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ABSTRACT

The unemployment problem in the defense industry has often had the attention of Federal policy makers over the past several years. Analyzing this problem was accomplished by first examining the job search behavior of skilled unemployed defense workers. This search strategy differs among the unemployed workers and depends on personal characteristics such as age, sex, level of education, and prelayoff salary. In addition, the job search behavior of these individuals depends on each worker's level of specific skill and his personal valuation of the probability of recall by his former employer. The manpower policies of firms in the defense industry were next examined through an analysis of the factors which affect the individual firm's optimal stock of labor. In addition, the influence of the displaced worker's job search strategy on the firm's management of its labor force was determined. These hypotheses were then empirically tested with data available from surveys of workers laid off by three defense firms during the years 1963-65. (Included is a three-page bibliography.) (Author/BP)

UNEMPLOYMENT IN THE DEFENSE INDUSTRY: AN ANALYSIS OF THE UNEMPLOYED WORKER'S JOB SEARCH STRATEGY AND THE MANPOWER POLICIES OF THE FIRM

A Dissertation

by

JAMES HICKMAN YEAGER, JR.

Submitted to the Graduate College of
Texas A&M University in
partial fulfillment of the requirement for the degree of

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ABSTRACT

Unemployment in the Defense Industry: An Analysis of the Unemployed Worker's Job Search Strategy and the Manpower Policies of the Firm. (December 1973)

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Directed by: Dr. Arthur S. De Vany

The purpose of this dissertation is to analyze the unemployment problem in the defense industry. This task is accomplished by first examining the job search behavior of skilled defense workers who are unemployed. This search strategy differs among the unemployed workers and depends upon personal characteristics such as age, sex, level of education, and prelayoff salary. In addition, the job search behavior of these individuals depends upon each worker's level of specific skill and his personal valuation of the probability of recall by his former employer.

The manpower policies of firms in the defense industry are next examined through an analysis of the factors which affect the individual firm's optimal stock of labor. In addition, the influence of the displaced worker's job search strategy upon the firm's management of its labor force is determined.

These hypotheses are then empirically tested with data available from surveys of workers laid off by three defense firms during the years 1963 through 1965.

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To my parents I would like to express my appreciation for their instilling within me the desire to excel. Their influence has given me the incentive to continue my education, and they are indirectly responsible for the completion of this dissertation.

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encouraged to express freely their professional judgment. Therefore, points of view or opinions stated in this document do not necessarily represent the official position or policy of the Department of Labor.

Finally, I must, of course, affirm that any errors or omissions which remain in this dissertation are my responsibility alone and in no way reflect upon the above-mentioned people or the U.S. Department of Labor.

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CHAPTER I

INTRODUCTION

The unemployment problem in the defense industry has often had the attention of federal policy makers over the past several years. At the national level, they have noticed a correlation between the variability and regional distribution of the defense budget and the unemployment of technical manpower. The underlying causes of this correlation depend upon the manpower policies of firms operating in this market characterized by substantial variation in the effective demand for each firm's product and on the job search strategies of the unemployed workers in the market who possess a high level of specific skill.

Several methods have been suggested as a possible cure for this problem. One is to allocate contracts to those firms and regions in which unemployment is highest. Another solution would be to create a national system for unemployment compensation so that the laid off workers would not have the additional cost of sacrificing this benefit if they should decide to migrate to another labor market in a different state. The costs of migration, which are a barrier to quick reemployment, could also be reduced if the defense industry were entirely located in one section of the country. Finally, federally subsidized

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The format of this dissertation follows the style of The American Economic Review

retraining programs could be provided for the displaced workers so that they could qualify for other positions in different industries.

Before policy makers can compare these and other solutions, however, the unemployment problem, itself, must be better understood. For example, how do defense firms which experience a reduction in demand decide which workers to lay off? Is the magnitude of these layoffs dependent upon the firm's expectations of future demand? What is the defense worker's optimal strategy upon being laid off? How is this strategy affected by the worker's level of specific skill and his expectations of recall?

In the following chapters these questions will all be analyzed and empirically tested so that the policy makers will gain this better understanding and more accurately control the unemployment problem in the defense industry.

CHAPTER II

THE JOB SEARCH BEHAVIOR OF UNEMPLOYED DEFENSE WORKERS

The purpose of this chapter is to develop a model that depicts an optimal reemployment search strategy for individuals who are presently unemployed. In particular, the analysis will focus upon the defense industry and show how specifically trained workers in this industry react upon being laid off by their respective firms. Two fundamental assumptions that will be used throughout the analysis are that the worker knows the distribution of wages in the marketplace and that he accepts a period of unemployment so that he can devote full time to his search for reemployment opportunities.[1] In addition, it is assumed that there is no decay of prior wage offers and that the worker can accept any previously made offer at any future point in time. Finally, it is assumed that the wage offers are normally distributed[2] and that the

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[1]This latter stipulation implies that the worker maximizes the level of his expected wealth by specializing in search activities (accepting a period of unemployment). His other option would have been to immediately accept a position offering a relatively low wage rate and then conduct a search of the labor market for better paying opportunities on a part time basis. For a discussion of these two general forms of search strategies, see the appendix of Alchian.

[2]An alternative approach would be to utilize a rectangular wage offer distribution with all offers situated in the interval between zero and one. For an analysis incorporating this type of distribution, see Stigler (1961).

distribution remains stationary with the passage of time.

The Formulation of the Reemployment Search Strategy

As the displaced worker searches the labor market for reemployment opportunities, the expected value of the maximum wage offer that he will encounter by the time he has obtained information on a random sample of N job possibilities is

$$(1) \qquad \varepsilon(W_{MAX}) = N \int_0^{\infty} x\, F(x)^{N-1}\, f(x)\, dx$$

Since it has been assumed that the worker obtains his random selection of wage offers from a normal population, this equation can be made more relevant for the analysis by substituting in the terms which characterize the normal distribution. Thus

$$(2) \qquad F(x) = \int_{-\infty}^{x} (2\pi)^{-\frac{1}{2}} e^{-\frac{z^2}{2}}\, dz$$

and

$$(3) \qquad f(x) = (2\pi)^{-\frac{1}{2}} e^{-\frac{x^2}{2}}$$

Once these equations are substituted into equation (1), the expected maximum wage offer that the worker will find by the time he has obtained information on a random sample of N job possibilities from a normal population is

$$(4) \qquad \varepsilon(W_{MAX}) = N \int_0^{\infty} x \left| \int_{-\infty}^{x} (2\pi)^{-\frac{1}{2}} e^{\frac{z^2}{2}} dz \right|^{N-1} (2\pi)^{-\frac{1}{2}} e^{-\frac{x^2}{2}} dx$$

This equation does not aid the analysis, however, because the normal distribution is open ended and cannot be integrated.[3] Nonetheless, the relationship between the number of searches and the expected maximum wage offer can still be quite accurately determined through the use of an approximation formula.[4] Thus, the expected maximum wage offer at any point in the search process can be shown to be equal to

$$(5) \qquad \varepsilon(W_{MAX}) = W_o + .65\, N^{.37}\, \sigma_w$$

in which

W_o = the mean wage rate prevailing in the labor market

N = the number of firms from which the worker has obtained an offer

σ_w = the standard deviation for the distribution of wages

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[3] See Magnus and Oberhettinger, p. 96.

[4] Alchian; and Stigler (1962) also utilized approximation formulas in the development of their search strategies. Stigler (1961), however, was able to circumvent the problem of trying to solve equation (4) by assuming that all wage offers are rectangularly distributed in the interval between zero and one. Nonetheless, in his latter article he admitted that this assumption was made for algebraic convenience and wasn't as realistic as assuming a normal distribution of wage offers. He thus abandoned the rectangular distribution in favor of the normal distribution and, by so doing, was forced to utilize an approximation formula which has been incorporated into the present analysis as equation (5).

Next, we specify that

$$(6) \qquad N = t * R * I$$

in which

t = time

R = the rate at which information is gathered on labor market activities per unit of time

I = the number of wage offers that can be evaluated per unit of information

If we now substitute equation (7) into equation (6), we obtain

$$(7) \qquad (W_{MAX}) = W_0 + .65\ (t * R * I)^{.37}\ \sigma_w$$

From this equation we can show that

$$(8) \qquad \frac{\partial\ \varepsilon(W_{MAX})}{\partial t} = \frac{.24\ \sigma_w}{(t * R * I)^{.63}} > 0$$

and

$$(9) \qquad \frac{\partial^2\ \varepsilon(W_{MAX})}{\partial t^2} = \frac{-.15\ \sigma_w}{(t * R * I)^{1.63}} < 0$$

These equations signify that the expected maximum wage offer that will be encountered by the unemployed worker increases at a decreasing rate as the duration of his search process increases.

In addition to illustrating the expected maximum wage offer, equation (7) shows the expected marginal cost of search at every

point in time. The maximum wage offer is equal to the marginal cost of search because it is assumed that the opportunity cost of remaining unemployed is the only cost associated with search activities. Equation (8) then shows the expected increase in the maximum wage offer as the duration of the search process is lengthened. In the proceeding pages we will show how this formulation is utilized for the determination of the expected marginal benefits of search. For the present, let us just state that the optimal predicted length of the search process will be determined at that point in time at which the expected marginal benefits of search equal the expected marginal cost. Thus, the worker formulates his ex ante search strategy by choosing an optimal duration of unemployment under the expectations of finding the expected wealth maximizing wage rate by the end of this period.

The optimal duration of search and expected wealth maximizing wage rate will differ among the displaced workers, however, depending in part upon their ability to secure reemployment positions within the defense industry. Whenever a laid off defense worker accepts an offer from a firm in another industry, his new wage rate will lie below his prelayoff wage rate, and this decrease in wages will represent the quasi rents that were accruing to his specific skills in the defense industry. In leaving this industry, the worker was unable to utilize many of his old skills which resulted in a decline in his productivity and wage rate. Thus, displaced defense workers will have an incentive to remain in their

former industry so that they can continue collecting quasi rents which represent payments to their level of specific skill.

The defense industry, however, is geographically dispersed in that its firms are located throughout the nation. Any displaced worker must, therefore, be willing to incur the costs of migration if he decides to remain in this industry. These costs of moving are comprised of both the pecuniary costs of migration and the psychic costs of changing communities and leaving old friends behind. In addition, the worker who does migrate gives up the opportunity of being recalled by his former employer. In order to determine the magnitude of this cost of migration, the worker would have to subjectively formulate his personal valuation of the probability of recall. During his initial days of unemployment, he may be overly optimistic in forming this probability, but as his period of unemployment increases, his expectations of recall will begin to decline. Since declining expectations cause the costs of migration to decrease, the displaced worker should become more mobile as his period of unemployment lengthens.

Even if the probability of recall is low, the displaced defense worker will still not migrate if the returns to migration are outweighed by the remaining costs. The returns to mobility vary among the unemployed workers and depend upon their level of specific skill. As an individual's level of specific skill increases, he will have a greater incentive to migrate to other defense firms in which he can utilize these skills. This direct

relationship between a worker's level of specific skill and degree of mobility occurs because the returns to migration are equal to the present value of the worker's quasi rents. Since these quasi rents are measured as the difference in wage rates in positions in which specific skills are utilized versus those where they are not, these rents and the returns to migration increase whenever the worker's level of specific skills increases. Thus, an unemployed defense engineer will be more willing to migrate to another defense firm than an unemployed janitor who previously had been employed by a defense firm.

In addition to the worker's willingness to migrate to other defense firms, his optimal reemployment wage rate and duration of unemployment will depend upon the market rate of interest, the time horizon of any new position, and the future rate of growth in wages. Given the expected increase in the maximum wage offer as the duration of search is lengthened, these three factors can jointly determine the expected marginal benefits of search.

As has often been shown, a variation in the market rate of interest causes the marginal benefits of search to change since the marginal wage rate gains are being discounted by a different factor. An increase in the interest rate will lower the present value of the marginal wage rate gains and cause the worker to shorten his optimal duration of search and accept reemployment at a wage rate below the former optimal level. Conversely, a decrease in the interest rate will have just the opposite effect

since the discounted value of the marginal wage rate gains increases. Thus, the optimal period of unemployment and the optimal reemployment wage rate will vary inversely with the market rate of interest.

In a similar manner it can be shown that a variation in the worker's time horizon for a new job will cause the marginal benefits of search to change since the marginal wage rate gains are being collected for a different length of time. An increase in the time horizon will increase the present value of the marginal wage rate gains and cause the worker to lengthen his optimal duration of search and permit him to accept reemployment at a wage rate above the former optimal level. Conversely, a decrease in the time horizon will have just the opposite effect since the discounted value of the marginal wage rate gains decreases. From this relationship it can be concluded that the younger workers will experience the greater marginal benefits of search since the time horizon for any new position is inversely correlated with the age of the worker.

These expected marginal benefits of search will even differ among the young workers, however, and account must be taken of the behavior of wages in each new position throughout future periods of time. A distribution of wages in the labor market for a given level of skill has in the past often been attributed to the worker's lack of perfect information on his various alternatives. This explanation is quite true but account must also be taken of

the fact that production functions differ among the various firms in the marketplace. These distinctions in production functions imply that the relative optimal amounts of inputs will vary among the different firms in the industry. The cost of a vacancy will, therefore, vary among the firms and each firm will maximize its profits by having its own distinct optimal level of vacancies. Those firms which have a relatively high optimal level of vacancies will offer a relatively low wage rate for a given level of skill and absorb the additional costs of a higher labor turnover. Conversely, other firms will maximize profits by holding labor turnover and vacancies to a minimum, and these will be the firms which offer a relatively high wage rate for a given level of skill. Thus, wage offers will differ among the firms in an industry depending upon the exact nature of each firm's production function.

High paying firms in an industry will, therefore, offer wage rates a certain percentage above those rates being offered by the low paying firms. As workers accept positions at each firm and gain additional experience, their productivity will increase and each firm will offer the workers a correspondingly higher wage rate. If the relative wage rates between firms remains constant, however, those workers who are employed by the high paying firm will receive a larger absolute pay raise than their counterparts who are employed by the low paying firms.

These various factors can be incorporated into the analysis by defining the expected marginal benefits of search as

$$(10) \qquad \varepsilon(MB) = \int_0^T \Delta\varepsilon(W_{MAX})\, e^{-rt}\, e^{Gt}\, dt \qquad ^5$$

in which

$\varepsilon(MB)$ = the expected marginal benefits of search

$\Delta\varepsilon(W_{MAX})$ = the rate of change in the expected maximum wage offer[6]

T = the end of the worker's time horizon for a new position

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[5]The conventional formulation for the expected marginal benefits of search is

$$\varepsilon(MB) = \int_0^T \Delta\varepsilon(W_{MAX})\, e^{-rt}\, dt$$

This specification is a special case of equation (10) in which the rate of growth for wages equals zero. In all situations in which intrafirm wage rates increase over time while relative interfirm wage rates remain constant, the conventional formulation underestimates the expected marginal benefits of search which are correctly shown by equation (10). The degree of this underestimation depends upon the relationship between the rate of growth for wages and the market rate of interest. As the growth rate for wages approaches the market rate of interest, future time periods are discounted less heavily and the expected marginal benefits of search increase. If there is equality between the two rates over the entire time horizon for the new position, no discounting is required, and the expected marginal benefits of search simply equal the change in the expected maximum wage offer multiplied by the number of periods in the time horizon. Finally, in the unlikely situation in which the growth rate for wages exceeds the market rate of interest, the expected marginal benefits of search exceed any previously mentioned case.

[6] $\Delta\varepsilon(W_{MAX})$ is actually equal to $\frac{\partial\varepsilon(W_{MAX})}{\partial t}$ which has previously been determined by equation (8) and is equal to $\frac{.24\sigma_w}{(t * R * I)^{.63}}$

r = the market rate of interest

t = time

G = the future rate of growth in wages

Furthermore, it is assumed that

(11) $G = G(A, E, OC)$

and

$$\frac{\partial G}{\partial A}, \frac{\partial G}{\partial OC} < 0 \qquad \frac{\partial G}{\partial E} > 0$$

in which

A = the worker's age

E = the worker's level of education

OC = the worker's occupational category which is defined in discrete terms (1 = professional and 2 = blue collar)

Thus, we can conclude that the expected marginal benefits of search do vary within a certain age group of workers and that they are highest for those individuals who are professionally trained and well educated.

The Revision of the Reemployment Search Strategy

As the search process is initiated the ex post results are going to deviate from those predicted in the initial strategy.

For any one searcher, the probability of exactly attaining the ex ante optimal wage rate at the end of the optimal period of unemployment is quite small because this ex ante optimal wage rate represents the average result that a group of workers could expect to find after searching the specified period of time. Confidence intervals must, therefore, be built around the ex ante optimal wage rate, and each unemployed worker must realize that his ex post search results are going to deviate from their predicted path.

In order to construct these confidence intervals, the expected maximum wage offer and its variance must be precisely determined for the various amounts of search that can be undertaken by the worker. Since equation (4) cannot be theoretically solved, however, this task can only be accomplished through the utilization of numerical methods. The results of this procedure are shown in Table 1 and graphically illustrated in Figure 1.[7] As the table is constructed, values for the expected maximum wage offer are expressed in standard deviations above the mean wage offer prevailing in the labor market. The figure then portrays the expected maximum wage offer and its confidence intervals as the worker continues his search for reemployment opportunities. Inspection of the table or figure illustrates the properties of equation (4) in that the expected maximum wage offer increases as

[7]These results were obtained from Rubin who was able to utilize these numerical methods for the determination of the moments of extreme members in samples of size N drawn from the normal population.

TABLE 1 - THE EXPECTED MAXIMUM WAGE OFFER AND ITS VARIANCE FOR SELECTIVE AMOUNTS OF SEARCH

Number of Wage Offers	Expected Maximum Wage Offer	Variance of the Expected Maximum Wage Offer
1	W_o	1.00000 σ_w
2	W_o + 0.56418 σ_w	0.68170 σ_w
3	W_o + 0.84628 σ_w	0.55947 σ_w
4	W_o + 1.02937 σ_w	0.49171 σ_w
5	W_o + 1.16296 σ_w	0.44754 σ_w
6	W_o + 1.26720 σ_w	0.41593 σ_w
7	W_o + 1.35217 σ_w	0.39193 σ_w
8	W_o + 1.42360 σ_w	0.37289 σ_w
9	W_o + 1.48501 σ_w	0.35735 σ_w
10	W_o + 1.53875 σ_w	0.34434 σ_w
11	W_o + 1.58643 σ_w	0.33325 σ_w
12	W_o + 1.62922 σ_w	0.32365 σ_w
13	W_o + 1.66799 σ_w	0.31519 σ_w
14	W_o + 1.70338 σ_w	0.30772 σ_w
15	W_o + 1.73591 σ_w	0.30104 σ_w
16	W_o + 1.76599 σ_w	0.29500 σ_w
17	W_o + 1.79394 σ_w	0.28953 σ_w
18	W_o + 1.82003 σ_w	0.28453 σ_w
19	W_o + 1.84448 σ_w	0.27875 σ_w
20	W_o + 1.86747 σ_w	0.27570 σ_w
21	W_o + 1.88916 σ_w	0.27179 σ_w
22	W_o + 1.90969 σ_w	0.26811 σ_w
23	W_o + 1.92916 σ_w	0.26470 σ_w
24	W_o + 1.94767 σ_w	0.26152 σ_w
25	W_o + 1.96531 σ_w	0.25852 σ_w
26	W_o + 1.98215 σ_w	0.25571 σ_w
27	W_o + 1.99826 σ_w	0.25305 σ_w
28	W_o + 2.01370 σ_w	0.25052 σ_w

TABLE 1 (Continued)

Number of Wage Offers	Expected Maximum Wage Offer	Variance of the Expected Maximum Wage Offer
29	$W_o + 2.02852\ \sigma_w$	$0.24811\ \sigma_w$
30	$W_o + 2.04276\ \sigma_w$	$0.24583\ \sigma_w$
31	$W_o + 2.05646\ \sigma_w$	$0.24369\ \sigma_w$
32	$W_o + 2.06966\ \sigma_w$	$0.24164\ \sigma_w$
33	$W_o + 2.08240\ \sigma_w$	$0.23968\ \sigma_w$
34	$W_o + 2.09471\ \sigma_w$	$0.23778\ \sigma_w$
35	$W_o + 2.10660\ \sigma_w$	$0.23600\ \sigma_w$
36	$W_o + 2.11812\ \sigma_w$	$0.23425\ \sigma_w$
37	$W_o + 2.12927\ \sigma_w$	$0.23261\ \sigma_w$
38	$W_o + 2.14009\ \sigma_w$	$0.23099\ \sigma_w$
39	$W_o + 2.15058\ \sigma_w$	$0.22948\ \sigma_w$
40	$W_o + 2.16077\ \sigma_w$	$0.22801\ \sigma_w$
41	$W_o + 2.17068\ \sigma_w$	$0.22657\ \sigma_w$
42	$W_o + 2.18031\ \sigma_w$	$0.22521\ \sigma_w$
43	$W_o + 2.18969\ \sigma_w$	$0.22387\ \sigma_w$
44	$W_o + 2.19882\ \sigma_w$	$0.22260\ \sigma_w$
45	$W_o + 2.20771\ \sigma_w$	$0.22139\ \sigma_w$
46	$W_o + 2.21639\ \sigma_w$	$0.22017\ \sigma_w$
47	$W_o + 2.22485\ \sigma_w$	$0.21903\ \sigma_w$
48	$W_o + 2.23312\ \sigma_w$	$0.21786\ \sigma_w$
49	$W_o + 2.24118\ \sigma_w$	$0.21681\ \sigma_w$
50	$W_o + 2.24907\ \sigma_w$	$0.21575\ \sigma_w$

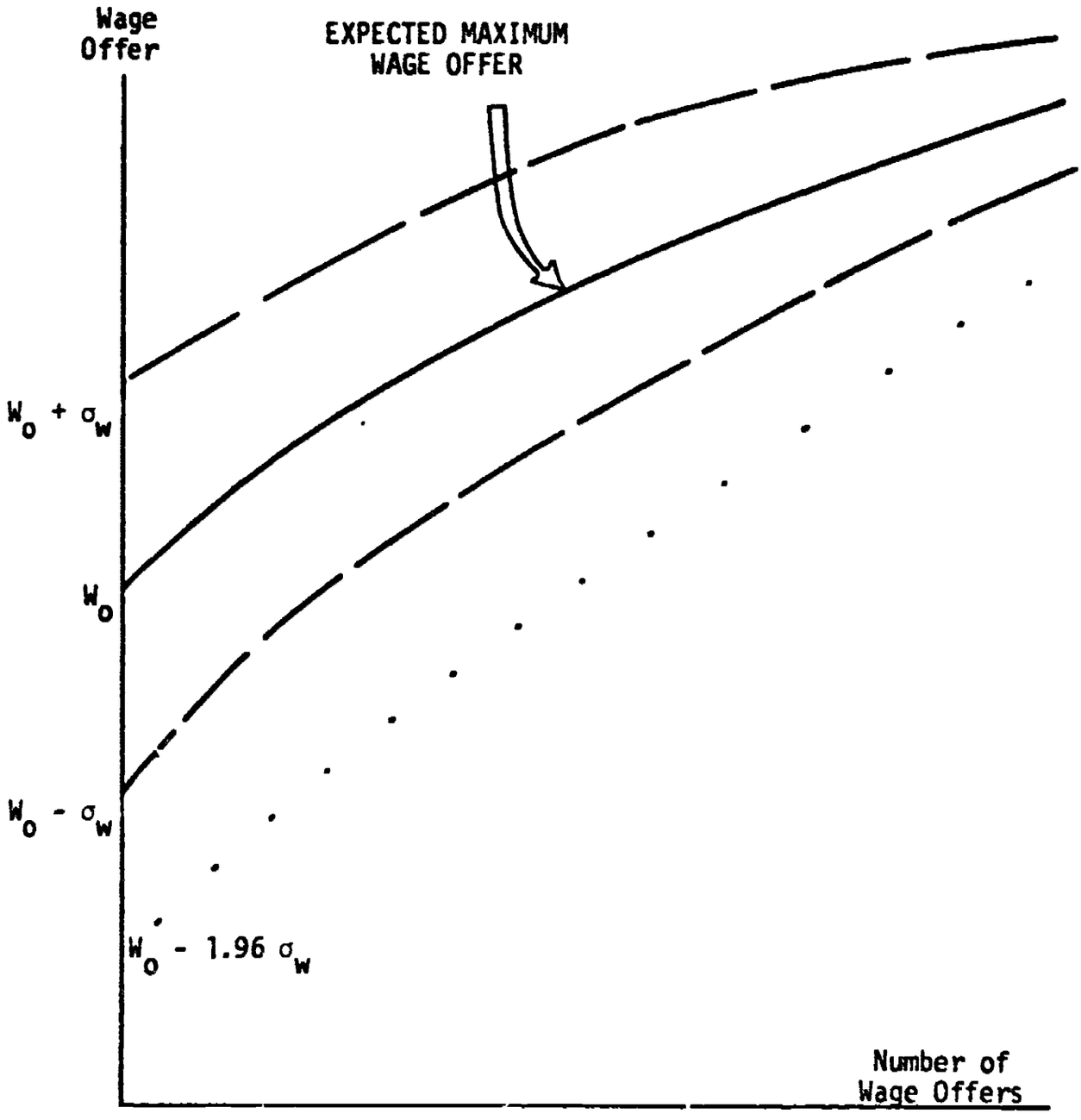

FIGURE 1. CONFIDENCE INTERVALS FOR THE EXPECTED MAXIMUM WAGE OFFER ENCOUNTERED DURING SELECTIVE AMOUNTS OF SEARCH

the number of searches is increased and that this increase is at a decreasing rate.[8] Furthermore, the table and figure show that the variance of the expected maximum wage offer decreases at a decreasing rate as the sample size is increased.

This characteristic of the variance has important implications for the search strategies of unemployed workers because it permits an analysis of the revisions of the ex ante search strategy as the ex post search results deviate from their predicted path.[9] One type of revision for the initial strategy will occur for that group of workers who have good luck in their search activities and obtain a wage offer exceeding the ex ante optimal level before the end of their optimal duration of unemployment. Since these workers have discovered a wage offer above their anticipations, their response will be to accept the offer and curtail their search activities. Any further search beyond this level will actually decrease their level of wealth because the actual marginal cost of search will exceed the expected marginal benefits. This situation

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[8]Notice that these properties are also possessed by the approximation formula which is shown in equation (5).

[9]In the search models of Alchian; and Stigler (1962) this revision of the initial search strategy was never considered because they both failed to distinguish the ex post results from the ex ante predictions. Each author merely chose the optimal amount of search and then assumed that the worker would find the wealth maximizing wage at the end of this specified period of time. Thus, their analyses must be carefully intepreted because their searchers would soon discover that the marginal returns to search are quite random in nature and depend exclusively upon the luck of the draw.

occurs because the marginal cost of search increases above its level predicted by equation (7) and the expected marginal benefits of search decrease below their ex ante level predicted by equation (10).

The revision of the marginal cost of search is caused by the unexpected increase above the initially predicted level for the worker's opportunity cost of remaining unemployed. The rationale for the revision of the expected marginal benefits of search is less straightforward and involves the probability of the worker's obtaining a higher wage offer during future periods of search. For example, with the aid of Table 1 assume that the optimal wage rate is $W_o + 1.965\ \sigma_w$, which can be expected to be found after the sampling of 25 firms. Now, assume that the worker is very lucky and obtains a wage offer of $W_o + 2.284\ \sigma_w$ from the fifteenth firm that he samples. This offer is above the optimal reemployment level and one standard deviation above the maximum offer expected at this point in the search process. Since it is above the expected maximum offer, the expected marginal benefits of search will decline below their initially predicted level for two reasons. On the one hand, even if the worker's good luck would hold out and he continued to receive wage offers one standard deviation above those expected, the rate of increase in the marginal cost of search would diminish below the initially predicted level because the variance of the expected maximum wage offer decreases as the sample size is increased. This situation can be graphically

illustrated through the use of Figure 1 in which the solid line shows the initially predicted increase in the marginal cost of search while the upper dashed line portrays the increase in the marginal cost of search one standard deviation above that expected. The figure shows that at any point in the search process the slope of the solid line is greater than the slope of the dashed line because the variance of the expected maximum wage offer decreases as the sample size is increased. Thus, the expected marginal benefits of search decrease below their ex ante level because they are calculated from equation (10) which utilizes the rate of increase in the expected marginal cost of search.

The second reason for the revision of the expected marginal benefits of search stems from the fact that the worker has a very low probability of continually obtaining wage offers one standard deviation above the expected maximum offer. In terms of Figure 1 this low probability of continued good luck implies that the expected marginal cost of search is not illustrated by the upper dashed line but rather by an undrawn line which lies between the two previously mentioned ones and is less steeply sloped than either. Thus, there is a further downward revision in the expected marginal benefits of search because of the additional decrease in the rate of increase in the expected marginal cost of search.

Since the wage offer of $W_0 + 2.284\,\sigma_w$ was above the ex ante optimal level, the expected marginal cost of further search will outweigh the expected marginal benefits and the search process will

be terminated. These workers who are lucky and obtain the very high wage offers will, therefore, have a shorter period of unemployment than that predicted by the ex ante search model and their reemployment wage rates will be higher.

The second type of revision for the initial search strategy will occur for those remaining workers who are unable to obtain the ex ante optimal wage rate during their optimal duration of unemployment. Since the maximum wage offer that they will have found is below the anticipated one, their actual marginal cost of search at the present point in time will lie below the level predicted in the initial strategy. This revision in the marginal cost of search will vary among the unemployed workers and will depend exclusively upon the luck of the individual searcher. As the marginal cost of search is revised downward below its level initially predicted by equation (7), the expected marginal benefits of search will increase above their level predicted by equation (10). These revisions will then cause each worker to lower his optimal reemployment wage rate and to extend his period of unemployment so that he can continue his search of the labor market for opportunities superior to those previously discovered.

These deviations of the ex post search results from their predicted path imply that the laid off worker's reemployment wage rate is inversely correlated with his actual period of unemployment. Thus, even though some workers possess identical characteristics, their reemployment strategies will yield different results

because of the dominating role played by luck in all search endeavors.

CHAPTER III

MANPOWER POLICIES OF FIRMS IN THE DEFENSE INDUSTRY

The purpose of this chapter is to analyze the manpower policies of firms in the defense industry. This examination is necessary so that the factors which influence the individual firm's optimal stock of labor can be determined. These factors are worthy of an in depth analysis because the demand for labor by defense firms is determined differently than the demand for labor by the conventional firm. This difference occurs because the contracting procedures practiced in the defense industry permit the individual firm to partially escape the consequences of its actions.[1]

Contracting Procedures

In order to compete in the defense industry, the firm must first determine what products the federal government is interested in buying. Next, the firm must submit proposals on those products that it thinks it is capable of producing. These proposals must include information on the technical characteristics of the product, the cost of producing the product, and a time schedule for delivering the product. The government then reviews all proposals for a certain product and hopefully awards the contract

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[1] See, for example, Cross; McCall; and Scherer (May 1964).

to that firm which appears most efficient in the production of this product.[2] The price that the selected firm charges the government for the finished product is determined by the cost-of-production figure submitted in the proposal. This estimate for the cost of production, which is commonly referred to as the target cost, is multiplied by some negotiated figure that both the firm and the government believe to be a normal rate of return on the project. The cost to the government is then equal to the target cost plus the negotiated rate of return times the target cost. Stated differently

$$(12) \qquad P = (1 + B)Ct$$

in which P equals the price that the government pays for the completed project, B equals the negotiated rate of return, and Ct equals the target cost.

From this equation the profits of the firm can be determined and are equal to B*Ct if, and only if, the actual cost of production coincides with the ex ante target cost. This event rately occurs in real world situations, and the profits of the firm diverge from B*Ct as the actual cost of production varies from the target cost. If the actual cost of production exceeds the target cost, an overrun is said to exist and the profits of the firm decline.

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[2]McCall has shown that the government often encounters difficulties in distinguishing the efficient firms from the inefficient firms.

Conversely, if the actual cost of production is less than the target cost, an underrun occurs and the level of profits increases. The exact relationship between the change in profits and the variations of the actual cost of production from the target cost depends upon the characteristics of the contract that the government awards to the firm.

Figure 2 illustrates the three types of contractual agreements that can be negotiated between the firm and the government. The profits of the firm are plotted on the vertical axis while the actual cost of production is plotted on the horizontal axis. A curve is then drawn through that point that depicts the ex ante situation, cost of production level Ct, and profit level B*Ct The slope of each curve, represented as α thus shows how profits change as the actual cost of production deviates from the target cost.

Case A represents the firm fixed price contract. The conventional theory of the firm holds with this type of contract since the firm is completely responsible for the consequences of its actions. In other words, if an overrun should occur, the level of profits for the firm would decrease by the same amount as the actual cost of production exceeded the target cost. Conversely, in the case of an underrun, the profits of the firm would increase by the same amount as the target cost overstated the actual cost of production. Obviously, α in this case equals one.

Diametrically opposite from the firm fixed price contract is

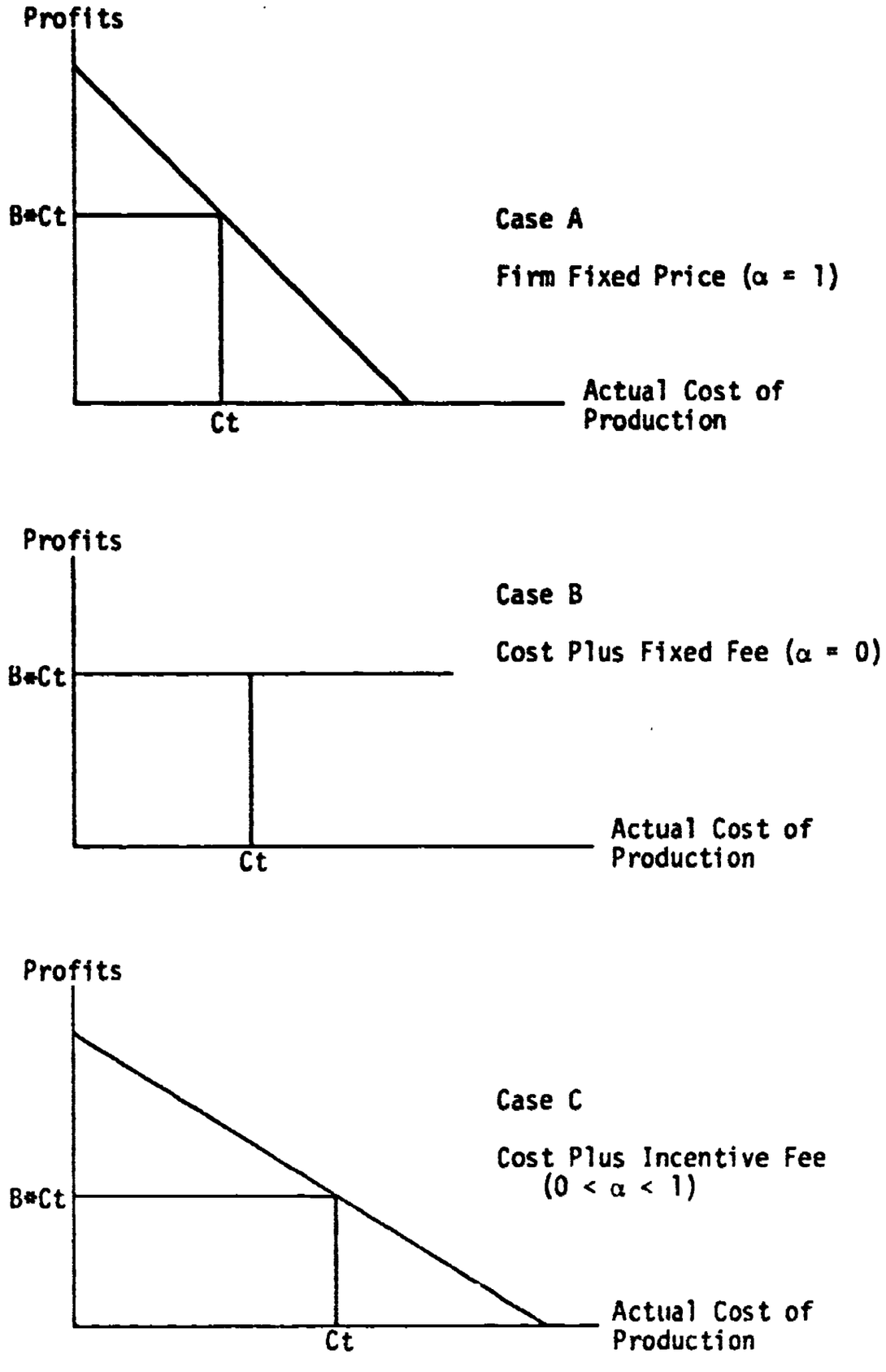

FIGURE 2. CONTRACTUAL AGREEMENTS UTILIZED IN THE DEFENSE INDUSTRY

the cost plus fixed fee contract which is illustrated in Case B. Under this type of contract the firm is guaranteed a certain profit level that is completely independent of the actual cost of production. If an overrun should occur, the firm bears none of the additional cost but neither does it receive any additional benefits if the actual cost of production falls short of the predicted target cost. In this case α equals zero.

The firm fixed price contract represents one extreme in government procurement while the cost plus fixed fee represents the other. Connecting these two limiting cases is the cost plus incentive fee, which is illustrated as Case C. Under the arrangements of cost plus incentive fee, α can vary between zero and one, its exact value depending upon the negotiations between the firm and the government. This type of contract is utilized most often in the defense industry, and under its provisions the firm and government both share the costs of overruns and the benefits of underruns, the exact sharing ratio being determined by α.

Factors Affecting the Profits of Defense Firms

Once these various contracting arrangements are taken into account, the price to the government for the completed project can be represented as

$$P = (1 + B)Ct + (1 - \alpha)(Ca - Ct) \tag{13}$$

in which Ca equals the actual cost of production and all other terms are as previously defined. Since the total cost incurred by the firm is represented by Ca, and P equals the firm's total revenue, the profits that the firm earns on the project are

$$(14) \qquad \pi = P - Ca$$

in which π stands for the level of profits. If equation (13) is now substituted into equation (14) and terms are rearranged, the profits of the firm can be shown as

$$(15) \qquad \pi = B*Ct + \alpha(Ct - Ca)$$

This profit equation, however, is not exactly correct because the government has the power to reward or punish the firm in future periods by either giving it additional contracts or fewer contracts. This decision by the government depends upon the firm's performance on each of its present contracts. The criteria through which the government judges the efficiency of the firm's current production process are the magnitude of the overruns in the cost and time dimensions and the quality of the final product. The smaller the magnitude of each of these overruns or the better the quality of the final product, the more likely will be the government to view the firm as efficient and the greater will be the probability of future contracts. Conversely, the government would be hesitant to award the firm any additional contracts if the firm constantly incurrs cost or time overruns in the production of mediocre goods.

Thus, the expected profits on any one contract must take into account the effects of this contract upon the future business of the firm.

One variable that influences the future business of the firm with the government is the number of workers that the firm has employed on each of its present contracts. As the firm employs additional workers on one of these contracts, for example, the i^{th} contract, its technical capabilities increase and it is able to complete the project in a shorter period of time and/or the quality of the final product will be improved. Either of these outcomes, *ceteris paribus*, will increase the efficiency of the firm, and the government could react to this higher level of efficiency by awarding the firm additional contracts in future periods.

All other things are not constant, however, in that the production costs of the i^{th} contract increase whenever the firm employs more workers on this contract. Since there is a direct relationship between the contract's production costs and level of overrun, the future business of the firm with government decreases as the actual cost of production increases. Thus, the employment of additional manpower on any one contract produces counterbalancing effects upon the future business of the firm. On the one hand, the firm's technical capabilities increase, which tends to increase the number of future contracts, while on the other, the actual cost of production increases, which results in overruns and a lower sales potential in the future.

The actual cost of production on the i^{th} contract is also determined by the total dollar volume of the firm's output. The current demand for the firm's output is able to influence the actual cost of production on the individual contracts because of the accounting methods utilized in the defense industry. In computing cost of production, the defense contractor must divide all of the costs of his firm into two categories, direct costs and indirect costs. A direct cost is any cost that can be directly attributed to a specific contract, while indirect costs comprise all others. More specifically,

> A direct cost is any cost which can be identified specifically with a particular cost objective. Direct costs are not limited to items which are incorporated in the end product as material or labor. Costs identified specifically with a contract are direct costs of the contract and are to be charged directly thereto. Costs identified specifically with other work of the contractor are direct costs of that work and are not to be charged to the contract directly or indirectly. When items ordinarily chargeable as indirect costs are charged to Government work as direct costs, the cost of like items applicable to other work of the contractor must be eliminated from indirect costs allocated to Government work (Martinson, p. 24).[3]

while

> An indirect cost is one which, because of its incurrence for common or joint objectives, is not readily subject to treatment as a direct cost. Minor direct cost items may be considered to be indirect costs for reasons of practicality. After direct costs have been determined and charged directly to the contract or other work as appropriate, indirect costs are those remaining to be allocated to the several classes

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[3]Martinson refers to Armed Services Procurement Regulation (1968), section 15-202(a) as the original source of this quote.

of work (Martinson, p. 30).[4]

Once these two components of total production costs are determined, the indirect costs are usually allocated among the various contracts on the basis of each contract's direct labor cost relative to the total direct labor cost for the entire firm. Thus, the labor costs of the i^{th} contract are determined by the wages of the employees working directly on this project and the level of their share of indirect costs.

The production costs of the i^{th} contract, therefore, increase whenever the firm increases its stock of workers who indirectly support a given number of contracts or whenever any contract is either completed without replacement or cancelled by the government. In this latter case, the magnitude of the increase in production costs on all remaining contracts depends upon the extent to which the firm hoards workers who were previously working on the affected project.[5] Even if no workers were hoarded from this other project, the indirect costs absorbed by the i^{th} contract will still increase because the i^{th} contract's direct labor force will have grown relative to the total direct labor force of the entire firm.[6] The greater the tendency of the firm to hoard laborers from the

[4]According to Martinson, the original source of this quote is Armed Services Procurement Regulation (1968), section 15-203(a).

[5]The determination of a defense firm's layoff policies will be fully analyzed in the proceeding pages of this chapter.

[6]This relative growth in indirect labor costs is caused by the presence of fixed factors which is discussed in detail below.

affected contract and transfer them to positions in which they indirectly support several contracts, the greater will be the indirect costs absorbed by the i^{th} contract. Not only has the labor force of the i^{th} contract increased relative to the total direct labor force of the firm but, in this case, the level of total indirect cost is higher than it would have been without the hoarding effect. Thus, the i^{th} contract would be absorbing a larger proportion of a greater level of indirect costs, and the actual cost of production on the i^{th} contract would increase correspondingly.

The shifting of personnel from the cancelled contract to a position in which they support several contracts has beneficial effects upon the future business of the firm, however, in that these workers increase the rate of production on the individual contracts and the quality of the finished product is improved. In addition, these workers who indirectly support several contracts add to the firm's technical capabilities, and their presence could cause the government to award the firm additional contracts in future periods. Finally, the employment of workers in support operations gives the firm a pool of excess workers from which it can obtain qualified personnel when the future contracts are awarded. Thus, the transfer of workers from cancelled contracts to support operations may increase the cost of production on all remaining contracts, but at the same time, the retainment of qualified personnel confers beneficial effects upon the future business of the firm.

The analysis can take these complications into account by

reformulating equation (15) for a firm that at the present time is producing several projects for the government. The total profits that this firm will incur during the current period can be defined as

$$(16) \qquad \pi = \sum_{i=1}^{N} B_i * Ct_i + \sum_{i=1}^{N} \alpha_i [Ct_i - Ca_i(M_i, M_I)]$$

$$+ \sum_{i=1}^{N} FB_i \left(O_i [Ca_i(M_i, M_I)], Q_i [M_i, M_I], t_i [M_i, M_I] \right)$$

$$+ FB[M_I]$$

in which

π = the level of profits for the firm

B_i = the negotiated rate of return on the i^{th} contract

Ct_i = the target cost on the i^{th} contract

α_i = the sharing ration on the i^{th} contract

Ca_i = the actual cost of production on the i^{th} contract

M_I = the firm's labor force working indirectly on various contracts

FB_i = the effects of the i^{th} contract upon the future business of the firm

O_i = the size of the overrun on the i^{th} contract (O_i is negative for underruns)

Q_i = the level of quality for the final product on the i^{th} contract

t_i = the time required to complete the i^{th} contract

FB = the effect of the firm's support manpower upon the future business of the firm.

The Demand for Labor by Defense Firms

The objective is for the defense firm to maximize its profits by choosing the optimal stock of workers to employ directly on each individual contract and the optimal stock of workers to indirectly support the individual contracts. This task is accomplished by solving the following equations simultaneously:

$$(17) \qquad \frac{\partial \pi}{\partial M_i} = -\alpha_i \frac{\partial Ca_i}{\partial M_i} + \frac{\partial FB_i}{\partial O_i} \frac{\partial O_i}{\partial Ca_i} \frac{\partial Ca_i}{\partial M_i} + \frac{\partial FB_i}{\partial Q_i} \frac{\partial Q_i}{\partial M_i} + \frac{\partial FB_i}{\partial t_i} \frac{\partial t_i}{\partial M_i} = 0$$

$$(18) \qquad \frac{\partial \pi}{\partial M_I} = \sum_{i=1}^{N} -\alpha_i \frac{\partial Ca_i}{\partial M_I} + \sum_{i=1}^{N} \frac{\partial FB_i}{\partial O_i} \frac{\partial O_i}{\partial Ca_i} \frac{\partial Ca_i}{\partial M_I} + \sum_{i=1}^{N} \frac{\partial FB_i}{\partial Q_i} \frac{\partial Q_i}{\partial M_I} + \sum_{i=1}^{N} \frac{\partial FB_i}{\partial t_i} \frac{\partial t_i}{\partial M_I} + \frac{\partial FB}{\partial M_I} = 0$$

in which

$$\frac{\partial Ca_i}{\partial M_i} \cdot \frac{\partial O_i}{\partial Ca_i} \cdot \frac{\partial FB_i}{\partial Q_i} \cdot \frac{\partial Q_i}{\partial M_i} \cdot \frac{\partial Ca_i}{\partial M_I} \cdot \frac{\partial Q_i}{\partial M_I} \cdot \frac{\partial FB}{\partial M_I} > 0$$

$$\frac{\partial FB_i}{\partial O_i} \cdot \frac{\partial FB_i}{\partial t_i} \cdot \frac{\partial t_i}{\partial M_i} \cdot \frac{\partial t_i}{\partial M_I} < 0$$

Furthermore, $\frac{\partial Ca_i}{\partial M_i}$ equals the worker's wage rate plus his share of indirect costs. If terms are now rearranged in these equations, we obtain the result that

$$(19) \qquad \frac{\partial Ca_i}{\partial M_i}\left(\frac{\partial FB_i}{\partial O_i}\frac{\partial O_i}{\partial Ca_i} - \alpha_i\right) = \frac{\partial FB_i}{\partial Q_i}\frac{\partial Q_i}{\partial M_i} + \frac{\partial FB_i}{\partial t_i}\frac{\partial t_i}{\partial M_i}$$

$$(20) \qquad \sum_{i=1}^{N}\left[\frac{\partial Ca_i}{\partial M_I}\left(\frac{\partial FB_i}{\partial O_i}\frac{\partial O_i}{\partial Ca_i} - \alpha_i\right)\right] = \sum_{i=1}^{N}\left(\frac{\partial FB_i}{\partial Q_i}\frac{\partial Q_i}{\partial M_I} + \frac{\partial FB_i}{\partial t_i}\frac{\partial t_i}{\partial M_I}\right) + \frac{\partial FB}{\partial M_I}$$

Equation (19) states that the firm's optimal stock of labor for the i^{th} contract is determined at that point at which the worker's marginal cost equals the value of his marginal product on the project, given the total volume of the firm's output and the optimal amount of workers in support operations. Equation (20) then shows that the optimal stock of labor for support purposes is obtained at that point at which the marginal cost of an additional worker in support equals the value of his marginal product, given

the volume of the firm's output and the optimal amount of direct manpower.

The above equations, however, are only correct if the firm bears none of the cost of training the worker. If the skills acquired by the worker were general in nature, this situation would hold because the worker would be completely responsible for the financing of his training. In the defense industry, however, the firm requires its workers to be skillful in tasks that are quite specific. Thus, the cost of acquiring these skills will be shared by both the firm and the worker, the exact sharing ratio being determined by the relationship between quit rates and wages and layoff rates and profits. In the periods following the training program, the firm will, therefore, pay the worker a wage rate that is less than the value of his marginal product but greater than his opportunity cost in other positions. The difference between the value of the worker's marginal product and his wage rate is the firm's return on its investment in specific human capital while the difference between the worker's wage rate and his opportunity cost represents the worker's return on his investment in specific human capital.[7]

The firm, however, may not be able to collect its entire return from its investment in specific human capital because the demand for the firm's output could decrease in some period following the

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[7]For a more detailed analysis, see Becker.

training program. As mentioned above, this decrease in demand could be caused by the government's cancellation of a contract or the firm's failure to receive an additional contract after completing an old one. Whenever either of these situations occur, direct manpower for the affected project will no longer be required, and the value of the marginal product for workers in support operations will fall because they have one less contract on which to work. At the same time, the marginal employment cost of all direct laborers will increase and the firm will initiate its layoff policies as the marginal cost of a worker rises above the value of his marginal product.[8] These layoff policies, however, will not be restricted to those workers who were previously employed on the cancelled contract but, rather, will affect the manpower requirements on each of the firm's existing projects.

Even if the firm laid off all workers who were directly associated with the cancelled contract, the marginal cost of labor on all remaining contracts would still increase because each project would now be absorbing a larger proportion of indirect costs. This higher level of indirect costs which must be charged to each of the remaining projects occurs because some inputs are fixed in the short run and their quantity cannot be immediately reduced when

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[8]As will be shown below, this situation is only correct if the firm expects the decline in demand to be permanent. In all other situations, layoffs will not be initiated until the value of the worker's marginal product falls a certain level below his marginal employment cost, the exact level being determined by the firm's expectations of future demand.

the firm experiences the reduction in demand.[9] As the total dollar volume of these inputs increases, the firm's ability to control its level of indirect costs is reduced. During periods of decreased demand, the presence of these fixed factors, therefore, causes the level of indirect costs to increase relative to the level of direct costs. This relatively higher level of indirect costs is then allocated among the remaining contracts according to the relative size of each project's direct labor pool. Thus, the loss of a contract causes the marginal cost of labor on all remaining contracts to increase because each project is now absorbing a higher level of indirect costs.

In addition to the magnitude of fixed factors, the change in the marginal employment cost of labor on the remaining contracts will depend upon the severity of the reduction in demand. As the size of a contract increases relative to the entire output of the firm, the proportion of indirect costs absorbed by this contract will increase, while that proportion charged to the other contracts will decline. Since some of these indirect costs represent payments to fixed factors, the major contract will also be absorbing a large proportion of these fixed payments. If this contract is suddenly cancelled by the government, the relative large amount of fixed indirect costs which were being charged to this project

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[9] In the defense industry, a major portion of these fixed inputs is comprised of the firm's specifically trained manpower which Oi has classified as quasi fixed factors of production.

will now have to be absorbed by the firm's other projects. Thus, there will be an increase in the marginal cost of labor on these remaining contracts, and the magnitude of this increase will vary directly with the relative importance of the cancelled contract.

In addition to this explicit increase in the projects' costs during periods of depressed demand, the presence of fixed factors causes an increase in the implicit marginal cost of labor. As previously shown, a growth in the actual cost of production on any project increases (decreases) the level of that project's overrun (underrun), and there is a corresponding decrease in the level of the firm's future business with the government. The magnitude of this implicit cost depends upon the government's reaction to an overrun and will increase if the marginal detrimental effects of an overrun are positively correlated with the size of the overrun. Thus, a defense firm which faces a reduced level of demand will experience an increase in the explicit and implicit marginal cost of labor. As this marginal employment cost then rises above the value of the worker's marginal product, the firm will initiate its layoff policies and reduce the level of its optimal stock of labor.

The Layoff Policies of Defense Firms

The firm's decision of whom to lay off is very critical and depends upon the firm's expectations of future demand and the worker's search strategy upon being laid off. Prior analyses have neglected the impact of the displaced worker's search strategy

upon the manpower policies of the firm and have implicitly assumed that the firm believes that the decline in demand is permanent.[10] With such a permanent decline in demand, the firm would have no interest in the unemployment activities of its displaced workers because no intentions would exist for the rehiring of these personnel at a later point in time. Accordingly, those workers would be laid off who had the lowest levels of specific skill and the shortest expected future period of tenure. By following this manpower policy, the firm would increase the average employment tenure of its work force and minimize its future costs of hiring and training new personnel.[11]

It is only in this case of a permanent decline that there are no interrelationships between the manpower policies of the firm and the search strategies of its displaced workers. Once a temporary decline in demand is introduced into the analysis, these results must be modified because interrelationships do develop between the employment policies of the firm and the search behavior of its laid off workers. When the firm does experience a lapse of time between the cancellation or completion of a contract and the awarding of another, it will initiate layoff policies quite different from the case in which the decline in demand was permanent.

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[10]The most noteworthy example of this type of analysis is Oi.

[11]If the displaced workers also realize that the decline in demand is permanent, their reemployment search strategies will be unaffected by the manpower policies of the firm because these individuals realize that there is no possibility of recall.

Whenever the firm expects the decline in demand to be temporary, it will not immediately lay off a worker as the value of his marginal product falls below his marginal employment cost.[12] Rather, a worker will only be displaced when the expected losses of his continued employment exceed the costs of layoff and subsequent rehiring once demand returns to its former level.[13] As the expected duration of the depressed demand is reduced, these latter costs will increase relative to the firm's losses associated with continued employment, and layoffs will become less extensive. Thus, the firm is, in effect, minimizing its losses by following a restrictive layoff policy when the decline in demand is expected to be temporary.

A second variation in the firm's manpower policies when facing a temporary decline in demand instead of a permanent one is that the firm will now have an incentive to displace those workers who possess a relatively large amount of specific human capital. These workers would be the ideal type for the firm to lay off whenever it expected the decline in demand to be temporary because they would be the ones most likely to be available for recall once demand returned to its former level. Since each of these workers is

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[12]This situation was recognized by Becker and more fully developed by Parsons.

[13]In addition to the costs of terminating a worker and then rehiring him once demand returns to its former level, the firm would have to incur the cost of retraining if the displaced worker weren't available for recall once a new contract was awarded to the firm.

specifically trained, the firm would have been paying them a wage rate above their opportunity cost. Expecting the decline in demand to be temporary, these displaced workers would have an incentive to simply remain at home and await their recall notice. Even if some of the workers actively sought and obtained reemployment opportunities in the local labor market, they would not hesitate in returning to their former positions upon being recalled. This incentive of these displaced workers to return to their former firm results from their relatively large amounts of specific skill which permit them to collect quasi rents in defense employment.

Since these quasi rents can be collected from any defense firm, however, the displaced workers' availability for recall will begin to diminish as their period of unemployment lengthens. As these workers remain unemployed, their subjective valuation of the probability of recall will decline and the option of migration to another defense firm will begin to look more attractive. Thus, the firm's ability to successfully recall these displaced workers will begin to diminish as it delays the initiation of its recall orders.

Since the firm has financed a portion of the displaced workers' specific training, it will experience a capital loss if the workers migrate to other defense firms from which they are unable to respond to recall notices. The parent firm will, therefore, have to reconsider its manpower policies as these workers begin to migrate during the period of decreased demand. Instead

of losing this highly skilled manpower to industry rivals, the firm could initiate recall orders for these workers and in their place lay off those employees with relatively low levels of specific skill. Once displaced, these low skilled workers would immediately begin to search out their reemployment opportunities in the labor market. As they obtain new positions, they will have virtually no incentive to respond to a subsequent recall notice because their low level of specific skill produces no significant difference between their prelayoff wage rate and their opportunity cost. Nonetheless, the firm would rather sacrifice its investment in these workers during a protracted period of decreased demand so that it will be able to maintain a relatively large labor pool of skilled manpower. Thus, the firm is, in effect, minimizing its losses when it decides to hoard its highly trained personnel during protracted periods of decreased demand.

As the firm continues to be unsuccessful in its attempts to obtain a new contract, it will begin to revise its expectations as to the permanency of this decreased level of demand. Under these new expectations, the firm will be less optimistic about its chances of being awarded a new contract and will be more reluctant to continue employing those workers whose marginal employment cost is above their VMP. Additional personnel will, therefore, be displaced by the firm since these revised expectations reduce the profitability of the firm's present level of hoarding. These layoffs will become more extensive as the firm's expectations of new

contracts continue to diminish, and at that point in time at which the firm believes the decline in demand to be permanent, all workers will be laid off whose marginal employment cost is above the value of their marginal product.

Thus, a defense firm which experiences a reduction in demand will decrease the magnitude and rearrange the composition of its optimal stock of labor. The reduction in magnitude will depend upon the firm's expectations of future demand while the change in composition will depend upon the unemployment activities of those workers who are displaced.

CHAPTER IV

THE EMPIRICAL EVIDENCE

The purpose of this chapter is to empirically test the hypotheses which were developed in Chapters II and III. This task will be accomplished through the utilization of data available from surveys of workers laid off by three defense firms during the years 1963 through 1965. The first survey was conducted in August, 1964, and involved the 5000 workers who were discharged by the Boeing Company (Seattle) after its Dyna-Soar contract was cancelled in December, 1963. The second survey was concerned with the 4000 workers laid off by the Martin Company (Denver) during 1964 as a result of the termination of the Titan program in late 1963. This survey, as well as the third one, took place in March, 1965. The last survey collected data on the 10,000 workers discharged by the Republic Aviation Company (Long Island) over a 21-month period after the completion of the F-105 program in April, 1963. In total, more than 7,000 of the workers displaced by these three firms provided information which will be analyzed below.

Setting the Scene

Even though these three firms were in the defense industry, each one possessed unique characteristics which distinguished it from the other two. Boeing, for example, was by far the largest

of the three and the only one with a diversified product line. In 1960, its total output was valued at $1.555 billion of which 68% represented military sales while the remainder was sold to commercial customers. This diversification towards commercial products had begun in 1958, and 1960 represented the first year in which an accounting profit was shown. Throughout the next few years the military-commercial sales ratio remained relatively constant, but production continued to increase and reached an annual level of $1.771 billion in 1963. At this point in time, Boeing's labor force numbered 100,000 workers with approximately 70 percent of them being employed at the Seattle plant.

During the latter part of 1963, however, Boeing's aerospace division experienced several setbacks which included a reduced level of demand for the Minuteman missile and culminated in the loss of the Dyna-Soar contract in December, 1963. During the first week of this month, Boeing announced that layoffs appeared imminent, and over the next four months, 5000 workers were discharged, most of whom had been employed in the aerospace division. Nonetheless, some of these workers were immediately recalled as Boeing was awarded several minor aerospace contracts. Moreover, employment was actually expanding in the airplane division during this period of time in that Boeing was developing a supersonic transport plane and had previously been awarded a contract to build twelve KC135 aerial tankers.

Neither Martin nor Republic possessed this diversified product

line and both firms experienced very significant reductiors in demand upon completing their major projects. Nonetheless, there were differences between the experiences of these two firms which become apparent upon examining the records of each. The Martin plant in Denver, for example, was relatively new in that it had initially been established in 1956 by a group of Martin employees who had been transferred from the Baltimore area. The primary objective of this newly founded firm was to design, produce, and test the Titan I weapon system. As the firm became proficient in this production process, the government reacted by awarding it the new contracts for the Titan II and Titan III missile projects. Through the procurement of these additional contracts, the firm was able to continuously expand its labor force, and by 1961, 13,000 workers were employed in the production of these missiles. This level of employment then remained constant until December, 1963 when the Titan program was completed.

As these projects were terminated, Martin was unsuccessful in obtaining new contracts and began to initiate layoffs among its labor force. The firm continued its attempts at obtaining new contracts, however, and only engaged in a restrictive layoff policy during the early months of the reduced level of demand. Nonetheless, these efforts were to no avail, and the layoffs eventually became more extensive. By October, 1964, eleven months after completing the Titan program, no new contracts had yet been awarded to the firm. Thus, Martin probably viewed the reduction in

demand as permanent and laid off an additional 333 workers which brought the total number of displaced workers to a level of 4264 individuals.

The Republic Aviation Company differed from Martin in that it had been established prior to World War II and had continuously concentrated its resources in the production of military aircraft. As a result of this narrow product line, Republic had experienced several periods of prosperity between the years 1942 and 1963. Each of these periods, however, was terminated by an interval of depressed demand.

The first period of prosperity resulted from World War II during which Republic tremendously increased its volume of aircraft sales to the government. Post war projects included the P-47 Thunderbird fighter, the F-84 fighter-bomber, and, finally, a contract to produce 830 F-105 fighter-bombers. During the completion of each of these projects, the workers at Republic were subjected to large scale layoffs, but they were immediately recalled once the new contracts were received. Workers, therefore, became accustomed to these occasional layoffs and accepted them as a peculiarity of their employment at Republic. Indeed, the firm and its workers both assumed that the government would always take care of Republic by awarding it new contracts whenever old ones were completed.

In view of this attitude, nobody seemed to worry when the Department of Defense announced early in 1962 that the F-105

program was soon to be phased out. Republic, its workers, and the entire community all believed that either the government would change its mind about the cancellation or a new contract would be awarded to replace the F-105. These expectations were thwarted, however, in that neither option materialized, and Republic initiated its massive layoffs in April, 1963. These layoffs continued over an extended period of time, and the firm's labor force fell from a level of 18,023 workers in March, 1963, to a level of 4,369 workers in May, 1965.

The Nexus Between Theory and Reality

Through the use of the data collected in the surveys of these three firms testable hypotheses can be formulated which should improve the understanding of the unemployment problem in the defense industry. The first set of hypotheses deals with the displaced worker's job search strategy in which the determinants of the reemployment wage rate and duration of unemployment are examined. Throughout this procedure, special attention is devoted to the worker's level of skill. As a measure of this variable, the analysis examines the worker's age, sex, prelayoff salary, and level of education. The proportion of this skill that can be used in new positions depends upon the worker's decisions concerning migration, defense reemployment, and future occupation. Once this level of skill has been determined, the worker's productivity and returns to specific human capital can be calculated. With

this information, the reemployment wage rate can be predicted and contrasted to the prelayoff wage level.

Skill is also an important determinant of the duration of unemployment. As the displaced worker's level of skill increases, he will have a greater incentive to devote his resources to the intensive margin of search so that he can determine the exact requirements of each position and decide whether or not his qualifications are applicable. In order to obtain additional information on any one job offer, the worker would have to personally visit the firm, observe the production process, and talk to his potential employer about the exact nature of his future responsibilities. All of these activities are time intensive in nature, which implies that the duration of unemployment can be predicted through an examination of those variables which determine the amount of skill possessed by the worker.

The second set of hypotheses concerns the magnitude of future pay raises for workers who obtain reemployment in the defense industry. Wage structures within Boeing, Martin, and Republic are examined by focusing attention upon the employee's age, occupation, and level of education. The analysis should show that the professional well educated workers experience the larger wage advancements because future increases in productivity are directly associated with the stock of human capital. Interfirm wage differentials for a given category of labor are examined by noting the worker's employer as well as his age, occupation, and

educational attainments. The results should show that for a specified level of skill the magnitude of future pay raises is dependent upon the firm with which the worker is employed.

Manpower policies of defense firms are analyzed by examining the layoff policies of Boeing, Martin, and Republic. These policies are formulated so that the firm can protect its investment in specific human capital. As a measure of this capital, the analysis focuses upon the discharged worker's seniority and occupation. The effect of these two variables upon the firm's management of its labor force during a period of reduced demand cannot be determined on an a priori basis because layoff policies are influenced by the displaced worker's job search strategy. Thus, the layoff policies of these three firms will be analyzed with a special emphasis being placed upon the relationship between the separation policies of the firm and the reemployment endeavors of the discharged worker.

The Evidence for the Job Search Behavior of Unemployed Defense Workers

The reemployment search results for the laid off defense workers can be empirically analyzed through the formulation of three models. The first model illustrates each worker's reemployment wage rate while the second model compares this new wage rate to the worker's prelayoff wage rate. Finally, the third model depicts the worker's status (employed or unemployed) in the

periods following his displacement.

Each of these models can be represented in standard statistical notation as

$$(21) \qquad \varepsilon(Y_i) = B_o + \sum_{j=1}^{N} B_j X_{ij}$$

The explanatory variables for the first two models are identical and include the worker's age, sex, prelayoff salary, and level of education. In addition, the new absolute and relative wage rates depend upon the worker's total duration of unemployment and his decisions concerning migration, defense reemployment, and occupational change. With the exception of the total duration of unemployment, all of these variables are again used in predicting the worker's probability of being employed in each of the periods following his layoff.

Each of these explanatory variables was coded in discrete form which requires the use of binary variables throughout the entire analysis. Age, for example, is not represented by the first independent variable alone but rather is shown by the first four independent variables in which

X_1 signifies that the worker is below 25 years old

X_2 signifies that the worker is between 25 and 34 years old

X_3 signifies that the worker is between 35 and 44 years old

X_4 signifies that the worker is between 45 and 54 years

old

If age were the only explanatory variable in the model, equation (21) could be rewritten as

$$(22) \qquad \varepsilon(Y_i) = B_0 + \sum_{j=1}^{4} B_j X_{ij}$$

If the worker were then known to be 29 years old, the binary variable 1 would be assigned to X_2 while all other X's would be assigned the binary variable 0. Thus, the above equation could be reduced to

$$(23) \qquad \varepsilon(Y_i) = B_0 + B_2 X_2$$

The only exception to this rule of assigning zeroes to all independent variables not applicable to the worker arises whenever none of the categories describes the worker's characteristic (age). In the above example, this situation would occur whenever the worker was over 55 years old. Nonetheless, this case presents no problems in that the value for the dependent variable for this group of workers is obtained from equation (21) in which X_1 through X_4 take on the binary variable -1. Thus, whenever the missing category for a characteristic is the applicable one, all independent variables for that characteristic are set equal to -1. In such a way, the regressions require N - 1 independent variables for the N categories of each explanatory characteristic.

Now that the statistical methods have been explained, attention can be turned to Table 2 which illustrates the analysis of

TABLE 2 - AOV RESULTS FOR REEMPLOYMENT WAGES OF BOEING, MARTIN, AND REPUBLIC WORKERS

Effect	Boeing		Martin		Republic	
	Absolute Wage	Relative Wage	Absolute Wage	Relative Wage	Absolute Wage	Relative Wage
Age	5.42**	5.39**	1.93	2.34*	10.69**	10.43**
Sex	47.77**	77.90**	10.15**	25.52**	43.98**	68.91**
Prelayoff Salary	49.87**	138.41**	44.29**	56.74**	43.49**	50.66**
Defense Reemployment	68.81**	42.98**	57.27**	44.55**	25.57**	16.20**
Migration	27.71**	15.04**	23.27**	22.53**	7.18**	3.81*
Level of Education	2.21	2.13	13.94**	8.37**	18.54**	13.21**
Occupation (old/new)	24.79**	16.87**	17.65**	13.75**	33.72**	12.15**
Duration of Unemployment	6.26**	4.94**	1.95*	2.05*	10.37**	10.05**
Migrat * Occupat (old/new)	9.81**	5.38**	7.41**	3.05*	2.94*	2.37
R^2	.65	.49	.58	.33	.58	.23
Sample Size	1426	1426	1256	1256	2058	2058

Numbers opposite the effects are F values in which
* indicates significance at the five percent level and
** indicates significance at the one percent level.

variance results for the reemployment wages of the workers discharged by Boeing, Martin, and Republic. The absolute and relative reemployment wage rates are the dependent variables and are shown in the top row of the table. The explanatory variables are then listed as effects in the first column of the table. The R^2 and sample size for each analysis are then given in the bottom two rows of the table. Finally, the numbers in the main body of the table are the F values for each of the explanatory variables in which one star indicates significance at the five percent level while two stars indicate significance at the one percent level.

Tables 3, 4, and 5 illustrate the regression results for the reemployment wages of the Boeing, Martin, and Republic workers, respectively. Absolute wage units in these tables are measured in $25 intervals in which a wage rate of 4.00 indicates that the worker is earning $137.50 per week while a wage rate of 5.00 indicates a weekly salary of $162.50. In order to obtain the reemployment wage for any worker, the intercept term is simply added to that term under each personal characteristic which describes the worker. If the worker's characteristic is not described by any of the present terms, the negative of each term is then added to the intercept.

The estimates for the effects of sex and education show that the better educated male workers obtain the highest absolute and

TABLE 3 - REGRESSION RESULTS FOR REEMPLOYMENT WAGES OF BOEING WORKERS

Effect	Absolute Wage	Relative Wage
Intercept	4.30 (41.95)**	0.99 (28.28)**
Age		
below 25	-0.21 (-3.95)**	-0.07 (-3.84)**
25-34	0.00 (0.02)	0.00 (-0.03)
35-44	0.14 (2.38)**	0.03 (1.86)*
45-54	0.13 (2.13)*	0.05 (2.73)**
Sex		
Male	0.28 (6.91)**	0.12 (8.82)**
Prelayoff Salary (weekly)		
below $75	-0.94 (-4.16)**	2.46 (31.73)**
$ 75 - $99	-1.98 (-18.11)**	0.07 (1.93)*
$100 - $124	-1.62 (-17.38)**	-0.15 (-4.94)**
$125 - $149	-1.02 (-12.30)**	-0.24 (-8.56)**
$150 - $174	-0.60 (-5.50)**	-0.37 (-9.89)**
$175 - $199	0.28 (2.10)*	-0.38 (-8.43)**
$200 - $224	0.68 (4.14)**	-0.47 (-8.50)**
$225 - $249	1.89 (6.64)**	-0.45 (-4.66)**
Defense Reemployment		
Yes	0.23 (8.29)**	0.06 (6.55)**
Migration		
Yes	0.21 (5.26)**	0.05 (3.87)**
Level of Education		
high school degree or less	-0.05 (-0.78)	0.00 (0.13)
some college	-0.16 (-2.51)**	-0.04 (-2.09)*
bachelor's degree	-0.02 (-0.39)	0.00 (-0.07)
Occupation (old/new)		
professional/professional	0.41 (6.18)**	0.09 (4.28)**
professional/worker	-0.44 (-5.43)**	-0.11 (-4.01)**
worker/professional	0.28 (3.17)**	0.10 (3.52)**

TABLE 3 (Continued)

Effect	Absolute Wage	Relative Wage
Duration of Unemployment		
less than 5 weeks	0.29 (4.83)**	0.09 (4.73)**
5 weeks - 8 weeks	0.30 (4.54)**	0.09 (4.14)**
9 weeks - 12 weeks	0.11 (1.61)	0.04 (1.98)*
13 weeks - 16 weeks	0.03 (0.42)	0.03 (1.26)
17 weeks - 20 weeks	0.00 (-0.08)	0.01 (0.72)
21 weeks - 24 weeks	-0.21 (-2.19)*	-0.04 (-1.33)
25 weeks - 28 weeks	-0.27 (-2.12)*	-0.08 (-1.96)*
Migration * Occupation (old/new)		
Yes * pro/pro	0.16 (2.96)**	0.02 (1.25)
Yes * pro/workers	-0.12 (-1.59)	-0.03 (-1.31)
Yes * worker/pro	0.15 (1.75)	0.06 (2.22)*

Numbers in parentheses are t values in which
* indicates significance at the five percent level and
** indicates significance at the one percent level.

TABLE 4 - REGRESSION RESULTS FOR REEMPLOYMENT WAGES OF MARTIN WORKERS

Effect	Absolute Wage	Relative Wage
Intercept	4.43 (41.43)**	0.80 (33.70)**
Age		
below 25	-0.25 (-2.61)**	-0.06 (-2.85)**
25-34	-0.13 (-1.71)	-0.03 (-1.99)*
35-44	-0.04 (-0.54)	-0.01 (-0.85)
45-54	0.01 (0.14)	0.00 (0.11)
Sex		
Male	0.21 (3.18)**	0.07 (5.05)**
Prelayoff Salary (weekly)		
$75 - $99	-1.22 (-10.29)**	0.49 (18.77)**
$100 - $124	-1.14 (-12.29)**	0.17 (8.27)**
$125 - $149	-0.93 (-12.01)**	0.01 (1.01)**
$150 - $174	-0.66 (-8.80)**	-0.08 (-5.11)**
$175 - $199	-0.01 (-0.18)	-0.10 (-4.51)**
$200 - $224	0.42 (3.53)**	-0.15 (-5.87)**
$225 - $250	1.13 (6.15)**	-0.17 (-4.32)**
Defense Reemployment		
Yes	0.30 (7.56)**	0.06 (6.67)**
Migration		
Yes	0.22 (4.82)**	0.04 (4.74)**
Level of Education		
high school degree or less	-0.44 (-6.14)**	-0.07 (-4.85)**
some college	-0.27 (-4.13)**	-0.03 (-2.47)**
bachelor's degree	0.17 (2.04)*	0.03 (1.86)*
Occupation (old/new)		
professional/professional	0.36 (5.48)**	0.06 (4.48)**
professional/worker	-0.25 (-3.62)**	-0.04 (-2.84)**
worker/professional	0.13 (1.18)	0.03 (1.46)

TABLE 4 (Continued)

Effect	Absolute Wage	Relative Wage
Duration of Unemployment		
less than 5 weeks	0.20 (2.68)**	0.04 (2.79)**
5 weeks - 8 weeks	0.15 (2.11)*	0.03 (2.26)*
9 weeks - 12 weeks	0.06 (0.84)	0.00 (0.50)
13 weeks - 16 weeks	0.09 (1.08)	0.02 (1.16)
17 weeks - 20 weeks	-0.23 (-2.22)*	-0.04 (-1.99)*
21 weeks - 24 weeks	-0.07 (-0.65)	-0.02 (-1.06)
25 weeks - 28 weeks	-0.04 (-0.35)	-0.01 (-0.63)
29 weeks - 32 weeks	-0.11 (-0.74)	-0.01 (-0.30)
Migration * Occupation (old/new)		
yes * pro/pro	0.21 (3.55)**	0.02 (2.09)*
yes * pro/worker	0.02 (0.32)	0.00 (0.43)
yes * worker/pro	-0.08 (-0.80)	-0.01 (-0.46)

Numbers in parentheses are t values in which
* indicates significance at the five percent level and
** indicates significance at the one percent level.

TABLE 5 - REGRESSION RESULTS FOR REEMPLOYMENT WAGES OF REPUBLIC WORKERS

Effect	Absolute Wage	Relative Wage
Intercept	4.17 (42.96)**	0.72 (24.49)**
Age		
below 25	-0.08 (-1.42)	-0.03 (-2.13)*
25-34	0.14 (3.13)**	0.04 (3.14)**
35-44	0.22 (5.63)**	0.06 (5.56)**
45-54	0.00 (-0.21)	0.00 (0.09)
Sex		
Male	0.29 (6.63)**	0.11 (8.30)**
Prelayoff Salary (weekly)		
$75 - $99	-1.27 (-14.92)**	0.48 (18.43)**
$100 - $124	-1.05 (-15.78)**	0.19 (9.73)**
$125 - $149	-0.57 (-8.12)**	0.11 (5.30)**
$150 - $174	-0.25 (-2.78)**	0.00 (0.24)
$175 - $199	0.13 (1.47)	-0.06 (-2.53)**
$200 - $224	0.51 (3.79)**	-0.15 (-3.66)**
$225 - $249	1.08 (6.11)**	-0.20 (-3.83)**
Defense Reemployment		
Yes	-0.11 (-5.05)**	-0.02 (-4.02)**
Migration		
Yes	0.17 (2.68)**	0.03 (1.95)*
Level of Education		
high school degree or less	-0.44 (-5.73)**	-0.10 (-4.51)**
some college	-0.09 (-1.22)	0.00 (-0.20)
bachelor's degree	0.30 (3.17)**	0.06 (2.18)*
Occupation (old/new)		
professional/professional	0.72 (7.47)**	0.11 (4.04)**
professional/worker	0.06 (0.42)	0.04 (0.85)
worker/professional	-0.34 (-2.92)**	-0.06 (-1.91)*

TABLE 5 (Continued)

Effect	Absolute Wage	Relative Wage
Duration of Unemployment		
less than 5 weeks	0.31 (5.43)**	0.08 (4.85)**
5 weeks - 8 weeks	0.13 (2.31)**	0.04 (2.46)**
9 weeks - 12 weeks	0.28 (4.28)**	0.08 (4.10)**
13 weeks - 16 weeks	-0.01 (-0.20)	0.00 (0.10)
17 weeks - 20 weeks	-0.03 (-0.63)	-0.01 (-0.64)
21 weeks - 24 weeks	-0.06 (-0.94)	-0.01 (-0.60)
25 weeks - 28 weeks	-0.12 (-1.77)	-0.02 (-1.36)
29 weeks - 32 weeks	-0.14 (-1.92)*	-0.04 (-2.03)*
Migration * Occupation (old/new)		
yes * pro/pro	-0.09 (-1.06)	-0.02 (-0.98)
yes * pro/worker	0.41 (2.57)**	0.10 (2.13)*
yes * worker/pro	-0.29 (-2.54)**	-0.08 (-2.24)*

Numbers in parentheses are t values in which
* indicates significance at the five percent level and
** indicates significance at the one percent level.

relative reemployment wage rates. According to the coefficients for age, these wages increase as the worker's age approaches 55 but then decline thereafter. This correlation between a worker's absolute reemployment wage rate and his age, sex, and educational attainment occurs because each of these variables could be used as a proxy for the worker's productivity. The older male workers who are highly educated are more productive than their counterparts and, accordingly, obtain higher wage offers. Nonetheless, productivity does decline during old age, and it is not surprising to discover that the absolute reemployment wage also declines for those workers over 55 years of age.

Whereas the absolute wage rate measures the worker's productivity, the relative reemployment wage rate measures the proportion of skills that can be transferred to new positions. Middle-aged male workers who are well educated appear to have been collecting the smallest amounts of quasi rents from their former employers since their relative reemployment wage rates are the highest. At first sight, part of this conclusion seems to go against the theory in that quasi rents should be positively correlated with the age of the worker. This paradox is resolved, however, once it is pointed out that the incentive towards retraining is inversely related to the age of the individual. The older workers, therefore, will try to obtain positions in which a minimal amount of retraining is required while their younger counterparts will invest more heavily and pay through

the acceptance of a lower wage rate.

Absolute wage rates also increase as the worker's prelayoff salary increases. This result is expected since the prelayoff wage rate is a measure of the worker's productivity. High productivity, however, is associated with a high yield on specific skills which implies that the displaced worker's relative reemployment wage rate should decline as his prelayoff salary increases. The estimates support this hypothesis in that there is a statistically significant inverse relationship between the prelayoff salary of the individual and his relative reemployment wage rate.

The theory predicts that defense reemployment will increase both the absolute and relative reemployment wage rates of the displaced worker because this decision allows him to continue using his specific skills. The reemployment experiences of Boeing and Martin workers conform to this hypothesis in that the reemployment wage rates were significantly higher ($12.00 per week for Boeing and $15.00 per week for Martin) for those individuals who remained in the defense industry. Republic workers who obtained defense reemployment, however, received a weekly salary $5.00 lower than their counterparts who left the industry. This apparent contradiction results from the highly unionized nature of the Republic work force. Those workers who remained in the defense industry lost many of their union benefits which could have been kept in nondefense work. These workers, therefore, were able to keep the return accruing to their specific skills while they lost

that return due to their union affiliation. These latter rents apparently outweighed the former, and those workers who remained in the defense industry experienced a slight reduction in their reemployment wage rates.

The absolute and relative reemployment wage rates also depend upon the worker's decisions concerning occupational change and migration. Occupational change is measured by comparing the worker's former position with his present one. For example, the professional/professional category signifies that the worker was formerly a professional worker and remained in this occupation upon becoming reemployed. The professional/worker category shows the results of a former professional worker who accepted a position as a blue collar employee.

The estimates in each table show that migration increases the weekly salary by approximately $10.00. The coefficients also show that professional workers who remain in their former occupations receive higher absolute and relative reemployment wage rates than their former professional counterparts who accept positions as blue collar workers. These wage differences are expected and illustrate the latter group's inability to utilize many specific skills which are still applicable to the individuals in the professional/professional category.

In addition to the individual effects of migration and occupational standing upon reemployment wages, these two variables combine into an interaction term which also influences the worker's

new wages. According to the estimates, this interaction effect greatly enhances the returns to migration for the professional/professional workers while reducing these returns to practically zero for those individuals in the worker/worker category. The theory would predict this result because professional workers have a much greater level of specific skill than their blue collar counterparts. These individuals will, therefore, experience a relatively large increase in their reemployment wages if they decide to remain professionals and migrate to positions in which they can continue utilizing their specific skills.

Given the worker's characteristics and decisions concerning migration, defense reemployment, and occupational change, the absolute and relative reemployment wage rates should decline as the duration of unemployment increases. The results of the reemployment experiences of Boeing, Martin, and Republic workers support this hypothesis at a statistically significant level. This relationship implies that the ex post search results do differ from their predicted path which causes the displaced worker to constantly reevaluate his search strategy as his duration of unemployment lengthens.

The duration of unemployment is analyzed in Tables 6 through 11. The dependent variable is the proportion of each sample that is employed in the various time periods following the layoff date. Each time period is assumed to be four weeks long and the analysis is continued through the first six of these periods. The first

TABLE 6 - AOV RESULTS FOR STATUS OF BOEING WORKERS

Effect	Status A	B	C	D	E	F
Age	10.81**	18.76**	15.18**	15.68**	9.23**	6.74**
Sex	1.30	0.00	1.79	1.48	0.03	0.27
Prelayoff Salary	5.40**	6.45**	3.61**	2.46**	1.72	1.66
Defense Reemployment	1.17	4.33*	7.07**	3.17	2.60	0.00
Migration	0.78	0.67	1.88	0.72	0.04	1.21
Level of Education	0.58	0.61	1.78	1.61	0.64	0.39
Occupation (old/new)	3.01*	8.19**	4.93**	1.57	1.21	2.57*
Migrat * Occupat (old/new)	2.79*	5.59**	5.33**	4.30**	0.90	1.54
R^2	.06	.11	.09	.07	.04	.03
Sample Size	1578	1578	1578	1578	1578	1578

Numbers opposite the effects are F values in which
* indicates significance at the five percent level and
** indicates significance at the one percent level.

TABLE 7 - REGRESSION RESULTS FOR STATUS OF BOEING WORKERS

Effect	Status A	B	C	D	E	F
Intercept	0.26 (6.39)**	0.44 (10.06)**	0.63 (14.83)**	0.76 (20.07)**	0.89 (30.99)**	0.95 (50.49)**
Age						
below 25	0.14 (5.96)**	0.19 (7.75)**	0.17 (6.94)**	0.13 (6.32)**	0.06 (3.93)**	0.02 (2.32)**
25-34	0.03 (1.56)	0.04 (2.13)*	0.05 (2.37)**	0.07 (3.52)**	0.03 (2.67)**	0.02 (2.93)**
35-44	0.01 (0.42)	0.03 (1.33)	0.02 (0.84)	0.03 (1.42)	0.03 (2.06)*	0.00 (-0.03)
45-54	-0.08 (-3.28)**	-0.09 (-3.36)**	-0.08 (-3.19)**	-0.08 (-3.51)**	-0.07 (-3.91)**	-0.05 (-4.46)**
Sex Male	-0.02 (-1.14)	0.00 (0.06)	0.02 (1.33)	0.02 (1.21)	0.00 (0.19)	0.00 (0.52)
Prelayoff Salary (weekly) below $75	0.08 (0.86)	0.13 (1.29)	0.15 (1.55)	0.02 (0.22)	-0.02 (-0.34)	-0.01 (-0.28)
$75 - $99	-0.21 (-4.57)**	-0.25 (-5.08)**	-0.19 (-4.15)**	-0.15 (-3.54)**	-0.07 (-2.25)*	-0.05 (-2.54)**
$100 - $124	-0.06 (-1.73)	-0.07 (-1.77)	-0.13 (-3.21)**	-0.10 (-2.89)**	-0.01 (-0.68)	-0.01 (-0.67)
$125 - $149	0.03 (0.98)	0.02 (0.63)	-0.02 (-0.66)	0.00 (-0.07)	0.01 (0.65)	0.00 (0.00)

TABLE 7 (Continued)

Effect	Status A	B	C	D	E	F
$150 - $174	0.07 (1.64)	0.11 (2.38)**	0.05 (1.06)	0.02 (0.52)	0.05 (1.67)	-0.01 (-0.55)
$175 - $199	-0.01 (-0.33)	0.04 (0.73)	0.00 (0.06)	0.00 (-0.10)	0.07 (1.82)	0.03 (1.42)
$200 - $224	0.10 (1.42)	0.15 (2.09)*	0.12 (1.70)	0.09 (1.47)	0.00 (0.03)	0.03 (1.10)
$225 - $249	-0.15 (-1.30)	-0.07 (-0.58)	-0.06 (-0.50)	0.12 (1.13)	0.03 (0.42)	0.05 (1.00)
Defense Reemployment Yes	-0.01 (-1.08)	-0.02 (-2.08)*	-0.03 (-2.65)**	-0.01 (-1.78)	-0.01 (-1.61)	0.00 (-0.09)
Migration Yes	-0.01 (-0.88)	0.01 (0.82)	0.02 (1.37)	0.01 (0.85)	0.00 (0.22)	0.00 (-1.10)
Level of Education high school degree or less	0.03 (1.08)	0.03 (1.06)	0.06 (2.01)*	0.00 (0.27)	-0.01 (-0.53)	0.00 (-0.60)
some college	0.03 (1.15)	0.02 (0.95)	0.01 (0.41)	0.01 (0.66)	-0.01 (-0.52)	0.00 (-0.16)
bachelor's degree	0.01 (0.47)	-0.01 (-0.47)	-0.02 (-0.78)	-0.05 (-1.94)*	-0.02 (-1.32)	-0.01 (-0.92)

TABLE 7 (Continued)

Effect	Status A	B	C	D	E	F
Occupation (old/new) professional/professional	0.06 (2.36)**	0.11 (3.78)**	0.06 (2.19)*	0.01 (0.61)	0.00 (-0.46)	0.00 (-0.64)
professional/worker	-0.06 (-2.02)*	-0.14 (-3.88)**	-0.11 (-3.17)**	-0.06 (-2.14)*	-0.03 (-1.63)	-0.03 (-2.48)**
worker/professional	-0.02 (-0.72)	0.03 (0.94)	0.07 (1.89)*	0.04 (1.23)	0.04 (1.60)	0.03 (1.91)*
Migration * Occupation (old/new) yes * pro/pro	0.02 (0.86)	0.03 (1.18)	0.04 (1.63)	0.04 (1.95)*	0.01 (1.05)	0.01 (1.51)
yes * pro/worker	-0.08 (-2.51)**	-0.09 (-2.68)**	-0.11 (-3.41)**	-0.08 (-2.78)**	-0.02 (-1.10)	-0.02 (-1.74)
yes * worker/pro	0.07 (2.06)*	0.11 (2.90)**	0.10 (2.51)**	0.06 (1.82)	0.01 (0.64)	0.01 (0.66)

Numbers in parentheses are t values in which
* indicates significance at the five percent level and
** indicates significance at the one percent level

TABLE 8 - AOV RESULTS FOR STATUS OF MARTIN WORKERS

Effect	Status A	B	C	D	E	F
Age	1.68	3.95**	5.66**	5.50**	5.26**	4.10**
Sex	1.01	4.12*	7.40**	9.59**	9.60**	5.96**
Prelayoff Salary	1.51	2.03*	1.98*	2.79**	2.01*	1.06
Defense Reemployment	0.20	1.53	0.02	0.05	0.16	4.34*
Migration	0.00	0.13	0.01	0.13	0.06	0.66
Level of Education	1.78	0.72	2.16	5.53**	1.34	1.26
Occupation (old/new)	1.37	1.03	3.65**	4.82**	3.87**	2.88*
Migrat * Occupat (old/new)	0.46	1.18	2.79*	1.19	0.86	0.75
R^2	.02	.03	.05	.06	.05	.04
Sample Size	1406	1406	1406	1406	1406	1406

Numbers opposite the effects are F values in which
* indicates signiticance at the five percent level and
** indicates significance at the one percent level.

TABLE 9 - REGRESSION RESULTS FOR STATUS OF MARTIN WORKERS

Effect	Status A	B	C	D	E	F
Intercept	0.19 (5.43)**	0.33 (7.64)**	0.48 (11.17)**	0.55 (14.06)**	0.68 (19.01)**	0.80 (26.13)**
Age						
below 25	0.01 (0.40)	0.04 (1.12)	0.08 (1.97)*	0.08 (2.19)*	0.06 (1.86)*	0.02 (0.84)
25-34	0.03 (1.30)	0.08 (2.78)**	0.10 (3.19)**	0.11 (3.96)**	0.10 (3.85)**	0.06 (2.71)**
35-44	0.00 (0.17)	0.00 (-0.26)	-0.04 (-1.31)	0.00 (-0.17)	0.00 (-0.28)	-0.02 (-1.16)
45-54	-0.06 (-1.83)	-0.07 (-1.68)	-0.03 (-0.75)	0.02 (0.53)	0.02 (0.62)	-0.02 (-0.81)
Sex						
Male	0.02 (1.00)	0.05 (2.03)*	0.07 (2.72)**	0.07 (3.09)**	0.06 (3.09)**	0.04 (2.44)**
Prelayoff Salary (weekly)						
$75 - $99	0.00 (-0.02)	-0.03 (-0.72)	-0.04 (-0.94)	-0.08 (-1.87)*	-0.06 (-1.63)	-0.05 (-1.46)
$100 - $124	0.02 (0.85)	0.07 (1.97)*	0.05 (1.33)	0.02 (0.60)	0.02 (0.91)	0.00 (0.28)
$125 - $149	-0.03 (-1.33)	-0.01 (-0.46)	0.00 (0.01)	0.00 (0.33)	0.00 (0.02)	-0.01 (-0.72)
$150 - $174	-0.03 (-1.20)	-0.05 (-1.66)	-0.04 (-1.42)	-0.03 (-1.35)	-0.03 (-1.39)	-0.01 (-0.76)

TABLE 9 (Continued)

Effect	Status A	B	C	D	E	F
$175 - $199	0.04 (1.30)	0.05 (1.20)	0.08 (2.01)*	0.04 (1.21)	0.04 (1.17)	0.02 (0.78)
$200 - $224	-0.04 (-1.10)	-0.05 (-1.07)	-0.06 (-1.44)	-0.09 (-2.27)*	-0.03 (-0.82)	-0.03 (-1.07)
$225 - $249	0.09 (1.64)	0.07 (0.98)	0.06 (0.91)	0.15 (2.44)**	0.11 (2.04)*	0.08 (1.63)
Defense Reemployment Yes	0.00 (-0.45)	0.02 (1.23)	0.00 (0.16)	0.00 (-0.23)	0.00 (0.40)	0.02 (2.08)*
Migration Yes	0.00 (0.01)	0.00 (-0.37)	0.00 (0.13)	0.00 (-0.36)	0.00 (-0.25)	-0.01 (-0.81)
Level of Education high school degree or less	-0.01 (-0.55)	0.02 (0.79)	0.03 (1.07)	0.05 (2.08)*	0.02 (0.93)	0.03 (1.42)
some college	0.00 (-0.13)	0.02 (0.95)	0.03 (1.38)	0.05 (2.15)*	0.02 (1.22)	0.02 (1.39)
bachelor's degree	0.06 (2.29)*	0.03 (0.89)	0.06 (1.88)*	0.09 (2.85)**	0.03 (1.35)	0.01 (0.76)

TABLE 9 (Continued)

Effect	Status A	B	C	D	E	F
Occupation (old/new)						
professional/professional	-0.02 (-1.00)	0.03 (1.12)	0.04 (1.68)	0.05 (2.01)*	0.02 (1.20)	0.01 (0.90)
professional/worker	-0.01 (-0.81)	0.00 (-0.23)	0.00 (0.06)	0.02 (0.92)	0.02 (1.07)	0.03 (1.77)
worker/professional	0.07 (1.95)*	0.01 (0.30)	0.03 (0.68)	0.00 (0.09)	0.01 (0.41)	-0.01 (-0.33)
Migration * Occupation (old/new)						
yes * pro/pro	-0.02 (-1.13)	-0.01 (-0.54)	-0.01 (-0.70)	0.00 (-0.17)	0.00 (-0.06)	0.00 (0.13)
yes * pro/worker	0.00 (0.23)	0.05 (1.78)	0.07 (2.82)**	0.04 (1.89)*	0.03 (1.60)	0.02 (1.36)
yes * worker/pro	0.01 (0.44)	-0.04 (-0.97)	-0.05 (-1.28)	-0.04 (-1.08)	-0.03 (-0.90)	-0.03 (-1.23)

Numbers in parentheses are t values in which
* indicates significance at the five percent level and
** indicates significance at the one percent level.

TABLE 10 - AOV RESULTS FOR STATUS OF REPUBLIC WORKERS

Effect	Status A	B	C	D	E	F
Age	6.71**	3.67**	5.93**	5.23**	3.30**	3.76**
Sex	0.35	2.02	7.57**	15.46**	16.09**	16.22**
Prelayoff Salary	3.29**	3.22**	4.08**	3.26**	4.00**	3.84**
Defense Reemployment	6.94**	5.19**	5.28*	1.82	4.51*	3.67*
Migration	0.62	1.32	0.95	4.19*	5.07*	3.13
Level of Education	0.19	1.19	1.08	0.55	1.06	1.26
Occupation (old/new)	0.79	0.65	1.32	0.16	0.21	0.54
Migrat * Occupat (old/new)	0.32	0.17	0.05	0.20	1.95	2.04
R^2	.03	.03	.05	.04	.04	.04
Sample Size	2133	2133	2133	2133	2133	2133

Numbers opposite the effects are F values in which
* indicates significance at the five percent level and
** indicates significance at the one percent level.

TABLE 11 - REGRESSION RESULTS FOR STATUS OF REPUBLIC WORKERS

Effect	Status A	B	C	D	E	F
Intercept	0.17 (5.47)**	0.27 (6.81)**	0.33 (7.69)**	0.45 (10.06)**	0.56 (12.71)**	0.68 (16.56)**
Age						
below 25	0.03 (1.76)	0.03 (1.28)	0.04 (1.49)	0.01 (0.38)	0.00 (0.14)	0.00 (0.01)
25-34	0.06 (4.06)**	0.06 (3.10)**	0.08 (4.03)**	0.08 (3.94)**	0.05 (2.71)**	0.06 (3.29)**
35-44	0.01 (0.93)	0.00 (0.39)	0.00 (0.52)	0.02 (1.45)	0.03 (1.96)*	0.01 (1.09)
45-54	-0.02 (-1.71)	-0.02 (-1.42)	-0.03 (-1.69)	-0.02 (-1.28)	0.00 (-0.33)	0.01 (0.61)
Sex						
Male	0.00 (-0.59)	0.02 (1.42)	0.05 (2.75)**	0.08 (3.93)**	0.08 (4.01)**	0.07 (4.02)**
Prelayoff Salary (weekly)						
$75 - $99	-0.08 (-3.09)**	-0.04 (-1.33)	-0.08 (-2.03)*	-0.04 (-1.05)	-0.02 (-0.58)	-0.05 (-1.37)
$100 - $124	-0.06 (-2.84)	-0.07 (-2.75)**	-0.11 (-3.68)**	-0.11 (-3.51)**	-0.10 (-3.21)**	-0.10 (-3.70)**
$125 - $149	0.02 (0.92)	0.04 (1.39)	0.02 (0.73)	0.01 (0.50)	0.04 (1.20)	0.02 (0.76)
$150 - $174	0.01 (0.54)	0.01 (0.37)	0.00 (-0.14)	-0.03 (-0.79)	-0.06 (-1.40)	-0.04 (-1.08)

TABLE 11 (Continued)

Effect	Status A	B	C	D	E	F
$175 - $199	0.01 (0.5º)	0.02 (0.59)	0.07 (1.69)	0.03 (0.76)	0.03 (0.87)	0.00 (0.22)
$200 - $224	-0.03 (-0.68)	-0.08 (-1.48)	-0.04 (-0.65)	0.03 (0.55)	0.01 (0.16)	0.00 (-0.10)
$225 - $249	0.11 (1.95)*	0.08 (1.14)	0.03 (0.42)	0.01 (0.11)	-0.03 (-0.42)	0.01 (0.23)
Defense Reemployment Yes	-0.02 (-2.63)**	-0.02 (-2.27)*	-0.02 (-2.29)*	-0.01 (-1.35)	-0.02 (-2.12)*	-0.02 (-1.91)*
Migration Yes	-0.01 (-0.78)	-0.03 (-1.15)	-0.02 (-0.97)	-0.06 (-2.04)*	-0.06 (-2.25)*	-0.04 (-1.76)
Level of Education high school degree or less	0.00 (0.11)	0.00 (-0.'2)	0.04 (1.25)	0.0C (-0.24)	-0.02 (-0.58)	-0.03 (-0.92)
some college	0.01 (0.44)	0.04 (1.30)	0.05 (1.69)	0.02 (0.80)	0.02 (0.67)	0.00 (-0.04)
bachelor's degree	-0.01 (-0.58)	0.02 (0.51)	0.02 (0.53)	0.00 (-0.02)	0.04 (0.96)	0.06 (1.55)

TABLE 11 (Continued)

Effect	Status A	B	C	D	E	F
Occupation (old/new) professional/professional	0.01 (0.33)	0.00 (-0.03)	0.05 (1.14)	0.01 (0.38)	-0.01 (-0.26)	-0.02 (-0.62)
professional/worker	-0.03 (-0.66)	0.04 (0.63)	-0.01 (-0.22)	0.01 (0.25)	0.00 (0.00)	-0.01 (-0.29)
worker/professional	0.04 (1.15)	0.00 (0.16)	0.01 (0.32)	-0.01 (-0.31)	-0.01 (-0.24)	0.00 (0.16)
Migration * Occupation (old/new) yes * pro/pro	0.00 (-0.32)	-0.01 (-0.50)	-0.01 (-0.27)	0.00 (0.17)	-0.02 (-0.67)	-0.03 (-0.97)
yes * pro/worker	-0.02 (-0.41)	0.03 (0.52)	0.00 (0.05)	0.00 (0.02)	0.04 (0.67)	0.06 (1.01)
yes * worker/pro	0.03 (0.96)	0.00 (0.09)	0.01 (0.29)	-0.03 (-0.53)	-0.07 (-1.32)	-0.07 (-1.37)

Numbers in parentheses are t values in which
* indicates significance at the five percent level and
** indicates significance at the one percent level.

interval is called status A while the remaining ones are called status B through F, respectively. Through the use of these analyses, the duration of search for the displaced workers of these three firms can be determined.

The analysis of variance results for the status of the workers displaced by these three firms are shown in Tables 6 (Boeing), 8 (Martin), and 10 (Republic). The regression results for the status variable are then shown in Tables 7 (Boeing), 9 (Martin) and 11 (Republic). The intercept term in these tables shows the proportion of individuals in each sample who are employed during each specified interval of time. The remaining variables in the regressions then show the adjustments that must be made to this mean value as the personal characteristics of the worker are taken into account. For example, during status A (up to four weeks following the layoff date) the average Boeing worker had a 26 percent probability of becoming reemployed. This probability, however, increased to 40 percent if the worker were below 25 years old while it decreased to 18 percent if the worker were between 45 and 54 years of age.

The most interesting and important result that emerges from this analysis is that the personnel displaced by Republic endured a much longer duration of unemployment than their counterparts who were discharged by Boeing and Martin. This result is valid irregardless of the decisions and personal characteristics imparted upon the worker. From these observations, however, we cannot

conclude that the Republic work force encountered the greatest obstacles in obtaining positions of reemployment. Rather, these longer periods of unemployment may result from perfectly rational search strategies formulated from a given set of expectations. As previously mentioned, the displaced Republic workers had high expectations for recall since the government had always bailed the firm out of financial trouble in the past. These high expectations then encouraged the workers to await at home for their recall orders instead of actively searching the labor market for reemployment opportunities that would only be abandoned once their former firm received its new contracts. As pointed out, however, these new contracts never materialized, and the workers eventually had to engage in full time search activities. Nonetheless, given their expectations, their behavior was rational and care must be taken not to judge their reemployment experiences on a hindsight basis.

The Wage Structures Within and Among Defense Firms

The wage structures within Boeing, Martin, and Republic are examined through the use of Tables 12 and 13. Table 12 presents the analysis of variance results while the latter table contains the regression results. These wage structures are analyzed through the use of the explanatory variables which include the worker's age, level of education, and occupation. In addition, two variables are included which show the interaction of the

TABLE 12 - AOV RESULTS FOR WAGE DIFFERENTIALS WITHIN DEFENSE FIRMS

Effect	Boeing Wages	Martin Wages	Republic Wages
Age	53.88**	62.76**	66.06**
Level of Education	97.31**	85.38**	78.67**
Occupation	452.28**	174.75**	328.96**
Age * Level of Education	2.10	4.61**	10.65**
Age * Occupation	21.43**	3.30**	14.01**
R^2	.55	.49	.49
Sample Size	1857	2238	3179

Numbers opposite the effects are F values in which
* indicates significance at the five percent level and
** indicates significance at the one percent level.

TABLE 13 - REGRESSION RESULTS FOR WAGE DIFFERENTIALS WITHIN DEFENSE FIRMS

Effect	Boeing Wages	Martin Wages	Republic Wages
Intercept	3.87 (93.55)**	4.89 (62.21)**	4.47 (81.73)**
Age			
below 25	-0.71 (-10.93)**	-1.44 (-9.74)**	-1.52 (-9.09)**
25-34	-0.14 (-2.79)**	-0.39 (-4.31)**	-0.55 (-6.59)**
35-44	0.41 (6.86)**	0.46 (4.85)**	0.57 (7.99)**
45-54	0.38 (5.69)**	0.95 (8.41)**	0.85 (10.44)**
Level of Education			
less than bachelor's degree	-0.45 (-9.86)**	-0.71 (-9.24)**	-0.59 (-8.86)**
Occupation			
professional	0.69 (21.26)**	0.70 (13.21)**	0.79 (18.13)**
Age * Level of Education			
below 25 * LT bachelor's degree	-0.06 (-0.79)	0.19 (1.28)	0.49 (2.27)*
25-34 * LT bachelor's degree	0.01 (0.20)	0.18 (2.06)*	0.30 (3.02)**
35-44 * LT bachelor's degree	-0.18 (-2.63)**	0.10 (1.11)	-0.18 (-2.14)*
45-54 * LT bachelor's degree	0.00 (0.08)	-0.30 (-2.72)**	-0.46 (-4.98)**
Age * Occupation			
below 25 * professional	-0.39 (-6.50)**	-0.25 (-2.94)**	-0.51 (-3.57)**
25-34 * professional	-0.23 (-4.98)**	-0.16 (-2.56)**	-0.22 (-3.47)**
35-44 * professional	0.07 (1.39)	-0.03 (-0.50)	0.21 (3.88)**
45-54 * professional	0.32 (5.28)**	-0.03 (-0.37)	0.17 (3.09)**

Numbers in parentheses are t values in which
* indicates significance at the five percent level and
** indicates significance at the one percent level.

worker's age and level of education and the interaction of the worker's age and occupation. Table 12 shows that each of these variables are statistically significant at the one percent level for explaining the variations in wages within a defense firm. The R^2 is .55 for Boeing and .49 for Martin and Republic.

Table 13 presents the regression results for the wage structure within each of these three defense firms. Wage rates are again measured in $25.00 intervals in which a wage rate of 4.00 indicates that the worker is earning $137.50 per week while a wage rate of 5.00 indicates a weekly salary of $162.50. The estimates show that wages within each firm are strongly correlated with the worker's age, educational attainment, and occupation. The highest paid employees within any age group are the professional workers who have a bachelor's degree or better. The returns to a college education or professional employment vary across the age groups, however, a fact illustrated by the coefficients of the two interaction terms. According to the age * education interaction variable, Martin and Republic increase the returns to being a college graduate as the worker moves from one age bracket to the next. The age * occupation interaction variable then shows that all three defense firms widen the professional-nonprofessional wage differential as the workers advance in age.

Given the age of the worker, the magnitude of these wage differentials depends upon the firm with which the worker is employed. This effect of the employer upon the worker's wage rate

is incorporated into the analysis through the use of Tables 14 and 15. In these tables the interfirm wage structure is analyzed through the use of four explanatory variables which include the worker's age, level of education, occupation, and employer (firm). Three interaction terms are also included for age * firm, education * firm, and occupation * firm. Table 14, which presents the analysis of variance results, shows that each of these variables is statistically significant at the one percent level.

The regression results are presented in Table 15 in which the wage rate is measured in the previously defined fashion. Once again, the estimates show that wage rates are positively correlated with the worker's age, educational attainment, and occupation (blue collar or professional). The coefficients for the employer variable then show that defense firms pay the same category of labor different wage rates; Martin is the highest paying firm followed by Republic and Boeing, respectively. These interfirm wage differentials vary with the characteristics of the worker, a fact verified by the coefficients of the three interaction terms.

The age * firm interaction variable shows that wage differentials between these three firms are positively correlated with the age of the worker. The estimates show that a worker below 25 years old will make an additional $7.50 per week in wages by working for Martin instead of Boeing. This wage differential increases as the worker grows older, and by the time he is fifty

TABLE 14 - AOV RESULTS FOR WAGE DIFFERENTIALS AMONG DEFENSE FIRMS

Effect	Wage Rate
Age	255.34**
Level of Education	713.33**
Occupation	1729.46**
Firm	185.84**
Age * Firm	20.29**
Level of Education * Firm	8.07**
Occupation * Firm	36.05**
R^2	.52
Sample Size	7272

Numbers opposite the effects are F values in which ** indicates significance at the one percent level.

TABLE 15 - REGRESSION RESULTS FOR WAGE DIFFERENTIALS AMONG DEFENSE FIRMS

Effect	Wage Rate
Intercept	4.48 (182.61)**
Age	
below 25	-0.80 (-25.73)**
25-34	-0.21 (-8.14)**
35-44	0.35 (12.60)**
45-54	0.42 (13.41)**
Level of Education	
less than bachelor's degree	-0.61 (-26.70)**
Occupation	
professional	0.70 (41.58)**
Firm	
Martin	0.40 (11.00)**
Republic	0.19 (5.56)**
Age * Firm	
below 25 * Martin	-0.45 (-9.59)**
25-34 * Martin	-0.11 (-2.84)**
35-44 * Martin	0.14 (3.42)**
45-54 * Martin	0.30 (6.12)**
below 25 * Republic	0.21 (5.12)**
25-34 * Republic	0.04 (1.35)
35-44 * Republic	-0.13 (-3.78)**
45-54 * Republic	-0.15 (-4.01)**
Level of Education * Firm	
LT bachelor's degree * Martin	-0.03 (-1.05)
LT bachelor's degree * Republic	-0.09 (-2.62)**
Occupation * Firm	
professional * Martin	-0.11 (-5.00)**
professional * Republic	0.19 (8.32)**

Numbers in parentheses are t values in which ** indicates significance at the one percent level.

years old, his weekly salary at Martin would be $36.00 above his salary at Boeing. From these coefficients we can conclude that discharged workers have an additional incentive to search out the high paying firms because the magnitude of future pay raises is directly associated with the current level of wages being offered by each firm.

The Layoff and Recall Policies of Defense Firms

This section of the chapter empirically examines the layoff policies of Boeing, Martin, and Republic. The recall policies of Boeing are also analyzed since a small proportion of its displaced workers was subsequently recalled. The analysis of recall policies had to be restricted to this single firm because Martin and Republic never did recover from their reduced level of demand and, hence, did not issue any recall notices. Even in the case of Boeing, the analysis must be carefully interpreted because the survey did not explicitly collect any data on recalls. As a proxy for this data, we assumed that an individual was recalled by Boeing if he was reemployed in defense work in the Seattle area. These characteristics seemed to depict the recalled worker quite well since Boeing was the only major defense contractor in the Seattle area during the period under consideration. In total, this proxy for recall shows that approximately 350 workers eventually returned to their former positions at Boeing.

Table 16 presents the analysis of variance results for the layoff policies of all three firms and the recall policies of Boeing. Table 17 depicts the regression results for the layoff policies of all firms and Table 18 illustrates the regression results for Boeing's recall. Layoff policies are analyzed through the use of the seniority and occupation explanatory variables. In addition, a seniority * occupation interaction term is included to further differentiate the layoff policies of these three defense firms. Finally, Boeing's recall policies are shown to be influenced by the worker's age, level of education, seniority, and occupation.

In examining the regression results for the layoff policies of the three firms, the intercept term shows the average period of time (measured in weeks) for the entire sample from the date of layoff to the survey date. As before, the remaining beta coefficients show how this average is adjusted as the personal characteristics of the worker are taken into account. Any coefficients which add to the intercept term imply that their corresponding characteristics cause early layoffs, while those which detract from B_0 are associated with the characteristics that delay the discharge of the worker.

The estimates in Table 17 show that the layoff of workers by each of the three firms is accomplished on a crude seniority basis with the less senior employees being discharged first. Nonetheless, Boeing workers with over eight years of seniority

TABLE 16 - AOV RESULTS FOR LAYOFF AND RECALL POLICIES OF DEFENSE FIRMS

Effect	Boeing Layoffs	Martin Layoffs	Republic Layoffs
Seniority	3.27**	15.56**	48.31**
Occupation	52.64**	3.84*	3.79*
Seniority * Occupation	1.27	1.92*	9.10**
R^2	.06	.07	.27
Sample Size	1897	2276	3341

Effect	Boeing Recalls
Age	5.99**
Level of Education	5.24**
Seniority	1.56
Occupation	12.65**
R^2	.07
Sample Size	1639

Numbers opposite the effects are F values in which
* indicates significance at the five percent level and
** indicates significance at the one percent level.

TABLE 17 - REGRESSION RESULTS FOR LAYOFF POLICIES OF DEFENSE FIRMS

Effect	Boeing Layoffs	Martin Layoffs	Republic Layoffs
Intercept	30.28 (281.14)**	46.31 (153.24)**	45.05 (109.37)**
Seniority			
less than 1 year	-0.03 (-0.16)	5.70 (10.19)**	6.09 (5.09)**
1 year - 2 years	0.72 (3.66)**	0.75 (1.36)	6.62 (7.95)**
2 years - 3 years	0.04 (0.20)	-0.09 (-0.19)	2.81 (2.79)**
3 years - 4 years	0.82 (2.85)**	-1.01 (-2.11)*	-1.50 (-1.07)
4 years - 5 years	-0.24 (-0.59)	-1.53 (-2.20)*	0.82 (0.66)
5 years - 6 years	0.02 (0.07)	-0.30 (-0.37)	1.73 (1.82)
6 years - 7 years	-0.19 (-0.54)	-1.23 (-1.28)	-14.35 (-9.35)**
7 years - 8 years	-0.51 (-1.34)	-1.01 (-0.98)	4.04 (2.86)**
Occupation			
professional	0.78 (7.25)**	-0.59 (-1.96)*	0.80 (1.94)*
Seniority * Occupation			
less than 1 year * pro	0.48 (2.19)*	-0.60 (-1.08)	-2.15 (-1.80)
1 year - 2 years * pro	-0.26 (-1.33)	-0.03 (-0.06)	-2.27 (-2.73)**
2 years - 3 years * pro	0.02 (0.10)	-0.29 (-0.57)	-1.14 (-1.13)
3 years - 4 years * pro	-0.07 (-0.25)	0.97 (2.02)*	-5.52 (-3.93)**
4 years - 5 years * pro	-0.38 (-0.95)	1.65 (2.36)**	0.22 (0.18)
5 years - 6 years * pro	0.46 (1.43)	0.37 (0.46)	3.24 (3.41)**
6 years - 7 years * pro	-0.29 (-0.82)	1.19 (1.25)	2.74 (1.79)
7 years - 8 years * pro	-0.08 (-0.22)	-0.54 (-0.53)	2.09 (1.48)

Numbers in parentheses are t values in which
* indicates significance at the five precent level and
** indicates significance at the one percent level.

TABLE 18 - REGRESSION RESULTS FOR RECALL POLICIES AT BOEING

Effect	Probability of Recall
Intercept	0.22 (9.78)**
Age	
below 25	-0.08 (-3.71)**
25-34	-0.06 (-3.07)**
35-44	0.03 (1.30)
45-54	0.03 (1.59)
Level of Education	
high school degree or less	0.10 (3.83)**
some college	0.02 (0.86)
bachelor's degree	0.00 (-0.07)
Seniority	
less than 1 year	0.03 (1.47)
1 year - 2 years	-0.02 (-0.99)
2 years - 3 years	0.03 (1.35)
3 years - 4 years	-0.06 (-1.67)
4 years - 5 years	-0.05 (-1.03)
5 years - 6 years	0.07 (1.80)
6 years - 7 years	0.02 (0.59)
7 years - 8 years	-0.03 (-0.64)
Occupation	
professional	-0.05 (-3.55)**

Numbers in parentheses are t values in which
** indicates significance at the one percent level.

and Republic workers with between seven and eight years seniority appear to have been very vulnerable to discharge. This result can be explained, however, by remembering that the firm has an incentive to lay off its more senior workers if expectations of recall are high. This situation held at both of these firms in that Boeing had a diversified product line while Republic and its workers believed that the government would eventually bail the firm out of trouble through the awarding of new contracts. Martin, on the other hand, had neither a diversified product line nor a history of occasionally being saved by the government from financial ruin. Thus, this firm laid off its less senior workers first while hoarding those in which it had a relatively large investment.

The coefficient for the occupation variable conforms to the hypothesis concerning separation policies in that the professional workers were laid off first by Boeing and Republic while being retained by Martin. Once again, this result shows that Boeing and Republic could displace those personnel in which they had invested heavily and be confident that they would be available for recall. Martin, however, could not take this gamble because the expectations of recall were always quite low, which increased the incentive of the displaced workers to migrate.

The seniority * occupation interaction term shows how the layoff policies of the firm are adjusted once account is taken of both the worker's seniority and occupation. According to

these coefficients, the more senior professional workers were discharged before the more senior nonprofessional workers. This result further verifies that Boeing and Republic laid off its skilled manpower first since these workers had the greatest incentive to await recall. Among the firm's less senior labor force, the coefficients of the interaction variable show that the nonprofessional workers were discharged before the professionals. This conclusion further reveals Martin's attempts to protect its investment in specific human capital in that the firm laid off the least senior nonprofessional workers first.

If attention is now turned to recall policies, Table 18 will illustrate the case at Boeing. The variable under analysis is the probability of recall, and as the intercept term shows, 22 percent of this sample of Boeing workers were eventually recalled. The probability of recall then diminishes, however, as the worker's level of education increases or as his age decreases. In addition, the estimates show that the probability of recall is lower for the professional workers than for the nonprofessionals. From these results we would conclude that Boeing delayed its recall notices too long. As a result, the displaced worker's subjective valuation of recall declined, and migration was undertaken by that group of employees who had the greatest incentive to obtain positions of reemployment in which their skills were applicable. Thus, we suggest that the younger workers who were professionally trained and well educated moved to other

firms in the defense industry from which they were unable to respond to any subsequent recall notice.

CHAPTER V

SUMMARY AND POLICY IMPLICATIONS

The purpose of this dissertation is to improve the understanding of the unemployment problem in the defense industry through a synthesis of the search strategies of laid off workers on the one hand and the manpower management of firms on the other.

This task was initiated in Chapter II in which it was shown that the displaced defense worker's reemployment wage rate and duration of unemployment depend in part upon his level of specific skill and his personal valuation of the probability of recall. It was shown that the reemployment search strategy depends upon the worker's personal characteristics such as his age, level of education, and occupation. Revisions of the search strategy were taken into account by realizing that the ex post search results are going to deviate from their path predicted in the initial ex ante strategy. It is this process that explains why the worker's optimal reemployment wage rate decreases as his period of unemployment lengthens.

Chapter III examined the manpower policies of firms in the defense industry. It was shown that these policies are determined by the contracting procedures and accounting methods practiced in this industry. Hoarding of skilled manpower was taken into account and the influence of the displaced worker's job search strategy upon the firm's management of its labor force was

determined.

The various hypotheses developed were empirically tested in Chapter IV, utilizing the data available from surveys of workers laid off by three defense firms (Boeing, Martin, and Republic) during the years 1963 through 1965. From these tests several statistically significant results emerged which should aid federal policy makers in combatting the unemployment problem in the defense industry during future periods of time. Among the findings were the following.

1. Absolute and relative reemployment wage rates are higher for male workers than for females and are positively correlated with the worker's level of education. Both measures of reemployment wages also increase as the age of the worker approaches 55 but then decline thereafter.
2. The absolute reemployment wage rate is positively correlated with the worker's prelayoff wage rate, while the relative reemployment wage rate is inversely correlated with the prelayoff wage rate.
3. Absolute and relative reemployment wage rates are higher for those workers who remain in the defense industry.
4. Both absolute and relative reemployment wage rates decrease as the worker's duration of unemployment lengthens.

5. Among professional workers, the absolute and relative reemployment wage rates are higher for those individuals who secure positions as professionals. Some blue collar workers will also become professionally employed, and their reemployment wage rates will be higher than their former counterparts who remain in the nonprofessional occupations.
6. The absolute and relative reemployment wage rates are higher for workers who migrate to a new position than for those who do not. The returns to migration vary among the unemployed, however, and are grestest for professional workers who obtain positions of reemployment as professionals.
7. The wage structure within the defense industry can be explained on the basis of the worker's age, level of education, occupation, and employer. Within any one defense firm, the wages of a worker are positively correlated with his age, educational attainment, and occupational standing (blue collar or professional). Employees who are college graduates and professionally trained realize the most rapid rate of wage advancement. For any given level of skill, however, the magnitude of future pay raises depends upon the firm with which the worker is employed and is highest for those firms which presently offer the most attractive

wages. The interfirm difference in the magnitude of future wage increases depends upon the worker's occupation and level of education and is greatest for those individuals who are professionally trained and well educated.

8. The layoff policies of defense firms depend upon the firm's expectations of future demand. If new contracts are anticipated within a short period of time, the layoffs will be very restrictive so that the firm can avoid the costs associated with displacing a worker and then immediately recalling him. In addition, the separation policies will depend upon the discharged worker's reemployment search strategy in that the firm will be very hesitant to lay off its more senior highly skilled laborers if there is a high probability that these individuals will migrate to other defense firms from which they would be unable to respond to a subsequent recall notice. Thus, the magnitude of a defense firm's layoffs during a period of depressed demand depends upon the employer's expectation of future business, while the composition of the displaced labor force depends upon the employee's subjective valuation of the probability of recall.
9. The long periods of unemployment experienced by the

discharged Republic labor force did not occur because these workers were confronted with great obstacles in their attempt to find positions of reemployment. Rather, these lengthy durations of unemployment resulted from perfectly rational search strategies in which workers expected the government to bail Republic out of financial trouble so that displaced personnel could be recalled. These false expectations of recall increased the severity of the layoff because they gave the displaced workers an incentive to remain unemployed in the local labor market.

Policy Implications

Through the use of the above findings, we can critically evaluate the past performance of policy makers in dealing with the unemployment problem in the defense industry. Upon examining these prior programs, the first fact that becomes apparent is that many members of Congress (if not all) are very concerned about any cutback or change in the regional distribution of the defense budget which creates unemployment in their respective districts.[1]

[1]This attitude became very obvious during the late 1950's when the relative and absolute expenditures on missiles increased significantly. Prior to this period of time, the majority of defense funds was spent on aircraft, ships, and ordnance, and a large proportion of contracts were awarded to firms in the eastern states which were highly industrialized. A ranking of these states by the magnitude of defense expenditures would show New York as the leader followed by Michigan, Ohio, New Jersey,

An example of this concern was expressed by Senator Javits (Democrat, New York) during the 86th Congress in which he stated

> To many of us in the East, the so-called missile gap has been translated into the defense order gap. Many New Yorkers apply this term to the steady loss of defense contracts in our State, while there has been a steady increase in prime defense missile contracts placed in other parts of the country, particularly with firms on the west coast.[2]

As a solution to this neglect of New York defense firms, he introduced a bill that would require the Department of Defense to consider " . . . the economic desirability of allocating purchases to different geographic areas of the Nation."[3]

Another example of political debate over the management of the defense budget occurred during the 88th Congress when the Secretary of Defense (McNamara) selectively cancelled or phased out several projects being produced by various defense firms

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Pennsylvania, and Illinois, respectively.

As the nation's defense needs then shifted towards the production of missiles, many firms in these states had difficulty maintaining their former level of demand in that a large proportion of new contracts were awarded to relatively young dynamic firms in California, Texas, and Washington. Needless to say, this change in the regional distribution of the defense budget upset many eastern politicians as the above remarks of Senator Javits illustrate.

[2]U.S. Congress, Joint Economic Committee, Subcommittee on Defense Procurement, Hearings, Impact of Defense Procurement, 86th Congress, 2nd Session (1960), p. 24.

[3]For the full content of this bill, see U.S. Congress, Senate, Subcommittee of Committee on Armed Services, Hearings, Military Procurement, 86th Congress, 1st Session (1959), pp. 22-24.

throughout the country. As before, New York politicians were involved in these discussions because one of the affected projects was the F-105 fighter-bomber which was being produced by Republic Aviation at its Long Island plant. Many of these officials were upset by this cancellation, and great political pressure was exerted with the intent of obtaining new contracts for the firm. In addition, Senator Javits criticized the Administration and stated that " . . . defense cutbacks are 'false economy because what the government may save . . . it will more than spend as a result of additional unemployment which will be created'" (Johnsen (1964a), p. 26).

According to many of these politicians, the unemployment problem in the defense industry should be combatted by allocating contracts on the basis of need. In our opinion, however, this solution is economically inefficient and completely ineffective in reducing the unemployment of technical manpower. Indeed, this course of action can actually intensify the unemployment problem in that it creates expectations of future demand which are often thwarted as the policy makers are unable to deliver the specified projects to the troubled areas of the industry. Nonetheless, the affected firms will at first anticipate these future contracts and hoard a certain level of skilled manpower, while those workers who are displaced will initially await recall. These expectations will change, however, as the period of decreased demand lengthens, and the manpower policies of the firm

and the job search strategies of the laid off workers will eventually reflect the true market conditions. In the interim, however, additional losses are imposed upon the firm and its displaced labor force which could have been avoided if the true probability of future contracts had been known at the beginning of the period of depressed demand.

The magnitude of these additional losses can be crudely estimated by comparing the Republic and Boeing experiences. Since many New York politicians tried unsuccessfully to aid Republic after its loss of the F-105 contract, we would predict that false expectations of future demand were generated which increased the severity of the adjustment period. In the case of Boeing, however, these false expectations never existed because the Washington senators (Jackson and Magnuson), although upset at the cancellation of the Dyna-Soar contract, planned no action to challenge its validity. Thus, the Boeing plant and its discharged workers were able to initially predict a realistic probability for future business and planned their strategies accordingly.

In comparing the duration of unemployment for each firm's labor force, we can state that the false expectations of recall cost the Republic workers several extra weeks of unemployment in that the median durations of unemployment for the Republic and Boeing labor forces were approximately eighteen and nine weeks, respectively. These figures can be adjusted by taking into

account the personal characteristics of the worker, but the results remain the same; employees of Republic endured longer periods of unemployment than their counterparts at Boeing who possess identical characteristics. Thus, the false expectations of recall were not limited to a single group of workers but, rather, affected all of Republic's discharged personnel.

Political pressures upon the procuring agencies appear not to have influenced Republic's management of its labor force because the layoff policies of the New York firm were similar to those employed by Boeing. This situation only occurred, however, because the high expectations of recall at Republic permitted the firm to lay off its skilled labor force and be quite confident that they would be available for rehiring once demand returned to its former level. From this evidence we suggest that the actions of various policy makers permitted Republic Aviation to undertake a more extensive layoff policy while the severity of the unemployment experiences of the displaced workers increased significantly.

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