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6 THE LABOR MARKET OF THE UNITED STATES
SHIPBUILDING INDUSTRY, 1960-1970

by

10 John Charles Martin

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30 June 1978

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THE GEORGE WASHINGTON UNIVERSITY
School of Engineering and Applied Science
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Abstract
of
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THE LABOR MARKET OF THE UNITED STATES
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This study presents a detailed analysis of the labor market of the United States shipbuilding industry. Primary emphasis is given to the wage rates and earnings in shipbuilding and their apparent impact on industry turnover and mobility. It appears that the noncompetitive wages and earnings of older, more experienced workers in shipbuilding results in a loss of these workers to the construction and durable manufacturing industries. To correct this loss, the findings suggest that the wages of older, more experienced shipbuilding workers be increased to levels competitive with those in other industries. In part, the resulting higher wage costs can be offset by dampening pay increases of young workers and through reduced training costs and improved productivity.

THE LABOR MARKET OF
THE UNITED STATES SHIPBUILDING INDUSTRY:
1960-1970

by

John Charles Martin

B. A. (Cum Laude) 1973, Millersville State College
Millersville, Pennsylvania

A Dissertation submitted to

The Faculty of

The Graduate School of Arts and Sciences
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Dissertation directed by
Sheldon Edward Haber
Associate Professor of Economics

ABSTRACT

In this study previously recognized problems affecting the shipbuilding labor market, for which little documentation has heretofore been available, are examined. In addition, some new problems which may impede the efficient operation of this labor market are investigated. Policy implications for an improved utilization of labor are also posited.

As background information for our study, we first look at trends in output and employment in the shipbuilding industry. The proportion of factor costs attributable to labor is also examined. It is found that labor receives more than three-quarters of total value added in shipbuilding, a larger share than received by labor in any of the other manufacturing transportation equipment industries. While the labor share has declined in these other industries, it has remained stable in shipbuilding.

Having established that labor is a significant element of ship cost, demographic aspects of the labor market are next investigated. The occupational, age, educational, and racial composition of the shipbuilding labor force are studied and contrasted with those in other industries. The fact that the occupational mix in shipbuilding and construction are similar underscores the need for shipbuilding to compete with construction for skilled labor. One important finding is that a relatively large percentage of government shipyard workers, who comprise a not insignificant proportion of the industry's work force, are beginning to reach retirement age. This could result in labor shortfalls in the near future.

The relationship between size of labor market in which a shipyard is located and the supply of skilled labor is investigated.

It is found that shipyards doing the majority of Navy ship construction are located in small labor markets where skilled labor shortages are likely. In contrast, yards building commercial ships are located in large labor markets where skilled labor is more easily available.

Because shipbuilding must compete with construction and manufacturing for skilled labor, wage rates and earnings in shipbuilding and other industries are investigated. It is found that not only is the average wage in shipbuilding less than in construction, but since 1965 the wage differential between the two industries, and other industries, has widened. Furthermore, young workers secure higher earnings in shipbuilding than in construction and durable manufacturing, while older workers now receive higher annual earnings in the latter two industries.

To determine the effect of the structure of earnings on worker turnover, trends in both short- and long-run accessions and separations, as well as inter-industry mobility patterns, are investigated. While short-run turnover has been improving, shipbuilding has been losing an increasingly larger number of workers to construction and durable goods industries, especially older workers, since 1965.

The most important policy oriented finding of this study is that in 1965 and 1970 younger, inexperienced workers in shipbuilding were being paid more than their counterparts in construction and durable manufacturing. Older, experienced workers, on the other hand, were being paid less than their counterparts in these industries. In order to reduce losses among the latter group, the findings suggest that the wage rate of older shipbuilding workers should be raised to a more competitive level. To some extent, higher wage rates for older workers can be offset by dampening the rate of increase in wages paid to younger workers. From the data of this and other studies, it would appear that this may not lead to significantly higher turnover among younger workers. By reducing replacement needs, training costs can also be lowered; long-run industry productivity is also likely to improve.

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CHAPTER 1

INTRODUCTION

This study focuses on the United States shipbuilding labor market during the period 1960 to 1970.¹ The United States Navy is the largest single customer of the shipbuilding industry and its procurement policies affect industry conditions such as output and employment levels. These conditions, in turn, affect the industry's ability to furnish ships to the Navy at competitive prices. In light of recent proposals to upgrade the present fleet, it is important that the industry be able to respond quickly and efficiently to Navy procurement demands. Two major constraints on industry performance in response to demand are (1) the physical capacity of yards and (2) the availability of skilled labor. While the first constraint is clearly important, it is treated here only peripherally; it is the second constraint which is the subject matter of this study.

The analysis is based on published and unpublished data obtained from a variety of sources including the United States Census of Population, Social Security Administration, Bureau of Labor Statistics, Maritime Administration, Naval Sea Systems Command and the Shipbuilders Council of America. These data are utilized to examine both macro and micro aspects of the shipbuilding labor market. An example of the former is the share of factor costs accounted for by labor. It is found that expenditures for labor comprise, on average, about 77 percent of value added in shipbuilding (see Chapter 11). Of the three

¹The major emphasis of this study is the analysis of the labor market of privately owned shipyards rather than government owned shipyards. However, where relevant labor market data for naval yards are available, these, too, are examined.

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major manufacturing transportation equipment industries--automobiles, aircraft and shipbuilding--labor received the largest share of value added in shipbuilding. This finding is important for it establishes shipbuilding as a labor intensive industry. Given that labor is a significant element of production costs, micro aspects of the shipbuilding labor market are examined to see how labor can be used more efficiently.

Despite the heavy subsidization of the industry, the demand for labor is still a derived demand. Hence, we first look at output and employment for the industry. In Chapter II it is found that although annual employment in shipbuilding has remained relatively stable vis-a-vis other industries, individual shipyards have experienced wide fluctuations in employment. This instability in shipyard employment is due to the unstable nature of shipyard work loads, which in turn results in high turnover rates and attendant losses in worker productivity. However, it appears that in recent years, i.e., since 1967, annual fluctuations in employment have been reduced. This reduction may have occurred not only in yards where the number of ships on order has increased, but also in yards where new construction may not have changed significantly from earlier years. Thus, it might be that increased employment stability is the result of management's ability to schedule ship production and repair work more efficiently. Direct evidence in support of this hypothesis, however, is lacking.

Given that labor is a significant factor of production in shipbuilding, the demographic aspects of its work force are looked at to determine their impact on industry performance. The demographic characteristics examined are age, education, and race. It is found in Chapter III that private shipyards have a relatively high concentration of workers under 35 years of age. As young workers are more mobile than older workers, this may be one factor accounting for the high degree of work force instability observed in the industry. The age distribution of workers in government shipyards, in contrast, is

heavily weighted toward the older age groups. In 1970, 36 percent of these workers were between 45 and 54 years of age. Here, again, work force instability is likely, but in this case it is due to retirements from the work force. These demographic factors add to the normal problem of turnover in shipbuilding, stemming from the fact that it and the construction industry compete for the same skilled labor.

In recent years naval ship construction has been concentrated in an increasingly fewer number of shipyards that are located in relatively small labor markets. One reason for this might be expected lower wage rates in smaller labor markets. However, one would also expect that shipyards located in small labor markets are more likely to encounter labor shortages for skilled workers than yards located in large labor markets, thereby increasing the cost of naval construction and the likelihood of delays in ship deliveries. Chapter IV documents the relationship between the size of a local labor market in which a major shipyard is located and the availability of skilled labor.

Because shipbuilding is labor intensive, reductions in production costs are most likely to be made by increasing the productivity of labor. As gains in productivity are achieved through increased training and experience of the labor force, an industry that has a high loss of experienced workers will tend to have lower overall productivity. Furthermore, training involves costs; high turnover, therefore, results in unrecouped expenditures. In Chapter V the current literature on turnover is surveyed. Empirical results from the literature are presented to ascertain which variables have been found to be significant determinants of worker mobility. Of these, the two most commonly cited are income and age.

Given that monetary compensation is a significant factor influencing worker mobility, trends in wage rates and earnings in shipbuilding, construction, and related industries are examined in Chapter VI. It is shown in this chapter that the hourly wage rate in

construction exceeds that of shipbuilding. The differential is not as large, however, when yearly earnings are considered. For both income measures, it is found that shipbuilding is not only becoming less competitive with construction but with other industries as well. Yearly earnings by occupation suggest that earnings in occupations in short supply in shipbuilding are not as high as earnings in these same occupations in other industries.

The relationship between wage rates and experience level is looked at in Chapter VI. It is found that wage rates rise much less rapidly with experience in shipbuilding vis-a-vis construction and all industries taken together. As an example, in 1973 the wage rate of a first class craftsman was only six percent higher than that of a third class craftsman at Bethlehem Steel Shipyard, Sparrows Point in Baltimore, Maryland. In contrast, for a similar increase in experience among construction workers in Baltimore in 1973, the average wage rate increased by 40 percent.

Because wage rates increase slowly with experience (and age) in shipbuilding, shipbuilding wage rates are less competitive vis-a-vis other industries among older workers than among young workers. Indeed, earnings for young workers in shipbuilding, i.e., those under 25 years of age, are higher than for young workers in construction and other durable goods industries. These findings imply that shipbuilding may be attracting young, inexperienced workers while, at the same time, it is losing older, experienced workers after they are given training in shipbuilding.

The wage structure, age distribution, and fluctuating work load in shipbuilding suggest that it has a high rate of labor turnover. Short-run annual turnover rates in shipbuilding are examined in Chapter VII. They are found to have declined in recent years. Attention is also given to changes over time in monthly turnover rates and seasonal fluctuations in quits and hires.

Long-term turnover, i.e., turnover over five year periods, is next examined. In contrast to the improvement in short-run monthly

turnover rates, the long-term separation rate from shipbuilding increased between the period 1960-1965 and 1965-1970. This increase in separations coincides with the decline in wage rates and yearly earnings in shipbuilding vis-a-vis other industries after the mid-1960s. Computing long-term separation rates by age, it is found that older workers in shipbuilding had higher separation rates than workers of the same age in other industries. As age is a proxy for experience, these findings indicate that shipbuilding lost a relatively larger number of experienced workers than did other industries. The larger loss of experienced shipbuilding workers is not surprising, given the fact that earnings of older workers in shipbuilding are lower than in construction and manufacturing industries.

As noted, wage and earnings data indicate that shipbuilding is becoming less competitive with construction and durable manufacturing. This raises the question of whether shipbuilding has been experiencing increasing losses of workers to these industries. Data on long-run interindustry mobility are analyzed in Chapter IX. It is found that the loss of workers from shipbuilding to other industries, especially construction and durable manufacturing, increased between 1965-1970 compared to 1960-1965. The former period coincides with the time span when earnings in shipbuilding became increasingly noncompetitive. The last chapter contains conclusions and policy recommendations.

In summary, this study focuses on various aspects of the shipbuilding labor market. It encompasses both macro and micro labor market characteristics of the industry. It is hoped that the study will increase knowledge concerning previously recognized problems affecting the shipbuilding labor market for which little documentation has heretofore been available, as well as problems which heretofore have not received the attention they warrant. The policy recommendations suggested in the study will, hopefully, improve the efficiency of the United States shipbuilding industry. The major policy recommendation

is that the shipbuilding industry could improve its competitive position by dampening wage increases for young, inexperienced workers and increasing them for older, experienced workers. This can be done while leaving the wage bill substantially unaltered. While not demonstrated, the data of this study lend support to the proposition that such a policy can lead to reduced training costs and increased productivity. It is recognized that further empirical research is needed before implementation of this policy would be warranted.

CHAPTER 11
TRENDS IN OUTPUT AND EMPLOYMENT OF
THE SHIPBUILDING INDUSTRY

In this chapter macroeconomic aspects of the shipbuilding industry are examined. The first section of the chapter is devoted to a general description of the industry. Recent trends in output and employment, with particular attention being given to individual yard employment, are discussed in Sections B and C, respectively. In Section D, the importance of labor as a factor of production is assessed. Shipbuilding is found to be very labor intensive. For this reason, measurement of the productivity of labor is desirable, but as noted in Section E, it is not easy to do this in shipbuilding. A primary factor influencing productivity is "learning"; this aspect of the shipbuilding production process is discussed in Section F. The last section contains policy implications and conclusions.

A. Description of the Structure of
the U.S. Shipbuilding Industry

The United States shipbuilding industry is a small segment of the world shipbuilding market and the national economy. The output of the industry represented only about 3.0 percent of the world's commercial ship construction in 1973. However, it accounted for 0.3 percent of the Gross National Product in that year.² Although it is small in relative terms, shipbuilding is an important sector of the United States economy since it has been argued that the industry output is important to national security.

²Commission on American Shipbuilding, Report of the Commission on American Shipbuilding, Volume II, Washington, D.C., October 1973, p. 21.

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The shipbuilding industry is composed of privately owned and government owned naval shipyards. Naval shipyards are no longer engaged in actual ship construction, in part because the development of nuclear propelled naval ships has outpaced the physical capabilities of naval shipyards. Furthermore, it has been suggested that construction of Navy ships would be more efficient in privately owned ship yards. The transfer of naval work to private yards has resulted in the closing of some naval yards; others have experienced a contraction of employment.³

Changes in employment in naval yards between 1960-1970 are shown in Table II.1. As can be seen from this table, employment appears to have declined in all yards between 1960-1970, except the Philadelphia Naval Yard, due, in part, to the transfer of new construction work to private yards. The New York Naval Yard was closed in 1966. The Boston Naval Yard and the Hunters Point Naval Yard were closed in 1974. The drop in employment at these yards between 1960 and 1970 reflects declining work load in anticipation of the closings. At the time of closing, the Boston Naval Yard employed 5,150 men; the Hunters Point Yard employed 5,600 men. After closing, only 473 men from the Boston Naval Yard and 1,900 men from Hunters Point Naval Yard were relocated to other naval shipyards. Of the remaining 8,377 men, 666 found employment in private industry. A total of 3,600 men from both yards retired; the remaining 4,111 employees relocated in local naval organizations, other federal agencies, or resigned.⁴ Thus, not only did the closings result in a loss of jobs, they also resulted in the industry losing skilled workers.

³ Naval yards are still engaged in the repair and conversion of ships. Recently, proposals have been made to again construct vessels in naval yards, but to date these proposals have not been implemented.

⁴ Memo from Captain J. A. Sisson, Department of the Navy, Naval SEASYSTEMS Command (SEA 073).

Table II.1
Labor Markets with Government Naval Yards,
1960-1970

	Government Naval Yard	<u>Employed Males^a</u>	
		<u>1960</u>	<u>1970</u>
Philadelphia, Pa.-N.J.	Philadelphia Naval Yard	7,899	8,932
Los Angeles-Long Beach, Cal.	Long Beach Naval Yard	4,934	4,598
Boston, Mass.	Boston Naval Yard	6,716	5,404
Norfolk-Portsmouth, Va.	Norfolk Naval Yard	8,894	7,593
San Francisco-Oakland, Cal.	Mare Island Naval Yard Hunters Point Naval Yard	10,791	5,847
Charleston, S.C. ^b	Charleston Naval Yard	6,230	5,727
Honolulu, Hawaii	Pearl Harbor Naval Yard	3,534	3,364
Portsmouth, N.H. ^c	Portsmouth Naval Yard	3,704	3,379
Bremerton, Wash.	Puget Sound Naval Yard	- ^d	-
New York, N.Y.	New York Naval Yard	10,053	473 ^e

^a Employed male government workers in other transportation equipment. Other transportation equipment includes shipbuilding, boatbuilding and repairing; railroads and locomotives; mobile dwellings and campers, cycles and miscellaneous transportation equipment industries.

^b State of South Carolina.

^c State of New Hampshire.

^d Not available.

^e Closed in May 1966. The employment of 473 workers in 1970 indicates government employment in other transportation equipment besides shipbuilding.

Source: U.S. Department of Commerce, Bureau of the Census, Census of Population: 1970, Detailed Characteristics, PC(1)-D (State volumes), 1972, Table 186 and Census of Population: 1960, Characteristics of the Population, PC(1)-D (State volumes), 1963, Table 129.

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As noted, private yards build both commercial and naval ships. There were thirteen major privately owned shipyards in the United States in 1973.⁵ Between 1960 and 1973 these yards accounted for 66 percent of commercial ships and 63 percent of naval vessels under construction or for which new contracts had been awarded. Most of the major private yards in the United States are divisions of large corporations such as Bethlehem Steel, National Steel, and Litton Industries.⁶ There is very little interaction among the yards as far as sharing new production techniques or cooperating in joint training programs for skilled workers. Such cooperation among yards is common to Europe and Japan.⁷

⁵The yards are Newport News Shipbuilding and Drydock Company, Sun Shipbuilding and Drydock Company, General Dynamics - Boston, General Dynamics - Groton, Sparrows Point Shipyard, Bath Iron Works, Ingalls Shipyards, Avondale Shipyard, American Shipbuilding Company - Loraine, Lockheed Shipbuilding, Todd Shipbuilding Company - Seattle, National Steel and Shipbuilding Company, Todd Shipbuilding - San Pedro. (One other shipyard mentioned in Chapter IV, Marinette Marine, which produces smaller craft for the Navy, is not a major shipyard.)

⁶The industry is fairly concentrated, especially in the production of naval vessels. In 1973, the four largest shipyards constructing naval vessels accounted for 96 percent of Navy work under construction or delivered in that year. In contrast, the four largest yards producing commercial ships accounted for 58 percent of commercial ships under construction or delivered in 1973.

⁷Commission on American Shipbuilding, op. cit., pp. 52-59. All shipbuilding nations except the United States have central planning associations which assist the yards in collecting marketing data and research. In Japan, all shipbuilders participate in the Japan Ship Exporters Association which coordinates sales activities for the industry. In Sweden, the shipbuilders are members of the Swedish Shipbuilding Association, which provides market analysis data and allows the yards to participate in joint material purchases. It is to be noted that all Japanese yards are privately owned, and for the most part, so, too, are the Swedish yards. The planning efforts are by these privately owned yards with little direct government intervention.

The United States shipbuilding industry fares poorly in the world market as the price of its vessels is higher than that of vessels constructed in other countries. One reason for the higher cost is that the industry is labor intensive and labor costs are high.⁸ Because it is expensive to build ships in the United States, the industry is highly subsidized by the federal government. The construction differential subsidy is the most direct aid to shipbuilders. The subsidy is computed after the buyer chooses a domestic yard to build his ship. It is assumed by the Maritime Commission that the potential buyer will seek out the lowest cost United States producer. The cost of the ship to the consumer is then compared to what the cost would be if the ship were produced in the lowest cost foreign yard. The shipbuilder is awarded a subsidy representing the difference between the domestic and foreign cost.⁹ It is argued that this method of granting the subsidy promotes economic efficiency, since the shipyards compete for contracts, and the buyer may be expected to award the contract to the lowest bidder. However, since the purchasers pay the subsidized price (equal to that in the lowest cost foreign yard) there is, in effect, no economic reason why the buyer would initially choose the lowest cost domestic yard. It should be noted that the fact that ships can be produced more cheaply elsewhere means that labor is drawn away from more efficient uses to the protected industry.

⁸ Ibid., p. 120.

⁹ Gerald R. Jantscher, Bread Upon the Water, Federal Aid to the Maritime Industry, The Brookings Institution, Washington, D.C., 1975, pp. 36-44.

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There are other regulations which also induce merchant ship-owners to buy from the high cost United States yards. Although not a direct subsidy, the Merchant Marine Act of 1920 requires that all intercoastal ocean traffic move in ships built in U.S. yards.¹⁰ Moreover, domestic commercial ship owners are granted interest free loans to buy ships and equipment from U.S. shipyards.¹¹ As a result of this protection, the incentive for domestic shipyards to reduce costs is lessened. Moreover, the industry is also protected in that it is highly unlikely that the Navy will buy warships from foreign producers.

As mentioned below, as long as the Navy awards contracts for one-of-a-kind ships, cost savings are not likely to be achieved by mechanization of production. Cost reduction, if it occurs, will most likely come about by improving labor utilization and productivity. Since output levels are an important factor in determining labor use and efficiency; we now review past trends in shipbuilding output and employment.

B. Trends in Shipbuilding Output

The shipbuilding industry produces two differentiated products, commercial and naval ships. Naval vessels, although usually smaller in size and tonnage than commercial ships, carry more crewmen, resulting in the need for larger crew facilities. The major difference,

¹⁰ Commission on American Shipbuilding, op. cit., p. 21.

¹¹ Gerald R. Jantscher, op. cit., p. 54.

however, between the two types of ships is in terms of their function: naval vessels are outfitted with weapons, advanced communication systems, a complex electrical plant, and are built for speed. Because naval vessels are more complex, they cost more to build than commercial ships (see Table II.2).

Between 1964 and 1974, the total dollar value of commercial ships on order or newly contracted increased nearly ten fold, while the total dollar value of naval vessels under construction or newly contracted more than tripled. Several factors appear responsible for this increase. The average value of commercial vessels more than quadrupled between 1964 and 1974, while the average value of naval vessels increased five fold during the same period. Part of the increase in the average value of commercial vessels under construction or newly contracted is due to larger ships, i.e., ships with larger tonnage, being produced. (This is documented below in Table II.3). Part of the increase in the average value of naval ships is due to an increase in the fraction of naval ships having nuclear power; the cost per ton for these ships is much larger than for conventional ships.

The principal determinant of employment and productivity in the shipbuilding industry is work load. The construction of a ship usually takes a considerable amount of time, for a wide variety of materials and labor must be used in proper sequence. The hull is constructed first, and then painting, rigging, and outfitting follow. It is important to have a backlog of ships on order, so that when one group of craftsmen has completed its work on a vessel, it can be transferred to another vessel, insuring that the yard's production is maintained. If the number of ships on order fluctuates, the production process will be interrupted; this is likely to cause productivity to suffer.

Historically, the work load in shipbuilding has fluctuated from year to year. These fluctuations are seen from Table II.3 which portrays the distribution of shipbuilding construction by stage of production and type of ship. The number of vessels delivered (Table II.3A)

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Table II.2

Dollar Value^a of Ships Under Construction or
Newly Contracted^b by Type,^c 1954-1976

	Commercial		Naval		Total	
	Aggregate	Average Per Ship	Aggregate	Average Per Ship	Aggregate	Average Per Ship
1954	256	- ^d	371	-	627	-
1955	122	4.9	601	14.3	723	10.8
1956	231	2.9	668	12.2	899	6.1
1957	949	11.3	704	15.3	1,653	12.7
1958	874	12.0	952	17.3	1,826	14.2
1959	659	11.0	1,060	20.4	1,719	16.3
1960	492	8.1	947	16.1	1,466	12.5
1961	490	7.4	965	14.4	1,455	10.9
1962	525	9.7	1,124	15.8	1,649	13.2
1963	369	8.2	1,249	15.1	1,618	12.6
1964	387	8.2	1,176	11.6	1,564	10.6
1965	519	11.5	1,728	16.3	2,247	14.4
1966	501	10.4	1,387	9.4	1,888	9.7
1967	543	8.5	1,751	13.1	2,294	11.6
1968	788	12.5	1,649	12.4	2,437	12.4
1969	800	16.3	1,700	15.7	2,500	15.9
1970	765	15.6	1,719	21.0	2,484	19.0
1971	765	13.0	1,925	30.1	2,690	21.9
1972	1,058	12.0	2,255	39.6	3,313	22.9
1973	2,950	31.1	3,160	56.4	6,110	40.5
1974	3,770	38.5	3,603	57.2	7,373	45.8
1975	4,350	47.8	5,424	71.4	9,774	58.5
1976	3,400	47.2	6,500	73.9	9,900	61.9

^aIn millions of dollars.

^bIncludes ships under construction at end of year or contracted for during the current or previous years.

^cPrivate yards only.

^dNot available.

Source: Shipbuilders Council of America, Annual Report, Washington, D.C., 1974, p. 34, and 1977, pp. 26, 27, 28 and 30.

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Table 11.3A

Distribution of Shipbuilding Construction by Type
and Stage of Production, 1955-1974

Vessels Delivered

Year	Commercial			Naval		
	No.	Tonnage ^a	Tonnage per Ship ^a	No.	Tonnage ^b	Tonnage per Ship ^b
1955	8	105	13.1	14	146	10.4
1956	9	126	14.0	9	49	5.4
1957	23	320	13.9	23	114	5.0
1958	31	573	18.5	8	24	3.0
1959	32	717	22.4	16	64	4.0
1960	25	404	16.2	12	39	3.3
1961	25	369	14.8	16	173	10.8
1962	27	385	14.3	15	76	5.1
1963	34	422	12.4	17	81	4.8
1964	16	224	14.0	21	107	5.1
1965	16	180	11.3	18	122	6.8
1966	13	161	12.4	13	74	5.7
1967	13	163	12.5	21	109	5.2
1968	24	329	13.7	16	138	8.6
1969	22	416	18.9	31	160	5.2
1970	13	370	28.5	32	166	5.2
1971	14	407	29.1	33	147	4.5
1972	19	491	25.8	21	95	4.5
1973	34	887	26.1	8	33	4.1
1974	24	684	28.5	9	38	4.2

Table II.3B
Vessels Under Construction^c

Year	Commercial			Naval		
	No.	Tonnage ^a	Tonnage per Ship ^a	No.	Tonnage ^b	Tonnage per Ship ^b
1955	7	116	16.6	29	154	5.3
1956	13	26	2.0	33	199	6.0
1957	49	1,189	24.3	32	181	5.7
1958	51	1,299	25.5	38	257	6.8
1959	41	783	19.1	39	271	6.9
1960	34	519	15.3	40	295	7.4
1961	32	421	13.2	43	230	5.3
1962	39	474	12.2	52	284	5.5
1963	20	226	11.3	54	302	5.6
1964	29	306	10.6	62	342	5.5
1965	29	370	12.8	83	415	5.0
1966	32	352	11.0	93	499	5.4
1967	35	471	13.5	126	636	5.0
1968	40	883	22.1	118	548	4.6
1969	41	1,079	26.3	102	541	5.3
1970	36	1,029	28.6	76	456	6.0
1971	35	1,202	34.3	49	441	9.0
1972	40	1,328	33.2	43	434	10.1
1973	54	2,006	37.1	49	487	9.9
1974	73	3,326	45.6	47	488	10.4

Table II.3C
Newly Contracted Vessels^d

Year	Commercial			Naval		
	No.	Tonnage ^a	Tonnage per Ship ^a	No.	Tonnage ^b	Tonnage per Ship ^b
1955	18	196	10.9	13	93	7.2
1956	68	1,715	25.2	22	87	4.0
1957	35	751	21.5	14	100	7.1
1958	22	176	8.0	17	78	4.6
1959	19	196	10.3	13	63	4.8
1960	23	270	11.7	19	115	6.1
1961	34	438	12.9	24	132	5.5
1962	15	174	11.6	19	99	5.2
1963	25	291	11.6	29	148	5.1
1964	18	244	13.6	39	195	5.0
1965	16	143	8.9	23	158	6.9
1966	16	244	15.3	54	246	4.6
1967	29	740	25.5	8	50	6.3
1968	23	612	26.6	15	153	10.2
1969	8	309	38.6	6	80	13.3
1970	13	580	44.6	6	132	22.0
1971	24	617	25.7	15	88	5.9
1972	48	1,565	32.6	14	86	6.1
1973	41	1,907	46.5	7	39	5.6
1974	25	1,771	70.8	16	171	10.7

Table II.3D
Total Ships on Order

Year	Commercial			Naval		
	No.	Tonnage ^a	Tonnage per Ship ^a	No.	Tonnage ^b	Tonnage per Ship ^b
1955	15	221	15	43	300	7
1956	22	152	7	42	248	6
1957	72	1,509	21	55	295	5
1958	82	1,872	23	40	281	6
1959	73	1,500	21	55	335	6
1960	59	923	16	52	334	6
1961	57	790	14	59	403	7
1962	66	859	13	67	360	5
1963	54	648	12	71	383	5
1964	45	530	12	83	449	5
1965	45	550	13	101	537	5
1966	45	513	12	106	573	5
1967	48	634	13	147	745	5
1968	64	1,212	19	134	686	5
1969	63	1,495	24	133	701	5
1970	49	1,399	29	108	622	6
1971	49	1,509	33	83	588	7
1972	59	1,819	31	64	529	8
1973	88	2,893	33	57	520	9
1974	98	5,097	52.6	56	526	9

^aIn thousands of tons. Includes ships of 1,000 gross tons and larger.

^bIn thousands of tons. Includes ships of 1,000 light displacement tons and larger.

^cIncludes ships under construction at end of year or contracted for in previous years (excluding the given year).

^dIncludes ships contracted for during year.

Source: Shipbuilding Council of America, Annual Report, Washington, D.C., 1974, pp. 28, 30 and 32.

plus the number under construction (Table II.3B) is called "ships on order" and refers to the ships actually being worked on during the year or ships contracted for in earlier years (see Table II.3D). Ships contracted for during the year are classified separately; they are counted as being "newly contracted". It is also important to note that tonnage of commercial ships is measured in gross dead-weight tons, while light displacement tons are used in measuring tonnage of naval vessels. Lightweight tonnage indicates the weight of the empty ship measured by water displacement, while gross tonnage reflects the total volumetric area.

Considering commercial ships, a large increase of ships on order occurred in 1957; in this year the number of ships on order rose to 72. This was the result of the industry receiving a substantial number of orders from foreign customers following the closing of the Suez Canal in 1956. The number of ships on order fell thereafter, reaching a low of 45 ships in 1964 and 1966. In 1973 and 1974 commercial ships on order again increased sharply, reaching a high of 98 ships in 1974. In part, this increase resulted from the increased demand for ships after the oil embargo of 1973; it also reflects the impact of the large merchant ship program initiated by the Maritime Administration in 1970. In contrast to commercial ships, the number of naval ships on order increased steadily from 43 in 1955 to 143 in 1969. The large number of naval vessels on order in 1966 through 1969 resulted from the demand for warships for Vietnam. After 1969, naval ships on order declined steadily, falling to 56 ships in 1974. In the next section, the impact of these fluctuations in work load on industry and shipyard employment is examined.

C. Trends in Shipbuilding Employment

Having looked at recent trends in output, we now examine recent trends in employment. Given the rather large swings in ships on order as indicated in Table II.3D, it might appear that industry employment levels are equally unstable. If this were so, it could account for the difficulty that the industry has in competing in the world market.

As can be seen from this table, for example, the number of commercial vessels on order in 1958, 1963, 1968, and 1973 declined from 82 to 54, then increased to 64, and increased, once again, to 88. Did aggregate industry employment follow the same pattern of decline and rise over the 15-year period?

Data on employment in shipbuilding are shown in Table II.4. Comparison of this table with Table II.3D indicates that fluctuations in industry employment are remarkably small compared to fluctuations in the number of ships on order. For example, the number of production workers employed in 1958, 1963, 1968, and 1973 is seen to be 103, 97, 115, and 114 thousand workers.

The explanation for this stability in employment is not clear. One partial explanation may relate to the long lead time in producing ships. While the number of ships on order fluctuates, at any point of time ships are in various stages of completion. When new orders build up, work on nearly completed ships can be delayed. When new orders diminish, work can be shifted to ships nearing completion. Additionally, besides construction work, shipyards engage in repair work. When construction work slows, repair work may be speeded up, and vice versa. Given the variability of demand for ships, additional study of its impact on employment, and policies for dampening employment fluctuations, appear warranted.

Some indication that the industry has had some success in reducing fluctuations in employment are found in Tables II.4 and 5. The figures in the right-hand column of the former table show the ratio of yearly industry employment to a three-year moving average. A three-year moving average is used because the production period for a ship is typically this long. The figures in Table II.5 were derived in a similar manner for two shipyards, General Dynamics (Groton, Conn.) and Avondale (New Orleans, La.). Not surprisingly, the amplitude of fluctuation in employment at the shipyard level is markedly greater than for the industry as a whole. It is worth noting, however, that in recent years the amplitude of fluctuation has decreased at both yards.

Table II.4

**Annual Employment of Production Workers
in Shipbuilding and Repairing**

<u>Year</u>	<u>Annual Employment^a</u>	<u>Ratio of Annual Employment to 3-Year Moving Average</u>
1958	103	-
1959	97	1.00
1960	92	.97
1961	96	1.01
1962	96	1.00
1963	97	1.00
1964	98	.97
1965	108	.94
1966	120	1.05
1967	115	.99
1968	115	1.00
1969	116	1.03
1970	107	.98
1971	105	.98
1972	110	1.00
1973	114	.99
1974	123	

^ain thousands.

Source: U.S. Department of Labor, Bureau of Labor Statistics,
Employment and Earnings Statistics for the United States,
1909-74, Bulletin 1312-10 (Preliminary), 1975.

Table II.5

Ratio of Annual Employment to Three-year Moving
Average, General Dynamics Electric Boat
Division and Avondale Shipyard

<u>Year</u>	<u>General Dynamics</u>	<u>Avondale</u>
1958	-	-
1959	1.15	.91
1960	.95	.71
1961	.88	1.19
1962	.97	1.14
1963	1.17	.32
1964	.89	1.26
1965	1.11	1.02
1966	1.08	1.05
1967	.48	.91
1968	1.09	.93
1969	1.06	.96
1970	.98	1.01
1971	1.02	1.06
1972	.88	1.00
1973	.96	1.08
1974	-	-

Source: Unpublished data from Naval Sea Systems Command.

One likely reason for the decrease at Avondale is that new ships under construction increased greatly after 1968 when the company received a contract for a series of 20 destroyer escort naval vessels. At General Dynamics, however, the number of ships on order per year during 1962-1967, 11, was greater than the average during 1968-1974, 9. At least for General Dynamics, it appears that the scheduling of ship construction was improved despite a somewhat reduced work load, thereby leading to a smoothing of employment. It might also be that rather than improved scheduling, additional repair work was taken on when new construction work declined. However, as yet these hypotheses remain to be validated. Further evidence that the industry has managed to reduce short-run fluctuations in employment is provided in Chapter VII.

D. The Importance of Labor in Shipbuilding

It has been noted earlier that shipbuilding is a relatively labor intensive industry. In this section, we present data pertaining to the fraction of production costs attributable to labor and the trend over time in this fraction. Also examined are trends in capital formation.

To measure the degree to which shipbuilding is labor intensive, value added data from the 1972 Census of Manufactures were utilized. Value added is the total annual expenditures for factors of production, including depreciation. The share of value added going to labor is represented by the ratio of wages and salaries paid to employees to total expenditures for all factors of production. The larger this ratio, the more labor intensive is an industry, i.e., the higher is the proportion that labor represents of final product costs.

The share of value added received by labor in shipbuilding and the aircraft industry, both heavily subsidized by the federal government, is shown in Table II.6. In 1958, labor received nearly identical shares, about seven-tenths, in shipbuilding and the aircraft industry. In both industries the share of value added going to labor increased somewhat between 1958 and 1962. After 1962, however, the share of value added received by labor dropped dramatically in the aircraft industry. Between 1962 and 1972, the value added going to labor in aircraft fell

Table II.6

Percent of Value Added Accruing to Labor in
Shipbuilding and the Aircraft Industry
1958-1972

<u>Year</u>	<u>Aircraft</u>	<u>Shipbuilding</u>
1958	69	73
1959	73	71
1960	68	78
1961	72	79
1962	73	77
1963	67	77
1964	68	78
1965	64	79
1966	69	78
1967	66	75
1968	60	84
1969	61	84
1970	60	72
1971	54	75
1972	56	76

Source: U.S. Department of Commerce, Bureau of the Census,
1972 Census of Manufactures, Industry Series,
MC 72(2)-37A-C, 1974, Table 1B.

by 17 percentage points. In contrast, the share of value added received by labor in shipbuilding remained fairly constant over the period.

Data supporting the finding that aircraft has become more capital intensive while shipbuilding has not is presented in Table II.7.¹² These data indicate that over the period 1959-1971 capital consumption increased by 485 percent in the aircraft industry; in contrast, the increase was only 156 percent for shipbuilding.¹³ Thus, while the aircraft industry has modernized production techniques, presumably resulting in improved labor productivity, very little change appears to be taking place in production techniques in shipbuilding.¹⁴ It should be noted, however, that the short-run turnover in shipbuilding has declined in recent years (see Chapter VII), so that gains in productivity have probably been realized despite the failure of the industry to mechanize production.

¹²The figures in Table II.7 refer to the ship and boat building and repairing industry rather than to shipbuilding, since data were only available for the larger industrial classification. However, inclusion of the boat building industry causes very little distortion of the depreciation deductions, since this industry is engaged in construction of small recreational boats. It should be noted that the use of capital consumption figures to represent capital intensity in the industry may underestimate this intensity, as some equipment may be fully depreciated.

¹³If 1971 is excluded, the increase is only 39 percent for shipbuilding, 491 percent for the aircraft industry. The significant increase in capital expenditure in 1971 may be due to increased investment by shipyards in response to the expected increase in demand for merchant ships resulting from the proposed new construction program under the Merchant Marine Act of 1970.

¹⁴It may be that the increased investment in aircraft was due to product innovations. For example, as more sophisticated airframe structures and propulsion systems were introduced, investments increased in response. It is difficult to determine, however, without additional information, whether worker productivity increased after the introduction of these new outputs. Finally, it should be noted that investment expanded in aircraft between 1959 and 1971 despite a 36 percent decline in employment during the period. In contrast, while investment in shipbuilding was fairly constant between 1959 and 1971, employment in shipbuilding expanded by eight percent during that period.

Table II.7
 Depreciation Deductions^a Per Year for Selected
 Industries in Other Transportation Equipment
 1959-1971

<u>Year</u>	<u>Aircraft, Guided Missiles and Parts</u>	<u>Ship and Boatbuilding and Repairing</u>
1959	151,630	25,883
1960	190,526	22,743
1961	189,691	23,047
1962	212,202	23,418
1963	277,934	24,604
1964	322,725	24,665
1965	325,454	32,875
1966	- ^b	30,731
1967	540,325	31,120
1968	726,776	30,513
1969	701,082	33,901
1970	895,794	36,002
1971	886,418	66,329

^aIn thousands of dollars.

^bNot available.

Source: For the period 1967 through 1970, Department of the Treasury, Internal Revenue Service, Statistics of Income, Corporation Income Tax Returns, 1970, Table 1. For the period 1959 through 1966 and 1971, U.S. Department of the Treasury, Internal Revenue Service, Source Book of Statistics of Income, Active Corporation Income Tax Returns, (balance sheets with and without net income).

E. Labor Productivity in Shipbuilding

Because shipbuilding is labor intensive, the productivity of its work force is an important factor in determining industry costs and, hence, its ability to compete in the world market. Attempts at measuring productivity in the shipbuilding industry have centered around aggregate industry measures such as tonnage per employee and value added per employee.¹⁵ These aggregate measures are not very reliable and a more accurate measure of productivity in shipbuilding is needed. This section describes some current productivity measures and points out their shortcomings.

One measure that suggests itself is value added per production worker. The basic difficulty with this measure is that it ignores product complexity. Moreover, it is not a physical measure of output; since it is based on dollar value of output, it requires the use of a price deflator. The choice of a price deflator is arbitrary and different deflators result in different productivity estimates. Additionally, value added measures cover both naval and commercial ships. Since these are two different products, it makes little sense to group them together.

Another measure of productivity in shipbuilding is compensated gross registered tonnage (cgrt) per employee. This is an improvement over a simple value added per employee measure, for it takes into account differences among commercial ships. Moreover, it is a physical measure of output. However, the cgrr measure has been developed only for commercial ships. Both measures, it should be noted, suffer from the fact that ships are often unique and they take several years to produce so that it is extremely difficult to measure output during a

¹⁵ Report of the Commission on American Shipbuilding, op. cit., pp. 73-77.

single year. These problems are so intractable that the Bureau of Labor Statistics refrains from publishing a productivity index for shipbuilding.¹⁶

F. The Phenomenon of Learning in Shipbuilding

Besides improvements in labor productivity resulting from mechanization, cost reductions can be achieved through gains from "learning". Learning, otherwise known as product curve analysis, determines the percentage reduction in labor hours or costs as additional, identical units of output are produced. Labor efficiency is improved through job familiarization resulting from repetition in manufacturing operations, introduction of more efficient tools, and reduced rework time. Management is also improved when a substantial number of ships of the same kind are ordered through improved scheduling of production.

Empirically it is very difficult to estimate the gains from learning in the shipbuilding industry since contracts for a large number of standardized vessels at a given yard have been rare. Past empirical evidence suggests that the largest gains in learning occur over the first seven to ten ships of a series. After this point

¹⁶One proposed method for measuring productivity makes use of physical measures of output for a given craft in the production of a ship. For example, a measure of productivity for the hull craft would be the amount of weld feet per man for a given period of time (usually a month). Such a measure for different crafts enables management to monitor ongoing work. The monthly craft measures can be aggregated over the various ships under construction and weighted by complexity measures to arrive at overall yard productivity. See Richard Claycombe and John Martin, Memo Serial 65540, Productivity of Ingalls Shipyard, The George Washington University, Program in Logistics, Washington, D.C., July 14, 1975.

learning falls off rapidly. During World War II, when a large number of ships of the same class were constructed, man-hours were reduced by about 15 to 20 percent over a series of ships as a result of on-the-job learning. In the post-war period, man-hours were reduced between five and ten percent over a series of ships.¹⁷ As these numbers suggest, the rate of learning has apparently declined in the post-war period. One possible reason for this is the many one-of-a-kind contracts and the numerous design changes in a given class in the post-war period. It is important to note that in the yards where learning is expected, labor turnover should be low. If skilled labor is not available, shortages in occupations will be likely and, thus, learning may not be reflected in a reduction of man-hours as production bottlenecks occur. This aspect of recent naval procurement policy is discussed more fully in Chapter IV.

G. Policy Implications and Conclusions

Several policy modifications appear necessary to promote the efficiency of the industry. As discussed in Section A, the industry is protected by subsidies provided by the government. The construction differential subsidy, as well as the laws requiring intercoastal shipments to move in U.S. built ships, provide little incentive for the

¹⁷James T. Bennett, John C. Martin and Henry Solomon, "The Phenomenon of Learning in Shipbuilding: A Survey", Program in Logistics, The George Washington University, Technical Memorandum Serial TM-65214, 3 January 1975, p. 16.

Specific articles dealing with learning and its measurement are: Armen Alchian, "Reliability of Progress Curves in Airframe Production", Econometrica, October 1963; W. Z. Hirsch, "Manufacturing Progress Functions", Review of Economics and Statistics, May 1952, pp. 143-155; Harry Williams, John D. Wells, Elizabeth Johnston and Edward G. Sanders, An Economic Analysis of U.S. Naval Shipbuilding Costs, Institute for Defense Analysis, Report Number T-120, Arlington, Virginia, 1966; Walter Oi, "The Neoclassical Foundations of Progress Functions", The Economic Journal, September 1967, pp. 579-594; and Kenneth J. Arrow, "The Economic Implications of Learning by Doing", Review of Economic Studies, June 1962, pp. 155-173.

industry to become more competitive with low-cost foreign producers. On economic grounds, it appears that a reduction in the protection given to the industry would result not only in cost reductions through the introduction of labor saving methods, but also through the more efficient use of labor.

The stability of employment in a shipyard is dependent on a large backlog of ships on order. Although employment in the shipbuilding industry appears to have been relatively stable, employment levels at individual yards have fluctuated widely from year to year. There is some indication, however, that fluctuations in yard employment have been reduced in recent years.

Data on value added in manufacturing indicates that approximately three-fourths of all expenditures on factors of production go to labor. High labor intensity and the relative constancy of labor's share of value added over time suggests that little mechanization of production has occurred in the last two decades. A recent study¹⁸ of European and Japanese yards provides evidence that these are more mechanized than U.S. yards and the cost of a ship in these yards is much less than that of a domestically built ship. However, for mechanization to be introduced in U.S. yards, it is necessary that ships be standardized.¹⁹ This may be easier to achieve in naval production, but it would also be required in the production of commercial ships.

¹⁸ Report of the Commission on American Shipbuilding, op. cit., Chapter 13.

¹⁹ Japan has established a comprehensive marine standards program which covers material, equipment, and testing. A similar standardization program exists in Sweden. Standardized parts facilitates "mass production" of vessels. Because of the lack of close coordination among yards in the U.S., no such comprehensive standardization program exists in this country. See Report of the Commission on American Shipbuilding, op. cit., Chapter 2.

Because of the importance of labor in the production process in shipbuilding, it is useful to determine some of the operating characteristics of the shipbuilding labor market. This analysis is begun in the next chapter where demographic aspects of the shipbuilding work force are investigated.

CHAPTER III

DEMOGRAPHIC ASPECTS OF SHIPBUILDING

The demographic and economic characteristics of a labor force convey important information about an industry. The particular characteristics discussed in this chapter relate to occupational structure and to age, education, and race.

Occupational structure indicates the kind of skills that are needed to produce an industry's output. In the case of shipbuilding, it is found that the occupational mix is similar to that of construction, a major sector of the economy. Since these two industries compete for similar labor, it is important that compensation in shipbuilding be competitive with that in construction, if the former is to attract a sufficient supply of workers. If shipbuilding compensation is lower than in construction, continued losses of shipyard workers to construction can be expected. In a subsequent chapter, interindustry comparisons of wage rates and earnings will be made for the particular occupations that are utilized in shipbuilding.

The educational attainment of shipyard workers is next examined. While it is difficult to measure the complexity of work performed by an industry, it may be that shipbuilding requires a higher level of formal education of its craftsmen than craftsmen in, say, the construction industry. If this is the case, it may imply asymmetrical substitution possibilities that could limit the supply of craftsmen to the shipbuilding industry.

Age composition is important in determining the stability of an industry's work force. A work force with a higher than average concentration of younger workers will most likely experience a higher than average quit rate. This follows since younger workers have

relatively low separation costs and are thus more mobile. As young workers often change jobs before settling into a career, they are likely to leave an industry as new opportunities become available.²⁰ Age is also a proxy for the experience level of a work force. The higher the percentage of young workers, the lower is the overall level of experience, as younger workers have less time than older ones to invest in training.²¹

As noted, the occupational composition of the work force in shipbuilding and construction are similar. Thus, the shipbuilding industry offers an opportunity for studying the phenomenon of discrimination in the two industries.²² As a first approximation, one would expect two industries having the same occupational mix to have a similar fraction of their work force comprised of minority workers. If, for example, the percentage of workers who are black differs in the two industries, this may indicate that one is discriminating. In this circumstance, it may be possible to gain insight into the factors which foster the practice of discrimination.²³

²⁰John H. Pencavel, An Analysis of the Quit Rate in American Manufacturing Industry, Industrial Relations Section, Princeton University, Princeton, New Jersey, 1970, p. 14.

²¹It may be argued that with rapid technological change in an industry, past training and experience obtained in the industry become obsolete. With respect to shipbuilding, technological improvements in this industry has apparently lagged behind other industries, like aircraft. As indicated in the previous chapter, the trend in labor's share of value added and the trend in capital consumption suggest that the industry's production function has remained virtually unchanged over the years.

²²Throughout this chapter discrimination refers to exclusion of a racial group from an industry.

²³It should be noted that if wage rates between two industries with similar occupational structures differ, differences in racial composition may not be due to racial discrimination, but instead may reflect differences in education and training between races. If wages do, in fact, reflect investment in training, then a high wage industry would attract those workers with more formal and on-the-job training. If, however, blacks are discriminated against in the education process and in on-the-job training programs, they would, by virtue of their lack of training, be at a disadvantage in entering the high wage industry.

A. Occupational Structure

The occupational structure of an industry reveals the type of labor that it requires. Comparison of the occupational mix among industries indicates which industries are in direct competition for labor. If industries with similar occupational needs are located in the same geographical area, competitive bidding for the limited supply of labor will be particularly strong. If wages between these industries differ, it is likely that the low wage industry will encounter difficulty in attracting labor. Thus, the study of the occupational structure of an industry is a preliminary step in assessing the factors which are most important in determining how that industry's labor market operates.

The occupational structure of shipbuilding and related industries is shown in Table III.1. It is seen from this table that there is a strong similarity in occupational structure between construction and shipbuilding.²⁴ This is evidenced by the large percentage of total employment in each industry that is comprised of craftsmen and kindred workers. About 53 percent of the shipbuilding work force and 60 percent of the construction work force was employed in this occupational category in 1970. The distribution of employment within the craftsmen occupations differs somewhat, however, between construction and shipbuilding. Not unexpectedly, relatively more

²⁴ Although the distribution of labor by major occupational distributions in shipbuilding and construction appear similar, within a given occupation, e.g., carpenters, different skill levels exist. Hence, a carpenter in construction may not perform the exact same tasks as a shipbuilding carpenter. A welder is another instructive example. Although all types of welders are classified under the occupation "welder" in Census reports, some may be nuclear welders while others are structural steel welders. This being the case, there may not be perfect occupational similarity between a shipbuilding craftsman and a construction craftsman with the same listed occupation. Because no finer level of detail within an occupation is available, we will assume that substitution, even if less than perfect, between a construction craftsmen and shipbuilding craftsman in the same "occupation" is possible.

Table III.1

Percentage Distribution of Employed Males
(Excluding Clerical and Sales Workers) by
Occupation^a in Selected Industries, 1970

	<u>All Industries</u>	<u>Manufacturing</u>			<u>Motor Vehicles</u>	<u>Aircraft</u>	<u>Shipbuilding and Repairing^b</u>
		<u>Construction</u>	<u>All</u>	<u>Durable Goods</u>			
Professional, technical and kindred workers	19.8	4.8	11.7	13.4	8.9	31.0	12.0
Accountants	1.2	0	1.0	1.1	1.1	1.6	0.8
Draftsmen	0.5	0.5	0.8	1.3	1.0	1.7	1.6
Engineers ^c	2.1	2.3	3.8	5.4	3.4	17.1	4.6
Technicians	1.4	1.3	2.5	3.0	2.5	5.1	3.0
Managers and administrators, except farm	11.1	10.2	6.1	5.8	3.0	5.6	3.7
Craftsmen and kindred workers	18.5	60.3	3.2	25.6	25.2	28.7	52.6
Blacksmiths and boiler-makers	0	0.3	0.2	0.1	0.2	0.1	2.3
Carpenters	1.5	14.9	0.5	0.8	0.2	0.3	8.1
Electricians	0.8	4.9	0.9	1.1	1.3	1.8	4.7
Foremen, n.e.c.	2.8	3.6	5.5	5.6	5.8	5.8	5.9
Machinists	0.7	0.1	1.9	2.7	1.3	3.7	5.8
Mechanics and repairmen	4.3	2.8	3.8	4.0	6.5	8.5	4.3
Painters (construction and repairmen)	0.6	4.9	0.3	0.3	0.5	0.4	3.3
Plumbers and pipefitters	0.7	5.5	0.5	0.5	0.7	0.4	5.1
Stationary engineers	0.3	0.7	0.3	0.2	0.2	0.3	0.3
Operatives	23.5	9.5	50.8	46.9	55.4	31.3	24.8
Assemblers	1.6	0.1	5.4	8.3	16.8	7.8	1.1
Painters, except construction and maintenance	0.2	-d	0.5	0.8	1.5	0.6	1.0
Welders and flame cutters	0.9	1.4	2.2	3.4	5.5	1.5	11.4

Table III.1 (Cont'd)

	All Industries	Manufacturing			Motor Vehicles	Aircraft	Shipbuilding and Repairing
		Construction	All	Durable Goods			
laborers, except farm	6.0	14.2	5.5	5.8	4.2	1.2	4.6
service workers, except household	15.0	1.1	2.7	2.6	3.3	2.3	2.3
all other occupations ^e	6.1	-	-	-	-	-	-
total employment ^f	57,360	4,248	16,832	10,121	904	592	232

Only selected detailed occupations are presented for each major occupational group. Because minor occupations are excluded, the percentages for detailed occupations do not sum to the percentages shown for the major occupational groups.

Includes boatbuilding and repairing.

Engineering and science technicians.

None employed.

Includes farmers and farm managers, farm laborers and farm foremen, and private household workers.

In thousands. Excludes sales and clerical workers.

Source: U.S. Department of Commerce, Bureau of the Census, U.S. Census of Population: 1970, Occupation by Industry, PC(2)-7C, 1972, Table 8.

carpenters are employed in construction than in shipbuilding. On the other hand, relatively more machinists, mechanics, and foremen are found in shipbuilding than in construction.

The second largest occupational group of workers in shipbuilding is operatives. The share of total employment in this occupational grouping is about the same as that of operatives and laborers in construction. Of interest, the proportion of welders among shipbuilding operatives is more than three times as large as the proportion of welders among all durable goods operatives. Thus, even among operatives, the skill requirements in shipbuilding are higher than in many other industries.

Table III.1 also reveals that professional workers comprise a smaller percentage of the shipbuilding work force than in other manufacturing industries. Of particular interest, there are nearly three times as many engineers per worker in aircraft than in shipbuilding, reflecting a greater emphasis on design in the aircraft industry. It should be noted, however, that the share of engineers in shipbuilding may underestimate the amount of design and research and development performed in the industry, for some of this is done by engineers working for the federal government. The figures do make it reasonably clear, however, that less labor is devoted to research and development in shipbuilding than in aircraft and this may account, in part, for the slow progress in mechanizing shipbuilding operations.

Table III.2 shows the employment distribution of shipyard workers and workers in related industries by major occupational group for both 1960 and 1970. The data indicate that for the most part, the occupational composition of the work force in shipbuilding has changed very little. In both years, craftsmen comprised over 50 percent of the total employment in shipbuilding, while nearly one-quarter of the shipbuilding work force consisted of operatives. In both years, the occupational structure of shipbuilding was similar to that in construction; in both industries more than one-half of the workers were craftsmen.

Table III.2

Percentage Distribution of Employed Males (Excluding Clerical and Sales Workers) by Major Occupation Group, 1960 and 1970

	1970				1960			
	<u>Construction</u>	<u>All</u>	<u>Manufacturing Durable Goods</u>	<u>Motor Vehicles</u>	<u>Aircraft</u>	<u>Shipbuilding and Repairing</u>		
Professional, technical, and kindred workers	4.8	11.7	13.3	8.9	31.0	12.0		
Managers and administrators, except farm	10.2	6.1	5.8	3.0	5.6	3.7		
Craftsmen and kindred workers	60.3	23.2	25.6	25.2	28.7	52.6		
Operatives	9.5	50.8	46.9	55.4	31.3	24.8		
Laborers, except farm	14.2	5.5	5.8	4.2	1.2	4.6		
Service workers	1.1	2.7	2.6	3.3	2.3	2.3		1
All Occupations	100.0	100.0	100.0	100.0	100.0	100.0		38
Total Employment ^b	4,248	16,832	10,121	904	592	232		1
<u>1960</u>								
Professional, technical, and kindred workers	4.9	9.1	10.9	7.8	27.6	7.4		
Managers and administrators, except farm	10.4	6.2	5.5	3.0	3.7	3.4		
Craftsmen and kindred workers	56.9	23.7	27.4	26.8	32.0	56.0		
Operatives	9.3	51.8	45.9	55.4	33.6	24.1		
Laborers, except farm and mine	17.9	7.2	8.4	4.5	0.9	6.9		
Service workers	0.5	2.0	1.9	2.5	2.1	2.1		
All Occupations	100.0	100.0	100.0	100.0	100.0	100.0		
Total Employment ^b	3,606	14,462	8,289	724	521	221		

Table III.2 (Cont'd)

^aIncludes boatbuilding and repairing.

^bIn thousands. Excludes sales and clerical workers.

Sources: U.S. Department of Commerce, Bureau of the Census, U.S. Census of Population: 1970, Occupation by Industry, PC(2)-7C, 1972, Table 8 and U.S. Census of Population: 1960, Occupation by Industry, PC(2)-7C, 1963, Table 2.

As can be seen, between 1960 and 1970 the share of professionals in shipbuilding increased nearly five percentage points. While the increase was not unique to shipbuilding, it was more pronounced for this industry than in aircraft, motor vehicles and other durable goods. The general rise in the fraction of workers who are professionals may be partly due to the advent of computers. The increase in professionals in shipbuilding may also reflect increased utilization of engineers and nuclear technicians, as both commercial and naval ships became more complex.

As mentioned in the last chapter, naval vessels in most cases are more complex than commercial vessels. Because of this, one would expect the construction of naval ships to require a higher proportion of skilled workers than that of commercial ships. Some indication that this is so may be obtained from data from the 1960 Census of Population. At that time, Navy yards were still engaged in the construction of naval ships. As can be seen from Table III.3, government yards did have a larger proportion of more highly skilled employees. These yards employed a larger percentage of professionals, electricians, machinists, and plumbers and pipefitters. On the other hand, carpenters and painters comprise a smaller percentage of workers in government yards. As private yards were also producing naval ships as well as commercial ships in 1960, even more striking differences in the occupational mix would be found if private yards had produced only commercial ships. These data are thus consistent with the hypothesis that construction of naval ships requires more highly skilled workers than construction of commercial ships.²⁵

The most important finding stemming from this section is that construction and shipbuilding have similar occupational structures in that in both industries over 50 percent of the work force is employed in occupations classified as craftsmen and kindred workers. As noted, because of the relatively large concentration of shipbuilding employment

²⁵In comparing the occupational composition of the work force in private and government shipyards, it should be noted that the latter are more integrated, as they do more work in-house. To some extent, the higher proportion of skilled workers in Navy yards reflects the fact that they are more integrated than commercial yards.

Table III.3

Percentage of Shipbuilding and Repairing^a Employment
(Excluding Clerical and Sales Workers) in Selected
Occupations by Class of Worker, 1960

	<u>Percent Distribution</u>	
	<u>Private</u>	<u>Government</u>
Professional, technical and kindred workers	6.5	8.7
Engineers	2.1	3.4
Managers and administrators, except farm	4.4	1.4
Craftsmen, foremen and kindred workers	52.7	59.5
Carpenters	11.2	3.5
Cranemen, derrickmen, and hoistmen	1.1	0.7
Electricians	3.1	7.4
Foremen, n.e.c.	4.9	3.3
Machinists	5.6	10.5
Mechanics and repairmen	3.9	5.7
Painters (construction and maintenance)	3.4	1.8
Plumbers and pipefitters	3.9	6.3
Stationary engineers	0.8	1.4
Structural metal workers	6.2	7.1
Tinsmiths, coppermiths and sheet metal workers	2.3	3.9
Operatives	26.1	19.5
Assemblers	1.4	b
Painters (except construction and maintenance)	1.2	0.5
Welders and flame cutters	10.4	7.1
Service workers, except household	2.2	1.9
Laborers, except farm and mine	6.4	7.6
Occupation not reported	1.7	1.4
Total Employment ^c	143,060	81,201

^aIncludes boatbuilding and repairing.

^bLess than 0.5 percent.

^cIn thousands. Excludes sales and clerical workers.

Source: U.S. Department of Commerce, Bureau of the Census,
U.S. Census of Population: 1960, Occupation by Industry,
PC(2)-7C, 1963, Table 2.

in higher skilled craftsmen and operative occupations, it is important that shipbuilding work be located in areas where sufficient skilled labor is available. The relationship between shipyard location and labor supply will be looked at in Chapter IV. The similarity of the occupational structures of shipbuilding and construction underscores the need for an investigation of wages and earnings in the two industries; Chapter VI is devoted to this task.

B. Educational Attainment

The educational attainment of workers in an industry reflects the occupational structure of that industry.²⁶ For example, an industry like shipbuilding, that employs a relatively large fraction of craftsmen and operatives, would be expected to have fewer high school and college graduates than an industry like aircraft, which employs a relatively large fraction of professional workers. The educational structure of an industry also reflects transferability of skills from one industry to another. Although two industries may have a similar occupational mix, it is possible that because the work in one is more complex than the work in another, the former industry may require a higher level of formal training in a given occupation than the latter. Based on common industry belief, shipbuilding work is more complex than contract construction work. For example, a welder in shipbuilding may need nuclear welding skills, while a welder in construction is not likely to use such skills. According to this argument, it may be that workers in shipbuilding need more formal education than workers in construction. If such is the case, it would be more difficult for a worker to transfer from construction to shipbuilding than vice versa, thereby reducing the supply of skilled workers available to shipbuilding.

²⁶Occupation is not the only determinant of educational attainment; another factor influencing educational attainment is the age structure of an industry's work force.

Information on the educational attainment of workers in shipbuilding and selected industries is given in Table III.4. This table shows the percentage of the work force that completed four or more years of high school and college in durable goods and related industries. As can be seen, a relatively small percentage of private wage and salary shipyard workers completed high school compared to aircraft workers, conforming to the expectation that the educational attainment of an industry's work force is a function of its occupational structure. Although it was anticipated that the shipbuilding work force would have a much larger percentage of workers with formal education than construction, the data indicate that this is not the case. Because of the similarity in educational attainment in both industries, educational barriers to symmetric mobility between construction and shipbuilding appear to be absent. In fact, since educational levels are about the same in shipbuilding as in manufacturing, formal educational requirements should not be a barrier to entry into shipbuilding.

In contrast to the low educational attainment of private shipyard workers, a large percentage of workers in government owned Navy yards have completed four years of high school. Because workers in Navy yards are civil servants, it is necessary for them to pass a written examination for employment at a government yard. These data suggest that government yards use formal education as a screening device for employee selection. To the extent that use of such a screen is not associated with higher productivity, it leads to greater costs than are necessary for performing naval repair work.

In summary, the major finding in this section is that a high level of formal training does not appear to be required for employment in private shipyards. Both shipbuilding and construction workers have relatively low levels of formal education and education does not appear to be a barrier

Table III.4

Educational Attainment of Employed Males^a
in Selected Industries, 1970

	Percent Completing Four <u>Years or More</u>	
	<u>High School</u>	<u>College</u>
Construction	43.8	3.9
Manufacturing	55.8	9.9
Durable goods	56.5	9.6
Motor vehicles	54.1	5.7
Aircraft	73.0	18.5
Shipbuilding and repairing ^b	52.3	5.7
Private wage and salary workers	48.6	5.7
Government workers	60.5	5.9
Railroad equipment	54.5	5.7

^aAge 16 and over.

^bIncludes boatbuilding and repairing.

Source: U.S. Department of Commerce, Bureau of the Census,
Census of Population: 1970, Industrial Characteristics,
PC(2)-7B, 1973, Table 3.

to interindustry transfer of workers. The fact that the production process in shipbuilding utilizes relatively high paying crafts that do not require large amounts of formal education makes shipbuilding an attractive industry to workers who have historically been discriminated against in the educational process (see Section D of this chapter).

C. Age Composition

We turn now to the age composition of workers in shipbuilding and selected industries. The age distribution of a work force is an important factor explaining industry turnover levels. As discussed in Chapter V, a work force with a relatively large concentration of young workers is expected to have a higher than average level of separations. Young workers are often engaged in job shopping; hence, they have a high degree of mobility. The costs of separation are low for this group since they have accumulated little seniority and few pension benefits. On the other hand, turnover may also be high in an industry with a relatively large concentration of older workers. In this case, the work force instability is the result of losses through retirement. The age distribution of an industry's work force has other implications besides its impact on turnover. A large percentage of young workers in an industry's work force may result in lower industry productivity, as young workers have less working experience. It also poses an additional problem to an industry in which on-the-job training is common, as it is in shipbuilding. A large fraction of young, inexperienced workers suggests that training costs will be higher than if the work force consisted of older, more experienced workers. Admittedly, it is difficult to determine an optimum age distribution for an industry but, nonetheless, age data can yield useful information.

Census data on the age distribution of the work force in shipbuilding and related industries are presented in Table III.5. These data include information pertaining to the age distribution of workers in both private and Navy shipyards.

Table III.5
 Percentage Distribution of Employed Males by Age
 in Selected Industries, 1970

	<u>16-24</u>	<u>25-34</u>	<u>35-44</u>	<u>45-54</u>	<u>55 and over</u>	<u>Total</u>
Construction	13.2	22.8	23.7	22.1	18.1	100.0
Manufacturing	15.1	24.3	22.3	21.9	16.4	100.0
Durable goods	14.3	24.7	22.7	22.5	15.9	100.0
Motor vehicles	13.4	26.9	23.6	22.5	13.3	100.0
Aircraft	9.2	25.0	26.4	26.7	12.7	100.0
Shipbuilding and boatbuilding ^a	13.9	22.7	19.7	25.6	18.1	100.0
Private wage and salary workers	15.9	25.7	20.1	21.3	17.0	100.0
Government workers	9.5	16.2	18.9	36.5	18.9	100.0
Railroad equipment	14.6	22.9	18.8	25.8	18.6	100.0

^aIncludes repairing.

Sources: U.S. Department of Commerce, Bureau of the Census, U.S. Census of Population: 1970, Industry Characteristics, PC(2)-7B, 1973, Table 34.

With respect to government yards, it is seen that there was a very large concentration of older workers as of 1970. Over 36 percent of the work force in Navy yards in 1970 was in the age group 45-54. The concentration of workers in this narrow age group is most likely due to the expansion in work force which occurred during World War II, as those aged 45 to 54 in 1970 were age 20 to 29 in 1945. This large concentration of older workers implies that a large percentage of the work force has remained in government employment since initial entry. Additionally, it is worth noting that over one-third of government shipyard workers are now between 52 and 61 years of age. Since male workers in Navy yards comprised about 23 percent of total male employment in the shipbuilding and boatbuilding and repairing industry, these older government workers represent at least eight percent of the industry's work force. The retirement of these workers will thus put additional strain on the shipbuilding labor market.²⁷ If no new steps are taken to recruit additional workers for government yards, labor shortages and production bottlenecks may be expected. Should the government meet its manpower requirements by recruiting workers from private yards, this would result in transferring the labor deficit to the private sector.²⁸

The age distribution of workers in private shipyards is also revealing. Contrasted with other transportation industries and construction, shipbuilding has a relatively large fraction of workers less

²⁷As noted in Chapter II, when the Boston and Hunters Point Navy yards closed, 43 percent of the workers not relocated in other naval yards retired.

²⁸In 1971 average hourly earnings for employees in private shipyards was \$4.12, while the average wage paid in Navy yards was \$4.72. See James T. Bennett and John C. Martin, "Recent Trends in the Shipbuilding Industry and the Implications for Naval Ship Procurement", Serial TM-65379, Program in Logistics, The George Washington University, January 13, 1975. Given higher wage rates, there is a very good possibility that workers in private yards will be attracted to Navy yards as jobs in the latter become available.

than age 35.²⁹ In 1970, almost 42 percent of the work force in private shipyards was in this age group compared, for example, to 36 percent for the construction industry, 34 percent for the aircraft industry, and 40 percent for motor vehicles. The younger age composition of the shipbuilding industry implies that its work force is less experienced than the work force in construction and aircraft. Moreover, a large part of the training of new workers in shipbuilding is in the form of on-the-job training. Much of the training is provided by experienced journeymen. Thus, the lack of experience may be costly not only in terms of lower productivity of new recruits, but also in terms of foregone output of experienced workers engaged in training new entrants.

D. Racial Composition

The recent literature concerning the effect of unions on labor supply suggests that craft unions discriminate to a greater extent than industrial unions. Furthermore, as noted by Ashenfelter, craft unions in construction discriminate to a greater extent than craft unions in nonconstruction industries.³⁰ Since (1) the occupational mix of shipbuilding is similar to that in construction, (2) both shipbuilding and construction are heavily unionized,³¹ and (3) in both,

²⁹ While a five percentage point differential in the educational requirements between construction and shipbuilding was found not to be a major difference, a six percentage point differential in the age composition is considered significant. The reason for these seemingly contradictory remarks is the fact that variations in educational attainment are much greater than variations in age.

³⁰ Orley Ashenfelter, "Discrimination and Trade Unionism". Discrimination in Labor Markets, Orley Ashenfelter and Albert Rees, eds., Princeton University Press, Princeton, New Jersey, 1973, pp. 88-112.

³¹ In 1973, about 75 percent of the nonsupervisory work force in construction was unionized. Among private shipyards in the United States, all but one is unionized. It should be noted that the craft union locals

craft unions predominate, it is of some interest to see if Ashenfelter's conclusion applies to shipbuilding, i.e., that discrimination is less prevalent in shipbuilding than in construction. If shipbuilding conforms to his generalization, it would mean that labor costs to shipbuilding are lower than they would be if discrimination occurred.

As noted in the previous section, the craft occupations do not require a large amount of formal education, and pay relatively high wages. For these reasons, one would expect blacks to be attracted to the craft occupations and, in the absence of discrimination, that the proportion of workers who are black in both shipbuilding and construction would be relatively large. Indeed, because the fraction of workers who are laborers is higher in construction, it would not be surprising, again, in the absence of discrimination, if blacks comprised a higher proportion of workers in construction than in shipbuilding.

Given, however, that construction craft unions do discriminate against blacks, and that the average wage in construction is greater than that paid in shipbuilding, one would expect the supply of white workers to shipbuilding to be reduced, thereby precluding shipyards and the industry's craft unions from maintaining entry barriers to blacks, even if they were disposed to do so. Thus, not only might the supply of black workers to shipbuilding be augmented by the lack of jobs for blacks in construction, but as just indicated, the demand for

in shipbuilding are generally not the same as the craft union locals in the construction industry. See U.S. Department of Labor, Bureau of Labor Statistics, Industry Wage Survey: Contract Construction, September 1973, Bulletin 1911, 1976, p. 3 and Daniel Mack Forlist and Arthur Newman, The Conversion of Shipbuilding from Military to Civilian Markets, Praeger Publishers, New York, 1970, p. 56.

blacks would also be augmented. This scenario suggests that the share of black workers in shipbuilding might be larger than their share in construction.

To determine the ease of entry of blacks into shipbuilding and construction, data from Negro Employment in the Maritime Industries and the U.S. Census of Population,³² classified by region, were examined. The results are shown in Table III.6. The regional data for shipbuilding refer to the racial composition of workers in shipyards located in each region. The data for construction (and all industries) are for those states in which major shipyards are located. It should be noted, that the share of blacks in construction understates the extent of discrimination by construction craft unions, since the data include both union and non-union construction workers.

Looking at Table III.6, one finds that in each region the percentage of blacks employed by shipbuilding is larger than in construction, and this is true of all blue collar occupational groups. Blacks comprise the largest share of shipbuilding employment in the Mid-Atlantic region, where more than one-fourth of the work force is black. In contrast, in the same region, only about 10 percent of the work force in construction is black. It is of interest to note that blacks employed by shipbuilding in the South Atlantic and Gulf Coast region comprised about 24 percent of the work force; for this region, nearly 22 percent of the construction work force was black. This greater utilization of blacks in construction in the South Atlantic and Gulf Coast vis-a-vis the Mid-Atlantic region is consistent with one of Ashenfelter's major findings: the extent of discrimination by construction unions varies among geographical areas depending upon the proportion of blacks in the population of the specific area. Racial discrimination will be less in areas with a large fraction of blacks

³²See Table III.6 for source citations.

Table III.6

The Percentage that Blacks Comprise of Employed Workers by Occupation and Region: Shipbuilding, Construction, and all Industries, 1970

	<u>Shipbuilding</u>	<u>Construction</u>	<u>All Industries</u>
Officials and Managers			
New England ^a	0.9	1.4	1.1
Mid Atlantic ^b	2.0	1.2	3.6
Pacific ^c	2.2	1.2	2.2
South Atlantic ^d and Gulf Coast	4.8	4.7	5.4
Professionals			
New England	0.9	0.8	1.9
Mid-Atlantic	-	2.5	6.2
Pacific	1.6	1.5	3.4
South Atlantic and Gulf Coast	2.1	1.7	14.9
Technicians			
New England	2.2	1.4	2.1
Mid-Atlantic	3.1	3.4	4.5
Pacific	1.9	2.2	2.7
South Atlantic and Gulf Coast	6.1	1.2	4.0
Sales Workers			
New England	-	0.1	1.2
Mid-Atlantic	-	2.0	4.2
Pacific	-	1.1	2.3
South Atlantic and Gulf Coast	-	3.4	5.7
Office and Clerical			
New England	2.1	1.8	3.0
Mid-Atlantic	11.0	3.8	10.3
Pacific ^c	5.9	2.0	13.8
South Atlantic and Gulf Coast	14.4	3.0	9.5

Table III.6 (Cont'd)

	<u>Shipbuilding</u>	<u>Construction</u>	<u>All Industries</u>
Craftsmen			
New England	5.0	2.1	2.3
Mid-Atlantic	24.8	7.5	7.6
Pacific	8.2	3.7	4.0
South Atlantic and Gulf Coast	22.8	18.0	14.5
Operatives			
New England	11.8	3.6	4.9
Mid-Atlantic	40.9	8.8	13.4
Pacific	13.7	3.7	7.6
South Atlantic and Gulf Coast	45.8	16.3	26.6
Laborers			
New England	8.7	3.2	5.0
Mid-Atlantic	62.1	20.7	20.7
Pacific	40.9	13.0	8.8
South Atlantic and Gulf Coast	66.5	39.3	52.2
Service Workers			
New England	5.8	12.4	4.6
Mid-Atlantic	48.0	6.6	14.7
Pacific	13.6	11.9	8.7
South Atlantic and Gulf Coast	36.4	38.5	31.4
Total			
New England	4.3	2.6	1.9
Mid-Atlantic	25.6	9.6	11.0
Pacific	10.1	4.4	5.4
South Atlantic and Gulf Coast	23.9	21.7	36.0

Table III.6 (Cont'd)

^aConnecticut, Maine and Massachusetts.

^bPennsylvania, Maryland, and Virginia.

^cCalifornia and Washington.

^dAlabama, Louisiana and Mississippi.

Sources: Data for shipbuilding from Lester Rubin, William S. Swift, and Herbert Northrup, Negro Employment in the Maritime Industries. The Wharton School, University of Pennsylvania, 1974, pp. 70, 73, 76 and 79.

Data for construction and all industries from U.S. Department of Commerce, Bureau of the Census, Census of the Population: 1970, Detailed Characteristics, PC(1)-D (State Volumes) 1972 and 1973, Tables 180 and 181.

in the population, since unions will have to admit blacks in order to unionize enough workers to obtain higher wages and larger fringe benefits.³³

Not only does shipbuilding employ a larger percentage of black blue collar workers than construction, but the share of blacks in these occupations in shipbuilding is also larger than in all industries considered jointly--irrespective of region. In particular, in the Mid-Atlantic, New England and Pacific regions, the black share of craftsmen in shipbuilding was at least two times greater than in construction and in all industries. Similar differentials are found among operatives and laborers, which together with craftsmen comprise about 85 percent of all shipbuilding workers.

These findings suggest that entry for blacks into shipbuilding may be easier than entry into construction. In part, this is undoubtedly due to discriminatory practices of construction craft unions. However, the large percentage of shipbuilding blue collar workers who are black also suggests that there may be other factors besides the restrictive practices of construction craft unions. One factor is the generally high rate of turnover in shipbuilding which results in a high demand for labor regardless of race. Additionally, as the major shipyards are, for the most part, located in the central cities of SMSAs with large black populations, the accessibility of shipbuilding jobs to central city residents further increases their attractiveness. Whatever the reason for the higher than average share of blacks in shipbuilding, the fact that the industry does utilize the skills of this population group implies that even though production costs are higher than in other countries, they would be even higher if the industry did practice racial discrimination.

³³ Orley Ashenfelter, op. cit., p. 94. The figures, however, are also consistent with another explanation, i.e., that a much smaller percentage of construction workers are unionized in the South than elsewhere. See U.S. Department of Labor, Bureau of Labor Statistics, op. cit., p.3.

E. Policy Implications and Conclusions

The similarity of the occupational structure in shipbuilding and construction is consistent with the argument that these industries compete for the same skilled labor. Thus, in order to attract labor, wage rates and earnings in shipbuilding need to be competitive with construction. If they are not, workers from one industry would be expected to transfer to the other where compensation is higher.

Transferability of labor between industries depends on factors besides relative wages and relative earnings. In particular, it depends on the technique of production in each industry. Based on the assumption that shipbuilding work is, in most cases, more complex than construction, it would be anticipated that the educational attainment of workers in the former would be higher than in the latter. If this were the case, the supply of skilled craftsmen to shipbuilding would be constrained in that workers would find it more difficult to enter shipbuilding from construction than vice versa. The data that were examined in this chapter indicate that the educational attainment in the two industries is about the same. Hence, while labor may not be able to flow with equal facility between the two industries, it does not appear that the disparity is large, at least in terms of formal education requirements.

Another finding of this chapter pertains to the age of workers in private and government shipyards. The relatively high proportion of young workers under 35 found in private shipyards suggests that high turnover is characteristic of the industry. On the other hand, the large proportion of older workers in government yards suggests losses of skilled workers in the near future. Given higher earnings in government yards than in private yards it would not be surprising if there is a shift of workers from the former to the latter.

Our examination of the racial composition of workers in shipbuilding indicates that entry for blacks into the industry is apparently much easier than entry into construction and into all other industries taken together. The relatively large concentration of black

craftsmen and operatives in shipbuilding is most likely the result of both supply and demand conditions. Because higher paying construction craft unions practice racial discrimination, the supply of white workers to shipbuilding is reduced. Although discrimination by construction is a factor explaining the larger share of blacks in shipbuilding, other factors, such as the location of shipyards in central cities where blacks are concentrated, and high work force turnover, may also be important. Because of the high rate of turnover in private shipyards (see Chapter VII), barriers to entry for all workers must be low, so the yards can readily replace workers who leave. If discrimination were practiced, yards would find it more difficult and costly to maintain work force size in the face of the high rate of attrition characteristic of the industry. Thus, there are powerful economic factors which preclude the industry from practicing racial exclusion. These factors impact on the shipbuilding craft unions as well as on employers, since the interests of both are so highly interrelated.

CHAPTER IV

THE RELATIONSHIP BETWEEN THE LOCATION
OF MAJOR SHIPYARDS AND THE SUPPLY
OF SKILLED LABOR

One of the most important problems facing the shipbuilding industry is the decline in naval ship construction in recent years. Clearly this also poses a problem to the Navy, but beyond the problem of the number of ships that will be at the Navy's disposal is the problem of procurement cost, which depends not only on the level of ship output, but where naval ships are produced. In particular, at the present time naval ships are being produced in small labor markets, with the possible result that procurement costs are higher than they need be.

Between 1962 and 1967, the bulk of new contracts for naval ships were awarded to eleven shipyards.³⁴ However, as noted in Chapter II, between 1968 and 1973, four shipyards received the bulk of naval contracts:³⁵ Newport News Shipbuilding and Drydock Co., General Dynamics Electric Boat Division, Ingalls Shipyard, and Marinette Marine (of these, Marinette Marine is not considered a major shipyard). One possible motive for the concentration of naval contracts in a small number of yards is to achieve lower costs through "learning". On the other hand, the fact that these yards are located in small labor markets also has implications for production costs.

³⁴ During this period there were nine other shipyards that received a total of three or fewer contracts for new naval ships.

³⁵ Four other shipyards received new contracts for a total of two or fewer naval ships.

It is a well-known proposition in economics that, all other things being equal, the supply curve of labor is more inelastic to an industry, the greater is the ratio of its work force to total employment. The implication of this proposition for an industry such as shipbuilding, which employs only a small proportion of the total labor force, is that it should have relatively little difficulty in recruiting labor at prevailing wage rates. In the case of shipyards receiving new contracts in recent years, however, all other things are not equal. As a major shipyard located in a small labor market will be a dominant employer in the area, it must of necessity draw labor from other labor markets, especially if it is expanding output in a short period of time. The mechanism for achieving this is, of course, higher wages and fringe benefits. Contrary to the expected positive relationship between wage rates and labor market size, wage rates (see Table VI.2) appear to be fairly uniform between shipyards located in small and large labor markets. For example, in 1973 shipyard electricians earned \$4.66 per hour in Philadelphia and \$4.71 per hour in Newport News, Virginia. In contrast, in 1973 electricians in manufacturing earned \$4.86 per hour in Philadelphia and \$4.65 per hour in Newport News.³⁶ These figures indicate that shipyard electricians in Newport News receive a wage rate higher than the average rate earned by electricians in manufacturing in that labor market, while shipyard electricians in Philadelphia earn a wage less than the average paid to manufacturing electricians in Philadelphia. The above data suggest that in Philadelphia the shipyard draws electricians from the existing supply of electricians in that area, at a wage less than the average manufacturing wage paid these workers. In contrast, the shipyard in Newport News apparently must pay a higher wage rate than the average manufacturing

³⁶U.S. Department of Labor, Bureau of Labor Statistics, Area Wage Surveys, Selected Metropolitan Areas, 1972-73, Bulletin 1775-97, October 1974. These wage data for manufacturing conform to the often observed relationship that wage rates in small labor markets are lower than those in large labor markets.

wage paid to electricians in that labor market. This higher wage in shipbuilding in Newport News may reflect the shortage of electricians to shipbuilding in this smaller labor market and the need to pay a premium in order to attract electricians to Newport News from other geographic labor markets. To the extent adjustments in work force size require time, delays in construction can be anticipated. That delays have occurred in recent years in the construction of naval ships should occasion little surprise.

Besides the inverse relationship between elasticity of supply and the size of a labor market, the location of major shipyards in small labor markets poses another problem which compounds the difficulty encountered in expanding output. Expansion of output by a large producer in a small labor market may have a large multiplier effect which increases the demand for local labor by other industries. Where the indirect demand for local labor is for skills also being utilized in shipbuilding, shortages of the common labor input may appear. The industry which employs a similar mix of labor to that of shipbuilding is, of course, construction, and it is the latter industry where requirements for labor expand rapidly when a small local economy experiences an upsurge in activity.

It is, of course, true that the ability of yards to attract labor depends on relative wage rates and earnings within the labor market in which it is located. This aspect of labor market adjustment is discussed in Chapter VI.

A. Labor Market Size and the Availability
of Skilled Labor

Of the four yards that received the bulk of naval contracts between 1968 and 1973, Newport News Shipbuilding and Drydock Co. is located in the largest labor market; the total labor force in the Newport News - Hampton, Virginia SMSA in 1970 was about 98,000 workers.

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In contrast, when employment in the automobile industry is examined, it is found that 57 percent of its work force is located in nineteen labor markets with an average labor force of 1,000,000 workers. In the aerospace industry 63 percent of employment is located in sixteen labor markets with an average work force of 1,100,000 workers.³⁷ The same economic factors leading to the location of these industries in large labor markets has also led to the production of commercial ships in large labor markets. Shipyards engaged in a significant amount of commercial work are located in relatively large SMSAs such as Philadelphia, Boston, and Baltimore. Moreover, in these large SMSAs, one also finds a number of yards. For example, Sun Shipbuilding and Drydock and the Philadelphia Naval Yard are located in Philadelphia. Bethlehem Steel, Sparrows Point and Maryland Shipbuilding and Drydock are located in the Baltimore SMSA. Before the closing of the Boston Naval Yard in 1974, two shipyards were active in the Boston SMSA. The importance of this is that the location of more than one yard in an SMSA increases the local availability of skilled labor from which the major yards can draw, and helps to shorten spells of unemployment among local shipyard workers, thereby reducing losses of labor to the industry.

It appears then, by concentrating naval work in yards located in relatively small labor markets, difficulties in obtaining skilled labor may be encountered. There are several probable reasons why naval contracts have been awarded to these yards. First, two of the yards have historically been engaged in naval ship construction for many years. Second, the three major yards produce nuclear propelled vessels. Because of the dangers involved with nuclear energy, it may be argued that it is desirable to locate nuclear ship construction in areas removed from urban areas. However, nuclear plants for generating power are located in urban areas and, thus, such a safety requirement is open to question.

³⁷U.S. Bureau of Census, Census of Population: 1970. Detailed Characteristics, PC(1)-D (State Volumes), 1972, Tables 180 and 164.

Third, political considerations may play a role in the distribution of naval contract awards. Whatever the reason, the availability of skilled labor still must be taken into account.

To further investigate the relationship between small labor markets and labor supply, data from the 1970 Census of Population and Social Security Administration Continuous Work History Sample were examined.³⁸ Because shipbuilding and repairing are not reported separately from other transportation equipment in the Census Standard Metropolitan Statistical Area (SMSA) tabulations, CWHS data were used to compute the share of shipbuilding employment in other transportation equipment for each SMSA in which a major private shipyard is located. SMSAs that had at least 80 percent of other transportation equipment employment in shipbuilding and repairing were selected for further analysis. For these SMSAs, data for the other transportation equipment industry can be used as a proxy for shipbuilding. Table IV.1 shows the percentage of other transportation workers employed in shipbuilding and repairing in labor markets with private shipyards. Unfortunately, three of the four shipyards that received a large number of naval contracts between 1968 and 1973 are not located in SMSAs. These three shipyards, Ingalls Shipyard, General Dynamics Electric Boat Division and Marinette Marine are excluded from the analysis. As indicated below, substantial differences in labor availability exist between the Newport News-Hampton SMSA and the remaining large SMSAs. These differences would most likely be even more striking if data were available for the areas in which Ingalls Shipyard and General Dynamics Electric Boat Division are located.

³⁸The Social Security Administration Continuous Work History Sample (CWHS) is a one percent sample of all workers covered by the Social Security Act. The CWHS file used in this study provides information such as age, race, earnings, place of work and industry attachment of workers as of 1960, 1965, and 1970. Data for 1975 were unavailable at the time this study was undertaken.

Table IV.1

Employed Workers in Other Transportation Equipment^a in Labor
Markets with Private Shipyards, 1970

	Employed workers in other transportation equipment ^b		Share of shipbuilding and repairing in other transportation equipment ^c
	All	Male	
Newport News-Hampton, Va.	16,291	15,231	99.5
Philadelphia, Pa. - N.J.	15,182	14,060	83.9
Los Angeles-Long Beach, Cal.	14,710	13,120	44.9
Boston, Mass.	12,227	11,292	95.4
New London-Groton- Norwich, Conn.	10,652 ^d	9,941 ^d	97.7
Baltimore, Md.	10,346	9,892	90.8
Seattle, Wash.	9,637	9,003	68.4
Pascagoula, Miss.	9,370 ^e	8,578 ^e	-
New Orleans, La.	8,542	8,170	98.2
Bath, Me.	7,008 ^f	6,519 ^f	90.2
San Diego, Cal.	6,038	5,717	95.9
Bremerton, Wash.	- ^g	-	-
Bay City, Mich.	-	-	-
Erie, Pa.	-	-	-

^aIncludes shipbuilding and repairing, boatbuilding and repairing, railroad equipment, and miscellaneous transportation equipment.

^bBased on 1970 Census of Population.

^cNon-government male workers in shipbuilding and repair as a percent of non-government male workers in other transportation equipment. Based on Continuous Work History Sample.

^dState of Connecticut. Shipbuilding and boatbuilding (including repair) workers only.

^eState of Mississippi. See footnote d for industry coverage.

^fState of Maine. See footnote d for industry coverage.

^gNot available.

Source: Social Security Administration, Continuous Work History Sample and U.S. Department of Commerce, Bureau of the Census, Census of Population: 1970, Detailed Characteristics, PC(1)-D (State Volumes), 1972, Tables 184 and 186.

Data bearing on the availability of local labor in occupations utilized by the shipbuilding industry are shown in Table IV.2. The six local areas examined are Newport News - Hampton, Va., New Orleans, La., San Diego, Calif., Boston, Mass., and Philadelphia, Pa. The SMSAs are arranged in ascending order according to total employment, which is used here as a measure of labor market size. From Row 3, Newport News is seen to be the smallest labor market while Philadelphia is the largest.

The first row of Table IV.2 shows the type and number of contracts received by the major shipyard located in each SMSA. Newport News Shipbuilding and Drydock Company was the only one of the six yards to receive contracts for naval vessels in 1969, 1970, and 1971. During this period, all the other yards received contracts for commercial ships except General Dynamics, Boston, which received no new contracts. Although Avondale received only commercial contracts during these three years, it has historically been engaged in naval construction. In fact, in 1969, 1970, and 1971, naval vessels under construction outnumbered commercial vessels at this yard. Similarly, the majority of work done at San Diego in 1969, 1970, and 1971 was naval work, even though it had not received any new naval contracts since 1968. General Dynamics, while it has not received a naval contract since 1967, also constructed more naval than commercial ships during 1969, 1970, and 1971. Bethlehem Steel and Sun Shipbuilding and Drydock Company specialized in commercial ship production. Looking at the total employment figures, Row 3 of Table IV.2, and the type of work done at the yard based on awards in 1969-1971 (Row 1 of Table IV.2), specialization in commercial work is seen to increase with SMSA size.

As noted above, the availability of labor to an industry in a given labor market depends on the relative size of the industry with respect to other industries located in the SMSA. The larger is employment in other industries with respect to employment in the given industry, the larger the potential supply of labor.

Table IV.2

Characteristics of Labor Markets in Selected SMSAs^a
in Which Major Shipyards Are Located, 1970

	Newport News Shipbuilding and Drydock Company: Newport News, Hampton, Va.	Avondale Shipyard: New Orleans, Louisiana	National Steel and Shipbuilding Company: San Diego, California	Bethlehem Steel, Sparrows Point: Baltimore, Maryland	General Dynamics: Boston, Mass.	Sun Ship- building and Drydock Company: Philadelphia, Pennsylvania
1. Contracts awarded in 1969, 1970, 1971	Nine naval	Seven com- mercial	Two com- mercial	Nine com- mercial	None	Nine commer- cial
2. Major type of ship construc- tion work 1969, 1970, 1971	Naval	Naval	Naval	Commercial	Naval	Commercial
3. Total SMSA employment	95,752	368,261	430,495	810,545	1,136,474	1,878,497
4. Percent of manufacturing employment in other trans- portation equipment ^b	68.3	16.4	8.0	5.1	4.8	2.6
5. Percent of total employment in manufacturing employ- ment (excluding other transportation equipment employment)	7.8	11.8	16.2	23.9	21.3	30.0
6. SMSA employment in other trans- portation equipment as a per- cent of total SMSA employ- ment in specific occupations						
Engineers	37.0	5.0	1.2	1.3	2.3	1.5
Welders and flamecutters	77.0	44.3	42.3	21.6	20.4	12.1
Electricians	51.6	9.6	6.2	6.6	9.1	7.7
Plumbers and pipefitters	59.8	11.4	21.1	8.9	11.8	7.5
Machinists	71.4	30.0	15.6	11.9	11.2	10.2
Mechanics	15.7	4.7	1.0	1.6	2.3	1.1

Table IV.2 (Cont'd)

	Newport News Shipbuilding and Drydock Company: Newport News, Hampton, Va.	Avondale Shipyard: New Orleans, Louisiana	National Steel and Shipbuilding Company: San Diego, California	Bethlehem Steel, Sparrows Point: Baltimore, Maryland	General Dynamics: Boston, Mass.	Sun Ship- building and Drydock Company: Philadelphia, Pennsylvania
7. Number of male experienced unemployed by occupation						
Engineers	3,175	6,214	10,799	15,673	26,987	34,950
Welders and flamecutters	1,390	4,047	2,591	5,055	4,084	11,977
Electricians	1,365	2,537	2,689	5,632	5,831	11,609
Plumbers and pipefitters	1,343	2,265	2,534	4,649	5,707	11,544
Machinists	952	1,162	2,428	4,354	7,332	9,593

^a Employment in shipbuilding, boatbuilding and repairing comprises 80 percent or more of employment in other transportation equipment industries in these SMSAs.

^b Other transportation equipment includes shipbuilding, boatbuilding and repairing, railroad equipment and miscellaneous transportation equipment.

Source: U.S. Department of Commerce, Bureau of the Census, Census of the Population: 1970, Detailed Characteristics, PC (1)-D (State Volumes), 1972, Tables 164, 171, 172, 189.

The relationship between shipbuilding and total employment can be refined by comparing employment in shipbuilding to manufacturing employment. One might expect the share of employment in manufacturing to rise as SMSA size increases over a wide range of SMSA sizes.³⁹ The importance of this relationship is that the skills required by shipbuilding are more closely tied to manufacturing than nonmanufacturing activities. For example, the availability of welders is likely to be smaller in Hartford, Connecticut, which is a center for insurance companies, than in Youngstown, Ohio, which is a "steel" town. Of course, neither of these places produces ships, but if they did, one would expect that it would be easier to recruit welders in the latter place than in the former. The same reasoning suggests that all other things the same, if shipbuilding is only a small segment of the manufacturing sector in a local area, it should be easier to recruit skilled workers than in areas where shipbuilding is the major manufacturing industry.

The fraction of total manufacturing employment which is engaged in shipbuilding is shown in Row 4 of Table IV.2. As noted, the larger this fraction, the smaller is the potential available supply of workers in other manufacturing industries from which shipbuilding can draw. In Newport News - Hampton, employment in the other transportation sector makes up about 68 percent of total manufacturing employment. In contrast, in Philadelphia, San Diego, Boston, and Baltimore more than 95 percent of manufacturing employment is in industries other than shipbuilding.

Even if shipbuilding comprises a small fraction of total manufacturing employment in a local area, the manufacturing sector may be relatively small compared to total area employment. If such is the case, few manufacturing industries are available from which

³⁹ See Michael Darcy and Edward Ullman, "Minimum Requirements Approach to Urban Economic Base," Papers and Proceedings, Regional Science Association, 1960, pp. 175-194.

shipbuilding can attract skilled workers. Thus, it is important to determine the size of the manufacturing sector with respect to total area employment. The larger the relative size of the manufacturing sector, given the level of total SMSA employment, the less is the likelihood of skilled labor shortages.

The fraction that manufacturing (excluding other transportation equipment)⁴⁰ employment comprises of total employment in each of the sample SMSAs is shown in the fifth row of Table IV.2. Only about eight percent of total employment at Newport News-Hampton is employed in manufacturing (excluding other transportation equipment). Not only is shipbuilding the major manufacturing employer in Newport News-Hampton, but the manufacturing sector excluding shipbuilding is very small. It can be seen from Table IV.2 that this is not true of the larger SMSAs. The relative size of the manufacturing sector excluding shipbuilding increases as SMSA size increases. For example, in Philadelphia the manufacturing sector excluding shipbuilding comprises 30 percent of total area employment.

Another measure of the supply of skilled workers can be derived from the sixth row of Table III.2. This row indicates for each SMSA, employment in other transportation equipment as a percent of total SMSA employment. This measure not only indicates workers available from manufacturing, but also from other industries in the SMSA, including construction. Again, it is noted that in each of these SMSAs shipbuilding employment comprises at least 80 percent of other transportation equipment employment. Bearing this in mind, the terms of other transportation equipment and shipbuilding are used interchangeably. The available supply of workers to shipbuilding, then, is comprised of workers not employed by shipbuilding. Hence, one minus the percentages shown in Row 6 is a measure of the available supply of labor to shipbuilding for each occupation. One notes that for Newport News-Hampton, more than 70 percent of all machinists and welders and

⁴⁰ For convenience, other transportation equipment and shipbuilding are used interchangeably in the text.

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flamecutters are employed in shipbuilding. Thus, only 30 percent of all workers employed in this SMSA in these occupations are available for employment in shipbuilding. Furthermore, nearly 60 percent of plumbers and pipefitters are also employed by shipbuilding at Newport News-Hampton. As the size of a labor market increases, it is seen that shipbuilding workers comprise a smaller share of total employment in a given occupation. For example, in Philadelphia no more than 12 percent of all welders were employed in shipbuilding. Thus, nearly 90 percent of employed welders in Philadelphia represent potential supply to shipbuilding in that SMSA. The fraction of employed workers in shipbuilding is even smaller for other occupations in Philadelphia.

These findings imply that for a given level of wages, skilled labor is less available in Newport News-Hampton than in the larger SMSAs where commercial ships are being produced. By implication, the market for skilled craftsmen, such as electricians, plumbers and pipefitters and welders, is probably even tighter in the three other smaller local labor markets where naval ships are being produced.

In addition to drawing on employed workers, an industry can also attract workers from the ranks of the unemployed to meet increases in work load. Indeed, typically one-half of all new job seekers are unemployed workers.⁴¹ Thus, in determining labor availability for a shipyard in a given SMSA, it is useful to look at the number of unemployed workers by occupation. Row 7 of Table IV.2 shows the occupational attachment of experienced unemployed workers for each SMSA. As can be seen, for each occupation the number of unemployed skilled workers is smallest in Newport News-Hampton. For example, the number of unemployed electricians in Newport News-Hampton, 1,390, is about one tenth the number in Philadelphia. That the absolute number of electricians (and other skilled

⁴¹Carl Rosenfeld, "The Extent of Job Search by Employed Workers", Monthly Labor Review, U.S. Department of Labor, Bureau of Labor Statistics, March 1977, p. 59.

workers) in Newport News-Hampton is small means that in periods of expanding demand they will have to be recruited from other labor markets.⁴² As noted, the mechanism by which workers are attracted from other labor markets is higher wage rates. If workers are reluctant to move into shipyards located in small labor markets, the marginal cost of attracting them will be higher than for shipyards located in large labor markets. Finally, the need to recruit from outside the local labor market implies production delays as workers must first become cognizant of employment opportunities before they can take advantage of such opportunities.

B. Conclusions and Policy Implications

If the purpose of concentrating naval contracts in a smaller number of yards, as occurred between 1968 and 1973, was to increase gains from "learning", it may be these gains were not realized. The yards that received the majority of naval contracts are located in extremely small labor markets. The smaller the labor market in which a yard is located, the more the yard will have to rely on drawing workers from other labor markets when demand expands.⁴³ Moreover, if the expansion in ship production is very large, this may induce growth in the construction industry and may drain away workers who are receiving training in shipbuilding. Hence, gains from "learning" might not be realized and delivery times could be lengthened beyond those that would have been incurred if the contracts were let to yards in large labor markets.

Some indication of the availability of skilled workers in small labor markets is obtained by looking at several labor supply measures for various sized SMSAs in which shipbuilding work is done. The findings of this chapter suggest that at prevailing wage rates, shortages of

⁴²It should be noted that the number of industries bidding for unemployed workers will also likely increase with SMSA size. Without vacancy data for each occupation, it is difficult to draw definitive conclusions on the number of unemployed versus the number of vacancies.

⁴³If shortages of labor exist, even with normal demand, workers from other labor markets will be needed.

skilled workers are most likely at Newport News Shipbuilding and Drydock Company and other shipyards located in small labor markets at which Navy work has been concentrated. As the size of an SMSA increases, the availability of labor increases, reducing the likelihood of skilled labor shortages. However, none of the yards located in such large SMSAs as Baltimore, Boston, and Philadelphia received naval contracts between 1968 and 1973.

This chapter has concentrated on the availability of skilled workers to shipyards. In order to attract skilled labor to shipbuilding, the industry must compete in the labor market with other industries using similar skills. Chapter VI investigates wage rates and earnings in shipbuilding and other related industries.

CHAPTER V

SURVEY OF CURRENT TURNOVER LITERATURE

The remaining chapters of this study concentrate on microeconomic aspects of labor market behavior. These pertain to turnover and mobility and the factors which explain them. As a preliminary step in investigating the turnover and mobility patterns of shipyard workers, some recent studies are reviewed. The purpose of this review is to indicate some of the variables that have been suggested as influencing turnover and to summarize the empirical findings of the literature dealing with this subject.

Turnover is composed of accessions, which are additions to the labor force, and separations, which are terminations of employment. Accessions consist of new hires and rehires of workers previously laid off. Separations consist of voluntary terminations of jobs, i.e., quits, and involuntary job terminations, i.e., layoffs, fires, retirements, etc.

A high rate of labor force turnover can be costly in terms of both real and opportunity costs. The real costs of turnover are the cost of gathering information about potential employees and the costs incurred in training newly hired workers. Examples of opportunity costs are the lower output of newly hired workers while they undergo training and the loss of productive time of experienced workers who help in their training.

With respect to turnover, the literature has for the most part focused on the quit rate and its determinants. Attention has been focused on the quit rate, since the voluntary decision to terminate employment is a revealed preference (in this case, a revealed lack of preference) for pay scales, work conditions, etc. Theoretically, the decision to quit depends on the relative gains and costs of leaving

one's present employment. For example, separation costs to a worker increase as income increases.⁴⁴ The cost of separation is also positively related to age. As the age of a worker increases not only does his income increase, but seniority rights, and pension benefits also increase. Thus, all other things being the same, the cost of leaving an employer is greater for an older worker than for a younger worker.

The expected gain of leaving an employer is related to the ease of finding new employment, which in turn depends on economic conditions, the availability of information concerning other jobs, the amount of formal and informal training one has, the extent of discrimination, etc.

More generally, the variables which affect the voluntary separation rate can be classified into economic opportunity, demographic, institutional, and human capital variables.

A. Theoretical Determinants of Turnover

i. Economic Opportunity Variables

As noted, one of the economic opportunity determinants of turnover is the wage rate. The wage rate is expected to have a negative effect on quits for the higher the wage or income one receives, the greater are the costs of quitting. Alternatively, the gains from quitting decrease as wages increase.

The vacancy rate, accession rate, and layoff rate are indicators of general economic activity and are variables measuring the ease of finding alternative employment. In times of economic expansion, search costs are reduced as a result of job advertising by employers. This, in turn, provides workers with information pertaining to employment

⁴⁴Alternatively, current income can be considered as a measure of the relative gain of remaining with an employer or in an industry.

opportunities and alternative wage rates. A prime measure of economic expansion is, of course, the vacancy rate. Hence the quit rate and vacancy rate are expected to display a positive relationship.

The relationship between quits and layoffs, however, is ambiguous. A high layoff rate can cause feelings of insecurity; to the extent that this occurs, workers may quit their jobs to obtain more stable employment in another field. On the other hand, a high layoff rate may reflect poor alternative job opportunities, i.e., greater difficulty in finding a new job. Hence, quits and layoffs may be negatively related. The actual relationship between quits and layoffs will thus depend upon which of these two effects is stronger.

The accession rate also acts as a proxy for the state of the economy. An expanding economy results in increased demand, and as demand increases so, too, do new hires. Still another measure of demand is the relative change in employment. A high rate of employment growth indicates economic expansion and increased job availability; again, quits would be expected to increase.

2. Demographic Variables

Included in the demographic determinants of turnover are age, race, sex, and location. Young workers enter the labor force with less knowledge about job opportunities than workers who have been in the labor force for some time. Such knowledge is acquired by changing jobs until one settles into a permanent job or career.⁴⁵ Age also acts as a proxy for the amount of training a worker has received. Older workers are more likely to have obtained specific training than younger workers; hence, the cost of quitting can be large. Additionally, older workers may accumulate seniority and pension rights, the loss of which would also be costly.

The percentage of blacks in an industry's work force is expected to have an ambiguous effect on the quit rate. Because of discrimination

⁴⁵John Pencavel, "Wages, Specific Training and Labor Turnover in U.S. Manufacturing Industries", International Economic Review, February 1972, p. 54.

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and because blacks obtain less on-the-job training than whites,⁴⁶ their wage is less than that of whites. Thus, the cost of quitting is less than that of whites. On the other hand, discrimination and less on-the-job training suggest that blacks are less likely than whites to find another job if they quit.⁴⁷ Depending upon the relative strengths of these two effects, the relationship between the fraction of blacks in an industry's work force and the quit rate could be either positive or negative.

The relationship between the fraction of an industry's work force which is female and the quit rate is also ambiguous. Women, too, receive less on-the-job training and lower wages. However, the likelihood of getting another job after quitting is less, reducing the payoff from quitting.

Where an individual works is another factor that affects both the cost of quitting and the ease of finding alternative employment. Workers residing in a metropolitan area have a larger number of employment opportunities available to them than workers located in a rural area, by virtue of the fact that there are a larger number of employers in the former area than in the latter. The greater availability of employment opportunities in metropolitan areas also means that changing jobs need not also result in the breaking of social-community ties. These two reinforcing effects imply that the larger the percentage of an industry's work force located in a metropolitan area, the higher is the expected quit rate for the industry. In larger metropolitan areas, however, there are also more individuals seeking the larger number of job opportunities. Therefore, the probability of finding

⁴⁶Jacob Mincer, "On the Job Training: Costs, Returns and Some Implications", Journal of Political Economy, October 1962 (Supplement), pp. 67-68.

⁴⁷Vladimir Stoikov and Robert Raimon, "Determinants of Differences in the Quit Rate Among Industries", American Economic Review, December 1968, p. 1288.

employment in a large metropolitan area may not be significantly different from the probability of finding employment in a smaller local area. This offsetting tendency may tend to weaken the expected positive relation between the quit rate and area size.

3. Institutional Variables

A number of institutional variables have been suggested as affecting turnover; these are firm size, the presence of a union, and the degree to which an industry is competitive.

An inverse relation between firm size and the quit rate has been postulated since there are more opportunities for advancement within a larger firm than a smaller one. On the other hand, a positive relationship between quits and firm size might be observed if employees feel more loyalty to small firms than to large ones. Thus, a priori, the overall effect of firm size on quits is not clear.

A high degree of industry concentration implies that the industry is dominated by a few large firms. As there are few competing firms, the possibility of finding alternative employment in the same industry is reduced. It may also be that anti-raiding agreements between firms in concentrated industries are easier to maintain.⁴⁸ Thus, the more concentrated an industry, the lower its expected quit rate.

To the extent that unions can extract higher wages and reduce worker discontent through union grievance procedures, their presence can be expected to decrease quits. Also, unions insulate workers from the pull of the market by providing seniority and pension rights, which in turn increases the cost of voluntarily leaving a job.

⁴⁸ Kenneth Arrow and William Capron, "Dynamic Shortages and Price Rises: The Engineer-Scientist Case", Quarterly Journal of Economics, May 1959, pp. 292-308.

4. Human Capital Variables

The human capital approach is based on concepts formally introduced by Becker in Human Capital.⁴⁹ In the human capital approach, two types of on-the-job training are differentiated: general training and specific training. General on-the-job training increases a worker's marginal productivity not only in the firm in which he receives training, but in all other firms using the same kind of labor. A worker that receives general training can transfer his newly acquired skill to other industries.⁵⁰ As an example, a worker trained as an electrician in shipbuilding can transfer his acquired skill to construction or manufacturing. A worker receiving general training pays for this training in the form of a lower wage, i.e., a wage which is less than his marginal product during the training period. In subsequent periods, his wage equals his marginal product, which is larger than it would be otherwise by virtue of the training he obtains. Because general training can be transferred from one industry to another, quits may be expected to be higher in industries where the occupational mix reflects large amounts of general training, particularly if the wage paid is less than the prevailing wage in other industries.

Completely specific training increases the trainee's marginal product only in the firm that provides this training. Individuals that receive specific training are paid their marginal product during training; this training is paid for by the firm. In subsequent periods after training, the firm recoups its training costs by paying the specifically trained worker less than his marginal product. The discounted value of this differential will, in turn, cover the costs to the firm of providing specific training.

⁴⁹ Gary Becker, Human Capital, National Bureau of Economic Research, New York, 1964.

⁵⁰ Ibid., pp. 11-15.

A firm is reluctant to lay off workers with specific training because of the risk of their accepting other employment.⁵¹ For this reason, most firms try to shift some of the cost of specific training on to the trainee so as to make quitting less likely.

The variables used to test the human capital approach to turnover include occupational mix, the level of formal education, and the proportion of the work force with brief job tenure. Regarding the occupational structure of an industry and its impact on labor turnover, it can be argued that professionals should have a relatively low quit rate because they have more specific training than other workers.⁵² On the other hand, they tend to have more information about jobs and greater resources for financing migration. As it is well known that professional workers are quite mobile, it may be that the latter factors outweigh the former. Finally, the larger the percentage of workers with brief job tenure, the more likely is the quit rate to be high. This is so, for the less time one is employed, the less the opportunity for investment in specific human capital to take place.⁵³

The next section of this chapter deals with empirical results of some recent studies that have attempted to validate the presumed relationship between the variables discussed above and the quit rate.

B. Empirical Results of Recent Cross-sectional Studies of the Quit Rate

The empirical results of several major studies concerning the determinants of the quit rate in manufacturing industries are summarized in Table V.1. Shown in the table are the author, the type of

⁵¹ Ibid., pp. 11-15.

⁵² Jacob Mincer, op. cit., pp. 50-73.

⁵³ Vladimir Stoikov and Robert Raimon, op. cit., p. 1289.

Table V.1

Summary of Cross-sectional and Time Series Studies

Time period	A. <u>Cross-sectional Studies</u>				B. <u>Time Series Studies</u>		
	<u>Pencavel</u> 1960	<u>Burton & Parker</u> 1960	<u>Stoikov & Raimon</u> 1963 1966	<u>Oi</u> 1951-1958 (Averages)	<u>Parsons</u> 1959 1963	<u>Parsons</u> 1959-1968	<u>Pencavel</u> 1947-1966
R ²	.78	.97	.73 .74	.49	.83 .80	.66 .92	.79
<u>Economic Opportunity Variables</u>							
Wages or income	-**#	-**#	-# -**#	-**#	-**#	+	-**#
Relative wage			-#	-#		-**#	-**#
Change in wage		-#	-**#	-#			
Layoff rate		-**#	+**#	+**#			+**#
Accession rate	+**#	+**#				+**#	
Vacancy rate							
Change in employment		-**		+#			
<u>Demographic Variables</u>							
Age	-**#				-**#	-#	-**#
Sex:							
Female	+**#		+**#	-#	-#		
Male	-**#						
Race:							
Black			-#	-#	-**#		-**#
White	-**#				-**#		

Table V.1 (Cont'd)
A. Cross-section Studies

B. Time Series Studies

Time period	Burton & Parker		Stoikov & Rajmon		Ol 1951-1958 (Averages)	Parsons		Pencavel 1947-1966
	1960	1960	1963	1966		1959	1963	
<u>Location:</u>								
South	-**#					-#	-#	
Rural	+					-#	-#	
Urban	+**#							
<u>Institutional Variables</u>								
Degree of unionization	-**#		-*#	-#		-**#	-**#	-#
Degree of concentration	-**#							
Firm size	+**#		-#	-##				
<u>Human Capital Variables</u>								
Fraction of work force comprised of:								
Professionals						+**#	+**#	
Managers	+					-#	-#	
Production workers	-							
Craftsmen	+#		+**#	+**#		+#	+**#	
Brief job tenure						+	-#	
Level of education								

* Indicates significance at .05 level.
 ** Indicates significance at .01 level.
 # Indicates the sign of the coefficient conforms to the model expectation.
 ## Indicates that the model expectation is uncertain.

study, i.e., whether time series or cross-sectional data were used, the variables tested, and the expected and estimated sign for each variable and its significance level.

These particular cross-sectional studies were chosen since the data base for each study is similar, i.e., the monthly data on turnover in manufacturing industries published by the Bureau of Labor Statistics. Since turnover rates are not published for sub-populations of an industry's work force, the empirical studies make use of regression analysis to determine the importance of the different variables influencing aggregate industry quit behavior. As in the previous section, the independent variables are classified as economic opportunity, demographic, institutional, and human capital variables.

1. Economic Opportunity Variables

The coefficients of the economic opportunity variables in the cross-sectional regressions display the signs that were predicted in the theoretical discussion. Pencavel, Burton and Parker, Parsons, and Oi⁵⁴ all find the level of wages to have a significant negative effect on quit rates. Stoikov and Raimon also find a significant negative effect between annual earnings and the quit rate after adjusting for work force quality.

⁵⁴John H. Pencavel, An Analysis of the Quit Rate in American Manufacturing Industry, Industrial Relations Section, Princeton University, Princeton, New Jersey, 1970.

John F. Burton and John E. Parker, "Interindustry Variations in Voluntary Labor Mobility", Industrial and Labor Relations Review, January 1969, pp. 199-216.

Vladimir Stoikov and Robert L. Raimon, op. cit., pp. 1283-1298.

Donald O. Parsons, "Specific Human Capital: An Application to Quit Rates and Layoff Rates", Journal of Political Economy, November/December 1972, pp. 1120-1143.

Walter Oi, Fixed Employment Costs and Labor Turnover in Manufacturing Industries, The Transportation Center and Department of

Burton and Parker, Stoikov and Raimon, and Oi also introduce dynamic variables to measure the effect of the rate of change of wages on the quit rate. The assumption here is that workers are less inclined to quit in industries where wages are increasing rapidly. As expected, a negative relation was found, but the relation was significant only for the 1966 test by Stoikov and Raimon.

Regarding business condition indicators, Pencavel and Burton and Parker used the accession rate as an explanation of quits. As predicted, the accession rate and quit rate are found to have a significant, positive relationship. Burton and Parker used the layoff rate to measure the state of the labor market; they found a strongly significant, negative relation with quits. Stoikov and Raimon also used layoffs as a predictor; however, they found a highly significant, positive relationship between layoffs and quits. These empirical findings indicate that the effect of layoffs on quits is, indeed, ambiguous.⁵⁵ Still another variable, the rate of change of industry employment, was used by Burton and Parker and Oi as a proxy for general business conditions. A significant, negative relation, contrary to expectations, was observed.

Of the economic opportunity variables used in the cross-sectional regressions, the effect of wages on quits was consistently negative and

Economics, Northwestern University, Evanston, Illinois. Cited in J. H. Pencavel, An Analysis of the Quit Rate in American Manufacturing Industry, op. cit.

For a further discussion of recent empirical turnover studies see: Donald O. Parsons, "Models of Labor Market Turnover: A Theoretical and Empirical survey", in Research in Labor Economics, edited by Ronald Ehrenberg, Vol. 1, Greenwich, Connecticut, JAI Press, 1977.

⁵⁵It should be noted that the layoff rate, like the quit rate, is an endogenous variable. When quits increase, layoffs may be reduced to maintain work force size. Thus, a simple least squares regression relating the effect of layoffs on the quit rate may produce a statistically unreliable coefficient for the layoff variable. To correct for this simultaneity problem, a two-stage least squares model might be preferable. In the models discussed, only the ordinary least squares method was used.

for the most part significant at the 0.01 level of significance. Variables representing business conditions also appeared to impact on the quit rate, but these do not appear to be as important as the wage variable.

2. Demographic Variables

Pencavel and Parsons used age as an independent demographic variable in their regressions and found a negative relationship, as expected, between quits and age. This reflects the higher job mobility and lower separation costs of younger workers. The relation was significant at the 0.5 level or higher for all tests except the 1963 regression by Parsons.

The effect of race on quits was investigated by Parsons, Stoikov and Raimon, and Burton and Parker. Parsons and Burton and Parker found a significant, negative relationship between the fraction of workers who are white in an industry's work force and its quit rate. Stoikov and Raimon found an insignificant, negative relationship between the fraction of the workers who were black and the quit rate. It would appear, therefore, that the relationship between race and the quit rate is weak.

A similar result was found with respect to the fraction of females employed in an industry. Pencavel and Burton and Parker found the proportion of females in an industry to be significant and positively related to the level of quits. The coefficients in the regressions of Parsons and Stoikov and Raimon were insignificant.⁵⁶ Thus, as for blacks, the relationship appears to be weak.

⁵⁶Recent work by Barnes and Jones sheds further light on the effect of sex on quits. They identify two types of quit rates: quits to move to another job and quits to exit from the labor force. It was found that males have a higher quit rate with respect to moving to another job, while females have a higher quit rate for the purpose of exiting from the labor force. When total quitting is compared (both types), females tend to have higher quit rates.

William F. Barnes and Ethel B. Jones, "Differences in Male and Female Quitting", The Journal of Human Resources, Fall 1974, pp. 339-451.

Locational variables were used by Burton and Parker, Pencavel, and Parsons to test the hypothesis that an industry with a large proportion of its work force residing in rural areas would have a lower quit rate than one that had a large fraction residing in metropolitan areas with greater job opportunities. Quit rates were not found to be significantly lower in rural areas in Parsons' model for 1959 and 1963. In Burton and Parker's model a significant negative relationship was found for the South variable. Similarly, in Pencavel's model a significant positive relationship was found for the urban variable. While not all of the coefficients of the locational variables were significant, they were, for the most part, consistent in sign.

Regarding the empirical results pertaining to demographic variables, age appeared to be most consistently related to quits; size of labor market appeared to be of minor importance; race and sex of little importance.

3. Institutional Variables

The three institutional variables examined in the literature are the degree of unionization, degree of concentration, and firm size. A significant negative relationship was found between the presence of unions and the quit rate in two of the four models in which this variable was included. All regressions have the expected negative sign, suggesting that unionized workers do have a lower quit rate, but the impact of unions on quits does not appear to be overly strong.

Oi, Burton and Parker, and Stoikov and Raimon examined the effect of firm size on the quit rate. Only in the Burton and Parker model was firm size significant; in this study it displayed a positive relationship with the quit rate.

Measures of industry concentration were used in the models of Parsons and Burton and Parker. This factor appeared as the strongest, most significant institutional variable. In each study, a significant, negative relation, at the .01 level of significance, was found.

Thus, concerning institutional variables, concentration appears to reduce labor mobility significantly, and to a lesser extent, so, too, does unionization.

4. Human Capital Variables

To test the relationship between human capital and the quit rate, Pencavel, OI, Parsons, and Burton and Parker included variables that measured differences in occupational mix. One variable used for this purpose was the proportion of the work force that were production workers. The coefficients for this variable were found to be insignificant. Pencavel also included craftsmen in his model, but this variable was also insignificant. Likewise, the variable measuring the fraction of the work force in managerial and related jobs was insignificant in Parson's and Pencavel's models. Parsons also included the fraction of workers who were professionals in his model; for this variable he found a significant positive relationship.

Parsons also tested the relationship between education and quit rates. According to previous findings that education and specific human capital were positively related, Parsons anticipated a negative relationship between quits and education. However, the relationship in both the 1963 and 1966 models was insignificant.

Stoikov and Raimon, and Parsons looked at the relationship between brief job tenure with a firm and the quit rate. As one would expect, the number of workers with less seniority and accumulated pension benefits (brief tenure) is significantly positively related to the quit rate.

The human capital variables appear to be the least important of the four groups of variables. Of the factors included in this group, the most important is job tenure. While this factor was not significant

In all the studies cited, our findings regarding job tenure and turnover suggest that a strong relationship does exist (see Chapter VIII). This positive relationship, which is intuitively reasonable, is also supported by BLS studies of job tenure.⁵⁷

C. Results of Recent Time Series
Studies of the Quit Rate

In the late 1950s, it was observed by Ross that quit rates had been declining since 1940.⁵⁸ Ross's explanation of this phenomenon focused on the spread of unionism, increased stability in manufacturing employment, and the aging of the labor force.⁵⁹ Ross broke ground for two recent analyses of temporal changes in quit rates. The studies by Pencavel⁶⁰ and Parsons⁶¹ emphasize the absolute level of wages in an industry, relative wages, economic conditions, the age of the work force, as well as other variables.

In the study by Pencavel, which covered the period 1947-1966, the quit rate was found to be significantly related to the relative wage rate, the accession rate, and the age of the work force.

Parsons found in his study that over time quits and the relative wage rate also displayed a significant relationship. Also, there was a significant relationship between quits and the vacancy rate.

⁵⁷U.S. Department of Labor, Bureau of Labor Statistics, Job Tenure of Workers, January 1973, Special Labor Report 172, Table A-2, p. A-3.

⁵⁸Arthur M. Ross, "A New Industrial Feudalism", American Economic Review, December 1958, pp. 903-920.

⁵⁹As noted in Chapter VII, quit rates, at least in durable goods, stabilized in the first half of the 1960s and appear to have risen since then. One explanation for this apparent reversal in trend is the entry of young workers into the labor force who were born during the post-World War II baby boom.

⁶⁰John Pencavel, An Analysis of the Quit Rate in American Manufacturing Industry, op. cit.

⁶¹Donald O. Parsons, "Quit Rates Over Time: A Search and Information Approach". American Economic Review, June 1973, p. 390-401.

The time series studies indicate that both relative wages and alternative job opportunities in the economy are highly significant determinants of the quit rate over time.

D. Summary and Implications for Shipbuilding

The theory of turnover and the empirical results reviewed in this chapter suggest that the prime determinants of voluntary separations from an industry work force are income, age, and employment opportunities. Wages and quits are negatively related, since the higher one's wage, the greater the loss resulting from leaving a firm or industry. Similarly, age and quits are negatively related because older workers have higher separation costs. Not only do older workers receive higher income, but they have social ties to their work place and the area in which they live. Also, the economic benefit of job change is less for older workers, since they have less time to recoup the gains from such change during their remaining working life. While general economic conditions were also found to be important, they were not as significant as the income and age variables.

Among the other variables evaluated in the recent cross-sectional studies of the quit rate, race and sex were not consistently significant and were often ambiguous in sign. Nor do institutional variables, such as the presence of unions and firm size, appear to be significant in explaining the behavior of the quit rate. Highly concentrated industries, however, do appear to have lower than average quit rates. Finally, the human capital variables used in the studies surveyed have only a tenuous relationship to quits at a point in time. As noted, while the studies surveyed do not give strong support to job tenure as a factor inhibiting turnover, our study suggests that it is, indeed, an important factor.

The studies reviewed in this chapter are especially relevant to an analysis of the labor market of the shipbuilding industry. In a previous chapter, it was shown that private shipyards have a

relatively large fraction of young workers. Since young workers have been found to have a high quit rate, one would anticipate, for this reason alone, that turnover is a serious problem for the industry. In the next chapter, it is shown that wage rates and earnings in shipbuilding are low relative to related industries. As just noted, there is a strong inverse relationship between relative earnings and the quit rate. A high quit rate in shipbuilding should, therefore, occasion little surprise. Of the two variables, age and wage rates (earnings), only the latter is subject to direct management policy. Management has little discretion over the age distribution of its employees, except insofar as it is determined indirectly, e.g., by wage policy. The importance of the wage rate on quits underscores the need to investigate the relationship between wages (earnings) and separations in shipbuilding. This is the subject of the remaining chapters.

In concluding this chapter, it must be emphasized that in the studies reviewed here, only industrywide turnover was examined. These studies are of great value, but they do not permit direct examination of turnover for specific groups of individuals and, hence, interaction effects are difficult to isolate. Despite the limitations just noted, the findings of the studies cited are invaluable for understanding some of the parameters that motivate workers to leave an employer and an industry.

CHAPTER VI

WAGE RATES AND EARNINGS IN SHIPBUILDING

The previous chapter suggests the important role played by wage rates and earnings in influencing turnover. Other factors held constant, if wages are not equal among industries, workers will migrate from the low wage industry to the high wage industry. If a low wage industry offers opportunities for training and the wage differential widens as experience level increases, workers will seek training in that industry and then leave. As noted below, this pattern is said to be occurring in shipbuilding.

In the first section of this chapter, we look at wage rates in shipbuilding⁶² and other related industries. Of particular importance is relative wage rates between shipbuilding and construction, since these industries employ the same kind of labor. In the second section, wage rates of specific labor markets are examined to obtain more accurate comparisons of wage rate differentials. It should be noted that yearly earnings, as distinct from the hourly wage rate, may also be important in determining the allocation of labor among industries. Even though wage rates in an industry may be lower than those in other industries that utilize the same kinds of labor, yearly earnings may be higher. A worker in a low wage industry may work more hours than a worker in a high wage industry. If the relative hours differential exceeds the relative wage differential, the low wage earner will earn more than the high wage earner. Such might be the case if the high

⁶²The data presented in this chapter are for privately owned shipyards. Comparable wage and earnings data for government, i.e., naval shipyards are, for the most part, unavailable. The Social Security Continuous Work History Sample is the primary data source used in this study for obtaining earnings data. As these data apply only to private wage and salary workers, employees of government owned naval yards are excluded.

wage industry is characterized by seasonal work, while the low wage industry is not. Thus, a worker may continue to work in a low wage industry if greater importance is attached to yearly earnings than to the hourly wage rate. For this reason, annual earnings in shipbuilding and selected industries are looked at in the third section. Age earnings profiles are also examined to determine if older, experienced workers in shipbuilding earn as much as similar workers in other industries.

A. Wage Rates in Shipbuilding Relative to Other Industries

All other things being the same, workers in a given occupation are attracted to industries which pay high wage rates. Assuming a static model, as workers move to the high wage industry, the marginal productivity of labor falls and, hence, the wage rate tends to fall. On the other hand, as the low wage industry experiences losses of workers, the marginal productivity of labor rises and so, too, does the wage rate. Given that labor is mobile and wages are flexible, the wage rate in the two industries should approach equality. However, if wages are not flexible, the wage differential will persist, and the low wage industry will experience a continual loss of workers to the high wage industry. Should the wage differential increase over time, the loss rate should also increase. According to the following statement from the 1974 Report of the Seapower Subcommittee of the House Committee on Armed Services,⁶³ this appears to be the case in the shipbuilding industry.

"There is a very rapid turnover in the first year of employment, for the new employees leave to go into the better paying construction field after learning a skill in shipbuilding."

⁶³ Seapower Subcommittee of the Committee on Armed Services, Current Status of Shipyards: 1974, House of Representatives, Ninety-third Congress, Second Session, 1975, p. 18.

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This statement raises several interesting questions. One of these is whether wages in shipbuilding are competitive with other industries, particularly construction. In order to determine whether, and the extent to which, the wage rate in construction is substantially higher than in shipbuilding, hourly wage data for production workers in shipbuilding and related industries were used to construct Table VI.1. The table shows the average wage rate of production workers in selected industries as a ratio of the wage rate of production workers in shipbuilding and repairing. A ratio of 1.00 indicates that the wage rate in a given industry and shipbuilding are equal.

Looking at the relative wage rate figures for construction, one notes that wage rates in construction have been consistently greater than in shipbuilding since 1947. Between 1947 and 1963, the wage rate in construction was greater than in shipbuilding by about ten percent. However, since 1963 the differential has widened until by 1974 the differential was 35 percent. With respect to other transportation equipment industries, in 1963 wage rates in these industries were one to five percent less than in shipbuilding, but in 1974, they were from 8 to 18 percent larger than in shipbuilding. The wage rate in durable goods manufacturing has typically been less than in shipbuilding, but by 1974 the differential had virtually disappeared. In recent years, wage rates have also been rising faster in all nonagricultural industries than in shipbuilding; however, they still remained 15 percent below those in shipbuilding in 1974. Generally, then, up to the early 1960s wage rates for production workers in shipbuilding were competitive with those in durable goods industries, but since that time, this competitive advantage has been eroded.

The data in Table VI.1 suggest that the decline in the relative wage rate in shipbuilding would result in increased worker turnover and mobility. In particular, it would be expected that the flow of workers from shipbuilding to other industries, especially construction and transportation equipment manufacturing would have increased after 1965. Because of the relatively large wage differential between

Table VI.1
Average Hourly Earnings of Production Workers in Selected
Industries as a Ratio of Average Hourly Earnings of
Production Workers in Shipbuilding and Repairing

Year	Private Nonagriculture Payrolls	Manufacturing					
		Construction	All Manufacturing	Durable Goods	Motor Vehicles	Aircraft	Railroad Equipment
1947	.87	1.05	.84	.88	1.01	.94	.95
1948	.75	1.08	.84	.89	1.02	.94	.96
1949	.81	1.09	.84	.88	1.04	.95	.96
1950	.76	1.11	.86	.91	1.07	.98	.98
1951	.83	1.12	.87	.92	1.07	.99	1.02
1952	.79	1.12	.86	.92	1.07	.99	.97
1953	.76	1.10	.84	.89	1.03	.96	.95
1954	.79	1.12	.83	.89	1.03	.97	.97
1955	.77	1.11	.84	.90	1.04	.98	.99
1956	.78	1.10	.84	.89	1.01	.97	.99
1957	.76	1.10	.83	.89	1.00	.95	1.00
1958	.76	1.09	.82	.88	.99	.97	1.00
1959	.75	1.08	.81	.87	1.00	.97	.99
1960	.74	1.10	.80	.87	1.00	.96	.99
1961	.73	1.09	.79	.85	.98	.95	.97
1962	.74	1.10	.79	.85	.99	.95	.98
1963	.73	1.09	.79	.84	.99	.95	.97
1964	.76	1.13	.80	.86	1.02	.96	.99
1965	.78	1.17	.83	.88	1.06	.99	1.03
1966	.77	1.17	.82	.87	1.04	1.00	1.01
1967	.78	1.19	.82	.87	1.03	1.00	.99

Table VI.1 (Cont'd)

Year	Private Nonagriculture Payrolls	Manufacturing					
		Construction	All Manufacturing	Durable Goods	Motor Vehicles	Aircraft	Railroad Equipment
1968	.80	1.23	.84	.89	1.09	1.01	.99
1969	.80	1.26	.84	.89	1.08	1.01	1.01
1970	.81	1.32	.85	.90	1.07	1.04	1.04
1971	.83	1.38	.87	.92	1.15	1.05	1.10
1972	.84	1.38	.87	.93	1.17	1.07	1.11
1973	.85	1.38	.88	.94	1.18	1.08	1.10
1974	.85	1.35	.88	.94	1.18	1.08	1.13

Source: U.S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings Statistics for the United States, 1909-74, Bulletin 1312-10 (Preliminary), 1975.

shipbuilding and the nonagricultural sector, one would expect shipbuilding to rely now more heavily on industries besides construction and manufacturing for its supply of workers. That this has, indeed, occurred will be noted in Chapter IX.

B. Wage Rate Differentials by Occupation:
Shipbuilding Versus Construction

According to the Shipbuilding Manpower Study,⁶⁴ private shipyards indicate that they are experiencing significant hiring difficulties for welders, electricians, machinists, plumbers and pipefitters and workers with structural steel skills. The lower wage scale for these occupations in shipbuilding (relative to construction) was cited as the primary causal factor for the industry's inability to retain workers. To establish the extent of this wage rate differential, data from individual shipyard-union wage settlement agreements are compared with union wage rates for the same occupations in construction for SMSAs in which major shipyards are located⁶⁵ (see Table VI.2).

It should be emphasized that the occupational categories in shipbuilding and construction may not be identical. For example, an electrician in construction may perform more complex work than an electrician in shipbuilding. This being the case, there may not be perfect occupational similarity between a shipbuilding craftsman and a construction craftsman with the same listed occupational title. However, because no finer detail within an occupation is available, it is assumed there is a reasonable degree of substitutability between craftsmen in the two industries, even if it is less than perfect. Supporting evidence for this assumption is provided by the Battle Study cited above.⁶⁶ In this study shipyard management stated that the welding, rigging, sheetmetal,

⁶⁴Mark Battle Associates, Inc., Shipbuilding Manpower Study, March 1974, Chapter 6.

⁶⁵As noted in Chapter III, all but one of the major shipyards are unionized.

⁶⁶Mark Battle Associates, Inc., op cit p.64.

Table VI.2
 Hourly Wages for Unionized Workers in Selected Occupations in the Shipbuilding
 and Construction Industries: Five Labor Markets, 1971-1974

	1971		1972		1973		1974	
	Shipbuilding ^a	Construction ^b	Shipbuilding	Construction ^b	Shipbuilding	Construction ^c	Shipbuilding	Construction ^d
<u>Newport News, Va.</u>								
Carpenter	3.90	\$5.25 ^e	\$4.46	\$5.85	\$4.71	\$6.05	\$4.97	\$6.60
Electrician	3.90	6.15	4.46	6.90	4.71	6.90	4.97	7.20
Machinist	3.90	-	4.46	-	4.71	-	4.97	-
Pipefitter	3.90	8.99	4.46	9.00	4.71	9.52	4.97	-
Sheetmetal	3.90	9.02	4.46	9.70	4.71	10.00	4.97	-
Welder	3.90	-	4.46	-	4.71	-	4.97	-
Shipfitter	3.90	-	4.46	-	4.71	-	4.97	-
<u>Groton, Conn.</u>								
Carpenter	\$4.03	\$6.05 ^g	\$4.36	\$7.45	\$4.64	\$8.00	\$4.94	\$9.30
Electrician	4.03	7.75	4.36	8.40	4.64	9.00	4.94	9.26
Machinist	4.03	-	4.36	-	4.64	-	4.94	-
Pipefitter	4.03	6.35	4.36	7.55	4.64	8.55	4.94	-
Sheetmetal	4.03	7.25	4.36	8.45	4.64	8.70	4.94	-
Welder	4.03	-	4.36	-	4.64	-	4.94	-
Shipfitter	4.03	-	4.36	-	4.64	-	4.94	-
<u>Baltimore, Md.</u>								
Carpenter	-	\$6.94	\$4.38	\$7.49	\$4.58	\$7.79	\$4.88	\$8.10
Electrician	-	7.15	4.38	8.10	4.58	8.50	4.88	8.50
Machinist	-	6.70	4.38	7.00	4.58	7.50	4.88	-
Pipefitter	-	7.46	4.38	7.91	4.58	7.91	4.88	-
Sheetmetal	-	7.10	4.38	8.17	4.58	8.17	4.88	-
Welder	-	-	4.38	-	4.58	-	4.88	-
Shipfitter	-	-	4.38	-	4.58	-	4.88	-

Table VI.2 (Cont'd)

	1971		1972		1973		1974	
	Shipbuilding	Construction	Shipbuilding	Construction	Shipbuilding	Construction	Shipbuilding	Construction
<u>Philadelphia, Pa.</u>								
Carpenter	-	\$7.65	-	\$8.57	\$4.46	\$ 8.77	\$4.71	\$ 9.27
Electrician	-	8.32	-	9.20	4.66	10.11	4.92	10.82
Machinist	-	7.95	-	8.50	4.46	8.95	4.71	-
Pipefitter	-	8.99	-	9.00	4.66	9.52	4.92	-
Sheetmetal	-	9.02	-	9.70	4.66	10.00	4.92	-
Welder	-	-	-	-	4.66	-	4.92	-
Shipfitter	-	-	-	-	4.46	-	4.71	-
<u>San Diego, Calif.</u>								
Carpenter	-	\$6.51	-	\$7.06	-	\$7.51	-	\$7.51
Electrician	\$4.43	8.75	\$4.63	8.75	\$4.83	7.68	\$5.03	8.75
Machinist	4.26	-	4.46	-	4.66	-	4.86	-
Pipefitter	4.26	8.30	4.46	8.30	4.66	8.62	4.86	-
Sheetmetal	4.26	7.60	4.46	7.63	4.66	7.63	4.86	-
Welder	4.26	-	4.46	-	4.66	-	4.86	-
Shipfitter	4.26	-	4.46	-	4.66	-	4.86	-

^a Information on shipbuilding wages obtained from union books of individual shipyards, 1971-74.

^b U.S. Department of Labor, Bureau of Labor Statistics, Union Wage and Hours, Building Trades, July 1, 1972, Bulletin 1807, 1974.

^c U.S. Department of Labor, Bureau of Labor Statistics, Union Wage Rates and Hours and Employee Contributions to Selected Funds in the Building Trades, July 1, 1973.

^d U.S. Department of Labor, Bureau of Labor Statistics, News, August 15, 1974.

^e Wages for construction occupations in Norfolk, Virginia.

^f Not available.

^g Wages for construction occupations in New Haven, Connecticut.

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and pipefitting trades were easily transferable among shipbuilding, construction, and other industries. Shipfitters were considered to be easily retrained for structural work in construction. On the other hand, pipefitters, sheetmetal workers, and machinists were identified as trades easily transferable from other industries into shipbuilding. The study further indicated that it is easier for a welder in shipbuilding to transfer to construction than vice versa. Management indicated that light metal welders who transferred from construction required, at the minimum, nearly two months of closely supervised on-the-job training in order to meet the requirements for shipbuilding work. These statements suggest that there exists a reasonable degree of substitutability for many occupations between shipbuilding and other industries, including construction. Nonetheless, the possible lack of perfect occupational similarity should be kept in mind.

From Table VI.2 it is seen that for given occupations and labor markets, the union wage rates in shipbuilding are consistently less than in construction. For example, at Newport News Shipbuilding and Drydock Company, electricians earned \$4.71 an hour in 1973. In contrast, the union wage for electricians working in contract construction was \$6.90 an hour. Similarly, the wage rate for pipefitters at Newport News Shipbuilding and Drydock was \$4.71 in 1973 while unionized contract construction pipefitters received \$9.52. Similar differences are found for yards located in large labor markets, e.g., pipefitters at Sun Shipbuilding and Drydock Company in Philadelphia earned \$4.66 a hour in 1973 while unionized construction pipefitters in Philadelphia earned \$9.52 an hour. From these examples the wage differential does not appear to be related to geographical location or labor market size.

It could be argued that even though wage rates in contract construction are higher than in shipbuilding, the differential would not result in a loss of shipbuilding workers because of the entry barriers established by construction unions. Entry into a construction union is generally difficult; in many cases a worker cannot join a construction craft union unless he is recommended by a union member. However, entry

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is unrestricted in the nonunionized sector of the construction industry. If nonunion construction wages are higher than shipbuilding wages, one would expect a loss of workers to this segment of the construction industry.

Fortunately, union and nonunion wage rates in construction are available for some SMSAs in which major shipyards are located. Moreover, the data are classified by level of experience. These data, along with corresponding shipbuilding data, are presented in Table VI.3. It is seen from this table that despite the difference in union-nonunion construction wages, wage rates in the latter are still consistently greater than those in shipbuilding. With few exceptions, lower wage rates in shipbuilding are found in each occupation and area. For all the occupations and areas considered, nonunion construction wages are about 10 percent higher than shipbuilding wages. Thus, even though there exist barriers to entry into union construction, one would still expect shipyard workers to seek construction work.

A second important finding, seen from Table VI.2, pertains to the dispersion of wages among occupations in shipbuilding. It is to be noted that the dispersion is very small. For example, all workers at Newport News Shipbuilding and Drydock Company received the same hourly wage rate irrespective of occupation. In yards such as National Steel and Shipbuilding Company, San Diego and Sun Shipbuilding and Drydock Company, Philadelphia there are variations in wage rates among occupations, but these are small. Wage rates in private shipyards differ from construction not only because they are lower, but also because they do not reflect differences in supply and demand conditions among different occupations.⁶⁷

⁶⁷ Conversations with shipyard managers suggest that one reason for the lack of dispersion in wages between occupations is to reduce inter-jurisdictional trade disputes.

Table VI.3

Wage Rates by Experience Level for Selected Occupations in
Shipbuilding and Contract Construction, 1973

	<u>Shipbuilding</u>		<u>Contract Construction</u>			
	<u>Wage Rate</u>	<u>Percent^a Increase</u>	<u>Union Wage Rate</u>	<u>Percent Increase</u>	<u>Nonunion Wage Rate</u>	<u>Percent Increase</u>
Baltimore, Md.						
Carpenter						
Apprentice ^b	\$4.32	6.0	\$6.41	23	\$4.94	33
Journeyman ^c	4.58		7.89		6.57	
Electrician						
Apprentice	4.32	6.0	5.78	47	3.40	53
Journeyman	4.58		8.50		5.21	
Pipefitter						
Apprentice	4.32	6.0	- ^d		-	
Journeyman	4.58		8.41		6.89	
Sheetmetal						
Apprentice	4.32	6.0	5.95	37	3.39	48
Journeyman	4.58		8.17		5.02	
Philadelphia, Pa.						
Carpenter						
Apprentice	4.12	8	5.60	58	4.86	16
Journeyman	4.46		8.85		5.64	
Electrician						
Apprentice	4.12	13	5.90	71	5.25	22
Journeyman	4.66		10.04		7.17	
Pipefitter						
Apprentice	4.12	13	5.63	59	-	-
Journeyman	4.66		9.51		5.31	
Sheetmetal						
Apprentice	4.12	13	6.78	47	-	-
Journeyman	4.66		10.01		5.33	

Table VI.3 (Cont'd)

	San Diego, Calif.					
	Shipbuilding		Contract Construction			
	Wage Rate	Percent Increase	Union ^e Wage Rate	Percent Increase	Nonunion ^e Wage Rate	Percent Increase
Carpenter						
Apprentice	-		\$4.93	43	\$4.97	29
Journeyman	-		7.05		6.42	
Electrician						
Apprentice	\$3.76	28	5.96	53	4.04	55
Journeyman	4.83		9.09		6.24	
Pipefitter						
Apprentice	3.63	28	5.99	43	-	
Journeyman	4.66		8.61		-	
Sheetmetal						
Apprentice	3.63	28	6.08	44	-	
Journeyman	4.66		8.75		6.90	

^aIndicates percent increase in wage rate between experience levels.

^bApprentice in shipbuilding represented by a third class craftsman.

^cJourneyman in shipbuilding represented by a first class craftsman.

^dNot available.

^eData for union and nonunion contract construction for Long Beach-Los Angeles area.

Source. For shipbuilding: individual union wage books, 1973; for construction: U.S. Department of Labor, Bureau of Labor Statistics, Industry Wage Survey, Contract Construction, September 1973. Bulletin 1911, 1976, Tables 2 and 3.

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In addition, one notes that the differential in wage rates is largest for electricians, pipefitters, and sheetmetal workers in each of the local areas surveyed. These occupations require the greatest amount of training and are commonly cited by shipyard management as being in short supply. For example, in 1973 at Newport News electricians, pipefitters, and sheet metal workers earned more than twice as much per hour in unionized construction as in shipbuilding. Similar differentials existed in the other labor markets. At Groton, Connecticut in 1973, union electricians earned 90 percent more per hour than shipbuilding electricians. Because of the higher wage rate differentials, shipbuilding appears to be encountering greater difficulty in attracting workers in the more skilled occupations.

Not only do wage rates in shipbuilding fail to reflect prevailing scarcities of labor relative to demand among different crafts, they also fail to show human capital differences as reflected by differences in experience within a given occupation. For example, in 1969 journeyman electricians received \$3.67 an hour while apprentice electricians earned \$3.26 at the Newport News Shipbuilding and Drydock Company.⁶⁸ The pay differential for these very different experience levels was 12 percent. Similar differentials existed for other occupations at the same yard. At Bethlehem steel, the differential between apprentice and journeyman wage rates in all craftsmen occupations was approximately eight percent in 1969, while at General Dynamics the differential was 11 percent in the same year. One may contrast these data with data classified by age, which can be taken as a proxy for experience. In 1969, for the U.S. as a whole, electricians aged 25-34, who presumably have a fair degree of experience, earned 45 percent more than electricians aged 18-24, the majority of whom have little experience. Similarly, pipefitters aged 25-34 earned about 41 percent more than pipefitters aged

⁶⁸ Union wage books for the major shipyards.

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18-24.⁶⁹ These data indicate that wage rates rise much less rapidly with experience in shipbuilding than in the same occupation in other industries. This being the case, there is a strong incentive for workers to leave shipbuilding after receiving training.

Of interest, not only do hourly earnings rise more rapidly with experience in construction (than in shipbuilding), but they tend to rise in a way which is consistent with human capital theory. This theory suggests that the longer the period of general training, the higher should be the wage rate in subsequent periods. Examination of Table VI.3 suggests that this is the case. While the number of observations are not large, it appears that the rate of increase in hourly wages is least for carpenters, the occupation with the shortest training period. In Baltimore, for example, journeyman carpenters earned 23 and 33 percent more per hour than apprentice carpenters in union and nonunion construction, respectively. Among electricians, hourly wages were 47 to 53 percent higher for journeymen than for apprentices. As noted above, for electricians in general in 1969, experienced, older electricians earned 45 percent more than electricians aged 18-24 years. This earnings-age (skill) differential is similar to the wage-skill differential observed, here, for electricians in construction. However, looking at the increase in hourly wages as a function of experience levels in shipbuilding, one finds no similar pattern exists. In conclusion, these findings suggest that not only does the structure of wages in shipbuilding fail to reflect differences in productivity associated with experience, it also appears not to reflect differences in length of training among occupations.

It should be noted that up to this point in the discussion it has been tacitly assumed that income is measured solely by the hourly wage. Another important measure of income is annual earnings. In the next section, differences in this alternative measure of income, between shipbuilding and other related industries, are examined.

⁶⁹ Figures refer to median earnings of males who worked 50-52 weeks in 1969. See U.S. Department of Commerce, Bureau of the Census, Census of Population: 1970, Occupational Characteristics, PC(2)-7A, 1972, Table 23.

C. Annual Earnings

It can be assumed that preferences for leisure and income vary in degree among individuals.⁷⁰ Some individuals have a high preference for income, while others prefer more leisure time. If yearly earnings are higher in shipbuilding than in construction because of the cyclical nature of construction work, individuals who have a strong preference for income may prefer to work in the former industry. Were the yearly earnings in the two industries identical, however, an individual could obtain a higher wage and enjoy more leisure by working in construction. Relative differentials in yearly earnings between shipbuilding and other industries are found in Table VI.4. The figures in this table, which show the annual earnings of males in selected industries as a ratio of annual earnings in shipbuilding, were constructed from data obtained from the Social Security Administration Continuous Work History Sample. The use of these data enables one to distinguish shipbuilding from boatbuilding; this distinction is important for the yearly earnings in shipbuilding in the three years examined were about 30 percent higher than those in boatbuilding. One notes from Table VI.4 that during the period 1960-1970, the ratio of annual earnings in construction to annual earnings in shipbuilding rose 12 percentage points.⁷¹ Not only does it appear that annual earnings rose more rapidly, but equally important, in 1970 annual earnings in construction and shipbuilding were nearly equivalent. In addition, annual earnings in shipbuilding also declined vis-a-vis annual earnings in manufacturing and aircraft between 1965 and 1970.

⁷⁰See Albert Rees, The Economics of Work and Pay, New York, Harper & Row, 1973.

⁷¹The rise was even more rapid between 1965 and 1970 (14 percentage points).

Table VI.4

Annual Earnings in Selected Industries as a Ratio of
Annual Earnings in Shipbuilding and Repairing,
Males, 1960, 1965, and 1970

	<u>1960</u>	<u>1965</u>	<u>1970</u>
Construction	0.86	0.84	.98
Manufacturing	1.10	1.03	1.06
Motor vehicles	1.27	1.21	1.10
Aircraft	1.31	1.30	1.33
Other transportation ^a	0.97	0.96	0.91
Shipbuilding ^b	1.00	1.00	1.00
Boatbuilding ^b	0.73	0.70	0.73
Railroad equipment	1.16	1.06	1.05

^aIncludes mobile dwellings and campers and cycling equipment in addition to industries shown.

^bIncludes repairing.

Source: Social Security Administration Continuous Work History Sample.

Table VI.5

Annual Earnings^a in Selected Industries
as a Ratio of Annual Earnings in Other
Transportation Equipment:^b Males, 1969

Occupations	All Industries	Construction	Manufacturing	Motor Vehicles	Aircraft
Professional, technical, and kindred workers	1.10	0.98	1.01	1.19	1.19
Accountants	1.09	0.97	0.81	1.10	0.90
Draftsmen	0.98	0.93	1.02	1.39	1.14
Engineers	1.10	1.05	1.10	1.13	1.20
Technicians ^c	0.90	0.79	0.93	1.25	1.05
Managers and administrators, except farm	0.91	0.94	1.13	1.19	1.13
Clerical workers	0.88	1.19	0.93	1.10	1.09
Sales workers	0.93	1.07	1.06	1.17	1.34
Craftsmen and kindred workers	1.06	1.04	1.13	1.37	1.23
Blacksmiths and boiler-makers	1.00	1.23	1.01	1.12	1.00
Carpenters	1.15	1.17	1.11	1.32	1.32
Electricians	1.22	1.30	1.20	1.50	1.20
Foremen, n.e.c.	0.99	1.00	1.01	1.23	1.20
Machinists	1.04	0.94	1.05	1.25	1.07
Mechanics and repairmen	0.92	1.04	1.02	1.16	1.10
Painters (construction and repairmen)	0.95	0.95	0.99	1.16	1.10
Plumbers and pipefitters	1.20	1.24	1.19	1.50	1.14
Stationary engineers	1.01	1.03	1.11	1.30	1.27

Table VI.5 (Cont'd)

Occupations	All Industries				
	Industries	Construction	Manufacturing	Motor Vehicles	Aircraft
Operatives	0.99	1.18	1.03	1.18	1.23
Assemblers	1.20	1.23	1.20	1.29	1.40
Painters, except construction and maintenance	1.03	-d	1.21	1.26	1.14
Welders and flame cutters	1.07	1.24	1.04	1.10	1.19
Laborers, except farm	0.09	.98	1.01	1.35	1.29
Service workers, except household	0.90	.93	0.99	1.32	1.32
All Occupations	1.07	1.05	1.10	1.18	1.33

^aEarnings from wage and salaries.

^bIncludes shipbuilding and repairing, boatbuilding and repairing, railroad equipment, and miscellaneous transportation (principally mobile dwellings and campers and cycling equipment).

^cEngineering and science technicians.

^dNone employed.

Source: U.S. Department of Commerce, Bureau of the Census, U.S. Census of Population: 1970, Occupation by Industry, PC(2)-7C, 1972, Table 4.

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Annual earnings data by occupation also suggest that shipbuilding no longer enjoys a competitive edge over construction. These data, taken from the 1970 Census of Population, are shown in Table VI.5. Unfortunately, the data available are only given for other transportation equipment industries, not shipbuilding. However, relative earnings comparisons can still be inferred from the data. The previous table, Table VI.4, indicates that annual earnings in shipbuilding in 1970 were about ten percentage points greater than in other transportation equipment. It has also been seen that wage rates vary little among occupations in shipbuilding; for most shipyards they are identical. It may be assumed that this ten percentage point differential between annual earnings in shipbuilding and other transportation equipment is fairly stable among occupations. To make the estimated comparison with shipbuilding, one can, as a first approximation, deduct ten percentage points from each of the relative earnings figures shown in Table VI.5.⁷² Thus, making the adjustment just noted, one finds over all occupations, annual earnings in shipbuilding appear to have been only slightly higher than in construction (subtracting 10 percentage points from 1.05 yields an estimate of 0.95 which is close to the 0.98 figure shown in Table VI.4).

Even though overall yearly earnings in shipbuilding were somewhat higher than in construction in 1969, the earnings of blacksmiths and boilermakers, electricians, plumbers and pipefitters, and welders and flamecutters in construction appear greater than the earnings for these same occupations in shipbuilding. The annual earnings of electricians and plumbers and pipefitters in manufacturing also appear to be higher

⁷²This approximation method does not correct for overtime pay which may be more prevalent in occupations in short supply in shipbuilding, e.g., welders, machinists, pipefitters and electricians. Given currently available data, there is no way of netting out overtime payments. Also, it is necessary to assume that wages are fairly constant over occupations in other transportation equipment industries.

than in shipbuilding. Thus, even though the industrywide earnings figures for shipbuilding appear competitive with other industries, important earnings differentials appear to exist for occupations reported by shipyards as being in short supply.⁷³ Contrarywise, the occupations in which shipbuilding appears to be competitive with construction are the low paying occupations such as carpenters, painters, and laborers--occupations for which the supply of labor is probably relatively large and for which training costs are relatively low.

D. Age-earnings Profiles in Shipbuilding and Selected Industries

If general training is relatively easy to obtain in an industry, and earnings are high during the period when training is received, this industry is likely to attract young, inexperienced workers. On the other hand, if earnings in this industry are relatively low for experienced workers, it will have difficulty retaining them after they receive training.⁷⁴

⁷³As indicated in footnote 72 of this chapter, the annual earnings data by occupation include overtime payments. As earnings in occupations in short supply would most likely have a higher overtime pay component, were these payments netted out of annual earnings for occupations in short supply in shipbuilding, it may be that differentials noted might even be larger.

⁷⁴General training, as explained in Chapter V, is training which increases a worker's productivity equally in all firms. This training is paid for by the employee, whose wage is less than his marginal product by an amount equal to all costs of training. After training, he receives a wage equal to his marginal productivity, which is higher than it would be in the absence of training. Because of this, workers who receive general training experience a steep increase in their earnings as they gain experience and become older. In contrast, a worker who does not receive general training will have a flatter age-earnings profile.

Earlier findings in this chapter suggest that shipbuilding may be characterized by these conditions. It was shown that wage rates in construction are higher than in shipbuilding, and the differential is especially large for experienced workers. The differential in annual earnings between the two industries is smaller, however, indicating that shipyard workers work more hours than construction workers. Since the wage differential is smaller for younger, inexperienced workers, one would not be surprised to find that the annual earnings for this group are greater in shipbuilding than in construction. Similarly, since the wage differential is larger for experienced workers, it is equally possible that their annual earnings are less in shipbuilding than in construction. Were this relative inversion of earnings to exist, it would provide a stimulus for young workers to acquire training in the shipbuilding industry and then leave shipbuilding for other industries after completing training.

To determine how earnings vary with age in shipbuilding and other industries, data from the Continuous Work History Sample were used to compute age-earnings profiles. These profiles for shipbuilding, construction, and the other related industries previously referred to in our analysis, are shown in Table VI.6. Examination of this table reveals that in 1970 annual earnings of workers under 25 were greater in shipbuilding than in construction and durable goods. For example, young workers in shipbuilding earned about \$1,200 more than their counterparts in construction. Among older workers, the converse is true.

The inversion in earnings is particularly striking in comparing workers age 35-54 in shipbuilding and durable goods; workers in the latter industries earned \$1,000 more than workers in the former. Again, the inversion in annual earnings in shipbuilding relative to other industries is not surprising given the narrow experience-wage differentials noted above. While young workers might be expected to leave shipbuilding after receiving training, one would not be surprised if older, experienced workers also leave shipbuilding as the gap between what they can earn in the industry and elsewhere widens with age.

Table VI.6
Annual Earnings of Males by Age Groups
in Selected Industries,
1960, 1965 and 1970

	<u>24 and less</u>	<u>25-34</u>	<u>35-44</u>	<u>45-54</u>	<u>55 and over</u>
1960					
Shipbuilding	\$3,206	\$4,585	\$5,670	\$5,432	\$4,769
Construction	2,536	4,205	4,880	4,612	4,306
Aircraft	4,411	6,181	7,185	6,788	5,885
Motor Vehicles	4,512	5,987	6,612	6,915	6,673
Durable Manufacturing ^a	3,332	5,180	6,163	6,069	5,555
1965					
Shipbuilding	4,506	6,079	6,624	6,935	6,086
Construction	2,904	4,345	6,096	5,716	5,253
Aircraft	4,868	7,589	8,954	8,810	7,570
Motor Vehicles	5,504	7,093	8,140	8,331	7,839
Durable Manufacturing	3,803	5,996	7,228	7,210	6,544
1970					
Shipbuilding	5,283	7,798	8,596	8,836	8,350
Construction	4,082	7,589	8,920	8,981	7,841
Aircraft	6,444	9,255	11,700	11,782	10,182
Motor Vehicles	5,558	8,184	9,592	9,909	9,347
Durable Manufacturing	4,738	8,013	9,721	9,808	8,513

^aExcludes transportation equipment industries.

Source: Social Security Administration Continuous Work History Sample.

It is important to note that earnings of older workers in shipbuilding were more competitive with the earnings of similarly aged workers in construction and durable goods in 1960 and 1965. Since the inversion of earnings by age became more pronounced after 1965, other things equal, one would expect the separation rate of older workers in shipbuilding to have risen after 1965. It is also of interest that young workers earned more than their counterparts in construction and durable goods in 1965 and 1970. However, since they could expect to earn about as much as elsewhere in 1965, i.e., in construction and manufacturing as they grew older, one would expect that the separation rate for this group would have been lower before 1965. Empirical data relating to separation rates by age will be presented in Chapter VIII.

E. Policy Implications and Conclusions

In this chapter, wage rates and annual earnings in shipbuilding were compared with those in other industries. Since the mid-1960s hourly wage rates in shipbuilding have risen less rapidly than in construction, other transportation equipment industries, manufacturing, and the private nonagricultural sector considered as a whole. This decline in the relative wage in shipbuilding implies that shipbuilding has become increasingly noncompetitive in attracting labor.

When hourly wage rates in specific occupations and labor markets are compared for shipbuilding and its closest competitor in terms of similarity of occupational mix, i.e., construction, the wage disparities become even more apparent.

Compounding the problem of lower hourly wage rates is the fact that the wage-experience differentials among occupations are very narrow in shipbuilding when contrasted with that in both union and nonunion contract construction and age-earnings differentials for craftsmen in the economy as a whole. Not only are the wage-experience differentials narrow in shipbuilding, but the differentials also fail to reflect differences in investment in human capital among occupations. In both

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union and nonunion contract construction, wage rates increase more rapidly with experience for occupations requiring lengthy training, e.g., electricians and pipefitters, than in shipbuilding. In the latter industry, wage rates rise negligibly in these occupations as a function of experience. The expected difficulty of retaining workers in these highly skilled occupations implies that productivity is undoubtedly adversely affected by the inverted structure of wages in the industry.

Because construction is characterized by seasonal fluctuations in demand, annual earnings in shipbuilding may be larger than in construction despite the construction industry's higher wage rates. If such is the case, it is uncertain that all workers would prefer construction over shipbuilding. Workers that have a preference for high annual earnings might prefer work in shipbuilding despite the low wage rate prevailing in the industry. On the other hand, workers with a high leisure preference might prefer to work in construction because wage rates are higher and the possibilities for leisure greater. Looking at annual earnings, it was found that annual earnings in shipbuilding have been larger than those in construction, but the differential narrowed after the mid-1960s. In fact, in 1970 annual earnings in shipbuilding and construction were nearly identical. Thus workers could secure nearly the same earnings, yet obtain more leisure in construction.

Although average annual earnings were not very different in the two industries, this does not appear to be true for several occupations vital to shipbuilding, i.e., electricians, plumbers and pipefitters, and welders receive higher yearly earnings in construction. Thus, with higher wage rates and possibly higher yearly earnings in these occupations in construction, workers in these occupations would most likely prefer construction to shipbuilding. It is these occupations commonly cited by management as being in short supply at shipyards.

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The findings pertaining to experience and earnings are found to be consistent with data pertaining to earnings as a function of age. In 1970, annual earnings of workers under 25 years of age in shipbuilding were found to be higher than that received by the same aged workers in both construction and durable goods manufacturing industries and competitive with other transportation equipment industries. However, as age (and experience) increase, annual earnings received in shipbuilding decline relative to what the same age workers receive in construction, durable goods industries, and other transportation equipment industries. In fact, in 1970 workers aged 35-44 and 45-54 earned more in these industries than workers in shipbuilding. Because of this inverted earnings-age profile in shipbuilding, other things equal, one would expect shipbuilding to encounter little difficulty attracting untrained workers, but to have difficulty keeping workers after training. Were this inversion to be corrected, it might be possible to reduce ship production costs through reduced training costs and increased labor productivity. It should be noted that higher wage payments to experienced workers could be financed, in part, by limiting wage rate increases for younger workers, thereby bringing their earnings more in line with what could be earned by this group in other industries.⁷⁵ However, before implementing this suggestion it would be desirable to look at more recent data, say for the 1970-75 period, to determine if the earnings and turnover relationships noted in this and the following chapters still prevail.

⁷⁵As a step toward this direction, the wage adjustment among older and younger workers might be linked in such a manner that the total wage bill remain unchanged.

CHAPTER VII

SHORT-RUN MEASURES OF INDUSTRY TURNOVER

Several characteristics of the shipbuilding labor force noted in the previous chapters suggest that the industry is subject to higher than average turnover rates. First, a high rate of accessions and separations are expected because of fluctuating work loads. When work loads diminish, layoffs increase. Conversely, when production picks up, labor is rehired. The instability of employment also impacts on voluntary quits; the more unstable is employment in an industry, the more likely are voluntary quits to occur. Second, voluntary quits are negatively related to the level of wage rates and earnings. As these have tended to diminish in recent years relative to other industries, one would expect to find that the voluntary quit rate has risen over time. Assuming relatively stable employment, new hires would also rise over time as workers who quit are replaced. In the first section of this chapter, monthly turnover rates are examined to see if these expectations are borne out.

The second section of the chapter is devoted to another aspect of short-run employment behavior, namely, seasonal variations in turnover. One implication of the quote, cited in the previous chapter, from the Seapower Subcommittee of the Committee on Armed Services, is that shipbuilding is a captive industry of construction. This suggests that voluntary quits may rise in shipbuilding during the summer when construction activity is at its seasonal peak. If employment levels are to be maintained, new hires must also rise. While voluntary quits would increase in the summer, they would fall off in the winter when construction activity slows. The long-term separation rate may, however, be uni-directional, i.e., may not reverse as long as wage rates

in shipbuilding decline relative to wage rates in other industries. This aspect of turnover is deferred until the next chapter.

A. Short-run Turnover in Shipbuilding

The only source of data on short-term turnover is the monthly data compiled by the Bureau of Labor Statistics. These data are shown in Tables VII.1 and 2 for the period 1958 through 1974. They indicate separations (quits and layoffs) and accessions (new hires and rehires) per 100 workers and are computed from monthly establishment reports submitted to the Bureau of Labor Statistics. It is important to note that the rates are aggregated by industry; they are not reported by demographic group, e.g., by age and sex.

In Tables VII.1 and VII.2, the turnover rates for shipbuilding are contrasted with those for the aircraft industry and durable goods. The aircraft industry was selected for analysis because, like shipbuilding, it relies heavily on orders from the federal government. Durable goods is also shown since shipbuilding is a durable goods industry. Looking at Tables VII.1 and VII.2, the following will be noted.

Layoff rates have historically been higher in shipbuilding than in the aircraft industry or in durable goods, due primarily to the difficulty of scheduling production. For example, during the period 1958-1966, the average layoff rate in shipbuilding was four times greater than the rate in durable goods manufacturing and six times greater than the rate in the aircraft industry.

Rehire rates are also higher in shipbuilding suggesting that laid off workers generally return to work when scheduling bottlenecks are resolved. However not all workers who are laid off are available for rehire. As a result, the industry has had to hire new workers at a rate markedly in excess of the rate experienced by the aircraft and durable goods industries.

Table VII.1
Separation Rates^a for Selected Industries, 1958-1974

	<u>Total Separations</u>			<u>Quits</u>			<u>Layoffs</u>		
	<u>D</u> ^b	<u>A</u> ^c	<u>S</u> ^d	<u>D</u>	<u>A</u>	<u>S</u>	<u>D</u>	<u>A</u>	<u>S</u>
1958	4.1	2.8	12.1	.9	.9	.7	2.7	1.6	9.6
1959	4.0	3.2	11.4	1.3	1.2	1.6	2.0	1.5	9.1
1960	4.3	3.3	11.2	1.1	1.0	1.7	2.5	1.7	8.8
1961	3.9	2.6	10.8	1.0	.9	1.6	2.2	1.3	8.6
1962	3.8	2.5	10.2	1.2	1.1	1.6	1.9	1.0	7.9
1963	3.6	2.5	10.6	1.2	1.0	1.6	1.7	1.1	8.2
1964	3.6	2.6	10.2	1.3	.9	1.8	1.5	1.2	7.7
1965	3.8	2.3	9.0	1.7	1.1	2.2	1.2	.7	5.8
1966	4.4	2.6	8.9	2.4	1.6	2.9	1.0	.3	4.8
1967	4.3	2.7	8.9	2.1	1.6	2.4	1.3	.5	5.4
1968	4.4	2.7	8.6	2.2	1.5	2.7	1.1	.7	4.6
1969	4.6	2.8	8.0	2.5	1.3	3.0	1.1	1.0	3.6
1970	4.7	3.5	8.1	1.8	.8	2.2	2.0	2.2	4.6
1971	3.9	3.0	8.6	1.5	.6	2.0	1.6	1.9	5.3
1972	3.7	2.0	7.8	1.9	.7	2.1	1.0	.9	4.2
1973	4.1	2.1	7.5	2.4	.9	2.7	.7	.7	3.3
1974	4.5	1.9	6.5	2.1	.8	2.6	1.5	.5	2.2

^aAnnual averages of monthly separations per 100 employees.

^bDurable goods industries

^cAircraft

^dShipbuilding

Source: U.S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings Statistics for the United States, 1909-74, Bulletin 1312-10 (Preliminary), 1975.

Table VII.2

Accession Rates^a for Selected Industries, 1958-1974

	<u>Total Accessions</u>			<u>New Hires</u>			<u>Rehires</u>		
	<u>D</u> ^b	<u>A</u> ^c	<u>S</u> ^d	<u>D</u>	<u>A</u>	<u>S</u>	<u>D</u>	<u>A</u>	<u>S</u>
1958	3.5	2.4	11.6	1.5	1.4	3.6	2.0	1.0	8.0
1959	4.2	2.3	11.1	2.5	1.5	3.0	1.7	.8	8.1
1960	3.5	2.4	11.4	1.9	1.4	3.6	1.6	1.0	7.8
1961	3.9	2.8	10.5	1.9	1.7	3.3	2.0	1.1	7.2
1962	3.8	2.9	10.3	2.3	2.1	3.2	1.5	.8	7.1
1963	3.6	2.4	9.7	2.1	1.7	3.6	1.5	.7	6.1
1964	3.7	2.1	11.5	2.4	1.4	4.8	1.3	.7	6.7
1965	4.1	3.2	9.8	3.0	2.5	5.1	1.1	.7	4.7
1966	4.8	4.2	8.9	3.8	3.6	5.0	1.0	.6	3.9
1967	4.1	3.1	8.6	3.0	2.6	4.6	1.1	.5	4.0
1968	4.3	2.3	9.1	3.2	1.8	4.9	1.1	.5	4.2
1969	4.4	2.0	8.3	3.4	1.4	5.0	1.0	.6	3.3
1970	3.5	1.4	7.3	2.3	.7	3.7	1.2	.7	3.6
1971	3.5	1.7	8.6	2.2	.7	3.9	1.3	1.0	4.7
1972	4.1	2.0	9.0	3.0	1.0	3.9	1.1	1.0	5.2
1973	4.4	2.3	8.3	3.6	1.5	4.8	.8	.8	3.5
1974	3.8	2.1	7.3	2.9	1.5	4.9	.9	.6	2.4

^a Annual averages of monthly accessions per 100 employees.

^b Durable goods industries

^c Aircraft

^d Shipbuilding and repairing.

Source: U.S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings Statistics for the United States, 1909-74, Bulletin 1312-10 (Preliminary), 1975.

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The most notable changes in turnover during the period have been the substantial decline in the layoff rate and the attendant substantial decline in the rehire rate. While the layoff rate in shipbuilding averaged 7.8 percent during 1958-1966, it fell to an average of 4.2 percent during 1967-1974. Similarly, the average rehire rate in the earlier period was about 70 percent higher than in the later period. These data do not by themselves indicate why the layoff rate has fallen so dramatically within the last two decades. One explanation may be that production scheduling has improved. Another may be that the industry is doing more repair work and, as a result, is better able to stabilize employment. Neither of these hypotheses can be verified by the data of this study.

One also notices from Table VII.1 that although the short-run turnover rate has been reduced in recent years, there is a discernible rise in the quit rate. This may reflect the rise in the percentage of younger workers in industry generally, due to the entrance into the labor market of workers born during the post-World War II baby boom. It may, however, also reflect the decline in shipbuilding wages relative to other industries.

B. Seasonal Variations in Shipbuilding Employment

Given the similarity of skills and that wage rates are significantly higher in construction than in shipbuilding, it might be expected that seasonal fluctuations in the demand for labor in the former would be mirrored by corresponding changes in the level of employment in the latter.

One way of assessing whether this is the case is to look at seasonal variations in shipbuilding employment and turnover. If shipbuilding is a captive of the construction industry, employment levels would diminish during the summer months and increase during the winter months. To compensate for rising voluntary quits during the summer season, layoffs should decline and new hires should rise.

To test the hypothesis regarding employment levels, monthly data on employment were divided by yearly averages to obtain a rough index of seasonal variation. The monthly ratios were then averaged over two equal time periods, 1947-1960 and 1961-1974. It is seen from Table VII.3A that construction employment is 6 to 12 percent above average during the months of June - October. No decline in employment, however, occurs in shipbuilding during these months. It may be, of course, that shipbuilding as well as construction activity picks up during the summer. It is also possible that voluntary quits rise but employment levels are maintained by reducing layoffs and increasing accessions. This possibility is examined in Table VII.3B where data are presented for the period 1958-1974.

In Table VII.3B, durable goods is used as a control since fluctuations in shipbuilding turnover can be due to other factors besides demand conditions in construction. If seasonal variations in shipbuilding turnover are larger than those experienced by durable goods industries, this would constitute evidence for the proposition that mobility into and out of shipbuilding ebbs and flows with short-run changes in demand for construction labor. From Table VII.3B, it is seen that the monthly quit rate index in shipbuilding is above average for the summer months, but it is not much higher than that for durable goods. Likewise, new hires are above the yearly average during the summer months, but again, no more so than in durable goods. Only with respect to layoffs is there any indication that shipbuilding turnover differs from durable goods turnover during the summer months; layoffs do tend to diminish somewhat in the former while no discernible trend is apparent in the latter. This decline in layoffs may reflect conservation of labor in response to increased building activity; however, it may also reflect increased shipbuilding activity, itself,

Table VII.3a

Ratio of Monthly Employment to Annual Average Employment,
Production and Nonsupervisory Workers,
Shipbuilding^a and Construction,
1947-1960 and 1961-1974

	<u>Jan.</u>	<u>Feb.</u>	<u>Mar.</u>	<u>Apr.</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sept.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>
Shipbuilding ^a												
1947-1960	1.02	1.02	1.02	1.01	1.02	1.02	.99	.98	.97	.97	.99	.99
1961-1974	.99	1.00	1.00	1.00	1.00	1.00	.98	1.00	.99	1.01	1.00	1.00
Construction												
1947-1960	0.87	0.84	0.87	0.94	1.00	1.06	1.09	1.12	1.11	1.09	1.05	0.97
1961-1974	0.86	0.85	0.88	0.95	1.00	1.07	1.10	1.12	1.09	1.08	1.05	0.97

Table VII.3b

Ratio of Monthly Turnover Rates to Annual Average
Turnover Rates, Shipbuilding^a and Durable Goods
1958-1974

	<u>Jan.</u>	<u>Feb.</u>	<u>Mar.</u>	<u>Apr.</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sept.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>
Shipbuilding ^a												
Quits	0.82	0.78	0.95	1.04	1.07	1.07	1.05	1.32	1.43	1.05	0.77	0.67
Layoffs	0.99	1.05	1.15	1.08	1.11	1.06	0.95	0.97	0.91	1.02	0.96	0.93
New Hires	0.99	0.87	0.97	1.01	1.02	1.23	1.10	1.11	1.05	1.09	0.82	0.69
Durable Goods												
Quits	0.87	0.74	0.89	0.93	0.99	1.00	0.98	1.48	1.58	1.11	0.81	0.63
Layoffs	1.20	0.96	0.89	0.77	0.76	0.82	1.37	1.03	0.82	1.04	1.09	1.23
New Hires	0.88	0.83	0.85	0.95	1.06	1.37	1.02	1.23	1.27	1.10	0.81	0.61

^aIncludes repairing.

Sources: U.S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings Statistics for the United States, 1909-1974. Bulletin 1312-10 (Preliminary), 1975 and Employment and Earnings Statistics, monthly publications, 1972, 1973, and 1974.

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during the summer months. Moreover, as noted in the preceding chapter, the supposition that workers in shipbuilding leave for construction work when it is available is based on the premise that construction pays better than shipbuilding. This premise is true when hourly wages are considered, but it is much less true when annual earnings are considered. The relatively stable turnover pattern, when viewed against durable goods, may be due to worker preferences for stable employment rather than a higher wage rate in the short run. In the long run, however, relative wages may be more important.

C. Policy Implications and Conclusions

In this chapter, short-run turnover data for the shipbuilding industry and related industries were examined. The most important finding in the first section is that very significant improvements have been made in reducing short-term fluctuation in the work force. Both layoff rates and rehires were reduced by about one-half over almost a two decade period. While the explanation for the decline is not self evident, one likely outcome of this trend is that short-term worker productivity is increasing in shipbuilding.

A second important finding is that short-run variations in construction, i.e., those relating to seasonal changes in the demand for labor, do not appear to have a disruptive impact on the shipbuilding labor market. Contrary to the seasonal pattern for construction, employment levels in shipbuilding do not vary by much from month-to-month. Nor do quit and new hire rates vary significantly more than they do in durable goods, where the seasonal demand for labor would be expected to be independent of construction activity. This is not to say that turnover is not a problem in shipbuilding. While the industry appears to be experiencing difficulty retaining workers over the long run, this difficulty appears to be diminishing in the short run.

CHAPTER VIII

LONG-RUN TURNOVER IN THE SHIPBUILDING INDUSTRY

The analysis of the last chapter indicates that substantial reductions in short-run turnover have been achieved in shipbuilding. In this chapter another aspect of turnover is examined, namely, long-term turnover. By long-term, we mean turnover during a five- or ten-year period. It might be thought that long-term and short-term turnover rates will move in the same direction, but this is not so as they reflect different influences. For example, short-term turnover could be declining as a result of improved production scheduling while long-term turnover is increasing, say, because relative wage rates are declining.

Except where noted, the long-term turnover rates of this chapter are defined as follows: The accession rate is the percent of workers in an industry in a given year who were not in the same industry five years earlier. The separation rate is the percentage of workers in an industry in a base year who were not in the industry five years later; one minus the separation rate is defined as the stayer rate. The separation rate is not synonymous with the voluntary quit rate; both layoffs and quits will be reflected by the separation rate.

The long run separation rate used in this chapter represents separations from the given industry, and not separations from establishments within a given industry as in (short-run) Bureau of Labor Statistics data (see Chapter VII). In this chapter, a worker is counted as a separation from an industry if he has no earnings in that industry in the first quarter of the year under consideration, or if he does, those earnings are less than that of his current (different) industry. Similarly, if a worker was laid off but still received earnings from the

industry in the first quarter of the current year, he will not be counted as a separation in the current year. Furthermore, workers who leave one firm in a given industry and accept positions in another firm in that same industry will not be counted as separations since they did not exit the industry. Finally, since we are considering separations over a five year period, workers who leave the industry during the five year period and later return to that industry during the same period are not counted as separations from that industry.⁷⁶

The long-term turnover rates examined in this chapter are derived from the Social Security Continuous Work History Sample. As this sample contains information on individual workers, it can be used to compute turnover rates for subgroups of an industry's work force; in particular, separation rates can be computed by age and earnings.

In the first section of this chapter, long-run accession and separation rates for shipbuilding and related industries are examined for the period 1960-1965 and 1965-1970. In the second section, accession and separation rates are looked at for different age groups. By looking at age-specific data, it should be possible to determine the effect of the inversion in shipbuilding earnings, noted in the previous chapter, on turnover. In the third section, stayer rates by age and earnings are examined; also examined is the relationship between the stayer rate and job tenure. The last section contains conclusions and policy implications.

⁷⁶ Similarly, workers who left the industry but were not employed in the base year are not counted in the separation rate calculation.

A. Long-term Accessions and Separations
in Shipbuilding

Data from the Continuous Work History Sample were used to compute accession and separation rates during 1960-1965 and 1965-1970 for shipbuilding and related industries. These rates are shown in Table VIII.1. It will be recalled from Chapter VI that wage rates in shipbuilding relative to wage rates in other industries diminished in the late 1960s. The expected effect of the decline in relative wage rates on worker losses is consistent with the data presented in Table VIII.1. Separations from shipbuilding increased between 1960-1965 and 1965-1970 from a rate of 46.8 per 100 workers to 53.9 per 100 workers. This is in sharp contrast with the other industries shown (except for motor vehicles) where the long-term separation rate either fell or rose only slightly. In particular, whereas the separation rate in shipbuilding was less than that in construction during 1960-1965, the former exceeded the latter during 1965-1970. Concomitantly, the accession rate in shipbuilding also rose between 1960-1965 and 1965-1970, from 51.6 to 56.1 per 100 workers due to the need to replace lost workers. These data indicate that even though short-run turnover was reduced in the industry, i.e., even though a smaller fraction of workers were being laid off for short periods of time and then recalled, an increasingly larger proportion of workers have been leaving the industry.

B. Long-term Accessions and
Separations by Age

In 1970 young, inexperienced workers (those under 25 years) were paid more in shipbuilding than their counterparts in construction and durable manufacturing. However, older, experienced workers in shipbuilding earned less than workers of the same age in these industries. Moreover, the relative earnings of older workers in shipbuilding declined between 1960-1965 and 1965-1970. As a result of these changes in relative earnings, one would expect not only that separation rates of older males in shipbuilding would be higher than for similar workers in related industries during 1965-1970, but that they have risen between

Table VIII.1

Turnover Rates, 1960-1965 and 1965-1970:
Male Workers in Selected Industries

	<u>Separation rate^a</u>	<u>Accession rate^a</u>
<u>1960-1965</u>		
Construction	47.9	54.9
Manufacturing ^b	54.8	56.3
Durable Manufacturing ^b	56.8	58.6
Motor Vehicles	35.3	45.1
Aircraft	46.4	42.7
Shipbuilding ^c	46.8	51.6
Railroad Equipment	46.3	58.0
<u>1965-1970</u>		
Construction	47.7	51.6
Manufacturing ^b	56.7	60.3
Durable Manufacturing ^b	58.0	62.0
Motor Vehicles	42.3	43.5
Aircraft	38.7	43.3
Shipbuilding ^c	53.9	56.1
Railroad Equipment	44.5	50.2

^aPer 100 workers.

^bAverage for four digit SIC industries.

^cIncludes repairing.

Source: Social Security Administration Continuous Work History Sample.

1960-1965 and 1965-1970. On the other hand, since the earnings of younger workers were higher in shipbuilding than in construction and durable manufacturing, one might expect the separation rate for this group to be lower than in these industries.

One notices from Table VIII.2 that during the period 1960-1965, separation rates of older workers in shipbuilding were high, but they were no higher in this industry than in construction or the aircraft industry. It is also noticed that separation rates rose sharply in shipbuilding among older workers during 1965-1970 vis-a-vis 1960-1965. For example, among those age 35-44, the separation rate rose from 42.0 during the latter period to 50.1 during the former. Older worker separation rates in construction and the aircraft industry, however, remained constant or fell.

The separation rate rose also in shipbuilding among younger workers, but it also rose in other industries, undoubtedly because of the Vietnam War. It is of particular interest that while young workers in shipbuilding earned more than their counterparts in other industries, particularly construction, this did not result in lower turnover, either during 1960-1965 or 1965-1970.

The high separation rate of younger workers in shipbuilding deserves special mention. Young people often do not choose a career upon entering the labor force. They first choose a job, sometimes several in succession, before settling on a career, which may involve choice of industry as well as choice of occupation. The large body of literature which documents this behavior⁷⁷ helps explain why the turnover rate of young shipbuilding workers is so high despite their higher

⁷⁷See Michael D. Ornstein and Peter H. Rossi, "Going to Work: An Analysis of the Determinants and Consequences of Entry Into the Labor Force", The Johns Hopkins University, Center for Social Organization of Schools, Report No. 113, October 1971; Herbert S. Parnes, et al, Career Thresholds, U.S. Department of Labor, Manpower Administration, Vol. 1, 1970, Vol. 2, 1971, and Vol. 3, 1973; William H. Sewell, Archibald O. Haller and Alejandro Portes, "The Educational and Early

Table VIII.2

Accession Rates, 1965-1970, and Separation Rates,
1960-1965 and 1965-1970, Male Workers
in Selected Industries^a by Age

	Under 25	25-34	35-44	45-54	55 and over	Total
Accession Rates, ^b 1965-1970						
Construction	94.9	60.9	42.3	36.3	31.7	51.6
Manufacturing ^c	98.2	74.3	52.1	43.2	37.3	60.3
Durable Goods ^c	98.2	74.5	54.5	45.9	40.4	62.0
Motor Vehicles	95.5	57.2	31.8	21.2	17.4	43.5
Aircraft	98.8	69.4	34.3	24.5	23.8	43.3
Shipbuilding ^d	96.7	70.8	51.9	41.4	24.7	56.1
Railroad Equipment	97.5	67.5	46.7	27.0	26.3	50.2
Separation Rates, ^e 1960-1965						
Construction	60.5	44.6	40.9	43.6	61.8	47.9
Manufacturing ^c	73.7	56.1	47.6	43.9	64.9	54.8
Durable Goods ^c	78.6	58.7	50.1	46.6	67.0	56.8
Motor Vehicles	52.8	33.2	27.2	24.6	55.6	35.3
Aircraft	62.9	50.1	39.5	39.1	63.1	46.4
Shipbuilding ^d	63.9	48.5	42.0	34.0	59.3	46.8
Railroad Equipment	69.2	57.3	35.6	29.6	34.1	46.8
Separation Rates, ^f 1965-1970						
Construction	63.3	45.7	38.6	41.1	61.1	47.7
Manufacturing ^c	78.6	60.3	47.9	43.1	64.6	56.7
Durable Goods ^c	77.7	61.5	50.0	45.4	66.9	58.0
Motor Vehicles	56.4	40.7	31.0	29.4	69.8	42.3
Aircraft	64.2	47.5	30.4	25.2	56.7	38.7
Shipbuilding ^d	68.0	53.4	50.1	44.5	63.4	53.9
Railroad Equipment	75.3	46.0	37.8	23.9	53.8	44.5

^aExcludes workers in noncovered industries and government workers (principally in government naval yards).

^bThe percentage of workers in the given industry in 1970 who worked in other industries or were not in the work force in 1965. Age as of 1970.

^cAverage for four digit SIC industries.

^dIncludes repairing.

^eThe percentage of workers in the given industry in 1960 who worked in other industries or were not in the work force in 1965. Age as of 1960.

^fThe percentage of workers in the given industry in 1965 who worked in other industries or were not in the work force in 1970. Age as of 1965.

Source: Social Security Administration Continuous Work History Sample.

earnings. It would appear from this literature and our findings that, other things equal, young workers are earning an unnecessary rent in shipbuilding, i.e., they are being paid more than is necessary to attract them to the industry. While it might be supposed that a lower wage rate may lead to a higher loss rate of young workers, it may be that young workers seek training opportunities rather than higher wage rates.⁷⁸ On the other hand, it appears that older workers are now being paid less than that necessary to retain them in shipbuilding.

Given the high loss of shipbuilding workers during 1965-1970, it is not surprising that accession rates are also high. What is surprising, however, is that the shipbuilding industry is hiring older workers (35-54) at a higher rate than other related industries, e.g., construction and transportation equipment. This may be due to the high cost of training inexperienced workers for craftsmen jobs. While information is lacking on the occupation of new, older entrants into the industry, it may be that they have had previous craft experience. Even so, unless that experience was in shipbuilding, some amount of training will have to be provided. The period in which such training costs can be recouped is, of course, much shorter than for younger workers. Moreover, because the time to complete a given sub-task, e.g., installation of boiler equipment, can be long in shipbuilding, repetition which gives rise to experience may only occur over an extended period of time. Thus, the hiring of older workers with craft experience, even at less than the competitive wage rate may not be efficient.⁷⁹ Because of the existing

Occupational Attainment Process", American Sociological Review, February 1969, pp. 82-92, and Lloyd V. Temme, Occupational Achievement: Some Remarks on Traditional Models and a Proposed Integration Within a New Conceptual Scheme, National Academy of Sciences, Board on Human Resources (undated).

⁷⁸ Some evidence that training rather than higher wage rates influence job choice of young people is found in the literature cited in footnote 77 of this chapter.

⁷⁹ For a discussion of the relationship between training costs and wage rates see Robert S. Goldfarb and James R. Husek, "Explaining Male-Female Wage Differentials for the Same Job", Journal of Human Resources, Winter 1976, pp. 98-109.

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wage structure in shipbuilding, it may be that shipyards find it economical to hire older workers at relatively low wages, particularly, given that turnover is less among older workers than among younger ones. On the other hand, the quality of labor available at lower than competitive wage rates may be relatively low.

Given the importance of continuous attachment to the industry, it is of some interest to determine the fraction of workers that were employed at all three dates (1960, 1965, and 1970) for which data are available. It is of equal interest to determine the fraction of workers who left the industry but later returned to it (denoted as the returnee rate), i.e., the fraction of workers who left shipbuilding between 1960 and 1965 but returned between 1965 and 1970. One might suspect that the lower the former fraction, the higher the latter one, e.g., if all workers were attached to the industry at each of the three dates, the fraction of workers who left the industry but later returned to it, as defined here, would be zero. As indicated below, however, this is not necessarily true.

Data from the Continuous Work History Sample were used to compute stayer rates and returnee rates for the 10-year period 1960-1970. The results of these calculations are shown in Table VIII.3. As can be seen from this table, the 10-year stayer rate is very low in shipbuilding; for example, only one-third of the workers in shipbuilding age 35-44 in 1965 were employed in the industry in 1960, 1965, and 1970. The difficulty which the industry has been experiencing in retaining older workers is seen even more clearly by comparing the 10-year stayer rates as worker age increases. Comparing shipbuilding and motor vehicles, for example, one notes that in the former the stayer rate increases from only 25.0 to 43.6 between the age groups 18-24 and 45-54; in the latter industry, on the other hand, the stayer rate increases from 25.9 to 61.7 over the same age groups.

Another conclusion to be drawn from Table VIII.3 is that returnee rates are very low in all industries at all ages. In particular, it is low for shipbuilding, despite the fact that the 10-year stayer rates for

Table VIII.3
 Stayer and Returnee Rates, 1960-1970,
 for Male Workers in Selected
 Industries^a by Age

	Under				<u>Total</u>
	<u>25</u>	<u>25-34</u>	<u>35-44</u>	<u>45-54</u>	
	Stayer Rates ^b				
Construction	14.1	32.3	41.8	40.1	37.7
Manufacturing ^c	7.1	20.3	33.2	38.4	30.4
Durable Goods ^c	13.5	27.4	41.3	45.5	38.7
Motor Vehicles	25.9	42.4	57.9	61.7	54.5
Aircraft	7.4	28.8	43.8	49.9	42.1
Shipbuilding ^d	25.0	25.0	32.6	43.6	34.6
	Returnee Rates ^e				
Construction	13.1	15.3	19.2	16.0	16.7
Manufacturing ^c	3.0	6.3	11.8	13.3	9.9
Durable Goods ^c	2.5	5.6	8.1	9.9	7.7
Motor Vehicles	6.9	9.4	11.2	13.3	10.9
Aircraft	4.3 ^f	5.6	8.3	11.5	8.4
Shipbuilding ^d	-	5.2	9.2	11.1	8.2

^aExcludes workers in noncovered industries and government workers (principally in government naval yards).

^bPercent of workers in the given industry in 1960 who were in the same industry in 1965 and 1970. Age as of 1965.

^cAverage for four digit SIC industries.

^dIncludes repairing.

^ePercentage of workers who were in a given industry in 1960 and 1970 but not in the industry in 1965. Age as of 1965.

^fLess than 50 observations in cell.

Source: Social Security Administration Continuous Work History Sample.

the industry were also low.⁸⁰ It appears, then, that some amount of training must be provided to newly hired older workers in shipbuilding, even though they may be experienced craftsmen, since few of them appear to have had prior experience in the industry.

C. The Relationship Between the Stayer Rate, Age, Earnings, and Job Tenure

As indicated in Chapter V, voluntary quits are inversely related to both earnings and age. Quits decline with higher earnings because the economic cost of quitting increases. Quits also decline with age because the economic gains (costs) from quitting diminish (increase). In part, however, the inverse relationship between the quit rate and age is due to the fact that earnings rise with experience, and the acquisition of experience implies aging. Hence, there is an interaction effect between earnings and age on the quit rate.

In order to determine what this interaction is, stayer rates, since they are somewhat easier to visualize, were computed by level of annual earnings and age for the period 1965-1970. These rates are shown in Table VIII.4 for shipbuilding and related industries. It should be noted that at this level of detail, the number of observations in a cell was typically small. Nonetheless, the data are of some interest. For example, it is seen that the stayer rates in shipbuilding are lower for older workers of the same age and with the same earnings vis-a-vis other related industries. This is probably due to the ceiling on wage rates in shipbuilding at a level not much higher than the apprenticeship wage. It might also reflect, however, the more arduous nature of shipbuilding work.

The data in Table VIII.4 also show that stayer rates rise with both earnings and age when each variable is held constant. The stayer rates, however, appear to stabilize after a sufficiently high level of

⁸⁰ Conversely, one notes that the returnee rates in other related industries were higher than for shipbuilding even though their 10-year stayer rates were also higher.

Table VIII.4

Male Stayer Rates,^a 1965-1970: Selected Industries^b by Annual Earnings and Age

Earnings	Motor Vehicles				Aircraft				Shipbuilding				Construction			
	Less than 24	25-34	35-44	45-54	Less than 24	25-34	35-44	45-54	Less than 24	25-34	35-44	45-54	Less than 24	25-34	35-44	45-54
2,000- 3,999	22.2	22.9	42.7	- ^c	27.0	20.7	-	-	-	-	-	-	37.1	45.4	50.0	51.3
4,000- 5,999	41.6	45.9	54.9	62.9	36.7	49.5	69.4	75.9	36.4	38.8	37.8	53.1	52.5	56.2	62.0	60.3
6,000- 7,999	53.5	65.7	74.8	73.0	48.9	54.9	72.3	78.5	-	48.8	50.0	56.3	45.2	65.7	68.2	68.0
8,000- 9,999	70.8	73.6	76.2	76.7	-	57.2	68.6	75.9	-	-	-	71.7	66.0	74.6	77.1	77.1
10,000-11,999	-	66.2	67.1	73.9	-	57.6	70.9	77.6	-	-	-	-	-	75.2	77.5	76.0
12,000-14,999	-	72.0	74.8	76.9	-	56.2	72.8	73.3	-	-	-	-	-	71.2	76.9	72.8
15,000-24,999	-	-	70.6	69.0	-	-	70.1	68.3	-	-	-	-	-	-	78.9	81.9

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^aThe percentage of workers in a given industry in 1965 who were in the same industry in 1970. Age as of 1965.

^bExcludes workers in noncovered industries and government workers (principally in government naval yards).

^cLess than 50 observations per cell.

Source: Social Security Administration Continuous Work History Sample.

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earnings is attained, i.e., above \$8,000. One notices that stayer rates around .70 - .75 are characteristic of both the 35-44 and 45-54 age groups at this level of earnings. One might also expect the stayer rates to stabilize with age, even at low earnings levels (in this case, under \$8,000). Except in construction, however, no strong tendency is apparent. Of particular importance for the discussion at hand, it appears that sufficiently high earnings attained at around age 35 tend to "lock" workers into an industry. Thus, if workers can be induced to remain in an industry till they reach age 35, the likelihood of their staying throughout the remainder of their work life appears to be considerably enhanced.

The supposition that the stayer rate is positively related to the time spent in an industry, as well as earnings and age, is intuitively reasonable. All other things being equal, the more time spent in an industry, the less time is available for gaining experience in another industry. The cost of transfer is particularly large if the experience gained in the given industry cannot easily be shifted to another industry.

Since our Continuous Work History Sample data cover the years 1960, 1965, and 1970, they can be used to determine the impact of industry tenure on the stayer rate. This information is summarized in Table VIII.5. In this table, stayer rates are shown for three groups of workers. Individuals in each group worked in construction (or durable goods) in 1965.⁸¹ What distinguishes the groups is their status in 1960. The first group contains individuals age 18-24 who had no earnings in covered employment in 1960; presumably, the vast majority of these workers were not in the work force at this date. The second and third groups both had earnings in 1960; for these groups, stayer rates are shown for several age categories. The second group was employed in the given industry in

⁸¹The industries shown in Table VIII.5 are restricted to construction and durable goods; data for shipbuilding, aircraft, and motor vehicles are not provided because only a small number of cells had more than 50 observations for these industries.

Table VIII.5

Stayer Rates,^a 1965-1970, for Male Workers in Selected Industries by Annual Earnings, Age, and Length of Tenure in Industry

Earnings	New Entrants ^b	Prior Work Experience But Not in Given Industry ^c				Prior Work Experience in Given Industry ^d		
		18-24	25-34	35-44	45-54	25-34	35-44	45-54
		<u>Construction</u>						
2,000- 3,999	36.4	38.5	42.6	42.1	47.0	55.4	59.6	56.1
4,000- 5,999	51.5	54.5	49.7	56.1	53.6	63.6	69.4	66.1
6,000- 7,999	56.6	-	63.3	63.6	56.5	70.3	74.2	74.0
8,000- 9,999	- ^e	-	73.1	66.8	74.8	80.0	81.5	78.9
10,000-11,999	-	-	-	67.5	-	81.9	81.4	79.3
12,000-14,999	-	-	-	67.2	-	-	83.5	77.7
15,000-24,999	-	-	-	-	-	-	87.0	87.4
		<u>Durable Manufacturing^f</u>						
2,000- 3,999	15.4	14.9	20.7	28.1	30.6	39.1	53.3	54.1
4,000- 5,999	27.3	29.2	30.1	37.3	38.9	55.0	64.3	66.6
6,000- 7,999	38.4	35.1	36.3	25.3	38.2	63.5	70.2	72.1
8,000- 9,999	-	-	35.7	39.3	34.1	66.7	72.5	74.3
10,000-11,999	-	-	32.1	33.6	34.4	68.2	71.9	71.1
12,000-14,999	-	-	33.8	34.6	36.4	88.9	67.5	73.1
15,000-24,999	-	-	-	37.4	37.9	-	67.2	65.9

^aExcludes workers in noncovered industries and government workers.

^bPercentage of workers not in the workforce or in noncovered industries in 1960, who were in a given industry in 1965 and 1970. Age as of 1965.

^cPercentage of workers in covered employment in 1960, who were in a given industry in 1965 and 1970 but not in 1960. Age as of 1965.

^dPercentage of workers in covered employment in 1960, who were in a given industry in 1960, 1965, and 1970. Age as of 1965. Age group 18-24 is omitted because of paucity of observations.

^eLess than 50 observations in cell.

^fAverage for four digit SIC industries.

Source: Social Security Administration Continuous Work History Sample.

1965 but a different one in 1960. The third group was employed in the given industry in 1965 and also in 1960. Thus, the second group was attached to the given industry less than five years as of 1965; on the other hand, the third group was attached at least five years to the industry as of 1965.

The data are again stratified by level of annual earnings and age, as these are important parameters determining the stayer rate. As can be seen from Table VIII.5, the stayer rate for young persons, 18-24, does not seem to depend on whether or not they were in covered employment during the five years prior to 1965. That is to say, for young people, the cost of time spent on gaining experience appears to be small.

The most important observations to be drawn, however, pertains to the older age groups. As indicated in Table VIII.2, accession rates for older workers during 1965-1970 were very high in shipbuilding. In Table VIII.3, it was shown that relatively few of the accessions were returnees. It is now seen from Table VIII.5 that older workers with less than five years of industry attachment have markedly lower stayer rates than those with five years or more of industry attachment. The difference in stayer rates as a function of industry tenure, holding age and earnings constant, is particularly striking in the case of durable goods. These figures, thus, suggest that newly hired older workers are much less likely to remain in an industry than older workers who have been employed in the industry for some time. Together with the findings based on Table VIII.4, they also suggest that if the wages paid to shipbuilding workers age 25-34 were raised, higher stayer rates would likely be realized. Of course, the same wage increases would have to be provided to workers in the age group 35-44, 45-54, etc. The cost of higher wage rates for these groups could be financed by dampening the rate at which wages of younger workers rise and by savings resulting from reduced training costs and increased productivity. The exact tradeoff between these variables which would result in an improvement in the competitive position of the industry is beyond the scope of this study.

D. Conclusions and Policy Implications

In this chapter, long-run turnover rates in shipbuilding and related industries were investigated. Contrary to the reduction in short-run (monthly) turnover that has occurred in shipbuilding, long-term turnover (computed over a five-year period) had increased. Thus, while it appears that management has been able to schedule production so as to reduce monthly layoffs and rehires, the decline in the relative wage rate and annual earnings in shipbuilding after 1965 has led to increased losses of workers from the industry.

The loss rate of older workers increased more in shipbuilding between 1960-1965 and 1965-1970 than in any of the other related industries studied. This finding is consistent with the decline after 1965 in annual earnings of older shipbuilding workers vis-a-vis the earnings of similar workers in related industries. Furthermore, despite the higher earnings of young workers in shipbuilding, the loss rate was not unlike the rates for these workers in other related industries. While the increased loss of workers, especially older workers, from shipbuilding is consistent with the decline in wage rates and annual earnings vis-a-vis other industries after the mid-1960s, other factors may partially account for this increased loss. It might be, for example, that pension benefits have declined in shipbuilding vis-a-vis the benefit packages offered in other industries. However, contact with union officials indicates that this did not occur. Another possible explanation is that working conditions in the industry may have deteriorated, in turn discouraging workers from remaining in the industry. Finally, it could be argued that the expansion of the economy between 1965 and 1970 resulted in an increase in the number of alternative jobs available to shipyard workers. Both of the latter explanations remain to be validated. Even if valid, they do not preclude the likelihood that decreasing relative wages were a contributory factor to the increased losses of older workers (and possibly younger workers, as well).

To offset the loss of experienced, older workers, the industry has had to hire new workers, a large fraction of whom are also older

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workers. While newly hired older workers may have had prior shipbuilding experience, "returnee" rates calculated from the Social Security data suggest that only a small percentage of this group did, in fact, have prior shipbuilding experience.

Long-term separation rates were also examined holding both age and annual earnings constant. While the data were scanty, it was found that for a given level of earnings and age, stayer rates in shipbuilding were lower than in other related industries. This could reflect the more arduous nature of shipbuilding work vis-a-vis the automobile and aircraft industries, as well as the low wage rate paid in shipbuilding.

Finally, the effect of job tenure on the stayer rate was investigated. For construction and durable goods manufacturing (sample sizes were too small for shipbuilding to use this industry), it was found that older workers with five or more years of prior work experience in an industry had a much smaller propensity to quit than workers of similar age who had less than five years of experience. This finding is of particular importance to shipbuilding, since the data imply that a relatively large fraction of older shipbuilding workers in 1970 had less than five years of experience in the industry. These job tenure data reenforce the need for policies which will increase the percentage of workers remaining in shipbuilding after acquiring training.

The findings presented in this chapter lend further support to the implication that in order to reduce the long-run loss of older workers from shipbuilding, the wages of these older workers need to be raised to levels competitive with those paid in other related industries. Our data suggest that workers with a sufficiently high level of earnings become locked into their industry after age 35. Hence, a wage policy should be structured so as to induce workers to remain in shipbuilding at least until they reach age 35. This may be achieved by adjusting the structure of wage rates and earnings over experience and age levels without significantly changing the wage bill. As noted, higher wages for older workers can be financed by dampening the wage rate increase for

younger workers and by reduced training costs and improved productivity. Further research is required to determine the nature of this tradeoff.

While this chapter has indicated that the long-run loss rate of older workers from shipbuilding has increased after 1965, the industries to which workers have gone have not been identified. This task is undertaken in the next chapter.

CHAPTER IX

MOBILITY PATTERNS OF SHIPYARD WORKERS

The discussion in Chapter VI suggests that shipbuilding may have been losing workers to construction and durable goods manufacturing industries since the mid-1960s when wage rates and earnings in these industries began to rise relative to shipbuilding (see Tables VI.1 and VI.6). Moreover, the inversion of wage rates, which led in 1970 to older, experienced workers earning less in shipbuilding than in other industries while younger, inexperienced workers continued to earn more than they could elsewhere, implies that the losses may have been particularly severe among the former group. The long-term turnover data of the preceding chapter indicate that this has, indeed, been the case, but they do not show the industries to which shipbuilding workers, particularly older ones, have transferred.

In the first section of this chapter, we examine mobility data showing the flow of labor between shipbuilding and related industries. The second section examines the geographic mobility of shipyard workers. Conclusions and policy implications follow in the last section.

A. Interindustry Mobility
of Shipyard Workers

As noted previously, the relative wage in shipbuilding fell with respect to construction and durable goods after the mid-1960s, as did yearly earnings. While relative earnings also fell with respect to non-manufacturing industries, wage rates were still substantially higher in shipbuilding so that it remained competitive with this sector of the economy.

As shown in the last chapter, long-term separation rates from shipbuilding increased during 1965-1970 compared to 1960-1965. Did

workers leave shipbuilding for construction and durable goods manufacturing? To answer this question, the Social Security Continuous Work History Sample was used to trace interindustry flows of workers during the 1960s. These flows are shown in Table IX.1.

Before examining Table IX.1 in detail, it is useful to describe its construction. The columns (rows) indicate industries in which individuals worked at the initial (terminal) date of each quinquennial period. For example, consider the figure in the 4th column, 1st row of Table IX.1a. This figure shows that 5.1 thousand male workers who worked in shipbuilding in 1960 transferred to construction by 1965. In contrast, from Table IX.1b, it is seen that during 1965-1970 8.8 thousand workers transferred from shipbuilding to construction. As expected, the outflow of workers to construction increased between the two periods. Likewise, by looking at the 1st column, 4th row of Tables IX.1a and 1b, it is seen that the outflow of workers from construction to shipbuilding decreased from 5.7 to 5.2 thousand between 1960-1965 and 1965-1970. The other entries in these two tables are interpreted in a similar manner.

Tables IX.1a and 1b can be looked at in another way that simplifies their interpretation. By comparing outflows from shipbuilding and inflows into shipbuilding, one can compute a net flow figure. For example, during 1960-1965, there was a net inflow to shipbuilding from construction of 600 workers (5,100 outflow from shipbuilding - 5,700 inflow to shipbuilding). This can be contrasted with a net outflow from shipbuilding to construction of 3,600 workers (8,800 outflow from shipbuilding--5,200 inflow to shipbuilding) between 1965-1970. These net figures and similar figures for other industries are shown in the first column of Tables IX.2a and IX.2b. One also notices from the first column of these tables that shipbuilding gained 900 workers (net) from durable goods manufacturing during 1960-1965, but it lost 1,500 workers (net) to this sector during 1965-1970. To offset these changes, shipbuilding attracted 1,300 more workers (10,200-8,900) from industries other than construction and manufacturing during 1965-1970 vis-a-vis

Table IX.1a
Flows of Male Workers^a Between Selected Industries
During 1960-1965

1960

	<u>Construction</u>	<u>Durable^b Manufacturing</u>	<u>Non-durable Manufacturing</u>	<u>Shipbuilding^c</u>	<u>Other Industries^d</u>	<u>Outside Labor Force^e</u>	<u>All Sources</u>
<u>1965</u>							
Construction	1,388.0	176.7	78.4	5.1	580.7	850.4	3,079.3
Durable							
Manufacturing ^b	130.5	5,488.4	240.2	10.9	1,147.1	1,536.1	8,553.2
Non-durable							
Manufacturing	56.4	219.1	2,923.0	2.2	713.4	943.5	4,857.6
Shipbuilding ^c	5.7	11.8	3.7	65.2	22.8	25.6	134.8
Other Industries ^d	407.2	953.4	722.3	13.9	13,334.3	7,008.9	22,440.0
Outside Labor							
Force ^e	676.9	1,320.5	800.6	25.3	4,320.2	11,703.7	18,847.2
All Sources	2,664.7	8,169.9	4,768.2	122.6	20,118.5	22,068.2	57,912.1

^aIn thousands.

^bExcludes shipbuilding and repairing.

^cIncludes repairing.

^dAll other industries besides construction and manufacturing.

^eOr not working in covered industries.

Source: Social Security Administration Continuous Work History Sample.

Table IX.1b
Flows of Male Workers^a Between Selected Industries
During 1965-1970

1965

	<u>Construction</u>	<u>Durable Manufacturing</u> ^b	<u>Non-durable Manufacturing</u>	<u>Shipbuilding</u> ^c	<u>Other Industries</u> ^d	<u>Outside Labor Force</u> ^e	<u>All Sources</u>
<u>1970</u>							
Construction	1,608.5	199.1	100.4	8.8	582.9	846.7	3,346.4
Durable Manufacturing ^b	171.3	5,565.8	341.0	15.6	1,527.9	1,875.7	9,497.3
Non-durable Manufacturing	75.4	274.1	2,802.1	3.0	889.4	1,197.0	5,241.0
Shipbuilding ^c	5.2	14.1	4.5	62.0	26.7	30.1	142.6
Other Industries ^d	489.0	1,163.2	808.3	16.5	14,709.9	9,312.4	26,499.3
Outside Labor Force ^e	729.9	1,336.9	801.3	28.9	4,703.2	5,585.3	13,185.5
All Sources	3,079.3	8,553.2	4,857.6	134.8	2,244.0	18,847.2	57,912.1

^aIn thousands.

^bExcludes shipbuilding and repairing.

^cIncludes repairing.

^dAll other industries besides construction and manufacturing.

^eOr not working in covered industries.

Source: Social Security Administration Continuous Work History Sample.

1960-1965. It is not unlikely that training costs are higher for these workers than for workers coming from construction and durable goods manufacturing where the production tasks and working environment are more similar to those in shipbuilding.

As just noted, the shipbuilding industry lost workers to construction and durable goods manufacturing. To determine which age groups the losses occurred in, the figures in the first column of Tables IX.2a and 2b were disaggregated. When the data are classified by age, several distinct patterns are noticed. Between the two quinquennial periods (a) net gains of older workers by shipbuilding from construction were converted into net losses; where there were net losses to begin with, they were increased, (b) with few exceptions net gains of older workers by shipbuilding from durable goods manufacturing and other manufacturing industries were sharply reduced or converted into losses, and (c) to compensate for the loss of older workers, net gains of younger workers from other industries increased. From these data it appears that during 1965-1970 older experienced workers began to view the industry as increasingly less attractive and to view employment in construction and durable goods industries as increasingly more attractive. The explanation for this change in outlook has been offered earlier; namely, that prior to 1965 earnings of older males in shipbuilding were competitive with those in other industries, but after 1965 older males could earn more by transferring out of the industry.⁸² While losses of young workers are common, the most important change in the industry in recent years has been the increase in losses among older, experienced workers.

⁸²The large loss of older shipbuilding workers (over 55 years) from the labor force during the 1965-1970 period may reflect normal retirements. In 1970, nearly 14,000 private shipbuilding and boatbuilding workers were 60 years of age. U.S. Department of Commerce, Bureau of the Census, U.S. Census of Population: 1970, Industry Characteristics, PC(2)-73, 1973, Table 34.

Table IX.2b

Net Gains and Losses of Male Workers:
Shipbuilding and Repairing Industry

1965-1970

All Males^a

Industry	All Males ^a		Males 18-24 Years in 1965		Males 25-34 Years in 1965	
	Net Gain From	Net Loss To	Net Gain From	Net Loss To	Net Gain From	Net Loss To
Construction		3,600		200		1,300
Durable Manufacturing ^b		1,500		200	300	
Non-durable Manufacturing	1,500		500		600	
Other Industries ^c	10,200		6,900			100
Outside Labor Force	1,200		6,300		900	

Males 35-44 Years in 1965

Industry	Males 35-44 Years in 1965		Males 45-54 Years in 1965	
	Net Gain From	Net Loss To	Net Gain From	Net Loss To
Construction		700		700
Durable Manufacturing ^b	400			1,200
Non-durable Manufacturing	200		300	
Other Industries ^c	1,900		100	
Outside Labor Force		1,200		5,300

Males 55 and Over in 1965

Industry	Males 55 and Over in 1965	
	Net Gain From	Net Loss To
Construction		800
Durable Manufacturing ^b		800
Non-durable Manufacturing		200
Other Industries ^c		700
Outside Labor Force		11,400

^aIncludes workers age 16-17.^bExcludes shipbuilding and repairing.^cAll other industries besides construction and manufacturing.

Source: Social Security Administration Continuous Work History Sample.

B. Geographical Mobility
of Shipyard Workers

Like interindustry mobility, geographical mobility has important implications for labor productivity. A firm in an industry with little worker attachment must rely on attracting workers from its own and other industries when demand increases. To the extent that it can draw workers from its own industry, training costs and productivity losses will be minimized. In the case of a shipbuilding firm, this often means attracting shipbuilding workers from labor markets in a state different from the one in which it is located, since most states (if they contain a shipyard at all) have only one or two.

One immediate question that comes to mind, therefore, is the extent to which geographic mobility is characteristic of shipyard workers. A second question is also of interest, namely, given that a shipyard worker relocates, say, in another state, what is the likelihood of his remaining in shipbuilding. It may be that while migration of shipbuilding workers is limited, when they do migrate they remain in shipbuilding.

To gain insight into the geographical mobility of shipbuilding workers, data from the 1970 Public Use Sample were utilized. For this analysis, mobility is defined in terms of whether a worker changed his state of residence between 1965 and 1970. The sample was limited to workers meeting both of the following conditions: (a) they were employed in both 1965 and 1970, and (b) they were employed in shipbuilding (or the aircraft industry) in 1965 or 1970.⁸³ Workers in either industry in 1965 who changed state of residence between the two dates were then identified; workers in this group were classified on the basis of whether they remained in the same industry in 1970. The counts of workers obtained are shown in the top portion of Table IX.3. A second calculation was also performed. Workers in either industry in 1970 were

⁸³The geographical mobility of aircraft workers are examined to provide a control group. Aircraft, like shipbuilding, is located in a small number of labor markets.

Table IX.3
 Geographical Mobility of Workers:
 Shipbuilding^a and Aircraft,
 1965-1970

	<u>Shipbuilding</u>	<u>Aircraft</u>
A. (1) Employed in 1965 in industry	211,600	602,700
(2) Moved to another state between 1965 and 1970	19,200	56,500
2a) In the same industry in 1970	6,900	27,200
2b) In a different industry in 1970	12,300	29,300
(3) = $\frac{(2)}{(1)} \times 100$ Percent of workers who moved to another state	9.1	9.4
(4) = $\frac{(2a)}{(2)} \times 100$ Percent of movers who stayed in the same industry	35.9	48.1
B. (1) Employed in 1970 in industry	230,800	660,700
(2) Moved from another state between 1965 and 1970	22,600	69,300
2a) In the same industry in 1965	6,900	27,200
2b) In a different industry in 1965	15,700	42,100
(3) = $\frac{(2)}{(1)} \times 100$ Percent of workers who came from another state	9.8	10.5
(4) = $\frac{(2a)}{(2)} \times 100$ Percent of movers who had been in the same industry	30.5	39.2

^aIncludes boatbuilding and repairing.

Source: U.S. Department of Commerce, Bureau of the Census, 1970 Public Use Sample.

grouped according to whether they changed their state of residence between 1965 and 1970; workers who did change their state of residence were further subdivided on the basis of whether they had been in the same industry in 1965. These counts are shown in the bottom portion of Table IX.3.

The first point to be noticed from Table IX.3 is that interstate mobility of shipbuilding workers is small in absolute terms. Approximately 10 percent of the industry's work force appears to have changed state of residence during the period 1965-1970. Second, the bulk of shipbuilding workers who do change state of residence do not remain in (or come from) the industry. Among workers employed in shipbuilding in 1965 who changed their state of residence only 36 percent remained in the industry in 1970. The comparable figure for aircraft workers was 48 percent. Similarly, among workers employed in shipbuilding in 1970 who resided in another state in 1965, only 31 percent had been in shipbuilding in 1965. The comparable figure for the aircraft industry was 39 percent. These figures suggest that there is not much interstate movement among workers, and when shipbuilding workers do move, the bulk of them do not stay in the industry.

It should be noted that these findings are based on a small sample of observations. Nonetheless, given recent trends in relative wage rates, one is not overly surprised by the results.

C. Conclusion and Policy Implications

The purpose of this chapter was to investigate mobility patterns of shipbuilding workers among industries and over geographic space. In Chapter VI it is indicated that shipbuilding became less competitive with construction and durable goods manufacturing during the mid-1960s, and that this was particularly true for older, experienced workers. The findings of this chapter confirm that between 1965-1970 shipbuilding did lose workers to construction and durable goods manufacturing vis-a-vis 1960-1965. Moreover, these losses were concentrated among

older, experienced workers. Other things equal, unless earnings of this group are increased to more competitive levels with those received in other industries, the losses would be expected to continue.

The second section of this chapter dealt briefly with the mobility of shipyard workers among labor markets. It was found that only a small fraction of workers employed in shipbuilding in 1965 (1970) resided in another state in 1970 (1965). Of those who did change state of residence, the bulk did not stay (or had not been) in the industry. Based on these findings, it would appear that shipyards undergoing rapid expansion, particularly those in a small labor market, may have difficulty drawing workers from labor markets in other states and, hence, may face long-term shortages of workers. Additionally, one can also infer that the closing of a shipyard is likely to result in the permanent loss of workers to the industry. Evidence supporting the latter conclusion, based on the closing of a naval shipyard, was provided in Chapter II.

CHAPTER X

CONCLUSIONS

Despite its smallness in terms of employment, the United States shipbuilding industry is an important sector of the economy, for its output, which includes naval vessels, is argued to be important to national security. The industry has difficulty in competing in the world market with lower cost, foreign mechanized yards. As a consequence, the industry is protected through construction subsidies and other government financial aids. Such subsidization can insulate the industry from the competitive pressures of the world market and may provide a basis for institutionalizing outdated production processes. It must be remembered, however, that modernization of the production process in foreign countries has been accompanied by governmental assistance, much more so than has occurred in this country.

As indicated in Chapter II, labor receives about 77 percent of value added in shipbuilding. The percentage of value added going to labor is higher for shipbuilding than for other transportation equipment industries. Whereas the share of value added received by labor decreased during 1958-1972 in industries such as aircraft and railroad equipment, the share received by labor in the shipbuilding industry remained nearly constant. These findings suggest that not only is labor a significant input in the production of ships, but that little mechanization of the production process has been undertaken by the industry. One reason for this is the lack of standardization of commercial and naval ships produced domestically. Be that as it may, because labor is the primary input, the most likely avenue for cost reduction is through improved utilization of labor.

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One method of reducing labor costs is by the production of a series of standardized vessels. Series production of ships can reduce costs as both management and workers become more adept at performing repeated tasks; perhaps more importantly, it encourages the introduction of facilities to "mass produce" ships of the same kind. Past Navy procurement policy, however, has not enabled shipyards to realize such gains, as contracts let by the Navy have, in most cases, been for one-of-a-kind ships. Likewise, it has not been possible to standardize the production of commercial ships. To the extent that standardization does not occur, improved labor utilization can only come about by other means. One of these, i.e., increased retention of workers, is given particular attention in this study.

In examining demographic and related characteristics of the shipbuilding labor market, it is found that shipbuilding and construction have the same occupational mix; in both industries over 50 percent of the work force are craftsmen. This similarity in occupational composition corroborates intuitive knowledge that the two industries compete for the same kinds of skilled labor. It is also found that workers in private shipyards and in the construction industry have similar levels of formal education. Thus, educational requirements appear to present no barriers for transference of skills from shipbuilding to construction or vice versa. The same finding is true for other industries as well.

Private shipyards were found to have a relatively large percentage of their work force under age 35 years (in 1970), which may partially explain the high rate of separations that has plagued the industry. On the other hand, in 1970 government yards had a higher than average concentration of workers age 45 years and over. Not only does this finding suggest that naval shipyards have been able to keep workers over time, but also that these yards will soon be experiencing a loss of experienced workers through retirement. Indeed, this has begun to occur. Moreover, it is likely that the higher paying naval yards will attract experienced workers from private shipyards, which will, in turn, exacerbate labor shortages in private yards. While current labor market conditions may

obscure the potential impact of the aging of the work force in naval yards, it cannot do so for long, as workers in naval yards comprise a substantial portion of the industry's total work force.

An examination of the racial composition of the shipbuilding work force reveals that entry of blacks into this industry is not only much easier than into construction, but it is also easier vis-a-vis all industries taken jointly. The relatively large concentration of black craftsmen and operatives in shipbuilding is most likely the result of both supply and demand conditions. Because many jobs in construction are "reserved" for white workers, the supply of white workers to shipbuilding is reduced. Even though racial discrimination by construction is no doubt an important factor explaining the large concentration of black workers in shipbuilding, other factors, such as shipyard location in central city areas and shipyard turnover, may also be important.

Because of the importance of skilled craftsmen in the production process, it is vital that shipyards be located in areas where such labor is available. Between 1968 and 1973, however, naval ship contracts were let to private shipyards that were located in small labor markets. The yards receiving the majority of naval contracts are the dominant employers of skilled labor in their respective areas. Hence, in order to meet the required manpower needs at normal operating levels and when work load expands, these yards would most likely have to draw skilled workers from other labor markets. This leads to increased production costs, as the means of attracting workers from other areas are higher wages and fringe benefits. Moreover, if the expansion of ship production is very large, this might induce growth in the construction sector which draws workers away from shipbuilding. As indicated in Chapter IV, as the size of an SMSA increases, the availability of skilled labor increases, thereby decreasing the likelihood of skilled labor shortages. In this connection it is of interest to note that the yards specializing in commercial ship construction are located in large labor markets, e.g., Philadelphia, Boston and Baltimore. Although one motive for the

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concentration of naval work may be to achieve lower costs through "learning", it is possible that such gains may not be realized if the yards are located in small labor markets where skilled labor is often in short supply.

The importance of labor in ship production and the need for increased productivity to reduce ship costs underscores the importance of work force stability. This being the case, the literature on labor turnover is examined in Chapter V. This literature indicates that wage rates (earnings) and age are the significant factors influencing a worker's decision on industry attachment. Wage rates and quits are negatively related, since the higher one's wage or income, the greater the loss and smaller the benefit resulting from leaving a firm or industry. Similarly, age and quits are negatively related because older workers not only receive higher earnings, but have social ties to their workplace and to the area in which they live. While other factors, such as industry concentration, influence turnover, they have been found to be much less important than the two factors cited.

Since compensation is a significant factor influencing industry turnover, wage rates and annual earnings in shipbuilding and related industries are investigated in Chapter VI. Although construction and shipbuilding compete for similar skilled labor, our investigation indicates that shipbuilding wage rates have historically been lower than wage rates in construction. Moreover, this differential has widened since the mid-1960s. Additionally, after the mid-1960s, the average wage declined vis-a-vis durable goods manufacturing, other transportation equipment industries, and the private nonagricultural sector considered as a whole. This decline in the relative wage in shipbuilding implies that the industry is becoming increasingly noncompetitive in attracting labor.

Not only was the wage rate for a given listed occupation lower in shipbuilding than in construction (union and nonunion) in 1970-1974, but for the same listed occupation the wage rate differential between apprentices and journeymen was also smaller in shipbuilding. The narrow experience-wage differential would appear to make shipbuilding work

increasingly less attractive to a worker as his level of experience in the industry increases. In addition, shipbuilding wages failed to reflect differentials in investment in human capital. In most shipyards all occupations were paid the same wage and workers received the same wage increase as they progressed from apprentice to journeyman. In contrast, in construction, wage rates increased more rapidly with experience in occupations that require large amounts of training, e.g., electricians and plumbers, vis-a-vis occupations that require little training, e.g., carpenters. Given the wage structure in shipbuilding that existed between 1970 and 1973, one would expect that it would have difficulty in keeping experienced workers in more highly skilled occupations. Hence, it is not surprising that electricians, plumbers and pipefitters, machinists, welders, and steel workers have often been reported by shipyards as being in short supply.

Despite the lower wage rates paid in shipbuilding, annual earnings may exceed those in construction, as the latter is characterized by seasonal fluctuations in demand. If such is the case, workers with a high preference for stable earnings might prefer shipbuilding work to employment in construction. As indicated in Chapter VI, although annual earnings in shipbuilding were higher than in construction in the early 1960s, the differential practically disappeared by 1970. Thus, in 1970 workers could earn almost the same annual income in both industries; workers in construction, however, could consume more leisure because wage rates were higher in this industry. It should also be noted that in occupations where shipyards have reported shortages, e.g., electricians, plumbers and pipefitters, and welders, annual earnings as well as wage rates appeared to be lower than in construction. Here again, the wage structure in shipbuilding is such that it makes difficult the retention of highly skilled workers.

Other aspects of the wage structure in shipbuilding are worth nothing. Annual earnings of young workers, i.e., less than age 25, were found to be larger in shipbuilding than in construction and durable manufacturing in 1965 and 1970. In contrast, in 1970 annual earnings of

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older workers in shipbuilding were less than for workers of the same age in construction, durable goods manufacturing, and transportation equipment industries; this was not the case, however, in 1960 and 1965.

The data presented in Chapter VII indicate that quits, layoffs, new hires, and rehires per 100 workers have historically been greater in shipbuilding than in aircraft and durable goods industries. Of particular interest are two important trends. The quit rate appears to be slowly increasing over time as relative wages in shipbuilding have declined. However, layoff and rehire rates have fallen substantially, so that short-term separations for all reasons have diminished. Two possible explanations for the latter trend which remain to be validated, however, are that management may have become more efficient in scheduling new construction; it may also be that to a greater extent than heretofore, repair work is being substituted for new construction.

Seasonal changes in shipbuilding employment were also looked at to determine whether the industry loses workers to construction during the summer months. From the empirical data examined, no seasonal fluctuation in shipbuilding employment could be found. Similarly, seasonal fluctuations in quits, new hires, and layoffs do not appear to be larger in shipbuilding than in other durable goods industries. While it may be that the impact of wages on turnover may be weak in the short run, it is clear that there is a strong relationship in the long run.

In contrast to the reduction in short-run turnover, long-run turnover among shipbuilding workers increased between 1960-1965 and 1965-1970. Although separation rates increased among all age groups, the largest increases occurred among older, experienced workers. This is consistent with what one would expect, given the structure of wages in the industry and recent trends in relative wages and earnings. It should be noted, however, that the loss of workers, especially among older workers,

might be influenced by other factors besides wages and earnings. Although not documented, it may be that working conditions in shipyards deteriorated after the mid-1960s; this may have induced older workers to leave the industry. Furthermore, as the economy expanded in the late 1960s, older shipyard workers may have been drawn away from shipbuilding. While these other factors may have contributed to the increased loss rate of workers, especially older workers, after 1965, the increased loss rate is consistent with the decline in earnings of older workers in shipbuilding vis-a-vis the earnings of their counterparts in other industries. Because of the high loss rate of workers, accession rates in shipbuilding were also high, among older as well as among younger workers. While it is likely that the older workers had prior craft experience, it was found that a relatively small percentage had prior shipbuilding experience. Hence, even for this group, some amount of training appeared to be necessary.

Since earnings and age are primary determinants of turnover, it was of interest to determine the level of turnover when these two variables were held constant. Although sample sizes were small, it appears that stayer rates in shipbuilding, computed over five-year periods, are lower in shipbuilding than in other industries (holding earnings and age constant). Again, this is consistent with the narrow wage-experience differential noted above. In addition, it was found that workers employed in a specified industry in 1960 had a much higher probability of remaining in the industry during 1965-1970 than workers who were employed in a different industry in 1960 (holding earnings and age constant). This finding suggests that newly hired older workers are much less likely to remain in an industry than older workers who have been attached to the industry for five or more years. This is particularly relevant to shipbuilding, where a large fraction of hires are older workers, with no prior shipbuilding experience. For this reason, it would appear to be important that incentives be provided which will induce workers to remain in the industry after they acquire experience. The most likely means of inducing

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workers to remain in the industry is to increase their future expected earnings so that they become competitive with earnings received by similar workers in related industries.

While Chapter VIII indicated that the loss rate of workers, especially older workers, from shipbuilding increased between 1965-1970 vis-a-vis 1960-1965, the industries to which workers were transferring were not identified. This aspect of the analysis is addressed in Chapter IX where interindustry mobility patterns of shipyard workers are investigated. The findings are consistent with expectations based on the recent trends in wage rates and earnings discussed in Chapter VI. Between 1965-1970 losses of workers to construction and durable goods manufacturing were incurred; on the other hand, during 1960-1965 net gains were experienced. As a result, the shipbuilding industry had to recruit workers from other industries. Even though the work environment and production tasks of shipbuilding are similar to those in construction and durable manufacturing, the greater reliance on workers from other industries most likely raised training costs to shipbuilding.

The geographic mobility of shipyard workers was also looked at in Chapter IX. From the data examined, it appears that only a small proportion of shipbuilding workers changed their state of residence during 1965-1970. Moreover, of those workers who do move, only one-third remained in shipbuilding. The fraction of movers who remained in the aircraft industry was found to be somewhat larger.

In conclusion, the most important finding of this study is that at the end of the period 1960-1970, older, experienced workers in shipbuilding received lower earnings than their counterparts in construction and durable manufacturing. At the same time younger, less experienced workers received higher annual earnings than their counterparts in construction and durable manufacturing. With the apparent impact on turnover, as pointed out in this research effort, it would appear that the structure of wages (by experience) in this industry is quite different than in other industries. There are several possible explanations which

might explain shipbuilding wage patterns. Shipyards may have attempted to depress wages in order to improve their short-run competitive position in the world shipbuilding market. Such a policy might also be followed as a means of garnering work that in the past has been performed by government yards, e.g., naval ship construction, and more recently, naval ship repair. The use of cost plus fixed fee contracts may also have reduced incentives for improving the long-run competitive position of the industry. A similar disincentive to improve the utilization of labor may be attributable to the heavy government subsidization of the industry.

Still another possible explanation of the relatively flat age-earnings and experience-earnings profiles that exist in the industry pertains to working conditions in a shipyard. It may be that because of unattractive working conditions, a higher entry wage is needed to attract workers to the industry. It may also be that higher wage rates would not induce older workers to stay in the industry given its unattractive, and possibly worsening working conditions. Finally, it has been suggested by union officials that the large concentration of young workers in shipbuilding has enabled them to obtain greater wage increases for themselves at the expense of older workers.

A second conclusion pertains to inter-occupational pay differentials. It appears that the largest pay differentials between shipbuilding and construction occur in the more skilled occupations, while smaller differentials occur between the lower skilled occupations. This results from the fact that all occupations in a shipyard earn the same, or nearly the same, hourly wage rate, regardless of differential investments in human capital. This being the case, it is not surprising that shipyards have commonly reported the most critical shortages in higher skilled occupations. To ameliorate these shortages, shipyard wages should be adjusted to reflect differential investments in human capital and prevailing market conditions. It should be noted that officials have suggested that such an adjustment could create interjurisdictional trade disputes. Why the threat of jurisdictional disputes is greater in the shipbuilding industry than in other industries is not clear, however.

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While the policy implications of our research have been set forth with a number of caveats as discussed in the body of the study, further research is necessary.

It should also be noted that while the problems alluded to above may not pose much difficulty today, given the state of the economy and the reduced level of activity in the shipbuilding industry, they may surface once again in the future.

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