APPRENTICESHIP TRAINING IN THE U.S. CONSTRUCTION INDUSTRY

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1. INTRODUCTION

Training is a topic of urgency for policymakers, industry groups and academics because it is linked with the pressing questions of the maintenance and expansion of high-skill labor force as well as the integration of women and minorities into the “non-traditional” occupations. Industry groups, for some time now, are warning about the persisting labor shortages in skilled trades (Business Roundtable, 1997). In spite of the advances that took place since the 1960s, labor market also remains segmented along gender and racial/ethnic lines. It is merely a platitude to emphasize the importance of training to achieve these goals. The question of how training should be done remains, however, controversial. Sources of disagreement include relative merits of alternative training systems, the potential of market failure in training, the role of unions, and the need for labor market regulation. Apprenticeship training, the focus of this paper, is particularly contentious. While some attack it as an outmoded and inflexible form of training, others argue that apprenticeship provides the best method to learn a craft by rigorously combining theoretical in-class and practical on-the-job (OJT) instruction. Extensive involvement of trade unions in apprenticeship training is alleged by some to inhibit training by limiting new entries and preserving better paying jobs for union members. The opposing view is that unions enhance training by participating in the creation of institutional framework that alleviates the problem of market failure in training. Promoters of apprenticeship maintain that it can be a tool to bring women and minorities to occupations from which they are traditionally excluded by virtue of apprenticeship programs’ well-specified and documented, objective entrance requirements and curriculum. Critics see it as an instrument of exclusion under the control of white males,

discriminating against women and people of color and preventing them from entering higher-paid skilled trades.[1]

Since the 1960s these questions are debated within academia, industry, and the government, generating a small but lively literature but they are far from being resolved. One obstacle that emerges in the debate is the dearth of data and actual information on the performance of apprentices and apprenticeship programs, especially for the more recent period. This is attributable, in part, to the changes in the apprenticeship information collection system during the 1980s. In the absence of data, the debate over the merits and faults of the apprenticeship systems runs the risk of becoming polemical or speculative. This paper attempts to mitigate this peril. It will not attempt to evaluate the controversies regarding apprenticeship training. Instead, it will utilize the data compiled by the Bureau of Apprenticeship Training (BAT) of the U.S. Department of Labor, to summarize some patterns observed in apprenticeship training between 1989 and 1995. My objective is to furnish a descriptive statistical background to facilitate a more informed and productive discussion of apprentices and apprenticeship programs. I will focus on the construction industry since the majority of apprentices are trained in building trades. Among all industries, construction is most seriously threatened by skill shortages because of its relatively old labor force, high young worker attrition rate, and inability to attract new workers.

The paper is organized as follows. The following section describes the basic features of apprenticeship training in the U.S. Section 3 describes the data. In section 4, I discuss the occupational distribution of apprentices and apprenticeship programs. Section 5 compares and contrasts apprenticeship programs sponsored solely by employers and jointly by management

[1] On debates over apprenticeship training raining, the role of unions, and alternative forms of training, see Mills (1972, Ch. Chs. 7, 8), Northrup and Foster (1975, Ch. 10), Bourdon and Leavitt (1980, 73-77), Glover (1989), Riccucci (1990), Northrup (1992), and Finkel (1997, Ch. 13).

and union. Relative effectiveness of these two types of programs is discussed in section 6. Section 7 describes the gender, ethnic/racial composition and age distribution of apprentices, their prior experience and their performance in the apprenticeship training. Main findings of the study are summarized in the concluding section.

2. APPRENTICESHIP IN THE U.S.

Apprenticeship is distinguished from other methods of training by the reciprocal rights and obligations it imposes on the provider and the receiver of training. The provider agrees to teach a broad range of skills required practicing an occupation and, in return, the apprentice agrees to work for the provider at a wage lower than that of a skilled worker. The system works on the premise that both sides would fulfill their obligations, which requires a formal or informal agreement.

The history of apprenticeship in Europe goes back to the Middle Ages. Introduced to the U.S by immigrants, apprenticeship has not become as significant a port of entry into skilled crafts in the U.S as in Europe. Factors that account for the inability of the apprenticeship to grow stronger in the U.S. include the difficulty of enforcement of apprenticeship contract in the midst of high degree of employment opportunities and geographic mobility, ready supply of immigrant workers to meet the skilled labor needs, and the expansion of mass production systems in manufacturing which reduced the demand for craftsworkers. One significant component of the institutional structure of apprenticeship training in the European countries, labor unions and multi-employer bargaining, was also missing in many sectors of the U.S. economy. Thus

apprenticeship in the U.S. failed to gain a strong foothold in the U.S., and by early 20th century was limited to a few crafts-based (mostly construction) trades.[2]

There were legislative attempts to expand apprenticeship training in the 1930s, and the administrative structure of the current National Apprenticeship Program is the product of these early efforts.[3] Currently, the Bureau of Apprenticeship Training (BAT) of the Department of Labor oversees the apprenticeship system. The primary objective of the BAT is to promote apprenticeship training. To this end, it determines the standards registered apprenticeship programs must implement, enforces compliance with these standards, provides technical assistance to establish and develop apprenticeship programs, registers apprenticeship programs, certifies registered apprentices, and monitors the progress of programs and appliances. The BAT also recognizes State Apprenticeship Agencies or Councils (SAC). In 27 states where they are established, SACs register and administer apprenticeship programs.[4] Although the registration of programs is not mandatory, program sponsors may prefer registration because it implies recognition of the adherence of the programs to apprenticeship standards, and apprentices who finish these programs are certified as skilled craftworkers by the BAT or the SAC. Another incentive to register is that employers do not pay registered apprentices journeyworker wages in Federal contracts.

Apprenticeship programs are sponsored either jointly by union and contractors signatory to collective bargaining, or unilaterally by employers. The BAT refers to these types of programs

[2] See Elbaum (1991), Jacoby (1991), Elbaum and Singh (1995), and Gospel (1994) for discussions of the history of apprenticeship in the U.S.

[3] For a detailed discussion of the evolution and current characteristics of the administrative structure of current national apprenticeship system see Bennici (1994, 9-23).

[4] See the Appendix for the list of BAT and SAC States (and the number of newly registered apprentices in each state).

as “joint” and “non-joint,” respectively, and I will adopt the same terminology. In joint programs the apprentice is indentured to the Joint Apprenticeship Committee (JAC) composed of equal numbers of representatives of employer(s) and the union. Although joint programs operate exclusively in the union sector of the construction industry, it is possible for the unilateral apprenticeship programs to coexist with collective bargaining. In general, however, unilateral programs characterize the open-shop sector of the industry. In either type of program employers may be single or multiple.

The central debate concerning the need for union-management cooperation in training is the potential of market failure. The employer-employee relationship is ephemeral in the construction industry. Since workers move constantly from one job site to another and from one contractor to another, there is no incentive for the employer to invest in training, and economic theory suggests that the trainee should pay for training. Credit constraints, asymmetric information, and other market imperfections, however, may prevent employees from acquiring sufficient training. One solution to this market failure problem is distributing the costs and benefits of training across the parties which have a stake in training -- unions, contractors and workers. There are varieties of institutional structures of union-employer cooperation in training across countries, with varying degrees of success. In the U.S., in joint apprenticeship programs signatory contractors contribute a pre-determined amount into the training fund per hour of labor employed (and hence the training costs are factored into the bids) and hire apprentices[5]; unions provide training coordinator, instructors, and participate in the administration of the program; and trainees accept apprenticeship wages.

[5] The number of journeyworkers per apprentice hired is also set by the collective bargaining agreement.

The central question of this study is to evaluate the relative performance of the joint and non-joint apprenticeship programs. There are few studies that undertake this task. GAO (1992) summarized the state of apprenticeship training using nationwide data from the BAT. It determined that the total number of apprentices in training constitutes a small portion of the civilian labor force (less than one percent), and that it has declined in relative terms between 1970 and 1990. About two-thirds of all apprentices are concentrated in 20 occupations out of more than 800 occupations recognized as apprenticeable by the BAT, and the majority of apprentices are in the construction industry. The share of minorities in apprenticeship has increased since the 1970s, but they seem to be confined to lower-skill, lower-pay occupations. Women's participation has remained very low (around seven percent) over the last 20 years and is limited to a few low-paying and traditionally female occupations. GAO did not report any information on the joint and non-joint apprenticeship programs. Bennici (1994), however, found that about half of the more than 40,000 registered programs did not have any apprentices in 1990, and although majority of the programs is unilateral, most of the apprentices are trained in the joint programs. In addition to these nationwide studies, there are also some statewide reports on apprenticeship training. Londrigan and Wise (1997) provide comparative information on the performance of unilateral and joint programs in Kentucky between 1985 and 1993. They present data showing that union programs not only had more apprentices but also experienced higher completion rates, and were more diverse in terms of race/ethnicity and gender.

Similar to these studies, the present paper is also descriptive. It will attempt to update the information presented in these studies and cover some aspects of apprenticeship training not addressed in these works.

3. THE DATA

Until 1979, data on apprenticeships were collected by the State and National Apprenticeship System (SNAPS) of the BAT, but this information management system was discontinued in 1979. By the late 1980s the Apprenticeship Information Management Systems (AIMS) of the BAT became operational and the raw data for this study come from this database. The most serious shortcoming of the AIMS dataset is that it does not include any information from seven SAC states that do not report to the BAT (California, Delaware, District of Columbia, Hawaii, North Carolina, Oregon, Wisconsin and Washington). Furthermore, data from some SAC states seem to be incomplete (e.g. New York, Connecticut, Massachusetts). Since the data prior to 1989 are also seriously incomplete, apprentices enrolled during this year constitute the starting point of my analysis. The final date for which data are available is November 1995. GAO (1992) reports that the AIMS dataset covers about 70 percent of all registered apprentices in the U.S.

All apprenticeship programs classified under the SIC industry codes between 1500 to 1799 are included in this study. I exclude the military and the prison apprenticeship programs. After excluding these, the population under study consists of almost 197,000 apprentices, which constitute 52 percent of all the new registrations between 1989 and 1995. Distribution of apprentices across states in reported in Appendix A. I will pay special attention to the ten largest trades (measured in terms of the apprentices enrolled). These are bricklaying, carpentry, electrical, operating engineer, painting, pipefitting, plumbing, roofing, sheet metal, and structural steel trades. The AMS codes of these occupations and their term lengths are reported in Appendix B.

4. OCCUPATIONAL DISTRIBUTION OF APPRENTICES AND APPRENTICESHIP PROGRAMS

Table 1 shows the distribution of new apprentices by year. The number of new apprentices registered between 1989 and 1995 was 196,374. No discernible trend emerges from the time series of six years. Annual new registrations declined in 1991 and 1992, paralleling the business cycle downturn with a one-year lag. Enrollment figures increased after 1993, reaching the peak level in 1994, and declined in 1995. The 1995 figures do not include apprentices registered in December. Even after this caveat, however, there seems to be a sharp decline in new trainees in 1995. Only with more recent information would it be possible to tell whether this is a temporary reduction or the start of a new trend.

Sponsorship is a critical factor in the success of an apprenticeship program because the sponsor carries out the day-to-day administration of the program, including selection of the apprentices among the applicants, job allocation, and monitoring and evaluation of their performance throughout training. The BAT provides very general guidelines concerning training standards. Practices of the individual SACs may differ across the states and some may impose more stringent standards than the others do. Under these Federal or state guidelines, it is the responsibility of the sponsor to determine the actual content, requirements, and curriculum of the training program.

The second and third columns of Table 1 show the distribution of new apprentices between the joint and non-joint programs over years. Overall, approximately 73 percent of the new apprentices were enrolled in joint programs. The distribution across program types is relatively stable over years, with joint programs accounting for 71 to 76 percent of new enrollments.

Table 2 breaks down new registration by occupation. Apprentices were not distributed uniformly across the trades. In terms of size, three discernible groups emerge. The first group of trades includes electrical and carpenter trades, accounting for 28 and 17 percent of all apprentices, respectively. A second group consists of sheet metal workers, pipefitters, plumbers, and roofers, each with six to nine percent of all new apprentices. The third group includes bricklayers, operating engineers, painters, and structural steel workers, each accounting for less that five percent of the new registrations.

Table 2 also shows the distribution of all new apprentices during the 1989-1995 period across joint and non-joint sponsorship. On average three new apprentices were registered in joint programs for every apprentice registered in a non-joint program. The majority of new enrollments were in joint programs in every trade, although there is some variations across trades. In operating engineer and painting trades the share of the non-joint programs is less than ten percent, and in the case of structural steel, it is almost nil. Non-joint program apprentices are concentrated in several trades. In relative terms, non-joint programs had the highest enrollments in electrical and plumbing trades, accounting for almost half of the new apprentices in each, followed by pipefitting and sheet metal trades. These electrical and mechanical trades are generally recognized as higher-skill trades and more frequently subject to state licensing regulations, which may explain the relatively large number of non-joint enrollments. Upon further examination, it is observed that the pattern holds even in states where these trades do not require licensing, shedding doubt on the pertinence of this explanation.

Table 3 focuses on apprenticeship programs. I define an “active” program as one in which at least one new apprentice registered during the 1989-1995 period. A total of 7,266 programs were active during the 1989-1995 period. More than half of these were in the electrician trade,

followed by plumbing. The second and the third columns of Table 3 report the joint—non-joint distribution of active programs. More than 70 percent of all programs were sponsored unilaterally by employers. The large number of non-joint programs in is accounted by two trades, electrical and plumbing. More than two-thirds of the non-joint programs operated and two-thirds of the non-joint apprentices were enrolled (according to Table 2) in these occupations.

Distributions of apprentices and program across sponsor types suggest that non-joint programs on average have far fewer apprentices than the joint programs. I define the "size" of a program as the number of new entrants during the 1989-1995 period. The last three columns of Table 3 report average program sizes. Across all trades and program types, the average program size was 27 apprentices, ranging from 11 (plumber) to 75 (roofer, structural steel). There was significant variation across trades and sponsor types, however. Second, there is a wide discrepancy between the average sizes of joint and non-joint programs. The average joint program size is 68 apprentices, almost seven times as large as the average non-joint program.

The open-shop sector of the industry, however, has attempted to pool its resources to establish apprenticeship programs that can exploit economies of scale as well. These programs involve multiple employers and which are generally coordinated and administered by contractor associations like Associated Building Contractors. The data distinguish between the single and multiple employer non-joint programs, which may be used as an first approximation to the extent of these efforts. As Table 4 illustrates, almost two-thirds of all non-joint apprentices were registered in the multi-employer programs,[6] while only 11 percent of the non-joint programs were multi-employer sponsored. Multi-employer programs had more than at least twice as many apprentices than the single-employer programs in carpentry, electrical, operating engineer, and

[6] In the joint programs, single employers programs account for less than one percent of all registrations.

sheet metal trades. These suggest that multi-employer programs are greater in size that the single-employer programs. The last two columns of Table 4 indicate the sharp scale difference between the two types of non-joint programs. While the overall size of single-employer programs is only four, the average size of multi-employer programs is 61, almost as high as the joint-programs. This outcome is attributable to the electrician programs which, on average, is larger than the joint programs. While union programs are on average still significantly larger than the multi-employer non-joint programs in most trades, non-joint multi-employer programs are on average larger than the joint programs in electrical trades. While the average size of non-joint multi-employer plumbing and pipefitting trades come close to their joint counterparts, they are far smaller in all other trades.

The size difference may have significant implications for the effectiveness of programs. If there exist economies of scale in training whereby larger programs deliver training more efficiently and effectively, then one may expect to observe significant advantages enjoyed by joint programs in comparison with the non-joint, and multi-employer programs, in comparison with the single employer.

Experience may complement the size in improving the efficiency of training programs. The joint and non-joint programs exhibit significant differences in terms of their life span. Among all the active programs, 16 percent of the non-joint and six percent of the joint programs were cancelled between 1989 and 1995. Moreover, on average, joint programs remain in operation for a much longer period of time than the non-joint programs. The median age of the joint programs still active in November 1995, was 27.7 years. The median age for joint programs that were cancelled was 15.8 years. The corresponding figures for the non-joint programs, on the other

hand, were 4.9 and 4.2 years. Thus, the non-joint programs have a much higher turnover rate which may affect their ability to deliver training effectively.

7. PERFORMANCE OF APPRENTICES

The status of each registered apprentice as of the last day of data collection (November 30, 1995) is identified as cancellation, completion, or still active.[7] Whether an apprentice completes the program or not depends on a variety of factors related the personal, occupational, and program characteristics, and the labor market conditions. I will consider the relationship between individual characteristics and the status in the next section. The impact of labor market conditions on the performance of the apprentices is outside the realm of this study and will not be considered here. In this section the focus is on the relationship between the program sponsorship, occupation, and the performance of the apprentice.

Since term lengths of apprenticeship programs in occupations can last up to five years, I considered only the apprenticeship classes of 1989, 1990 and 1991 in evaluating the apprenticeship performance. It should be borne in mind that termination of apprenticeship does not necessarily imply failure. If an apprentice quits the program upon discovering that he/she is not satisfied with the occupation, it does not mean that the apprentice or the program has been unsuccessful. An apprentice who has learned sufficient skills and has the opportunity to work at the journey-level may also drop out to take advantage of the higher non-apprentice wages. Conversely, in a joint program, an apprentice may complete the program not to learn more skills,

[7] The AIMS data record an apprentice who has transferred to another occupation or program as a quit from the first program and a new apprentice in the second program. Similarly, if there are any are any errors in the entry record of an apprentices (e.g. misrecording the age or occupation) then the apprentice is recorded as a quit and then a new record is opened. Where they were detectable, I corrected such problems which accounted for about eight percent of all cancellations.

but to maintain union membership and the access to the hiring hall. Thus, the status is not the best indicator of the success of the apprentice or the program, and the reported findings should be interpreted accordingly. In the AIMS dataset there are remarks indicating the reasons for dropping-out for some of the apprentices. But these remarks are not standardized and their quality is, at this point in time, dubious.

Chart 1 summarizes the relative performance of apprentices in joint and non-joint programs. Forty-one percent of the joint and 25 percent of non-joint program apprentices complete the programs. The respective cancellation rates are 37 and 54 percent, mirroring the completion rates. Thus joint programs experience significantly higher retention and lower attrition rates than the non-joint programs. Table 5 provides more detailed information by occupation. The completion rates are the highest in the electrical, sheetmetal, and structural steel trades, passing 45 percent level in the joint and the 25 percent level in the non-joint programs. In some occupations such as roofer, painter and carpenter, cancellation rates exceed easily 50 percent, regardless of sponsorship type. While it would be hasty to pass judgement about the performance of programs on the basis of these figures without further information on why apprentices drop out, the high cancellation rates presents and worrisome picture. Nonetheless, the comparative completion rates suggest that the joint programs are more effective in graduating apprentices. This finding seems to support to contention that the institutional framework created by the union-management cooperation is more conducive to the continuation and completion of training.

The greater ability of the union programs to turn out journeyworkers may in part be attributable their size. Earlier, however, it was also shown that non-joint multi-employer programs attain larger size in certain trades. The next question is whether these larger multi-employer programs are more effective in graduating apprentices than their single employer

counterparts that have much smaller sizes. Table 6 indicates that this is not the case. There are no significant differences between the single- and multi-employer programs in terms of the performance of apprentices. The overall rates of completion are virtually identical at 26 and 24 percent, respectively. Even in the electrician programs, where the average size of non-joint multi employer programs is higher than the joint program average size, the multi-employer non-joint programs do not perform better than the single-employer programs, and lag far behind the joint programs in terms of the completion rate.

Table 7 combines the information available on the enrollment and completion statistics to evaluate the relative contribution of joint and non-joint apprenticeship programs to the new entrants into the journeyworker labor force. The last row of this Table shows that 82 percent of the graduates of apprenticeship classes of 1989, 1990 and 1991 completed joint programs while the remaining 18 percent completed non-joint programs. In view of the fact that only 15 percent of the construction workforce is unionized, this figure shows that the unionized sector of the industry performs a disproportionately greater volume of apprenticeship training. In operating engineer, painter, and structural steel trades, the contribution of the non-union sector to the trained labor force is virtually non-existent. Even in the electrical and mechanical trades, where non-joint program enrollments are relatively higher, the contribution of the non-joint programs are quite limited, reaching as high as 30 and 34 percent for electrical and plumbing trades, respectively.

Open shop representatives of the construction industry frequently express that the high rate of attrition in non-joint programs is simply a consequence of the unnecessarily lengthy training periods imposed by the BAT (and trade unions). The argument is that the apprentices learn the sufficient skills to work at the journey-level within a shorter period of time and leave

apprenticeship before fulfilling the required on the job training hours. The union apprentice would not take this route unless he or she is willing to quit from union as well. Thus, the cancellation of the apprenticeship does not imply relatively low performance of the non-joint program. The data record the dates of cancellation or completion in addition to the enrollment date. I used this information to evaluate how far the apprentice was into the program by the time he or she dropped-out (or graduated), and compare the joint and the non-joint programs in terms of duration of training. Since term lengths differ across trades, the absolute training periods do not lend themselves to aggregation and some normalization procedure is necessary. In order to solve this problem, I measured the time elapsed between registration and the time of termination as the percentage of the total term length of each occupation. Before reporting the results on the duration of training of the drop-outs, two caveats are in order. First, these results should be interpreted cautiously because the recorded dates are the administrative apprenticeship cancellation dates and could have been recorded after the date the apprentice actually drops-out. Hence, the measured elapsed time may overstate the actual. Secondly, the time spent in training until termination period is an imperfect proxy for the quantity of training the apprentice has acquired because the quantity (and quality) of training also depends on other factors such as the apprentice's motivation and job availability during apprenticeship.

Chart 2 gives detailed information on the timing of the termination. The vertical axis measures what percentage of the drop-outs cancelled at any point during training. The horizontal axis of the chart measures the training period as the percentage of the term length that has elapsed at the time of termination. For instance 12.3 percent of the joint and 15.6 percent of the non-joint drop-outs cancelled by the time 10 percent of the term length has expired. Thus, the curves on Chart 2 can be interpreted as the "over-time attrition rate" schedule. According to this

chart, the over-time attrition rates are quite close for the two types of programs although joint program apprentices stick with the training program for a slightly longer duration than the non-joint program apprentices before they drop off. Attrition rate of the non-joint programs is slightly higher than that of the joint programs early in the apprenticeship period, during the first 30 percent of the term length. The median joint-program quitter completed 42 percent of the term length while the median non-joint program quitter completed 36 percent of the term length. Cancellations of non-joint apprentices are concentrated at the early stages of training and whether this much training provides sufficient learning of skills is dubious, especially keeping in mind that up to six months often passes between the registration and the actual start of OJT training. This finding sheds doubt on the credibility of the argument that non-joint apprentices receive the necessary journey-level skills by the time they quit.

Chart 3 compares the joint and non-joint programs in terms of the rate at which graduates complete the program. By construction, it is similar to chart 2. It shows, for instance, that it took the completion of full term for 19.6 percent of the joint program graduate and 26.1 percent of non-joint graduates to complete the apprenticeship training program. This diagram suggests that apprentices who graduate from the non-joint programs do it at a significantly faster pace than the graduates of the joint programs. Explanation why this is so requires a more detailed multivariate analysis.

6. DEMOGRAPHIC COMPOSITION OF APPRENTICES

The AIMS dataset provides information on the age, sex, race/ethnicity, and education of apprentices. In this section I will discuss three of these characteristics: sex, ethnicity/race, and age composition of apprentices, and compare the demographic distribution of apprentices across

joint and non-joint programs. I exclude education because of the large number of missing values concerning this variable in the data.

Minority's and Women's Share in Apprenticeship Training:

People of color and women were historically excluded from the building trades. The ethnic/racial minorities started making inroads into construction crafts after the 1964 Civil Rights Act.[8] In 1965, President Johnson signed an Executive Order, which required affirmative action for minorities on federally assisted construction projects. Since then, the share of minorities in construction labor force as well as apprenticeship programs has increased. I will refer to Asian, Black, Hispanic and Native Americans as minorities. According to Table 8, approximately 19 percent of apprentices belonged to minority groups, which is roughly comparable to their proportion in the population. Minority shares are the highest in roofer trade, followed by painter, operating engineer trades. Electrical and mechanical trades have relatively fewer minority apprentices, which raises the question of exclusion of minorities from the "higher-skill trades." Representations of the people of color in joint and non-joint programs are quite close. The share of minorities in joint programs is 2.4 percentage higher than their share in non-joint programs.

The change in legal environment came much later for women. After women's groups sued the U.S. DOL in1976, President Carter expanded Johnson's Executive Order in 1978 to cover women, and also set goals and timetables to provide equal opportunity employment for women in construction industry. Although there was a surge of women applying to apprenticeship programs following these new regulations, the momentum weakened in the 1980s, and women workers failed to gain a strong foothold in the construction industry. Table 9 reports the shares of women by occupations and program types. This Table suggests that construction remains a

[8] Data allow distinguishing between these groups, but I will not attempt this here.

bastion of male dominance. Overall, women's representation is very low, constituting 4.5 percent of all apprentices. Women's share in joint programs is almost twice as high as the non-joint program share, but reaching only 5.2 percent. One trade, operating engineers stand out with more than 20 percent share of women apprentices in both joint and non-joint programs. This may be an outcome of the long-standing active out-reach and recruitment efforts of operating engineer apprenticeship program sponsors, as well as extensive employment of operating engineers by the government, especially in road construction, and the associated regulations. Shares of women in the painting trade (8.4 percent) is also higher than overall average, but this figure is driven primarily by women's enrollment in joint programs.

GOA (1992) has stated that women and minorities tend to concentrate in occupations with lower earnings. I calculated the correlation coefficients between the women's and minorities' shares on apprenticeship, on the one hand, and the median weekly earnings of the occupation on the other. The correlation coefficient between the share of women in apprenticeship and median earnings, for the ten occupations considered here, is 0.03, which indicates no relationship between the two variables. This is not surprising because more extensive involvement of women in training programs of lower paying service occupations drove the GAO result. The relationship between the minority share and median is significantly stronger. In this case the correlation coefficient turns out to be –0.67, suggesting that minorities are concentrated in lower paying trades. I also calculated the correlation coefficients between the women and minority shares and the term length of the apprenticeship programs. The correlation coefficients are –0.36 and –0.74. If the term length can be taken as a proxy for the skill level of the trade, these coefficients indicate that women and, to a greater extent, minorities are concentrated in the lower skill trades.

Relative Performances of Minority and Women Apprentices:

Chart 4 compares the performances of white and minority apprentices of the joint and non-joint 1989, 1990 and 1991 classes. Table 10 provides more detailed information on the rates of completion across occupations and program types. Two results follow from these figures. First, regardless of the program type, white apprentices are more likely to complete the program than the apprentices of color. While 44 percent of whites in joint programs completed, only 28 percent of the minorities did. In the non-joint programs, the completion rate of whites is also higher than that of the minorities, by almost ten percentage points. The lower completion rates of minorities (or their higher cancellation rates) require further analysis in order to uncover the relative impacts of personal and institutional factors on their performance.

The second point that follows from Chart 4 and Table 10 is that regardless of their ethnic or racial origin, apprentices in joint programs are more likely to complete than the non-joint apprentices do. The comparison of columns 2 and 3 underscores this point. Overall, almost 28 percent of the minority apprentices in joint programs completed training and became journeyworkers. This is slightly higher than the completion rate of non-joint white apprentices and significantly higher than the minority non-joint apprentices. The joint programs, however seem to have a relatively higher benefit for the white apprentices. Completion rate of whites in joint programs is 18 percentage points higher than their non-joint counterparts. This differential is 10 percentage points for the minorities.;

Chart 5 and Table 11 make similar comparisons for the relative performances of male and female apprentices. Overall, men are more likely to complete than women in both kinds of programs, by roughly 15 percentage points. Across trade and program types, men are more likely to complete than women. The completion rate of women in joint programs exceeds that of the

men in non-joint programs by five percentage points. Joint programs help both men and women to complete training raising the completion of women by 19 and men by 16 percentage points relative to their non-joint peers.

Age of the Apprentices at the Start of Training:

The median apprentice age at the time of enrollment is 25 and about 50 percent of the new apprentices were in the 20-28 age bracket. This median age is significantly higher than what is observed in the European countries where high school and apprenticeship training are more closely integrated. In the U.S., there is a significant interval of time between high school graduation and the entry into the apprenticeship training. Across demographic groups there are considerable differences in the median age. Median woman apprentice was 29.4 years old while the median male apprentice was 24.8 years old when they entered the program. Thus, women tend to start apprenticeship at a later age than men do. Similarly, minority apprentices tend to be older than the white apprentices at the start of training. The median ages of these two groups were 26.7 and 24.6, respectively. The median age differences between men and women, and whites and minorities were both statistically significant.

Previous Experience of Apprentices:

Apprenticeship standards require 2,000 hours of OJT training per year. New apprentices, however, may receive credit toward fulfillment of this requirement if they have previous experience in the trade. The apprenticeship training coordinator decides how many hours of credit an apprentice deserves. I used these credit hours to evaluate the previous experience of apprentices across program types, minority status, and gender. This required first standardization of the OJT credit hours across trades, because the latter have different term lengths, i.e. total OJT requirements. For this purpose, I expressed the number of credit hours each apprentice is

awarded as a percentage of the total OJT hour requirement. Table 12 summarizes the distribution of credit hours as percentages across program types and demographic groups for the ten largest trades. In joint programs, for instance, 79.03 percent of the apprentices did not receive ant OJT credit, while 9.67 percent was awarded credit that was equivalent to less than ten percent of the required OJT hours. In the non-joint programs, on the other hand, 68.43 percent of the apprentices did not get any credit, and 14.32 percent received credit equaling less than 10 percent of the required hours of training. Relatively higher OJT credit awarded in the non-joint programs may be a contributing factor to the relatively shorter time it takes to graduate from the programs in the non-joint programs, albeit a very modest one if at all given the magnitudes credit and time to complete.

Table 12 indicates that the majority of apprentices does not have any experience, and receive no credit at the time of enrollment, regardless of program type, minority status or gender. The mean and median credit hours are (as percentage of the required training) 0.05 and 0.0 percent, respectively. There are some differences between the different categories of apprentices, however. First, comparison of columns 1 and 2 of Table 12 shows that apprentices in non-joint programs are more likely to be awarded OJT credit than the joint-program apprentices. Whether this is because of the difference between the personal characteristics of apprentices enrolling in these types of programs, or differential standards applied in joint and non-joint programs one subject for future research. Secondly, men are more likely to be awarded credit hours than the women. Again, individual characteristics of men vs. women and differential attitudes of the program coordinators to men and women may account for this outcome, and the determination of relative contributions of each factor requires further research. In contrast, there does not appear to be any difference between whites and minorities in terms of the credit hours, which is

probably an outcome of the continuing integration of minorities into the construction labor force over the last three decades.

7. CONCLUSION

Construction industry has been suffering from high attrition rate among the younger members of the crafts workers and inability to attract new workers in sufficient numbers. One significant construction industry trade paper, *Engineering News Record* has been warning about the chronic and worsening skills shortage for over a decade. The Business Roundtable (1997) has emphasized that craft training is a requisite to improve the image of the construction industry and solve the retention problem. Unless these problems are resolved, costs will escalate, schedule delays will be endemic, and the quality of construction will suffer. Apprenticeship is the traditional method of training by which construction workers learn and teach their craft, and it has a critical role in alleviating the skills shortage in the industry.

This study described the performance of apprentices and apprenticeship programs in the U.S. construction industry and compared programs that are sponsored jointly by unions and contractors signatory to collective bargaining and unilaterally by contractors. It has determined that there is a wide discrepancy between the performances of the apprentices enrolled in the two types of programs. The majority of apprentices are in the joint programs, and an overwhelming number of the apprentices who reach journey-level status are trained in the joint programs. Although non-joint programs account for most of the apprenticeship programs, they are on average are much smaller in size than the joint programs. The average size of multi-employer non-joint programs are significantly larger but their performance, measured in terms of the percentage of the apprentices they graduate, is no different from the much smaller single-

employer non-joint programs. The life span of non-joint programs is also much shorter than that of the joint programs.

People of color are well-represented in both the joint and the non-joint apprenticeship programs, although their number are relatively higher in the lower-skill trades. The construction labor force may remain a male dominated industry in the future, however. Women constitute a small fraction of the apprentices. Their relative representation is twice as high in joint programs than the non-joint programs. The performances of both minorities and women exhibit stark differences across the two types of programs. Although the completion rate of whites is higher than the completion rate of minorities, there is no difference between the completion rates of minorities in joint programs and the whites in non-joint programs. Similarly, the completion rate of male apprentices is higher than that of the women apprentices. The completion rate of women in joint programs, however, exceeds the completion rate of men in non-joint programs.

Given the relative effectiveness of union-management joint apprenticeship programs, it is not surprising that the Business Roundtable recommends the expansion of similar apprenticeship programs in the open-shop sector. The source of the problem for the open-shop sector is that in construction skills are general and ties that bind the worker and the employer are very loose. Individual contractor does not have an incentive to train because there is no guarantee that he or she will reap the benefits of this investment. Individual worker, who is expected to bear the costs of training exclusively under these conditions may choose not to invest in human capital either, given imperfect capital markets, or uncertainty over the quality of training. Creation of an extra-market institution to distribute risks as well as benefits across the whole industry is necessary to overcome market failure generating low-training, low-skill, low productivity nexus. The joint program seem to perform this function in the U.S. in the unionized sector of construction.

Whether a similar institution can be replicated in the open-shop sector is doubtful. Given the performance of the multi-employer non-joint programs, there is reason to be pessimistic about such efforts coming to fruition.

Although training performed under the joint sponsorship of unions and contractors signatory to collective bargaining is more successful in attracting new workers and graduating them to journey-level regardless of race/ethnicity and gender, there is little reason to be complacent about their performance. There is significant room for improving the performance of the joint programs. The overall completion rate in joint programs hardly reaches 50 percent. Within the joint programs, there are differences in completion rates in favor of whites and minorities. With few exceptions, the participation of women in apprenticeship training in joint programs across trades is hardly satisfactory. As the unionization rate declines the enrollment figures and the performance of apprentices may suffer even more, and the efforts to integrate the labor force demographically may be frustrated. Unless it is reversed or the open shop sector offsets it, and so far it does not seem to be able to do so, this trend is likely to deepen the skills shortage in the U.S. construction industry.

APPENDIX A:

DISTRIBUTION OF NEWLY REGISTERED APPRENTICES ACROSS THE BAT AND SAC STATES (1989-1995)

BAT States:	No. of Apprentices	SAC States:	No. of Apprentices
Alabama	3,730	Arizona	4,519
Alaska	1,556	California	NA
Arkansas	3,523	Connecticut	786
Colorado	5,331	Delaware	NA
Georgia	5,343	Florida	15,536
Idaho	2,290	Hawaii	NA
Iowa	4,479	Kansas	1,458
Illinois	18,209	Kentucky	2,582
Indiana	11,330	Louisiana	2,854
Michigan	9,669	Maine	603
Mississippi	1,482	Maryland	2,995
Missouri	10,047	Massachusetts	1,833
Nebraska	1,272	Minnesota	5,844
New Jersey	7,019	Montana	1,063
North Dakota	478	Nevada	4,790
Oklahoma	2,227	New Hampshire	1,051
South Carolina	1,231	New Mexico	4,027
South Dakota	708	New York	4,202
Tennessee	5,205	North Carolina	NA
Texas	13,576	Ohio	14,399
Utah	3,162	Oregon	NA
West Virginia	1,779	Pennsylvania	11,688
Wyoming	321	Rhode Island	818
		Vermont	346
		Virginia	1,013
		Wisconsin	NA
		Washington	NA
TOTAL	113,967	TOTAL	82,407

APPENDIX B: TRADES

Occupation	AMS Code
Bricklayer (construction)	52
Carpenter	67
Electrician	159
Operating Eng.	365
Painter	379
Pipefitter (all industries)	414
Plumber	432
Roofer	480
Sheet metal worker	510
Structural steel worker	669

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TABLE 1: New Apprentices by Year and Program Type

	New Registrations	Union Registrations %	Non-joint Registrations %
1989	27,414	75.62	24.38
1990	29,378	73.22	26.78
1991	24,594	72.12	27.88
1992	23,937	70.79	29.21
1993	28,034	73.19	26.81
1994	34,677	71.79	28.21
1995*	28,340	73.24	26.76
1989-1995	196,374	72.87	27.13

Note: 1995 figure does not include the December enrollments.

Table 2: Newly Registered Apprentices by Occupation (1989-1995)

	New Registrations	Joint Registrations (%)	Non-joint Registrations (%)
Bricklayer	5,507	88.52	11.48
Carpenter	33,376	88.84	11.16
Electrician	55,067	53.72	46.28
Operating Engineer	5,430	91.12	8.88
Painter	6,859	93.26	6.74
Pipefitter	11,914	77.53	22.47
Plumber	17,800	51.28	48.72
Roofer	12,072	87.21	12.79
Sheet Metal	14,012	78.15	21.85
Structural steel	9,465	98.13	1.87
Other trades	24,872	74.40	25.60
All trades	196,374	72.87	27.13

Table 3: Active Apprenticeship Programs and Average Program Size (1989-1995)

	Programs			Average Program Size		
	All	Joint (%)	Non-joint (%)	All	Joint	Non-joint
Bricklayer	247	65.18	34.82	22	30	7
Carpenter	502	35.46	64.54	66	167	12
Electrician	2,248	12.41	87.59	24	106	13
Operating Eng.	84	63.10	36.90	65	93	16
Painter	223	60.99	39.01	31	47	5
Pipefitter	460	39.13	60.87	26	51	10
Plumber	1,626	12.55	87.45	11	45	6
Roofer	161	49.69	50.31	75	132	19
Sheet Metal	348	36.78	63.22	40	86	14
Structural Steel	127	86.61	13.39	75	84	10
Other trades	1,240	48.06	51.94	20	31	10
All trades	7,266	28.97	71.03	27	68	10

Table 4: Single and Multi-employer Non-joint Programs

	Multi-employer Share in (%)		Average Program Size	
	Apprentices	Programs	Single	Multi
Bricklayer	56.49	23.26	4	18
Carpenter	76.24	19.44	3	45
Electrician	71.18	7.01	4	131
Operating Eng.	81.50	35.48	4	36
Painter	44.69	17.24	4	14
Pipefitter	56.85	13.93	5	39
Plumber	51.37	8.09	3	39
Roofer	18.13	16.05	19	22
Sheet Metal	71.13	22.27	5	44
Structural Steel	55.37	29.41	7	20
Other trades	49.93	12.27	6	40
All trades	63.16	10.60	4	61

Chart 1: Performance of Apprentices in Joint and Non-joint Programs (Classes of 1989, 1990, and 1991)

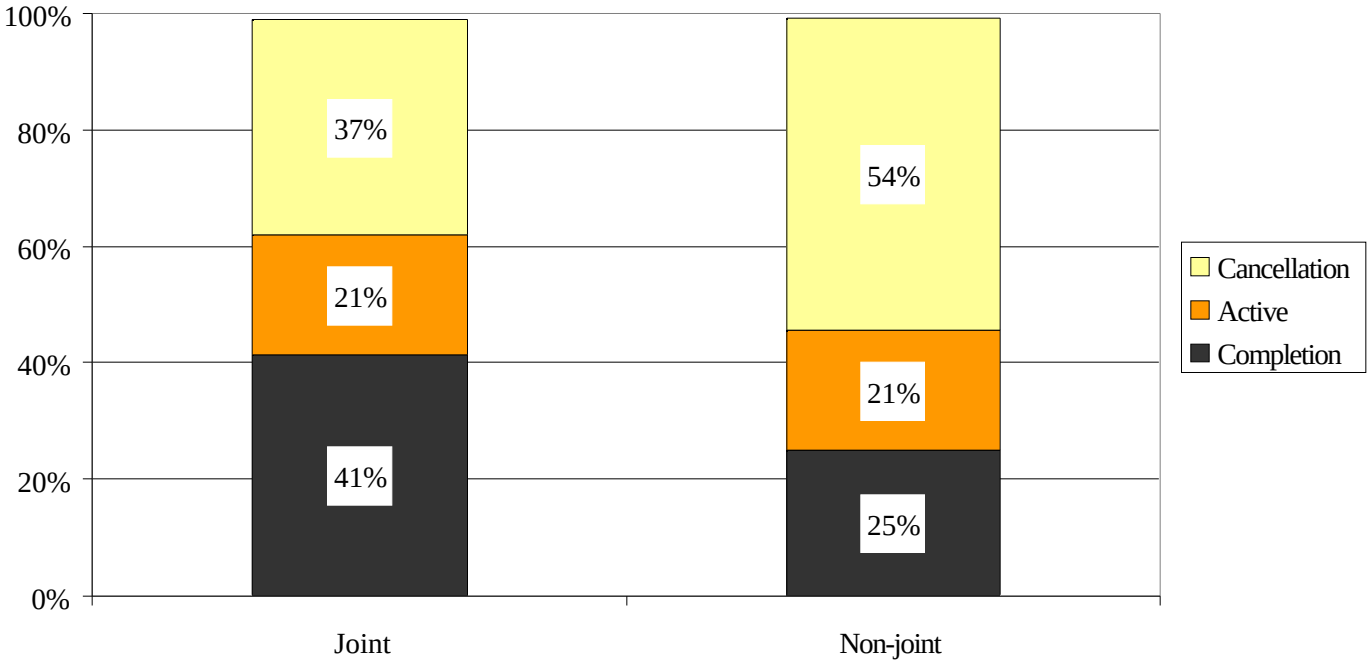

Table 5: Performance of Apprentices

(Classes of 1989, 1990, and 1991)

	Joint Apprentices			Non-joint Apprentices		
	Complete	Cancel	Active	Complete	Cancel	Active
Bricklayer	41.98	47.90	9.79	30.93	46.39	22.68
Carpenter	36.91	49.01	13.04	23.65	53.41	21.92
Electrician	45.58	21.07	32.58	26.02	53.27	19.81
Operating Eng.	39.95	38.04	19.81	5.00	73.64	21.36
Painter	30.73	52.04	16.13	12.90	72.40	11.11
Pipefitter	41.90	23.93	30.33	20.10	53.46	25.06
Plumber	41.61	23.93	33.15	25.07	53.64	20.12
Roofer	21.26	66.65	11.15	13.81	80.04	6.16
Sheet Metal	49.93	30.87	18.71	29.03	52.71	17.57
Structural Steel	45.41	40.66	11.83	30.68	61.36	4.55
Other trades	46.90	37.56	15.10	27.09	46.13	26.44
All trades	41.33	36.96	20.55	25.07	53.51	20.53

Table 6: Performance of Non-joint Apprentices

(Classes of 1989, 1990, and 1991)

	Single-employer Apprentices			Multi-employer Apprentices		
	Complete	Cancel	Active	Complete	Cancel	Active
Bricklayer	42.95	46.15	10.90	17.04	46.67	36.30
Carpenter	19.11	57.59	22.77	25.11	52.06	21.65
Electrician	24.54	58.61	15.49	26.57	51.31	21.39
Operating Eng.	4.00	92.00	4.00	5.29	68.24	26.47
Painter	16.06	64.96	13.87	9.86	79.58	8.45
Pipefitter	30.89	45.73	21.14	12.89	58.62	27.68
Plumber	23.56	59.18	15.59	26.22	49.42	23.57
Roofer	12.74	82.07	5.18	20.55	67.12	12.33
Sheet Metal	29.92	59.58	9.71	28.66	49.89	20.80
Structural Steel	42.19	48.44	6.25	0.00	95.83	0.00
Other trades	35.14	53.52	11.05	18.55	38.29	42.77
All trades	26.17	58.40	14.25	24.46	50.83	23.97

Table 7: Relative Shares of Joint and Non-joint Programs in Graduating Apprentices (Classes of 1989, 1990, and 1991)

	Joint	Non-joint
Bricklayer	90.91	9.09
Carpenter	91.92	8.08
Electrician	69.53	30.47
Operating Engineer	98.73	1.27
Painter	96.01	3.99
Pipefitter	87.81	12.19
Plumber	65.58	34.42
Roofer	91.69	8.31
Sheet Metal	86.14	13.86
Structural Steel	98.46	1.54
Other trades	84.13	15.87
All trades	82.21	17.79

Chart 2: How Soon Do Drop-outs Leave the Apprenticeship Program?
(Classes of 1989, 1990,1991)

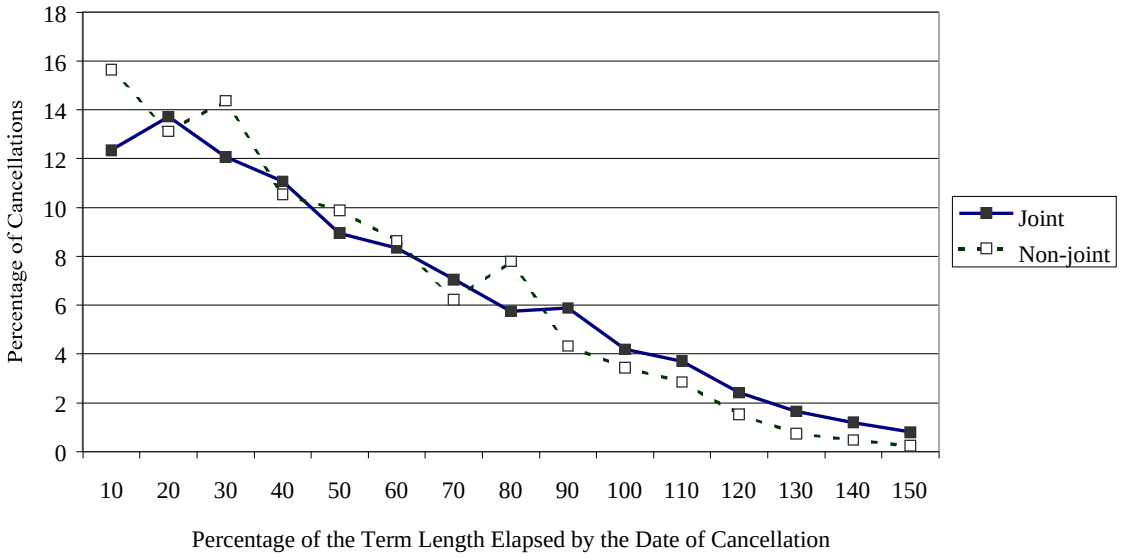

Chart 3: How Soon Do Graduates Complete the Apprenticeship Program (Classes of 1989, 1990, 1991)

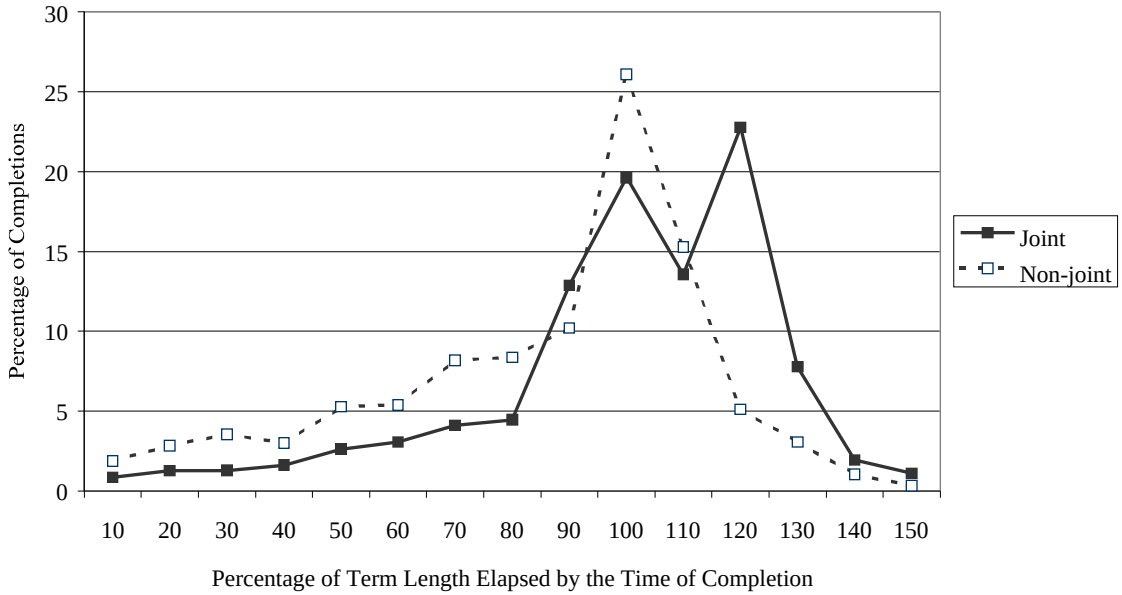

Table 8: Relative Share of Minorities in Newly Registered Apprentices (1989-1995)

	All Programs (%)	Joint Programs (%)	Non-joint Programs (%)
Bricklayer	20.28	20.27	20.41
Carpenter	21.35	20.92	24.80
Electrician	16.19	16.13	16.26
Oper. Eng.	23.96	23.52	28.42
Painter	23.34	23.04	27.49
Pipefitter	16.04	15.73	17.11
Plumber	13.63	16.24	10.90
Roofer	30.76	28.39	46.89
Sheet Metal	18.39	18.94	16.43
Structural Steel	21.66	21.63	23.16
Other trades	19.05	19.49	17.76
All trades	19.08	19.72	17.38

Table 9: The Share of Women Apprentices in Total Enrollment (1989-1995)

	All Programs (%)	Joint Programs (%)	Non-joint Programs (%)
Bricklayer	2.54	2.65	1.74
Carpenter	5.57	5.63	5.13
Electrician	3.90	5.04	2.58
Oper. Eng.	21.82	21.34	26.76
Painter	8.43	8.63	5.63
Pipefitter	3.61	4.19	1.61
Plumber	2.25	3.05	1.41
Roofer	2.00	2.14	1.04
Sheet Metal	2.42	2.63	1.67
Structural steel	3.68	3.69	2.82
Other trades	4.74	5.29	3.16
All trades	4.51	5.17	2.72

Chart 4: Relative Performance of White and Minority Apprentices in the Joint and Non-joint Programs (Classes of 1989, 1990, and 1991)

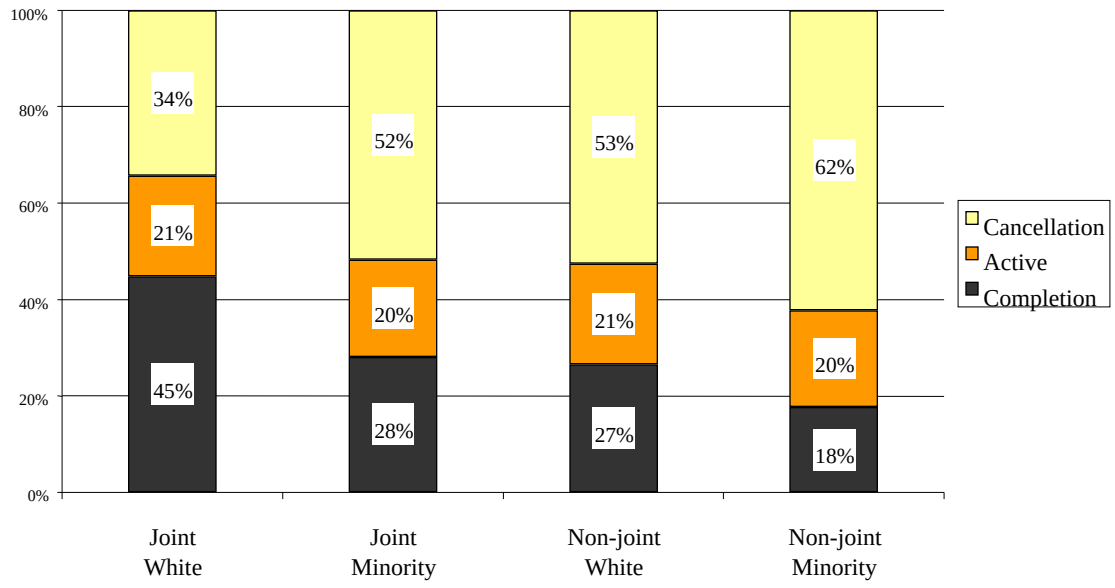

Table 10: Completion Rates of White and Minority Apprentices (1989, 1990, 1991 Classes)

	Joint Programs (%)		Non-joint Programs (%)	
	White	Minority	White	Minority
Bricklayer	44.09	30.79	31.60	26.83
Carpenter	41.03	18.75	26.32	13.31
Electrician	47.44	34.92	26.99	19.42
Operating Eng.	41.93	33.27	6.59	0.00
Painter	33.20	21.57	10.14	20.83
Pipefitter	43.68	31.51	22.05	9.74
Plumber	44.40	25.95	25.62	19.68
Roofer	24.24	14.10	15.31	11.79
Sheet Metal	52.00	40.88	30.37	20.77
Structural Steel	49.82	26.79	40.91	0.00
Other trades	49.80	33.43	27.91	22.07
All trades	44.33	27.71	26.30	17.67

Chart 5: Relative Performance of Men and Women Apprentices in Joint and Non-joint Programs (Classes of 1989, 1990 and 1991)

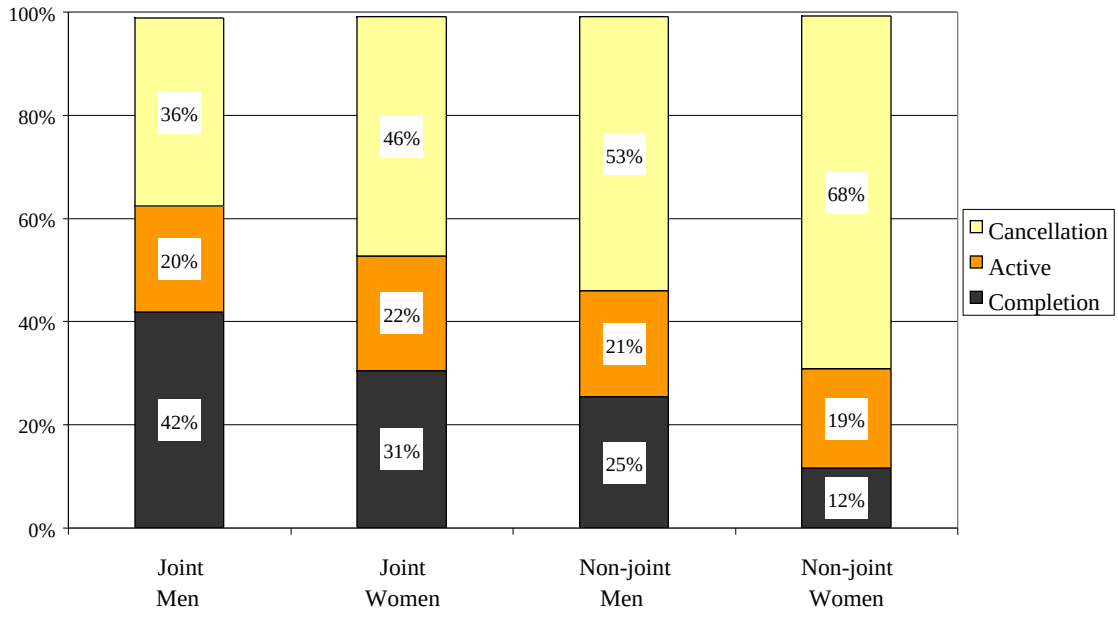

Table 11: Completion Rates of Men and Women Apprentices (1989, 1990, 1991 Classes)

	Joint Programs (%)		Non-joint Programs (%)	
	Men	Women	Men	Women
Bricklayer	42.04	39.13	31.36	0.00
Carpenter	37.36	29.05	24.35	7.58
Electrician	46.25	32.54	26.37	11.54
Operating Eng.	42.65	29.45	6.32	0.00
Painter	30.95	28.26	13.08	10.53
Pipefitter	42.32	31.01	20.35	5.00
Plumber	41.86	32.67	25.28	10.42
Roofer	21.23	22.86	13.96	0.00
Sheet Metal	50.30	35.54	29.07	26.92
Structural Steel	45.80	32.74	31.40	0.00
Other trades	47.76	29.69	27.25	21.62
All trades	41.88	30.54	25.42	11.56

Table 12: Distribution of OJT Credit Hours

(Ten largest trades)

OJT hours credited (%)	Percentage of Apprentices Receiving OJT Credit					
	Program Type		Minority Status		Gender	
	Union (%)	Non-union (%)	White (%)	Minority (%)	Men (%)	Women (%)
0 %	78.35	67.71	74.94	77.67	75.10	83.12
0-10 %	10.09	14.29	11.47	10.23	11.36	8.62
10-20 %	3.12	4.08	3.32	3.66	3.40	3.02
20-30 %	2.32	4.63	3.09	2.33	3.00	1.74
30-40 %	1.97	2.25	2.05	2.03	2.09	1.11
40-50 %	1.76	3.26	2.27	1.74	2.22	1.01
>50 %	2.39	3.77	2.87	2.35	2.83	1.38