Comparative Job Performance by Age:

Office Workers

Bulletin No. 1273

UNITED STATES DEPARTMENT OF LABOR
James P. Mitchell, Secretary

BUREAU OF LABOR STATISTICS
Ewan Clague, Commissioner

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Preface

The U.S. Department of Labor has been deeply concerned with the problem of the employment of older-workers and has inaugurated several programs dealing with various facets of this problem. Among these are studies designed primarily to compare the relative work performance of older workers with that of other workers in similar occupations. Other studies conducted by the Department have considered the older worker in relation to pension costs, insurance plans, counseling and placement service, and other employment problems. 1/

This study was conducted in the Bureau of Labor Statistics' Division of Productivity and Technological Developments under the direction of James F. Walker, assisted by Stanley F. Miller and Ronald E. Kutscher. The statistical procedures used were those developed by Jerome A. Mark in an earlier study of factory workers.

The Bureau wishes to express its appreciation to the organizations which cooperated in the study. The Office Executives Association of New York was also helpful in locating companies having work measurement systems.

1/ For a list of the studies made by the Department see the back cover.

CONTENTS

TABLES

Page

CHARTS

APPENDIX

COMPARATIVE JOB PERFORMANCE BY AGE: OFFICE WORKERS

Currently, almost 40 percent of the workers in the labor force are 45 years old or over. When these workers become unemployed, for any reason, they often meet resistance when seeking a new job, as evidenced by the fact that long-term unemployment is proportionately greater among those 45 years of age or older.

Many firms, either through policy or practice, restrict the hiring of older workers, frequently setting age limits below 45. This practice is especially prevalent in the hiring of office workers. 2/

One of the most frequently cited reasons for refusal to hire workers over 45 is that they are less productive than younger workers. 3/ Individual output per man-hour, therefore, is one of the most important factors affecting a worker's ability to find and hold a job. Studies on the work performance of office workers by age groups have generally been limited to opinion surveys. This study, based on actual records of work performed on the job, attempts to show how the output of office workers aged 45 or over compares with the output of other age groups. 4/ The workers covered in the study were office clerical workers for whom production records were maintained. The great majority of them were in routine jobs such as typing, filing, posting, sorting, and card punching.

Earlier studies made by both government agencies and by private organizations have shown that older workers have records of attendance, safety, and turnover equal or superior to those of younger age groups. 5/ This study did not include such records.

2/ See Counseling and Placement Services for Older Workers (BES No. E 152, 1956).

3/ The reasons most frequently given by employers for not hiring older workers were "inability to meet production standards," "inability to meet physical requirements," "lack of flexibility to meet changing conditions," "pension and insurance costs," and "too close to retirement age." See article by Abraham Stahler, The Older Worker, Job Problems and Their Solution (in Monthly Labor Review, January 1957, pp. 22-28); also see the article The Older Worker (in Factory Management and Maintenance, New York, March 1958, pp. 85-96).

4/ Previous studies by the BLS covered factory workers. For example, see Comparative Job Performance by Age (BLS Bull. 1223, 1957).

5/ For example, see Absenteeism and Injury Experience of Older Workers (in Monthly Labor Review, July 1948, pp. 16-19) and James H. Mullen, Proceedings of Second Conference on the Problems of Making a Living While Growing Old, Commonwealth of Pennsylvania and Temple University, September 1953, pp. 183-204.

General Findings

Three important findings emerge from this study. First, the differences in the output per man-hour among age groups of the office workers within the scope of the survey were for the most part insignificant. Second, there was considerable variation among workers within age groups, so that large proportions of workers in the older age groups exceeded the average performance of younger groups. Third, workers in the older age groups had a steadier rate of output, with considerably less variation from week to week, than workers in the younger age groups. Thus, arbitrary barriers to the hiring of older workers which are related to output seem unwarranted. The findings substantiate the need for individual evaluation of workers.

The average output per man-hour of workers in the group aged 35 to 44 was used as a base and assigned the value of 100 for purposes of comparison. The average for each of the other age groups was within 5 percent of the base group, except for the youngest group, which was greatly affected by lack of experience. Workers in the higher age groups not only maintained output equal on the average to younger groups but also maintained an equal degree of accuracy.

Experience appeared to be the major factor where differences in average performance occurred among the various age groups. When only the more experienced workers on the job were considered, all age groups studied had similar average rates of output. 6/ The effect of experience on average output was also indicated when workers with less than 18 months' service in the company were excluded, and the variation between groups was reduced.

Similarly, when workers were divided into smaller comparison groups, such as time and incentive workers, higher and lower skilled jobs, Government and private employment, and into different occupations, no major differences in work performance that can be attributed to age appeared.

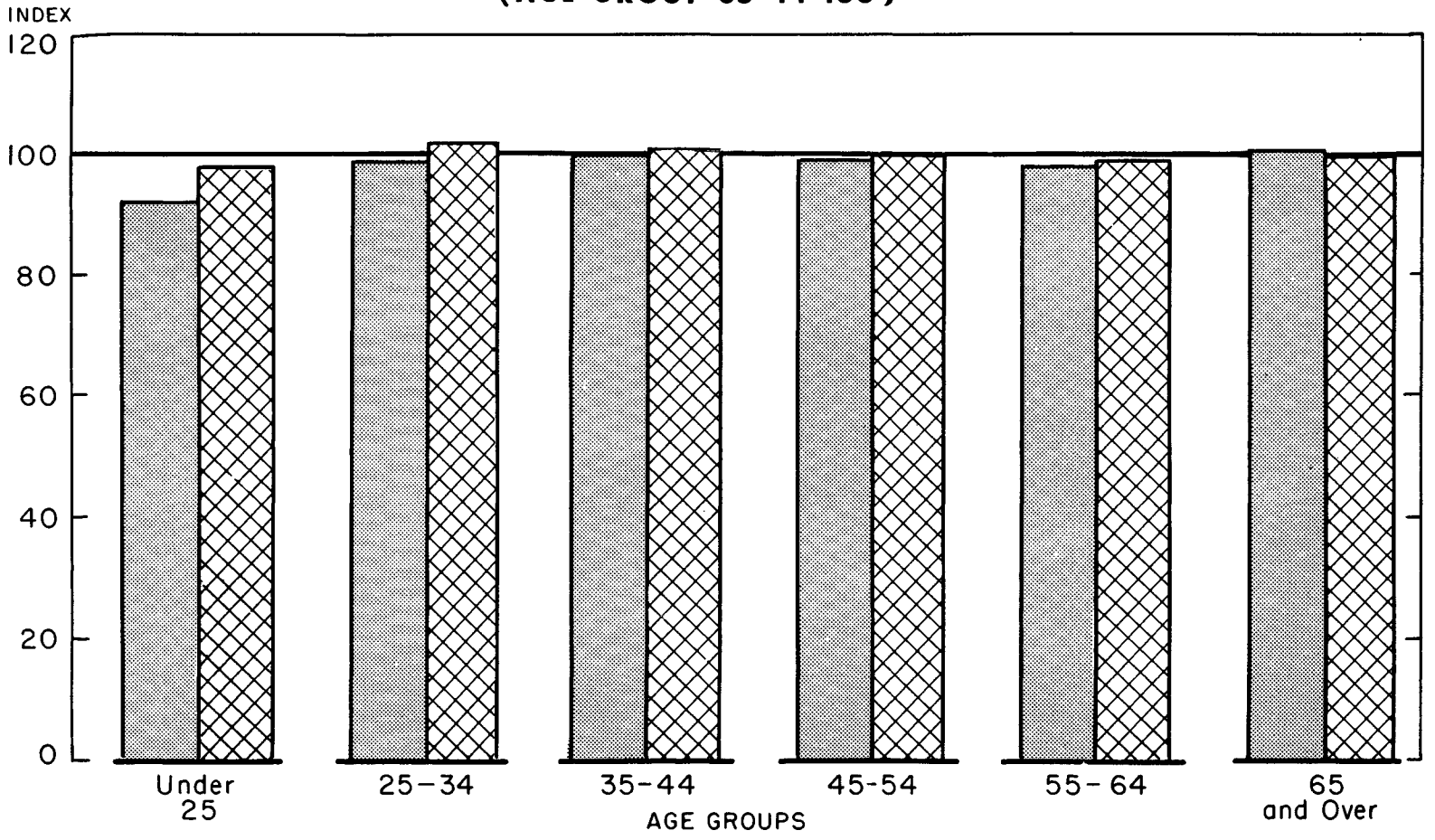
Although there were practically no differences in averages between age groups among experienced workers, there was considerable variation in output among workers within the groups. Frequently, an individual worker produced at least twice as much as some of the other workers in the same group. Generally, however, the great majority of the workers within a group produced within 20 percent of the average output for all workers in that group. About 45 percent of workers aged 45 or over produced at a higher rate than the average of workers in the 35 to 44 age group (tables 1, 2, and 3).

6/ Information was obtained for trainees, but they were omitted from all tabulations because their work standards were not considered comparable to experienced workers.

Workers 65 or over generally averaged as high as any other group, and many of the individual workers had very high rates of output. This relatively high rate of output may have been the result of retirement plans which were in effect in the establishments studied. 7/ With adequate retirement plans, the less efficient older workers could be encouraged to retire, with the result that those who remained would tend to be the more able and productive.

7/ Supplementing social security in the private companies. In the case of Government workers, most are covered by a retirement plan that generally provides greater benefits than social security.

Chart 1. RELATIVE OUTPUT PER MAN-HOUR OF WOMEN OFFICE WORKERS
By Age Group and Experience on Job
(AGE GROUP 35-44=100)



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Scope of Survey 8/

Data for the survey were collected in the winter of 1958-59 for about 6,000 workers whose employment was almost equally divided between 5 Federal Government agencies and 21 companies in private industry. The companies included mail-order houses, insurance companies, aircraft manufacturers, machinery manufacturers, refineries, public utilities, banks, publishing companies, and retail stores. All of the establishments studied were located in the eastern half of the country and were large employers in their industrial categories. Almost half of the workers studied were employed under some type of incentive pay system.

Many additional establishments were asked to cooperate in the survey but they had inadequate data; e.g., their records were on a group basis or output could not be associated with hours worked.

The occupations covered included the usual clerical functions, such as typing, secretarial work, and filing, maintaining, sorting, or classifying of records. To those occupations were added keypunch and business- and duplicating-machine operations.

8/ A detailed report on the procedures employed in the survey is given in the appendix.

Concepts and Definitions

In evaluating a worker's performance, many factors are important. Among these are his output per man-hour, the accuracy of his work, the consistency of his performance, his absenteeism, his continuity of service, his adaptability, and his ability to get along with others. Some factors cannot readily be measured. As mentioned earlier, many have already been studied and the older worker's relative position has been assessed. This study was designed primarily to compare work performance of individual workers by age group. Information on two other factors, accuracy and consistency of performance, was obtained as a byproduct of the study.

The office workers studied in each establishment were classified by sex and occupation. Within these classifications, they were divided into six age groups. An index of output was obtained for each worker by dividing his output per man-hour by the average output per man-hour of workers aged 35 to 44 years in his same classification. The indexes for individual workers from the various establishments were combined into age-group indexes with reliability weights based on the number of workers in the base group. In order to hold constant, or to keep to a minimum, the influence of factors other than age which might affect worker performance, comparisons were restricted to workers in different age groups within the same major classification.

Some factors that could affect output, such as education, marital status, and previous experience, were not studied because they were considered too difficult to measure, or were of relatively minor importance, or randomly distributed.

The variation of a worker's output per man-hour from week to week is also important in evaluating his overall performance. Output data were collected for periods covering from 4 to 13 weeks for each employee in the study, and for those workers for whom information was obtained on a weekly basis, it was possible to measure consistency of performance, through measuring the variation of a worker's weekly average output per man-hour from his own average output.

Accuracy of work, another important criteria of performance, was also measured whenever the employer kept records of individual errors.

Data were collected on the length of time each worker had been employed in the specific job on which he was being measured, and on the total length of time that he had been employed in the establishment studied. Experience obtained in similar work, in the same or different establishment, was not recorded.

Limitations of the Data

In considering the results of the survey, some qualifications and limitations of the data should be noted. Information was collected only from offices which kept production records for individual workers. Therefore, the data cover only a small proportion of total office workers in the selected establishments and do not represent a cross section of various office skills. For example, production measures generally were limited to the more routine types of work and included only a few highly skilled occupations.

Moreover, a high proportion of the workers studied were on incentive work, and those on time work were aware that their work was being measured by the company. It is not known whether these employees would work at the same or different rates if they were not receiving a pay incentive or if they knew their production was not being measured. Consequently, the workers covered were possibly operating under different motivations from most office workers.

It is possible that the older workers studied were not representative of all older workers since only employed persons were included in the study and they might, therefore, have been a select group. On the other hand, it may also be assumed that superior workers have gone on to better paying jobs, where production is rarely measured. Thus the older worker's average output rate was undoubtedly influenced by the omission of these two extremes.

Workers 45 and over represented about 27 percent of all those included in the study. Information on the age distribution of all office workers is not available. Since current population reports indicate workers 45 or over represent about 40 percent of total nonagricultural employment, it would appear that the age distribution of the workers studied might have been somewhat different from the age distribution of all office workers.

Comparisons Within Groups

In order to evaluate the effect of some of these other factors on the relationship of age to work performance, tabulations were prepared comparing indexes of output per man-hour within limited groups. Although the various divisions of the data revealed some variations in the average indexes of output none of the differences could be attributed to age.

Differences by Sex

Among women, little variation was found in the average output per man-hour among the different age groups except that output was significantly below average for the youngest, where lack of experience was apparently an important factor. When workers with less than 9 months' experience on the job measured were excluded from each of the age groups, average indexes generally rose and the average for the youngest group rose substantially. 9/

There was somewhat greater variation in the average performance, by age group, among experienced men, although the differences were still not large. In addition, both the younger and older age groups (except for the youngest group of all men) showed a higher average than the base group aged 35 to 44, although this was probably a reflection of the higher sampling error for the relatively small sample.

Since men were seldom found in measured office activities they represented only 15 percent of the workers included in the study. Therefore, it was necessary to restrict to women most of the detailed observations and analysis of the effect of various factors.

Private and Government Employees

A few small differences appeared in the relationship of output per man-hour to age when output of workers in Government agencies was compared with that of workers in private industry. (See tables 4, 5, 6, and 7.) The average performance of women in Government showed a slight drop in the 55 to 64 group, but nearly half of the drop was wiped out when only those workers with 9 or more months' experience on the job were considered.

Women 65 and over in private industry had a much lower average performance index (93.7) than other age groups, but the sample for this group was very small.

9/ In considering experience, only the time spent on the specific job measured was counted. Experience on similar jobs in the same establishment or in other establishments was not studied.

In the other age groups, from under 25 through age 54, the relationship of the indexes for women in Government and in private employment was strikingly similar.

Another difference between the two groups was in the variation in output between individuals, which was greater among the Government workers in each age group. A higher proportion of women Government workers had output indexes either exceedingly high (over 130) or low (under 70).

The difference in age distribution is also of some interest. The Government agencies studied employed a much higher proportion of workers 55 years or over in the jobs studied than did the private companies. 10/ In contrast, in the private companies a much higher proportion of workers under 25 were found.

Effects of Incentive Payments

It has been estimated that no more than 3 percent of all office workers are employed under incentive plans. A much higher proportion of the workers in this study were employed under an incentive system and records kept under such plans were the best source of information on individual output. 11/ However, about half of the workers studied were not employed under an incentive plan, so that comparison of relative performance by age among workers having direct wage incentives and those workers paid on a time basis could be made.

The study revealed only minor differences in the relationship between age groups, whether workers were paid on a time or an incentive basis (table 8, 9, and 10). Women and men aged 65 or over, paid on a time basis, had the highest output index of all age groups. Incentive-paid, experienced women aged 65 or over averaged 5 percent less output than comparable workers in the base group.

In private industry establishments, where incentives are substantially higher, there was some evidence that younger workers were relatively more productive when direct pay incentives were offered. Workers who were 45 or over in both the incentive and nonincentive groups, on the other hand, had about the same relative output index. The relative production efficiency of experienced women office workers in private establishments, classified by method of wage payment, is shown in the tabulation on the following page.

10/ Some of the establishments studied had mandatory retirement policies.

11/ In contrast to factory worker incentive plans, which are most frequently based on a straight piecework system, most office incentive plans are bonus-type payments given in addition to regular weekly salary.

Age group	Workers 1/ paid on a-- Time basis	Incentive basis
Under 25 years	93.8	97.6
25-34 years	98.5	101.2
35-44 years	100.0	100.0
45-54 years	99.1	99.0
55-64 years	98.6	99.7

1/ Excludes workers with less than 9 months' experience on the job studied. Insufficient data were available for workers 65 and over to warrant presentation.

Incentive and time workers in Government agencies had approximately the same age-performance relationships. The incentive systems in the Government agencies are limited and provide for very small production bonuses, amounting generally to no more than 5 percent above basic rates paid to timeworkers and they may be insufficient to alter the age-performance relationships.

In examining the time and incentive tabulations, as in the case of other comparisons, it should be kept in mind that the indexes do not reflect actual levels of output, enabling direct comparisons between the groups. Rather, they reflect only the relative output per man-hour within a group. Incentive plans evidently reduce the proportion of workers doing substandard work in all age groups. The proportion of women workers with 9 or more months' experience and with output indexes of less than 70 was at least twice as large for time-workers as it was for incentive workers. (See tables 8 and 9.) Furthermore, the proportion of workers with relatively high production rates was greater among the group of incentive workers studied.

Since all time-rated workers were on work measurement programs, their performance may not be indicative of all time-rated workers in the occupations studied. It is generally agreed that the presence of a work measurement program has an effect on the workers, at least temporarily, very similar to an incentive plan.

Occupational and Skill Differences

Workers studied were divided into 10 occupational categories for purposes of comparison, but some of the groups were too small to warrant separate analysis. The largest group represented those workers classified as general clerks, who did posting, checking, and general maintenance of records. Other classifications for which data could be published were typists, keypunch operators, sorters and classifiers, and filing clerks (table 11).

None of the occupational categories studied showed substantially different age-performance relationships, except that keypunch operators under 35 years of age had much lower average indexes than other age groups. Older workers, particularly those 55 or over, had higher than average indexes of output in routine jobs, such as typing, sorting, and filing.

The role of experience was further illustrated when occupational comparisons were limited to workers having 9 months' or more experience on the job. In their case, nearly all of the differences in the keypunch operator classification disappeared and other differences between age groups generally narrowed.

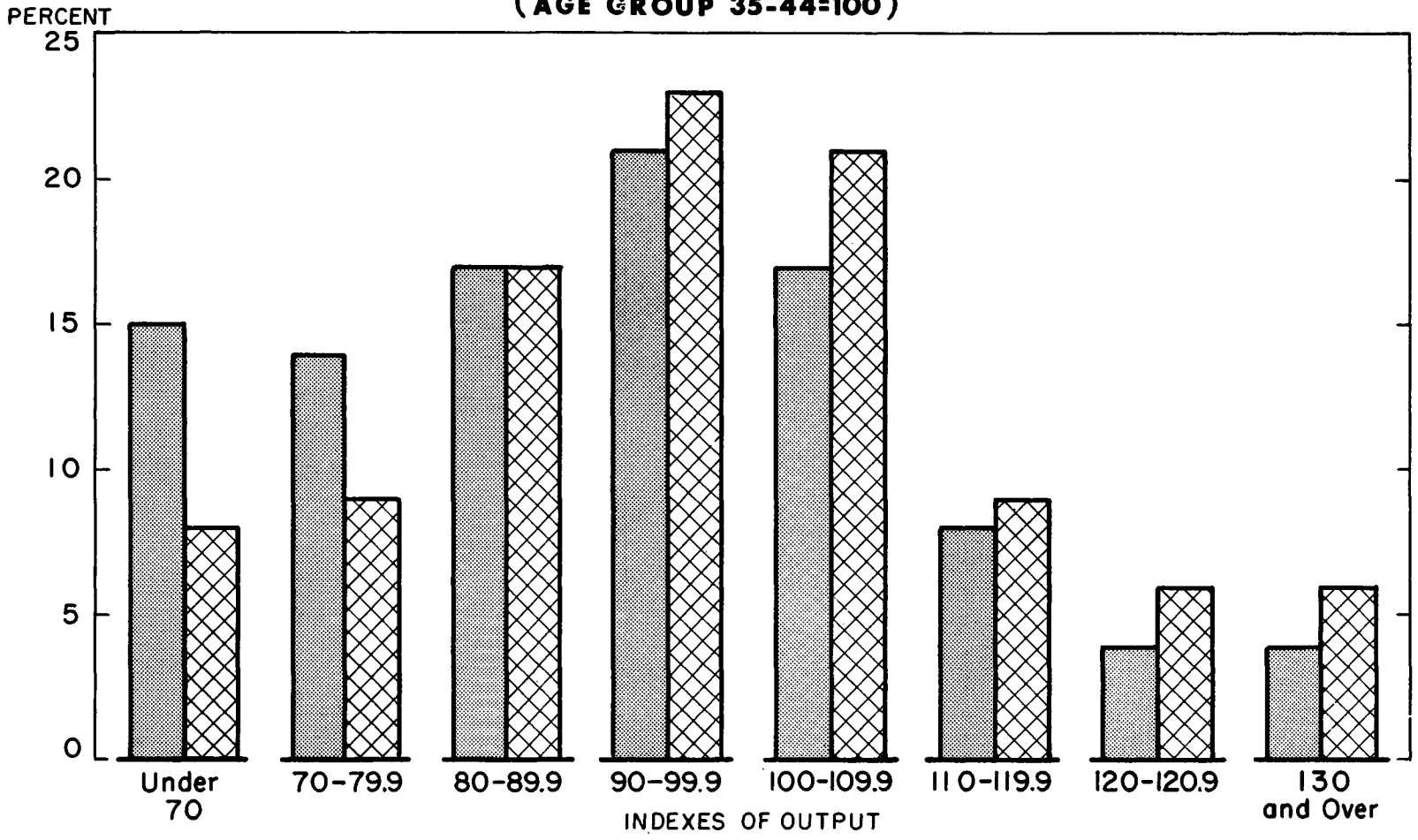
Almost all workers studied, as mentioned earlier, were in routine types of jobs where performance is more readily measurable (table 12). One out of 12 of the women studied was in a job that required higher skills. 12/ When workers in these jobs were compared by age group, the average performance of workers in the age groups between 25 and 64 showed very small differences. The average for those under 25 was much higher (111.5) but very few workers were in this category and they were probably very select.

12/ Workers classified in the "higher" jobs were expected to exercise some independent judgment. These jobs could not be considered "higher" jobs in the office as a whole, but only the higher among the jobs studied. Typical of the jobs classified as higher was that of correspondence clerks.

Chart 2. EFFECT OF EXPERIENCE ON OUTPUT

Percentage Distribution of Women Under Age 25, by Relative Output

(AGE GROUP 35-44=100)



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Individual Worker Variation

The great majority of workers in each age group, both men and women, had production indexes in the range between 80 and 120. This concentration around the average was particularly noticeable in the older groups. In each age group, there were small proportions of workers with average output considerably above or below the average for the group. Only a very few workers 55 or over had rate-of-output indexes below 60 and younger workers with indexes below 60 were generally those with less than 9 months' experience on the job.

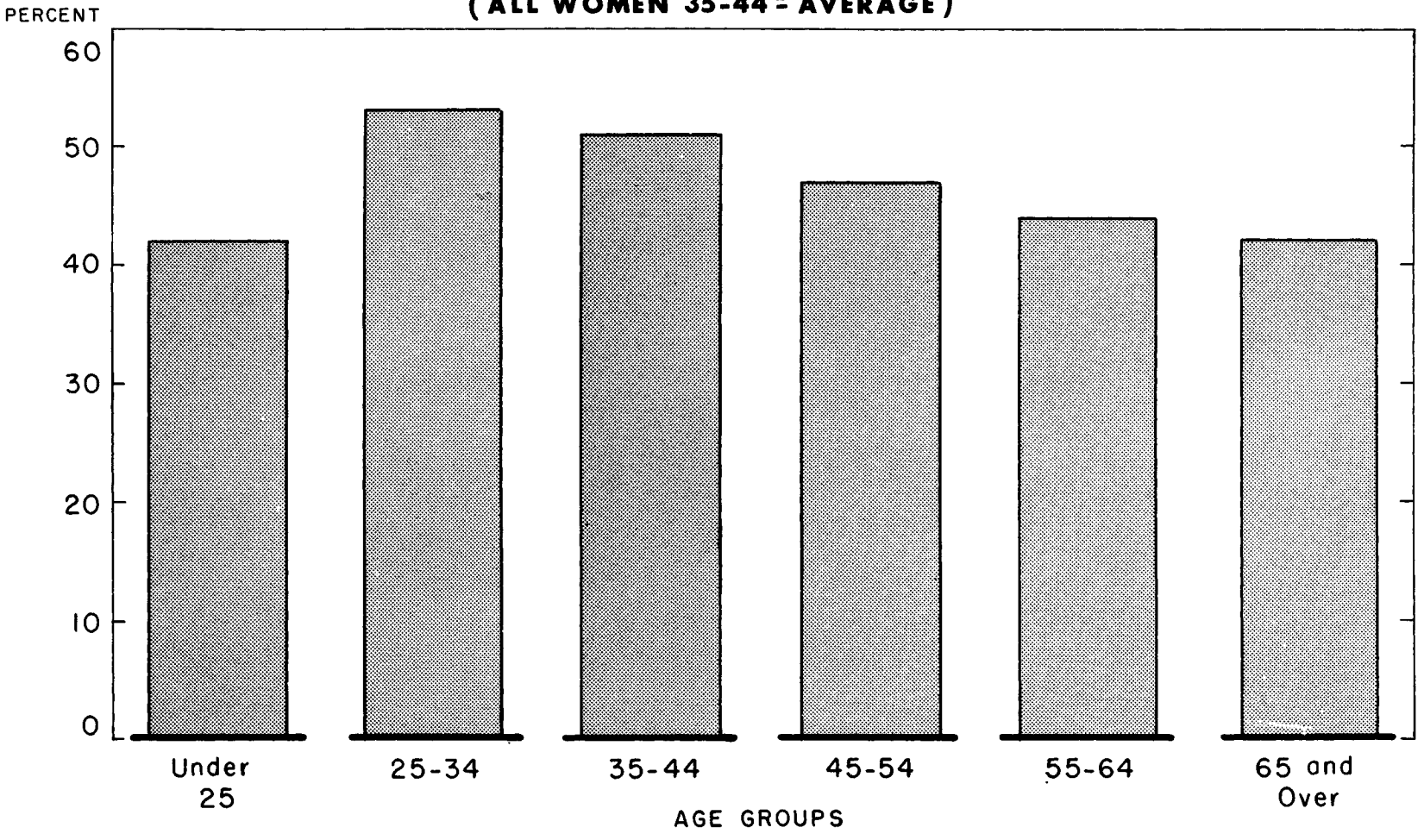
The proportion of women office workers with indexes of output over 100 was greatest for the 25 to 34 age group and decreased gradually in each higher age group. (See chart 3.) Among experienced workers, the proportion of workers in the youngest age group with indexes of output over 100 was the same as for those 65 and over.

A substantial proportion of workers aged 45 and over had higher than average output per man-hour. About 47 percent of those 45 to 54, 44 percent of those 55 to 64, and 42 percent of those 65 and over had scores greater than 100. The latter group had about the same proportion as found in the youngest group, under 25.

Workers 45 or over typically had a lower modal group than did groups under 45, even though as a group they averaged as high or higher than the younger groups. The percent of workers 45 and over with production indexes of less than 80 was about the same as for most of the younger groups, but the lack of extremely low producers among the workers 45 years and over balanced the higher modal groups among the younger workers.

Chart 3. PERCENT OF WOMEN OFFICE WORKERS HAVING INDEXES OF OUTPUT ABOVE AVERAGE AFTER 9 OR MORE MONTHS' EXPERIENCE ON JOB

(ALL WOMEN 35-44 = AVERAGE)



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Consistency and Accuracy of Performance

Where four or more individual weekly production figures were available, it was possible to examine the week-to-week variation in production among women workers. An "index of consistency" 13/ was derived for each age group by comparing the individual weekly output per man-hour of each woman worker with her average output over the period of study. The following indexes of consistency for women were found:

Age group 1/	Number of workers	Index of consistency
Under 25 years	451	85.8
25-34 years	468	98.9
35-44 years	346	100.0
45-54 years	241	107.0
55-64 years	61	125.8

1/ Insufficient data were available for workers aged 65 and over to warrant presentation.

Thus, the index of 125.8 for the 55-64 year age group showed that they were 25.8 percent more consistent in their week-to-week performance than the base group. The tendency toward consistent performance in this group was noted in nearly all of the establishments for which data were available.

In the younger age groups, output per man-hour varied from week to week, resulting in lower indexes of consistency. The low rate for the youngest group may be partly attributable to the relatively larger number of less experienced workers in that group.

13/ A consistency index for each individual was found by comparing the average percent deviation about his own average over the total period with the average of this deviation for the base group (35-44 years). The individual indexes were combined to form average indexes for each age group by using the same method as for the output indexes. The reciprocals of these indexes were used to measure consistency. Comparisons were limited to women because of the small number of reports obtained for men.

Although the major objective of this study was to compare the relationship of output per man-hour to age, some comparison of the quality (accuracy) of work among the age groups was also possible in some of the cooperating establishments where a record was maintained of the errors made by each individual on measured work. 14/

The results, presented in the following tabulation, while not conclusive because of the small number of workers covered, show no appreciable differences in accuracy of output between age groups:

Age group	Accuracy index
Under 25 years	100.2
25-34 years	99.7
35-44 years	100.0
45-54 years	99.7
55-64 years	100.0
65 years and over	98.0

14/ This comparison was made by calculating an index of relative accuracy. Each worker's accuracy percentage was obtained by subtracting his error percentage from 100. The average accuracy rating for the base group was then determined and an accuracy index for each individual calculated relative to the base group average. These data were then combined in the same manner as the output data to get an average accuracy rating for each age group.

Office Jobs Versus Plant Jobs

Two earlier studies of the Bureau of Labor Statistics on job performance by age were confined to factory workers in the men's footwear, men's clothing, and household furniture industries. 15/ All workers included in those studies were on jobs with incentive systems of payment.

The results for office workers and factory workers were very similar. For both groups there was relatively little variation in average performance among age groups, but considerable variation among individuals within age groups; a large proportion of workers in the higher age groups exceeded the performance of the base group average. There were, however, a few differences. The study of office workers showed little or no variation among age groups; in most cases, the youngest group (under 25) had a lower average, but this was primarily because of less experience. Among factory workers, performance tended to be highest for the 25 to 34 year group. The older workers in the factory study had somewhat lower average performance rates than the base group, 35 to 44, while the averages for older office workers were about the same as the base group. All of the studies showed that nearly half of the workers aged 45 to 54 had output per man-hour indexes greater than the average in the worker age group 35 to 44. On the other hand, only a small number of office workers 45 years old and over had very low scores; whereas the proportion was higher among the factory workers 45 and over.

Another difference in the findings of the studies was related to the individual performance of workers 55 and over. The proportion of office workers 55 and over who had output indexes greater than 100 was almost the same as the proportion for the 45 to 54 age group. In the case of factory workers, the proportion was lower. This difference might be a reflection of the greater physical demands which factory jobs make on persons in the older age groups.

15/ Comparative Job Performance by Age, op. cit.; and Job Performance and Age (BLS Bull. 1203, 1956).

Table 1. Indexes of output per man-hour of office workers by age group and experience on job

[Age group 35-44=100]

Age group	Number of workers	Average index	Percentage distribution of workers with indexes of--							
			Under 70	70 to 79.9	80 to 89.9	90 to 99.9	100 to 109.9	110 to 119.9	120 to 129.9	130 and over
	All workers									
Under 25 ..	1,084	92.4	15	13	17	20	18	8	5	4
25-34	1,506	99.4	7	9	15	21	21	13	7	7
35-44	1,466	100.0	6	6	14	24	25	14	6	5
45-54	1,023	100.1	6	8	15	23	19	13	6	8
55-64	429	98.6	7	6	18	24	18	12	8	6
65 and over	86	101.2	7	4	24	19	17	14	4	10
	Workers with 9 months' or more experience on job 1/									
Under 25 ..	582	98.7	7	9	17	23	22	9	6	6
25-34	1,074	101.9	5	7	14	22	23	14	7	8
35-44	1,189	100.8	5	5	13	25	26	14	6	5
45-54	877	100.8	5	7	17	24	21	13	5	9
55-64	371	99.5	6	6	18	25	19	13	8	5
65 and over	74	101.1	7	3	25	21	16	12	5	11

1/ Does not include data for about 450 workers for whom data on length of experience were not available. Previous experience in similar or identical work was not considered.

NOTE: Because of rounding, the percentages may not equal 100.

Table 2. Indexes of output per man-hour of women office workers, by age group and experience on job

[Age group 35-44=100]

Age group	Number of workers	Average index	Percentage distribution of workers with indexes of--							
			Under 70	70 to 79.9	80 to 89.9	90 to 99.9	100 to 109.9	110 to 119.9	120 to 129.9	130 and over
	All workers									
Under 25 ..	1,055	92.1	15	14	17	21	17	8	4	4
25-34	1,271	99.2	7	8	15	21	22	13	7	6
35-44	1,198	100.0	5	6	13	25	26	14	6	5
45-54	832	99.2	6	8	16	24	20	13	6	7
55-64	351	98.1	7	6	18	27	18	11	7	6
65 and over	67	100.9	8	5	24	17	14	17	4	10
	Workers with 9 months' or more experience on job 1/									
Under 25 ..	568	97.8	8	9	17	23	21	9	6	6
25-34	871	101.5	5	6	14	21	25	14	7	7
35-44	955	100.9	4	5	13	26	28	14	6	5
45-54	700	100.0	4	7	17	24	22	13	5	7
55-64	301	99.2	5	5	18	28	19	12	7	6
65 and over	60	99.9	9	4	25	19	12	15	5	10

1/ Does not include data for about 400 workers for whom data on length of experience were not available. Previous experience in similar or identical work was not considered.

NOTE: Because of rounding, the percentages may not equal 100.

Table 3. Indexes of output per man-hour of men office workers, by age group and experience on job

[Age group 35-44=100]

Age group	Number of workers	Average index	Percentage distribution of workers with indexes of--							
			Under 70	70 to 79.9	80 to 89.9	90 to 99.9	100 to 109.9	110 to 119.9	120 to 129.9	130 and over
	All workers									
Under 25 ..	29	98.6	16	-	15	5	29	20	12	2
25-34	235	103.0	5	10	13	24	17	14	5	12
35-44	268	100.0	7	5	17	21	21	15	8	6
45-54	191	103.5	9	8	13	23	16	10	5	16
55-64	78	100.3	7	9	20	14	18	15	11	6
65 and over	19	101.9	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
	Workers with 9 months' or more experience on job 2/									
Under 25 ..	14	107.9	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
25-34	203	103.7	4	11	15	23	15	14	5	13
35-44	234	100.2	7	5	16	21	21	15	8	6
45-54	177	103.7	9	7	14	25	15	10	5	15
55-64	70	100.4	6	10	20	13	18	17	11	5
65 and over	14	105.9	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)

1/ Data were considered insufficient to present distribution.

2/ Does not include data for about 50 workers for whom data on length of experience were not available. Previous experience in similar or identical work was not considered.

NOTE: Because of rounding, the percentages may not equal 100.

Table 4. Indexes of output per man-hour of women office workers in Government agencies, by age group and experience on job

[Age group 35-44=100]

Age group	Number of workers	Average index	Percentage distribution of workers with indexes of--							
			Under 70	70 to 79.9	80 to 89.9	90 to 99.9	100 to 109.9	110 to 119.9	120 to 129.9	130 and over
	All workers									
Under 25 ..	197	91.9	17	14	14	22	14	9	4	5
25-34	480	99.6	10	7	13	21	20	14	7	8
35-44	593	100.0	6	6	13	25	26	14	4	6
45-54	368	99.0	8	8	17	22	16	13	8	8
55-64	210	96.4	9	6	21	23	19	7	10	5
65 and over	57	102.6	7	4	21	18	15	19	5	11
	Workers with 9 months' or more experience on job 1/									
Under 25 ..	61	97.8	12	10	12	25	16	10	5	9
25-34	311	101.6	6	5	13	24	21	15	6	9
35-44	466	100.6	5	5	13	26	28	14	4	6
45-54	289	99.7	6	8	19	20	19	12	6	9
55-64	173	98.5	7	5	22	22	20	7	10	6
65 and over	50	101.6	8	3	22	22	13	17	6	10

1/ Does not include data for about 400 workers for whom data on length of experience were not available. Previous experience in similar or identical work was not considered.

NOTE: Because of rounding, the percentages may not equal 100.

Table 5. Indexes of output per man-hour of men office workers in Government agencies, by age group and experience on job

[Age group 35-44=100]

Age group	Number of workers	Average index	Percentage distribution of workers with indexes of--							
			Under 70	70 to 79.9	80 to 89.9	90 to 99.9	100 to 109.9	110 to 119.9	120 to 129.9	130 and over
	All workers									
Under 25 ..	14	96.1	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
25-34	172	104.3	6	10	12	22	17	5	6	13
35-44	229	100.0	6	5	18	20	22	15	8	6
45-54	153	104.4	8	8	15	22	14	11	5	16
55-64	57	100.5	8	7	18	15	17	18	11	5
65 and over	11	101.5	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
	Workers with 9 months' or more experience on job 2/									
Under 25 ..	5	(3/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
25-34	146	105.2	5	11	14	21	15	15	6	14
35-44	195	100.2	6	5	17	21	22	15	8	6
45-54	139	104.8	9	6	16	23	14	11	6	15
55-64	49	100.8	8	8	17	14	18	21	10	4
65 and over	6	(3/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)

1/ Data were considered insufficient to present distribution.

2/ Does not include data for about 50 workers for whom data on length of experience were not available. Previous experience in similar or identical work was not considered.

3/ An age group containing fewer than 10 workers was considered too small for presentation of an index.

NOTE: Because of rounding, the percentages may not equal 100.

Table 6. Indexes of output per man-hour of women office workers in private industry, by age group and experience on job

[Age group 35-44=100]

Age group	Number of workers	Average index	Percentage distribution of workers with indexes of--							
			Under 70	70 to 79.9	80 to 89.9	90 to 99.9	100 to 109.9	110 to 119.9	120 to 129.9	130 and over
	All workers									
Under 25 ..	858	92.1	14	13	18	20	18	8	4	4
25-34	791	98.8	5	10	17	20	24	12	7	5
35-44	605	100.0	5	6	13	25	25	13	7	5
45-54	464	99.5	4	9	15	25	24	14	4	6
55-64	141	100.4	6	5	12	33	18	17	4	6
65 and over	10	93.7	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
	Workers with 9 months' or more experience on job									
Under 25 ..	507	97.8	7	9	18	23	23	9	6	5
25-34	560	101.4	3	8	15	19	28	13	8	6
35-44	489	101.2	3	5	13	26	28	13	7	4
45-54	411	100.2	3	7	15	26	25	14	3	5
55-64	128	100.2	4	5	13	35	18	17	4	5
65 and over	10	93.7	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)

1/ Data were considered insufficient to present distribution.

NOTE: Because of rounding, the percentages may not equal 100.

Table 7. Indexes of output per man-hour of men office workers in private industry, by age group and experience on job

[Age group 35-44=100]

Age group	Number of workers	Average index	Percentage distribution of workers with indexes of--							
			Under 70	70 to 79.9	80 to 89.9	90 to 99.9	100 to 109.9	110 to 119.9	120 to 129.9	130 and over
	All workers									
Under 25 ..	15	102.7	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
25-34	63	98.3	3	9	18	31	18	9	2	9
35-44	39	100.0	10	5	13	23	18	15	8	8
45-54	38	99.4	10	10	5	30	21	5	5	13
55-64	21	99.4	0	16	28	10	18	6	15	6
65 and over	8	(2/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
	Workers with 9 months' or more experience on job									
Under 25 ..	9	(2/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
25-34	57	98.4	4	11	18	29	16	11	2	9
35-44	39	100.0	10	5	13	23	18	15	8	8
45-54	38	99.4	10	10	5	30	21	5	5	13
55-64	21	99.4	0	16	28	10	18	6	15	6
65 and over	8	(2/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)

1/ Data were considered insufficient to present distribution.
2/ An age group containing fewer than 10 workers was considered too small for presentation of an average index.

NOTE: Because of rounding, the percentages may not equal 100.

Table 8. Indexes of output per man-hour of women office workers paid on a time-rate basis, by age group and experience on job

[Age group 35-44=100]

Age group	Number of workers	Average index	Percentage distribution of workers with indexes of--							
			Under 70	70 to 79.9	80 to 89.9	90 to 99.9	100 to 109.9	110 to 119.9	120 to 129.9	130 and over
	All workers									
Under 25 ..	302	92.8	13	15	16	21	17	8	5	5
25-34	572	99.0	7	7	14	21	24	14	5	6
35-44	712	100.0	5	6	12	25	29	13	4	5
45-54	423	99.6	7	7	16	22	22	13	5	8
55-64	147	97.5	9	6	17	24	22	11	5	6
65 and over	24	103.7	18	0	8	19	16	17	4	17
	Workers with 9 months or more experience on job									
Under 25 ..	157	95.7	9	11	17	24	19	7	6	6
25-34	467	100.6	6	6	14	22	25	15	6	7
35-44	636	100.5	5	6	11	25	30	14	4	5
45-54	383	99.8	6	7	16	23	22	13	5	8
55-64	134	97.7	9	6	17	23	23	11	6	5
65 and over	24	103.7	18	0	8	19	16	17	4	17

NOTE: Because of rounding, the percentages may not equal 100.

Table 9. Indexes of output per man-hour of women office workers paid on an incentive basis, by age group and experience on job

[Age group 35-44=100]

Age group	Number of workers	Average index	Percentage distribution of workers with indexes of--							
			Under 70	70 to 79.9	80 to 89.9	90 to 99.9	100 to 109.9	110 to 119.9	120 to 129.9	130 and over
	All workers									
Under 25 ..	753	91.6	15	13	18	21	18	8	4	4
25-34	699	99.4	7	10	16	20	21	12	8	7
35-44	486	100.0	5	6	15	24	21	14	8	5
45-54	409	98.8	5	10	16	25	19	14	7	5
55-64	204	98.8	6	5	18	30	14	11	9	6
65 and over	43	99.0	0	9	36	15	13	17	4	6
	Workers with 9 months' or more experience on job 1/									
Under 25 ..	411	99.2	6	8	17	23	23	10	6	6
25-34	404	102.9	3	7	15	21	24	13	9	8
35-44	319	101.6	2	3	15	28	24	13	8	5
45-54	317	100.4	2	8	18	25	23	14	5	5
55-64	167	101.1	2	3	19	34	14	13	9	6
65 and over	36	96.5	0	8	42	19	9	14	5	3

1/ Does not include data for about 400 workers for whom data on length of experience were not available. Previous experience in similar or identical work was not considered.

NOTE: Because of rounding, the percentages may not equal 100.

Table 10. Indexes of output per man-hour of men office workers paid on a time-rate basis, by age group and experience on job

/Age group 35-44=100/

Age group	Number of workers	Average index	Percentage distribution of workers with indexes of--							
			Under 70	70 to 79.9	80 to 89.9	90 to 99.9	100 to 109.9	110 to 119.9	120 to 129.9	130 and over
	All workers									
Under 25 ..	16	91.1	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
25-34	203	103.5	5	10	15	23	16	14	5	13
35-44	240	100.0	7	5	17	20	21	15	8	6
45-54	184	103.5	9	7	14	23	16	10	5	15
55-64	64	100.9	6	10	17	14	18	18	12	5
65 and over	15	106.6	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
	Workers with 9 months' or more experience on job									
Under 25 ..	9	(2/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
25-34	194	103.9	4	11	15	22	15	14	5	14
35-44	231	100.2	7	5	16	21	21	16	8	6
45-54	176	103.8	9	7	14	24	15	10	6	15
55-64	63	101.0	6	10	17	13	18	18	12	5
65 and over	14	105.9	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)

1/ Data were considered insufficient to present distribution.
2/ An age group containing fewer than 10 workers was considered too small for presentation of an average index.

NOTE: Because of rounding, the percentages may not equal 100.

Table 11. Indexes of output per man-hour of women office workers, by age group, occupational group, and experience on job

[Age group 35-44=100]

Age group	General clerks		Typists		Keypunch operators		Sorters, classifiers		File clerks	
	Number of workers	Average index	Number of workers	Average index	Number of workers	Average index	Number of workers	Average index	Number of workers	Average index
	All workers									
Under 25	347	93.0	168	94.0	80	85.4	90	99.4	174	88.4
25-34	573	100.3	119	102.2	78	86.6	138	100.8	128	96.0
35-44	575	100.0	91	100.0	61	100.0	120	100.0	107	100.0
45-54	387	98.6	135	100.1	39	97.5	61	103.1	58	94.9
55-64	165	98.1	38	100.7	21	97.0	18	103.6	38	102.3
65 and over .	42	98.5	3	(1/)	5	(1/)	2	(1/)	6	(1/)
	Workers with 9 months' or more experience on job 2/									
Under 25	199	95.5	92	99.4	28	100.0	45	104.4	96	96.4
25-34	460	101.3	81	105.4	25	99.6	94	103.0	71	99.5
35-44	510	100.1	74	100.4	30	98.4	88	103.9	84	102.1
45-54	348	98.7	120	101.7	19	100.6	60	103.4	45	96.5
55-64	154	97.9	35	102.4	16	96.3	16	104.1	32	102.4
65 and over .	38	96.6	3	(1/)	5	(1/)	2	(1/)	5	(1/)

1/ An age group containing fewer than 10 workers was considered too small for presentation of an average index.

2/ Does not include data for some workers for whom data on length of experience were not available. Previous experience in similar or identical work was not considered.

Table 12. Indexes of output per man-hour of women office workers, by age group and skill level 1/

[Age group 35-44=100]

Age group	Number of workers	Average index	Percentage distribution of workers with indexes of--							
			Under 70	70 to 79.9	80 to 89.9	90 to 99.9	100 to 109.9	110 to 119.9	120 to 129.9	130 and over
	Higher level jobs									
Under 25 ..	16	111.5	(2/)	(2/)	(2/)	(2/)	(2/)	(2/)	(2/)	(2/)
25-34	108	99.7	12	6	9	24	18	12	9	9
35-44	177	100.0	9	9	12	24	21	11	5	9
45-54	125	98.2	16	9	12	19	15	9	7	13
55-64	42	96.0	18	8	17	12	22	8	5	10
65 and over	7	(3/)	(2/)	(2/)	(2/)	(2/)	(2/)	(2/)	(2/)	(2/)
	Lower level jobs									
Under 25 ..	1,036	91.6	15	14	17	20	18	8	4	4
25-34	1,154	99.0	6	9	16	20	23	13	6	6
35-44	1,006	100.0	4	5	14	25	27	14	6	4
45-54	705	99.5	4	8	17	24	21	14	6	6
55-64	309	98.4	6	5	18	30	18	11	8	5
65 and over	60	101.9	4	6	27	16	16	13	5	12

1/ Higher level jobs were those in which workers were expected to exercise some independent judgment.

2/ Data were considered insufficient to present distribution.

3/ An age group containing fewer than 10 workers was considered too small for presentation of an average index.

NOTE: Because of rounding, the percentages may not equal 100.

Table 13. Indexes of output per man-hour of women office workers with 18 or more months' service with the company

[Age group 35-44=100]

Age group	Number of workers	Average index	Percentage distribution of workers with indexes of--							
			Under 70	70 to 79.9	80 to 89.9	90 to 99.9	100 to 109.9	110 to 119.9	120 to 129.9	130 and over
Under 25 ..	409	99.4	6	6	17	25	22	12	6	6
25-34	928	101.7	5	6	14	21	25	14	8	7
35-44	1,044	100.9	4	6	13	25	26	14	6	6
45-54	786	99.5	6	8	16	23	20	13	6	7
55-64	334	98.7	7	6	17	27	19	11	7	6
65 and over	67	100.9	8	5	24	17	14	17	4	10

NOTE: Because of rounding, the percentages may not equal 100.

Table 14. Indexes of output per man-hour of men office workers with 18 or more months' service with the company

[Age group 35-44=100]

Age group	Number of workers	Average index	Percentage distribution of workers with indexes of--							
			Under 70	70 to 79.9	80 to 89.9	90 to 99.9	100 to 109.9	110 to 119.9	120 to 129.9	130 and over
Under 25 ..	15	94.5	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
25-34	217	102.7	5	10	14	24	17	12	5	12
35-44	260	99.8	7	5	17	21	22	15	8	5
45-54	187	103.8	9	8	14	23	15	10	5	16
55-64	75	100.5	7	9	19	13	18	16	12	6
65 and over	17	104.2	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)

1/ Data were considered insufficient to present distribution.

NOTE: Because of rounding, the percentages may not equal 100.

APPENDIX. Scope and Method of Survey

Only companies or governmental agencies which had a work measurement system for individual clerical employees and employed both younger and older workers on comparable work were included in the survey. Twenty-one companies were found that met these criteria and data were collected covering 3,043 of their clerical employees. The five cooperating governmental agencies supplied data on 2,891 workers. Only a few offices from any one company or agency having a number of district offices were included, in order to limit the effect any one establishment would have on the final results.

Typing and secretarial work, keypunch operation, tabulating, computing and bookkeeping machine operation, operation of duplicating machines, and filing, sorting and routing and assembling records were considered to be office or clerical functions.

The geographic scope of the study was nationwide; however, no companies from the far western region met the necessary criteria. Many companies initially contacted could not be included in the study because they met only a portion of the necessary criteria, such as having group rather than individual measurement programs or employing only younger workers on measured activities during the period covered by the survey.

Concepts and Methods

For the purpose of this study productivity was defined as an individual's physical volume of production per hour worked--his output per man-hour. To derive this measure it was necessary, therefore, to obtain data on an employee's output in measurable units and to relate that output to the corresponding hours spent in its production.

For the most part, companies maintained records of the physical production which could be related to time on the job. In some cases, however, an individual's output per man-hour was measured in terms of the standard performance for his job. In such establishments, the company maintained a record of the ratio of each individual's actual output per man-hour to the standard hourly output for his job. These standards were usually obtained by measuring the production of all individuals over a period of time to determine the average or expected performance. In either case, a single output per man-hour figure was obtained, whether output was recorded directly or whether the ratio of actual to standard performance was taken. The observation period for the output per man-hour data ranged from 4 to 12 weeks in the various companies. This was a compromise between a very long period which would tend to even out atypical influences of a temporary nature, and a very short period which would permit the inclusion of a larger number of individuals.

In order to isolate the influence of age from the many other factors which affect output per man-hour and at the same time to combine measures drawn from small groups of persons into larger aggregates, certain statistical procedures were applied to the original data.

First, each individual employee was classified by age, into 1 of 6 age groups; namely, under 25, 25 to 34, 35 to 44, 45 to 54, 55 to 64, and 65 years and over. The employees were then further classified into groups by selected characteristics which might affect work performance, such as sex, specific occupation, length of service, and method of payment. The purpose of this classification was to insure that age-performance observations were made only among individuals having in common those characteristics which might have an important bearing on productivity.

This basic comparison group varied somewhat according to the method used for deriving an individual's output figure. Where records were maintained as an actual count of production, the comparison group was limited to individuals of the same sex and occupation within a company. In companies maintaining records of productivity as a percent of standard performance, the basic comparison group was broadened to include all measured workers of the same sex. The purpose was to enlarge the sample of individuals to secure greater reliability in the basic measures. This procedure was adopted only where company officials were satisfied that their standards had the same chance of achievement among the different jobs. In cases where the standards were not considered entirely comparable between occupations, the basic comparison group was limited to the same occupation within a company.

Within each basic comparison group, the average productivity for the age group 35 to 44 was determined. This group was designated as the base group and the ratio of output of each individual within the basic comparison group to the average for the base group was computed.

Through the use of these indexes and the classification system, the influence of other than age factors was largely eliminated, since each individual was being compared only with other individuals having most factors in common. The individual indexes were then comparable from one comparison group to another and combined to derive average indexes for each age group. The

combinations were made using weights based on the reliability of the individual indexes. This weight was a reflection of the number of people in the age group and the number in the base group within each comparison group, 16/ and was applied to the individual output indexes, which were combined to derive average indexes of output for each of the six age groups. 17/

Derivation of Formula

The basic age group index for each comparison group takes the form:

$$\frac{\bar{X}_{ci}}{\bar{X}_{bi}}$$

Where $\bar{X}_{ci}$ is the average performance rate of individuals within a specific age group (c) within the basic comparison group (i), and $\bar{X}_{bi}$ is the average performance rate of workers in the base group (35-44) within the same basic comparison group.

The performance rate represents output per man-hour and, as indicated elsewhere, the basic comparison group varies with type of records used. In aggregating these original indexes so that they will represent larger groupings, it is desirable that the aggregate indexes should have the minimum possible variance. Therefore, each component index is weighted according to its reliability; i.e., according to the reciprocal of its squared standard error.

16/ For formula used, see derivation of formula below.

17/ In the earlier study of factory workers' job performance by age, the combinations were made by significant groups, using constant weights in order to minimize the effects of other factors on the data. This method was not considered necessary in this study and in order to obtain the distribution of indexes the data were combined as described above. A comparison of both methods showed the results to be similar.

If the numerator and denominator samples are uncorrelated, then the rel-variance of each group index for a direct comparison group is

$$V^2(I_{ci}) = \frac{V_c^2}{N_{ci}} + \frac{V_b^2}{N_{bi}}$$

where V_c^2 and V_b^2 are the population rel-variances of the individual scores and N_{ci} and N_{bi} are number of individuals in the age group and base group, respectively. Another form of $V^2(I_{ci})$ is

$$V^2(I_{ci}) = \frac{V_c^2 \left(\frac{V_b^2}{V_c^2} N_{ci} + N_{bi} \right)}{N_{bi} N_{ci}} .$$

Setting $$W_i = \frac{N_{bi} N_{ci}}{\frac{V_b^2}{V_c^2} N_{ci} + N_{bi}} ,$$

then $$V^2(I_{ci}) = \frac{V_c^2}{W_{ci}} ; \quad \text{but} \quad V^2(I_{ci}) = \frac{\sigma^2(I_{ci})}{I_c^2}$$

where I_c is the population index for age group c and $\sigma^2(I_{ci})$ is the variance of the sample index.

Using the reciprocal of each direct comparison group sample index as the weight, then the aggregate index is

$$\frac{\sum \frac{1}{\sigma^2(I_{ci})} I_{ci}}{\sum \frac{1}{\sigma^2(I_{ci})}} = \frac{\sum \frac{W_i}{V_c^2 I_c^2} I_{ci}}{\sum \frac{W_i}{V_c^2 I_c^2}} .$$

Since V_c^2 and I_c^2 are constant with respect to the summation,

$$\bar{I}_c = \frac{\sum W_i I_{ci}}{\sum W_i} = \sum \frac{N_{bi} N_{ci} I_{ci}}{\frac{V_b^2}{V_c^2} N_{ci} + N_{bi}} \Bigg/ \sum \frac{N_{bi} N_{ci}}{\frac{V_b^2}{V_c^2} N_{ci} + N_{bi}}$$

If the assumption is made that the rel-variance of the age groups are the same, i.e. $V_b^2 = V_c^2$

then, $W_i = \frac{N_{bi} N_{ci}}{N_{bi} + N_{ci}}$.

If these weights were to be applied to individuals within each group, the weight for any individual in age group c and comparison group i would be found by dividing the above formula by the number of individuals in group c to get

$$W_i = \frac{N_{bi}}{N_{bi} + N_{ci}} .$$

The basic form used in collecting the data is reproduced below.

BLS 2482B WORKSHEET

1-3	4-5	6-7	8	9-10	11-12	13	14-16	17	18	19	20
EMPLOYEE I.D. #	COMPANY CODE	DEPARTMENT CODE	M=1 F=2	DATE OF BIRTH	AGE	AGE GROUP	OCCUPATION CODE		I=1 T=2	U=1 L=2	G=1 P=2

21-22	23-25	26-29	30	31-34	35	36-38	39-41	42-45	46-49	50-51
DISTRIBUTION CLASS	BASE HOURLY WAGE	DATE OF HIRE	LENGTH OF SERVICE CODE	DATE ON PRESENT JOB	EXPERIENCE ON JOB CODE	NUMBER IN AGE GROUP	NUMBER IN BASE GROUP	AVERAGE INDIVIDUAL OUTPUT	AVERAGE BASE GROUP OUTPUT	WEIGHT

OCCUPATION

LEARNER'S TIME

PERIOD ENDING	OUTPUT	MANHOURS	OUTPUT INCENTIVE OR RELATIVE	QUALITY RATING
1				
2				
3				
4				
5				
6				
7				
8				
TOTAL				
AVERAGE				

EMPLOYEE'S NAME

COMPANY

DEPARTMENT

★ U.S. GOVERNMENT PRINTING OFFICE : 1960 O—540764