if employment protection legislation serves a useful social purpose, against which potentially negative effects on employment must be weighed, the probable size of these employment effects is important. The purpose of this paper is to provide a framework for assessing the impact on labor demand of social policies that make firing workers costly. In Section II the existing literature on the impact of severance costs on employment demand is surveyed. In Section III a simple model of the firm's employment decision, in the presence of significant severance costs, is presented and solved. In Section IV the model developed in Section III is used to make judgements about the likely empirical importance of severance costs for the unemployment problem in Europe. Section V concludes.

II. Survey of the Literature

The empirical literature on the impact of labor market rigidities in general, and severance costs in particular, is surprisingly scarce, given the attention paid to the issue in policy recommendations.

Two kinds of evidence may be identified: surveys of employer attitudes, and more formal, econometric tests. Neither provides unambiguous answers. There have been several surveys of employer attitudes in the United Kingdom. Early surveys, such as Daniel and Stilgoe (1978) and Clifton and Tatton-Brown (1979) tended to downplay the importance of employment protection legislation to employers. However, there was an exception in the Wilson Committee survey on investment attitudes, in which employers expressed strong opposition to such legislation, citing the consequent difficulties in adjusting the size of the workforce to changes in economic conditions. A more recent report by the Confederation of British Industries, however, found that "removing or relaxing redundancy entitlement or individual employment rights would not generally lead to higher employment, but lifting the burden placed on smaller firms might help. (C.B.I (1984) p.3, quoted in Nickell (1985))

Formal econometric studies are scarce. Several authors have noted that firing costs would provide an incentive to shift labor fluctuations from employment changes toward changes in hours. In a cross-country study, Kaufman (1979) found that in European countries, output fluctuations tended to generate larger changes in hours, and smaller changes in employment, than they do in the United States, and interpreted this as evidence that severance costs were important. Nickell (1979) estimated hours and employment equations for two periods: 1955 to 1966, and 1967 to 1976, which correspond to the periods before and after the Redundancy Payments Act was introduced. He found weak evidence that employment fluctuated less, and hours more, in response to demand fluctuations after the introduction of the Act.

With respect to the level of employment demand, rather than its cyclicality, the evidence is somewhat weaker. Nickell (1979) formalizes a model in which flows into unemployment are directly reduced by employment protection legislation, with an offsetting reduction in flows from unemployment into employment. The latter effect occurs because firing costs give firms an increased incentive to screen workers more effectively, because it is expensive to get rid of bad workers. The econometric results in that paper provided weak evidence that employment protection legislation reduced equilibrium employment, and increased the equilibrium unemployment rate. However, the proxy for increases in employment legislation was a time trend, which undermines confidence in the link between his regressions and severance costs.

In his 1982 paper, Nickell used as a proxy for severance costs the number of unfair dismissal cases brought before industrial tribunals, an important, though not the only, cost of firing workers in Britain. This paper found that the increase in unfair dismissal cases from 1966 to 1976 actually lowered the equilibrium unemployment rate by almost a full percentage point, though in a later paper (Nickell (1985)) he argues that this result is very tentative.

The theoretical framework that follows provides further reason for viewing these aggregate time-series regressions skeptically. First, it is shown that the impact of firing costs on employment demand depends upon the state of demand; in high demand conditions employment should be lower than it would be in the absence of severance costs, but in low demand conditions it should be higher. Second, it is shown that proxies for the costliness of severance restrictions which rely on the incidence of firing, such as the number of unfair dismissal cases used by Nickell, may for plausible parameter values be inversely related to the total cost of the severance restrictions. This is because, as the cost of firing increases, firms find it optimal to do less firing. Thus, while costliness of firing restrictions increases, the incidence of firing may fall.

The empirical literature to date does not, therefore, represent a consensus of any sort on the magnitude, or even the direction, of the impact of severance payments on employment. To a large extent, this reflects the difficulty of finding adequate proxies for the cost of employment protection schemes, and the low power of aggregate time-series econometrics. The strategy followed in this analysis is to ground the analysis more firmly in an explicit theoretical model. While the theoretical construct is necessarily incomplete, and therefore will not provide definitive empirical results, it provides substantial insight into the empirical relevance of the problem by articulating the link between severance costs, other structural parameters that characterize the economy, and the employment decision.

III. The Model

The insight that I intend to capture in the following analysis is simple. Severance costs can affect employment in two ways. In periods of low demand, when the firm would otherwise want to lay off employees, imposing a cost of firing will result in fewer layoffs. The severance costs will, then, fulfill the objective of raising employment in states of low demand. However, the very effectiveness of the severance payments policy, by leading the firm to employ an excessive number of workers and by imposing actual severance payments, will reduce profits. The firm will, when deciding whether to hire a worker, consider not only the current wage that must be paid, but also the reduction in future profits associated with the prospect that the severance costs will "bite" in the future. Thus, severance costs impose on the firm an additional expected marginal cost of employment, which will tend to decrease employment demand when the firm would otherwise be hiring.

The purpose of the following model is to capture this element of labor costs, to characterize the nature of the firm's employment decision when the costs are significant, and to make an assessment of the likely magnitude of the costs. The magnitude will, of course, depend on a variety of structural factors including the variability and trend growth rate of labor demand, the short-run wage elasticity of labor demand, the size of the severance payment, the rate of attrition of the firm's labor force due to retirements and other forms of voluntary worker departure, and the persistence of demand shocks. While these parameters cannot be known with certainty, plausible bounds on the likely magnitude of the significance of severance payments can be determined.

Throughout the analysis, it will be assumed that the real wage is exogenously given at a level too high to sustain full employment. Thus, labor is supplied with perfect elasticity at the prevailing, excessive, real wage, and employment is determined by labor demand. The focus of this analysis is not the "natural" or "full-employment" rate of unemployment, which is presumably determined by job search considerations that lie beyond the scope of this paper. I confine myself to the specific question: in the presence of unemployment due to a failure of markets to clear in the short to medium term, what will be the effect on employment of social policies that make it costly to fire workers?

The analysis is partial equilibrium; while I model the firm's determination of output and employment given demand for the firm's output, I do not consider the impact of the firm's employment decision on the level of aggregate demand. Nor do I model the firm's inventory or fixed investment decision, an omission that is potentially significant. To the extent that high labor costs cause firms to substitute capital for labor, the analysis will understate the reduction in labor demand caused by severance restrictions. The restricted analysis can be justified as a reasonable preliminary to a more complete analysis, providing an indication of the incentive caused by severance restrictions to substitute capital for labor.

Finally, this paper does not consider the implications of severance payments for labor supply or wage-setting behavior, considerations of obvious importance. The impact of firing costs for labor supply are unclear. In particular, it would seem to depend upon which of several competing labor-supply paradigms is correct. The labor contracting literature, exemplified by Azariadas and Stiglitz (1983), views firms as bargaining with atomistic workers. This paradigm stresses the risk-sharing aspects of labor contracts, and it is likely, though it has not been demonstrated, that the increase in employment security generated by the firing costs would be at least partially offset by a reduction in the real wage that must be paid to workers.[3/]

On the other hand, recent work by Lindbeck and Snower (1984) shows, in the context of a labor-union bargaining model, that firing costs can increase a union's bargaining power, and help explain excessive real wages and resultant involuntary unemployment. It may well be that the most important impact of severance costs on employment operates through changed real wage demands, rather than lower labor demand at a given real wage. This important extension is left for future research.

The firm is viewed as having a short-run demand for labor schedule, the marginal product of labor, that includes a stochastic shift parameter D_t. The current value of this parameter is known to the firm, but future values are uncertain. For notational convenience, I normalize the marginal product of labor schedule as follows:

1) $MPL_t = w + \alpha(D_t - L_t)$

where: w is the (fixed) real wage,

D_t is the demand shift parameter,

L_t is the amount of labor utilized by the firm.

Thus D_t is, by normalization, the labor input that equates the real wage with the marginal product of labor. This is no more than a convenient normalization. There is, in particular, no implication that the marginal product of labor schedule is causally related to the real wage. Equation (1) can be viewed as a reduced form consistent with a variey of structural interpretations. For example, D_t may be thought of as deriving from shifts in the demand for the firm's output. Alternatively, and in a more classical vein, D_t may represent fluctuations in the technical conditions of production. All that matters for my purposes is that there is an amount of labor, D_t, that would be optimal in period t if the wage were the only labor cost to the firm, that this optimal level of employment fluctuates stochastically over time, and that deviations of actual employment from the optimal level reduce the firm's profits at an increasing rate.

However, the point of this excercise is to explore firm behavior when the wage is <u>not</u> the only labor cost faced by the firm. When firms fire workers they must pay substantial severance and, sometimes, legal costs. It will be assumed that the firm must pay a a fixed amount, c, for each worker fired. Assuming that the firm's workforce "decays" at a constant rate b, as a result of retirement or other forms of voluntary departure, the number of firings can be written:

2) $\text{firings} = \max(0,\ (1-b)L_{t-1} - L_t)$

The firm's profits in period t can then be written:

$$3)\quad \pi_t = Y(L_t;D_t) - wL_t - c\max(0,\ \beta L_{t-1} - L_t)$$

where $\beta = (1-b)$ is the firm's rate of workforce retention.

The firm's period-one problem, then, is to maximize the present value of expected profits:

$$4)\quad \max_{L_1} V(1) = E_1\left\{\sum_{t=1}^{\infty} \pi_t(1+\delta)^{-t+1}\right\}$$

where the expectation is conditional on all information available as of period one, including the period-one demand realization, D_1.

Although the maximization (4) is, in principle, conducted over an infinite horizon, I solve the problem as though the firm's planning horizon were finite. For plausible parameters, the solution to the finite horizon case will be essentially the same as the infinite horizon case. This statement is not formally proven, but it can be justified as follows. The firm's period-one employment decision is affected by period-n outcomes only to the extent that the period-one marginal worker affects the nth period's optimal labor demand or firing decision. This will occur only if the period-one marginal worker is also the period-n marginal worker, which requires (1) no hiring between period one and period n, (2) no firing between period one and period n, and (3) a bad demand realization in period n so that the optimal labor demand is below the period-n labor force, which is (with no hiring and firing between period one and period n) $\beta^n L_1$. For plausible workforce departure rates, the probability that this combination of events will occur becomes very low even for fairly short planning horizons.

I will therefore focus on the solution to the three-period case. Once this case is understood, the extension to a longer planning horizon is conceptually trivial (although computationally cumbersome, because it requires numerical integration in progressively higher dimensional spaces). The numerical simulations discussed below indicate that increasing the planning horizon beyond three periods would have essentially no impact on the results.[4]

In the three-period case, the firm's problem can be written:

$$5)\quad \max_{L_1} V(1) = \pi_1 + E_1(\pi_2)/(1+\delta) + E_1(\pi_3)/(1+\delta)^2$$

$$\begin{aligned} \text{s.t. } \pi_1 &= Y(L_1;D_1) - wL_1 - c\max(0,\ \beta L_0 - L_1) \\ \pi_2 &= Y(L_2;D_2) - wL_2 - c\max(0,\ \beta L_1 - L_2) \\ \pi_3 &= Y(L_3;D_3) - wL_3 - c\max(0,\ \beta L_2 - L_3) \end{aligned}$$

where D_1 is known but subsequent realizations of the demand shift variable are stochastic with cumulative probability function $F(D_2,D_3)$. The expectation is conditional on all information available in period one, so when the demand shift is autocorrelated this probability function depends upon D_1.

When determining period-one employment, the firm must of course consider the period-two and period-three employment decisions because the impact of period-one employment on the firm's value depends, through the firing cost terms, on future employment levels. This is a straightforward problem in dynamic programming; to solve it the firm first considers the period-three employment decision. It determines the optimal period-three employment policy as a function of D_3 and L_2. It then uses this to determine the optimal period-two employment policy by taking the expectation of period-three profits over D_3, and maximizing the discounted sum of period-two and -three profits. This gives period-two employment as a function of L_1 and D_2, which is used to calculate expected period-two and -three profits as a function of L_1. The optimal period-one employment is then the one that maximizes the discounted sum of period-one, -two, and -three expected profits, taking into account the impact of period-one employment on future periods' employment and, therefore, profits.

Period-Three Employment: In period three, labor demand will be adjusted to maximize period-three profits, because there is by assumption no fourth period to worry about. Differentiating period-three profits with respect to period-three employment, we have:

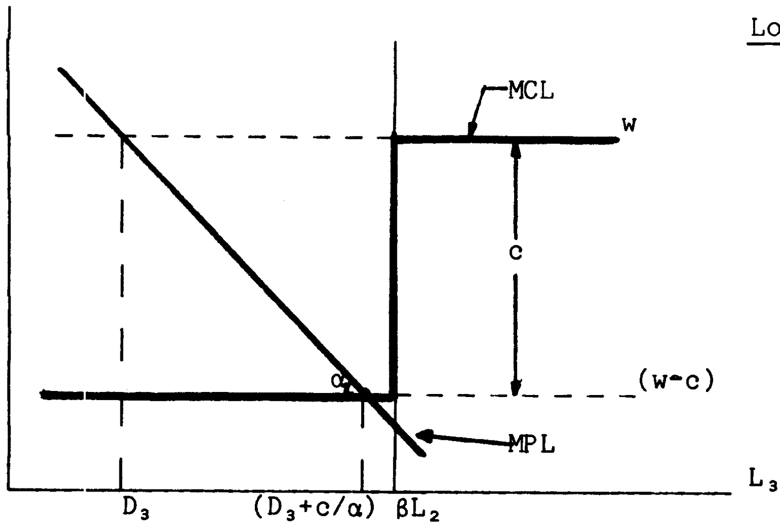
$$6) \quad \frac{d\pi_3}{dL_3} = \begin{cases} (w + \alpha(D_3 - L_3)) - w & \text{if } \beta L_2 < L_3 \\ (w + \alpha(D_3 - L_3)) - (w-c) & \text{if } \beta L_2 > L_3 \end{cases}$$

If $\beta L_2 < L_3$, then a change in employment involves no firing, only hiring, so that the marginal cost of employment is the real wage, w. It thus pays the firm to employ up to the point that the wage equals the marginal product of labor, so that $L_3=D_3$ as it would be without severance restrictions. If, however, $\beta L_2 > L_3$, the marginal cost of labor is not w, but (w-c). This is because changes in employment correspond to changes in the number of workers fired, not hired, so that an increase (decrease) in employment saves (costs) the firm c in severance costs. The appropriate employment policy, then, is to set the marginal product of labor equal to the wage net of the severance cost. Thus, for adverse demand shocks, the firm will indeed be induced to increase employment, relative to the no-severance cost level, as a result of the severance costs.

The derivation of the firm's optimal period-three labor demand can be derived from first-order conditions (6) with the help of Figure One, which depicts the marginal product of labor, MPL, and the marginal cost of labor which is the solid locus MCL. The first order conditions (6) are satisfied at the intersection of the period-three MPL curve and the MCL curve.

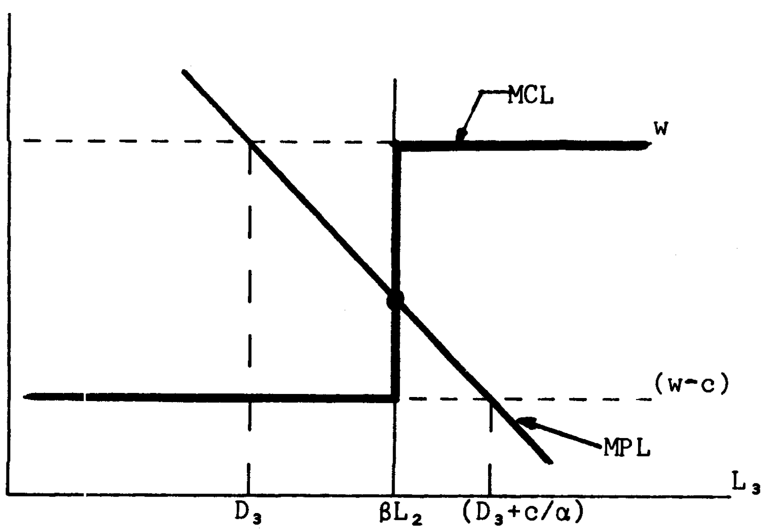
If, as in Figure 1a, demand is low enough so that the MPL curve cuts the βL_2 curve below (w-c), then the optimal level of employment is less than βL_2, so that the marginal cost of employment is (w-c) and the optimal level of employment is (D_3+c/α). If fewer workers were employed, the gap between the marginal product of labor and the wage would be less than c, the cost of firing a worker. Then an increase in employment, which means firing fewer workers, would lead to a "production loss" of (w-MPL) and a "severance cost" gain of c on each worker retained. Since (w-MPL) is less than c, such an increase in

FIGURE ONE



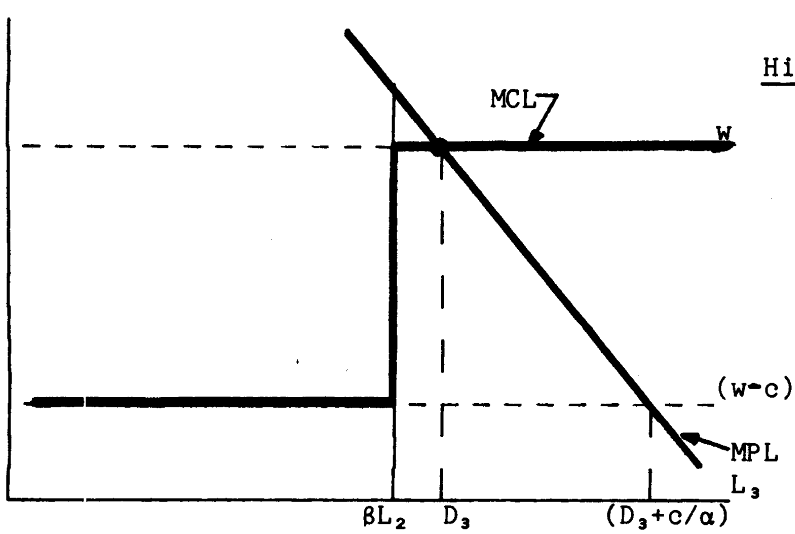
Case a:
Low Demand Realization

$(D_3 < \beta L_2 - c/\alpha)$



Case b:
Intermediate Demand

$(\beta L_2 - c/\alpha < D_3 < \beta L_2)$



Case c:
High Demand Realization

$(D_3 > \beta L_2)$

employment would be profitable. The converse is true when employment is above (D_3+c/α).

In Figure 1c, period-three demand is high enough so that the marginal product of labor curve passes through βL_2 above w. In this case, the marginal product of labor equals the marginal cost at an employment level greater than βL_2, so that the marginal cost is w, and labor demand equals D_3. Thus, when demand is this high, the firm behaves as though there were no severance costs.

In Figure 1b, period-three demand is intermediate so that the MPL curve passes through βL_2 between (w-c) and w. In this case, the marginal cost of labor depends upon whether the firm is contemplating an increase or a decrease in employment. If the latter, then the change in employment is associated with an increase in firing, so that a reduction in employment from βL_2 would save the firm (w-c) in labor costs, but cost the firm a reduction in output equal to the marginal product of labor, which is, in this case of intermediate demand, greater than (w-c). Thus, it would not pay to reduce employment from βL_2. On the other hand, an increase in employment from βL_2 requires hiring new workers, and does not lead to a reduction in the level of firings. Thus, the marginal cost of increasing employment is w, which, in this intermediate demand case, is greater than the marginal product of labor. Consequently, in the intermediate demand case, the firm's optimal employment is βL_2.

The above discussion can be summarized in the following period-three labor demand schedule:

$$7) \quad L_3^* = \begin{cases} D_3 + c/\alpha & \text{if } D_3 < \beta L_2 - c/\alpha \\ \beta L_2 & \text{if } \beta L_2 - c/\alpha < D_3 < \beta L_2 \\ D_3 & \text{if } D_3 > \beta L_2 \end{cases}$$

To summarize, the impact of the severance costs in period three depends upon in which of three regions is the period-three demand shock. If demand is high enough, then there is no effect on the firm's employment or profits. If demand is intermediate, there is no firing, but because the firm is induced to employ an uneconomically large workforce, the firm's profits are reduced. If the demand shock is bad enough, so that the excess of the wage over the marginal product of labor exceeds the firing cost, c, then the firm does fire workers, and its profits are reduced both because of actual severance payments, and because of an excessively large labor force.

A notable feature of this labor demand schedule is that the optimal level of employment is always greater than or equal to what it would be in the absence of severance costs. This is because of the unrealistic assumption that the firm's planning horizon does not extend beyond the current period. We shall see that the impact of severance costs on employment is less positive when the firm does have to plan ahead.

Period-Two Employment: Having determined its period-three employment policy as a function of period-two employment and the period-three demand shock, and the consequences for period-three profitability, the firm can turn to the period-two employment decision. Using equation (7) to substitute for L_3, it is possible to derive an expression for the optimal level of period-three profits, conditional on period-three demand and period-two employment, as follows:

$$
8) \quad \pi_3^* = \begin{cases} (\alpha/2)D_3^2 - c^2/2\alpha - c(\beta L_2 - D_3 - c/\alpha) & \text{if } D_3 < \beta L_2 - c/\alpha \\ (\alpha/2)D_3^2 - (\alpha/2)(\beta L_2 - D_3)^2 & \text{if } \beta L_2 - c/\alpha < D_3 < \beta L_2 \\ (\alpha/2)D_3^2 & \text{if } D_3 > \beta L_2 \end{cases}
$$

In this expression, the first term, $(\alpha/2)D^2$, is what profits would be in the absence of severance costs. The second terms, (c^2/α) and $(\alpha/2)(\beta L_2 - D_3)^2$ for the low-demand and high-demand cases respectively, are the costs to the firm of the overemployment induced by the severance costs. This cost is borne by the firm in both the low- and medium demand cases. The final term, $c(\beta L_2 - D_3 - c/\alpha)$, is the cost of actual severance payments by the firm. These arise only in the low-demand case, when optimal employment is $D_3 + c/\alpha$; to reach this level of employment requires that $(\beta L_2 - D_3 - c/\alpha)$ workers be fired.

In period two, the firm will set employment to maximize the discounted sum of period-two profits and expected period-three profits where, because the firm knows that it will behave optimally in period three, the period-three profit function is given by (8). Denoting $F_3(D_3)$ as the cumulative probability function for D_3 conditional on D_1 and D_2, expected period-three profits are:

$$
9) \quad E_2(\pi_3; L_2) = (\alpha/2)E(D_3)^2 - c \int_{-\infty}^{\beta L_2 - c/\alpha} \{(L_2 - D_3 - c/\alpha)dF_3(D_3) - (c^2/\alpha)\int_{-\infty}^{\beta L_2 - c/\alpha} dF_3(D_3) - (\alpha/2)\int_{\beta L_2 - c/\alpha}^{\beta L_2} (\beta L_2 - D_3)^2 dF_3(D_3)
$$

The first term is what expected profits would be if there were no severance costs. The second term is the expected cost of actual severance payments in period three, which are only paid if D_3 is less than $(\beta L_2 - c/\alpha)$. This cost of severance payments is zero if c is zero, but it also approaches zero (at least for the normal probability function) as c becomes very large. The reason for this is that as c approaches infinity, there are no situations in which the firm would find it optimal to fire a worker. Instead, it will always be forced to accept the cost of excessive employment. The last two terms are the expected cost of the excess employment induced by the severance costs.

Equation (9) gives the impact of the severance payments on gross period-three profitability. However, for the purpose of determining labor demand, what matters is not the impact of severance costs on total profits, but rather the impact of the severance costs on the profitability of labor at the margin. This is, of course, strictly true only if the firm in question remains in business. If firms produce subject to a minimum expected profit condition, then the severance costs may result in bankruptcies, with obvious implications for labor demand. For the remainder of this paper, I abstract from the bankruptcy issue and focus on the labor demand response of firms that are not driven out of business by the severance payments. The reader should bear in mind, however, that the bankruptcy problem may be quantitatively significant.

The firm, in period two, thus cares about the impact on period-two and -three profits of hiring an additional worker. The impact on period-two profits is the marginal product of labor less the wage.

The impact on period-three profits is the derivative of (9) with respect to period-two employment. This can be written:

$$(10)\ \frac{dE(\pi_2)}{dL_2} = -c\beta F_3(\beta L_2-c/\alpha)\ -\alpha\beta\left\{F_3(\beta L_2)-F_3(\beta L_2-c/\alpha)\right\}\left\{\beta L_2-E(D_3|\ D_3\ \epsilon\ \Omega)\right\}$$

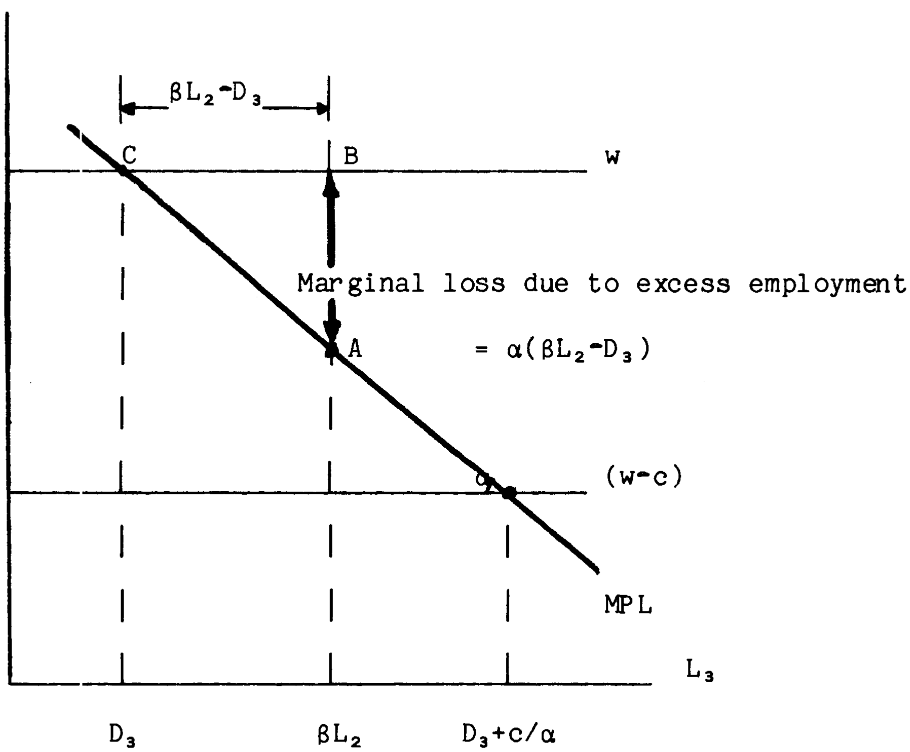
Where $\Omega = [D_3 \text{ s.t. } (\beta L_2-c/\alpha) < D_3 < \beta L_2]$

The first term in the expression in the increase in the expected cost of severance payments in period three due to an increase in period-two employment. An extra employee hired in period two implies β extra employees in period three (ignoring indivisibilities)5/, and if he is fired it will cost the firm $c\beta$. The probability that demand will be low enough to cause workers to be fired in period three is $F_3(\beta L_2-c/\alpha)$, so the expected increase in period-three severance payments due to an increase in period-two employment is the first term of (10). It is increasing in L_2, and is increasing in the variability of the labor demand shock (D_3) if βL_2 is less than the expected value of D_3.

The second term is the change in the expected cost of excess period-three employment from a change in period-two employment. This term follows from mechanistic differentiation of (9), but it can be understood intuitively as well. An increase in L_2 affects period-three employment (and through employment, profits) only if the marginal worker in period 2 is also the marginal worker in period 3. This occurs only if D_3 is in the intermediate case discussed above, that is, only if in period three there are no hirings or firings. If D_3 is below $(\beta L_2-c/\alpha)$, then employment is (D_3-c/α), and if D_3 is above βL_2, then employment is D_3. In either case it is unaffected by L_2. On the other hand, if D_3 is between βL_2 and $(\beta L_2-c/\alpha)$, then period-three employment is βL_2, so that a unit increase in period-two employment raises optimal period-three employment by β.

If D_3 is in the intermediate region, then the marginal reduction in period-three profits due to a marginal increase in period-three employment is, as illustrated in Figure Two, equal to $\alpha(\beta L_2-D_3)$.

Figure Two



The total cost to the firm of overemployment is the triangle ABC. An increase in βL_2 thus increases the total cost of overemployment by the distance $AB = \alpha(\beta L_2 - D_3)$, which means that in the case of intermediate demand under discussion, an increase in L_2 raises the expected cost of overemployment by $\beta\alpha(\beta L_2 - D_3)$.

The expected value of this marginal cost is therefore the probability that the cost will be incurred (that is, that D_3 will be between βL_2 and $\beta L_2 - c/\alpha$) which is $[F_3(\beta L_2) - F_3(\beta L_2 - c/\alpha)]$, times the expected value of the marginal cost given that it does occur, which is $E[\alpha(\beta L_2 - D_3) \mid (\beta L_2 - c/\alpha) < D_3 < \beta L_3]$.

Having calculated the impact of an increase in period-two employment on period-three profits, we can now characterize the firm's period-two employment decision. The firm's objective in period two is to maximize the discounted sum of expected period-two and period-three profits. The first order condition is:

$$11) \quad 0 = \frac{d\pi_2}{dL_2} + \frac{dE(\pi_3)}{dL_2} / (1+\delta)$$

where the expectation on the right hand side of (11) is given by (10), and the marginal profitability of labor in period two is:

$$12) \quad \frac{d\pi_2}{dL_2} = \begin{cases} \alpha(D_2 - L_2) + c & \text{if } L_2 < \beta L_1 \\ \alpha(D_2 - L_2) & \text{if } L_2 > \beta L_1 \end{cases}$$

Because the marginal impact on period-three profits of an increase in period-two employment is necessarily negative, the firm will be induced to reduce period-two employment in order to offset the adverse implications for expected period-three profits of high period-two employment, at the expense of period-two profits.

For notational convenience, define $\phi(L_2)$ as the discounted reduction in expected period-three profits from a marginal increase in period-two employment:

13) $$\phi(L_2) = -\frac{dE(\pi_3)}{dL_2} / (1+\delta)$$

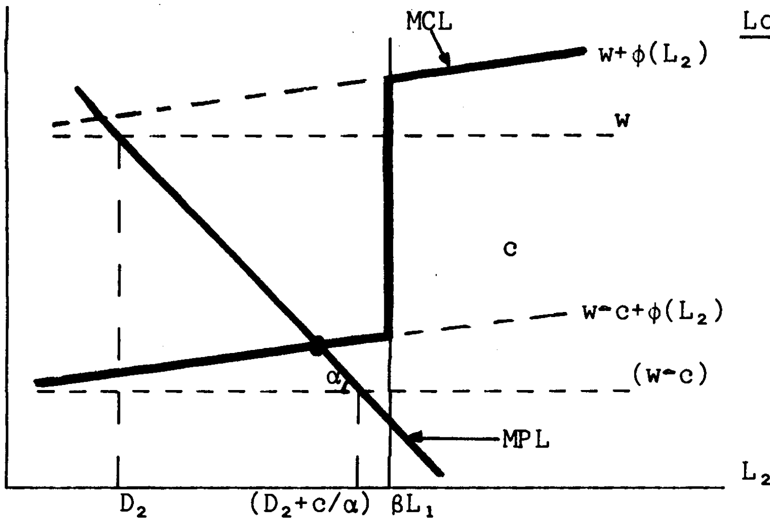
Then the derivation of the optimal period-two labor demand from the first-order condition (11) can be illustrated by Figure Three, which is analogous to Figure One, above. As in Figure One, the first order conditions are met at the intersection of the marginal product of labor curve and the marginal cost of labor curve. However, in this case the firm's marginal cost of labor curve includes a term reflecting the adverse impact on future profitability of an increase in the current period's level of employment. As in the period-three analysis, employment is higher in low-demand realizations than it would be in the absence of severance costs, where "low" means relative to βL_2. However, in contrast to the period-three analysis, employment is reduced in high-demand conditions compared with what it would be without severance restrictions.

Formally, the firm's period-two employment policy can be summarized as follows:

FIGURE THREE

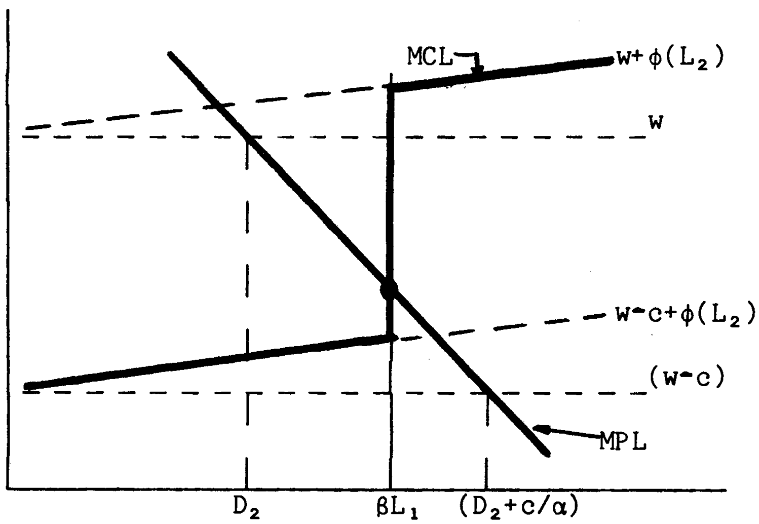
Case a:
Low Demand Realization

$(D_3 < \tilde{D}_2 - c/\alpha)$



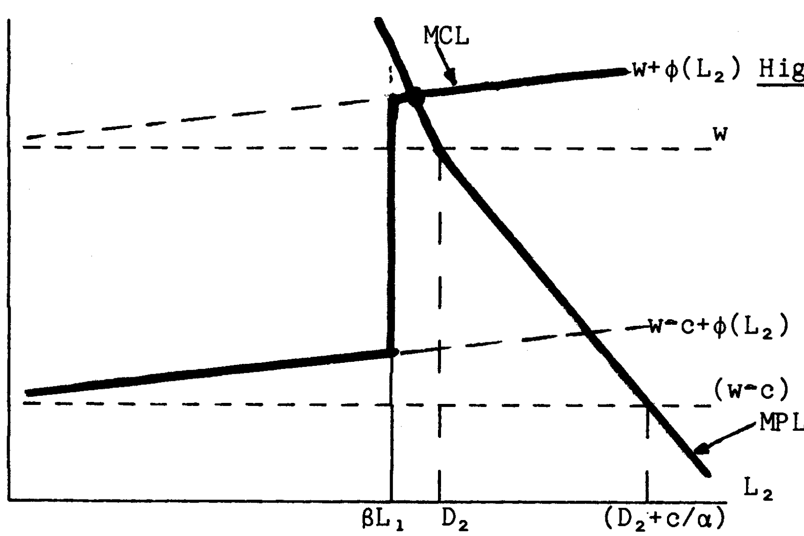
Case b:
Intermediate Demand

$(\tilde{D}_2 - c/\alpha < D_3 < \tilde{D}_2)$



Case c:
High Demand Realization

$(D_3 > \tilde{D}_2)$



$$14)\quad L_2^*(D_2;L_1) = \begin{cases} \underline{L}_2(D_2) & \text{if } D_2 < \tilde{D}_2 - c/\alpha \\ \beta L_1 & \text{if } \tilde{D}_2 - c/\alpha < D_2 < \tilde{D}_2\ \beta L_1 \\ \hat{L}_2(D_2) & \text{if } D_2 > \tilde{D}_2 \end{cases}$$

where $\underline{L}_2(D_2)$ sets the marginal product of labor equal to $(w-c+\phi)$, $\hat{L}_2(D_2)$ sets the marginal product of labor equal to $(w+\phi)$, and $\tilde{D}_2$ solves:

$$15)\quad \tilde{D}_2(L_1) = \beta\left\{L_1 + \frac{c\tilde{F}_3(\beta^2L_1-c/\alpha) + \alpha[\tilde{F}_3(\beta^2L_1-c/\alpha)-\tilde{F}_3(\beta^2L_1)][\beta^2L_1-E(D_3|\,D_3\epsilon\Omega)]}{\alpha(1+\delta)}\right\}$$

where $\Omega = (D_2, D_3 \text{ s.t. } D_2 = \tilde{D}_2, \text{ and } (\beta^2L_1-c/\alpha) < D_3 < \beta^2L_1)$, and $\tilde{F}_3(D_3)$ is the cumulative distribution function for D_3 conditional on D_2 being equal to $\tilde{D}_2$. $\tilde{D}_2$ is the critical level of period-two demand at which the firm finds it profitable to start hiring workers. It serves the same purpose as βL_2 in equation (7) and Figure One.

As expected, the presence of severance costs tend to increase employment when demand is weak, and decrease employment when demand is relatively strong. Thus, although the impact on employment depends upon the state of the economy, it will certainly be true that employment will be less variable in the presence of severance costs.

<u>Period-One Employment:</u> Having determined employment policies $L_2(D_2,L_1)$ and $L_3(D_3,L_2(D_2,L_1))$, we can consider the firm's period-one problem. The employment policies summarized in equations (7) and (14) can be used to determine period-two and period-three optimal profits as a function of L_1, D_2 and D_3. The firm now takes the expectation of the present value of expected profits in periods one through three, and

maximizes this with respect to period-one employment. Period-one profits are:

$$16) \quad \pi_1 = Y(D_1, L_1) - wL_1 - c\max(0,\ \beta L_0 - L_1)$$

This is non-stochastic. The marginal period-one profitability of period-one employment is:

$$17) \quad \frac{d\pi_1}{dL_1} = \begin{cases} \alpha(D_1 - L_1) & \text{if } L_1 > \beta L_0 \\ \alpha(D_1 - L_1) + c & \text{if } L_1 < \beta L_0 \end{cases}$$

Now consider period two. Expected period-two profits are:

$$18) \quad E(\pi_2) = \int_{-\infty}^{+\infty}\int_{-\infty}^{+\infty} \pi_2(D_2, L_1, L_2)\ f(D_2, D_3 | D_1)\ dD_2 dD_3$$

where:

$$19) \quad \pi_2 = Y(D_2, L_2(D_2, L_1)) - wL_2 - c\ \max(0,\ \beta L_1 - L_2)$$

Differentiating (18) with respect to period-one employment, we obtain:

$$\frac{dE(\pi_2)}{dL_1} = \int_{-\infty}^{\infty} \frac{d\pi_2(D_2, L_1)}{dL_1}\ f_2(D_2)\ dD_2$$

$$= \int_{-\infty}^{\infty} \left\{\alpha(D_2 - L_2(\circ))\frac{dL_2}{dL_1} - c\ \frac{d}{dL_1}\ \max(0,\ \beta L_1 - L_2)\ \right\}\ f_2(D_2)\ dD_2$$

$$= \int_{\tilde{D}_2 - c/\alpha}^{\tilde{D}_2} -\beta\alpha(\beta L_1 - D_2)\ f_2(D_2)\ dD_2 \ - \int_{-\infty}^{\tilde{D}_2 - c/\alpha} \beta\alpha\ f_2(\tilde{D}_2) dD_2$$

$$(20)\quad \frac{dE(\pi_2)}{dL_1} = -\beta \left\{cF_2(\tilde{D}_2 - c/\alpha) + \alpha[F_2(\tilde{D}_2) - F_2(\tilde{D}_2 - c/\alpha)][\beta L_1 - E(D_2 \mid D_2 \in \Omega_2)]\right\}$$

where $\tilde{D}_2$ was defined above, $F_2()$ is the cumulative probability distribution function for D_2 conditional on D_1, and Ω_2 is defined as follows:

$$\Omega_2 = (D_2 \mid (\tilde{D}_2 - c/\alpha) < D_2 < \tilde{D}_2)$$

Comparison with equation (10) indicates that the impact on next-period profits of an increase in this period's employment in the three-period problem is similar in some respects to that in the two-period problem. The difference is the replacement of βL_1 with $\tilde{D}_2$, which, with $\tilde{D}_2 > \beta L_1$, increases the adverse impact of an increase in this period's employment on next period's expected profits. The intuition for this effect is that, with a third period to worry about, period-two employment will be lower (for a given realization of the labor demand shock) than it would be if the next period were the last in the planning horizon. This means that, for a given level of period-one employment, the probability that the firm will in the next period want to fire some of the workers is increased relative to what it would be in the absence of a third period.

An additional difference between the two-period and the three-period analysis is that the firm must, in period one, consider the impact of its employment decision not only on next period's expected profits, but also on expected profits two periods into the future. The derivative of expected period-three profits with respect to period-one employment is:

$$\frac{dE(\pi_3)}{dL_1} = -\beta^2\left\{ \alpha \int_{\beta^2L_1-c/\alpha}^{\beta^2L_1} \int_{\tilde{D}_2-c/\alpha}^{\tilde{D}_2} (\beta^2L_1-D_3)f(D_2,D_3)dD_2dD_3 + c \int_{-\infty}^{\beta^2L_1-c/\alpha} \int_{\tilde{D}_2-c/\alpha}^{\tilde{D}_2} f(D_2,D_3)dD_2dD_3 \right\}$$

Or, more intuitively:

$$21)\quad \frac{dE(\pi_3)}{dL_1} = -\beta^2\{\alpha \text{ Prob}[D_2,D_3\varepsilon\ \Omega_{3a}][\beta^2L_1-E(D_3 \mid D_2,D_3\varepsilon\ \Omega_{3a})] + +c \text{ Prob}[D_2,D_3\varepsilon\ \Omega_{3b}]\}$$

where:

$$\Omega_{3a} = \{D_2,D_3 \mid (\tilde{D}_2-c/\alpha) < D_2 < \tilde{D}_2 \text{ and } (\beta^2L_1-c/\alpha) < D_3 < \beta^2L_1\}$$

$$\Omega_{3b} = \{D_2,D_3 \mid (\tilde{D}_2-c/\alpha) < D_2 < \tilde{D}_2 \text{ and } D_3 < \beta^2L_1-c/\alpha\}$$

that is, Ω_{3a} is the region of realizations for D_2 and D_3 such that there are no hirings or firings in either period two or period three. Ω_3b is the region in which there are no hirings or firings in period two, and there is firing in period three.

The intuitive explanation of this expression is fairly straightforward. The first term of (21) is the impact of an increase in period-one employment on the expected period-three cost of overemployment. This cost is non-zero only if (D_2, D_3) falls into the region that I have labelled Ω_{3a}, which is to say, only if there are no hirings or firings in both period two and period three. This makes intuitive sense; for the first-period's marginal worker to affect the cost of overemployment in period three, that worker must also be the marginal worker in period three, which will not be the case if he is fired or if additional workers are hired after him, making them the marginal workers.

The second term is the increase in the expected cost of period-three severance payments due to an increase in period-one employment. This is non-zero only if there are no hirings or firings in the second period, and if the demand realization is bad enough in the third period to make firings optimal. Because the labor force in period three that is left over from period one is lower due to attrition, (it equals $\beta^2 L_1$), this would require a very bad demand realization.

Having determined the expected marginal cost of period-one employment, we can characterize the period-one employment decision. This is broadly similar to the two-period decision, illustrated in Figure Three and equation (14). In fact, (14) holds precisely if $\phi(L_1)$ is defined as:

$$24) \quad \phi(L_1) = - \frac{dE(\pi_2)}{dL_1} / (1+\delta) - \frac{dE(\pi_3)}{dL_1} / (1+\delta)^2$$

where the derivatives on the right side of (24) are given in equations (20) and (21).

This theoretical statement of the firm's employment policy is of limited interest if the impacts are empirically small. To explore the empirical significance of these social policies, the next section of the paper assigns plausible values to the parameters identified in this section as key determinants of the cost of severance restrictions.

IV. Empirical Assessment

We are now in a position to discuss the implications of severance restrictions for labor demand in more quantitative terms. While it would be possible, in principle, to examine the algebraic equations derived above for general insights, it would be difficult, and it would be impossible to make any statements about the quantitative significance. Instead, I will attach plausible values to the key determinants of the costs discussed above, to obtain insights into the actual impact of severance restrictions. To do so, it will be necessary to obtain estimates of several important parameters, namely:

1) The actual size of the severance cost, c. (Without loss of generality, I normalize so that the wage equals 100, so that the cost of severance restrictions should be interpreted as a fraction of the annual wage.)

2) D_1, the labor demand shock. I normalize so that the expected value of D_1 is 100; numbers less than 100 are interpreted as "recessions", numbers greater as "booms."

3) The joint distribution of D_1, D_2, and D_3. I assume that they are jointly normally distributed, with a standard deviation of σ, and an autocorrelation parameter of ρ. The (unconditional) expected level of the labor demand shift parameter is labelled T_t (as noted above, this is normalized at 100 for period one). T_t is assumed to grow at a constant rate g, so that the expected level of period-two and period-three demand conditional on the (known) level of period-one demand can be written:

25) $$E_1(D_2) = (1+g)T_1 + \rho(D_1-T_1)$$

26) $$E_1(D_3) = (1+g)^2T_1 + \rho^2(D_1-T_1)$$

4) The short-run wage elasticity of labor demand, which (given the normalizations discussed above) $1/\alpha$.

5) The rate at which workers leave the firm voluntarily, which is $1-\beta$. This, along with σ, is one of the most important parameters.

6) The firm's discount rate, δ. Estimates of the cost of the severance restrictions are not sensitive to this parameter, so I specify $\delta = .1$ for all of the calculations that follow.

Base Case: It can hardly be hoped that the parameters chosen in the following calculations will be uncontroversial; consequently I will present the calculations for a reasonable base case, and will then explore the sensitivity of my conclusions to variations in the important parameters. At the very least, this will demonstrate which of the parameters have most influence on the conclusions, so that a more systematic empirical examination will know on which aspects of the labor market to focus.

Because the severance cost per fired worker, c, is the center of concern, I prefer not to make assumptions about its magnitude and will instead discuss the impact of the severance costs for a range of estimates for c, ranging from 20 percent to 100 percent of the annual wage. This permits conclusions to be drawn about the impact of policies designed to reduce the cost of firing workers.

For the base case, it is assumed that D_1, the period-one labor demand realization is 100, that is, the economy is neither in a recession nor a boom. Later I explore in more detail the relationship between D_1 and employment in the presence of severance restrictions.

As for the distribution of D_1 and D_2, I assume that expected labor demand has a growth rate of zero, in line with the stagnant employment experience in Europe during the past ten years. The labor demand variability parameter, σ, is set at 5. Thus, in the absence of severance costs, it is assumed that the standard deviation of employment would be about 5 percent of employment. This, as the sensitivity analysis below demonstrates, is one of the most important assumptions. The autocorrelation of the demand shock, ρ, is assumed to be 0.5. While this parameter makes a difference, the conclusions are not highly sensitive to ρ.

In the base case, the slope of the labor demand (marginal product of labor) curve, α, is assumed to be 4, corresponding to a low but nonnegligible estimate of the short-run wage elasticity of labor demand of .25 (at the expected level of D_1).

The rate of workforce retention, β, is a crucial parameter, and one on which comparatively little evidence exists. For the base case I assume that 4 percent of the workforce voluntarily leaves in a given year, so that β=0.96. This is speculative, and can be justified as a conservative estimate as follows. Assume that the working life is 40 years, and that over the past 40 years the workforce has been growing at about one percent per year. On these assumptions, the cohort that is retiring accounts for about 2 percent of the workforce. The other reason for voluntary workforce attrition is voluntary departures to change jobs. If the probability of each worker changing jobs in a given year is two percent, then roughly 20 percent workers would change jobs (<u>voluntarily)</u> more than once in their career, 35 percent would change once, and 45 percent would stay with a single employer (unless fired at some point in their career.) This is almost certainly an overstatement of workers' attachment to their employer, and therefore an overstatement of the impact of severance costs on the expected cost of a worker.

A recent study by the OECD (1985) sheds some light on this important parameter. As Table One indicates, aggregate quit rates in manufacturing seem to be falling, but are substantially higher than the 4 percent assumed in the base case:

TABLE ONE
QUITS PER 100 EMPLOYEES IN MANUFACTURING

Year:	Austria	Italy*	Japan	Sweden	United States
1971			17	25	31
1972			16	22	38
1973			17	23	46
1974			14	26	41
1975			12	23	25
1976			12	21	30
1977	30		12	18	32
1978	27	9	11	15	36
1979	28	10	12	21	35
1980	30	11	12	22	28
1981	28	11	11	17	24
1982	27		11	15	
1983			10		

* Manual workers only
Source: OECD (1985) p. 9

Even in countries with the lowest quit rates, they are almost never below 10 percent.

What matters in this analysis is not the quit rate per se, but the quit rate relative to the variability of demand. This is what determines the likelihood that the company will experience a bad enough demand realization that the severance costs will "bite," either through a unprofitably large level of employment or actual, costly firings. Table Two, from the same OECD study, compares employment declines, in percent, and quit rates in several industries. The industries selected were those with the most rapid employment declines.

TABLE TWO
PERCENT EMPLOYMENT DECREASE (ED) AND QUIT RATES (Q)
IN SELECTED INDUSTRIES

Italy (1981)*

Industry	ED	Q
Pulp-based textiles	19.6	5.6
Mining	10.6	5.2
Wood	10.1	10.7
Textile	8.0	7.3
Primary metals	7.2	5.7
Wood products	7.0	9.7
Apparel	6.9	6.8
Chemicals	6.4	4.7
Mechanics	6.0	6.7
Shoes	5.7	9.5
Rubber	5.2	4.5
Transport equipment	5.1	6.2

Sweden (1984)**

Industry	ED	Q
Shipyards	11.8	11.8
Printing	9.1	20.6
Instruments	3.4	17.4

United States (1980)

Industry	ED	Q
Wood	6.9	27.6
Primary metals	6.8	7.2
Stone, clay	6.0	15.6
Metal products	5.8	16.8
Rubber	5.5	22.8
Transport equipment	5.3	9.6
Furniture	4.6	25.2
Textile	3.6	26.4

* Manual workers in establishments with fifty or more employees
** Manual workers
Source: OECD (1985) p. 13

In the United States and Sweden, quits are generally substantially higher than declines in employment, which implies that firms are generally able to bring their employment into line with the desired level without recourse to firing. In Italy, on the other hand, there are many cases in which the quit rate is below or approximately equal to the employment decline. For these industries, employment could not be reduced more quickly without resorting to firing.

An intriguing aspect of the Italian data is the number of cases in which the employment decline is approximately equal to the quit rate. This is consistent with the theoretical model offered above, in which bad, but not catastrophic demand shocks are optimally handled by neither hiring nor firing, but keeping employment at the level that is left over from the previous period. This warns against interpreting the employment declines in Table Two as representing fluctuations in the simple labor demand curve, that is, in the context of the theoretical model offered in this paper, the MPL curve.

We return now to the simulation experiments. On the basis of these base case assumptions, Table Three calculates the expected marginal cost of severance restrictions for severance payments ranging from 20 to 100 percent of the annual wage. The calculations were accomplished by carrying out numerically the two-dimensional integrations in equations (15), (20), and (21). (A copy of the FORTRAN computer program used to do this integrating is available from the author on request.)

These numbers are estimates of the quantity $\phi(L_1)$ defined in equations (20), (21) and (24), and should be interpreted as a percent of the annual wage. Thus, if it costs 40 percent of the annual wage to fire a worker, then at an employment level of L_1=100, the expected marginal cost of an additional worker is roughly 2-1/2 percent higher than it would be in the absence of severance costs. With the assumed labor demand curve, employment would be reduced as a consequence by about 1/2 percent _if_, of course, the labor force left over from the previous period is small enough so that the firm is in the "high demand" case of Figure Three. This effect on costs and employment, while perhaps marginal in the context of the current unemployment problem in Europe, is far from trivial.

The base case provides some other interesting insights into the structure of the severance cost problem. It is surprisingly insensitive to the size of the severance payment, once that payment reaches about 20 percent of the annual wage. This is because, at such high severance costs, it very seldom pays actually to fire a worker. For example, suppose employment is 100 in period one. In period two it will, because of voluntary worker departures, be only 96. It doesn't pay to fire a worker until demand is c/α, or $40/4 = 10$ units below 96, that is, unless demand in period 2 falls below 86. This is almost three standard deviations below the expected level of period-two demand, and the probability of demand being so low is slight. So, the expected cost of the severance payments is primarily due to anticipated overemployment, rather than actual severance payments, and this overemployment cost is relatively insensitive to c.

It is interesting to note the <u>inverse</u> relation between the expected cost of actual severance payments, the first column of Table Three, and the payment per worker hired. This suggests that empirical studies which use as a measure of the burden of the severance payments policy some variable that is related to the number of firings undertaken (for example, Nickell (1982)) are likely to run into the difficulty that their proxy for the overall burden of severance payments is declining when the actual burden is increasing.

An aspect that does not emerge from Table Three is that the increase in expected labor costs due to the severance payments is almost all due to costs expected to be incurred in period two; only about 15 to 20 percent of the increase in expected labor costs is due to costs expected to be incurred in period three. This, again, is because the attrition rate is large in relation to the standard deviation of the demand shock, so the probability that demand will be bad enough in period three to make the optimal labor force be below what is left over from period one, $\beta^2 L_1$, is very low. For this reason, it is apparent that adding a fourth period to the firm's planning horizon would have a neglibibly small impact on these conclusions.

Sensitivity Analysis: Before evaluating in more detail the implications for employment of these estimates of the incremental marginal cost of employment attributable to severance costs, I examine in Tables Four through Nine the sensitivity of this cost to the various assumptions that were made. In Table Four I examine the influence of expected labor demand growth, which is the trend rightward shift in the labor demand curve. Three cases are considered: the base case, discussed above, in which the trend growth in employment is zero, a low growth case in which it is expected to decline by one percent per year, and a high growth case in which it is expected to increase by one percent per year. Table Four indicates that the estimated burden of severance costs is fairly sensitive to anticipated labor demand growth. An increase (decrease) in the expected growth rate of one percentage point reduces (increases) the marginal cost of labor by about one percentage point which, under the assumed labor demand elasticity, would increase (reduce) the firm's optimal level of employment by about .25 percent. Thus, as Blanchard et. al. point out, the reduction in trend employment growth has made a social policy that was reasonably costless in the high growth years of the 1960s more costly now that trend demand growth has fallen.

The intuitive reason for this inverse relation between trend demand growth and employment is obvious. If a firm expects to want a much higher labor force in future periods, then the probability that demand will be low enough to make the firm want to fire workers from a labor force of a given size declines, reducing the expected costliness of the severance payments policy.

In Table Five I investigate the impact of changes in the variability of labor demand. As one would expect, an increase in the variability of labor demand increases the expected cost of severance payments, because - for a given trend growth in demand - an increase in the variance of labor demand raises the probability that demand will fall below the level of employment left over from the previous period. An increase in labor demand variability also makes the cost more sensitive to c. The reason for this is that the more variable is demand, the more likely it is that demand will be low enough to make the firm start actually firing workers. This means that more of the expected cost is due to expected severance payments, rather than expected overemployment costs, and the value of expected severance payments are more closely related to c than is the expected overemployment cost.

In Table Six I examine the impact of different assumptions about the firm's labor force attrition rate. Again, the results are perfectly intuitive; an increase in the rate of attrition (decrease in β) decreases the expected cost of the severance payments significantly. This makes sense because the faster the natural reduction in the firm's workforce, the less firing it is going to have to do to get down to a given next-period level of employment.

In Table Seven the impact of alternative assumptions about the slope of the labor demand curve is examined. The steeper the slope, the higher is the expected marginal cost due to the severance payments. The reason for this is fairly straightforward. If the labor demand curve is shallow, this means that the firm can be far away from the optimal level of employment with fairly minimal implications for profits. Thus, if it has extra workers in a given period, it need not accept the cost of firing them; it can hang onto them with only a small profit loss until demand recovers and the size of the workforce dwindles. On the other hand, if the labor demand curve is very steep, being away from the optimal level of employment has a large impact on profits. The firm must either maintain its excessive workforce at a large cost in terms of profits, or fire the excess and pay the severance cost. It is also worth noting that, when the demand curve is steep, the cost of severance payments is much more closely related to c. That is because, again, the firm will more often be forced to fire workers when demand is low, making the overall burden much more sensitive to the size of the payment.

It is important to note that the increase in the marginal cost of labor due to an increase in α does not imply that the adverse impact on employment is greater; as the marginal cost increases, the sensitivity of employment to the marginal cost decreases. In fact, for the cases considered in Table Seven, the two effects are approximately offsetting. In all three cases, the impact on employment, at c=40, is about one half percent.

In Table Eight, I consider the impact of increasing ρ, the autocorrelation of the demand shocks. The higher the autocorrelation, the higher the expected cost of the severance payments. This is because, when the autocorrelation parameter is higher, a bad demand realization in period two, when no hiring is done, is likely to be followed by another bad one in period three. This makes it more likely that the severance costs will apply in the third period, thus raising the contribution of period-three expected costs to the total, from a minor amount in the case when $\rho=0.0$ to on the order of 1/3 of the total when $\rho=0.95$.

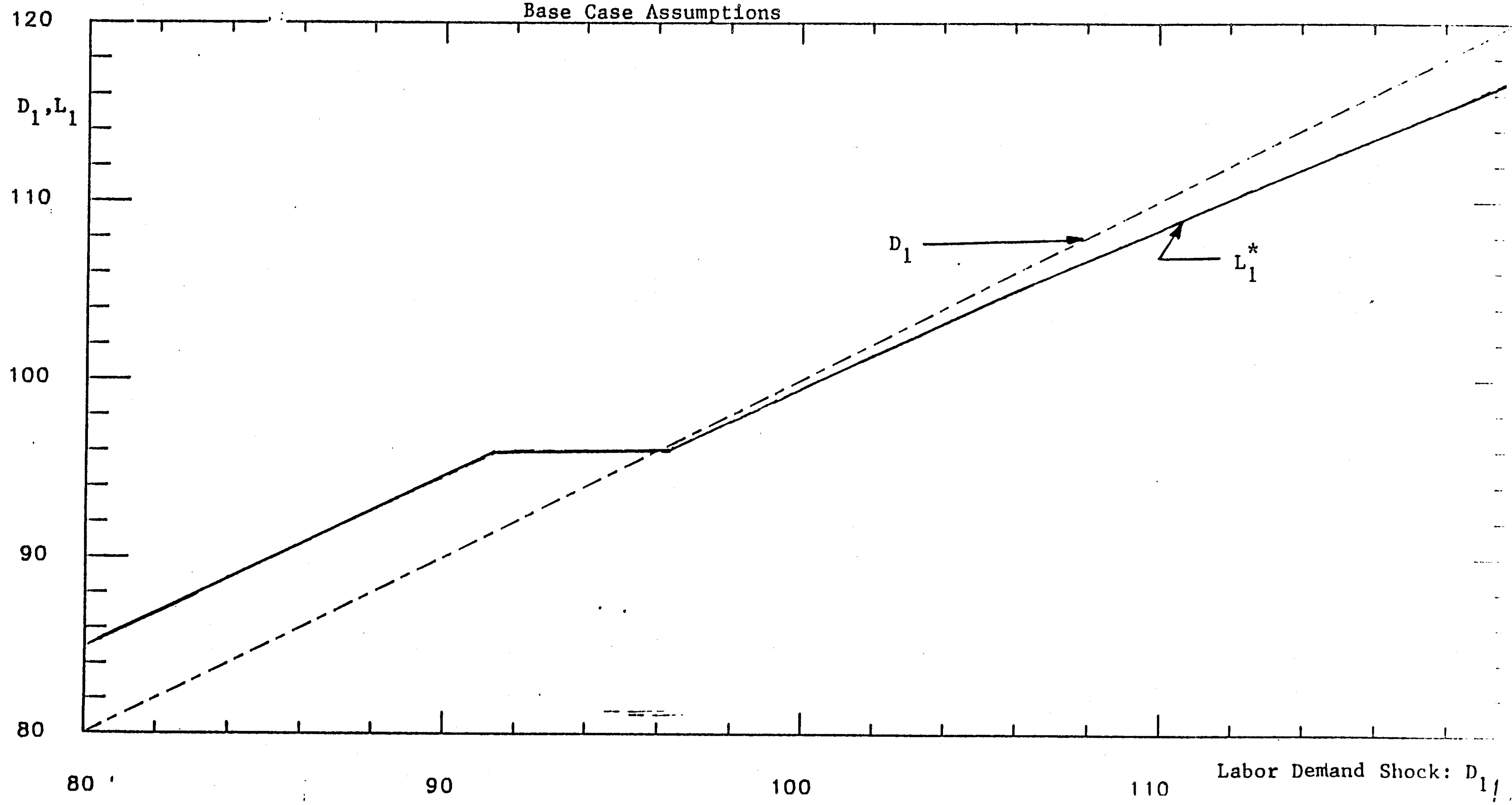
Finally, in Table Nine I consider the impact of period-one labor demand shocks. A reduction in period-one demand raises the expected marginal cost of employment for a given level of period-one employment. This is only because demand is assumed to be autocorrelated, so that a bad period-one demand shock tends to be followed by a bad period-two demand shock. When demand is not autocorrelated, this shift in the $\phi(L_1)$ schedule does not occur.

Impact on Employment: These calulations of the addition to the marginal cost of labor due to the severance costs add insight into the potential magnitude of the problem, but they do not directly answer the question that ultimately concerns us; what is the impact on employment? The discussion has, at least, clarified that the answer is not unambiguous; it depends upon whether the current state of labor demand is high or low relative to the size of last period's level of employment. To illustrate this, Table Ten and Figure Four give the optimal level of employment as a function of D_1, under the base case assumptions discussed above, assuming also that $L_0=100$ and that $C=20$.

FIGURE FOUR

RELATIONSHIP BETWEEN PERIOD-ONE DEMAND AND EMPLOYMENT

Base Case Assumptions



At $D_1=100$, its average value, the severance costs reduce employment by about one-half percent. As demand increases the expected future cost of severance payments rises, and the impact on employment becomes greater. At $D_1=105$ employment is about one percent lower and at $D_1=110$ it is about 1-1/2 percent lower than it would be in the absence of the severance costs.

For unfavorable demand shocks employment is higher than it would be in the absence of the severance payments. At $D_1=95$ employment is increased by about one percent, and at $D_1=90$ it is increased by almost five percent.

V. Summary and Conclusions:

This paper presents a simple formulation of the firm's employment decision in the presence of firing costs, which is solved for the firm's optimal employment decision. In this way, the key structural parameters that determine the importance of severance costs for employment are identified. Although a detailed empirical application remains to be done, the quantitative significance of the problem is investigated for plausible parameters, and the sensitivity of the conclusions to alternative assumptions is explored.

The analysis has implications for future empirical work on this topic. First, future work should recognize that the impact on employment depends very much on whether the firm would or would not, in the absence of firing costs, want to be firing workers, that is, whether labor demand is greater than or less than the workforce left over from the previous period. A second conclusion is that for plausible parameter values, the incidence of firing decreases as the firing cost, C, increases. Thus, empirical work which uses a measure related to the incidence of firing (for example, Nickell (1982)) as a proxy for the costliness of severance restrictions may run into problems. Third, and within the context of the analytical framework advanced in this paper, it appears that the costliness of severance payments is much more sensitive to estimates of the workforce retention rate (β) and the variability of labor demand (σ) than the other structural parameters identified above. Thus, a sensible empirical strategy would probably focus on obtaining information about these parameters.

One should be reluctant to draw firm policy conclusions until a more thorough empirical investigation is completed, but if the conclusions discussed above are supported by such an investigation, then there would be some policy conclusions to be drawn. First, while the impact of severance costs on employment is non-negligible, it is unlikely to account for more than a fairly minor fraction of the unemployment currently being experienced in the European economies. Further, it may well be that at current levels of demand abolition of severance costs would reduce employment, so that the long-run benefits of the policy would be accompanied by a short-run reduction in employment. (This was the conclusion of the study by INSEE (1985), although that study did not attempt to estimate the impact of severance restrictions on firms' desired labor demand.) An additional implication of the above estimates is that marginal reductions of the firing cost, c, from a level above two or three months' wages would have a negligible impact on the expected burden of the firing costs. To reduce significantly the impact of firing costs it would be necessary to lower them to a very low level. (This conclusion is, of course, sensitive to the parameter values assumed above, and in particular to the short-run wage elasticity of labor demand. A very low elasticity would tend to undermine this conclusion.)

Before taking these policy conclusions seriously, of course, there needs to be more adequate empirical grounding for the scenarios presented above. In addition, it would in principle be desirable to expand the theoretical model to incorporate important aspects of the labor market such as heterogeneity of labor. Perhaps a more important issue is the impact of severance costs on average profits, and therefore entry and exit of firms. This issue was raised above, but not seriously addressed.

Finally, the impact of severance costs on labor supply and wage bargaining should be addressed. As noted above, the effect of severance costs on workers' wage demands will probably depend upon the theoretical paradigm used to model the bargaining process. Some work has been done in this area, and more work is called for.

TABLE THREE
BASE CASE

	Expected Firing Cost	Expected Overemployment Cost	Expected Total Cost
C = 20			
L_1 = 95.0	0.06	0.22	0.28
97.5	0.23	0.60	0.83
100.0	0.76	1.30	2.07
102.5	2.02	2.25	4.27
105.0	4.35	3.05	7.41
C = 40			
L_1 = 95.0	0.00	0.29	0.30
97.5	0.02	0.90	0.93
100.0	0.12	2.31	2.43
102.5	0.49	4.92	5.41
105.0	1.64	8.66	10.29
C = 60			
L_1 = 95.0	0.00	0.30	0.30
97.5	0.00	0.93	0.93
100.0	0.01	2.46	2.45
102.5	0.04	5.53	5.57
105.0	0.19	10.71	10.90
C = [illegible]			
L_1 = 95.0	0.00	0.30	0.30
97.5	0.00	0.93	0.93
100.0	0.01	2.46	2.46
[illegible]	0.04	5.53	5.57
[illegible]	0.19	10.71	10.90
C = 100			
L_1 = 95.0	0.00	0.30	0.30
97.5	0.00	0.93	0.93
100.0	0.00	2.46	2.46
102.5	0.00	5.58	5.58
105.0	0.01	[illegible]	[illegible]

TABLE FOUR
EXPECTED LABOR DEMAND GROWTH

	Low Growth g=-0.01	Base Case g=0.00	High Growth g=0.01
C = 20			
L_1 = 95.0	0.47	0.28	0.16
97.5	1.30	0.83	0.52
100.0	2.98	2.07	1.40
102.5	5.71	4.27	3.11
105.0	9.18	7.41	5.81
C = 40			
L_1 = 95.0	0.51	0.30	0.17
97.5	1.49	0.93	0.57
100.0	3.68	2.43	1.59
102.5	7.68	5.41	3.76
105.0	13.64	10.29	7.60
C = 60			
L_1 = 95.0	0.51	0.30	0.17
97.5	1.51	0.93	0.57
100.0	3.76	2.43	1.60
102.5	8.02	5.41	3.83
105.0	14.82	10.29	7.89
C = 80			
L_1 = 95.0	0.51	0.30	0.17
97.5	1.51	0.93	0.57
100.0	3.76	2.46	1.60
102.5	8.05	5.57	3.83
105.0	14.97	10.90	7.92
C = 100			
L_1 = 95.0	0.51	0.30	0.17
97.5	1.51	0.93	1.30
100.0	3.76	2.46	2.98
102.5	8.05	5.58	5.71
105.0	14.97	10.95	9.18

TABLE FIVE

LABOR DEMAND SHOCK VARIABILITY

	Low Variability S= 4.0	Base Case $\sigma = 5.0$	High Variability $\sigma = 6.0$
C = 20			
L_1 = 95.0	0.07	0.28	0.64
97.5	0.33	0.83	1.46
100.0	1.20	2.07	2.89
102.5	3.26	4.27	5.05
105.0	6.81	7.41	7.80
C = 40			
L_1 = 95.0	0.07	0.30	0.75
97.5	0.34	0.93	1.78
100.0	1.28	2.43	3.75
102.5	3.71	5.41	7.03
105.0	8.53	10.29	11.71
C = 60			
L_1 = 95.0	0.07	0.30	0.76
97.5	0.34	0.93	1.82
100.0	1.28	2.43	3.90
102.5	3.73	5.41	7.51
105.0	8.69	10.29	13.00
C = 80			
L_1 = 95.0	0.07	0.30	0.76
97.5	0.34	0.93	1.82
100.0	1.28	2.46	3.92
102.5	3.73	5.57	7.58
105.0	8.69	10.90	13.25
C = 100			
L_1 = 95.0	0.07	0.30	0.76
97.5	0.34	0.93	1.82
100.0	1.28	2.46	3.92
102.5	3.73	5.58	7.58
105.0	8.69	10.95	13.28

TABLE SIX
LABOR FORCE ATTRITION RATE

	Low Attrition $\beta = 0.97$	Base Case $\beta = 0.96$	High Attrition $\beta = 0.95$
C = 20			
L_1 = 95.0	0.46	0.28	0.17
97.5	1.29	0.83	0.53
100.0	3.01	2.07	1.39
102.5	5.81	4.27	3.06
105.0	9.36	7.41	5.69
C = 40			
L_1 = 95.0	0.50	0.30	0.18
97.5	1.49	0.93	0.57
100.0	3.71	2.43	1.58
102.5	7.81	5.41	3.70
105.0	13.95	10.29	7.43
C = 60			
L_1 = 95.0	0.50	0.30	0.18
97.5	1.50	0.93	0.57
100.0	3.79	2.43	1.59
102.5	8.17	5.41	3.76
105.0	15.18	10.29	7.71
C = 80			
L_1 = 95.0	0.50	0.30	0.18
97.5	1.50	0.93	0.57
100.0	3.79	2.46	1.59
102.5	8.19	5.57	3.77
105.0	15.33	10.90	7.73
C = 100			
L_1 = 95.0	0.50	0.30	0.18
97.5	1.50	0.93	0.57
100.0	3.79	2.46	1.59
102.5	8.19	5.58	3.77
105.0	15.34	10.95	7.74

TABLE SEVEN
LABOR DEMAND ELASTICITY

	Low Elasticity $\alpha = 10.0$	Base Case $\alpha = 4.0$	High Elasticity $\alpha = 2.0$
C = 20			
L_1 = 95.0	0.47	0.28	0.15
97.5	1.29	0.83	0.46
100.0	2.95	2.07	1.22
102.5	5.59	4.27	2.71
105.0	8.93	7.41	5.15
C = 40			
L_1 = 95.0	0.65	0.30	0.15
97.5	1.92	0.93	0.47
100.0	4.65	2.43	1.23
102.5	9.37	5.41	2.79
105.0	15.84	10.29	5.48
C = 60			
L_1 = 95.0	0.72	0.30	0.15
97.5	2.18	0.93	0.47
100.0	5.52	2.43	1.23
102.5	11.67	5.41	2.79
105.0	20.73	10.29	5.48
C = 80			
L_1 = 95.0	0.74	0.30	0.15
97.5	2.28	0.93	0.47
100.0	5.92	2.46	1.23
102.5	12.92	5.57	2.79
105.0	23.89	10.90	5.48
C = 100			
L_1 = 95.0	0.75	0.30	0.15
97.5	2.32	0.93	0.47
100.0	6.08	2.46	1.23
102.5	13.54	5.58	2.79
105.0	25.74	10.95	5.48

TABLE EIGHT
LABOR DEMAND SHOCK AUTOCORRELATION

	Low Autocorrelation $\rho = 0.00$	Base Case $\rho = 0.50$	High Autocorrelation $\rho = 0.95$
C = 20			
L_1 = 95.0	0.26	0.28	0.36
97.5	0.77	0.83	1.01
100.0	1.91	2.07	2.35
102.5	4.03	4.27	4.59
105.0	7.26	7.41	7.60
C = 40			
L_1 = 95.0	0.28	0.30	0.42
97.5	0.84	0.93	1.23
100.0	2.17	2.43	3.04
102.5	4.85	5.41	6.34
105.0	9.53	10.29	11.34
C = 60			
L_1 = 95.0	0.28	0.30	0.43
97.5	0.84	0.93	1.26
100.0	2.18	2.43	3.14
102.5	4.92	5.41	6.70
105.0	9.84	10.29	12.41
C = 80			
L_1 = 95.0	0.28	0.30	0.43
97.5	0.84	0.93	1.26
100.0	2.18	2.46	3.14
102.5	4.92	5.57	6.73
105.0	9.85	10.90	12.54
C = 100			
L_1 = 95.0	0.28	0.30	0.43
97.5	0.84	0.93	1.26
100.0	2.18	2.46	3.14
102.5	4.92	5.58	6.73
105.0	9.85	10.95	12.54

TABLE NINE
PERIOD ONE LABOR DEMAND SHOCK

	Low Demand D_1= 95	Base Case D_1= 100	High Demand D_1= 105
C = 20			
L_1 = 95.0	0.84	0.28	0.07
97.5	2.06	0.83	0.27
100.0	4.22	2.07	0.83
102.5	7.29	4.27	2.10
105.0	10.75	7.41	4.36
C = 40			
L_1 = 95.0	0.93	0.30	0.08
97.5	2.40	0.93	0.30
100.0	5.27	2.43	0.94
102.5	9.94	5.41	2.51
105.0	16.20	10.29	5.54
C = 60			
L_1 = 95.0	0.93	0.30	0.08
97.5	2.42	0.93	0.30
100.0	5.40	2.43	0.95
102.5	10.46	5.41	2.54
105.0	17.84	10.29	5.82
C = 80			
L_1 = 95.0	0.93	0.30	0.08
97.5	2.42	0.93	0.30
100.0	5.41	2.46	0.95
102.5	10.51	5.57	2.54
105.0	18.07	10.90	5.84
C = 100			
L_1 = 95.0	0.93	0.30	0.08
97.5	2.42	0.93	0.30
100.0	5.41	2.46	0.95
102.5	10.51	5.58	2.54
105.0	18.09	10.95	5.84

TABLE TEN
OPTIMAL EMPLOYMENT: BASE CASE

Period-One Demand Shock: D_1	Optimal Employment
90.0	94.51
92.5	96.00
95.0	96.00
97.5	97.17
100.0	99.51
102.5	101.81
105.0	104.06
107.5	106.26
110.0	108.42

Footnotes

* Division of International Finance, Federal Reserve Board. This paper represents the views of the author, and should not be interpreted as reflecting the views of the Board of Governors, or of any other members of its staff.

1/ For influential examples of this approach, see Sachs(1979, 1983) and Artus (1984).

2/ See, in particular, Blanchard et. al. (1985), OECD (1983), Krugman (1982), and Nickell (1979).

3/ This possibility is raised in OECD (1985) p.195, which views the Chrysler and Uniroyal union contracts as evidence that collective bargaining contracts trade off wages for job security.

4/ This is true for simulations in which firm's quit rate, b, is not much larger than σ, the standard deviation of fluctuations in the MPL curve. If the rate of workforce attrition is much lower than this measure of the variability of labor demand, then it is possible that extending the planning horizon would have a larger effect.

5/ This assumes no "vintage" effects, that is, that the probability of workers' leaving the firm is independent of how long they have been employed with the firm. This assumption is clearly imprecise, especially for retirements. However, a more realistic and complicated assumption would have a very minor impact on the results.

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