An Effectiveness Assessment and Cost-Benefit Analysis of Registered Apprenticeship in 10 States

Final Report

July 25, 2012

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We are especially grateful to our Administrative Data Research and Evaluation (ADARE) alliance partners for their advice and data analyses. The ADARE partners have access to confidential administrative records required for this study. We provided them with computer programs, which they ran on-site in order to deliver to us aggregated results with no individual information. The ADARE partners in Georgia, Kentucky, Maryland, Missouri, New Jersey, Ohio, and Texas graciously ran many computer programs at our request.

We thank the directors of RA programs in the 10 study states, their federal OA counterparts, and members of their staffs for discussing their programs with us and for providing detailed information on program costs.

Several people discussed with us the experiences of women in RA programs and their thoughts on ways to promote the success of women in the program. We thank the 15 women who anonymously discussed their experiences with us. We are also grateful to the executive directors of five community-based organizations that work with women in apprenticeships and the skilled trades: Apprenticeship and Nontraditional Occupations for Women, Hard Hatted Women, Oregon Tradeswomen, Vermont Works for Women, and Wider Opportunities for Women.

We are grateful to staff members of the employment departments in Florida, Iowa, and Pennsylvania, who worked with us to ensure the appropriate use of unemployment insurance (UI) wage records from those states. These workers extracted UI wage records for registered apprentices from state data systems and provided us with the extracts. To make this sharing possible, they developed data use agreements to ensure the confidentiality, limited purpose, and ultimate destruction of the data extracts provided to Mathematica.

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ACRONYMS

ADARE = Administrative Data Research and Evaluation alliance

ARRA = American Recovery and Reinvestment Act of 2009

CBO = community-based organization

CPI-U = Consumer Price Index – All Urban Consumers

CPS = Current Population Survey

DOL = U.S. Department of Labor

EEO = equal employment opportuntity

NAICS = North American Industry Classification System

NCES = National Center for Education Statistics

OA = Office of Apprenticeship (at the U.S. Department of Labor)

OJT = on-the-job training

RA= Registered Apprenticeship

RAPIDS = Registered Apprenticeship Partners Information Data System

RTI = related technical instruction

SAA = State Apprenticeship Agency

SSN = Social Security Number

TANF = Temporary Assistance for Needy Families

UI = unemployment insurance

WANTO = Women in Apprenticeship and Nontraditional Occupations (DOL grantees)

WIB = Workforce Investment Board

EXECUTIVE SUMMARY

Registered Apprenticeship (RA) is a career-training program that offers structured on-the-job training combined with related technical instruction tailored to industry needs. The program, created in 1937, seeks to produce well-trained workers whose skills are in high demand. In 2010, almost 450,000 people across the nation were enrolled in RA.

RA is administered by the Employment and Training Administration's Office of Apprenticeship (OA) within the U.S. Department of Labor (DOL), in conjunction with State Apprenticeship Agencies (SAAs). OA registers apprenticeship programs and apprentices in 25 states and assists and oversees SAAs, which register programs and apprentices in the other 25 states and the District of Columbia. OA and SAAs also issue certificates of completion to apprentices; conduct outreach to potential sponsors; monitor programs for compliance and quality assurance; provide technical assistance; and build partnerships with sponsors, employers, education providers, and the workforce development system.

Apprenticeship programs range from one to six years and are offered in approximately 1,000 occupations, including the traditional skilled trades such as electrician, plumber, and carpenter, as well as such occupations as truck driver, child care worker, nursing aide, and correctional officer. For apprentices, RA provides on-the-job training, related technical instruction, incremental wage increases as skills are attained, and, upon completion, nationally recognized certification in the chosen career area. RA programs are delivered by sponsors—employers, employer associations, and labor management organizations. Employers cover the costs of training, wages paid to apprentices, costs of managing the program, and costs associated with time spent by senior employees to mentor and train apprentices.

The primary purposes of this study were to assess the effectiveness of RA and to perform a cost-benefit analysis of RA. The study measured the net effects of apprenticeship for participants as well as the social costs and benefits of RA across a variety of state settings. The study considered whether substantial net social benefits found by previous research for Washington state (Hollenbeck and Huang 2006) could be found in a wide range of other states. The study also examined the barriers that women face in RA and the best practices for promoting their success. In addition, the study explored whether federal and state administered RA programs have patterns of differences in the programs themselves and their outcomes. Specifically, the study addressed four questions:

1. Is RA effective in raising the annual earnings and employment of participants?
2. Do the total social benefits of RA outweigh the total social costs?
3. What are the experiences of women in RA and what can be done to further promote their success in the program?
4. Are there differences between the RA programs of states administered by the OA and of states administered by SAAs?

The study examined RA in 10 states selected to vary in program features and labor market characteristics, including program size, region, the degree of union representation in the state, administrative type (federal or state), and the degree to which RA is concentrated in a few occupations. The states are Florida, Georgia, Iowa, Kentucky, Maryland, Missouri, New Jersey, Ohio, Pennsylvania, and Texas.

The study found:

- **RA participants had substantially higher earnings than did nonparticipants**. In the ninth year following program enrollment, RA participants earned an average of $5,839 more than similar nonparticipants. Over a career, the estimated earnings of RA participants are an average of $98,718 more than similar nonparticipants. For RA participants who completed their program, the estimated career earnings are an average of $240,037 more than similar nonparticipants.
- **The benefits of the RA program appear to be much larger than the costs.** Over the career of an apprentice, the estimated social benefits of RA exceed the social costs by more than $49,000.
- **Female apprentices expressed positive views of RA but recommended some changes to promote women's success.** Female apprentices viewed their participation in RA as a pathway to career advancement and higher pay. Suggestions for strategies to promote the success of women in RA included targeted outreach and information, support for basic skills development, assistance with child care, further efforts to combat harassment, and facilitating peer support.
- **RA programs are largely similar in OA and SAA states**. We found no patterns of differences in the priorities or activities of RA staff in OA and SAA states. The most notable difference we observed is that a SAA's home agency can help foster relationships that generate support and growth opportunities for RA, for example with the workforce development system or educational institutions.

The remainder of this summary provides a fuller description of these findings.

RA is Associated with Higher Earnings

RA is designed to improve the productivity of apprentices through on-the-job training and related technical instruction. We assessed RA effectiveness by comparing the earnings of RA participants to those of nonparticipants, adjusting for differences in pre-enrollment earnings and demographic characteristics. We found that RA participation was associated with substantially higher annual earnings in every state studied.

In the short term, defined as the sixth year after enrollment, RA participation was associated with an average gain in annual earnings of $6,595 over the earnings of nonparticipants (Table 1). In the medium term, defined as the ninth year after enrollment, RA participation was associated with an average annual gain of $5,839. The average gain (as well as the gain in most states) declined between the sixth and ninth years after enrollment. This is a frequent finding for training programs in general and may reflect the decay of learned skills over time among program participants or the development of new skills by the nonparticipants, among other possible reasons. Alternatively, the period between the sixth year and the ninth year was 2006 to 2009, during which there was an economic downturn with very high unemployment rates, especially in construction trades. If the economic downturn had a stronger negative effect on RA participants relative to nonparticipants, the decline in estimated earnings gains may be a temporary effect of the downturn.

Table 1. Average Annual Earnings Differences for RA Participants Versus Nonparticipants (Dollars)

	Short Term Sixth Year After Enrollment			Medium Term Ninth Year After Enrollment		
	All	Men	Women	All	Men	Women
Florida	5,242***	5,494***	79	4,451***	4,525***	2,134**
Georgia	6,508***	6,290***	9,120**	4,547***	4,355***	6,309
Iowa	4,680***	4,843***	5,095	n.a.	n.a.	n.a.
Kentucky	5,770***	5,719***	6,153	n.a.	n.a.	n.a.
Maryland	14,977***	14,843***	20,039	15,561***	15,615***	-7,569
Missouri	7,239***	7,425***	4,069	5,587***	5,724***	4,821***
New Jersey	6,870***	7,328***	-2,215	n.a.	n.a.	n.a.
Ohio	6,914***	6,897***	6,889***	n.a.	n.a.	n.a.
Pennsylvania	8,304***	8,483***	2,643**	7,827***	7,930***	6,566**
Texas	5,504***	5,644***	1,044	5,838***	5,948***	2,422
OA states	6,284***	6,401***	3,169**	5,587***	5,671***	3,763**
SAA states	6,793***	6,960***	2,435***	6,087***	6,235***	3,501***
All states	6,595***	6,737***	2,615***	5,839***	5,948***	3,581***

Source: RAPIDS and state UI wage records.

Note: The short-term period is less than the sixth year for Iowa (fourth year), Kentucky (second year), and New Jersey (fifth year). These states are not included in the averages in the bottom rows of the table. Medium-term estimates are not available for Iowa, Kentucky, New Jersey, and Ohio (indicated by n.a.) due to the limited range of the available state UI wage record data. Data for Maryland are not comparable and Maryland is not included in the averages in the bottom rows of the table. The OA states are Georgia, Iowa, Missouri, New Jersey, and Texas; the others are SAA states. All dollar values are adjusted for inflation to real 2000 dollars.

*/**/*** The estimate is significantly different from zero at the .10/.05/.01 level, respectively, using a two-tailed t-test.

The estimated association between RA participation and annual earnings varies across the states, but it is large and statistically significant in every state. In the medium term, Florida had the smallest measured gain ($4,451). Maryland had the highest measured gain ($15,561); however, the results for Maryland may not be comparable to other states because the RA data come from a different source. Due to limitations in the available state unemployment insurance (UI) wage record data, the short-term results for Kentucky, Iowa, and New Jersey were measured for periods of less than six years, but even over these shorter periods, RA was associated with substantial gains in annual earnings. (Due to the shorter follow-up period in these three states and the different data source in Maryland, these states are not included in the overall averages reported in the three bottom rows of Table 1.)

The estimates for men are similar to the overall estimates, which is not surprising since the majority of apprentices (about 90 percent in the study states) are men. The estimates for women do not show a consistent pattern across states. In most states, the sample of women was too small to find statistically significant results even for sizable estimates. In Florida, which had the largest sample of women, we found no gain in earnings for female RA participants in the short term and, a moderate gain of $2,134 in the medium term, less than half the size of men's gain. In Ohio, another state with statistically significant estimated gains for women, we found a more substantial gain for women ($6,889 in the short term), similar to the gain for men in that state. These differences may be explained by the occupations of RA women in the two states. However, we could not examine the wage gains by occupation for women because the sample sizes for women were too small to

allow for precise estimates. Averaged across the study states, participation in RA was associated with an earnings increase for women of $2,615 in the short term and $3,581 in the medium term.

When we looked at administrative type (federal or state), we estimated a stronger relationship between RA participation and earnings in SAA states than in OA states for men. For women, the relationship was stronger in the OA states. However, these differences are not statistically significant at the 10 percent level (statistical significance of difference not shown in table). The differences between OA and SAA states are discussed further in a separate section of this summary.

The gains shown in Table 1 are for two specific years. Summed over the first 9 years after enrollment, the total gain averaged about $47,586 for the five states with medium-term estimates (Maryland is not included in overall averages). Over the career of an apprentice (which we assumed is 36 years based on the average enrollment age of 29), we estimated the average earnings gain would be $98,718. Including benefits such as health insurance, RA participants receive an average of $123,906 more in compensation than nonparticipants over their careers.

The earnings gains described above are estimates for all RA participants, including those who did not complete the RA program. We found that just under half of RA participants in our study states completed the RA program. Although we found average earnings gains for people who participate in RA even if they complete only a small portion of the program, the average earnings gains for RA completers were substantially higher. For completers, the estimated earnings gains were an average of $14,404 in the sixth year after enrollment and $12,733 in the ninth year after enrollment. Over the career of an apprentice, we estimated the average earnings gain associated with completing the RA program would be $240,037. Including benefits, RA completers would receive an average of $301,533 more in compensation than nonparticipants over their careers.

Our results offer insights into the effects of RA on apprentices' future earnings, although the approaches we used do not identify purely causal effects of RA. Although the estimates account for pre-enrollment differences in earnings and demographic characteristics between RA participants and nonparticipants, our analysis cannot fully account for the selection processes that lead people to participate in RA. For example, if RA participants have greater skills or stronger self-motivation than nonparticipants do, our measured earnings effects may be due to these factors and not to RA participation itself. Furthermore, RA completers would likely have even greater skills and self-motivation than other RA participants do. Therefore, our findings are suggestive but not conclusive evidence of the effects of RA on earnings.

Social Benefits Appear to be Substantially Larger than Social Costs

Our comparison of the costs and benefits of RA examined whether the benefits of the program appear large enough to justify the investment of resources. We considered the value of the costs and benefits for apprentices, government agencies, and society. We included the potential benefits of added productivity of workers trained through RA as well as RA participants' reduced use of government programs (unemployment insurance, welfare, and food stamps) as a result of their higher earnings. On the cost side, we included the federal and state costs of administering RA programs and the cost of community colleges providing related technical instruction.

We found that RA had strong, positive net social benefits under our baseline assumptions for all five states with medium-term estimates. In the medium term, summing over the first nine years after enrollment, the benefits of RA averaged $59,606 (Table 2). The total government cost incurred for RA participants averaged $718 (summing over all years of participation and including

participants who do not complete RA). Thus, the net social benefits in the medium term were $58,888 on average. Even in the state with the lowest net social benefits, Florida, the net benefits were substantial at $46,981.

Over the assumed 36-year career of an RA participant, the net social benefits are notably greater: $124,057 on average. As before, even the state with the lowest net social benefits, Florida, has substantial net benefits over the career of $96,735. The differences across states are mainly due to differences in the estimated earnings gains for RA participants (as shown in Table 1).

Table 2. Social Costs and Benefits: Medium- Term and Career Under Baseline Assumptions (Dollars)

	Medium Term For 9 Years After Enrollment			Career For 36 Years After Enrollment		
	Benefits	Costs	Net	Benefits	Costs	Net
Florida	47,696	715	46,981	97,450	715	96,735
Georgia	53,787	767	53,020	104,484	767	103,717
Missouri	63,735	737	62,998	126,021	737	125,284
Pennsylvania	76,526	720	75,806	163,775	720	163,055
Texas	53,671	693	52,978	118,914	693	118,221
OA states	57,505	719	56,786	119,866	719	119,148
SAA states	61,670	717	60,952	129,598	717	128,880
All states	59,606	718	58,888	124,775	718	124,057

Source: RAPIDS, state UI wage records, and OA and SAA annual budget estimates.

Note: We calculated social benefits as the sum of productivity benefits and reduced administrative costs of unemployment insurance, welfare, and food stamps. The OA states are Georgia, Missouri, and Texas; the other states are SAA states.

The social benefits shown in Table 2 were calculated under a set of baseline assumptions. For example, we assumed that employers' net benefits are zero. We made this assumption because we do not have measures of costs and benefits for employers. However, we expect that the employers have net positive benefits because they participate voluntarily in the program. If employers' net benefits are positive, inclusion of these benefits would increase the net social benefits shown in Table 2.

Perhaps the most important baseline assumption is that our estimated associations between RA participation and earnings are entirely due to the causal effects of RA participation. Although we do not find this to be a credible assumption due to the likelihood that RA participants differ from nonparticipants in important ways (such as being more motivated or more skilled), we find this to be a useful assumption for providing baseline estimates of net social benefits. If part (or all) of the gain in earnings associated with RA participation is not the result of that participation, the net social benefits stated in Table 2 are too high. We have no way to estimate the potential bias due to the underlying differences between RA participants and nonparticipants. Rather, we considered a fairly extreme scenario under which one-half of the estimated association between RA participation and earnings is due to underlying differences, and only one-half of the estimate is due to the causal effect of RA on earnings. Even under this scenario, RA has strong, positive net social benefits of $29,042 in the medium term and $61,596 over an apprentice's career (Table 3).

Table 3. Net Social Benefits Under Alternative Scenarios: Average Over Five States with Medium-Term Earnings Estimates (Dollars)

	Medium Term: For 9 Years After Enrollment	Career: For 36 Years After Enrollment
Baseline	58,888	124,057
Productivity benefit estimate is 50 percent lower	29,042	61,596
Cost to government is 20 percent higher	58,744	123,913
Cost to apprentice is $500 (not zero)	58,388	123,557
Employers experience a net loss of $5,000	53,888	119,057
No effect on UI compensation and public assistance	58,425	123,188
Discount rate of future earnings is 20 percent higher	57,812	118,097
Rate of decay in earnings gains is 20 percent higher	58,888	116,910
All of the above	22,677	49,427

Source: RAPIDS, state UI wage records, and OA and SAA annual budget estimates.

Note: Estimates are averages of results for Florida, Georgia, Missouri, Pennsylvania, and Texas. All dollar values are adjusted for inflation to real 2000 dollars.

Under further alternative scenarios, the findings of strong, positive net social benefits remain. For example, if our estimates of government cost are 20 percent too low or if the cost of participation to apprentices is $500 instead of zero (for example, for books or tools), the net social benefits are still positive. In our discussions with state directors, we learned that some sponsors receive incentives of up to $5,000 per apprentice. If we assume that sponsors break even only if they receive this incentive (that is, that employers have a net cost of $5,000 rather than zero), the net social benefits are still strong and positive. Even if RA had no effect on UI compensation or public assistance, if the rate we use to discount future earnings is 20 percent too low, or if the earnings benefits decay at a 20 percent higher rate than we estimated, the net social benefits to RA are strong and positive. Even combining all of these scenarios, the net social benefits remain positive and substantial at $49,427 over the career of an apprentice.

The estimates of strong, positive net social benefits suggest that investment in RA is warranted: the benefits outweigh the costs. However, the findings do not necessarily imply that government investment in RA is warranted. RA is a public-private partnership, with both sectors providing investments. It is possible that all the benefits of RA are due to the private investment. Put differently, without the government RA program, private sponsors and employers might run apprenticeships with equally strong outcomes. However, our discussions with RA directors in the 10 study states suggest that the government is investing in a number of activities that are likely to contribute to the effectiveness of the program through outreach to candidates and partners that can attract quality participants, technical assistance to the sponsors, and quality assurance. We have no way of estimating the net social benefits of the government investment as distinct from those of the private investment. As a final scenario, we calculated that, even if the government investment were responsible for only 5 percent of the greater productivity of apprentices, the government investment has positive net social benefits per RA participant of $2,252 in the medium term and $5,504 over the career of a RA participant (not shown in Table 3).

For people considering entering the RA program, the net benefits that accrue to RA participants are likely to be an important factor. The benefits to RA participants include an increase in compensation over the career: an estimated average of $98,718 in earnings and $25,187 in fringe benefits such as health insurance, for a total of $123,906 under our baseline assumptions. Adjusting

for estimates of taxes paid on the earnings gains and lower levels of UI compensation and public assistance benefits, the estimated net benefits to RA participants are $101,467. We did not measure the cost of RA participation for apprentices, but the main costs are covered by employers. In fact, we found that, on average, RA participants begin receiving higher earnings than nonparticipants even in the first year after enrolling in the program, a period when most participants are still in training. If we include a $500 financial cost of participation in our baseline assumption, the net benefits of RA participation are $100,967. Many RA occupations are unionized. If we also deduct $50 per month for union dues (to represent the average difference in union dues paid by RA participants compared to nonparticipants), the estimated net benefits are $96,911. If some of the estimated earnings gains accrue to RA participants because they have stronger skills or motivation than nonparticipants, then they would likely have received higher earnings than nonparticipants even in the absence of RA. If we include an additional assumption that half of the estimated gains are not a result of RA participation but rather due to underlying characteristics of RA participants, then the estimated net benefits to RA participation are $46,335.

For people who complete the RA program, the estimated average gains over the career are $240,037 in earnings and $61,496 in fringe benefits for a total of $301,533. Adjusting for estimates taxes, reduced UI compensation, and lower public assistance benefits, the net benefits of RA completion are $242,417. If we include $500 in upfront financial costs and $100 per month for union dues, the average net benefits are $233,828. If we also assume half of the earnings gains are not a result of RA completion, then the estimated net benefits to RA completion are $111,426.

Female Apprentices Have Positive Views of RA, but More Could Be Done to Promote Their Success

The study also examined the barriers that women face in RA and the best practices for promoting their success. We explored these issues through discussions with women who have participated in the program, executive directors of community-based organizations that received DOL grants from the Women in Apprenticeship and Nontraditional Occupations (WANTO) program, and state apprenticeship directors.

Women are vastly underrepresented in the RA program compared to men. Fewer than 9 percent of people entering RA in the study states in 2010 were female, and, in the skilled trades occupations, the shares of females were even lower. The two largest occupations for women were child care (34 percent of women entering RA in the study states in 2010) and nursing aide (6 percent of women). In contrast, almost no men enrolled in apprenticeships in social services occupations. Women's concentration in apprenticeships in social services occupations leads to different experiences with the program. The duration of these apprenticeships is typically shorter: often one to two years, compared to four years or more for electricians, plumbers, and carpenters. Among women who started apprenticeships in the study states in 2000, 44 percent completed the program, roughly the same rate as for men. However, the completion rates for women in the skilled trades were lower than for men. For example, among apprentice electricians, 37 percent of women completed RA, compared to 43 percent of men. For carpenters, the completion rate was only 17 percent for women, compared to 39 percent for men.

The women we spoke with see their participation in RA as a pathway to career advancement and higher pay. Despite their generally positive opinions of the program, they and the WANTO grantees noted that many women struggle to find and pay for child care, and some women are confused about their program's requirements. In addition, women who want to pursue

apprenticeships in construction have difficulty obtaining information on those apprenticeships and jobs, and they often must contend with harassment and discrimination at male-dominated worksites.

Women participants, WANTO grantees, and state directors suggested several promising strategies to enhance the success of women in RA. First, they recommended that RA and program sponsors attract women and girls to apprenticeship through targeted outreach campaigns. After women learn about the program, organizations like those run by the WANTO grantees can help position women for success by building their basic skills and managing their expectations about particular occupations. After women are enrolled in the program, RA can support their success by helping them arrange and pay for adequate child care that accommodates their demanding classroom and on-the-job training schedules. RA can further promote women's success in apprenticeship in higher-wage industries, such as construction, by helping employers create and enforce policies to combat harassment at male-dominated worksites and by connecting women with their peers for support and encouragement.

RA Programs are Similar in OA and SAA States

The final question addressed in this study was whether RA programs in states federally administered by OA differ from those administered by SAAs. The OA states in the study are Georgia, Iowa, Missouri, New Jersey, and Texas; all other states are SAA states. To explore whether the RA program operates differently in the OA and SAA states, we spoke with the state-level directors and their staff in each of the 10 study states about their priorities and the activities of their staff. Overall, we found that the RA programs in OA and SAA states are largely similar.

The basic structure of RA in staffing, recruitment, and registration was similar across all states. In general, the activities of staff were similar across the states, with no patterns of differences between the OA and SAA states. Similarly, the priorities of state directors in most states included expanding the program and further developing partnerships with workforce development agencies and educational institutions. The common concern of state directors was limited and declining budgets.

We did find some differences in the relationships that OA and SAA staff have within their states. The most notable difference we observed was that a SAA's home agency can help foster relationships that generate support and growth opportunities for RA, for example with the workforce development system or educational institutions. OA state directors tended to express more frustration regarding the development of these types of partnerships.

We found only modest differences between OA and SAA states in the demographics, occupational distribution, and completion rates of apprentices. In the effectiveness assessment, we found the OA states had a somewhat smaller association between RA participation and earnings than SAA states, although the differences were not statistically significant (Table 1). This modest difference translated into somewhat lower net social benefits in the OA states (Table 2). The total public cost of RA per participant was similar in OA states and SAA states.

There are many potential reasons for small differences in RA for OA and SAA states, including differences in the local labor markets and different activities by sponsors. In our discussions with state directors, we found no evidence to suggest that differences in RA were caused by different priorities, activities, or decisions on the part of OA and SAA state directors and their staff.

Conclusion

RA appears to be effective at increasing the earnings of participants and achieving net social benefits across a wide range of state settings. Our estimates show that participation in RA was associated with substantial gains in earnings of $47,586 over a nine-year period following enrollment in the program. Over the career of an apprentice, the gain in total compensation, including employer-sponsored health insurance and other benefits, averages $123,906.

Our research design does not conclusively identify the causal impact of RA on earnings; however, even if only one-half of the estimated earnings gain is causal, we estimated a net social benefit of $29,042 in the medium term and $61,596 over an apprentice's career. The finding of strong, positive net social benefits is robust to a number of assumptions regarding the costs and benefits of RA.

The estimates of strong, positive net social benefits suggest that the benefits of RA outweigh the costs. However, we are not able to determine the extent to which these benefits are due to government investments compared to employer investments that might occur even without the RA program. With this in mind, we note that, even if government investment in RA is responsible for only 5 percent of the greater productivity of apprentices, the government investment still has positive net social benefits.

I. INTRODUCTION

Registered Apprenticeship (RA) is a career-training program that seeks to produce well-trained workers whose skills are in high demand. RA offers structured on-the-job training (OJT), combined with related technical instruction (RTI) tailored to industry needs. Nationally, RA has almost 450,000 apprentices in more than 29,000 programs linked to roughly a quarter million employers.[1]

The Employment and Training Administration's Office of Apprenticeship (OA) within the U.S. Department of Labor (DOL), in conjunction with State Apprenticeship Agencies (SAAs), registers apprenticeship programs that meet federal and state standards and issues certificates of completion to apprentices. In recent years, OA has actively encouraged many program improvements, including greater integration of apprenticeship training with the public workforce system, using apprenticeships as a key workforce development strategy to meet the skilled workforce needs of green jobs and other industries, and forming partnerships with key stakeholders such as postsecondary educational institutions and community-based organizations (CBOs). To further the success of these initiatives and to expand the use of apprenticeship programs to support economic growth, OA seeks to demonstrate to its partners and other stakeholders the value and impact of apprenticeship.

The primary purposes of this study were to assess the effectiveness of RA programs and perform a cost-benefit analysis of RA. The study measured the net effects of apprenticeship for participants as well as the social costs and benefits of RA across a variety of state settings. The study examined whether substantial net social benefits found by previous research for Washington state (Hollenbeck and Huang 2006) could be found in a wide range of other states. The study also examined the barriers that women face in RA and sought to identify best practices for promoting their success. In addition, the study explored whether federal and state administered RA programs have patterns of differences in the programs themselves and their outcomes. Specifically, the study addressed four questions:

1. Is RA effective in raising the annual earnings and employment of participants?
2. Do the total social benefits of RA outweigh the total social costs?
3. What are the experiences of women in RAs and what can be done to further promote their success in the program?
4. Are there differences between the RA programs of states federally administered by the OA and of states administered by SAAs?

[1] Statistics are for 2010 from U.S. Department of Labor, Employment and Training Administration (2010).

A. Registered Apprenticeship Program

The RA system was created by the National Apprenticeship Act of 1937, which directed the secretary of labor to establish labor standards for apprentices. Today, the standards are administered by OA and SAAs. OA registers apprenticeship programs and apprentices in 25 states and assists and oversees SAAs, which register programs and apprentices in 25 states and the District of Columbia.[2]

RA program sponsors are employers, employer associations, and labor management organizations. Sponsors vary from small businesses to large national employers and national industry associations. Sponsors and employers customize apprenticeship training to their needs, within the bounds of federal and state standards. Employers and sponsors cover the costs of training, wages paid to apprentices, costs of managing the program, and costs associated with time spent by senior employees to mentor and train apprentices.

Employers and sponsors recruit apprentices in a number of ways. The most common method is for current employees to reach out to people in their social networks. Current employees encourage their contacts to apply, and they provide information to the employer about the applicants they know. In addition, many apprentices come to RA through vocational education in a high school or postsecondary program. Advertisements in newspapers and through the Internet are another recruiting approach. Less common routes to apprenticeship include CBOs, pre-apprenticeship programs, the One-Stop Career Center system, and unions.[3]

Qualifications required for enrolling in RA vary across programs, though for all programs apprentices must be at least 16 years old. Program sponsors identify additional minimum qualifications, such as educational levels and the ability to perform essential physical functions. A sponsor's selection process may include aptitude tests, interviews, school grades, and prior work experience.

For apprentices, RA provides OJT; RTI; incremental wage increases as skills are gained; and, upon completion, nationally recognized certification in the chosen career. In addition, many apprentices obtain credit from participating community colleges that can be used toward an associate's or bachelor's degree. Apprentices may participate in any of approximately 1,000 career areas. The occupations with the largest number of apprentices are in the traditional skilled trades, such as electrician, plumber, and carpenter. RA programs are also available for truck drivers, child care workers, nursing aides, correctional officers, chefs, and dental assistants, among other occupations. Apprenticeship programs range from one to six years, depending on the complexity of the occupation and the type of program; the majority are four years in length.

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[2] SAAs also operate RA programs in Puerto Rico, Guam, and the U.S. Virgin Islands. Unless otherwise noted, information provided in this chapter about the RA program came from the DOL website at [http://www.doleta.gov/OA/], accessed in June 2011.

[3] Information on apprentice recruitment is based on a survey of sponsors conducted by Lerman, Eyster, and Chambers (2009).

Staff in state registration agencies, whether they are OA or SAA staff, perform three core functions in administering RA: (1) outreach and registration, (2) compliance and quality assurance, and (3) operations and building of partnerships.[4]

1. Outreach and Registration

RA staff regularly reach out to businesses and industry associations that are potential sponsors for RA programs. Their objective is to make these groups aware of the services RA provides and encourage the development and registration of new RA programs. Outreach efforts include building relationships with local workforce investment boards (WIBs), business leaders, and jobseekers to identify the needs of the community and opportunities suited to the apprenticeship model. Staff then work with interested sponsors to create standards for a new program, develop a plan for recruiting apprentices, and complete registration paperwork.

2. Compliance and Quality Assurance

To establish and maintain existing RA programs, state registration agencies must (1) ensure programs are in compliance with equal employment opportunity (EEO) policies and federal legislation that govern RA; and (2) conduct quality assessments of program activities, such as instruction and training. Compliance reviews are typically done when a new program is registered, and then carried out every few years unless there is an EEO-related complaint in the interim. As part of the initial compliance review, sponsors are required to develop an affirmative action plan that has timetables and goals for the participation of minorities and females. Staff from the state registration agency provide technical assistance to sponsors to help them meet the goals laid out in the plan. Quality assessments involve an on-site inspection and a review of the standards and overall program quality. The assessments determine if the program is meeting the federal standards for apprenticeships; agency staff provide technical assistance if the program is lacking in some areas. Staff may also look at apprentice attendance and completion rates.

3. Operations and Partnerships

The balance of agency staff's time is spent processing paperwork, overseeing general operations, and networking with other organizations to explore opportunities for partnerships. General operations include certifying the completion of apprenticeships and issuing certificates, providing technical assistance to sponsors and providers of related instruction, and responding to inquiries from the public. Staff also regularly promote RA to other workforce agencies and community organizations to make them aware of the benefits of apprenticeship and to pursue mutually beneficial partnerships. These partnerships can be helpful in recruiting sponsors for new programs, increasing apprenticeship applications to existing programs, and increasing the participation of women and minorities.

[4] Information on the activities of federal and state registration agency staff is based on our discussions with directors in the 10 study states.

B. Research Objectives and Approach

The primary goals of the study were to measure the effectiveness and the net benefits of RA across a variety of state settings. We selected 10 states that vary in administrative type (OA versus SAA administered), program size, region, union representation, and the degree to which RA is concentrated in a few occupations. In selecting states, we also took into account the ease of access to necessary administrative data. In collaboration with OA staff, we selected Florida, Georgia, Iowa, Kentucky, Maryland, Missouri, New Jersey, Ohio, Pennsylvania, and Texas. We conducted semistructured telephone discussions with the RA directors in each state to better understand the nature and characteristics of their programs. We analyzed the effectiveness of RA and the costs and benefits for each state separately.

We measured the effects of RA on employment and earnings using unemployment insurance (UI) wage records from each state. To measure the effects, we needed to compare the outcomes apprentices actually attained to estimates of the outcomes they would have attained without the program. Ideally, we would have a comparison group that was identical to the apprentices on all dimensions except for participation in RA. Such a comparison could be created through random assignment of people interested in RA into a treatment group that received apprenticeship training and a control group that did not. However, the resources and time frame for this study did not permit consideration of such a randomized control trial design.

In the absence of random assignment, we measured the gains in employment and earnings for registered apprentices relative to similar individuals who did not participate in RA (called nonparticipants). In our primary analysis, we estimated the relationship between earnings in each year following RA enrollment and the share of the RA program completed by the enrollee, accounting for pre-enrollment earnings and demographic characteristics. The model results allowed us to estimate the average earnings in each year for participants and the predicted earnings for individuals who enrolled in the program but did not complete any of it (the nonparticipants). As a check on our findings from the primary analysis, we used two alternative approaches: we compared the outcomes of enrollees who completed RA relative to outcomes of enrollees who did not complete the program and we compared the outcomes of RA participants to outcomes of similar individuals living in the same state. For Missouri, data were available for an additional comparison: outcomes of RA participants compared to outcomes of participants in Employment Service programs.

Estimates from each of these comparisons offer insights into the effects of RA on employment and earnings, although none of the comparisons identifies purely causal effects of RA. Because our analysis cannot fully account for the selection mechanisms that lead certain people to participate in RA, our findings are suggestive, but not conclusive evidence of the effects of RA on employment and earnings. For example, if people who participate in RA tend to be particularly career-oriented, their employment and earnings gains (relative to the comparison groups) may have been due to their commitment to career success rather than to participation in RA.

To assess the net social benefits of RA, we estimated the economic benefits to apprentices, government, and society and compared those to the costs. We used the estimated effects on employment and earnings to simulate the gains in lifetime earnings from RA. Our estimates of the benefits to government included the increased taxes and reduced use of public programs that result from higher lifetime earnings for apprentices. We gathered information on the federal and state costs of RA from program administrators. Because collecting information on benefits and costs for employers was outside the scope of our study, our cost-benefit analysis assumes no net benefit to

employers. It is reasonable to expect that net benefits for employers are positive: their voluntary participation in RA suggests they perceive a positive benefit. Under the assumption of no employer net benefit, then, our estimate of net social benefits is understated.

Beyond program effectiveness and cost-benefit analysis, the study addressed two additional research goals. First, the study examined the barriers that women face in RA and sought to identify the best practices for promoting women's success. We explored these issues through discussions with women who have participated in the program, DOL grantees that focus on women's success in apprenticeship, and state apprenticeship directors. We also studied whether the patterns of RA participation and effectiveness were different for women by conducting all analyses separately by gender. Second, we considered whether there are patterns of differences in apprenticeship programs and outcomes between states federally administered by OA and those administered by SAAs. We examined this question by looking for patterns of differences between OA and SAA states in our discussions with state directors and in our quantitative analyses of RA effectiveness and benefits.

Before turning to the findings, we briefly describe our study design and methods in Chapter II. Chapter III provides a statistical portrait of apprenticeship in the study states from 2000 to 2010. Chapters IV and V provide our estimates of the effects of RA on employment and earnings and the cost-benefit analysis. Chapter VI describes the experiences of women in apprenticeship based on our discussions with women participants, DOL grantees, and state directors. Chapter VII provides our findings on differences between OA and SAA states. We conclude, in Chapter VIII, with a discussion of the findings. Appendix A provides a further description of the methods and data. Appendix B has additional tables of findings including statistical portraits of RA in each of the study states. The protocols for our structured discussions are in Appendix C.

II. METHODS AND DATA SOURCES

This study sought to examine the effectiveness and net social benefits of RA programs using the most appropriate methods and best available data given the schedule and resource constraints of the project. In this chapter, we provide a brief description of the study design. The chapter describes our process for selecting the 10 study states, the methods used for the effectiveness assessment, our approach to the cost-benefit analysis, and the methods for gathering qualitative information on RA programs and women's experiences in RA. Appendix A provides additional details for each of these topics.

A. Selection of States

A key research objective of this study was to examine whether RA has substantial net social benefits across a wide variety of states. At the outset, we determined that data from 10 states would be enough to produce estimates that would indicate RA effectiveness in a broad range of environments.

For the study to be broadly informative, we selected states that vary across many important dimensions that could affect program content and performance. This allowed us to examine whether program features and the net benefits of apprenticeship are consistent across states or vary substantially. Our goal was to select a broad enough range of states so that apprenticeship program partners, employers, and other stakeholders would have access to the analysis for their own state or for a state similar to theirs. We were unable to compare the selected states to a national sample because federal RA administrative records include information on only 32 states. In addition, with RA information available on only 32 states, we did not have information to select states such that the aggregate would be nationally representative.

We considered five dimensions of program characteristics. First, we selected states that vary by administrative type: those with programs administered by the federal Office of Apprenticeship (OA) and those with programs administered by State Apprenticeship Agencies (SAAs). Second, we selected states that ranged in the number of apprentices. Third, we chose states in different economic regions. Fourth, we considered the importance of unions in the state because unions sponsor apprenticeships, contribute to program content, and affect the labor markets in which apprentices typically work. Finally, we considered the degree to which apprenticeship programs were concentrated in a few occupations, choosing states that varied substantially in this regard.

In addition to considering these five dimensions, a practical consideration in the selection of states was the availability of necessary administrative data. We restricted our selections to states included in the OA administrative database, the Registered Apprenticeship Partners Information Data System (RAPIDS), which covers the RA program in 32 states for the period 2000 to 2010. We were able to include one additional state, Maryland, for which we were able to make use of administrative records kept by the state. However, due to differences in the data sources, estimates for Maryland are not comparable to estimates for other states (see Appendix A for details).

We also chose states based on access to their unemployment insurance (UI) wage record data. In seven states, the study had access to UI data through the Administrative Data Research and Evaluation (ADARE) alliance. ADARE is an alliance of state partners that have negotiated data-sharing agreements with state agencies to permit controlled access to administrative data sources to conduct research and evaluation studies of immediate policy relevance. The ADARE partners'

access to UI wage records and willingness to participate in the study was a key factor in selecting Georgia, Kentucky, Maryland, Missouri, New Jersey, Ohio, and Texas. The three remaining states (Florida, Iowa, and Pennsylvania) were chosen in part based on Mathematica's and DOL's prior success in obtaining access to their UI wage records.

B. Effectiveness Assessment

A primary objective of this study was to examine the effectiveness of the RA program. We measured effectiveness as the association between RA participation and employment and earnings over a period of up to nine years following entrance into the RA program. This section briefly describes the analysis approach, data sources, and analytic samples for the effectiveness assessment.

We estimated effectiveness using measures of employment and earnings for RA participants. To measure the extent to which employment and earnings outcomes could be attributed to the RA program, we would need estimates of participants' employment and earnings if they had not entered the program. These estimated levels are known as the counterfactual outcomes. The counterfactual outcomes are typically estimated by measuring the outcomes of a similar group that did not receive the program. Random assignment of individuals into a group that receives RA training and a group that does not receive RA training could create the ideal comparison group, similar to RA participants in all ways except program participation. However, because of the limited resources and time frame for this study, we did not consider such a random assignment design.

In our primary analysis, we estimated the relationship between earnings and the share of the RA program completed. For RA participants, we constructed measures of their earnings and employment for each year for up to nine years after enrollment, measures of their pre-enrollment earnings and employment for each year for up to four years prior to enrollment, and measures of the share of the RA program that each enrollee ultimately completed. We estimated models of the relationships between earnings after enrollment and the share of RA completed, accounting for pre-enrollment earnings and employment as well as demographic characteristics measured at the time of enrollment. We refer to this as a "dosage model" because it relates outcomes to the dose (or share) of the program that each participant received. We also estimated dosage models for employment outcomes in addition to earnings outcomes.

Using the estimates of the dosage model, we estimated the average earnings of RA participants, averaging across the distribution of share completed at the average values of pre-enrollment earnings, employment, and demographic characteristics. We also used the model estimates to calculate the expected earnings for people who did not complete any of the RA program, or nonparticipants. The expected earnings for nonparticipants was calculated as the predicted earnings from the model estimates when the share completed was set to zero and average values were used for pre-enrollment earnings, employment, and demographic characteristics. The models provided reasonable predictions for outcomes when the share of completion was set to zero because a sizable number of RA enrollees completed small shares of the program: almost 9 percent of enrollees completed less than 10 percent of the program.

The dosage model measures the outcomes of RA participants as a function of the share of the program completed. Although the model includes controls for pre-enrollment earnings, employment, and demographic characteristics, we expect that participants who complete more of the program differ in unmeasured ways from those who complete less of the program. In particular, RA participants who complete a large share of the program may have been more motivated or more skilled than those who completed only a small share. Such a difference between the groups at

enrollment could explain some (or even all) of the post-enrollment differences in outcomes. In other words, our estimates of effects are likely to be upwardly biased estimates of the true causal effect of RA participation on outcomes.

Although we could not directly address this limitation, we used alternative comparison approaches to provide a check on our results. First, we compared the outcomes of RA enrollees who completed the program to the outcomes of similar individuals who enrolled but did not complete the program. Second, we compared the outcomes of RA participants to the outcomes of similar individuals who live in the same state. Finally, for Missouri, we were able to compare the outcomes of RA participants to the outcomes of similar individuals who participated in Employment Service programs. The findings based on these alternative comparison groups confirm the strong, positive association of RA participation with earnings and employment. None of our estimates is likely to represent the true causal impact of RA on employment and earnings because none of the comparison groups is likely to be identical to the apprentices.

We believe the dosage model produces better estimates than the other approaches for several reasons. For the comparison of RA completers versus noncompleters, we were not able to estimate the effects of partial completion of RA. For the state population comparison group, our findings suggest that the measures of labor market outcomes for this group (obtained from U.S. Census Bureau surveys) are not comparable to measures for RA participants (obtained from UI wage records) for reasons that are likely to affect the estimates. Finally, for the Employment Service comparison in Missouri, we were not able to find close matches in pre-period earnings and employment patterns between the RA participants and the Employment Service comparison group. The estimates suggest that the two groups should not be compared. For this reason, we do not report the results from the Employment Service comparisons in the main text (see Appendix A).

Our analysis of the association between RA participation and employment and earnings relied on several data sources. Information on RA participants came from RAPIDS data and from state administrative records in the case of Maryland. For ease of exposition in this report, we generally refer to the RA administrative records, including the Maryland data, as being from RAPIDS. Our analysis of the state population comparison group relied on demographic, employment, and earnings information in the Current Population Survey (CPS) collected by the U.S. Census Bureau. We obtained information on the Employment Service comparison group in Missouri from administrative data for that program. Due to data limitations, we did not estimate comparisons with Employment Service participants in other states (see Appendix A).

For both RA and Employment Service participants, information on quarterly employment and earnings came from UI wage records covering periods before and after enrollment. The UI wage records are the only information consistently available to measure employment and earnings outcomes for apprentices. Indeed, OA uses UI wage records to measure program performance for RA, in compliance with federal regulations on performance measures for job training and employment programs. However, the use of UI wage records has several limitations. First, because UI records are only available by state, they do not include information on earnings for people who work for out-of-state employers (for example, those who have moved outside the state and work in their new state of residence and those who commute to a different state for work). In addition, UI wage records are collected only for employees of firms covered by state UI programs. As a result,

they are not available for the self-employed, workers paid solely by commission, employees of small agricultural employers, or federal government employees (who are covered by a separate UI system).[5]

The limited coverage of the UI wage record data is a source of potential bias in our estimates. In our measures of earnings, we included a value of zero for the calendar quarter if a person has no reported earnings in the UI wage records for that quarter. If RA participants, regardless of share of the program completed, are equally likely to work in another state, be self-employed, or be working in other uncovered jobs, then our estimates from the dosage model are not biased by the limited coverage of the UI wage records. However, self-employment is fairly common in the contracting trades. Therefore, if RA completers are more likely than noncompleters to remain in their career of apprenticeship, they may be more likely to be self-employed during their careers.[6] Thus, we expect our estimates of the association between RA participation and earnings are likely to be biased downward by the lack of measures of earnings among the self-employed.[7]

We conducted the analysis on specific cohorts of RA participants defined by the period of entry into the program. The cohorts were chosen based on the availability of RAPIDS and UI wage records for each state. We chose apprentices who enrolled several years ago because we needed to have information on their program outcomes and post-enrollment employment and earnings. In addition, in order to have pre-enrollment measures of earnings, we chose the analytic samples such that there would be several years of UI data available prior to entering RA. For most states, these considerations resulted in the selection of apprentices who enrolled in RA in 2000 to 2001. However, for several states we selected a later enrollment cohort due to limited data availability (Table II.1).

[5] The U.S. House of Representatives, Committee on Ways and Means (2008), reported that UI wage records covered 89 percent of the civilian labor force in 2006.

[6] For example, in Florida in 2010, 16 percent of construction industry workers were self-employed, compared to only 8 percent of workers in all industries (self-employment information is based on authors' calculations from the CPS, March 2010 file).

[7] For the estimates to be unbiased, not only would the share of self-employed workers among RA participants and the comparison group need to be the same, but their income from self-employment would also need to be the same (on average). If RA were effective at raising income among the self-employed, the effect would not be captured in our estimates.

Table II.1. Data Availability and Enrollment Cohorts for Analysis (Years)

State	UI Wage Records Available	Enrollment Cohort for Noncompleter and State Population Comparisons
Florida	1992–2010	2000–2001
Georgia	1985–2010	2000–2001
Iowa	2003–2010	2005–2006
Kentucky	2002–2007	2004–2005
Maryland	1985–2010	2000–2001
Missouri	1988–2010	2000–2001
New Jersey	2000–2010	2004–2005
Ohio	1995–2008	2000–2001
Pennsylvania	1996–2010	2000–2001
Texas	1994–2010	2000–2001

Note: We chose enrollment cohorts based on data availability. For states with limited data, we chose the enrollment cohorts such that we would have substantial periods for measuring employment and earnings prior to enrollment and after enrollment. RAPIDS data were available for the study states for 2000 to 2010 (except Maryland, for which we used state administrative data).

C. Approach to Cost-Benefit Analysis

In this section, we describe our broad approach to the cost-benefit analysis and the conceptual framework underlying that analysis. Our cost-benefit analysis began with a set of baseline assumptions under which we could measure costs, benefits, and net social benefits. We then examined the net social benefits under alternative assumptions. Our overall approach was based on approaches developed for other studies of training and employment programs, especially the National Job Corps Study (McConnell and Glazerman 2001).

1. Conceptual Framework for the Cost-Benefit Analysis

To examine the total social costs and benefits of RA, we considered the costs and benefits from the perspective of each stakeholder: apprentices, employers, sponsors, government agencies, and society as a whole. Conceptually, we considered all costs and benefits from enrollment throughout the career of the apprentice. Empirically, we measured these costs and benefits over a nine-year period and extrapolated from these estimates to career-long estimates.

The main potential benefit of RA comes from the added productivity of workers who have become highly skilled through RA training. The value of this added productivity is accrued by employers and then paid to apprentices as additional earnings and fringe benefits. To the extent that employers pass the value of added productivity on to the apprentices, those employers experience neither costs nor benefits from the added productivity. However, some of the added productivity may actually remain with employers.[8] Overall, summing across apprentices and employers, the net social benefits of added productivity are positive. In our baseline analysis, we calculated productivity gains based on the estimated earnings gains from RA under the assumption that the measured association between RA participation and earnings (as estimated in the dosage model) is a causal

[8] For example, some of the training received by apprentices may be specific to the needs of the sponsoring employer. In the case of employer-specific skills, the added value of those skills may be shared between the employer and the worker.

estimate of the effect of participating in RA. Although we do not find this a credible assumption due to the likelihood of important differences between participants who complete a large share of the program and those who do not (such as being more motivated or more skilled), we find this is a useful assumption to provide baseline estimates of net social benefits.

Table II.2. Costs and Potential Benefits of Registered Apprenticeship

	Apprentices	Sponsors and Employers	Government Agencies	Society
Potential Benefits				
Productivity				
Earnings	+	0	0	+
Fringe benefits	+	0	0	+
Uncompensated	0	+	0	+
Taxes				
Federal	-	0	+	0
State	-	0	+	0
Public Programs				
Food stamps	-	0	+	0
Welfare	-	0	+	0
Unemployment compensation	-	0	+	0
Administrative costs	0	0	+	+
Costs				
Costs of Program				
Employer/sponsor costs	0	-	0	-
OA and SAA costs	0	0	-	-
RTI	0	-	-	-

Apprentices pay local, state, and federal taxes on their increased earnings.[9] These taxes accrue to the government. The additional taxes are a transfer of money from apprentices to government, resulting in no net social gain when summed.

With higher earnings and fringe benefits, apprentices are less likely to receive public assistance and unemployment compensation. For apprentices, we estimated a decline in the value of food stamps, welfare payments (which includes Temporary Assistance for Needy Families [TANF] and local welfare programs), and unemployment compensation. Government receives a benefit of equal size by not providing these payments. In addition, government has a reduction in the costs of administering the programs. The net social benefits, summed over apprentices and government, are only the value of the reduction in administrative costs. We do not include the effects of RA on the use of public health insurance because we have no measures of the use or cost of public health insurance for this population. If RA reduces the use of public health insurance, then the benefits to government would be larger than we have measured, but the overall social benefits would only be larger by the related reduction in public health insurance administrative costs.

[9] Employers also pay additional taxes in the form of payroll taxes (for example, Social Security taxes). Because these taxes are paid on behalf of the employee, we included the value of these taxes as a fringe benefit to the apprentices and the payment of these taxes in the estimates of effective taxes paid by apprentices.

Our measure of the costs of RA is based on the government cost. The government pays for the activities of the OA and SAAs: outreach, registration, compliance and quality assurance, and building partnerships. In addition, when a public community college provides the RTI, there is an associated public subsidy.

Employers and sponsors pay many of the costs associated with apprenticeship. They pay for recruiting apprentices, training costs, and administrative costs associated with registering apprentices and reporting on the program. Training costs include paying the tuition and similar costs for related technical training and paying more senior employees for time spent providing OJT and mentoring. In light of the time frame and resources available for this study, we chose not to attempt to measure the costs and benefits to employers and sponsors. Accurately estimating these costs and benefits is extremely difficult. For example, to measure the benefits, employers must estimate the value of the added productivity that comes from the RA training and subtract the amount of that value that they pass on to apprentices as compensation. On the cost side, employers would need to include an estimate of the value of the amount of time spent by senior employees providing training and mentoring. An accurate estimation process would need to include a large number of employers, because the benefits and costs are likely to vary substantially by occupation and possibly by employer size and other specific program characteristics. Gunn and De Silva (2008) found that employer estimates of their RA costs per participant varied widely, from as little as $600 per year to as much as $52,000 per year, depending on what factors employers included. However, the employers they interviewed for their study did not identify employer costs as a problem with RA programs.

In our baseline cost-benefit analysis, we assumed that the net benefits to employers are zero. Indeed, as a voluntary program, the employers who choose to participate in RA probably perceive their benefits to outweigh their costs. If this perception is correct, then by not including employer costs and benefits, we have underestimated the net social benefits of RA. That is, even the substantial net social benefits that we estimated could be lower than the true net social benefits if employer benefits are included. On the other hand, it is not certain that employers benefit from RA. Employers may participate because they perceive benefits that they do not realize due to uncertainties or incomplete information. In addition, the RA program sometimes offers incentives to employers for their participation. In our discussions with state directors, we learned that some employers cease to participate when the financial incentive is no longer available. This suggests that, for these employers, the incentives encouraged participation beyond the level that would be directly beneficial without incentives. As a result, we considered alternative assumptions about employer net benefits in our sensitivity analysis.

Apprentices pay little or no direct costs for RA. In some cases, they may pay for books required for the RTI. In addition, in some cases they are not compensated for time spent in RTI, which is time they might have spent working. Apprentices also have expenses associated with working, such as paying for child care, transportation, work clothes, and sometimes work supplies (for example, if they bring some of their own tools to the job site). It would be inappropriate to consider all these expenses as costs of RA because, even without RA, many of the apprentices would likely be working or looking for work and would still be incurring at least some of these work-related expenses. As a practical matter, we did not have estimates of the direct or indirect costs of RA for apprentices. For example, we did not have data on work hours from which we might estimate child care costs. In our baseline net social benefits calculation, then, we included no costs of RA for apprentices.

Finally, there are some indirect costs and benefits for which estimated values would be so inaccurate that they are typically not included in a cost-benefit analysis. For example, if RA participants had not chosen RA, they might have had more time for leisure or work around the home. The value of this time is not included in our analysis. Similarly, we did not include any nonmonetary benefits RA participants potentially experience from greater job satisfaction or less stress over job security than they would have experienced without RA.

2. Testing Key Assumptions and Adjusting Estimates

Our baseline estimates of the net social benefits of RA are based on estimates and assumptions that have varying degrees of uncertainty. We tested the sensitivity of our results to alternative estimates and assumptions. We calculated the net social benefits under different assumptions about the costs to government, apprentices, and employers. We also varied our assumptions about the effects of RA on earnings, public assistance and unemployment compensation. In addition, we considered alternative rates for discounting future earnings (to take into account that a dollar in 2000 is worth more than a dollar in later years because it can be invested and earn interest) and for reducing the earnings benefit over time (known as the rate of decay of the earnings gain).

Finally, we considered that RA is a public-private partnership funded by government and private employers. Even if RA has a positive net social benefit, investment by the government is only warranted if the government investment generates a net social benefit. Our measure of the benefit includes the effects of all invested dollars—public and private. That is, we could not separately measure the effectiveness of the public investment from that of private investment by sponsors and employers. For example, it is conceivable that we would find substantial effects of RA on earnings due to private apprenticeship programs even without the government investment. Although there are reasons to believe that the government investment contributes to the overall benefits of RA through outreach to attract candidates and partners, technical assistance to the sponsors, and quality assurance, the full benefit of the program should not be attributed to the public investment. Therefore, our sensitivity analysis examined the net social benefits due to government investment under an alternative scenario for the effectiveness of the public investment.

D. Qualitative Data Collection

We augmented our analysis of administrative data with qualitative data in order to further our understanding of the RA program in the study states and to examine the experiences of women in RA.

- To learn about the RA program in the selected states, we conducted semistructured telephone discussions with state apprenticeship directors in each study state. For states federally administered by OA, we spoke with the state-level OA director. For states administered by an SAA, we spoke jointly with the SAA director and the OA director for that state. We invited directors to include staff members in the discussion.
- To examine the experiences of women in apprenticeships, we conducted semistructured telephone discussions with 15 women who participated in RA. The women were randomly selected to be broadly representative of women who participated in RA during the period 2000 to 2010.

- We also learned about the experiences of women in apprenticeship through semistructured telephone discussions with the executive directors of five CBOs that received Women in Apprenticeship and Nontraditional Occupations (WANTO) grants from DOL. The purpose of the WANTO grant program, jointly administered by DOL's Women's Bureau and OA, is to increase the number of women entering and completing apprenticeship.

III. STATISTICAL PORTRAIT OF REGISTERED APPRENTICESHIP IN THE STUDY STATES

RA is a diverse, evolving career-training program. The apprentices in RA come from variety of backgrounds and enroll in programs in a broad range of occupations. In this chapter, we focus on the current state of RA in the study states and how it has changed during the decade this study covers in demographic characteristics, occupations, apprenticeship requirements, and completion status of apprentices. This statistical portrait provides information on the number, nature, and activities of apprentices. It also provides a context for interpreting our estimates of the effects and net social benefits of RA. The statistics provided in this chapter cover the 10 study states with the exception of Maryland, which is not included in the RAPIDS database.[10]

A. Enrollment Patterns Over Time

The number of new apprenticeships has changed considerably in the past 10 years (Figure III.1). In 2010, 21,558 people enrolled in apprenticeship in the study states. This number represents a 39 percent decline from the number of new apprenticeships in 2000. Rather than decreasing consistently each year, however, the size of enrollment cohorts experienced substantial swings. The 2007 cohort had the most new apprentices (42,142). In contrast, the 2010 cohort had the fewest number of new apprentices. The rapid decline between the peak and current cohorts coincides with the economic recession that began in late 2007. This decline is perhaps not surprising as construction and manufacturing, industries that widely use the apprenticeship model, experienced high levels of unemployment since 2007. Therefore, the number of new apprenticeships may continue to stagnate unless economic prospects improve.[11]

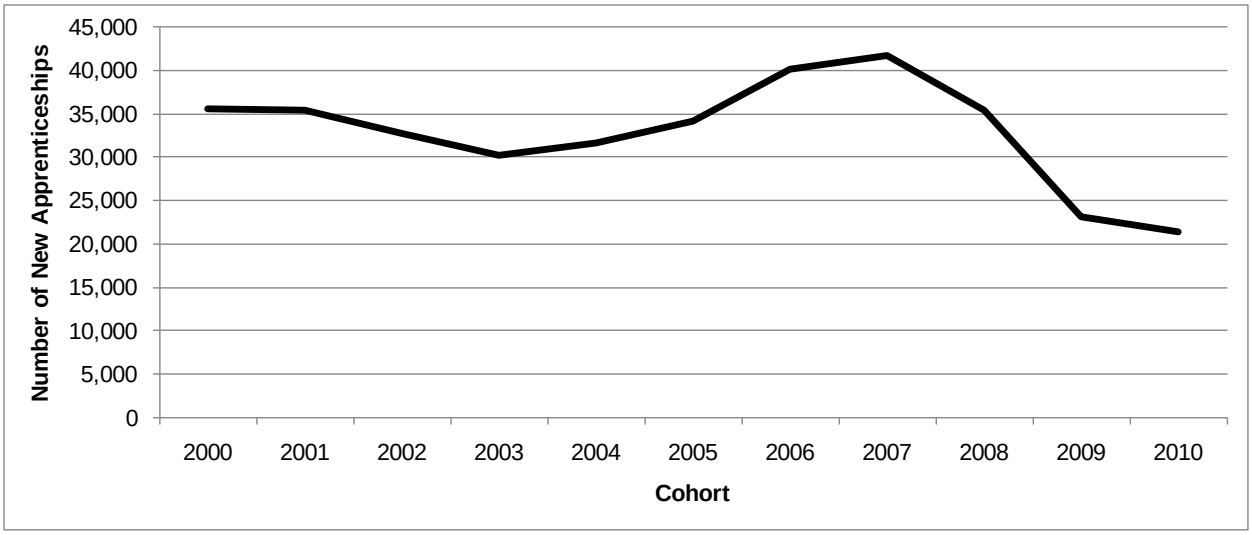
The largest numbers of new apprentices were in the most populous states: Florida, Ohio, Pennsylvania, and Texas (Figure III.2). Interestingly, the 2010 cohort in Missouri was similar in size to the cohorts in some of these states, even though it had a much smaller population. At the other extreme, Kentucky had the fewest new apprenticeships (only 875); it had the smallest population among the study states.

Over the past 10 years, the number of new apprenticeships decreased in every study state, although the degree of decline differed substantially. For example, the size of the enrollment cohort in Ohio declined 59 percent during the past decade; in Kentucky it declined only 9 percent. In general, the states with the most new apprenticeships in 2000 experienced greater relative declines. The one exception to this pattern was Texas, which experienced only a 12 percent decrease in the number of new apprenticeships. However, because the Texas enrollment cohort was quite large, this decline still represented a rather large decline in total numbers (745 fewer new apprenticeships).

[10] For Maryland, we used RA administrative data available from the state for the effectiveness analysis. However, the Maryland data were not comparable to the RAPIDS data used in this chapter for the other study states. Information for Maryland is provided in Appendix Tables B. 7 and B.17.

[11] The quarterly enrollment patterns had local peaks in the third quarter (not shown in Figure III.1). This may be due to enhanced recruitment towards the end of the fiscal year as programs attempt to meet enrollment targets. Alternatively, it may be due to a tendency for people to begin training programs after the summer.

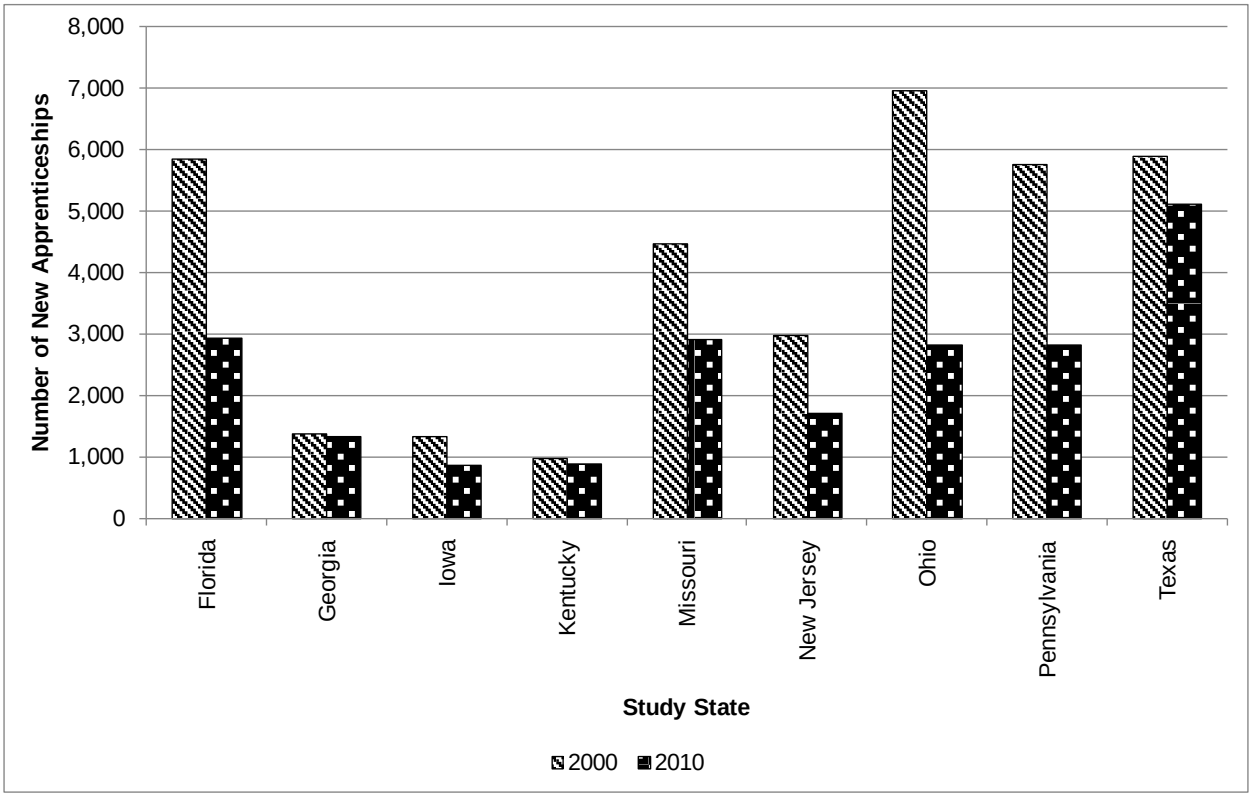
Figure III.1. Number of New Apprenticeships, by Enrollment Cohort



Source: RAPIDS.

Note: The figure shows the number of people enrolling in RA each year in Florida, Georgia, Iowa, Kentucky, Missouri, New Jersey, Ohio, Pennsylvania, and Texas.

Figure III.2. Number of New Apprenticeships, by State, 2000 and 2010 Enrollment Cohorts



Source: RAPIDS.

B. Demographic Characteristics of Apprentices

Most apprentices were men under 40 years old (Table III.1). Among those in the 2010 cohort, 13 percent of apprentices were younger than 21 and 69 percent were between the ages of 21 and 39. Most apprentices (91 percent) were men. The racial composition of the 2010 cohort showed slightly more diversity than the population as a whole. The largest racial group among apprentices was whites, at 68 percent. In contrast, whites made up 79 percent of the 2010 population in the study states (not shown in table).[12] Nearly all new apprentices, 93 percent, had at least a high school diploma when they started their apprenticeship, and 10 percent of new apprentices had postsecondary education or technical training.

Table III.1. Demographic Characteristics of the 2010 Enrollment Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Difference Between Men and Women		OA	SAA	Difference Between OA and SAA	
Age					***				***
16 to 20 years old	13.4	13.9	7.9	5.9		12.3	14.6	-2.3	
21 to 39 years old	69.2	70.0	59.7	10.4		69.4	68.9	0.5	
At least 40 years old	17.5	16.1	32.4	-16.3		18.3	16.5	1.8	
Average age (years)	30.7	30.3	34.9	-4.6	***	31.0	30.3	0.7	***
Gender									***
Male	91.4	100.0	0.0	100.0		92.0	90.5	1.5	
Female	8.6	0.0	100.0	-100.0		8.0	9.5	-1.5	
Race/Ethnicity					***				***
White	67.6	68.6	56.7	12.0		60.9	75.9	-15.0	
Black	14.4	13.5	23.0	-9.5		14.8	13.8	0.9	
Hispanic	16.6	16.6	17.4	-0.9		22.8	9.0	13.8	
Other race	1.4	1.3	2.9	-1.6		1.5	1.3	0.2	
Education					***				***
Less than high school	0.5	0.5	0.3	0.2		0.6	0.3	0.3	
Some high school	6.1	6.2	4.3	2.0		5.7	6.5	-0.8	
High school graduate	83.2	82.8	86.9	-4.0		78.5	89.2	-10.7	
Postsecondary	10.3	10.4	8.5	1.9		15.2	4.0	11.1	
Veteran	9.2	9.7	3.1	6.7	***	8.0	10.6	-2.6	***
Prisoner at enrollment	11.0	9.3	29.0	-19.7		12.7	8.8	3.9	
Sample Size	**21,426**	**19,575**	**1,851**			**11,966**	**9,460**		

Source: RAPIDS.

Note: The sample consisted of apprentices living in Florida, Georgia, Iowa, Kentucky, Missouri, New Jersey, Ohio, Pennsylvania, and Texas. The calculations were based on apprentices for whom there were no missing data for the specified characteristic. The OA states are Georgia, Iowa, Missouri, New Jersey, and Texas; all other states are SAA states.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level, respectively, using a two-tailed test.

[12] Population estimates came from the U.S. Census Bureau at [http://www.census.gov/popest/states/asrh/SC-EST2009-04.html] (accessed on July 10, 2011). The estimates are for the entire state population regardless of age and employment status.

RA also serves many veterans and prisoners, subgroups that may be in particular need of job training services. After being discharged from the military, veterans face unique barriers (such as mental and physical impairments) when they try to enter the labor force (Bouman and Coleman 2009). In the 2010 enrollment cohort, 9 percent of apprentices were veterans. Prisoners face barriers to employment and have limited opportunities to invest in their human capital (Solomon et al. 2004). In 2010, 11 percent of new apprentices were incarcerated when they enrolled in RA.

An important objective of this study was to examine the experiences of women in RA. Women are substantially underrepresented in RA: in 2010, they made up only 9 percent of new apprentices. Female apprentices tended to be older than male apprentices, with an average age at entrance of 35 years compared to 30 years for men. In addition, a larger share of female apprentices were black (23 percent, compared to only 14 percent of men). Interestingly, women were much more likely than men to have enrolled in RA while incarcerated: 29 percent of women were prisoners at the time of enrollment, compared to 9 percent of men.

Another study objective was to explore differences in RA by administrative type. The right-hand columns of Table III.1 show the differences in demographic characteristics of apprentices living in OA and SAA states. The only substantial differences were the racial and educational distributions of apprentices. OA states enrolled a larger share of Hispanics and a smaller share of whites than did SAA states. The difference mainly reflects differences in the state populations: the OA states had a much larger share of Hispanic residents than did SAA states (22 percent compared to 11 percent).[13] OA states also tended to enroll more apprentices who have some postsecondary education or technical training.

The demographic characteristics presented in Table III.1 for the study states combined mask some notable differences across states (see Appendix B for state-specific tables). For example, Florida had the highest share of women apprentices (18 percent), and Iowa has the lowest share (2 percent). There are also differences in the share of apprentices who were prisoners at the time of enrollment. Incarcerated apprentices were most common in Kentucky (23 percent) and Missouri (39 percent).

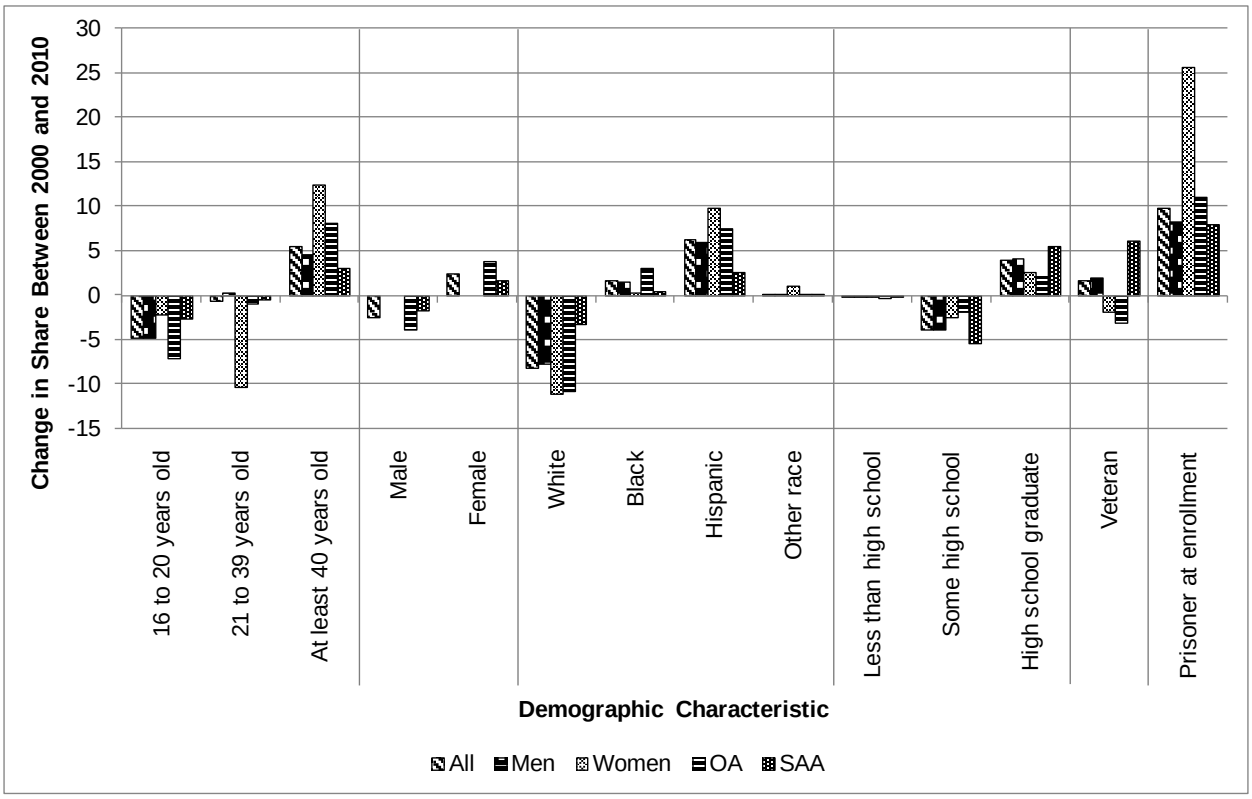
The characteristics of new apprentices have changed over the past decade (Figure III.3). The share of women apprentices increased slightly, with greater growth in OA states than in SAA states. Although the share of women grew, the actual number of new female apprentices declined from 2,194 in the 2000 enrollment cohort to only 1,851 in the 2010 cohort (Appendix Table B.1 provides numbers of new apprentices by demographic characteristic). The share of women only increased because the number of women declined relatively less than did the number of men. The share of new Hispanic apprentices also increased over the decade, as the number of enrollees who were

[13] The share of residents who are Hispanic was calculated for the OA states (combined) and the SAA states (combined) using data from the U.S. Census Bureau at [http://www.census.gov/popest/states/asrh/SC-EST2009-04.html] (accessed on July 10, 2011). The estimates are for the entire state population regardless of age and employment status.

white declined more substantially than did the number who were Hispanic (48 percent decline for whites compared to 6 percent decline for Hispanics).[14]

RA has also changed substantially in the extent to which it enrolls prisoners. The share of prisoners among new apprentices increased 10 percentage points over the past decade. In absolute numbers, the number of prisoners in the enrollment cohort grew from 430 in 2000 to 2,374 in 2010. The growth was especially strong for women: from 74 to 538 individuals. This growth is especially striking because the overall number of women declined by 321 over those 10 years.

Figure III.3. Changes in Demographic Characteristics Over Time, 2000 and 2010 Enrollment Cohorts



Source: RAPIDS.

Note: The sample consisted of apprentices living in Florida, Georgia, Iowa, Kentucky, Missouri, New Jersey, Ohio, Pennsylvania, and Texas. The calculations were based on apprentices for whom there were no missing data for the specified characteristic. Information on educational attainment beyond high school was not available for 2000. The OA states are Georgia, Iowa, Missouri, New Jersey, and Texas; all other states are SAA states.

[14] The decline in the share of apprentices who were white also occurred within traditional occupations. Among electricians, plumbers, and carpenters, the share of new enrollees who were white declined from 75 percent in 2000 to 66 percent in 2010.

C. Apprenticeship Occupations and Training Requirements

RA programs provide career training in many occupations. Table III.2 shows the shares of apprenticeships in the largest five occupations among men and women. Most of the largest occupations were in the construction trades. The most common occupation in the 2010 enrollment cohort was electrician, followed by plumber and carpenter. These three occupations represented over 40 percent of all new apprenticeships in the study states.

There were some notable differences in the occupations of women compared to those of men. The most common occupation for men was electrician, and the most common one for women was child care worker. Among women in the 2010 enrollment cohort, 34 percent were in child care apprenticeships, but only eight men were in child care. The second most common apprenticeship for women was nursing aide, at 6 percent. Here, too, the number of males was small: only three men enrolled in these apprenticeships.

Table III.2. Occupations of the 2010 Enrollment Cohort (Percentages)

	All	Men	Women	Difference Between Men and Women		OA	SAA	Difference Between OA and SAA	
Occupation					***				***
Electricians	23.4	25.1	4.6	20.5		26.1	19.9	6.2	
Plumbers, pipefitters, and steamfitters	11.6	12.6	1.6	11.0		13.0	9.9	3.1	
Carpenters	7.0	7.4	2.9	4.5		6.3	7.9	-1.6	
Heavy and tractor-trailer truck drivers	5.7	5.9	3.5	2.5		7.8	3.1	4.7	
Sheet metal workers	3.5	3.8	0.3	3.5		3.8	3.2	0.6	
Electrical power-line installers and repairers	3.5	3.8	0.1	3.7		3.5	3.5	-0.1	
Correctional officers and jailers	3.1	2.9	4.6	-1.7		1.0	5.6	-4.6	
Child care workers	3.0	0.0	33.8	-33.7		1.5	4.8	-3.4	
Home appliance repairers	0.6	0.2	4.7	-4.5		0.9	0.2	0.6	
Nursing aides, orderlies, and attendants	0.6	0.0	6.3	-6.3		0.7	0.4	0.4	
All other occupations	38.1	38.1	37.6	0.5		35.5	41.4	-5.9	
Sample Size	**21,426**	**19,575**	**1,851**			**11,966**	**9,460**		

Source: RAPIDS.

Note: The sample consisted of apprentices living in Florida, Georgia, Iowa, Kentucky, Missouri, New Jersey, Ohio, Pennsylvania, and Texas. The calculations were based on apprentices for whom no occupation data were missing. The OA states are Georgia, Iowa, Missouri, New Jersey, and Texas; all other states are SAA states.

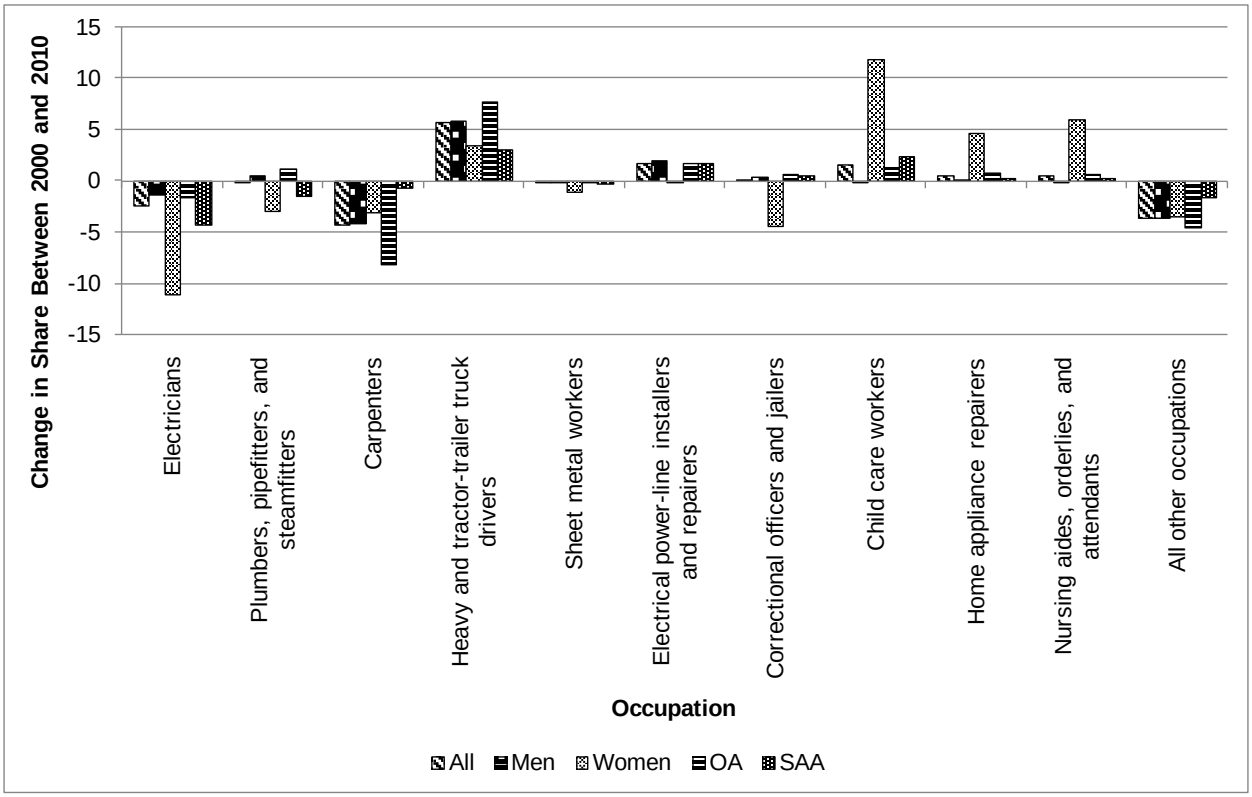
*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level, respectively, using a two-tailed test.

The compositions of occupations in OA and SAA states were qualitatively similar. One difference is that OA states had greater shares of electricians and plumbers while SAA states had greater shares of correctional workers and child care workers. These differences may be driven by differences in state labor markets, sponsor decisions, or the activities of OA and SAA state staff. However, in our discussions with the state directors, we did not learn of any differences in OA and SAA staff activities that would lead to these occupational differences.

The occupational distributions among 2010 enrollees in each state were fairly similar to the overall occupational distribution shown in Table III.2 (see Appendix B for state-specific tables). One notable exception is the most common occupation in Pennsylvania: correctional officer. In addition, women who enrolled in child care worker apprenticeships were concentrated in Florida and New Jersey. Many other states did not have enrollees, male or female, in child care.

The occupational distribution in RA has changed in the past 10 years (Figure III.4). The shares of electricians and carpenters have declined for all apprentices, by gender, and by state administrative type. In their place has been growth in the share of apprenticeships in heavy truck driving. Among women, the share in traditional RA occupations in the skilled trades declined with growth in the share in the nontraditional occupations of child care and nursing (Appendix Table B.2 provides the numbers of apprentices by occupation).

Figure III.4. Changes in Apprenticeship Occupations Over Time, 2000 and 2010 Enrollment Cohorts



Source: RAPIDS.

Note: The sample consisted of apprentices living in Florida, Georgia, Iowa, Kentucky, Missouri, New Jersey, Ohio, Pennsylvania, and Texas. The calculations were based on apprentices for whom no occupation data were missing. The OA states are Georgia, Iowa, Missouri, New Jersey, and Texas; all other states are SAA states.

For each occupation, RA requires apprentices to complete a combination of on-the-job training (OJT) and related technical instruction (RTI) (Table III.3). Sponsors determine the specific requirements for each apprenticeship. For the 2010 cohort, the average amount of OJT required to complete an apprenticeship was 6,745 hours, the equivalent of 3.4 years based on 2,000 hours per year. To put this number into perspective, according the Bureau of Labor Statistics, the median tenure for wage and salary workers between ages 25 and 34 is 3.1 years.[15] Therefore, the amount of OJT time in an apprenticeship is comparable to the average amount of time that other young workers have spent with their employer. In addition, the duration of OJT provided in RA is more than a year longer than the period typically required to earn a two-year associate's degree. Apprentices also were required to complete an average of 46 hours of RTI. RTI consists of course content provided by third-party vendors, and apprentices often complete this component at community colleges.

Table III.3. Program Requirements of the 2010 Cohort (Average Hours)

	All	Men	Women	Difference Between Men and Women		OA	SAA	Difference Between OA and SAA	
OJT	6,745	6,988	4,176	2,813	***	6,680	6,827	-147	***
RTI	46	44	65	-21	***	56	33	23	***
Sample Size	**21,426**	**19,575**	**1,851**			**11,966**	**9,460**		

Source: RAPIDS.

Note: The sample consisted of apprentices living in Florida, Georgia, Iowa, Kentucky, Missouri, New Jersey, Ohio, Pennsylvania, and Texas. The calculations were based on apprentices for whom no data were missing for the specified characteristic. The OA states are Georgia, Iowa, Missouri, New Jersey, and Texas; all other states are SAA states.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level, respectively, using a two-tailed t-test.

The amount of time required to complete an apprenticeship differed substantially by gender. The average length of OJT was 6,988 hours for men and only 4,176 hours for women (roughly 1.4 years shorter than for men). The main reason for the gender difference is that women tend to be in occupations with fewer required hours. We calculated that, if women were to have the same distribution of occupations as men, the average hours requirement for women would be 6,350—much closer, but still below, the 6,988 hours for men. The result suggests that much, but not all, of the gender difference in hours required is due to different occupational choices.[16]

OA and SAA states showed a small difference in the total length of apprenticeships. Sponsors in OA states required an average of 147 fewer hours of OJT than sponsors in SAA states, equal to about an additional month of training. The difference is not driven by the differences in the distribution of the occupations in the two sets of states. We calculated that, if SAA states were to

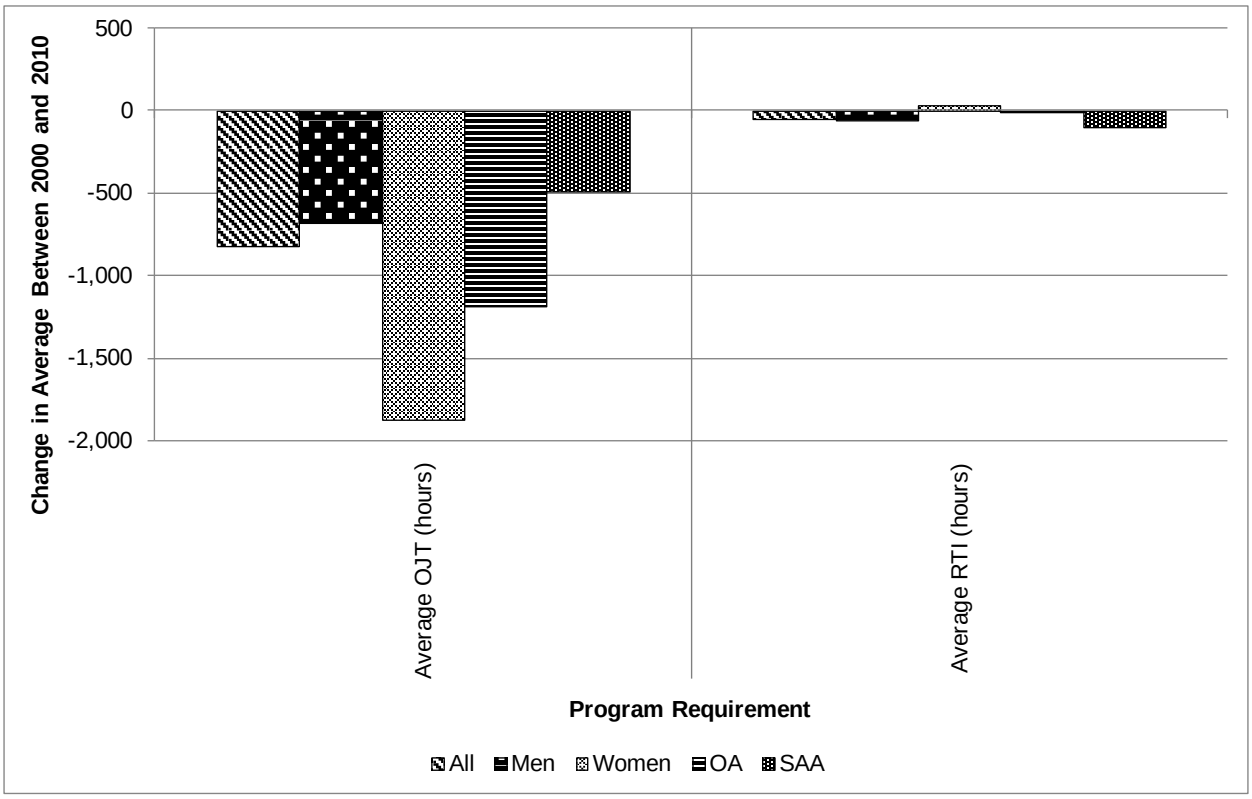
[15] Job tenure information came from the Bureau of Labor Statistics website at [http://www.bls.gov/news.release/tenure.t01.htm]. Accessed on June 11, 2011.

[16] To assess the underlying factors that contribute to gender differences in hours required, we reweighted the women's occupational distribution to match that of the men's.

have the same distribution of occupations as found in OA states, the difference in hours required would actually be 329 hours.[17] The results imply that sponsors in SAA states require more hours, even in the same occupational categories.

The time requirements for apprenticeships have changed over the last decade (Figure III.5). The average apprenticeship in 2010 was 830 hours shorter than 10 years ago, an 11 percent decrease. The decline was larger for women apprentices than for men. The decrease was also larger for OA states than for SAA states. These changes can be traced to two causes: (1) changes in the composition of occupations over the past decade, and (2) changes in the training requirements within each occupation.

Figure III.5. Changes in the Program Requirements Over Time (Hours)



Source: RAPIDS.

Note: The sample consisted of apprentices living in Florida, Georgia, Iowa, Kentucky, Missouri, New Jersey, Ohio, Pennsylvania, and Texas. The calculations were based on apprentices for whom no data were missing for the specific characteristic. The OA states are Georgia, Iowa, Missouri, New Jersey, and Texas; all other states are SAA states.

[17] For this calculation, we reweighted the SAA states' occupational distribution to match that of OA states.

D. Apprenticeship Outcomes for the 2000 Enrollment Cohort

Gaining an understanding of the share of apprentices who complete the program and the time it takes for them to do so, is central to evaluating RA. To examine program outcomes, we chose the earliest available enrollment cohort, the 2000 cohort. Using this cohort allows up to 11 years from enrollment to the most recent information. Over this time, most apprentices have either completed or cancelled their apprenticeship. As of 2010, less than 1 percent of apprentices in this cohort are still considered enrolled in the apprenticeship program they entered in 2000.

Overall, RA had mixed success in program completion. About 45 percent of apprentices completed their apprenticeships and obtained a certificate (Table III.4). More than half, however, cancelled without completing the program. Based on the enrollment date and the final event date, the completers took 7,273 hours to finish the program.[18] This amount of time is equal to 3.6 years in RA. The time it takes to complete an apprenticeship may differ from the time required if participants transfer credit hours or get behind on their training, or if the requirements in RAPIDS are approximations.

Apprentices who cancelled their apprenticeships spent an average of 3,781 hours (about 1.9 years) in the program. For noncompleters, we calculated the share of the RA program completed as the total hours of enrollment divided by the hours of OJT required for their apprenticeship. The calculation is approximate because the RAPIDS does not contain information on the number of hours of OJT acquired by an apprentice. Rather, we used hours of enrollment calculated as 40 hours per week between the enrollment date and the cancellation date (with a cap at 100 percent). About 27 percent of apprentices completed less than a third of their apprenticeship. Almost 55 percent of apprentices were enrolled in apprenticeship for enough time to have completed 100 percent of the program, although only 45 percent actually completed the program with a certificate.[19]

Men and women in the 2000 enrollment cohort completed apprenticeships at similar rates (about 45 percent). However, as we have shown, apprenticeship occupations differed by gender. If women were in the same occupations as men, their estimated completion rate would be only 35 percent.[20] In other words, women tended to be in occupations with higher completion rates. Within the more male-dominated occupations, women tended to have lower completion rates than men.

The average amount of time in RA among men who completed the program was 1,841 hours longer than the average for women (a gap of about 0.9 years). The gender gap is due to differences in the distribution of occupations. If women were in the same occupations as men, their estimated average amount of hours to complete RA would be about the same as that of men.

[18] We calculated the hours spent in RA based on the enrollment date and the last event date for each apprentice. The calculation is based on an eight-hour work day for five days each week.

[19] For RA completers, we set the percent completed to 100 percent regardless of time enrolled in the program.

[20] To assess the underlying factors that contribute to gender differences in completion rates and time to completion, we reweighted the women's occupational distribution to match that of the men.

Table III.4. Outcomes and Time in RA for the 2000 Enrollment Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Difference Between Men and Women		OA	SAA	Difference Between Men and Women	
Outcome						41.2	48.6	-7.4	***
Completed	45.3	45.3	44.3	1.0		57.9	50.5	7.4	
Cancelled	53.8	53.7	54.9	-1.2		0.9	0.9	0.0	
Active	0.9	0.9	0.8	0.2		41.2	48.6	-7.4	
Average Time in RA (hours)									
Completers	7,273	7,384	5,543	1,841		7,673	6,994	679	
Noncompleters	3,781	3,804	3,447	357		3,633	3,922	-289	
Percent Completed					*				***
0–33 percent	26.7	26.6	27.5	-0.9		30.4	23.7	6.7	
34–66 percent	12.3	12.4	10.6	1.8		13.1	11.6	1.5	
67–99 percent	6.2	6.2	6.6	-0.4		6.7	5.9	0.8	
100 percent	54.8	54.7	55.3	-0.6		49.8	58.8	-9.0	
Average percent completed	70.1	70.1	70.2	-0.1		66.4	73.2	-6.8	***
Sample Size	**35,609**	**33,415**	**2,194**			**16,070**	**19,539**		

Source: RAPIDS.

Note: The sample consisted of apprentices living in Florida, Georgia, Iowa, Kentucky, Missouri, New Jersey, Ohio, Pennsylvania, and Texas. The calculations were based on apprentices for whom no data were missing for the specific characteristic. The OA states are Georgia, Iowa, Missouri, New Jersey, and Texas; all other states are SAA states.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level, respectively, using a two-tailed test.

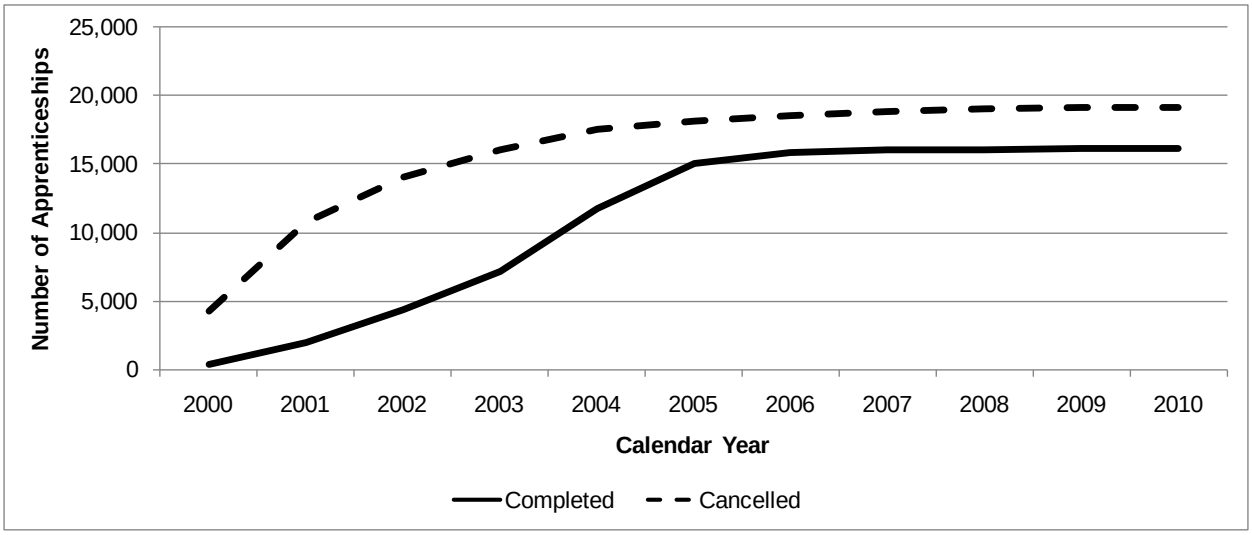
There were also some differences between OA and SAA states in RA outcomes. The completion rate in SAA states was 7 percentage points higher than that in OA states. The difference is not due to differences in the distribution of occupations. In fact, if SAA states had the same occupational distribution as OA states, the completion rate would have been 46 percent, which was still 5 percentage points greater than the completion rate in OA states. [21]

The study states show important variation in outcomes (Appendix B). The completion rates varied widely, ranging from 27 percent in Texas to 61 percent in Pennsylvania. These completion rates also varied when we looked separately at men and women. In Florida, the completion rate for women (46 percent) was higher than that for men (32 percent). In Iowa, Kentucky, Missouri, Pennsylvania, and Texas, the completion rates were about the same for men and women. In Georgia, New Jersey, and Ohio, the rates for men were higher.

[21] To assess the underlying factors that contribute to OA and SAA differences in completion rates, we reweighted the SAA states' occupational distribution to match that of the OA states.

The average length of time to complete an apprenticeship is helpful in understanding RA, but it does not indicate the distribution of that time. An examination of time in the apprenticeship shows that few apprentices completed in the first year (Figure III.6). About half of apprentices who completed their program did so by the fourth year (2003). In contrast, more than one in five apprentices who cancelled their apprenticeship did so in the first year. By the second year, more than half of apprentices who cancelled had done so.

Figure III.6. Cumulative Apprenticeship Outcomes of the 2000 Cohort



Source: RAPIDS.

Note: The sample consisted of apprentices living in Florida, Georgia, Iowa, Kentucky, Missouri, New Jersey, Ohio, Pennsylvania, and Texas.

IV. EFFECTIVENESS ASSESSMENT

The RA program is designed to improve the productivity of apprentices. If RA is effective, it will increase participants' earnings and employment. This chapter presents our estimates of the relationship between RA participation and measures of annual earnings and employment.

Our primary approach to measuring effectiveness was based on estimates of the relationship of earnings to the share of RA program completed by participants (see Chapter II and Appendix A for a discussion of the methods). As a check on the findings from that approach, we also compared the earnings and employment of RA completers to similar noncompleters, and we compared the outcomes of RA participants to similar individuals living in the same state.[22] The results from the three methods offer insights into the effects of RA on labor market outcomes, although none of the approaches identifies a purely causal impact of RA. Our analysis could not fully account for the selection mechanisms that lead people to participate in RA. Therefore, our findings are suggestive but not conclusive evidence of the effects of RA on earnings and employment.

A. Primary Results: Dosage Models

Our first approach to examining the relationship between RA participation and labor market outcomes was to estimate models of earnings and employment as a function of the share of the RA program completed.[23] Using these models, we calculated earnings and employment of RA participants averaged across the distribution of share completed (controlling for pre-enrollment earnings, employment, and demographic characteristics). We also calculated the earnings and employment for someone who enrolled in RA but completed 0 percent of the program, a group we call nonparticipants.[24] The difference in the estimated earnings and employment between RA participants and nonparticipants is our estimate of the association between RA participation and those outcomes.

We found a strong positive relationship between RA participation and annual earnings (Table IV.1). For example, in Florida RA participation was associated with a $5,242 gain in earnings in the sixth year after enrollment, which we refer to as the short term. To put this amount into perspective, the average earnings of RA participants in Florida that year was $18,459 (average earnings included values of zero for people who were not employed; average earnings are not shown

[22] An additional comparison of RA participants with Employment Service participants for Missouri is provided in Appendix A.

[23] The model included the share of RA completed, the square of the share completed, and an indicator for full completion of the program. The results show that earnings were positively associated with the share of the program completed and there was a significant increase in earnings associated with full completion. Section E of Appendix A has further details on the estimation approach.

[24] The expected earnings for nonparticipants was calculated as the predicted earnings from the model results when the share completed was set to zero and average values were used for pre-enrollment earnings, employment, and demographic characteristics. The predicted outcomes for nonparticipants are out-of-sample predictions because the RA enrollee sample does not have enrollees who completed zero percent of the program. However, almost 9 percent of enrollees completed less than one-tenth of the program.

in the table).[25] Our estimates indicate that RA participants would have only earned an average of $13,217 if they had not participated in RA. In most other states, we found an even larger gain in annual earnings associated with RA participation. In Maryland, the estimated gain was $14,977 in the sixth year. However, due to concerns about data quality, the Maryland findings may not be comparable to the findings for other states.[26] Averaged across the study states, RA participation was associated with an earnings increase of $6,595 in the short term.[27]

Table IV.1. Average Annual Earnings Differences for RA Participants Versus Nonparticipants (Dollars)

	Short Term Sixth Year After Enrollment			Medium Term Ninth Year After Enrollment		
	All	Men	Women	All	Men	Women
Florida	5,242***	5,494***	79	4,451***	4,525***	2,134**
Georgia	6,508***	6,290***	9,120**	4,547***	4,355***	6,309
Iowa	4,680***	4,843***	5,095	n.a.	n.a.	n.a.
Kentucky	5,770***	5,719***	6,153	n.a.	n.a.	n.a.
Maryland	14,977***	14,843***	20,039	15,561***	15,615***	-7,569
Missouri	7,239***	7,425***	4,069	5,587***	5,724***	4,821***
New Jersey	6,870***	7,328***	-2,215	n.a.	n.a.	n.a.
Ohio	6,914***	6,897***	6,889***	n.a.	n.a.	n.a.
Pennsylvania	8,304***	8,483***	2,643**	7,827***	7,930***	6,566**
Texas	5,504***	5,644***	1,044	5,838***	5,948***	2,422
OA states	6,284***	6,401***	3,169**	5,587***	5,671***	3,763**
SAA states	6,793***	6,960***	2,435***	6,087***	6,235***	3,501***
All states	6,595***	6,737***	2,615***	5,839***	5,948***	3,581***

Source: RAPIDS and state UI wage records.

Note: The short-term period is less than the sixth year for Iowa (fourth year), Kentucky (second year), and New Jersey (fifth year). These states are not included in the averages in the bottom rows of the table. Medium-term estimates are not available for Iowa, Kentucky, New Jersey, and Ohio (indicated by n.a.) due to the limited range of the available state UI wage record data. Data for Maryland are not comparable and Maryland is not included in the averages in the bottom rows of the table. The OA states are Georgia, Iowa, Missouri, New Jersey, and Texas; the others are SAA states. All dollar values are adjusted for inflation to real 2000 dollars.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level, respectively, using a two-tailed t-test.

The positive association between RA participation and earnings persisted in the medium term, which we defined as the ninth year after program enrollment. For example, in Florida, RA participation was associated with an annual earnings gain of $4,451 in the medium term. The

[25] As noted in Chapter II, our measure of not employed during a year included anyone with no UI wage record in the state in which they enrolled in RA, which would have included people who were self-employed, worked in another state, or worked in jobs not covered by state unemployment insurance.

[26] For Maryland, we used state administrative data on RA participants. Due to differences in the Maryland state data and the RAPIDS, the estimates for Maryland are not comparable to estimates for the other states. See Appendix A for further information.

[27] We calculated all averages by weighting each state by the number of RA participants in the enrollment cohort. The averages do not include Maryland or the three states for which the follow-up period is shorter than the sixth year.

average earnings of Florida RA participants in the medium term was $14,596 compared to $10,145 for nonparticipants (average earnings not shown in table). When we averaged over the study states, we found that RA participation was associated with a $5,839 earnings increase in the medium term.

The differences between the short- and medium-term estimates of the gains associated with RA participation show evidence that the earnings gains from RA diminish over time. In most states, the medium-term estimate is lower than the short-term estimate. This finding is common in the evaluations of other job-training programs and may reflect the decay of learned skills over time among program participants or the development of new skills by the nonparticipants. What is striking about our study's results, though, is that the association between participation and earnings in the ninth year after enrollment is still large. In contrast, the National Job Corps Study found no program effect by the fifth year after enrollment (Schochet, McConnell, and Burghardt 2003). Furthermore, the estimated decline in earnings gains associated with RA participation may be a temporary effect of the recent economic downturn. The period between the sixth year and the ninth year was 2006 to 2009, during which unemployment rates in the construction trades were especially high, suggesting that the economic downturn may have had a stronger negative effect on RA participants relative to nonparticipants.

The estimates for men are similar to the overall estimates, which is not surprising given that the majority of apprentices are men. The estimates for women do not show a consistent pattern across states. In most states, the sample of women was too small to find statistically significant results even for sizable estimates. In Florida, the state with the largest sample of women, we found no gain in earnings for female RA participants in the short term and a moderate gain of $2,134 (less than half the size of men's gain) in the medium term. In Pennsylvania, another state with statistically significant estimated gains for women, we found a more substantial gain for women ($6,566 in the medium term), much closer to the gain for men in that state. These differences may be explained by the occupations of RA women in the two states. However, we could not examine the wage gains by occupation for women because the sample sizes for women are too small to allow for precise estimates. Averaged over the study states, the earnings gains for women participants were positive and statistically significant, but smaller than those of men.

When we looked at differences in the estimates by administrative type, for men we found a weaker relationship between RA participation and earnings in OA states than in SAA states. For women, we found a stronger relationship in OA states than in SAA states. However, these differences between OA and SAA states are not statistically significant at the 10 percent level (statistical significance of difference not shown in table).

We also found that RA participation had a strong positive association with employment in all study states except Iowa (Table IV.2). For example, in Florida, RA participation was associated with a 9.4 percentage point increase in employment in the sixth year after enrollment. The employment rate among those who participated in Florida was 75.0 percent but would have been 65.7 percent if they had not participated (employment levels not shown in table). The state with the highest estimate was Maryland, at 13.5 percentage points (estimates for Maryland are not comparable to estimates for other states). In Iowa, we found no association between RA participation and employment. This finding is a bit surprising given the positive association between RA participation and earnings in Iowa.

The relationship between RA participation and employment persisted into the medium term. For example, in Florida, RA participation was associated with a 10.2 percentage point increase in employment in the ninth year. Averaged over five states with medium-term estimates, RA

participation was associated with a 8.6 percentage point increase in employment in the medium term, the same as the estimate for the short term. Thus, the employment pattern does not show the diminishing returns that we found for annual earnings.

Similar to our earnings results, the associations between RA participation and employment for women do not show a consistent pattern across states. In several states, the estimates suggest that by the sixth year after enrollment, women who participated in RA were less likely to be employed than nonparticipants, but these estimates are not statistically significant. Averaged over the study states, the association is positive for women, but smaller than the association for men (and not statistically significant in the medium term).

Table IV.2. Average Annual Employment Differences for RA Participants Versus Nonparticipants (Percentages)

	Short Term Sixth Year After Enrollment			Medium Term Ninth Year After Enrollment		
	All	Men	Women	All	Men	Women
Florida	9.4***	9.5***	6.2	10.2***	9.8***	14.5***
Georgia	11.0***	10.0***	24.3***	5.4**	5.0*	7.1
Iowa	0.0	2.2	-13.1	n.a.	n.a.	n.a.
Kentucky	12.4***	11.9***	23.1	n.a.	n.a.	n.a.
Maryland	13.5***	14.0***	-1.5	11.1***	11.6***	-18.8
Missouri	9.2***	9.8***	-5.2	9.0***	9.8***	-7.9
New Jersey	11.0***	12.4***	-10.5	n.a.	n.a.	n.a.
Ohio	9.4***	9.2***	11.9*	n.a.	n.a.	n.a.
Pennsylvania	8.9***	8.6***	13.9*	9.4***	10.3***	-7.0
Texas	5.6***	6.0***	-5.8	6.4***	6.7***	-2.2
OA states	7.6***	7.9***	-1.5	7.3***	7.7***	-2.9
SAA states	9.2***	9.1***	9.4***	9.8***	10.1***	7.9**
All states	8.6***	8.6***	6.8***	8.6***	8.8***	4.6

Source: RAPIDS and state UI wage records.

Note: The short-term period is less than the sixth year for Iowa (fourth year), Kentucky (second year), and New Jersey (fifth year). These states are not included in the averages in the bottom rows of the table. Medium-term estimates are not available for Iowa, Kentucky, New Jersey, and Ohio (indicated by n.a.) due to the limited range of the available state UI wage record data. Data for Maryland are not comparable and Maryland is not included in the averages in the bottom rows of the table. The OA states are Georgia, Iowa, Missouri, New Jersey, and Texas; the others are SAA states.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level, respectively, using a two-tailed t-test.

The estimated relationship between RA participation and employment is weaker in OA states than in SAA states for both men and women. However, these differences between OA and SAA states are not statistically significant (statistical significance of OA and SAA differences is not shown in the table).

We also used the dosage models to estimate annual earnings and employment rates of RA completers relative to similar nonparticipants. That is, we calculated the labor market outcomes for RA participants who completed the full RA program relative to people with similar characteristics who completed zero percent of the program. The dosage model estimates show that participating in RA even for a short period is associated with average earnings gains and that there is an additional large positive gain associated with RA completion. Completion was associated with an estimated

average earnings gain across the states of $14,404 in the sixth year after enrollment and $12,733 in the ninth year after enrollment. RA completion was also associated with an 18.3 percentage point increase in the probability of employment in the sixth year after enrollment and 18.9 percentage point increase in the ninth year after enrollment. Additional details on the estimates, including estimates by state, are available in Appendix A (Section J).

B. Alternative Approach: RA Completers Versus Noncompleters

As an alternative specification to the dosage model, we estimated the association between labor market outcomes and completion of RA by comparing RA completers to people who participated in RA but left the program without receiving an apprenticeship certificate (the noncompleters). The sample used, all RA enrollees, was the same as the one for the dosage model. However, this model measured the gains in earnings and employment associated with RA completion relative to RA noncompletion, whereas the dosage model measured the gains associated with RA participation relative to nonparticipation. In the completer versus noncompleter approach, we used a statistically matched sample (based on a propensity score matching method, see Appendix A).

The results of the completer versus noncompleter comparisons are largely consistent with the results of the dosage model. We found that RA completers had substantially higher earnings and employment than RA noncompleters (Tables IV.3 and IV.4). The one exception is Kentucky where the estimated earnings association is much smaller than we found using the dosage model and the estimated employment association is negative. This difference is likely due to the very short period of estimation for Kentucky. The short-term estimates are for the second year after enrollment, when most RA completers are still participating in the apprenticeship program. We found similar results when we limited the estimation to men. We did not estimate propensity score models for women due to the very small sample sizes.[28]

[28] For Florida, the state with the largest sample of women RA enrollees, we were able to estimate the propensity score model for women. We found that RA completion was associated with a gain in earnings of $3,425 in the ninth year after enrollment (statistically significant at the one percent level).

Table IV.3. Average Annual Earnings Differences for RA Completers Versus Noncompleters (Dollars)

	Short-Term Sixth Year After Enrollment		Medium-Term Ninth Year After Enrollment	
	All	Men	All	Men
Florida	9,230***	10,470***	8,826***	9,673***
Georgia	16,363***	16,333***	11,759***	11,929***
Iowa	7,266***	7,699***	N.A.	N.A.
Kentucky	2,014**	2,088**	N.A.	N.A.
Maryland	20,102***	21,286***	20,488***	21,227***
Missouri	16,923***	17,159***	12,970***	13,157***
New Jersey	12,590***	12,943***	N.A.	N.A.
Ohio	13,635***	13,499***	N.A.	N.A.
Pennsylvania	13,475***	13,166***	12,432***	12,321***
Texas	12,769***	13,368***	12,270***	12,982***
OA states	14,781***	15,171***	12,474***	12,922***
SAA states	12,122***	11,869***	10,574***	11,003***
All states	13,153***	13,527***	11,516***	11,980***

Source: RAPIDS and state UI wage records.

Note: The short-term period is less than the sixth year for Iowa (fourth year), Kentucky (second year), and New Jersey (fifth year). These states are not included in the averages in the bottom rows of the table. Medium-term estimates are not available for Iowa, Kentucky, New Jersey, and Ohio (indicated by n.a.) due to the limited range of the available state UI wage record data. Data for Maryland are not comparable and Maryland is not included in the averages in the bottom rows of the table. The OA states are Georgia, Iowa, Missouri, New Jersey, and Texas; the others are SAA states. All dollar values are adjusted for inflation to real 2000 dollars.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level, respectively, using a two-tailed t-test.

Table IV.4. Average Annual Employment Differences for RA Completers Versus Noncompleters (Percentage)

	Short-Term Sixth Year After Enrollment		Medium-Term Ninth Year After Enrollment	
	All	Men	All	Men
Florida	14.1***	15.7***	16.3***	16.2***
Georgia	20.2***	20.5***	17.7***	17.8***
Iowa	6.2***	7.0***	n.a.	n.a.
Kentucky	-11.9***	-12.0***	n.a.	n.a.
Maryland	17.3***	18.0***	19.5***	20.8***
Missouri	16.4***	16.4***	16.7***	16.9***
New Jersey	14.9***	15.7***	n.a.	n.a.
Ohio	13.0***	13.0***	n.a.	n.a.
Pennsylvania	17.2***	16.6***	16.8***	15.5***
Texas	13.9***	15.0***	13.8***	14.0***
OA states	15.6***	16.0***	15.4***	15.7***
SAA states	14.7***	15.0***	16.6***	15.8***
All states	15.0***	15.4***	16.0***	15.8***

Source: RAPIDS and state UI wage records.

Note: The short-term period is less than the sixth year for Iowa (fourth year), Kentucky (second year), and New Jersey (fifth year). These states are not included in the averages in the bottom rows of the table. Medium-term estimates are not available for Iowa, Kentucky, New Jersey, and Ohio (indicated by n.a.) due to the limited range of the available state UI wage record data. Data for Maryland are not comparable and Maryland is not included in the averages in the bottom rows of the table. The OA states are Georgia, Iowa, Missouri, New Jersey, and Texas; the others are SAA states.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level, respectively, using a two-tailed t-test.

With the exception of Kentucky, the estimated gains in annual earnings in the completer versus noncompleter comparison are larger than in the dosage model. Using the dosage model, the earnings gains were calculated for all RA participants (completers and noncompleters). In contrast, using the completer versus noncompleter comparison, the earnings gains were calculated for completers. To create a better comparison across the models, we adjusted the estimates for completers to include all participants under the assumption that partial completion has no effect on annual earnings (Table IV.5).[27] Because the results of the dosage model suggest that partial completion is associated with gains in annual earnings, the estimates in Table IV.5 are likely to be too low. Indeed, the estimates are lower than found for the dosage model, but the estimated gains in earnings associated with RA participation are still substantial.

[27] Under the assumption that partial completion of RA has no effect on annual earnings, the association between RA participation and earnings is the product of the share who completed RA and the earnings gains of completers relative to noncompleters.

Table IV.5. Average Annual Earnings Differences for RA Participants Versus Nonparticipants: Adjusted Estimates Based on Completers Versus Noncompleters (Dollars)

	Short-Term Sixth Year After Enrollment		Medium-Term Ninth Year After Enrollment	
	All	Men	All	Men
Florida	3,083***	3,309***	2,948***	3,057***
Georgia	6,382***	6,566***	4,586***	4,795***
Iowa	4,207***	4,465***	n.a.	n.a.
Kentucky	1,049**	1,098**	n.a.	n.a.
Maryland	7,599***	7,918***	7,744***	7,896***
Missouri	7,463***	7,584***	5,720***	5,815***
New Jersey	7,340***	7,610***	n.a.	n.a.
Ohio	6,899***	6,938***	n.a.	n.a.
Pennsylvania	8,220***	7,992***	7,584***	7,479***
Texas	3,488***	3,609***	3,313***	3,505***
OA states	5,327***	5,481***	4,381***	4,541***
SAA states	6,044***	6,062***	5,195***	5,200***
All states	5,766***	5,835***	4,791***	4,887***

Source: RAPIDS and state UI wage records.

Note: The short-term period is less than the sixth year for Iowa (fourth year), Kentucky (second year), and New Jersey (fifth year). These states are not included in the averages in the bottom rows of the table. Medium-term estimates are not available for Iowa, Kentucky, New Jersey, and Ohio (indicated by n.a.) due to the limited range of the available state UI wage record data. Data for Maryland are not comparable and Maryland is not included in the averages in the bottom rows of the table. The OA states are Georgia, Iowa, Missouri, New Jersey, and Texas; the others are SAA states. All dollar values are adjusted for inflation to real 2000 dollars.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level, respectively, using a two-tailed t-test.

C. Alternative Comparison Group: State Population

The third approach was based on a comparison of labor market outcomes of RA participants to outcomes of similar individuals in the same state. The rationale for this method is that, if the participants were not in RA, they would have average outcomes similar to those of people with similar characteristics (age, education, race, and gender) in the same state. A disadvantage of the approach is that survey-based measures of earnings and employment for the state population are not comparable to the measures from unemployment insurance (UI) wage records.[28] Therefore, we did not use these estimates in our cost-benefit analysis as measures of the association between RA participation and outcomes; rather, we considered whether the direction and magnitude of these findings confirm or challenge the results from the other approaches.

[28] We measured the gains in earnings and employment between the pre-enrollment period and the post-enrollment periods for RA participants compared to similar people in the same state. As described in this section, the gains were larger for RA participants. However, much of the larger gain is explained by low pre-enrollment earnings and employment among RA participants (see Appendix A for further discussion).

As in the primary approach (the dosage model), we found a consistent pattern of strong, positive relationships between RA participation and earnings (Table IV.6). For example, in Florida, RA participation was associated with a gain of $5,958 in annual earnings in the short term and $4,203 in the medium term. Again, the one exception is Kentucky where there was no association between RA participation and earnings. However, as mentioned in the previous section, due to data limitations the short term for Kentucky is only the second year after enrollment. Most RA participants were still participating in the program in the second year. Averaged over the states, the association between RA and earnings was $6,549 in the short term and $5,650 in the medium term.

The estimates for employment are more mixed (Table IV.7). In the short term, participation in RA was associated with gains in employment in most states and for the overall average. However, in the medium term, participation in RA was associated with a decline in employment in the two states with statistically significant estimates and for the overall average. This result may be due to the differences between the survey data used to measure outcomes for the state population and the UI wage records used for the RA participants. In particular, the UI wage records do not include earnings for the self-employed. A large majority of RA participants are in the construction trades which include several occupations in which self-employment is relatively common. For this reason, employment among RA participants may be particularly low as measured in the UI wage records. Nevertheless, the average annual earnings gains for RA participants, which incorporated lower employment rates by including no earnings for people who were not employed, were positive and substantial relative to the state population (Table IV.5).

Table IV.6. Average Annual Earnings Gains for RA Participants Versus Similar People in the Same State (Dollars)

	Short Term Sixth Year After Enrollment			Medium Term Ninth Year After Enrollment		
	All	Men	Women	All	Men	Women
Florida	5,958***	6,312***	3,089***	4,203***	4,502***	1,877***
Georgia	7,578***	7,807***	2,870	5,760***	5,961***	1,727
Iowa	5,454***	5,712***	1,526	n.a.	n.a.	n.a.
Kentucky	-27	-82	2,746	n.a.	n.a.	n.a.
Maryland	21,871***	21,710***	25,546***	22,039***	22,162***	17,158***
Missouri	7,372***	7,450***	5,558***	5,613***	5,742***	1,911
New Jersey	7,093***	7,012***	8,801***	n.a.	n.a.	n.a.
Ohio	6,695***	6,801***	5,049***	n.a.	n.a.	n.a.
Pennsylvania	5,724***	5,591***	8,195***	5,015***	4,822***	8,514***
Texas	5,589***	5,774***	1,433*	6,140***	6,295***	2,853***
OA states	6,529***	6,683***	2,813***	6,008***	6,157***	2,524***
SAA states	6,557***	6,680***	4,682***	5,175***	5,263***	3,726***
All states	6,549***	6,696***	4,255***	5,650***	5,811***	3,368***

Source: RAPIDS, state UI wage records, and CPS (March files).

Note: The short-term period is less than the sixth year for Iowa (fourth year), Kentucky (second year), and New Jersey (fifth year). These states are not included in the averages in the bottom rows of the table. Medium-term estimates are not available for Iowa, Kentucky, New Jersey, and Ohio (indicated by n.a.) due to the limited range of the available state UI wage record data. Data for Maryland are not comparable and Maryland is not included in the averages in the bottom rows of the table. The OA states are Georgia, Iowa, Missouri, New Jersey, and Texas; the others are SAA states. All dollar values are adjusted for inflation to real 2000 dollars.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level, respectively, using a two-tailed t-test.

Table IV.7. Average Annual Employment Gains for RA Participants Versus Similar People in the Same State (Percentages)

	Short Term Sixth Year After Enrollment			Medium Term Ninth Year After Enrollment		
	All	Men	Women	All	Men	Women
Florida	4.9***	4.8***	5.5**	1.1	0.9	2.4
Georgia	5.9***	5.7***	8.8	-0.2	-0.1	-3.4
Iowa	-3.1*	-2.9	-7.1	n.a.	n.a.	n.a.
Kentucky	-1.1	-1.5	9.0	n.a.	n.a.	n.a.
Maryland	8.0***	7.7*	29.8***	1.4	1.1	24.4*
Missouri	0.1	-0.2	6.6	-4.1*	-4.1**	-2.3
New Jersey	1.0	0.8	4.5	n.a.	n.a.	n.a.
Ohio	5.1***	5.4***	-0.1	n.a.	n.a.	n.a.
Pennsylvania	-1.2	-2.0	4.3	-4.1***	-4.7***	-2.4
Texas	1.7*	1.9**	-2.0	-1.4	-1.3	-2.4
OA states	1.6**	1.6*	2.4	-2.3***	-2.2**	-2.5
SAA states	3.0***	2.8***	3.8**	-1.4**	-1.9*	0.9
All states	2.5***	2.3***	3.4**	-1.9***	-2.1***	-0.1

Source: RAPIDS, state UI wage records, and CPS (March files).

Note: The table shows the difference in the change in annual employment for RA participants in each state compared to similar people living in the same state. For most states, the short-term period begins four years prior to enrollment (1996–1997) and ends in the sixth year after enrollment (2005–2006). The short-term period is shorter for Iowa (2003-2004 to 2008–2009), Kentucky (2002–2003 to 2005–2006), and New Jersey (2000–2001 to 2008-2009). These states are not included in the averages in the bottom rows of the table. The medium-term period is 1996–1997 to 2008–2009 for all states except Iowa, Kentucky, New Jersey, and Ohio, where estimates are not available (indicated by n.a.) due to the limited range of the available state UI wage record data. Data for Maryland are not comparable and Maryland is not included in the averages in the bottom rows of the table. The OA states are Georgia, Iowa, Missouri, New Jersey, and Texas; all other states are SAA states.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level, respectively, using a two-tailed t-test.

V. COST-BENEFIT ANALYSIS

Our comparison of the costs and benefits of RA examined whether the benefits of the program appear large enough to justify the investment of resources. Our conceptual framework for the cost-benefit analysis began with consideration of the costs and benefits from each stakeholder's perspective (see Chapter II for our conceptual framework and Appendix A for technical details regarding the data and methods). In this chapter, we discuss our estimates for the dollar value of the costs and benefits for apprentices, government agencies, and society.[31]

As explained in Chapter II, we excluded sponsors and employers from our cost-benefit analysis because we do not have information on their costs or benefits. It is reasonable to assume that net benefits for sponsors and employers are positive: their voluntary participation in RA suggests they perceive net benefits. Under this assumption, our estimate of net social benefits would be too low due to the omission of net benefits for employers and sponsors.

In this chapter, we present estimates of the net social benefits of RA under our baseline assumptions and several alterative scenarios. We limited our cost-benefit analysis to the states for which we have medium-term estimates of the association between RA participation and earnings because our results suggest that the short-term estimates of the association appear to be temporarily high and not indicative of medium-term estimates (see Chapter IV).[32] We found that RA has strong, positive net social benefits under the baseline assumptions and that the findings are robust to a wide range of alternative scenarios. For a comparison of our estimates to those found in Washington state (Hollenbeck and Huang 2006), see Appendix A, Section F.

A. Estimates of Productivity Benefits

The primary potential benefit of RA is the added productivity of the workers trained in the program. The productivity benefits of RA are measured as the additional earnings and fringe benefits apprentices receive because of their participation in RA. Under our baseline assumptions that the earnings associated with participating in RA measure the causal effects of RA participation on earnings, we estimated the productivity benefits of RA participation based on our findings using the dosage model. Although we do not believe this is a credible assumption, it provides a definitive baseline from which to begin the cost-benefit analysis.

We found that the productivity benefits of RA were positive and substantial for all states, but they varied widely across states (Table V.1). In Florida, the medium-term benefits (for the first 9 years after enrollment) were $47,350 per apprentice, the lowest of any state. The highest medium-

[31] Our cost-benefit analysis examined whether the social benefits of the program exceed the social costs. From a policy perspective, an important question for future research is whether the social benefits of expanding the program exceed the social costs of such an expansion. The analysis would need to account for the government costs of increasing the number of apprenticeships (for example, through marketing and technical assistance). The analysis should also examine the earnings gains associated with expansion of RA. For example, if RA expansion were to be focused on adding new types of occupations, it would be important to examine the earnings gains associated with RA for those occupations.

[32] We did not include Maryland in the cost-benefit analysis because the effectiveness estimates for Maryland are not comparable to those of other states due to differences between the state RA administrative data and RAPIDS.

term benefits were in Pennsylvania: $75,606. Extrapolating the 9-year findings to a full 36-year career, we found that the overall productivity benefits range from a low of $96,708 in Florida to a high of $162,424 in Pennsylvania. Differences across states in productivity benefits are driven by differences in the estimated earnings gains (Chapter IV, Table IV.1).

On average, we found productivity benefits of $59,143 in the medium term and $123,906 over a career. The averages were similar but somewhat higher for SAA states compared to OA states. This difference is driven by small differences in the earnings gains (as reported in Chapter IV).

Table V.1. Productivity Benefits: Medium- Term and Career Under Baseline Assumptions (Dollars)

	Medium-Term Benefits For 9 Years After Enrollment			Career Benefits For 36 Years After Enrollment		
	Earnings	Fringe	Total	Earnings	Fringe	Total
Florida	38,102	9,248	47,350	77,072	19,636	96,708
Georgia	43,099	10,445	53,544	82,931	21,063	103,994
Missouri	51,070	12,425	63,495	99,993	25,466	125,458
Pennsylvania	60,816	14,789	75,606	129,362	33,062	162,424
Texas	42,915	10,399	53,314	94,036	24,026	118,063
OA states	46,033	11,174	57,206	94,954	24,214	119,168
SAA states	49,111	11,934	61,045	102,417	26,143	128,561
All states	47,586	11,557	59,143	98,718	25,187	123,906

Source: RAPIDS and state UI wage records. See Appendix A for additional sources.

Note: All dollar values are adjusted for inflation and discounted to real 2000 dollars. The OA states are Georgia, Missouri, and Texas; the other states are SAA states.

B. Estimates of Other Benefits

The benefits of RA for government in increased tax receipts and reduced use of public assistance are directly related to the earnings benefits. If RA increases participants' earnings, it also will increase their tax payments and is likely to reduce their reliance on public assistance or unemployment insurance (UI) compensation.

The estimated earnings benefits detailed in Table V.1 imply growth in medium-term federal tax receipts of $3,886 per apprentice in Florida and $6,203 in Pennsylvania, with an average of $4,854 across the study states (per apprentice; Table V.2). State and local tax revenues would grow by slightly less, an average of $4,728 in the medium term. Over an apprentice's career, the federal government averages $10,069 in tax receipts per participant, and state and local governments average $9,806 in tax receipts per RA participant.

The estimated earnings benefits imply a reduction in the receipt of UI compensation, food stamps, and welfare. The estimates in Table V.3 are imprecise and likely to be underestimated because they are based on the estimated growth in annual earnings rather than on estimates of variability in earnings, which may be more important for determining benefit receipts (see Appendix A for details). Nevertheless, the estimates suggest that RA leads to reduced receipt of UI compensation and public assistance.

Table V.2. Tax Benefits: Medium- Term and Career Under Baseline Assumptions (Dollars)

	Medium-Term Benefits For 9 Years After Enrollment		Career Benefits For 36 Years After Enrollment	
	Federal	State and Local	Federal	State and Local
Florida	3,886	3,963	7,861	8,015
Georgia	4,396	4,827	8,459	9,288
Missouri	5,209	4,852	10,199	9,499
Pennsylvania	6,203	5,778	13,195	12,289
Texas	4,377	4,377	9,592	9,592
OA states	4,695	4,612	9,685	9,520
SAA states	5,009	4,842	10,447	10,087
All states	4,854	4,728	10,069	9,806

Source: RAPIDS and state UI wage records. See Appendix A for additional sources.

Note: The table shows the increase in taxes collected based on the earnings gains in Table V.1. All values are adjusted for inflation and discounted to real 2000 dollars. The OA states are Georgia, Missouri, and Texas; the other states are SAA states.

Table V.3. Reduced Receipt of UI Compensation and Public Assistance: Medium- Term and Career Under Baseline Assumptions (Dollars)

	Medium-Term Benefits For 9 Years After Enrollment				Career Benefits For 36 Years After Enrollment			
	UI Comp.	Food Stamps	Welfare	Admin. Costs	UI Comp.	Food Stamps	Welfare	Admin. Costs
Florida	1,238	429	117	346	2,668	891	259	742
Georgia	757	587	6	243	1,483	1,259	20	490
Missouri	587	770	210	240	1,445	1,654	503	562
Pennsylvania	3,221	1,262	346	920	4,249	2,643	804	1,351
Texas	1,000	873	321	356	2,430	2,003	765	851
OA states	814	799	241	299	1,942	1,781	575	698
SAA states	2,199	832	228	624	3,434	1,740	523	1,037
All states	1,513	816	234	463	2,694	1,760	549	869

Source: RAPIDS and state UI wage records. See Appendix A for additional sources.

Note: The table shows the reduction in receipt of UI compensation, foods stamps, and welfare based on the earnings gains in Table V.1. Administrative costs include all three programs. All values are adjusted for inflation and discounted to real 2000 dollars. The OA states are Georgia, Missouri, and Texas; the other states are SAA states.

C. Estimates of Government Costs and Benefits

We estimated that the total state and federal costs of administering the RA program were between $106 and $180 per participant in these five states and that the government costs of related technical instruction provided by community colleges was about $587 (Table V.4). These were the average total program costs per participant in the 2000–2001 enrollment cohort, including the costs for individuals who did not complete the program, summed over the years of participation.

Table V.4. Total Government Costs per RA Participant (Dollars)

	Federal and State RA Agency Costs	Community College Costs	Total
Florida	128	587	715
Georgia	180	587	767
Missouri	150	587	737
Pennsylvania	133	587	720
Texas	106	587	693
OA states	132	587	719
SAA states	130	587	717
All states	131	587	718

Source: OA and SAA budget experts and RAPIDS. See Appendix A for additional sources.

Note: Estimates are for the 2000–2001 enrollment cohort. Costs include costs for completed and noncompleted apprenticeships and are summed over all years of participation. All values are adjusted for inflation to real 2000 dollars. The OA states are Georgia, Missouri, and Texas; the other states are SAA states.

We combined the estimates of government costs and benefits to measure the government return for each dollar invested in RA. In Florida, in the medium term, the total cost per RA participant was $715, and the total tax benefit was $7,849 (Table V.5). This implies that, for every government dollar invested in RA in Florida, the government receives about $11 in added tax receipts. Including the value of reduced use of UI compensation and public assistance, the government receives almost $14 for every dollar invested in RA in Florida. Averaged across the five states, the government receives over $13 in taxes for every dollar invested in RA and over $17 in total benefits for every dollar invested. Extrapolating over the career of an apprentice, the tax returns are more than $27 per dollar invested, and the total benefits are more than $35 per dollar invested, on average (Table V.6).

Table V.5. Government Costs and Benefits in the Medium Term Under Baseline Assumptions (Dollars)

	Total Costs	Tax Benefits	Tax Benefits per Dollar Invested	Total Benefits	Total Benefits per Dollar Invested
Florida	715	7,849	10.98	9,979	13.96
Georgia	767	9,223	12.02	10,816	14.10
Missouri	737	10,061	13.65	11,868	16.10
Pennsylvania	720	11,981	16.64	17,729	24.62
Texas	693	8,755	12.63	11,305	16.31
OA states	719	9,307	12.95	11,460	15.95
SAA states	717	9,852	13.73	13,735	19.15
All states	718	9,582	13.34	12,608	17.56

Source: OA and SAA budget experts, RAPIDS, and state UI wage records. See Appendix A for additional sources.

Note: We calculated tax benefits as the sum of columns in Table V.2. Total benefits include the tax benefits and the sum of the columns in Table V.3. All values are adjusted for inflation and discounted to real 2000 dollars. The OA states are Georgia, Missouri, and Texas; the other states are SAA states.

Table V.6. Government Costs and Benefits Over a Career Under Baseline Assumptions (Dollars)

	Total Costs	Tax Benefits	Tax Benefits per Dollar Invested	Total Benefits	Total Benefits per Dollar Invested
Florida	715	15,877	22.21	20,437	28.58
Georgia	767	17,747	23.14	20,999	27.38
Missouri	737	19,699	26.73	23,863	32.38
Pennsylvania	720	25,484	35.39	34,531	47.96
Texas	693	19,183	27.68	25,234	36.41
OA states	719	19,205	26.72	24,201	33.68
SAA states	717	20,534	28.62	27,268	38.01
All states	718	19,875	27.68	25,748	35.86

Source: OA and SAA budget experts, RAPIDS, and state UI wage records. See Appendix A for additional sources.

Note: We calculated tax benefits as the sum of columns in Table V.2. Total benefits include the tax benefits and the sum of the columns in Table V.3. All values are adjusted for inflation and discounted to real 2000 dollars. The OA states are Georgia, Missouri, and Texas; the other states are SAA states.

D. Estimates of Net Social Benefits

Although the estimates suggest that governments recover any investment in RA as increased taxes and reduced use of UI compensation and public assistance, net government benefits do not imply net social benefits. The net government benefits are mainly driven by transfers of taxes from RA participants to governments and the reduction of transfers for UI compensation and public assistance from governments to RA participants. The net social benefit of a transfer is zero (summing costs and benefits across apprentices and governments).

Removing transfers, the social benefits of RA are the additional productivity of apprentices (measured by gains in earnings and fringe benefits) and the reduction in government administrative costs as a result of reduced use of UI compensation and public assistance. Under the baseline assumptions in the medium term, the net social benefits of RA were $58,888 (on average; Table V.7). Over an apprentice's career, the net social benefits are $124,057 on average.

Table V.7. Social Costs and Benefits: Medium-Term and Career Under Baseline Assumptions (Dollars)

	Medium-Term For 9 Years After Enrollment			Career For 36 Years After Enrollment		
	Benefits	Costs	Net	Benefits	Costs	Net
Florida	47,696	715	46,981	97,450	715	96,735
Georgia	53,787	767	53,020	104,484	767	103,717
Missouri	63,735	737	62,998	126,021	737	125,284
Pennsylvania	76,526	720	75,806	163,775	720	163,055
Texas	53,671	693	52,978	118,914	693	118,221
OA states	57,505	719	56,786	119,866	719	119,148
SAA states	61,670	717	60,952	129,598	717	128,880
All states	59,606	718	58,888	124,775	718	124,057

Source: OA and SAA budget experts, RAPIDS, and state UI wage records. See Appendix A for additional sources.

Note: We calculated social benefits as the sum of productivity benefits (Table V.1) and reduced administrative costs of public programs (Table V.3). All values are adjusted for inflation and discounted to real 2000 dollars. The OA states are Georgia, Missouri, and Texas; the other states are SAA states.

E. Scenarios for Net Social Benefits

The net social benefit estimates in Table V.7 were calculated under a set of baseline assumptions that may not be realistic. In this section, we adjust the assumptions to explore whether the positive net social benefits of RA are robust under alternative scenarios.

A key baseline assumption was that estimates from the primary model (the dosage model) measure the causal effect of RA participation on earnings. However, because RA participants are likely to have more commitment or stronger skills than nonparticipants, some of the earnings gains associated with RA participation are likely to be due to these underlying differences. On the other hand, because we controlled for pre-enrollment earnings and employment (as well as demographic characteristics), the underlying differences between participants could be minimal. We had no way to estimate the potential bias due to the underlying differences. Rather, we considered a fairly extreme scenario under which one-half of the estimated association between RA participation and earnings is due to underlying differences and only one-half of the estimate is due to the causal effect of RA on earnings. Even under this scenario, RA would have strong, positive net social benefits of $29,042 in the medium term and $61,596 over an apprentice's career (on average; Table V.8).

Table V.8. Net Social Benefits Under Alternative Scenarios: Average Over Five States with Medium-Term Earnings Estimates (Dollars)

	Medium Term For 9 Years	Career For 36 Years
Baseline	58,888	124,057
Productivity benefit estimate is 50 percent lower	29,042	61,596
Cost to government is 20 percent higher	58,744	123,913
Cost to apprentice is $500 (not zero)	58,388	123,557
Employers experience a net loss of $5,000	53,888	119,057
No effect on UI compensation and public assistance	58,425	123,188
Discount rate of future earnings is 20 percent higher	57,812	118,097
Rate of decay in earnings gains is 20 percent higher	58,888	116,910
All of the above	**22,677**	**49,427**

Source: OA and SAA budget experts, RAPIDS, and state UI wage records. See Appendix A for additional sources.

Note: All values are adjusted for inflation and discounted to real 2000 dollars. Estimates are averages of results for Florida, Georgia, Missouri, Pennsylvania, and Texas.

Under every alternative scenario, the findings of a strong, positive net social benefit remain. For example, if our estimate of government cost is 20 percent too low, or if the costs to apprentices is $500 instead of zero (for example, to cover the costs of books or tools), the net social benefits are still positive. In our discussions with state directors, we learned that some sponsors receive incentives of up to $5,000 per apprentice. If we assume that sponsors break even only if they receive this incentive, the net social benefits are still strong and positive. Even if RA has no effect on UI compensation or public assistance, or we use a 20 percent higher rate to discount the future value of earnings, or if the earnings benefits decay at a 20 percent higher rate than we used, the net social benefits to RA are strong and positive. Even combining all of these scenarios, the net social benefits remain positive.

The estimates of strong, positive net social benefits suggest that investment in RA is warranted: the benefits outweigh the costs. However, the findings do not necessarily imply that government investment in RA is warranted. RA is a public-private partnership with investments coming from both government and private employers. It is possible that all the benefits of RA are due to the private investment. Put differently, without the government RA program, private sponsors and employers might run apprenticeships with equally strong outcomes. We have no way of estimating the net social benefits of the government investment as distinct from those of the private investment. It is conceivable that the government investment does not have net social benefits. However, our discussions with RA directors in the 10 study states suggest that the government is investing in a number of activities that are likely to contribute to the effectiveness of the program through outreach to candidates and partners that can attract quality participants, technical assistance to the sponsors, and quality assurance. As a final scenario, we calculated that, even if the government investment were responsible for only 5 percent of the greater productivity of apprentices, the government investment would have positive net social benefits of $2,252 in the medium term per RA participant and $5,504 over the career of a RA participant (not shown in Table V.8).

F. Net Benefits to Apprentices

For people considering entering the RA program, the net benefits that accrue to RA participants are likely to be an important factor. The net benefits to RA participants include an increase in compensation over the career: an estimated average of $98,718 in earnings and $25,187 in fringe benefits such as health insurance, for a total of $123,906 under our baseline assumptions (Table V.9). Adjusting for estimates of taxes paid on the earnings gains and lower levels of UI compensation and public assistance benefits, the estimated net benefits to RA participants are $101,467.

We did not measure the cost of RA participation for apprentices, but the main costs are covered by employers. For many training programs, the costs for participants include lower earnings during the training period. However, we found average earnings gains for people participating in RA for a short period without completing the program. If we include a $500 financial cost of participation, the estimated net benefits of RA participation are $100,967. Many RA occupations are unionized. We do not have estimates of union dues paid by RA participants and nonparticipants. Because we expect that some RA participants do not pay union dues and some nonparticipants pay union dues, we chose a fairly low average of $50 per month to represent the difference in the average dues paid by RA participants relative to nonparticipants. With the adjustment for union dues, the estimated net benefits are $96,911.

As noted previously, some (or all) of the estimated earnings gains associated with RA participation may not be causally related to RA participation. For example, if some of the estimated earnings gains accrue to RA participants because they have stronger skills or motivation than nonparticipants, then they would likely have received higher earnings than nonparticipants even in the absence of RA. If we include an additional assumption that half of the estimated gains in earnings and fringe benefits are not a result of RA participation but rather due to underlying characteristics of RA participants, then the estimated net benefits to RA participation are $46,335.[30]

For people who complete the RA program, the estimated average gains over the career are $240,037 in earnings and $61,496 in fringe benefits for a total of $301,533. Adjusting for estimates of taxes, reduced UI compensation, and lower public assistance benefits, the net benefits of RA completion are $242,417. If we include $500 in upfront financial costs and $100 per month for union dues (to represent the average differences in dues between RA completers and nonparticipants), the average net benefits are $233,828.[31] If we also assume half of the gains in earnings and fringe benefits are not a result of RA completion, then the estimated net benefits to RA completion are $111,426.

[30] Under this assumption, the estimated net benefits are less than half of the estimate in the baseline calculation due to nonlinearities in the relationship of earnings with UI compensation and public assistance.

[31] We use a larger value of union dues for RA completers ($100 per month) than for RA participants ($50 per month) under the assumption that RA completers are more likely to be unionized (because they are more likely to remain in RA occupations) and more likely to attain higher levels within the occupation (which is associated with higher union dues).

Table V.9. Net Benefits to Apprentices Over the Career: Average Over States with Medium-Term Earnings Estimates (Dollars)

	RA Participants	RA Completers
Baseline earnings and fringe benefits	123,906	301,533
Add reduction for taxes	104,030	252,628
Add reduction for lower UI compensation and public assistance receipt	101,467	242,417
Add reduction for upfront costs of $500	100,967	241,917
Add reduction for union dues	96,911	233,828
Add assumption that half of earnings gain is not causal	46,335	111,426

Source: RAPIDS and state UI wage records.

Note: Reported estimates are for 36 years after enrollment. Each row of the table includes the indicated adjustment for that row and all adjustments made in the preceding rows. For RA participants, union dues are assumed to be $50 per month and reported estimates are averages for Florida, Georgia, Missouri, Pennsylvania, and Texas. For RA completers, union dues are assumed to be $100 per month and reported estimates are averages for Florida, Georgia, Missouri, and Texas. All dollar values are adjusted for inflation to real 2000 dollars.

VI. WOMEN'S EXPERIENCES IN REGISTERED APPRENTICESHIP

Women's experiences in RA programs are very different from those of men: women participate at lower rates than men and are concentrated in social services occupations (mainly child care and health care). The nature of their apprenticeship programs is also different, largely because of their representation in these occupations, as social services apprenticeships are shorter than construction industry programs that the majority of males enter. Because of the differences in the types of programs women pursue and because they are typically the primary child care providers in their families, women participating in RA programs face a different set of challenges than men. It is important to examine these differences in order to promote women's participation in apprenticeship programs, which can provide a pathway into steady jobs, often with relatively good wages and benefits.

This chapter explores the challenges to women's successful participation in apprenticeship programs. We drew on the experiences and insights of 15 women who are program participants, state RA directors in the 10 study states,[32] and executive directors of five community-based organizations (CBOs) that received WANTO grants from DOL. The chapter describes the impediments women face and strategies to increase their enrollment and success in apprenticeship programs. We begin by briefly summarizing women's enrollment and completion patterns in RA. We then describe women's experiences in apprenticeship and highlight the challenges reported by women. Next, we discuss the unique challenges of women in traditionally male occupations in construction and the skilled trades. Finally, we present respondents' recommendations for making RA a more accessible and rewarding experience for women.

A. Women's Participation in Registered Apprenticeship Programs

Women's participation in RA programs differs from men's in three main ways: (1) they participate at lower levels, (2) they train in different occupations, and (3) they have lower completion rates in construction and other skilled trades, which are the hallmark of the RA program. This section briefly highlights these key differences to provide background and context for subsequent sections of the chapter.[33]

Women enroll in RA programs at relatively low rates, and the rates are even lower for apprenticeships in the skilled trades. Less than 9 percent of people entering RA in 2010 were female. In the skilled trades occupations, the shares of females were even lower: less than 5 percent for electricians, less than 2 percent for plumbers, and less than 3 percent for carpenters (Chapter III, Table III.2). This is despite the fact that employment in the skilled trades can provide a way for single mothers and female heads of household to gain steady jobs and benefits and help lift their families out of poverty (Ericksen and Shultheiss 2009).

[32] Our discussions with state RA directors typically included some of their staff (see Appendix A). For ease of reference, we refer to all comments from these discussions as state director comments, but the actual comment may have been made by a staff person.

[33] Statistics in this section are based on the authors' calculations using RAPIDS.

Women are far more concentrated in social services occupations than are men. In 2010, almost no men enrolled in apprenticeships in these occupations. However, the two largest occupations for women were child care (34 percent of women) and nursing aides (6 percent of women). The prevalence of women in social services occupations is especially interesting considering apprenticeships in these occupations have begun only fairly recently.

The concentration of women in social services apprenticeships leads to different experiences with the program. The duration of these apprenticeships is typically shorter: often one to two years, compared to about four years or more for electricians, plumbers, and carpenters. In addition, although apprenticeships in these industries can provide a pathway to occupations in which earnings potential is higher—for example, nursing assistance can be a stepping-stone to nursing—the pathway is not always self-contained within the apprenticeship program. For example, someone who has completed a nursing assistant apprenticeship and wants to pursue a licensed practical nursing apprenticeship (which is a step up in responsibilities and pay) would have to find another program offering this training and enter it as a separate step rather than completing it as part of the apprenticeship.[34] Thus, the career progression in these types of apprenticeships differs from that in the skilled trades.

Finally, women's completion rates in the skilled trades are lower than men's. Among women who started apprenticeships in 2000, about 45 percent completed the program, roughly the same completion rate as men. However, among electricians, the completion rate was only 37 percent for women compared to 43 percent for men. Similarly, in plumbing, the completion rate was 35 percent for women compared to 47 percent for men, and in carpentry the rate was only 17 percent for women compared to 39 percent for men. The relatively low completion rates for women in the skilled trades reflect the challenges for women apprenticed in male-dominated fields, as we describe in subsequent sections of this chapter.

B. Women's Experiences

Despite the almost uniformly positive impression of RA expressed by the female apprentices with whom we spoke, most respondents highlighted several factors that hinder women's enrollment and successful completion. This section explores women's experiences in greater detail.

1. Women's Views on RA

Women view RA as beneficial; interviews with women who participated in RA indicated that they hold positive views of the program. Seven of the nine women we spoke with who had completed or were still enrolled in an RA program indicated that they thought RA was beneficial and that they would recommend it to their peers. All the women who did not successfully complete the program still contended that they had learned a lot from both the classroom activities and on-the-job training; on the whole, these respondents indicated they had mostly positive and valuable experiences.

[34] Our discussions with state directors suggest that the structure of apprenticeships in the health profession may be due to the licensing and other certification requirements of specific health occupations.

Box VI.1. Selected Women's Views on Registered Apprenticeship

"The teachers were great; they helped me a lot. It was a really good program."

"I really enjoyed it. Overall, it was a very enjoyable experience. [The apprenticeship program] definitely made me better at my job."

It has been "one of the best experiences of my life."

In addition to liking the program in general, the women described RA as a pathway to better pay and career advancement. Ten of the women we spoke with pursued an apprenticeship to break into a new, higher-paying occupation that would also offer health benefits. These women had previously held jobs such as child care worker, retail sales associate, manufacturing worker, or food service worker. As one of these women explained, as a single mother her goal was to become financially self-sufficient, and she believed that her health care apprenticeship was a stepping-stone to a stable and financially rewarding career in health care.

The other five women entered the program to advance in their current career and obtain higher pay. For example, one woman was working as a child care worker in a day care center. She pursued an apprenticeship to gain certification in early childhood education as a first step in advancing to the position of assistant center director, and she planned to eventually pursue her bachelor's degree in early childhood education after completing the apprenticeship. Another woman had been working as a day laborer in construction and entered a RA to establish herself with the union, thereby gaining higher wages and benefits.

The WANTO grantees' responses concurred with the women's; they described apprenticeships in the skilled trades as an effective way to escape dead-end, low-wage jobs and to move toward self-sufficiency. Although all five grantees help women enter the trades through a number of avenues—including basic skills training, job placement, and placement in apprenticeships—they noted that RA is the best way to do so; one grantee called it "the Cadillac" of programs.

2. Securing Child Care

Women reported that the lack of access to consistent, affordable child care is a major challenge to their participation in apprenticeship programs, citing several reasons. First, apprentices participating in both classroom training and on-the-job training have demanding schedules, so mothers may need child care when center-based care may not be available. For example, some corrections officer apprenticeship programs require apprentices to attend training camps that require them to leave their families during the week for up to four months. Although women from these programs could return home to their families on weekends, they lamented that it was very difficult to find friends and family to care for their children while they were away, and it was even more difficult being separated from them for such a long time. In construction, apprentices may be expected to rise early to commute to the worksite, work all day, and then attend classes after work two nights each week. One woman in Indiana described driving 70 miles each way to and from her apprenticeship, leaving the house at about 5:00 A.M. and returning at 5:30 P.M. each day. Two women in construction said they had put off having children because it was not feasible given their 18-hour workdays. Some state RA directors echoed these comments, indicating that the long work hours, commutes, and classroom training responsibilities of apprentices served as a general barrier to women's participation, especially for single mothers.

The second child care-related barrier is difficulty paying for child care. Although some women were reimbursed for things like transportation, uniforms, and classroom materials while enrolled in an apprenticeship, none were provided any money or subsidies to help cover child care costs. Women might have access to, and be eligible for, child care subsidies like those offered through TANF. However, the WANTO grantees noted that, even if the women were eligible for them, the subsidies would not be adequate given the large number of hours of child care these women required. Therefore, apprentices mostly depend on family for their child care needs. One woman claimed that, had she not had family living nearby, she would not have been able to complete her apprenticeship program.

The final child care-related barrier is that supervisors at some worksites, particularly those that typically have many male workers, may not be used to workers with intensive parenting obligations and may not tolerate tardiness or absences related to child care issues. Two of the six noncompleters we spoke to failed to complete their apprenticeships for reasons directly related to child care issues. One single mother in a construction apprenticeship was fired for excessive absenteeism when her three children were sick with strep throat. She explained the challenge in getting her male supervisor to understand her situation: "He has probably never left his job to pick up his kids from school, and trying to explain to him that my kids were sick and that I needed to get them from school [was really difficult]." Another was dismissed from her probationary year as a corrections officer because of poor attendance related to custody disputes in a difficult divorce. Neither woman expected or wanted to be treated differently from her male colleagues; however, having primary child care responsibilities meant that, in effect, these women did not have the same circumstances as their male colleagues.

3. Lack of Pay During Classroom Training

Although RA programs follow an earn-while-you-learn model, some of the women we spoke with reported not earning a wage or stipend while participating in some of the training components of RA. Three of the five women in social services apprenticeships indicated that they did not earn a wage or stipend during the period of classroom training. Women in corrections officer apprenticeships also did not receive wages or a stipend during their initial training sessions, which ranged from 4 to 16 weeks. They only began receiving wages when their probationary work period began.

This lack of pay during classroom training components of the apprenticeship was only mentioned in our interviews with women in social services and corrections officer apprenticeships, where having a set of skills—and in some cases a credential or license—is necessary before the OJT component of the apprenticeship can begin. Thus, these apprenticeships are sequential in nature, with apprentices first attaining the credential and then progressing to on-the-job training. This sequential nature is in contrast to construction apprenticeships, in which classroom and OJT are typically done together.

The women who were not assisted financially during their classroom training reported that lack of pay was a major hindrance to their participation in the program. It was common among respondents we spoke to in health care for them to work fulltime while pursuing the classroom

component of their apprenticeship training. One respondent mentioned that, to attend classes to become a nursing assistant, she had to take leave from her regular job as a home health aide.

Together, lack of access to affordable child care and not getting paid during classroom training presented substantial challenges to women successfully completing these programs.[35]

4. Confusion About Participation and Credentialing

Some women, particularly those in health care, expressed confusion about participation and credentialing. Although all the women we contacted were chosen from the records of RA participants, some were uncertain, and some flatly denied, that they had participated in an apprenticeship. Three of the five women we spoke with from health care programs were unclear about their participation in an apprenticeship; two of them did not know if they had participated in an apprenticeship at all, and the third was unsure about whether she had successfully completed the program. We did not complete interviews with three additional women because they emphatically stated they had not participated in an apprenticeship.

Although all RA participants receive a completion certificate at the end of the program, some of the women we spoke to were confused about the requirements of their programs and whether they were eligible for a certificate. One woman knew she had received some kind of nursing certificate, but was confused about how long it was valid. Another woman was unsure whether she had completed the first phase of a multiphase program and did not know how to advance to the next phase.

Interviews with state RA directors indicated that states have had a hard time expanding into health care and that some apprenticeships, like nursing assistant, have an industry credential in addition to the RA credential. Therefore, some of this confusion could stem from the fact that health care is a relatively new and not yet fully developed area of the apprenticeship program. Regardless of its source, this apparent confusion over credentialing and advancing along the career pathway kept women from fully using the apprenticeship experience, according to some of the women we interviewed.

C. Women's Experiences in Construction Occupations

In addition to the challenges described in the previous section, interviews with women in construction, WANTO grantees (who work mostly with women in construction trades), and state RA directors revealed challenges specific to women in the construction industry. WANTO grantees and the women we interviewed noted that jobs in construction can provide a way for single mothers to reach economic self-sufficiency. Apprenticeships in construction, the hallmark of the RA program, are long-standing, established programs with well-defined skill benchmarks and wage progression. Yet, women continue to make up a very small fraction of all apprentices in this industry.

[35] We do not have information to determine whether this concern is just as great among male apprentices. However, given that few men have primary childcare responsibilities and that few men enroll in the types of programs where classroom training is unpaid and must be completed before on-the-job training can begin, it seems unlikely that these concerns influence men's completion of the programs to the same extent as they do women's.

Respondents indicated that women face three primary barriers that help explain this low participation rate. First, women do not usually know what skills are needed to work in construction or about the wage and benefits gains of doing so. Second, women may have unrealistic expectations about construction work, which sets them up for failure. Finally, women who try to pursue a career in construction face challenges associated with the male-dominated work culture. We discuss these challenges next.

1. Incomplete Information on the Skilled Trades

According to all five WANTO grantees, a major barrier facing women as they navigate apprenticeship programs in construction is lack of information on the skilled trades and the requirements for entering into apprenticeships. The WANTO grantees unanimously reported that the women they encounter know little about working in a skilled trade, including the required basic skills and wage potential. The women do not know what apprenticeship programs are, and they have rarely heard of RA. The grantees indicated this was largely because women lacked the networks of family members and friends working in the skilled trades who typically provide this information and an entrée to interested men.

State RA directors in two states echoed this point and indicated their belief that women are not interested in the skilled trades and view them as too physically difficult and more suitable for men, probably because they know little about them. According to these directors, RA sponsors that host five or more apprentices are required to make a good-faith effort to recruit women and minorities. In the directors' opinions, however, these efforts are met with little success. Women who participated in apprenticeship generally agreed on the lack of information. One said, "It's something people don't know is available." Another added, "I don't think these unions advertise. If you want to know about [apprenticeship] you have to go online and search or hear from word-of-mouth."

2. Unrealistic Expectations About Working in the Skilled Trades

Even if women know about the existence of apprenticeships in construction and can successfully navigate the application process, WANTO grantees reported that women (and men, according to one state director) can have incomplete information leading to unrealistic expectations about what the job will be like; this can be a barrier to completion. For example, one WANTO grantee explained that, although women may be aware that the earning potential in the trades is high, they sometimes do not know that starting wages are low and only increase with proven skill development. The WANTO grantees further noted that women may have mistaken beliefs about the type of work they will be doing at first, when much of the work is unskilled labor such as sweeping and other worksite cleanup. Women may not realize that work in the construction industry often requires long commutes to worksites and can have unpredictable schedules and odd hours. They stated that a woman who enters an apprenticeship or job site with incorrect information and unrealistic expectations is less likely to succeed.

One of the two noncompleters in construction with whom we spoke echoed this sentiment, noting that her failure to complete her apprenticeship was due, at least in part, to her expectations of the program not aligning with the reality of its activities and requirements. She had pursued an apprenticeship as a bricklayer because she wanted to do residential work, such as building hearths and outdoor landscaping. However, the bricklaying apprenticeship focused on industrial stone work, which was physically difficult and not the kind of work she had hoped for. As a result, she dropped out of the program.

3. Harassment and Exclusion at Male-Dominated Worksites

According to our respondents, women face another set of challenges inherent in working at construction sites, where workers are overwhelmingly male. Some women reported encountering explicit discrimination and harassment, despite well-established laws that prohibit both. Respondents also reported that male-dominated worksites lead women to feel isolated and excluded, which can hinder them from acquiring needed skills and make it more difficult to acquire information on job openings and opportunities for promotions.

Four of the five women in construction that we spoke to had experienced explicit discrimination or harassment at worksites. One woman mentioned that the apprenticeship program coordinator at the union had a chauvinistic attitude and treated her in a patronizing manner, especially when she had to ask permission to leave early for child care reasons. Two other women had been on the receiving end of lewd remarks and unwelcome sexual advances. A fourth woman mentioned threatening graffiti being written in the common bathroom on a site where she was not provided with her own facilities; despite her repeated complaints to the foreman, the graffiti was not removed.

Although none of the state RA directors mentioned that workplace harassment of women was common, one state director commented that "ribbing" by male colleagues probably still took place. The perception that harassment is not common may be because some instances go unreported; two women in construction we talked to who faced harassment or overt discrimination hesitated before filing a complaint or did not file one at all. They did not want to "ruffle feathers" or look like complainers. These women talked about a tension between wanting to be treated "like one of the guys" but at the same time wanting to use the accommodations that women before them had fought for, such as separate restroom facilities.

Male attitudes toward women—even when not rising to the level of explicit harassment—can create an uncomfortable, or even hostile, work environment for women. Two women we spoke to were explicitly told that they would not be able to handle the physical aspect of the work. One state RA director acknowledged that men may not think that women can handle the physical demands of work in the trades, and that these attitudes can create a hostile, or just uncomfortable, work environment. State RA directors from two states noted that some women might feel a hostile work environment or lack of support at a job site as a barrier to completing a program.

Box VI.2. Women's Experiences at Male- Dominated Worksites

"It's about who you know, not what you know."

"He said, 'Women's hips are different and they can't handle [physical labor].'"

"I was rather embarrassed over it.... He seemed chauvinistic to me ... didn't think women could do [construction].... He made me feel really uncomfortable.... I felt alone when it happened.... I felt guilty, but I had to be a mother."

"Being a woman in a male-dominated field is always a problem. As a woman you have to work twice as hard to get the recognition that a man gets just for showing up."

In addition to the overt harassment and hostile work environments that women sometimes confront, women's experiences in male-dominated worksites are often characterized by more subtle forms of discrimination, such as exclusion and isolation, which can keep them from acquiring the skills they need to successfully complete an apprenticeship. According to all five WANTO grantees and all five of the women from construction apprenticeships, worksites have fraternal cultures that can make women feel isolated from "the crew." One woman mentioned being overlooked for jobs because of "union favoritism" among male friends; she sat in the union hall for days while less experienced male workers were sent out on jobs. Others complained of being consistently relegated to unskilled labor on the site without getting opportunities to learn new skills; because construction apprentices primarily acquire job skills through informal interactions with their colleagues, this type of isolation means women may not acquire all the skills they need for successful completion of the apprenticeship. Finally, one WANTO grantee explained that men are accustomed to training other men and may not be comfortable, or know how to interact, with women on the job site, which can make them less effective at teaching women necessary job skills.

Although the women in construction described challenges associated with working in a male-dominated environment, they also reported being able to build successful working relationships with some male colleagues. The three women we spoke to who had successfully completed the program or were still enrolled in it were quite happy with the job, despite facing some uncomfortable situations on their job sites. One woman who did her construction apprenticeship through a union and recently worked on a nonunionized job site noted that she was treated substantially better by her well-trained and more professional union colleagues.

D. Respondents' Recommendations for Increasing Women's Success

As part of our discussions with women, WANTO grantees, and state RA directors, we asked about strategies that have shown or could show promise in addressing the challenges that women in apprenticeship face. These recommendations encompass existing practices that seem to be successful and could be expanded, including many that align closely with the missions of the WANTO grantees, as well as ideas for new practices.

1. Undertake Targeted Outreach

The WANTO grantees and four of the state RA directors agreed that school-age girls should be a target audience for advertisements about RA in the skilled trades. They explained that teaching girls and young women about the trades through career fairs, summer camps, subsidized summer employment programs, and visits to schools may help break down stereotypes that women should not or cannot work in industries such as construction. Two grantees operate the Rosie's Girls summer day camp to expose girls to the trades, build their self-esteem, give them hands-on experience with tools, and introduce them to tradeswomen. On the other hand, two women from construction apprenticeships suggested that programs should more heavily target women who are out of high school and have some work experience in the retail or service industries or are already enrolled in community college. They believed these women would aspire to jobs with higher wages and health benefits and recognize the potential of working in the skilled trades, perhaps looking beyond the "unglamorous" nature of construction work.

The WANTO grantees noted that outreach to women must be targeted, tailored, and systematic. One grantee, Hard Hatted Women, distributes the *TOOLKIT for the Recruitment and Retention of Women,* which gives employers strategies for effectively reaching out to women. The *TOOLKIT* reviews how to target program messages and advertising materials to women and where

to find women who may be interested in pursuing a career in the trades. Many respondents also agreed that the best way to get women interested in apprenticeships in the trades is to hear from other women who have successfully completed such apprenticeships. Women may be more likely to pursue an apprenticeship program if they learn of it from another woman, especially one who has had a positive experience.

2. Develop Skills and Manage Expectations Through Pre-apprenticeship Training

According to the WANTO grantees, many women they work with lack the basic occupational skills required to have a successful RA experience in the skilled trades, such as trade-related math skills, Occupational Safety and Health Administration training, and the appropriate level of physical fitness. To address this and prepare women for the rigors of construction apprenticeships, four of the WANTO grantees operate pre-apprenticeship training programs (when they have adequate funding). Through these programs, women acquire the basic required skills before entering an apprenticeship. They also meet tradeswomen (and tradesmen) and learn about the sometimes complicated RA application process. Armed with this knowledge, a woman is better equipped to decide if the trades are truly the best career path for her and select the occupation that best matches her skills, interests, and life circumstances. One WANTO grantee asserted, "Pre-apprenticeship training is critical if we are going to get women into apprenticeships. Most [women] will not become apprentices without exposure to the tools of the trade through training and job shadowing. They just need the experience. Pre-apprenticeship is so important to getting women into the trades; they need to touch it, feel it, experience it before they can see it for themselves."

The information provided in pre-apprenticeship training courses is also an effective way to help manage women's expectations about work in traditionally male occupations; WANTO grantees and state RA directors in two states stressed the importance of this aspect of pre-apprenticeship. One state director noted that the programs allow women to experience the unfamiliar and help them realize they are a good match for the job.

3. Provide Child Care Support or Classes That Better Accommodate the Schedules of Single Mothers

Finding adequate child care that accommodates rigorous apprenticeship schedules is challenging, as is finding the money to cover these extensive child care needs. RA could consider providing child care subsidies, as suggested by directors in two states and by women respondents. Alternative, more convenient, class schedules or online learning (when possible) could be arranged.

A focus on setting up detailed child care plans before the apprenticeship begins, perhaps as a step in the application process, could also be helpful. For example, one WANTO grantee requires women to have a child care plan, a backup child care plan, and a backup to their backup plan before helping them get into an RA program. According to the grantee, this has been a successful strategy.

4. Address the Culture of Male-Dominated Construction Worksites

Respondents noted challenges across industries, but the barriers associated with work in the construction industry dominated many of our conversations. Although mentorship (discussed in the next section) may be a particularly promising strategy to address these issues, respondents suggested three additional approaches:

- **Help employers create and enforce policies to prevent harassment and discrimination at worksites.** The WANTO grantees provide technical assistance to employers to develop methods to recruit women and to develop and implement effective sexual harassment policies. However, because of limited funds, it is not possible to provide these services to all employers that could benefit from them. WANTO grantees suggested that employers use existing resources like Hard Hatted Women's *TOOLKIT* to develop procedures and train male employees to follow them. This manual reviews effective methods for developing, revising, implementing, and monitoring sexual harassment policies on job sites.

- **Set goals for enrolling women in RA.** State RA offices recommend targets for the percentage of women apprentices in a program based on calculations of the percentage of women in the local area, but these are not quotas. An administrator in one state noted that his state used to have targets for women in construction trades (2 to 6 percent, for example), but they have not been able to meet those goals for the past 20 years. In recommendations given to Secretary of Labor Hilda Solis in March 2010, two WANTO grantees urged DOL to move beyond requiring that sponsors make a good-faith effort to recruit women for RA and, instead, set concrete enrollment and completion targets for women. These grantees also stated that OA should hold states accountable for reaching these goals through required annual reporting, an idea with which the other three grantees concurred.

- **Increase monitoring of sponsors and employers.** Monitoring RA programs for compliance with equal employment opportunity (EEO) laws focuses on ensuring that program sponsors are making "a good-faith effort" to recruit women, but it is perhaps less successful in ensuring that women are treated well in the workplace. Although EEO laws offer continual protection to workers from harassment or discrimination, and women can make a complaint at any time, women and the WANTO grantee directors stated that harassment and discrimination are prevalent across construction industry worksites. Moreover, some women we spoke to had hesitated to file complaints for fear of being labeled troublemakers or inviting further harassment.

Increased monitoring could improve working conditions without women having to directly file a complaint. One female apprentice in heavy highway construction indicated that a monitor stopped by her worksite to ensure that she was being trained appropriately and had bathroom facilities. She stated, "Ever since [the monitor] came, they started actually teaching me stuff."

5. Connect Women with Effective Mentors and Peer Support

The learn-while-working model of apprenticeships means that new apprentices rely on peers at the worksite to teach them vital occupational skills and help them acclimate to workplace cultures and norms. The WANTO grantees emphatically suggested that apprenticeship programs should teach effective mentorship techniques to all workers. State RA directors from two states concurred that connecting women to a mentor is the single most important form of support for women in the program.

Two WANTO grantees pointed to a specific mentorship program, Wisconsin's Transition to Trainer, as a successful approach to developing strong mentorship programs at construction worksites. This eight-hour course "teaches soon-to-be journey workers how to serve as a mentor and job coach, how to provide hands-on skill training, and how to give positive and effective

performance feedback" (Wisconsin Department of Workforce Development, Bureau of Apprenticeship Standards 2010). WANTO grantees suggested that RA could use techniques similar to those of the Wisconsin program to increase men's comfort with and ability to work with women, which could contribute to decreasing overt and subtle discrimination at worksites.

In addition, the WANTO grantees, some state directors, and women respondents also said that women sharing their experiences with one another is a necessary component to successful completion of the program, even if the women are not on the same job site. Although most of the women we spoke with did not have a mentor during their apprenticeship, the three women who did connect with more experienced peers explained how beneficial that interaction had been. One noted that just hearing "Hey, I've been there and I made it" kept her encouraged and energized. The WANTO grantees suggested having peer-to-peer support group meetings when an on-the-job female mentor cannot be provided (for example, due to lack of experienced women on the job site). One grantee hosts monthly social hours for tradeswomen, during which they share their experiences on male-dominated worksites, give each other advice on how to stand up for themselves, and discuss techniques for effectively communicating with worksite foremen. According to the grantee, a woman who had strongly considered dropping out of her bricklaying apprenticeship successfully completed the program after receiving support from this group.

VII. DIFFERENCES BETWEEN FEDERALLY ADMINISTERED AND STATE ADMINISTERED PROGRAMS

The final question examined by the study was whether RA programs and outcomes show patterns of differences across states administered by the OA and those administered by SAAs. To explore whether the RA program operates differently in the OA and SAA states, we spoke with the state-level directors and their staff in each of the 10 study states. The discussions covered six topic areas: (1) staffing and organization of the state apprenticeship agency, (2) the process for recruiting and registering sponsors, (3) partnerships with workforce development and educational systems at the state and local levels, (4) benefits and costs to sponsors and apprentices, (5) participation of women, and (6) use of funds from the American Recovery and Reinvestment Act of 2009 (ARRA). Overall, we found that the RA programs in OA and SAA states are largely similar.

We found the basic structure of RA in staffing, recruitment, and registration to be similar across all states. This finding is not surprising as all states follow the same federal codes authorizing RA. In general, the reported activities of staff were similar across the states, with no patterns of differences between the OA and SAA states. Similarly, the priorities of state directors in most states included expanding the program and further developing partnerships with workforce development agencies and educational institutions. The common concern of state directors was limited and declining budgets.

We did find a pattern of divergence as a result of OA and SAA differences in relationships within their states. The most notable difference was that an SAA's home agency can help foster relationships that generate support and growth opportunities for RA. The apprenticeship agency in Ohio, for example, is housed within the Office of Workforce Development and funded through WIA formula funding, a starting point that has helped agency staff collaborate with workforce development efforts. The relationship helps them stay in "constant communication" with groups that use WIA funds, which helps ensure they are present to represent RA's interests during discussions with state-level staff of other workforce development programs. Furthermore, it enables them to direct WIA-funded grant opportunities to sponsors: "Being within the agency that oversees the workforce investment system makes it a little easier for [sponsors] to get the backing of all the local WIBs, if need be, for some of those larger grants [that need] workforce investment system support…. I think we're positioned in a good place to be able to facilitate communication and assist our sponsors moving forward." Another example is Maryland's collaboration with the correctional education department (housed in the same state department as RA) to establish a pre-apprenticeship program for former prisoners. As part of the Florida State Department of Education, the apprenticeship agency in Florida has a good relationship with secondary and postsecondary institutions and is connected to an adult education career pathway. In contrast, apprenticeship agencies in OA states must work hard as outsiders to gain a seat at the table.

A second difference relates to disparate funding streams and bureaucratic requirements. Directors and staff in the OA states said they must obtain regional approval before committing travel funds for marketing. As a result, they feel they lack the budget authority to promote RA, which reduces their flexibility and results in barriers to growth. As was stated in the discussion with Missouri's director, "We just have to depend on what we've done in the past and our website."

Directors in SAA states are in a stronger position to influence state RA funding, and, in turn, state policymakers can bolster and prioritize RA as a tool for meeting the state's workforce needs. The SAA in Maryland, where apprenticeship is "not lost on the Governor's table" and the labor

commissioner was himself an apprentice, provides a good example. Having risen through an apprenticeship program, the labor commissioner understands the value of RA and supports its efforts. Maryland's RA director feels that the support and leadership the agency receives from the highest levels in the state is important encouragement for RA's growth, especially when resources are limited. Despite the ongoing recession and lack of funding for additional staff, Maryland's state director feels the apprenticeship program is in its strongest position in years.

State fiscal support for RA in OA states exists, but it is limited. For example, the New Jersey Department of Workforce Development has issued annual grants to vocational and technical schools for county apprenticeship coordinators who promote RA and provide technical assistance. In the past, the grants were funded up to about $600,000. In recent years the grants have been funded at about $300,000. In addition, the coordinators have taken on additional roles not related to RA. For the current school year (2011-2012), the Department has yet to issue the grant solicitation.

In addition to the differences in OA and SAA relationships within their states, we found modest differences between OA and SAA study states in the demographics, occupational distribution, and completion rates of apprentices in the study states. OA states enrolled a larger share of Hispanics than did SAA states (23 percent compared to 9 percent). The difference mainly reflects differences in the state populations, as OA states in our study sample had a larger share of Hispanic residents. OA states also tended to enroll more apprentices with some postsecondary education or technical training (15 percent compared to 4 percent). OA states had a larger share of apprentices in the large, traditional occupations of electrician, plumber, and carpenter (45 percent compared to 38 percent). Finally, OA states had a lower completion rate (41 percent compared to 49 percent).

In the effectiveness assessment, we found that OA states had a somewhat smaller association between RA participation and earnings than SAA states, although the differences are not statistically significant. The modest difference of about 8 percent translates into lower net social benefits of RA in the OA states of $119,148 compared to $128,880 in SAA states over the career of an apprentice (in the baseline cost-benefit analysis). The average total public cost of RA per participant was similar in OA states ($719) and SAA states ($718).

There are many potential reasons for these small differences in RA for OA and SAA states, including differences in the local labor markets and different activities by the sponsors. In our discussions with state directors, we found no evidence to suggest that differences in RA outcomes are caused by different priorities, activities, or decisions on the part of OA and SAA state directors and their staff.

VIII. CONCLUSIONS

This study examined the effectiveness, costs, and benefits of the Registered Apprenticeship (RA) program; the barriers that women face in RA and the best practices for promoting their success; and the patterns of differences in the RA program and outcomes between states that are federally administered and those that are administered by state agencies. The study addressed four questions:

1. Is RA effective in raising the annual earnings and employment of participants?
2. Do the total social benefits of RA outweigh the total social costs?
3. What are the experiences of women in RA and what can be done to further promote their success in the program?
4. Are there differences between the RA programs of states federally administered by the OA and states administered by State Apprenticeship Agencies (SAAs)?

With respect to the first question, our estimates show that RA participation was associated with substantial gains in earnings, on the order of $47,586 over a 9-year period following enrollment in the program and $98,718 when extended over the career of an apprentice (under our baseline assumptions).

Regarding the second question, our research design did not conclusively identify the causal impact of RA on earnings. Our baseline scenario indicates a net social benefit of $124,057 over an apprentice's career; however, even if only one-half of the estimated earnings gain were the result of participation in the RA program, we estimated a net social benefit of $61,596 in an apprentice's career. The finding of strong, positive net social benefits is robust to a number of scenarios regarding the costs and benefits of RA. We were not able to determine the extent to which these benefits are due to government investments compared to employer investments in apprenticeship that might occur even without the RA program. With this in mind, we note that, even if government investment were responsible for only 5 percent of the greater productivity of apprentices, the government investment would still have positive net social benefits.

With respect to the third question, we found that women participate in RA at lower rates than men and are concentrated in social services occupations (mainly child care and health care). Women are much less likely than men to enroll in RA in the traditional skilled trades occupations and, when they do, they are less likely than men to complete RA. Although women reported generally positive opinions of the RA program, many women struggle to find and pay for child care, and some women are confused about their program's requirements. In addition, women who want to pursue apprenticeships in construction have difficulty obtaining information on those apprenticeships and on jobs, and they often contend with harassment and discrimination at male-dominated worksites. The women, DOL grantees, and state directors we spoke with suggested several promising strategies to enhance the success of women in RA: undertaking targeted outreach campaigns, building women's basic skills, helping women develop accurate expectations about particular occupations, helping them arrange adequate child care, assisting employers to enforce policies to combat harassment at male-dominated worksites, and connecting women with their peers for support and encouragement.

Finally, regarding the fourth question, we found only modest differences between OA and SAA states in terms of the demographics, occupational distribution, completion rates, and earnings gains of apprentices. Furthermore, based on our discussions with state-level directors and their staff, we found no patterns of differences in the directors' priorities or the staff's activities.

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APPENDIX A

ADDITIONAL ANALYSES AND TECHNICAL DISCUSSION

In this appendix, we provide detailed information on the methods and data sources briefly described in Chapter II. We begin with details on the selection of states and the characteristics of the study states relative to other states. Section B describes the data sources and Section C describes the selection of the analytic sample for the effectiveness assessment. In Section D, we describe the trends in pre-enrollment earnings as a precursor to the detailed description of the estimation methods in Section E. Section F provides details on the cost-benefit analysis and Section G focuses on our method for estimating the costs per apprentice. The final two sections describe our qualitative data collection and analysis, first for the state director discussions and then for the discussions with women who participated in Registered Apprenticeship (RA) and executive directors of community-based organizations that received grants from DOL for promoting women's success in apprenticeship. The protocols for these discussions are included in Appendix C.

A. Selection of States

We selected states that varied across five important dimensions (Table A.1):

1. *Administrative type.* To examine program characteristics and outcomes by administrative type, we selected five states administered by the Office of Apprenticeship (OA) and five states administered by State Apprenticeship Agencies (SAAs). One state, Pennsylvania, is officially administered by an SAA but also receives significant resources from OA. In Ohio, RA was a collaborative effort of OA and the SAA for many years, but RA is currently administered by the SAA.

2. *Number of apprenticeships.* We selected states with a large range in the number of apprenticeships. However, we did not select states with very small numbers of apprentices because we needed to have substantial sample sizes to statistically detect program effectiveness. Nationally, the median number of apprentices per state in 2009 was 6,194. Three of our selected states had numbers close to the median and two had numbers less than twice the median. The remaining five states had more than 17,000 apprentices, which put them in the top 10 states nationwide in terms of number of apprentices.

3. *Region.* We chose states in different economic regions, in part to cover variation in regional labor market conditions. Our selected states represent five of the six DOL regions. Only the San Francisco region is not included (primarily due to lack of availability of necessary data for the states in this region).

4. *Union representation.* When selecting the states, we considered the importance of unions in the state labor market. Unions sponsor apprenticeships, contribute to program content, and affect the labor markets in which apprentices typically work. Of the 10 states we chose, 4 are Right-to-Work states and 6 are not. Nationally, 23 states are Right-to-Work states. The states also range in the degree to which unions represent workers in the state (that is, the degree to which their employment is covered by a collective bargaining agreement). Based on information from 2008, three of the selected states were in the first quartile of union representation nationally (below 8.1 percent), an additional two states were at or below the median (12.8 percent), four states were in the third quartile (between the median and 16.95 percent), and only one state was in the highest quartile (above 16.95 percent).

5. *Concentration of Occupations.* Finally, we considered the degree to which apprenticeship programs are concentrated in a few occupations and chose states that varied substantially along this dimension. Based on information from 2009, four of the selected states were in the first quartile of the national distribution (under 28 percent), an additional two states were below the median (38 percent), two states were in the third quartile (between the median and 53 percent) and only one state was in the highest quartile (above 53 percent).

Table A.1. Characteristics of Selected States

State	OA or SAA?	Number of Apprentices (2009)	DOL Region	Right to Work?	Union Representation (%)	Concentration in Top Five Occupations (%)	ADARE Partner?
Florida	SAA	23,040	Atlanta	Yes	7.9	22.8	No
Georgia	OA	5,000[a]	Atlanta	Yes	4.6	26.8	Yes
Iowa	OA	7,021	Chicago	Yes	13.0	48.2	No
Kentucky	SAA	6,592	Atlanta	No	9.6	51.1	Yes
Maryland	SAA	9,908	Philadelphia	No	14.5	25.6	Yes
Missouri	OA	21,002	Chicago	No	12.8	29.9	Yes
New Jersey	OA	10,323	Boston	No	19.0	73.4	Yes
Ohio	SAA	18,241	Chicago	No	15.5	35.6	Yes
Pennsylvania	SAA	20,370	Philadelphia	No	16.3	35.5	No
Texas	OA	17,981	Dallas	Yes	5.6	24.0	Yes

Source: Information on administrative type and number of apprentices is from OA (provided in October 2009). Information on Right-to-Work legislation is from the National Right to Work Legal Defense Foundation, available at http://www.nrtw.org/rtws.htm (accessed on November 23, 2009). Information on unionization is from the Bureau of Labor Statistics for 2008, available at http://www.bls.gov/news.release/union2.t05.htm (accessed on November 23, 2009). Statistics on the distribution of occupations are based on authors' calculations from the data on the OA website, http://oa.doleta.gov/bat.cfm (accessed on November 23, 2009).

Note: Type text here.

[a]The number of apprentices in Georgia is based on an estimation from OA (provided by email correspondence, September 2011).

The aggregated sample of apprentices in the study states and the full sample of apprentices in RAPIDS, which covers 32 states, were roughly comparable in terms of their demographic characteristics, program characteristics, and program outcomes.[1] For the cohort of apprentices who enrolled in 2000, Table A.2 reports only small differences between the study states and the other states in these characteristics and outcomes. Because of the large sample size, many of the differences in Table A.2 are statistically significant but not substantively important. Note that Maryland is not included in Table A.2 and other descriptive tables based on RAPIDS data because RAPIDS does not include Maryland.

[1] For the states not covered in RAPIDS (18 states and DC), RAPIDS includes information on federal apprenticeships in those states. These observations were included with the non-study states in Table A.2 (federal apprenticeships in Maryland, a study state, were not included in Table A.2). In addition, the non-study states in Table A.2 included RAPIDS information on U.S. territories: Federated States of Micronesia and Guam (104 apprentices). The total number of new enrollees during 2000 in the study states (35,609) is large relative to the total number of apprentices shown in Table A.1 for 2009 (about 130,000 without Maryland). This is due to declining enrollment in RA over the period (see Chapter III).

Table A.2. Demographic Characteristics, Occupations, and Program Outcomes in Study and Nonstudy States for Apprentices Enrolling in 2000 (Percentages, Unless Otherwise Noted)

	All States in RAPIDS	Study States	Nonstudy States	Study States - Nonstudy States	
Age					***
16 to 20 years old	18.3	18.2	18.4	-0.2	
21 to 39 years old	70.3	69.8	70.7	-0.9	
At least 40 years old	11.4	12.0	10.9	1.1	
Average age (years)	28.7	28.9	28.5	0.3	***
Gender					
Male	93.8	93.8	93.7	0.2	
Female	6.2	6.2	6.3	-0.2	
Race/Ethnicity					***
White	76.3	75.7	76.7	-1.0	
Black	10.4	12.6	8.7	3.9	
Hispanic	10.7	10.4	10.9	-0.5	
Other race	2.6	1.2	3.6	-2.4	
Education					***
Less than high school	0.6	0.7	0.5	0.2	
Some high school	8.3	9.9	7.0	2.8	
High school graduate	91.1	89.4	92.4	-3.0	
Veteran	5.4	7.6	3.7	3.8	***
Prisoner at enrollment	0.8	1.2	0.5	0.7	
Occupation					***
Electricians	22.1	25.8	19.2	6.6	
Plumbers, pipefitters, and steamfitters	12.1	11.6	12.6	-1.0	
Carpenters	12.4	11.2	13.3	-2.1	
Heavy and tractor-trailer truck drivers	0.1	0.0	0.1	-0.1	
Sheet metal workers	3.9	3.7	4.0	-0.3	
Electrical power-line installers and repairers	2.2	1.8	2.6	-0.9	
Correctional officers and jailers	1.8	2.9	0.9	2.0	
Child care workers	1.2	1.4	1.0	0.3	
Home appliance repairers	0.0	0.0	0.0	0.0	
Nursing aides, orderlies, and attendants	0.0	0.0	0.0	0.0	
All other occupations	44.1	41.6	46.1	-4.5	
Outcome					***
Completed	43.8	45.3	42.7	2.6	
Cancelled	55.4	53.8	56.7	-2.8	
Active	0.8	0.9	0.7	0.2	
Sample Size	**82,405**	**35,609**	**46,796**		

Source: RAPIDS.

Note: The sample for study states consisted of apprentices living in Florida, Georgia, Iowa, Kentucky, Missouri, New Jersey, Ohio, Pennsylvania, and Texas. The calculations were based on apprentices for whom there were no missing data for the specified characteristic.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level, respectively, using a two-tailed test.

B. Data Sources for the Effectiveness Assessment

This section provides details on the four data sources used for the effectiveness assessment: RAPIDS, unemployment insurance (UI) wage records, the Current Population Survey (CPS), and Employment Service participant administrative records (for Missouri only).

RAPIDS. RAPIDS contains information on RA from 2000 to 2010 for all 25 federally administered states and for 7 SAA states.[2] OA collects administrative data from sponsors, employers, and apprentices for the federally administered states, and similar information is voluntarily provided by SAAs in the other states.[3] For apprentices, we used information from RAPIDS on demographic characteristics (age, gender, race, education level, veteran status, and prisoner status)[4] and program participation characteristics: occupation, industry, hours of related technical instruction (RTI), hours of on-the-job training (OJT), date of entry, completion status, and date of completion or cancellation. For programs, we used information from RAPIDS on the required hours of OJT participation.

RAPIDS has information on the apprentice social security number (SSN) that we used to link apprenticeship records to UI wage records. However, the SSN was provided voluntarily by apprentices and is not available for a nontrivial share of apprentices. The degree to which the SSN is missing varies substantially by enrollment cohort. For the study states, SSN is missing for less than five percent of apprentices who enrolled in 2000 and 2001. From 2002 to 2004, DOL did not collect SSNs for RA participants, and the records for most apprentices who enrolled in this period do not have an SSN. Among 2005 enrollees, 27 percent are missing an SSN. In more recent years, the share of enrollees missing an SSN ranges from 12 to 27 percent. In choosing the enrollment cohort to analyze, we considered the degree of missing SSNs (as described in the next section of this appendix).

UI Wage Records. As part of state UI programs, state employment agencies collect information from employers on the quarterly earnings of each employee. We used UI wage records to measure employment and earnings outcomes.[5] We linked the wage records to apprenticeship records using the apprentice SSN. Even among apprentices for whom RAPIDS includes an SSN, there are some for whom we could not locate any UI wage records: 3 to 14 percent of apprentices

[2] The 25 OA states are Alabama, Alaska, Arkansas, California, Colorado, Georgia, Idaho, Illinois, Indiana, Iowa, Michigan, Mississippi, Missouri, Nebraska, New Hampshire, New Jersey, North Dakota, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Utah, West Virginia, and Wyoming. The 7 SAA states are Arizona, Florida, Kentucky, Nevada, Ohio, Pennsylvania, and Rhode Island.

[3] s mentioned above, Maryland is not included in RAPIDS. For Maryland, we used RA administrative records from the state. For brevity, we refer to all RA administrative data as "from RAPIDS."

[4] We also used RAPIDS information on the ZIP Code of residence at the time of enrollment. We extracted information on neighborhood characteristics from the 2000 decennial U.S. Census (SF3 files) for each ZIP Code and linked the information to apprentices in our analytic sample using the ZIP Codes provided in RAPIDS. We used this neighborhood information, along with individual characteristics, to match apprentices to similar people in the comparison groups.

[5] We adjusted quarterly earnings for inflation using the Consumer Price Index — All Urban Consumers (CPI-U) from the U.S. Bureau of Labor Statistics. The CPI-U statistics are provided monthly and measure prices relative to 1982–1984. We averaged the monthly statistics over three months to create quarterly statistics. All earnings values from UI wage records are reported adjusted for inflation to real 2000 dollars (first quarter).

(depending on the state). For these apprentices, we used a value of zero for earnings and employment. The limitations of the UI wage records are discussed in Chapter II.

Current Population Survey (CPS). The U.S. Census Bureau conducts the CPS on a monthly basis. The CPS is the source of federal statistics on monthly employment and unemployment. Every March, a supplement to the CPS includes information on employment and earnings for the prior year, as well as demographic information such as age, gender, race/ethnicity, and education.[6] For the state population comparison groups, we used the CPS March files from 1997 to 2010. The data cover earnings and employment from 1996 to 2009 (at the time of our analysis, the March 2011 file with earnings information for 2010 had not yet been released).

Administrative Records on Employment Service Participants. Six of the ADARE partners had access to data on Employment Service participants. However, for five of these states we chose not to use the data due to data coverage problems. In Georgia, the ADARE partner did not have access to the data. In Kentucky and Ohio, the available UI data did not cover the medium-term period. For Maryland, the administrative RA data was incomplete, rendering the analysis not comparable with other states. In New Jersey, the Employment Service data did not have demographic characteristics needed to statistically match these participants to RA participants. Finally, in Texas, the Employment Service data did not cover the relevant enrollment cohort. Missouri was the only ADARE partner with access to the necessary data for medium-term estimates for the relevant enrollment cohort. For Missouri, we used administrative records with information on Employment Service participants' enrollment cohort, age, gender, race/ethnicity, and education. We used SSNs to link the administrative records to UI wage records for information on employment and earnings for Employment Service participants.

C. Defining the Analytic Samples for the Effectiveness Assessment

We determined the analytic samples for our estimates of the relationships between RA and employment and earnings based on the availability of RAPIDS (and SSNs in RAPIDS) and UI wage records for each state. In choosing the analytic samples, we chose apprentices who enrolled several years ago because we needed to have information on their program outcomes and post-program employment and earnings. In this section, we first describe the selection of the enrollment cohorts for the analytic samples (Chapter II, Table II.1, summarizes the data availability and chosen enrollment cohorts). We then describe other factors used to define the samples. The bulk of this section describes the process for the nine study states in RAPIDS. The process for Maryland is discussed at the end of the section.

RAPIDS data were available for 2000–2010 for all study states except Maryland. This implies that the earliest enrollment cohort that we could study was the 2000 cohort. To have substantial sample sizes for more precise estimates, we typically combined two enrollment years to define the enrollment cohort. Therefore, the earliest enrollment cohort was 2000–2001.

[6] The CPS reports annual earnings information. We adjusted annual earnings for inflation using the CPI-U (annual average). Annual earnings values from the CPS are reported adjusted for inflation to real 2000 dollars.

We used UI wage records to measure pre-enrollment employment and earnings. Ideally, we would have liked to have several years of pre-enrollment UI wage records. For many job training programs, participants enter the program after experiencing a decline in employment and earnings (Ashenfelter 1978). If we were to measure the gains in employment and earnings starting with the period immediately preceding enrollment, we would measure artificially large gains (because we would have started with a period of unusually low earnings). We examined employment and earnings patterns for RA participants for several years before enrollment. For some RA participants, there was a dip in employment and earnings that began as much as three years before enrollment.[7] Therefore, we used the earliest enrollment cohort (2000–2001) only when UI wage records were available beginning in 1996 or earlier.[8]

In three states—Iowa, Kentucky, and New Jersey—UI wage records were not available until after 1996 (see Chapter II, Table II.1 for a summary of data availability). In Iowa, UI wage records were available from 2003 to 2010. To have four years of pre-enrollment UI wage records, we would have chosen the enrollment cohort of 2007–2008. However, this would have resulted in post-enrollment earnings outcomes for only two years. After only two years post-enrollment, nearly all apprentices would not have completed the apprenticeship. Instead, we chose the enrollment cohort of 2005–2006 for Iowa, allowing us to have earnings for two years pre-enrollment and for four years post-enrollment. For Kentucky, we had a similar problem with UI wage records available from 2002 to 2007. We chose the 2004–2005 enrollment for Kentucky. This allowed us to have earnings for two years pre-enrollment (the same as in Iowa) but only for two years post-enrollment. For New Jersey, where wage records were available from 2000 to 2010, we chose the 2004–2005 enrollment cohort, allowing us to have pre-enrollment earnings for the desired period of four years and post-enrollment earnings outcomes for five years.

In Missouri, Employment Service records were available beginning in 2001. We considered using the 2001–2002 enrollment cohort for the Employment Service comparison, but 84 percent of apprentices who enrolled in Missouri in 2002 did not have an SSN recorded. Fortunately, for the 2001 enrollment cohort, only 3 percent of apprentices did not have an SSN recorded, and this cohort has a substantial sample size (4,263 apprentices with SSN information). Therefore, for the Employment Service comparisons for Missouri, we chose the 2001 enrollment cohort.

Enrollment cohort was the primary factor used to determine the analytic samples.[9] For this reason, we only included apprentices for whom the enrollment date was available in RAPIDS.

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[7] Heinrich, Mueser, and Troske (2008) also found that four years was a sufficient pre-period for their investigation of the effects of the Adult and Dislocated Worker programs under the Workforce Investment Act.

[8] The UI wage records we received from Pennsylvania were missing the fourth quarter of 1996. For the dosage model, we used the earnings and employment in the first three quarters of 1996 as control variables. For the propensity score matching model and the reweighting of CPS data, we dropped the 1996 data and used only three pre-periods.

[9] The RAPIDS data show that some apprentices participated in more than one program. For example, an apprentice might have begun in a program in one occupation and later switched to another program in a different occupation. We included apprentices in the analytic sample if they enrolled in a program during the specified enrollment cohort period, whether or not they enrolled in programs in other periods. If they enrolled in more than one program within the specified period, we used the earliest enrollment. Therefore, our analytic samples had only one observation per apprentice.

In addition, we dropped from the analysis apprentices for whom the enrollment date appeared incorrect (that is, apprentices for whom the recorded enrollment date was after the date provided for completion or cancellation). We also dropped apprentices for whom the completion (or cancellation) date was missing or appeared incorrect (that is, apprentices for whom the completion date was after 2010, the latest year of data available in RAPIDS).[10]

We also dropped from the analysis apprentices who were missing information on either of two key demographic characteristics: gender and age. Gender is a key characteristic because we conducted all of our analysis separately by gender. For the chosen enrollment cohort in most study states, there was no missing information on gender. The two exceptions were Kentucky (9 percent missing) and New Jersey (15 percent missing). Age is a key characteristic because it is strongly associated with earnings (a key outcome for this study). For the chosen enrollment cohort in most study states, less than one percent of the sample was missing information on age. The three exceptions were Iowa (3 percent missing), Kentucky (13 percent missing), and New Jersey (18 percent missing).

For other demographic characteristics, we did not require complete information for inclusion of apprentices in the analytic samples. The degree of missing information on demographic characteristics was relatively small. For the analytic samples in every state, less than 2 percent of apprentices had missing information on race/ethnicity, and less than 3 percent had missing information on education (with the important exception of Kentucky, where 78 percent of apprentices in the chosen enrollment cohort are missing information on education). Veteran status was more likely to be missing but was generally missing for less than 10 percent of apprentices in the analytic samples (except in Pennsylvania, where 14 percent of apprentices were missing information on veteran status).[11]

Table A.3 shows the number of observations at each point in the process of identifying the analytic sample from RAPIDS. The first column shows the total number of entries into RA recorded in RAPIDS. The second column shows the number with a start year in the study period (2000 to 2010). The third column shows the number of these records that had complete information on the critical variables (start date, end date, gender, and age). In each state, the sample declined by 2 percent to 7 percent due to missing information on the critical variables. The fourth column shows the number of these records that had a start year in the enrollment cohort chosen for analysis (most often 2000–2001). After identifying the observations with information on the critical variables and with entry into RA during the chosen cohort period, we then removed multiple entries for the same apprentice by choosing only the first program entered. This selection removed 2 percent or less of the observations and the resulting number is reported in column 5.[12] Finally, we removed observations with no SSN. In most states, this final selection on SSN removed 4 percent or less of the sample. However, in states where we chose later enrollment cohorts due to data

[10] We also identified an unusual spike in enrollments on July 19, 2004. Nearly all the reported enrollments on this date were duplicative of earlier enrollments. For this reason, we dropped all observations with this enrollment date.

[11] In our statistical models, we included a set of dummy variables to indicate apprentices with missing information for race/ethnicity, education, or veteran status.

[12] We removed observations with multiple entries for the same apprentice using the SSN. A small number of apprentices without SSNs may have had more than one observation (that is, more than one entry into RA) in the count shown in column 5.

availability, a greater share of the cohort sample was missing SSN information: Iowa (25 percent), Kentucky (23 percent) and Missouri (15 percent). Column 6 shows the size of our analytic sample for the effectiveness assessment.

Table A.3. Number of Observations by State

	1. Study state spells	2. With start year between 2000 and 2010	3. With critical variables	4. With start year in the analysis cohort	5. Number of apprentices	6. With SSN
Main Cohort						
Florida	70,509	69,762	66,543	12,234	12,074	11,586
Georgia	18,761	18,591	17,719	2,803	2,785	2,693
Iowa	15,646	15,474	14,650	2,980	2,942	2,198
Kentucky	13,432	13,285	12,583	2,122	2,080	1,608
Missouri	53,648	53,276	51,549	8,880	8,739	8,543
New Jersey	30,560	30,477	28,404	5,136	5,060	4,305
Ohio	57,265	56,546	55,225	13,102	12,918	12,558
Pennsylvania	55,129	54,807	53,573	11,498	11,357	11,210
Texas	64,621	64,166	61,996	11,640	11,498	11,334
Special Cohort for Employment Service Comparison						
Missouri	53,648	53,276	51,549	4,402	4,370	4,227

Source: RAPIDS.

Note: The analysis was conducted for specific enrollment cohorts, which were chosen based on data availability. For Missouri, we used a single year cohort (2001) for the Employment Service comparison. The process for Maryland is discussed later in this section. The critical variables are start date, end date, gender, and age. Chapter II, Table II.1, summarizes the dates for the chosen enrollment cohorts for each state.

If the apprentices with SSN information in RAPIDS are different from the apprentices without SSN information, using the sample of those with SSN information could have biased our estimates of the relationship between RA and employment and earning. We examined the differences in demographic and program characteristics of the analytic sample (those with SSN information) relative to the fuller sample (all apprentices regardless of SSN information). In general, we found no patterns of differences in the samples across the states. Nevertheless, to reduce the potential bias from selectivity, we weighted our effectiveness analysis by the inverse probability of being in the analytic sample (estimated as a function of age, gender, race, education, veteran status, and prisoner status and calculated separately for completers and noncompleters).

Table A.4 provides an example of the comparison for Florida. There are some differences between apprentices with SSN information and those with no SSN information. The analytic sample (those with SSN information) had a larger share of blacks, a lower share of high school graduates, a lower share of veterans, a higher share of electricians, and a lower completion rate.

Table A.4. Comparison of Apprentices With and Without SSN in Florida (Percentages, Unless Otherwise Noted)

	All	With SSN	Without SSN	With SSN – Without SSN	
Age					
16 to 20 years old	16.9	17.0	13.9	3.1	
21 to 39 years old	68.6	68.5	72.7	-4.3	
At least 40 years old	14.5	14.5	13.3	1.2	
Average age (years)	29.7	29.7	30.0	-0.3	
Gender					
Male	87.8	87.7	90.0	-2.3	
Female	12.2	12.3	10.0	2.3	
Race/Ethnicity					**
White	62.1	62.0	65.2	-3.2	
Black	19.2	19.5	14.1	5.3	
Hispanic	16.8	16.7	18.0	-1.3	
Other race	1.9	1.8	2.7	-0.8	
Education					***
Less than high school	1.5	1.5	2.0	-0.6	
Some high school	21.8	22.4	8.4	14.0	
High school graduate	76.7	76.2	89.5	-13.4	
Veteran	2.5	2.2	9.2	-7.0	***
Prisoner at enrollment	0.0	0.0	0.2	-0.2	
Occupation					***
Electricians	35.4	36.0	19.9	16.2	
Plumbers, pipefitters, and steamfitters	15.8	15.9	13.5	2.4	
Carpenters	4.6	4.7	1.2	3.5	
Heavy and tractor-trailer truck drivers	0.0	0.0	0.0	0.0	
Sheet metal workers	3.5	3.6	1.0	2.5	
Electrical power-line installers and repairers	2.5	2.6	0.6	2.0	
Correctional officers and jailers	0.0	0.0	0.0	0.0	
Child care workers	8.4	8.5	7.8	0.7	
Home appliance repairers	0.0	0.0	0.0	0.0	
Nursing aides, orderlies, and attendants	0.0	0.0	0.0	0.0	
All other occupations	29.8	28.7	55.9	-27.2	
Outcome					***
Completed	32.8	32.4	43.2	-10.9	
Cancelled	66.4	66.9	56.4	10.5	
Active	0.8	0.8	0.4	0.4	
Sample Size	**12,074**	**11,586**	**488**		

Source: RAPIDS.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level, respectively, using a two-tailed test.

Maryland does not report RA participant information to the federal RAPIDS. For the Maryland analysis, the ADARE partner gained access to RA administrative data from the state. The data were not directly comparable to the RAPIDS. For example, information on RA start date was not coded the same as in RAPIDS, which may have affected the identification of the analytic sample. In addition, the Maryland data included roughly 30,000 observations in the 2000-2001 enrollment cohort from which there were 5,157 unique SSNs. We were unable to determine the reason that the majority of SSNs had multiple observations. Of the identified observations, we only located 66 percent in the UI wage records. In RAPIDS states, we located more than 85 percent of the apprentice cohort in the UI wage records. The low rate of matching between the SSNs in the RA data and the SSNs in the UI wage records suggests there may have been a problem with the SSNs in the RA data. For this reason, we deleted observations for which there was no match in the UI wage records during the entire period 1996-2010. Due to these differences in the administrative data and the identification of the analytic sample, the results for Maryland are not comparable to those for other states. Indeed, the estimated association between RA participation and earnings as measured in the dosage model lies in the range $4,451 to $7,827 for all states with medium-term estimates except for Maryland where it is $15,561. When we followed the same approach as with the RAPIDS states by maintaining all SSNs identified in the RA data regardless of match with UI wage records, the medium-term estimate was $11,054 (statistically significant at the 1-percent level).

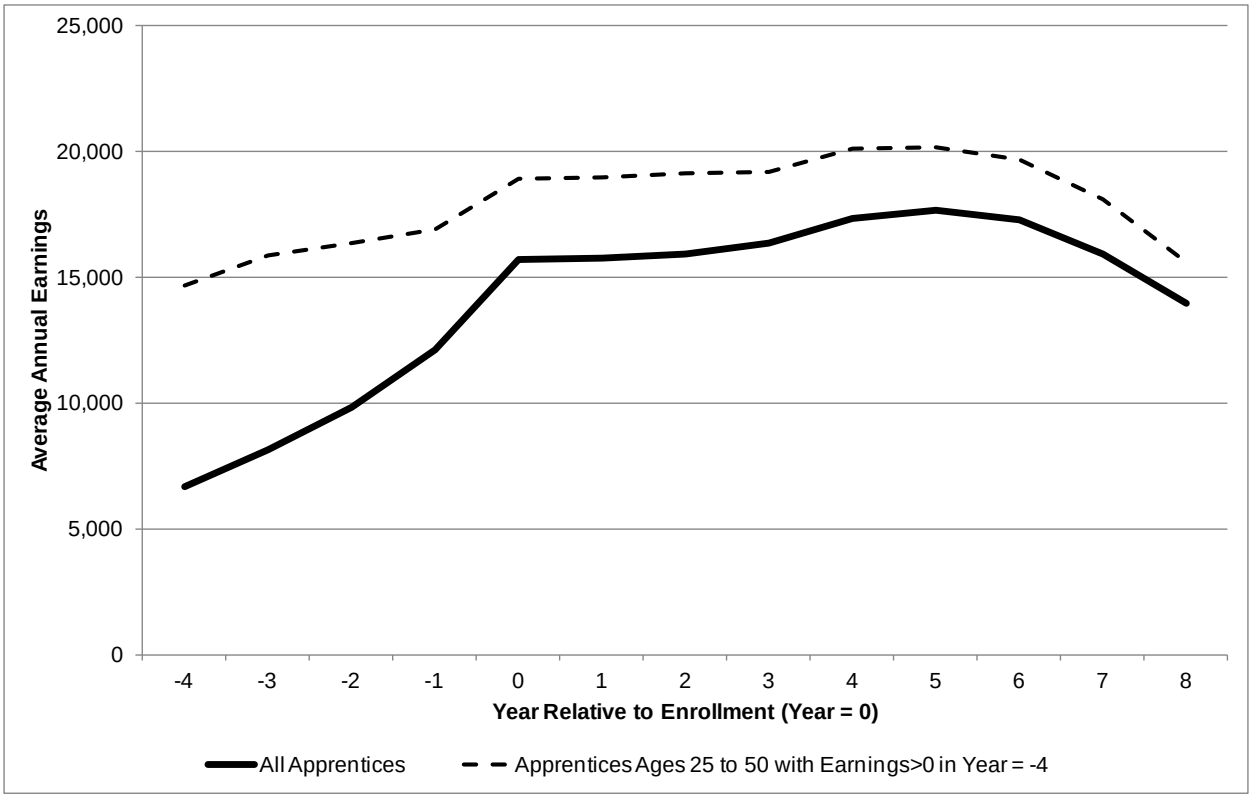
D. Patterns in Pre-enrollment Earnings

For several study states, we found that earnings grew substantially in the years before enrollment in RA. For example, in Florida, the average earnings of RA participants was about $7,000 four years before enrollment and over $12,000 one year before enrollment (Figure A.1, solid line). If we limited the analysis to a more stable sample of apprentices who were between ages 25 and 50 (at enrollment) and had a state UI wage record four years before enrollment (that is, in at least one quarter in year negative 4), we found much less earnings growth in the pre-period (Figure A.1, dotted line).

The main reason for the rapid growth in average earnings is that many RA participants were not in the state UI wage records four years before enrollment and the share with wage records increased in the years leading up to enrollment. There are many potential reasons that the number of RA participants with state UI wage records increased before enrollment. Some RA participants were likely to be in school before enrollment (13 percent were 20 years old or less at the time of enrollment). Some may have been out of the labor market for other reasons such as incarceration or raising children. Some may have been working but were not included in the state UI wage records because they were self-employed or worked in a state that was different from their state of residence at the time of enrollment. Regardless of the reason, the tremendous growth in average earnings between the period four years prior to RA enrollment and enrollment is clearly not due to RA participation.[13]

[13] Some of the apprentices in the enrollment cohorts of 2000 and 2001 could have participated in RA prior to 2000. Based on RAPIDS information for 2000-2010, we expect the share of apprentices enrolling in more than one program over a 10-year period would be less than 5 percent.

Figure A.1. Average Annual Earnings Trends for RA Participants in Florida (Dollars)



Source: RAPIDS and state UI wage records.

Note: The sample included Florida RA participants who enrolled in 2000 or 2001.

The pre-enrollment earnings trends highlight the importance of controlling for pre-enrollment earnings and employment. In the primary model, the dosage model, we included controls for multiple measures of employment and earnings in the four years prior to RA enrollment: earning in each of the four years, the squared values of earnings in each of the four years, and employment in each of the four years. In the RA completer versus noncompleter comparison, we matched the noncompleter sample to completers on pre-enrollment earnings and thus the two samples have the same growth in earnings over the period prior to enrollment. By using a statistically matched comparison group, our measures of the effects of RA on earnings only include the additional earnings gains achieved by RA participants relative to the comparison group in the post-enrollment period.

E. Estimation of Effectiveness: Alternative Models

The primary approach used to estimate the relationships between RA participation and labor markets outcomes is the dosage model described in Chapter II. To check whether the results of the dosage model are consistent with results from substantially different methods of estimating the association between RA participation and labor market outcomes, we used three alternative approaches. First, we compared the earnings of RA completers to the earnings of RA participants who did not complete the certification (noncompleters). Second, we compared RA participants to similar people living in the same state. Third, for Missouri, we compared RA participants to similar Employment Service participants. Because the results for the Employment Service comparison

suggest that RA participants and Employment Service participants were not similar, we did not rely on these estimates and we report them only in this appendix.

In this section, we begin by providing additional details for the dosage model. We then describe the methods used for the completer/noncompleter comparison and the comparison with similar people in the same state. We conclude with the comparison between RA participants and Employment Service participants.

1. Primary Method: Dosage Model

In our primary analysis, for each state we estimated dosage models of the relationships between labor market outcomes after enrollment and the share of RA completed (i.e., the "dose" of RA received), accounting for pre-enrollment earnings and employment as well as demographic characteristics (measured at the time of enrollment). The measures of RA completion were the share of RA completed, the square of the share completed, and an indicator variable for full completion of the program.[14] The models included controls for multiple measures of employment and earnings in the four years prior to RA enrollment: earnings in each of the four years, the squared values of earnings in each of the four years, and employment in each of the four years. Finally, the models included several demographic characteristics: gender, age, race, a broad measure of educational attainment, veteran status, and prisoner status at the time of enrollment. We also estimated the model with interactions of gender with the measures of RA completion and the measures of pre-enrollment earnings and employment.

The dosage models were estimated by ordinary least squares (OLS) regression for each year. The dosage model for employment was estimated as a linear probability model using OLS. Across all specifications, the R-squared is at least 0.18 for the wage models and 0.11 for the employment models. The models were most successful at explaining the variance of wages and employment near the enrollment date and less so over time, primarily because the share of apprentices with no earnings in the UI wage records increased over time (for reasons discussed in this appendix, Section D).[15]

Using the results of the dosage model, we estimated the average earnings of RA participants. The average earnings of RA participants was calculated as an average over the distribution of share completed (that is, for participants with less one percent of the program completed up to those with 100 percent of the program completed). The average was calculated at the average values of pre-enrollment earnings and employment as well as the average demographic characteristics (measured at enrollment). We also used the results of the model to estimate the expected earnings for people who enrolled in RA but did not complete any of the program (nonparticipants). The expected earnings for nonparticipants was calculated as the predicted earnings from the model results when

[14] For noncompleters, we calculated the share of the RA program completed as the total hours of enrollment divided by the hours of OJT required for their apprenticeship (with a cap at 100 percent). The RAPIDS does not contain information on the number of hours of OJT acquired by an apprentice, so we used hours of enrollment calculated as 40 hours per week between the enrollment date and the cancellation date. The measurement error in this explanatory variable biases toward zero the estimated coefficient on share completed. This bias causes our estimates of the earnings and employment gains associated with RA participation to be too low.

[15] The model results suggest that the relationship between share completed and the outcomes is non-linear: the quadratic term is generally statistically significant.

the share completed was set to zero and average values were used for pre-enrollment earnings, employment, and demographic characteristics.

The models provide reasonable predictions for outcomes when the share of the program completed is set to zero because a sizeable number of RA enrollees completed only a small share of the program: Almost 9 percent of enrollees completed less than one-tenth of the program. However, the predicted outcomes for nonparticipants are out-of-sample predictions because the RA enrollee sample does not have enrollees who actually completed zero percent of the program. For this reason, we estimated an alternative model to measure the earnings gains from fully completing RA relative to enrolling in RA but not completing the program. This completer/noncompleter comparison used the same sample as the dosage model, but the measure of dosage was a 0/1 indicator of completion so the model does not require an out-of-sample prediction.

2. Noncompleter Comparison Group

As an alternative specification to the dosage model, we estimated the association between labor market outcomes and completion of RA by comparing RA completers to people who participated in RA but cancelled without receiving an apprenticeship certificate (noncompleters). The sample used, all RA enrollees, was the same as the one for the dosage model. However, this model measured the gains in earnings and employment associated with RA completion relative to RA noncompletion, whereas the dosage model measured the gains associated with RA participation relative to nonparticipation.

To estimate the completer/noncompleter comparison model, we used a propensity score method to match the sample of noncompleters to the completers. That is, among noncompleters, we selected the comparison group to be only those people who were similar to RA completers in the baseline period—the period before enrolling in RA. Prior to enrollment in RA, the earnings trends of eventual RA completers were similar to those of noncompleters, but the average level of earnings was higher among RA completers. To improve the pre-enrollment match between the two groups, we applied a propensity score matching model (for each state separately). First, we estimated a logistic regression model that predicted whether each apprentice would complete RA. The model included controls for gender, pre-enrollment earnings for each of the four years before enrollment (and the squared values of each of these terms), and employment for each of the four years (measured by setting employment equal to one if annual earnings were greater than zero). In addition to these control variables, we tested covariates one at a time (age, race, education, and neighborhood characteristics).[16] If a covariate was significant at the 5 percent level, it was included in the logistic model.

Based on the logistic model, we computed the propensity for each participant to be a RA completer (that is, the predicted probability of RA completions for each participant). For each RA completer, we selected at most five RA noncompleters with similar propensity scores (within 0.001)

[16] For categorical variables (such as age, race, and education), we tested the joint significance of the group of variables (for example, the joint significance of the race dummies).

to be in the comparison group. Completers without any matches were dropped from the sample.[17] We examined the robustness of our results to different matching procedures, namely the nearest five matches without the caliper and the nearest single match without the caliper. The results were comparable across these specifications.[18]

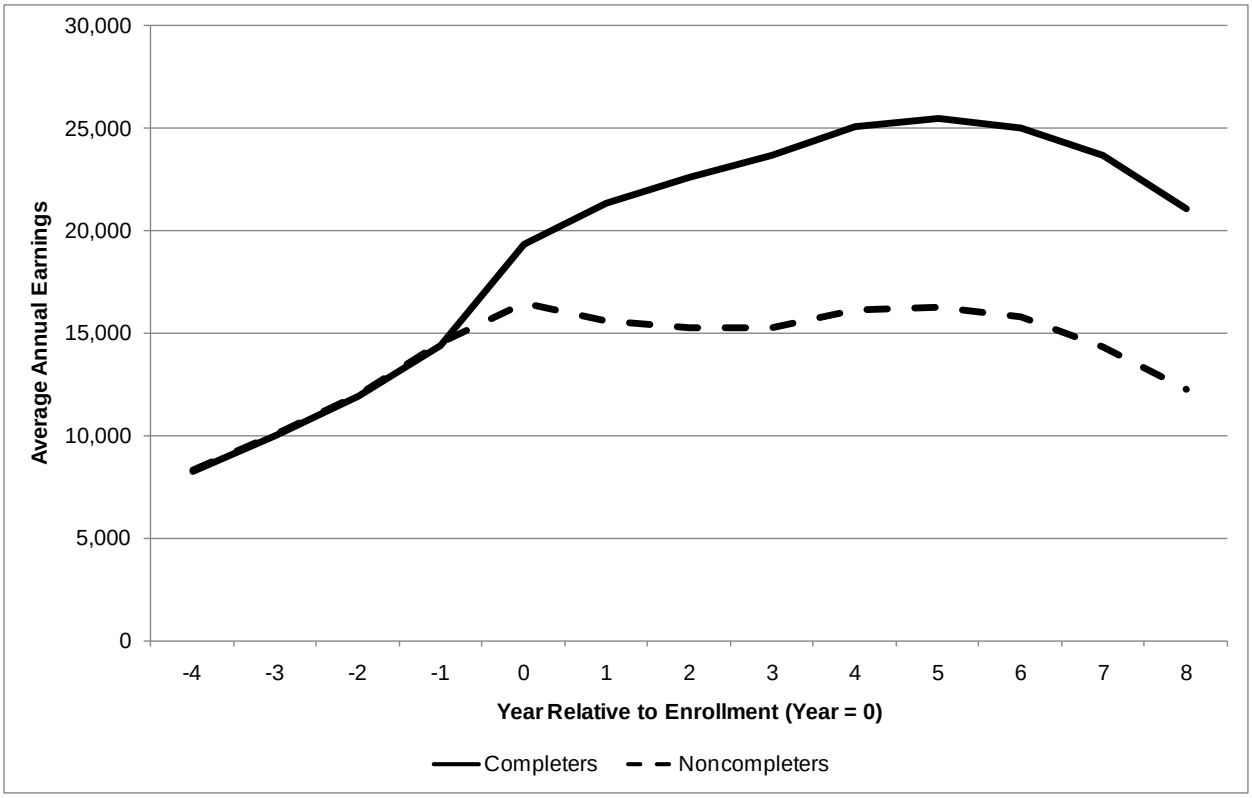
Using the propensity score approach, the RA completer sample was matched to a sample of RA noncompleters with very similar pre-enrollment earnings trends (see Figure A.2 for Florida). There is little consensus on the best balance test to assess the quality of the matching procedure, and thus the best practice is to look across multiple tests (Smith and Todd 2005). We conducted two tests for evidence that the matched groups were balanced on the covariates. First, we conducted t-tests of the difference in the mean of each covariate between the completer and noncompleter samples (Table A.5). In every state, there were no covariates that had a statistically significant difference at the 5-percent level. Only three states had differences that are statistically significant at the 10-percent level; in addition, in these three states there are only two statistically significant differences out of 28 or more covariates used in the models. Second, we computed the standardized bias after matching for each covariate (Rosenbaum and Rubin 1985). In all states, the standardized bias after matching was never greater than ten percent, and except for in three states, the standardized bias was not greater than five percent. Taken together, the balance tests indicate that we were largely successful in constructing a sample of RA noncompleters that were similar to RA completers.

After constructing the balanced sample of completers and noncompleters, we used the average earnings for each group to calculate the earnings gains associated with completion of RA (not regression-adjusted).

[17] Very few completers were dropped from the analysis due to a lack of a match with noncompleters. For example, in Florida, 3,719 of 3,748 completers were matched to at least one noncompleter. Only 29 completers did not match to a noncompleter (within the caliper of 0.001).

[18] Propensity score models typically use a bootstrap approach for estimating standard errors. We did not use a bootstrap method because we were running most of our analysis through the ADARE partners and the calculations required substantial computer resources. We did calculate bootstrapped standard errors for Florida and found them to be about 10 to 50 percent larger than the traditional standard errors. The propensity score results for earnings gains, presented in Chapter IV (Table IV.3), would be statistically different from zero at the 1-percent significance level even if the standard errors were multiplied by a factor of 2, with the exception of the estimate for Kentucky (for the sample with both genders combined).

Figure A.2. Propensity Score Adjusted Average Annual Earnings Trends for RA Completers and Noncompleters in Florida (Dollars)



Source: RAPIDS and UI wage records.

Note: The sample is weighted to represent the sample of all Florida RA participants who enrolled in 2000 or 2001.

Table A.5. Propensity Score Balance Tests

		Share of Covariates With Statistically Significant t-tests by Level of Significance		Share of Covariates with Standardized Bias Greater than Indicated Level		
	Number of Covariates	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
RA Completer Versus Noncompleter						
Florida	34	0.0	0.0	0.0	0.0	0.0
Georgia	32	0.0	0.0	37.5	12.5	0.0
Iowa	25	0.0	0.0	28.0	4.0	0.0
Kentucky	17	0.0	0.0	41.2	17.6	0.0
Maryland	35	0.0	0.0	14.3	0.0	0.0
Missouri	34	0.0	0.0	5.9	0.0	0.0
New Jersey	38	0.0	0.0	21.0	0.0	0.0
Ohio	28	0.0	7.1	10.7	0.0	0.0
Pennsylvania	33	0.0	6.1	6.1	0.0	0.0
Texas	39	0.0	5.1	30.8	0.0	0.0
RA Participant Versus Employment Service Participants						
Missouri (standard)	27	70.4	85.2	92.6	70.4	55.6
Missouri (expanded)	39	56.4	59.0	71.8	51.3	23.1

Source: RAPIDS and state UI wage records.

Note: Data for Maryland are not comparable.

3. State Population Comparison Group

The third comparison group was made up of people who had demographic characteristics similar to those of the RA participants and were living in the same state. In other words, we examined whether the growth in employment and earnings achieved by RA participants was greater (on average) than the growth achieved by a similar group of people living in the same state.

We constructed the comparison group from the sample of people in the CPS who were in the same age range as RA participants (ages 16 to 60 in the enrollment cohort years). We then constructed weights so that, when weighted, the CPS sample matched RA participants on demographic characteristics (gender, age, race/ethnicity, and education). In each study state, the reweighted CPS sample matched the RA participant distribution of these demographic characteristics within less than one-tenth of a percentage point.[19]

[19] The time periods in the CPS analysis did not match perfectly with the time periods for apprentices. For apprentices, we measured calendar time in terms of the year since enrollment. For example, an apprentice who enrolled in RA in the fourth quarter of 2001 experienced the sixth year of enrollment starting in the fourth quarter of 2006 and ending in the third quarter of 2007. In the CPS, we used calendar years. For example, the 2001 enrollment cohort was in the sixth year in calendar year 2006.

A complexity of using this comparison group is that outcomes for the RA participants are measured in the UI wage records, outcomes for the state population are measured in the CPS, and the two data sources have different ways of measuring the outcomes. The UI wage records are made up of employer reports of quarterly earnings for all employees in the state who are covered by state UI. The CPS has self-reported annual earnings for a representative sample of the state population. To make the coverage more similar, we did not include income from self-employment in the CPS earnings estimate. We also dropped federal government workers from the CPS estimates. In addition, we compared the changes over time within each data source to reduce the influence of measurement differences. Even if earnings as measured using the CPS method are 10 percent lower than earnings measured using the UI wage record method, for example, the percentage growth in earnings as measured in the CPS could be comparable to the percentage growth as measured by UI wage records.

Even with these adjustments, the differences between the data sources have important implications for the results. For the state population comparison group, the matching did not take into account pre-period earnings and employment because the CPS has earnings for a different sample each year rather than earnings for the same sample over time. In addition, in the CPS, employment of the state population was relatively stable between the short term and the medium term (that is, between the 6th year and the 9th year after base year). In the UI wage records, employment of RA participants fell substantially over this period. Some of this apparent decline may represent RA participants moving into self-employment, which tends to be common in the skilled trades occupations that are prominent in RA. For the self-employed, state UI wage records would show no employment. Therefore, part of the measured decline in employment for RA participants is due to the limitations of the UI wage record information. For these reasons, we used the state population comparison group to support or challenge the findings from the other models, but we do not consider the magnitudes of the estimates from this comparison group to be indicative of the effects of RA.

4. Employment Service Comparison Group

We constructed the fourth comparison group, the Employment Service group, from administrative records of people who participated in Employment Service in Missouri. Employment Service programs are offered through One-Stop Career Centers and include employment-related services such as job search assistance, job referral, and job placement assistance.[20] Employment Service may include career guidance, job search workshops, and assessments of job seeker skill levels, abilities, and aptitudes. The services may be delivered in one of three modes: (1) self-service, (2) facilitated self-help service, or (3) staff-assisted service. Employment Service participants are potentially an appropriate comparison group for apprentices because some apprentices initially become involved in RA through a One-Stop Career Center. People looking for employment assistance at a One-Stop Career Center may be given the option to participate in Employment Service programs, RA, or other programs.

As with the noncompleter comparison group, we attempted to select the Employment Service comparison group to be only Employment Service participants who were similar to apprentices in

[20] The Employment Service programs were established under the Wagner-Peyser Act of 1993 and are sometimes referred to as Wagner-Peyser services.

the baseline period (the period before participating in Employment Service or RA). We used the same propensity score matching procedure as described for the noncompleter comparison.

The results of the balance tests based on the same variable selection procedure as the completer/noncompleter approach indicate that we were unsuccessful in constructing a comparison group of Employment Service participants that were similar to the RA participants. The differences in means between the samples were statistically significant for 19 of the 27 covariates. In addition, 15 of the covariates had standardized bias levels of at least 10. We also attempted to include the set of matching variables from Hollenbeck and Huang (2006). To this end, we added the percent of quarters with employment, the annual wage trend over the four years prior to enrollment, the variance of annual wages prior to enrollment, a dummy variable for having an annual wage decrease of at least 20 percent in two consecutive years, and the size of the annual wage decrease. As with our initial specification, the balance tests indicate that we were unsuccessful in constructing a control group with similar observable characteristics (Table A.5). Because we were unable to identify a statistically matched comparison group, we report the results of the Employment Service comparison only in this appendix.

The estimation of associations using the Employment Service comparison group is subject to some of the same types of potential bias as estimates from the dosage model. First, we expect selection bias to lead to overestimates of the true causal effect of RA. RA participants have chosen to join a long-term career training program and, as such, are people who are making an investment in their career success. In addition, RA sponsors and employers choose RA candidates they believe will succeed in the program. On the other hand, Employment Service participants are people looking for work, many of whom may have had trouble finding or keeping a job in the past. For these reasons, level of career orientation and ability among RA participants is likely to be higher than among Employment Service participants, even for groups that are matched in terms of demographics and pre-enrollment employment. The only solution for this type of selection bias is to identify a process for selection that is exogenous to underlying characteristics of the participants. In the absence of a random assignment evaluation, we know of no such process for RA.

In addition, the estimates from the Employment Service comparison group are also likely to be biased from limited coverage of the UI wage record data. Because self-employment is fairly common in the contracting trades, the RA participants may be more likely than Employment Service participants to be self-employed during their careers. Therefore, we expect our estimates of the effects of RA on earnings are biased downward by the lack of earnings measures among the self-employed.

The results indicate that RA participation was associated with greater annual earnings and employment compared to Employment Service participation. In the baseline specification, the earnings gains from RA participation were $13,062 in the short-term and $9,571 in the medium-term (Table A.6). The earnings gains measured relative to Employment Service participants are larger than the gains measured in the dosage model, which is likely due to positive selection into RA relative to Employment Service programs. In addition, we found that RA was associated with an 8 percentage point increase in the probability of employment in the short term relative to Employment Service participation (Table A.7). We found similar employment gains from RA in the medium term. In the expanded specification that matches that of Hollenbeck and Huang (2006), we found similar estimates of the earnings and employment gains from RA participation.

Table A.6. Average Annual Earnings Differences for RA Participants Versus Employment Service Participants (Dollars)

	Short-Term Sixth Year After Enrollment		Medium-Term Ninth Year After Enrollment	
	All	Men	All	Men
Missouri (standard)	13,062	13,270	9,571	9,475
Missouri (expanded)	12,988	13,332	9,353	9,667

Source: RAPIDS and state UI wage records.

Note: All dollar values are adjusted for inflation to real 2000 dollars.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level, respectively, using a two-tailed t-test.

Table A.7. Average Annual Employment Differences for RA Participants Versus Employment Service Participants (Percent)

	Short-Term Sixth Year After Enrollment		Medium-Term Ninth Year After Enrollment	
	All	Men	All	Men
Missouri (standard)	7.8	8.3	8.4	8.5
Missouri (expanded)	8.6	9.3	9.1	10.2

Source: RAPIDS and state UI wage records.

Note: All dollar values are adjusted for inflation to real 2000 dollars.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level, respectively, using a two-tailed t-test.

5. Alternative Models for Future Research

Although our models take into account pre-enrollment earnings, employment, and demographic characteristics, we expect that RA participants (and completers) differ in unmeasured ways from our comparison groups. For example, people who complete RA may have been more motivated or more skilled than people who do not enroll in RA or those who complete very little of the program. These differences could explain some (or even all) of the measured association between RA and earnings. Random assignment of individuals into a group that receives RA training and a group that does not receive such training could create the ideal comparison group for estimating the causal relationship between RA and future earnings. Due to the limited resources and time frame for this study, we did not consider a random assignment design.

We did consider alternative approaches for identifying sources of variation in RA completion that are arguably unrelated to individual characteristics such as motivation and skill. For example, firm closures would be associated with the cancellation of RA participation but arguably not associated with individual characteristics of the RA participants.[21] The RAPIDS has a measure that is intended to provide information on the reason that a participant cancelled participation in the

[21] Fersterer, Pischke, and Winter-Ebner (2008) used this approach to examine the relationship between earnings and apprenticeship training in Austria.

program. We found that this measure was often incomplete and we did not have a sufficient sample of participants whose firm had closed to use this alternative approach. If other sources of information on firm closures can be identified, this approach should be considered for future research on the effectiveness of RA. A related alternative would be to use local labor market conditions for specific industries as an instrumental variable associated with RA participation and completion. Either of these approaches would need to carefully account for the potential relationships between firm closures, local labor market conditions, and future earnings.[22]

F. Measurement of Costs and Benefits

In this section, we provide details on the measurement of costs and benefits for the cost-benefit analysis described in Chapter II. We conducted the cost-benefit analysis for the five states for which we had reliable medium-term estimates: Florida, Georgia, Missouri, Pennsylvania, and Texas. The final subsection of this section compares our results with previous research on Washington state (Hollenbeck and Huang 2006).

1. Measuring Costs

Our main measures of costs are estimates of the costs incurred by the federal and state agencies that run the RA program. We also included government costs of RTI that public community colleges provided. As discussed in Chapter II, we did not include employer costs (or benefits) or apprentice costs in our baseline estimates.

We collected information on federal and state costs of RA from OA and the SAAs for the 10 study states.[23] We collected information by fiscal year for the enrollment cohorts that were used in our effectiveness assessment (2000–2005; as described in Table II.1) and for the most recent fiscal year. We developed a budget form that specifically requested labor costs, operations and maintenance costs, any other costs, and total expenses. OA provided information on the federal expenses for every study state. For the states administered by SAAs, we asked the state director who on their staff would be best able to provide budget information, and we coordinated with that person to complete the form.

The budget information is estimated. For example, OA used the number and level of staff assigned to each state to estimate labor costs. These numbers were converted into "full-time equivalent" staff. For example, if an OA director covered two states, the cost estimate for each state included half the personnel costs for that director. OA calculated the personnel costs for each level from the Office of Personnel Management General Pay Schedule. OA did not include the costs of benefits in the labor costs but provided an estimate of approximately 30 percent for benefits. We increased all OA-calculated labor costs to include 30 percent for benefits. For operations and maintenance costs, OA reviewed the lease bills to gather information on space costs, reviewed travel allocation records for each region, received computer equipment cost figures from the DOL Office

[22] Another alternative would be to consider the use of earnings data as reported to the Social Security Administration. This information could cover all states and include self-employment income.

[23] These costs included all costs incurred at the state level, including the costs of federal staff assigned to specific states. Costs incurred at the federal level were not included (for example, the cost of OA staff working in the national office in Washington, DC, and not assigned to specific states). On a per-apprentice basis, the costs at the federal level are likely to be very low and were not included in our calculation of net social benefits.

of Information and Technology, and added an estimate of yearly maintenance and supply costs for office equipment.

For some SAAs, the agency had budget information on expenditures and revenues for each year. In other SAA states, the apprenticeship program was housed within a larger budget division and expenditures were estimated based on the fraction of time employees worked with the apprenticeship program. In Pennsylvania, RA is one of more than 10 programs administered by the same budget division. Pennsylvania is the one SAA state for which we did not receive budget information for the relevant enrollment cohorts from the SAA.[24] We estimated costs for Pennsylvania based on the average per apprenticeship costs in other SAA study states.[25]

We converted the total yearly expenditures for each state to the average cost per apprenticeship in the state. We converted from fiscal years to calendar years by calculating the monthly expenditures as one-twelfth of the annual expenditures and summing over months. We also needed to estimate the total number of apprentices in each state in each calendar year from RAPIDS information that begins with the enrollment cohort in 2000. To convert from yearly costs per apprentice to total costs over all years spent in apprenticeship, we used the distribution of years in apprenticeship for the relevant enrollment cohort (including completers and noncompleters). Table A.8 provides our estimates of the costs per RA participant in the 2000-2001 enrollment cohort. The estimation procedure is described in detail in the next section of this appendix. We did not compute a cost per RA participant for Maryland because we had problems identifying the number of apprentices and the time spent in apprenticeship using the Maryland RA administrative data.

[24] Pennsylvania provided the total state budget for the Bureau of Labor Law Compliance: $3,560,091 in the current fiscal year. However, because this budget information does not relate to the relevant period for the enrollment cohorts of interest and it covers multiple departments, we did not use this information in calculating the costs in Table A.7.

[25] We used the average per apprenticeship costs in Florida and Kentucky (both SAA states) for Pennsylvania. We did not use Ohio to construct the average because Ohio had unusually high per apprenticeship costs. We did not use Maryland because of problems computing per apprenticeship costs from the RA administrative data.

Table A.8. Federal and State RA Agency Costs per RA Participant in the 2000- 2001 Enrollment Cohort (Dollars)

State	Estimated Cost
Florida	128
Georgia	180
Iowa	194
Kentucky	138
Missouri	150
New Jersey	155
Ohio	217
Pennsylvania	133
Texas	106

Source: OA and SAA budget experts and RAPIDS.

Note: Estimates are for the 2000–2001 enrollment cohort. Costs include costs for completed and noncompleted apprenticeships, over the full duration of the apprenticeships. See Section G of this appendix for details on the estimation method. We did not estimate costs per apprenticeship for Maryland due to problems identifying the number and duration of apprenticeships in their state RA data. Pennsylvania is based on an average of other SAA states. Costs are adjusted for inflation to year 2000 dollars.

In addition to the costs incurred by the federal and state registration agencies, the government costs of RA include costs incurred by partner agencies in the workforce development system and the education system. We planned to gather information on these partner costs from the state directors and budget experts in each of the study states. However, they reported that they do not have even a ballpark sense of these costs. In our analysis, we did not include any costs for the workforce development system because these costs are likely to be fairly low. The workforce development agencies offer a myriad of events and services, and including RA among them may be very cost-effective.

We did include an estimate of the cost of providing RTI in public community colleges. Public community colleges are perhaps the most common provider of RTI, although it is also provided by private colleges and other private entities. In our baseline analysis, we assumed that public community colleges provide 75 percent of RTI. Based on estimates from the National Center for Education Statistics (NCES), we estimated that the public cost of community college instruction was $8.69 per student-hour (NCES 2010).[26] On average, RA required 90 hours of RTI in 2000–2001.[27] If public community colleges provided 75 percent of this instruction, the average public cost was $587 per apprentice (that is, 75 percent of 90 hours times $8.69 per hour).

[26] NCES (2010, Table 373) reports total expenditures of $10,158 per full-time student in public community colleges in 2003–2004. Adjusting for inflation, this is $9,381 in 2000. Dividing by 900 hours of student contact per full-time student, we calculated costs of $10.42 per hour. Adjusted for 16.6 percent of expenditures covered by tuition and fees, the calculation results in $8.69 of public cost per student-hour. The assumption of 900 hours per full-time student comes from an earlier NCES publication (NCES 2001) and is consistent with 25 student contact hours per week for 36 weeks. The estimate of 16.6 percent of expenditures covered by tuition is based on the total revenue from tuition and fees (NCES 2010, Table 362).

[27] This statistic is based on authors' calculations from RAPIDS for the enrollment cohort of 2000–2001 in the study states.

Some RA participants receive pre-apprenticeship training to prepare them for RA. Pre-apprenticeship training is often provided by community-based organizations (CBOs) (often funded by government grants) and community colleges or other public educational institutions. We did not have information on enrollment or costs per student in pre-apprenticeship. Our baseline analysis includes no costs of pre-apprenticeship.

2. Measuring Benefits

The main benefits of RA are due to worker productivity gains from RA training. Productivity gains were measured by the additional compensation that apprentices received because of their participation in RA. In this section, we describe our approach to converting from estimates of the association of RA with earnings to estimates of productivity benefits. We also discuss how our measures of the other benefits (such as taxes and reduced public assistance) were derived from the findings for earnings.

In our baseline analysis, we began with the assumption that the measured association between RA participation and gains in annual earnings is a causal effect. Although we do not believe this is a credible assumption, it does provide a definitive baseline from which to begin the cost-benefit analysis. Under this assumption, productivity benefits in the medium term can be measured from the earnings gains associated with RA participation as estimated using the dosage model. We summed the earnings gains through nine years to measure the total earnings gains from RA in the medium term. To account for the fact that a dollar earned in 2000 was worth more than a dollar earned in later years, we adjusted for inflation and discounted future earnings based on interest rates, as we describe in the next section.

We also extrapolated from the medium-term effects on earnings to estimate the career effects. On average in our study states, RA participants were 29 years old when they enrolled in RA (in year 0). We assumed they would continue to receive earnings benefits through year 36, when they would be 65 years old. To estimate the earnings effects beyond the observed medium-term effects, we assumed that the effect in each year would be the same as in the prior year, less a small adjustment for "decay." The adjustment for decay accounts for the decline in effectiveness of the RA training as time passes. We assumed that the degree of decay would be the same as we estimated for years 7 to 9. That is, we used our estimates of the effects on earnings to calculate the decay between years 7 and 8 and the decay between years 8 and 9, and we took the average of these two decay rates in each state. We averaged the state-specific decay rates across the five states with medium-term estimates (the average was weighted by the size of the 2000-2001 enrollment cohort). We applied the across-state average of 5.9 percent to each year after year 9.[28] After applying the decay rate, we summed the estimates of earnings gains from years 0 to 36 to measure the total effect of RA on earnings over a career (with adjustments for inflation and discounting of the future, as described below). Years 7 to 9 in our analysis cover the years 2006 to 2009, during which there was an economic downturn with very high unemployment rates, especially in construction trades. If the downturn had a stronger negative effect on RA participants relative to nonparticipants, the measured decay rate will be overestimated and the earnings gains and net social benefits will be underestimated.

[28] A 5.9 percent decay rate implies that, in the 36th year, the earnings gains will have decayed to about 18 percent of their value in the 9th year, the last year for which we could measure the earnings gains.

We did not have information on the fringe benefits RA participants receive. Fringe benefits include employer contributions to health and other insurance, retirement benefits, paid leave, and legally required benefits (payments to Social Security, Medicare, UI, and workers' compensation). We estimated the value of these fringe benefits as a function of earnings. We used estimates from the U.S. Bureau of Labor Statistics for the share of total compensation (earnings plus fringe benefits) that is spent on fringe benefits to calculate an average value of fringe benefit as a percentage of earnings.[29] Under the assumption that this average is applicable to employers of RA participants, we used this statistic to calculate the fringe benefits based on our measure of earnings effects in each year. We applied the fringe benefit rate to the estimated earnings gain associated with RA participation. If RA recipients receive better fringe benefits than nonparticipants, which may be the case because RA is more prevalent in occupations with high rates of unionization, then the gain in fringe benefits associated with RA is underestimated and the total productivity gain and the net social benefits are underestimated.

We also calculated the effects of RA on taxes based on the estimated effects on earnings. For federal taxes, we used a rate of 10.2 percent based on measures of the effective federal tax rate for lower-middle income households for 2004 to 2007.[30] For state and local taxes, we used rates that include sales and excise taxes, property taxes, and income taxes for lower-middle income families for 2007. The total state and local tax rate (after federal deduction offset) ranged from 9.5 percent in Missouri and Pennsylvania to 11.2 percent in Georgia.[31]

We did not have information on RA participants' receipt of UI compensation and public assistance (food stamps and welfare). We used CPS data from 2004 to 2009 to estimate the relationships between earnings and UI compensation, food stamps, and welfare. We then used the estimates to predict the decline in value of UI compensation, food stamps, and welfare that would be expected based on the estimated increase in earnings due to RA (at the average level of earnings of the comparison group). This approach provides an inaccurate measure of the effects of RA because UI compensation and public assistance receipt depend on the variability of earnings, and not simply on average annual earnings. The CPS data do not have measures of variation in earnings at a monthly level. A preferred method would be to use administrative data on UI compensation

[29] The Bureau of Labor Statistics publishes "Employer Costs for Employee Compensation." We used the values published for each year from 2000 to 2010 for March (because that month was available in all years). We assumed that the 2010 value would hold for future years. As an example of our method, in 2010, the published average share of compensation spent on fringe benefits was 21.2 percent (this does not include paid leave and supplemental pay, which are already included in the earnings gains). This implies that fringe benefits can be calculated by multiplying earnings by 26.9 (that is, 21.2/78.8). We did not adjust the fringe benefit calculation to account for self-employment because self-employment earnings were not included in our earnings estimates (because the UI wage records do not include self-employment income).

[30] The effective federal tax rate includes payroll taxes paid by the employer on behalf of the employee (Urban Institute Tax Policy Center 2011). We used tax rates for the second quintile.

[31] We used the most recent available information on state and local taxes from Davis et al. (2009).

and public assistance receipt from the states. However, we did not have access to these confidential data, and the time and resources required to gain access were beyond the scope of this project.[32]

For the administrative costs of UI compensation and public assistance programs, we relied on data from the U.S. House of Representatives, Committee on Ways and Means (2008). Administrative costs were estimated to be 10.2 percent for UI and 18.9 percent for food stamps. Administrative costs for cash assistance ranged from a low of 3.9 percent in Georgia and Missouri to a high of 12.4 percent in New Jersey.[33]

3. Comparing Costs and Benefits That Occur at Different Times

Because benefits and costs can occur at different times, we made two adjustments before summing them. First, we corrected for inflation by adjusting to 2000 dollars.[34] Second, we applied a discount rate to take into account that a dollar in 2000 was worth more than a dollar in later years because it could be invested and earn interest. We used the long-term average yield on inflation-indexed bonds from the U.S. Treasury. As reported by the U.S. Federal Reserve Board of Governors, this rate fluctuated between 1.72 and 2.54 over the period 2003 to 2010. We used the average of 2.18.[35]

4. Comparison to Results for Washington State

In a study of the net impacts of RA in Washington state, Hollenbeck and Huang (2006) concluded that RA had a substantial impact on the earnings of participants and strong positive net social benefits. Although our findings are similar, the approaches in the two studies are quite different. For example, the Washington state study used a propensity score matching method to compare RA participants to Employment Service participants. We did not have data on Employment Service participants for the appropriate enrollment cohort, except for in Missouri

[32] We estimated the models separately for UI compensation, food stamps, and welfare and for each state. The models allow for a highly nonlinear relationship (the explanatory variables included earnings to the second, third, and fourth power, interacted with a dummy variable indicating annual earnings of over $50,000). Overall, the models explain less than 6 percent of the variation in unemployment compensation, welfare, and food stamps. We could have potentially improved our estimates by using panel data from the Survey of Income and Program Participation. The approach would be difficult to implement because it would require us to measure the effects of RA on earnings variability. In addition, because survey measures of earnings are not comparable to the measures from UI wage records, the estimates from this method also would be inaccurate.

[33] Our measure of administrative costs for cash assistance was the cost of administering TANF.

[34] We used the CPI-U. Quarterly earnings information from the UI wage records was adjusted to the first quarter of 2000. Annual earnings from the CPS and annual RA cost information was adjusted to year 2000.

[35] The U.S. General Accounting Office (1991) recommended using the real rate of return on 30-year Treasury bonds averaged over the past 10 years. Our approach was similar: the average rate of return on inflation-indexed Treasury bonds with maturities of 10 years or more, averaged over the period 2003–2010. The Federal Reserve Board of Governors makes these statistics available at http://www.federalreserve.gov/releases/h15/data.htm (accessed on July 9, 2011).

where we found the Employment Service participants were not a good comparison group for RA participants.[36] In addition, the Washington state study examined outcomes through the third year after program exit whereas we examined outcomes through the ninth year after enrollment (about three-to-four years longer, on average). The final year in the Washington state study was 2005 whereas in our study the final year was 2009. This difference could be important if the economic downturn in recent years had a stronger effect on RA participants (for example, because of the high unemployment in the construction trades). Other differences between the studies include: (1) the use of surrounding states (Idaho and Oregon) in the Washington study whereas we had UI wage records only for the study states; (2) the use of actual measures of UI compensation and public benefit receipt in the Washington study whereas we used rough estimates based on the estimated earnings gains; and (3) the Washington study had more direct estimates of the costs of RA.

In light of all the differences between the studies, it is remarkable that the estimated short-term gain in earnings associated with participation in RA is similar. The Washington study found a gain of $2,281 dollars per quarter (in 2005 dollars; Table 1.2, p. 8). For comparison with our results, we converted this to an annual value in 2000 dollars (multiplying by 4 and then by an inflation adjustment of 0.882), for a result of $8,047. This result lies within the high end of our estimated range across states for the short-term gains based on our primary model: $5,242 in Florida and $8,304 in Pennsylvania.

The estimates for the lifetime earnings gains associated with RA participation are somewhat different between the two studies. In Washington, the preferred estimate is $187,223 assuming no decay in the gains over time, with an alternate estimate of $130,725 assuming that the observed decay rate continues over the career (p. 163). In addition, the earnings gains during RA participation are separately reported as a negative cost of $23,345 for the apprentices. Summing these estimates and converting these values to inflation-adjusted 2000 dollars to compare with our estimates, the Washington results are $185,721 with no decay rate and $135,890 with a decay rate. Our estimates include a decay rate and we find a range in estimates over the states from a low of $77,072 in Florida to a high of $129,362 in Pennsylvania. The evidence for decay is much stronger in our study. In four of the five states for which we have medium-term estimates, the estimated earnings gains grow until the sixth or seventh year and then decline. The Washington study only has estimates through about the sixth or seventh year after enrollment (the study covers up to the third year after exit). If the Washington study continued for a few more years, there may have been more evidence for decay in the estimated earnings gains.

Although we believe that the estimates with a decay rate are preferred, there are at least two reasons that the estimated decay rate may be too high. First, the majority of RA programs are in the construction trades. In this industry, self-employment is prevalent and thus RA participants may be more likely become self-employed as their career progresses. Because UI wage records do not include self-employment earnings, increases in self-employment earnings would cause the estimated earnings gains to decline over time. Second, we estimated the decay rate in the earnings gains based

[36] In Missouri, we found that Employment Service participants were not a good comparison group for RA participants based on our inability to statistically match the two groups. Hollenbeck and Huang (2006) were able to statistically match the two groups in Washington state. Our matching approach was slightly different in that we attempted to match using four years of pre-enrollment employment and earnings data whereas in the Hollenbeck and Huang study they had only six quarters of pre-enrollment UI wage records.

on the decay rate observed from years 7 to 9. This period corresponds to years 2006 to 2009, a period of economic downturn and very high unemployment rates in the construction trades. If the economic downturn had a larger effect on the earnings of RA participants, this would lead to a temporary decline in the measured earnings gains between years 7 and 9. In sum, both of these factors suggest that our estimates of lifetime earnings gains may be underestimated.

Other differences in the approaches used by the studies had only small effects on the estimates. The lifetime net social benefits in the Washington study are $267,790 (summing the four final columns in Table 1.3, p. 8), which is about 27 percent higher than the lifetime earnings estimate. The lifetime net benefits in our study are about 25 percent higher than our lifetime earnings estimate. Thus, the differences in the lifetime earnings estimates (which are driven by differences in the decay rate) drive the differences in the estimated net social benefits.

G. Estimated Costs per Apprenticeship

We collected budget information from OA and the SAAs for each state. These data provided the total expenditures by fiscal year for each state. In this section, we describe how we converted this information to per apprentice costs by calendar year and then to average costs per apprenticeship.

First, we converted expenditure information from fiscal years to calendar years. OA expenditure data were provided by the federal fiscal year (October 1 to September 30). SAA expenditure data were provided by the state fiscal year (July 1 to June 30). For SAA states, we needed to combine OA expenditures and SSA expenditures. For each month in the fiscal year, we assumed expenditures were equal to one-twelfth of the annual expenditures. Using this assumption, we calculated the monthly OA expenditures and the monthly SAA expenditures (for SAA states). We then summed over the months in the calendar year to create total expenditures for each calendar year.[37]

Next, we estimated the total number of apprentices served in each calendar year for each of the nine study states in RAPIDS. RAPIDS has information on apprentices starting with the cohort enrolling in 2000. We used this information to simulate the number of apprentices who had enrolled before 2000 and were still active in calendar years 2000 and beyond (separately for each state). We combined the simulated numbers for enrollment cohorts pre-2000 with the actual numbers from RAPIDS for enrollment cohorts in 2000 and later. This resulted in estimates of the total number of active apprenticeships in each year from 2000 to 2010 for each state. The process had three steps:

1. To estimate the size of the entry cohorts for 1990–1999, we estimated a simple linear regression model. The dependent variable was the size of the state enrollment cohort, and the explanatory variables were the size of the state male population ages 20 to 40 and the unemployment rate in the state (and a fixed effect for each state). The size of the male population served as a measure of the potential demand for apprenticeships. The state unemployment rate served as a measure of state economic conditions that

[37] For 2010, we did not have expenditure data for the whole year. We used monthly expenditures in June 2010 and multiplied by 12. We did not collect expenditure data for 2005–2009. We describe the estimation procedure for these years later in this section.

affect employer demand for new apprentices, workers' demand for new job opportunities, and state budget constraints. The regression covered the nine study states in RAPIDS over 11 years (99 observations).[38] We used the regression coefficients to simulate the size of the enrollment cohort in each state from 1990 to 1999.

2. For the 2000–2001 enrollment cohort in RAPIDS, we calculated the distribution of years in apprenticeship (separately for each state). That is, we calculated the number of 2000–2001 apprentices who were still in an apprenticeship program after one year, two years, and so forth.[39] We then applied that distribution to the estimated enrollment cohorts for 1990–1999.[40] This resulted in a simulated number of active apprentices by enrollment cohort for each calendar year for each state (for cohorts enrolling from 1990 to 1999).
3. We combined these simulated numbers for the enrollment cohorts 1990–1999 with the information in RAPIDS on the total number of apprentices by calendar year for cohorts enrolling 2000–2010. The result was an estimate of the total number of active apprentices in each year for each state. Table A.9 reports these estimates.

Table A.9. Estimated Number of Apprentices, by State and Year

State	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Florida	14,035	16,099	16,499	17,453	18,950	19,996	22,503	22,728	19,374	12,766
Georgia	12,382	10,350	8,740	7,084	5,790	5,444	5,815	6,515	5,821	4,365
Iowa	12,632	10,611	8,674	6,828	5,768	5,467	5,426	5,150	4,926	3,718
Kentucky	12,615	10,071	8,143	6,186	4,954	4,258	4,155	4,359	4,040	2,803
Missouri	16,629	16,516	16,126	16,071	16,432	16,766	17,550	17,143	15,774	10,070
New Jersey	18,205	17,174	15,637	13,460	11,881	11,477	11,024	10,013	8,119	5,573
Ohio	20,802	22,176	21,875	21,016	20,537	19,479	19,922	19,619	16,870	10,344
Pennsylvania	19,532	20,268	20,589	19,456	18,760	18,020	18,355	17,522	14,943	10,532
Texas	15,793	16,364	17,021	16,398	15,280	15,106	16,282	16,971	16,800	14,296

Source: RAPIDS.

Note: See text for details on estimation method. We were not able to create this information for Maryland from the state RA data.

We divided the total expenditures in each calendar year by the total number of apprentices in each calendar year to estimate the annual federal and state costs per apprentice. Because we anticipated using the 2000 enrollment cohort for the analytic sample in all states, we expected that apprentices would not be enrolled after 2005 and we did not request expenditure information after the 2005 fiscal year. However, a minority of apprentices from 2000–2001 were enrolled in 2005 and beyond. To cover the later apprenticeship period, we needed estimates beyond 2005. To estimate costs after the 2005 fiscal year, we used linear interpolation between the 2004 per apprentice

[38] This simple linear model explained 89.5 percent of the total variation in enrollment cohorts.

[39] We had 11 years of data for the 2000 enrollment cohort (through 2010). The share of apprentices remaining in RA for 11 years is very small (less than half of one percent in every state except Georgia, where the share is 1.4 percent). Our simulations assumed that no apprentices remained in RA for more than 11 years.

[40] This calculation implicitly assumed that the distribution of duration in RA for the 2000–2001 cohort is relevant for the cohorts in the 1990s. We had no way of testing this assumption. If it is incorrect, our measures of the total number of active apprentices are inaccurate.

estimate and the per apprentice estimate for 2010 (we requested the 2010 estimate to provide context for current programs). Finally, we adjusted all costs for inflation using the Consumer Price Index from the Bureau of Labor Statistics (CPI-U).

The per apprentice costs were particularly high in Ohio in 2010 (Table A.10). The high costs in Ohio were driven by high SAA costs ($227.8 per apprentice) and not the OA costs ($26.9 per apprentice). It appears that growth in the per apprentice cost in Ohio occurred as total expenditures increased while the number of apprentices declined. Between 2004 and 2010 (years for which we collected expenditure data), Ohio had a 62 percent increase in expenditures and a 68 percent decline in the estimated number of apprentices (not shown in table).

Table A.10. Estimated Expenditures per Apprentice, by State and Year (Dollars)

State	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Florida	54.4	46.4	43.2	36.2	34.9	40.2	45.2	50.0	54.0	60.0
Georgia	32.3	40.5	46.6	49.9	57.6	58.5	59.5	60.5	60.8	63.6
Iowa	31.8	38.2	43.8	46.8	71.9	74.6	77.2	79.8	81.5	86.4
Kentucky	18.9	23.9	30.0	39.9	47.9	53.7	59.1	64.3	68.6	75.5
Missouri	43.8	41.3	42.5	39.7	39.4	43.9	48.2	52.3	55.7	61.2
New Jersey	27.6	28.4	28.4	33.5	38.4	51.1	63.0	74.4	84.3	97.3
Ohio	49.2	46.6	50.8	52.0	50.8	88.3	123.6	157.1	186.8	223.2
Texas	34.9	34.8	35.4	38.2	41.9	44.6	47.0	49.5	51.3	55.1

Source: RAPIDS.

Note: See text for details on estimation method. We did not estimate expenditures for Maryland. For Pennsylvania we used an average of other SAA states.

In the final step, we converted the estimates from per apprentice per year to the average cost per apprenticeship. That is, we accounted for the multiple years that each apprentice may spend in the program. For the distribution of years in the program, we used the experience of the 2000–2001 enrollment cohort. We first calculated the number of apprentices from the 2000–2001 cohort active in each calendar year. From this, we calculated the probability that an apprentice who started in 2000–2001 would be still active after one year, two years, and so forth. For the 2000 and 2001 cohorts, we multiplied the probability of being active in each calendar year by the cost per apprentice in that calendar year; we then summed the results over the years. This gave us the cost per apprenticeship for those enrolled in 2000 and 2001. We averaged the costs for the 2000 enrollment cohort and the 2001 enrollment cohort to arrive at the cost per apprenticeship for the 2000–2001 enrollment cohort. The results are reported in Table A.8 (in the previous section of this appendix).

H. Qualitative Data Collection and Analysis: Semistructured Discussions with State Directors

We conducted semistructured telephone discussions with state apprenticeship directors for each of the 10 selected states to learn about the RA program in each state. The discussions covered six topic areas: (1) staffing and organization of the state apprenticeship agency, (2) the process for recruiting and registering sponsors, (3) partnerships with workforce development and educational systems at the state and local levels, (4) benefits and costs to sponsors and apprentices,

(5) participation of women, and (6) use of funds from the American Recovery and Reinvestment Act of 2009 (ARRA). We conducted the discussions, which took about 90 minutes, by telephone primarily from October to December 2010, except for Missouri, which was not confirmed for participation in the study until May 2011, at which time we conducted the state director discussion. The protocol for the discussion is in Appendix C.

For states federally administered by OA, we spoke with the state-level OA director. For states administered by an SAA, we spoke jointly with the SAA director and the OA director for the state. We invited directors to include their staff in the discussion. Field staff, referred to as apprenticeship training representatives, participated in the discussions for several states; these staff work directly with sponsors and partners. Table A.11 lists the participants for each state.

Before the first state director discussion, we developed a protocol to guide the discussion. We organized the protocol according to the six topic areas listed above. Conducting semistructured discussions, rather than a survey or scripted interview, allowed a less formal conversation to take place, in which the respondents could feel free to elaborate on topics they thought were important and take the conversation in directions we had not anticipated. After the first discussion, the protocol was revised slightly and finalized for use in the remaining discussions.

Before each conference call, we spoke with the director for each state to describe the study and ask a few basic questions about the RA agency in their state. We used these initial questions to streamline the conference call discussion and identify areas in which to probe more deeply during the discussion. We also conducted a brief document search over the Internet to learn about the basic organization of the agency and note interesting programmatic features.

Table A.11. Participants in State Director Discussions

State	Participants	Home Agency for SAA States
Florida	SAA director, OA director, one field staff, two administrative staff, and the bureau chief for Career and Adult Education	Apprenticeship is a unit in the Florida Department of Education, within Career and Adult Education.
Georgia	OA director	
Iowa	OA director	
Kentucky	SAA director, OA director, two field staff	Apprenticeship and Training is housed within the Kentucky Labor Cabinet in the Division of Employment Standards under Apprenticeship and Mediation. Apprenticeship and Mediation is responsible for the administration and enforcement of Kentucky's wage and equal opportunity provisions, including prevailing wage regulations.
Maryland	SAA director, OA director, one field staff	Maryland Apprenticeship and Training is housed in the Maryland Department of Labor, Licensing, and Regulation, as a unit within the Division of Labor & Industry.
Missouri	OA director, two field staff	
New Jersey	OA director	
Ohio	SAA director, OA director	RA is administered by the Ohio State Apprenticeship Council, which is under the Ohio Department of Jobs and Family Services.
Pennsylvania	SAA director, OA director, OA regional executive assistant, one representative from the state Apprenticeship Council	RA is one of more than 10 programs administered by the Bureau of Labor Law Compliance within the Pennsylvania Department of Labor and Industry.
Texas	OA director, two field staff	

During each discussion, a lead team member asked questions, and a second team member took detailed notes. Each discussion was recorded (with the permission of all participants) to ensure the information was fully and accurately captured. Team members debriefed on what they learned immediately following each telephone conversation, then combined their notes into a write-up template. Both members of the study team reviewed the notes and discussed any edits or revisions necessary to accurately record salient details or themes. The write-up template, organized by discussion topic, was also used to identify common themes across states. Members of the team discussed themes and findings throughout the data collection period to refine and confirm their understanding during subsequent discussions with directors.

After conducting discussions, the team members transferred the information collected in write-ups to a spreadsheet organized by question and major theme. The information was analyzed within each of the six topic areas by major themes.

I. Qualitative Data Collection and Analysis: Semistructured Discussions with Female Apprentices and Grantees Working with Female Apprentices

An important objective of the study was to examine the experiences of women in apprenticeships. To do so, we conducted semistructured telephone discussions with 15 women who participated in RA. We also conducted discussions with the executive directors of five CBOs that received grants from DOL for promoting women's success in apprenticeship. As described in the previous section, we also spoke with the 10 state directors about women's experiences in apprenticeship. The protocols for these discussions are in Appendix C.

Selection of Female RA Participants. We conducted semistructured discussions with 15 women across the country who were broadly representative of women who participated in RA during the period 2000 to 2010. We first used information from RAPIDS to identify the three industries with the greatest number of female participants between 2000 and 2010: social services, construction, and public administration.[41] Within each of the top three industries, we stratified the sample by race and RA completions status (completed, cancelled, and active). We randomly selected women from these groupings and contacted them using telephone numbers recorded in RAPIDS.

We spoke with five women from each of the top three industries. Within the construction industry, we spoke with two electricians, a bricklayer, a woman in commercial construction, and a woman in heavy highway construction. Within social services, we spoke with three women who participated in nursing aide apprenticeships and two who participated in apprenticeships for child care occupations. Within public administration, three women were in apprenticeships for correctional officers and jailers, one woman participated in a military truck driving apprenticeship, and one participated in a public lighting apprenticeship. Of the 15 women with whom we spoke, 9 had completed the RA program or were still enrolled, and 6 had cancelled from the program without completion. We spoke with seven women who are white and eight women who are black or Hispanic.

Selection of DOL Grantees Working with Female Apprentices. We conducted semistructured discussions with five executive directors of organizations receiving Women in Apprenticeship and Nontraditional Occupations (WANTO) grants. The purpose of the WANTO grant program, jointly administered by DOL's Women's Bureau and OA, is to increase the number of women entering and completing apprenticeship (DOL Women's Bureau 2010). Staff from the Women's Bureau selected the WANTO grantees based on their perception of grantee effectiveness in helping women pursue apprenticeships and work in the skilled trades.

The five WANTO grantees selected for the study included both current and former recipients of WANTO grants (Table A.12). All five were in operation in 2010 and four of the five grantees had been in operation for more than 20 years. All five grantees are CBOs that (1) reach out to women and educate them about the trades, (2) provide short-term pre-apprenticeship training (funding permitting), (3) connect women with apprenticeships and jobs, and (4) provide technical

[41] We analyzed industry of participation in aggregated categories (using two-digit classifications from the North American Industry Classification System, or NAICS). In the social services industry, the largest apprenticeship industries are nursing care and child day care. In the NAICS category of public administration, apprenticeships are run by public agencies in a variety of occupations, most commonly correctional officers and jailers.

assistance to apprenticeship employers. In addition, four of the grantees provided some type of pre-apprenticeship training program. All the grantees indicated that they served a similar population of women: low-income women, often single mothers, who are looking for a career instead of transitioning from one low-wage job to another. Two of the grantees also mentioned having special programs for female ex-offenders.

Table A.12. WANTO Grantees: Location, Years in Operation, and Primary Activities

Grantee	Location	Years in Operation	Primary Activities
Apprenticeship and Nontraditional Employment for Women	Renton, WA	30	Comprehensive outreach and pre-apprenticeship training to low-income women
Hard Hatted Women	Cleveland, OH	31	Outreach to women and girls, supportive services, mentoring, leadership development for women already in skilled trade
Oregon Tradeswomen	Portland, OR	6	Outreach to women and girls, job training and placement, career counseling, leadership development for women in trades
Vermont Works for Women	Winooski, VT	23	Outreach to women and girls, training in construction, highway construction, IT, and law enforcement
Wider Opportunities for Women	Washington, DC	40	Pre-apprenticeship training, case management, outreach to women and girls

Source: Grantee websites and telephone conversations with grantees.

Data Collection and Analysis. The process for conducting these discussions and analyzing the information was similar to that for the state director discussions. The discussion protocol for female apprentices covered their enrollment in the program, their experiences as apprentices, any barriers or challenges to their success, and their suggestions for ways the RA program might further foster the success of female apprentices. Our telephone discussions with the women took about 30 minutes and were conducted during April and May 2011.

The protocol for executive directors of the grantee organizations covered the technical assistance and training they provide to employers, the barriers and challenges women in apprenticeship programs face, and their suggestions for improvements to the RA program to facilitate the successful recruitment and retention of women. The telephone discussions with the directors of grantee organizations took about 90 minutes and were conducted from March to May 2010. Information obtained during these discussions was supplemented by documentation provided by the grantees, such as copies of program descriptions, brochures, technical assistance materials, and newsletters.

Preparation of the data for analysis began immediately after each discussion. First, we prepared a summary of the discussion by using the discussion protocol as a guide and filling in information under the relevant topic areas. Then, we entered key elements of the responses by topic area into spreadsheets to facilitate analysis across respondents. Looking across the responses by topic area, several themes emerged in answer to the research questions. We report the findings in Chapter VI.

J. Measurement of Net Benefits to Apprentices

In this section, we describe our approach to measuring the net benefits to apprentices. We measure the net benefits for apprenticeship participation relative to nonparticipation as well as the net benefits for apprenticeship completion relative to nonparticipation. The section begins with a description of our approach to measuring the earnings and employment gains associated with RA completion. The discussion of the earnings and employment gains associated with RA participation can be found in Section E of this appendix.

1. Measuring Earnings and Employment Gains Associated with RA Completion

We used the dosage model to calculate the average annual earnings and employment rates of RA participants who completed 100 percent of the program and obtained a certificate of completion relative to nonparticipants. We calculated the average annual earnings and employment for RA completers using the model estimates with the share of RA completed set to 100 percent and the completion indicator set to one. This analysis was added to the final report after the original contract for the project was completed and, thus, after we destroyed the restricted-use data. Therefore, we were limited to using the model estimates available from the original analyses rather than the microdata. For this reason, we were not able to calculate statistical significance associated with the estimated average earnings gains and employment rates. However, because these estimates are based on the same models as the estimates for participants and nonparticipants, we hypothesize that statistical significance would be of roughly the same order of magnitude as found for those estimates (Tables IV.1 and IV.2); namely, the estimates of gains for RA completers are likely to be strongly statistically significant in most states. Unfortunately, we did not retain the appropriate output to create estimates for RA completers in Pennsylvania. In addition, for Iowa, the estimates are based on the output we did retain, which used a different statistical software package than was used in for the Iowa results in the rest of the report.

Table A.13 presents the estimates for average annual earnings gains associated with RA completion relative to nonparticipation. Not surprisingly, for all states the estimated gains for RA completion are substantially higher than the estimated gains for RA participation. For example, in Florida, RA completion was associated with an $11,891 increase in earnings relative to nonparticipation in the short term. This earnings gain is over twice the magnitude of the earnings gain of $5,242 from the comparison between RA participation and nonparticipation. The average earnings gain across the states was $14,404 in the sixth year after enrollment $12,733 in the ninth year after enrollment.

Table A.13. Average Annual Earnings Differences for RA Completers Versus Nonparticipants (Dollars)

	Short-Term Sixth Year After Enrollment	Medium-Term Ninth Year After Enrollment
Florida	11,891	10,612
Georgia	16,448	11,742
Iowa	9,201	n.a.
Kentucky	7,897	n.a.
Maryland	28,907	30,011
Missouri	16,763	12,637
New Jersey	13,616	n.a.
Ohio	13,969	n.a.
Pennsylvania	n.a.	n.a.
Texas	15,246	15,272
All States	14,404	12,733

Source: RAPIDS and state UI wage records.

Note: The short-term period is less than the sixth year for Iowa (fourth year), Kentucky (second year), and New Jersey (fifth year). These states are not included in the averages in the bottom rows of the table. Medium-term estimates are not available for Iowa, Kentucky, New Jersey, and Ohio (indicated by n.a.) due to the limited range of the available state UI wage record data. Data for Maryland are not comparable and Maryland is not included in the averages in the bottom rows of the table. Estimates for Pennsylvania are not available. Estimates for Iowa were calculated using a different statistical software package than was used for Iowa in the rest of the report. All dollar values are adjusted for inflation to real 2000 dollars.

Table A.14 presents the estimates of employment rate gains from RA completion relative to nonparticipation. As with the earnings gains, the employment rate gains in this comparison are substantially larger than the employment gains from comparing RA participation to nonparticipation. For example, in Florida, RA completion was associated with a 20.0 percentage point increase in the employment rate relative to nonparticipation in the short term. This employment rate gain is over twice the magnitude of the employment rate gain of 9.4 percentage points from the comparison between RA participation and nonparticipation. The average employment rate gain across the states was 18.3 percentage points in the sixth year after enrollment and 18.9 percentage points in the ninth year after enrollment.

Table A.14. Average Annual Employment Differences for RA Completers Versus Nonparticipants (Percentages)

	Short-Term Sixth Year After Enrollment	Medium-Term Ninth Year After Enrollment
Florida	20.0	21.7
Georgia	22.7	15.8
Iowa	4.1	n.a.
Kentucky	8.9	n.a.
Maryland	25.2	24.7
Missouri	19.0	18.5
New Jersey	19.6	n.a.
Ohio	16.9	n.a.
Pennsylvania	n.a.	n.a.
Texas	16.5	17.1
All States	18.3	18.9

Source: RAPIDS and state UI wage records.

Note: The short-term period is less than the sixth year for Iowa (fourth year), Kentucky (second year), and New Jersey (fifth year). These states are not included in the averages in the bottom rows of the table. Medium-term estimates are not available for Iowa, Kentucky, New Jersey, and Ohio (indicated by n.a.) due to the limited range of the available state UI wage record data. Data for Maryland are not comparable and Maryland is not included in the averages in the bottom rows of the table. Estimates for Pennsylvania are not available. Estimates for Iowa were calculated using a different statistical software package than was used for Iowa in the rest of the report. All dollar values are adjusted for inflation to real 2000 dollars.

2. Measuring Net Benefits to Apprentices of RA Participation

The major benefit to RA participation is the increased compensation through gains in earnings and fringe benefits over the career. For net benefits, the compensation gains are reduced to reflect payment of taxes as well as lower receipt of UI compensation and public assistance. We estimated the net benefits to apprenticeship participants following the approach described in Section F of this appendix regarding the calculation of earnings gains over the career adjusted for fringe benefits, taxes, receipt of UI compensation and public assistance, inflation and future discounting. We include union dues and adjust taxes accordingly (under the assumption that taxes are not paid on union dues). Most of the upfront financial costs of the RA program, such as paying for training courses, are covered by employers. We include $500 in upfront costs as an estimate of what RA participants may pay for books or tools. For many training programs, the costs for participants include lower earnings during the training period. However, we found average earnings gains for people participating in RA for a short period without completing the program. The estimated earnings gains during training are included in our estimates of the total earnings gains.

3. Measuring Net Benefits to Apprentices of RA Completion

We measured the net benefits to RA completion following the same approach as we used for the net benefits to RA participation. However, because the analysis was completed using available model estimates rather than microdata, there were some necessary deviations to our approach:

- The analysis was based only on the estimated averages for states with medium-term estimates: Florida, Georgia, Missouri, and Texas.

- We calculated the average earnings gains for the sixth year and ninth year after enrollment and used these calculations to create estimates for all other years. We estimated gains for the first year through the fifth year by using our estimates for RA participants. We calculated the ratio of gains in each early year relative to the sixth year for RA participants and applied those ratios to RA completers for the first year through the fifth year.
- For earnings calculations in later years, we first estimated an annual decay rate of 4.0 percent based on the calculations for the sixth year and the ninth year. We applied that rate to impute values for the seventh year and eighth year and to estimate values for the tenth year and beyond.
- Finally, for tax rates, we used the weighted average across the four states. Similarly, for UI compensation and receipt of public assistance, we used the weighted average across the four states.

APPENDIX B

ADDITIONAL TABLES

In this appendix, we provide additional tables to augment the tables and information provided in the text.

Table B.1. Number of New Apprentices by Demographic Characteristic

	All	Men	Women	OA	SAA
2000 Enrollment Cohort					
Age					
16 to 20 years old	6,475	6,252	223	3,116	3,359
21 to 39 years old	24,864	23,329	1,535	11,310	13,554
At least 40 years old	4,270	3,834	436	1,644	2,626
Gender					
Male	33,415	33,415	0	15,398	18,017
Female	2,194	0	2,194	672	1,522
Race/Ethnicity					
White	26,917	25,433	1,484	11,487	15,430
Black	4,488	3,991	497	1,876	2,612
Hispanic	3,699	3,532	167	2,457	1,242
Other race	432	391	41	223	209
Education					
Less than high school	251	242	9	156	95
Some high school	3,446	3,300	146	1,212	2,234
High school graduate	31,184	29,188	1,996	14,635	16,549
Veteran	2,490	2,388	102	1,704	786
Prisoner at Enrollment	427	353	74	269	158
2010 Enrollment Cohort					
Age					
16 to 20 years old	2,861	2,714	147	1,476	1,385
21 to 39 years old	14,817	13,712	1,105	8,303	6,514
At least 40 years old	3,748	3,149	599	2,187	1,561
Gender					
Male	19,575	19,575	0	11,009	8,566
Female	1,851	0	1,851	957	894
Race/Ethnicity					
White	14,059	13,038	1,021	7,016	7,043
Black	2,986	2,571	415	1,701	1,285
Hispanic	3,460	3,146	314	2,628	832
Other race	294	242	52	175	119
Education					
Less than high school	101	95	6	72	29
Some high school	1,273	1,195	78	675	598
High school graduate	19,608	17,865	1,743	11,025	8,583
Veteran	1,962	1,905	57	960	1,002
Prisoner at Enrollment	2,351	1,815	536	1,520	831

Source: RAPIDS.

Note: The sample consisted of apprentices living in Florida, Georgia, Iowa, Kentucky, Missouri, New Jersey, Ohio, Pennsylvania, and Texas. The calculations were based on apprentices for whom there were no missing data for the specified characteristic.

Table B.2. Number of New Apprentices by Occupation

	All	Men	Women	OA	SAA
2000 Enrollment Cohort					
Occupation					
Electricians	9,180	8,838	342	4,449	4,731
Plumbers, pipefitters, and steamfitters	4,124	4,024	100	1,899	2,225
Carpenters	3,998	3,866	132	2,319	1,679
Heavy and tractor-trailer truck drivers	0	0	0	0	0
Sheet metal workers	1,304	1,274	30	625	679
Electrical power-line installers and repairers	626	623	3	268	358
Correctional officers and jailers	1,047	851	196	55	992
Child care workers	485	4	481	11	474
Home appliance repairers	4	4	0	4	0
Nursing aides, orderlies, and attendants	10	2	8	5	5
All other occupations	14,811	13,913	898	6,430	8,381
2010 Enrollment Cohort					
Occupation					
Electricians	5,005	4,920	85	3,121	1,884
Plumbers, pipefitters, and steamfitters	2,493	2,463	30	1,557	936
Carpenters	1,506	1,452	54	757	749
Heavy and tractor-trailer truck drivers	1,225	1,161	64	930	295
Sheet metal workers	755	749	6	452	303
Electrical power-line installers and repairers	749	747	2	415	334
Correctional officers and jailers	655	570	85	123	532
Child care workers	633	8	625	175	458
Home appliance repairers	126	39	87	103	23
Nursing aides, orderlies, and attendants	120	3	117	86	34
All other occupations	8,158	7,462	696	4,246	3,912

Source: RAPIDS.

Note: The sample consisted of apprentices living in Florida, Georgia, Iowa, Kentucky, Missouri, New Jersey, Ohio, Pennsylvania, and Texas. The calculations were based on apprentices for whom there were no missing data for the specified characteristic.

Table B.3. Demographic Characteristics, Occupation, and Program Requirements of the 2010 Florida Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women	
Age					***
16 to 20 years old	12.5	12.6	12.5	0.1	
21 to 39 years old	67.6	69.3	60.1	9.2	
At least 40 years old	19.8	18.1	27.4	-9.3	
Average age (years)	31.3	30.8	33.3	-2.5	***
Gender					
Male	81.7	100.0	0.0	100.0	
Female	18.3	0.0	100.0	-100.0	
Race/Ethnicity					
White	60.1	60.4	58.7	1.7	
Black	15.9	15.2	18.9	-3.7	
Hispanic	21.8	22.2	19.9	2.3	
Other race	2.2	2.2	2.5	-0.3	
Education					***
Less than high school	0.7	0.8	0.2	0.7	
Some high school	12.7	14.3	5.4	8.9	
High school graduate	86.6	84.8	94.4	-9.5	
Veteran	6.0	7.0	1.5	5.5	***
Prisoner at enrollment	2.7	2.0	5.6	-3.6	
Occupation					***
Electricians	23.7	28.5	2.4	26.0	
Plumbers, pipefitters, and steamfitters	14.4	17.4	0.9	16.5	
Carpenters	3.1	3.8	0.4	3.4	
Heavy and tractor-trailer truck drivers	1.0	1.2	0.0	1.2	
Sheet metal workers	4.5	5.5	0.0	5.5	
Electrical power-line installers and repairers	3.8	4.6	0.0	4.6	
Correctional officers and jailers	0.0	0.0	0.0	0.0	
Child care workers	15.4	0.3	83.2	-83.0	
Home appliance repairers	0.0	0.0	0.0	0.0	
Nursing aides, orderlies, and attendants	0.0	0.0	0.0	0.0	
All other occupations	34.1	38.8	13.0	25.8	
Average OJT Requirement (hours)	7,018	7,620	4,334	3,285	***
Average RTI Requirement (hours)	30	23	65	-42	***
Sample Size	**2,933**	**2,396**	**537**		

Source: RAPIDS.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. OJT is on-the-job training. RTI is related technical instruction.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

Table B.4. Demographic Characteristics, Occupation, and Program Requirements of the 2010 Georgia Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women	
Age					**
16 to 20 years old	16.7	17.1	8.5	8.7	
21 to 39 years old	68.6	68.8	66.2	2.6	
At least 40 years old	14.7	14.1	25.4	-11.2	
Average age (years)	29.8	29.7	32.6	-3.0	***
Gender					
Male	94.7	100.0	0.0	100.0	
Female	5.3	0.0	100.0	-100.0	
Race/Ethnicity					***
White	69.8	70.9	49.3	21.6	
Black	24.5	23.0	50.7	-27.7	
Hispanic	4.8	5.1	0.0	5.1	
Other race	0.9	1.0	0.0	1.0	
Education					
Less than high school	0.2	0.2	0.0	0.2	
Some high school	4.1	4.2	2.9	1.3	
High school graduate	95.7	95.6	97.1	-1.5	
Veteran	10.4	10.8	2.9	8.0	**
Prisoner at enrollment	1.0	1.0	1.4	-0.4	
Occupation					***
Electricians	40.6	41.7	21.1	20.6	
Plumbers, pipefitters, and steamfitters	16.8	17.4	5.6	11.8	
Carpenters	9.7	10.1	2.8	7.3	
Heavy and tractor-trailer truck drivers	7.2	7.5	1.4	6.1	
Sheet metal workers	1.7	1.8	0.0	1.8	
Electrical power-line installers and repairers	1.5	1.6	0.0	1.6	
Correctional officers and jailers	0.0	0.0	0.0	0.0	
Child care workers	0.0	0.0	0.0	0.0	
Home appliance repairers	1.2	0.2	19.7	-19.6	
Nursing aides, orderlies, and attendants	1.1	0.0	21.1	-21.1	
All other occupations	20.2	19.7	28.2	-8.5	
Average OJT Requirement (hours)	7,511	7,669	4,677	2,993	***
Average RTI Requirement (hours)	48	47	59	-12	
Sample Size	**1,339**	**1,268**	**71**		

Source: RAPIDS.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. OJT is on-the-job training. RTI is related technical instruction.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

Table B.5. Demographic Characteristics, Occupation, and Program Requirements of the 2010 Iowa Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women	
Age					***
16 to 20 years old	15.9	16.0	10.5	5.5	
21 to 39 years old	72.0	72.5	47.4	25.2	
At least 40 years old	12.1	11.4	42.1	-30.7	
Average age (years)	29.1	29.0	35.5	-6.4	***
Gender					
Male	97.8	100.0	0.0	100.0	
Female	2.2	0.0	100.0	-100.0	
Race/Ethnicity					
White	92.5	92.3	100.0	-7.7	
Black	2.3	2.3	0.0	2.3	
Hispanic	4.1	4.2	0.0	4.2	
Other race	1.1	1.1	0.0	1.1	
Education					
Less than high school	0.0	0.0	0.0	0.0	
Some high school	9.9	10.0	5.3	4.7	
High school graduate	90.1	90.0	94.7	-4.7	
Veteran	7.6	7.6	5.3	2.3	
Prisoner at enrollment	0.3	0.1	10.5	-10.4	
Occupation					***
Electricians	32.9	33.3	15.8	17.5	
Plumbers, pipefitters, and steamfitters	15.2	15.2	15.8	-0.6	
Carpenters	2.7	2.8	0.0	2.8	
Heavy and tractor-trailer truck drivers	2.2	2.2	0.0	2.2	
Sheet metal workers	5.7	5.8	0.0	5.8	
Electrical power-line installers and repairers	5.6	5.7	0.0	5.7	
Correctional officers and jailers	0.0	0.0	0.0	0.0	
Child care workers	0.0	0.0	0.0	0.0	
Home appliance repairers	1.4	1.3	5.3	-4.0	
Nursing aides, orderlies, and attendants	0.2	0.0	10.5	-10.5	
All other occupations	34.1	33.6	52.6	-19.0	
Average OJT Requirement (hours)	7,425	7,457	5,989	1,468	***
Average RTI Requirement (hours)	47	47	11	37	
Sample Size	**875**	**856**	**19**		

Source: RAPIDS.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. OJT is on-the-job training. RTI is related technical instruction.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

Table B.6. Demographic Characteristics, Occupation, and Program Requirements of the 2010 Kentucky Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women	
Age					***
16 to 20 years old	12.0	12.5	2.0	10.5	
21 to 39 years old	70.0	71.1	52.0	19.1	
At least 40 years old	18.0	16.4	46.0	-29.6	
Average age (years)	31.0	30.5	39.1	-8.6	***
Gender					
Male	94.4	100.0	0.0	100.0	
Female	5.6	0.0	100.0	-100.0	
Race/Ethnicity					***
White	81.6	81.6	81.6	-0.0	
Black	15.5	15.7	12.2	3.4	
Hispanic	2.2	2.3	0.0	2.3	
Other race	0.7	0.4	6.1	-5.8	
Education					
Less than high school	0.0	0.0	0.0	0.0	
Some high school	2.3	2.4	0.0	2.4	
High school graduate	97.7	97.6	100.0	-2.4	
Veteran	8.0	8.2	4.0	4.2	
Prisoner at enrollment	22.5	20.0	66.0	-46.0	
Occupation					***
Electricians	17.2	18.0	4.0	14.0	
Plumbers, pipefitters, and steamfitters	7.6	7.6	6.0	1.6	
Carpenters	9.7	10.2	2.0	8.2	
Heavy and tractor-trailer truck drivers	7.0	7.4	0.0	7.4	
Sheet metal workers	1.9	2.0	0.0	2.0	
Electrical power-line installers and repairers	3.2	3.3	0.0	3.3	
Correctional officers and jailers	0.0	0.0	0.0	0.0	
Child care workers	0.0	0.0	0.0	0.0	
Home appliance repairers	2.6	2.7	0.0	2.7	
Nursing aides, orderlies, and attendants	0.0	0.0	0.0	0.0	
All other occupations	50.8	48.6	88.0	-39.4	
Average OJT Requirement (hours)	6,321	6,390	5,170	1,220	***
Average RTI Requirement (hours)	64	68	14	53	
Sample Size	**887**	**837**	**50**		

Source: RAPIDS.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. OJT is on-the-job training. RTI is related technical instruction.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

Table B.7. Demographic Characteristics, Occupation, and Program Requirements of the 2010 Maryland Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women	
Age					
16 to 20 years old	2.2	2.3	0.0	2.3	
21 to 39 years old	65.9	66.1	60.0	6.1	
At least 40 years old	31.9	31.6	40.0	-8.4	
Average age (years)	36.9	36.8	43.3	-6.6	
Gender					
Male	97.3	100.0	0.0	100.0	
Female	2.7	0.0	100.0	-100.0	
Race/Ethnicity					
White	38.8	39.7	0.0	39.7	
Black	42.1	40.8	100.0	-59.2	
Hispanic	16.3	16.7	0.0	16.7	
Other race	2.8	2.9	0.0	2.9	
Education					
Less than high school	1.7	1.7	0.0	1.7	
Some high school	11.0	11.4	0.0	11.4	
High school graduate	87.3	86.9	100.0	-13.1	
Veteran	12.1	12.4	0.0	12.4	
Prisoner at enrollment					
Occupation					
Electricians					
Plumbers, pipefitters, and steamfitters					
Carpenters					
Heavy and tractor-trailer truck drivers					
Sheet metal workers					
Electrical power-line installers and repairers					
Correctional officers and jailers					
Child care workers					
Home appliance repairers					
Nursing aides, orderlies, and attendants					
All other occupations					
Average OJT Requirement (hours)	7,312	7,349	6,000	1,349	***
Average RTI Requirement (hours)					
Sample Size[a]	**182**	**177**	**5**		

Source: State administrative records for RA.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. OJT is on-the-job training. Information on prisoner status at the time of enrollment and related technical instruction (RTI) was not available. We did not analyze the occupation codes in the Maryland data.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

[a]The Maryland RA administrative records included 12,354 observations with a start date in 2010. Of those, there were only 182 observations with unique SSNs. The pattern is similar for other years. For example, in 2009, there were 19,056 observations and 227 unique SSNs.

Table B.8. Demographic Characteristics, Occupation, and Program Requirements of the 2010 Missouri Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women	
Age					***
16 to 20 years old	10.6	12.4	0.7	11.7	
21 to 39 years old	68.7	69.2	66.3	2.9	
At least 40 years old	20.6	18.5	33.0	-14.5	
Average age (years)	31.8	31.1	36.0	-4.9	***
Gender					
Male	85.2	100.0	0.0	100.0	
Female	14.8	0.0	100.0	-100.0	
Race/Ethnicity					**
White	76.3	76.8	73.5	3.3	
Black	18.5	18.3	20.1	-1.8	
Hispanic	3.4	3.5	2.8	0.6	
Other race	1.8	1.4	3.5	-2.1	
Education					***
Less than high school	0.3	0.4	0.0	0.4	
Some high school	3.9	4.4	1.2	3.3	
High school graduate	95.7	95.2	98.8	-3.7	
Veteran	7.2	8.1	2.3	5.8	***
Prisoner at enrollment	39.2	30.6	89.1	-58.5	***
Occupation					
Electricians	12.3	14.3	1.2	13.1	
Plumbers, pipefitters, and steamfitters	5.4	6.3	0.2	6.1	
Carpenters	11.7	13.5	1.2	12.3	
Heavy and tractor-trailer truck drivers	2.6	3.0	0.0	3.0	
Sheet metal workers	2.0	2.3	0.2	2.1	
Electrical power-line installers and repairers	1.1	1.3	0.2	1.1	
Correctional officers and jailers	0.0	0.0	0.0	0.0	
Child care workers	0.0	0.0	0.0	0.0	
Home appliance repairers	2.6	0.1	16.7	-16.6	
Nursing aides, orderlies, and attendants	2.0	0.0	13.3	-13.3	
All other occupations	60.4	59.2	67.0	-7.8	
Average OJT Requirement (hours)	5,387	5,863	2,635	3,228	***
Average RTI Requirement (hours)	51	56	20	37	*
Sample Size[a]	**2,914**	**2,484**	**430**		

Source: RAPIDS.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. OJT is on-the-job training. RTI is related technical instruction.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

Table B.9. Demographic Characteristics, Occupation, and Program Requirements of the 2010 New Jersey Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women	
Age					***
16 to 20 years old	10.9	11.9	4.1	7.8	
21 to 39 years old	69.0	72.3	46.6	25.7	
At least 40 years old	20.1	15.8	49.3	-33.5	
Average age (years)	31.5	30.4	39.0	-8.7	***
Gender					
Male	87.2	100.0	0.0	100.0	
Female	12.8	0.0	100.0	-100.0	
Race/Ethnicity					***
White	63.6	70.4	17.5	52.9	
Black	18.2	16.8	27.6	-10.9	
Hispanic	16.6	11.4	51.6	-40.2	
Other race	1.6	1.4	3.2	-1.9	
Education					
Less than high school	0.0	0.0	0.0	0.0	
Some high school	1.3	1.2	2.3	-1.1	
High school graduate	98.7	98.8	97.7	1.1	
Veteran	5.7	6.3	1.8	4.5	***
Prisoner at enrollment	13.7	15.4	2.3	13.1	
Occupation					***
Electricians	10.5	11.9	0.9	11.0	
Plumbers, pipefitters, and steamfitters	19.1	21.6	2.3	19.3	
Carpenters	8.9	9.7	3.6	6.1	
Heavy and tractor-trailer truck drivers	0.3	0.3	0.0	0.3	
Sheet metal workers	1.3	1.5	0.0	1.5	
Electrical power-line installers and repairers	2.9	3.3	0.0	3.3	
Correctional officers and jailers	7.1	7.2	6.8	0.4	
Child care workers	10.2	0.1	78.3	-78.1	
Home appliance repairers	0.0	0.0	0.0	0.0	
Nursing aides, orderlies, and attendants	0.1	0.1	0.0	0.1	
All other occupations	39.6	44.2	8.1	36.1	
Average OJT Requirement (hours)	6,520	6,859	4,214	2,645	***
Average RTI Requirement (hours)	187	174	280	-106	***
Sample Size	**1,721**	**1,500**	**221**		

Source: RAPIDS.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. OJT is on-the-job training. RTI is related technical instruction.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

Table B.10. Demographic Characteristics, Occupation, and Program Requirements of the 2010 Ohio Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women	
Age					***
16 to 20 years old	15.2	15.3	12.8	2.5	
21 to 39 years old	69.7	70.4	58.3	12.0	
At least 40 years old	15.1	14.3	28.8	-14.6	
Average age (years)	30.1	29.9	33.2	-3.3	***
Gender					
Male	94.5	100.0	0.0	100.0	
Female	5.5	0.0	100.0	-100.0	
Race/Ethnicity					***
White	81.9	83.2	58.9	24.3	
Black	14.1	12.7	37.7	-25.0	
Hispanic	3.1	3.2	2.0	1.2	
Other race	0.9	0.9	1.3	-0.4	
Education					***
Less than high school	0.3	0.2	1.4	-1.2	
Some high school	4.5	4.1	12.3	-8.3	
High school graduate	95.2	95.7	86.3	9.4	
Veteran	7.6	8.0	0.6	7.3	***
Prisoner at enrollment	16.2	15.6	26.9	-11.3	
Occupation					***
Electricians	20.2	21.0	5.1	15.9	
Plumbers, pipefitters, and steamfitters	7.7	8.1	0.6	7.5	
Carpenters	10.4	10.6	7.7	2.9	
Heavy and tractor-trailer truck drivers	5.5	5.7	1.3	4.4	
Sheet metal workers	3.2	3.4	0.0	3.4	
Electrical power-line installers and repairers	1.6	1.7	0.0	1.7	
Correctional officers and jailers	0.0	0.0	0.0	0.0	
Child care workers	0.1	0.0	2.6	-2.6	
Home appliance repairers	0.0	0.0	0.0	0.0	
Nursing aides, orderlies, and attendants	1.1	0.1	18.6	-18.5	
All other occupations	50.2	49.4	64.1	-14.7	
Average OJT Requirement (hours)	6,780	6,890	4,891	1,999	***
Average RTI Requirement (hours)	47	48	25	23	*
Sample Size	**2,822**	**2,666**	**156**		

Source: RAPIDS.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. OJT is on-the-job training. RTI is related technical instruction.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

Table B.11. Demographic Characteristics, Occupation, and Program Requirements of the 2010 Pennsylvania Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women	
Age					
16 to 20 years old	17.1	17.0	19.2	-2.2	
21 to 39 years old	68.9	69.3	62.9	6.3	
At least 40 years old	14.0	13.8	17.9	-4.1	
Average age (years)	29.4	29.3	30.3	-1.0	
Gender					
Male	94.6	100.0	0.0	100.0	
Female	5.4	0.0	100.0	-100.0	
Race/Ethnicity					***
White	84.6	85.8	62.9	22.9	
Black	11.0	9.9	29.8	-19.9	
Hispanic	3.6	3.6	4.0	-0.4	
Other race	0.9	0.7	3.3	-2.6	
Education					
Less than high school	0.0	0.0	0.0	0.0	
Some high school	3.2	3.2	3.3	-0.2	
High school graduate	96.8	96.8	96.7	0.1	
Veteran	19.2	19.7	11.3	8.4	**
Prisoner at enrollment	3.4	3.6	0.0	3.6	
Occupation					***
Electricians	16.6	16.9	10.6	6.3	
Plumbers, pipefitters, and steamfitters	8.1	8.5	0.7	7.9	
Carpenters	9.8	9.9	8.6	1.3	
Heavy and tractor-trailer truck drivers	1.8	1.9	0.0	1.9	
Sheet metal workers	2.3	2.4	0.7	1.7	
Electrical power-line installers and repairers	5.4	5.6	0.7	5.0	
Correctional officers and jailers	18.9	17.3	46.4	-29.0	
Child care workers	0.0	0.0	0.7	-0.7	
Home appliance repairers	0.0	0.0	0.0	0.0	
Nursing aides, orderlies, and attendants	0.1	0.0	2.0	-2.0	
All other occupations	37.0	37.4	29.8	7.6	
Average OJT Requirement (hours)	6,836	6,915	5,430	1,486	***
Average RTI Requirement (hours)	14	14	9	5	
Sample Size	**2,818**	**2,667**	**151**		

Source: RAPIDS.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. OJT is on-the-job training. RTI is related technical instruction.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

Table B.12. Demographic Characteristics, Occupation, and Program Requirements of the 2010 Texas Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women	
Age					***
16 to 20 years old	12.1	12.4	4.6	7.8	
21 to 39 years old	69.6	70.1	58.3	11.8	
At least 40 years old	18.3	17.5	37.0	-19.6	
Average age (years)	31.0	30.7	36.9	-6.2	***
Gender					
Male	95.8	100.0	0.0	100.0	
Female	4.2	0.0	100.0	-100.0	
Race/Ethnicity					**
White	43.2	43.1	44.3	-1.1	
Black	10.9	10.8	13.9	-3.2	
Hispanic	44.4	44.6	38.3	6.3	
Other race	1.6	1.5	3.5	-2.0	
Education					
Less than high school	1.2	1.2	1.4	-0.2	
Some high school	8.0	8.0	6.1	1.9	
High school graduate	90.8	90.8	92.5	-1.7	
Veteran	8.7	8.9	5.6	3.3	*
Prisoner at enrollment	2.4	1.7	18.5	-16.8	
Occupation					***
Electricians	34.2	35.3	9.7	25.5	
Plumbers, pipefitters, and steamfitters	13.9	14.4	3.2	11.2	
Carpenters	2.1	2.0	5.1	-3.1	
Heavy and tractor-trailer truck drivers	14.4	13.8	28.2	-14.5	
Sheet metal workers	5.8	6.0	1.9	4.1	
Electrical power-line installers and repairers	5.1	5.4	0.0	5.4	
Correctional officers and jailers	0.0	0.0	0.0	0.0	
Child care workers	0.0	0.0	0.0	0.0	
Home appliance repairers	0.0	0.0	0.0	0.0	
Nursing aides, orderlies, and attendants	0.2	0.0	5.1	-5.1	
All other occupations	24.2	23.2	46.8	-23.5	
Average OJT Requirement (hours)	7,126	7,226	4,861	2,365	***
Average RTI Requirement (hours)	19	19	25	-7	
Sample Size	**5,117**	**4,901**	**216**		

Source: RAPIDS.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. OJT is on-the-job training. RTI is related technical instruction.

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

Table B.13. Outcomes and Time in RA of the 2000 Florida Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women	
Outcome					***
Completed	33.4	31.6	46.1	-14.5	
Cancelled	65.9	67.6	53.4	14.3	
Active	0.8	0.8	0.6	0.3	
Average time in RA (hours)					
Completers	6,719	7,302	3,905	3,397	
Noncompleters	2,838	2,921	2,094	827	
Percent completed					***
0 to 33 percent	40.0	40.9	33.8	7.1	
34 to 66 percent	14.7	15.1	11.4	3.7	
67 to 99 percent	6.0	6.3	4.1	2.2	
100 percent	39.3	37.6	50.6	-13.0	
Average percent completed	57.4	56.3	64.9	-8.6	***
Sample Size	**5,848**	**5,121**	**727**		

Source: RAPIDS.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. For noncompleters, the share of the program completed is based on the following calculation: the calendar time (measured as 40 hours per week) between enrollment and program cancellation, divided by the hours of on-the-job training required by the program (with a cap of 100 percent). The share with 100 percent completed exceeds the share of completers because some participants had active enrollments for long enough to complete the required hours, but did not complete the program (e.g., they did not earn a certificate of completion).

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

Table B.14. Outcomes and Time in RA of the 2000 Georgia Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women	
Outcome					***
Completed	39.0	40.2	21.2	19.0	
Cancelled	57.4	56.0	78.8	-22.8	
Active	3.6	3.9	0.0	3.9	
Average time in RA (hours)					
Completers	8,320	8,350	7,448	903	
Noncompleters	4,381	4,346	4,767	-422	
Percent completed					*
0 to 33 percent	30.4	29.8	38.8	-9.0	
34 to 66 percent	11.0	11.2	8.2	2.9	
67 to 99 percent	6.3	6.0	10.6	-4.6	
100 percent	52.3	53.0	42.4	10.6	
Average percent completed	67.6	68.1	60.9	7.2	*
Sample Size	**1,382**	**1,297**	**85**		

Source: RAPIDS.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. For noncompleters, the share of the program completed is based on the following calculation: the calendar time (measured as 40 hours per week) between enrollment and program cancellation, divided by the hours of on-the-job training required by the program (with a cap of 100 percent). The share with 100 percent completed exceeds the share of completers because some participants had active enrollments for long enough to complete the required hours, but did not complete the program (e.g., they did not earn a certificate of completion).

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

Table B.15. Outcomes and Time in RA of the 2000 Iowa Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women
Outcome				
Completed	57.9	58.0	57.1	0.8
Cancelled	41.8	41.7	42.9	-1.1
Active	0.3	0.3	0.0	0.3
Average time in RA (hours)				
Completers	7,345	7,358	6,724	634
Noncompleters	4,199	4,219	3,320	899
Percent completed				
0 to 33 percent	19.6	19.8	14.3	5.5
34 to 66 percent	7.5	7.3	17.9	-10.6
67 to 99 percent	7.3	7.3	7.1	0.1
100 percent	65.6	65.7	60.7	5.0
Average percent completed	78.0	78.0	77.3	0.7
Sample Size	**1,334**	**1,306**	**28**	

Source: RAPIDS.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. For noncompleters, the share of the program completed is based on the following calculation: the calendar time (measured as 40 hours per week) between enrollment and program cancellation, divided by the hours of on-the-job training required by the program (with a cap of 100 percent). The share with 100 percent completed exceeds the share of completers because some participants had active enrollments for long enough to complete the required hours, but did not complete the program (e.g., they did not earn a certificate of completion).

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

Table B.16. Outcomes and Time in RA of the 2000 Kentucky Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women
Outcome				
Completed	52.1	52.6	44.4	8.1
Cancelled	44.8	44.5	50.0	-5.5
Active	3.1	2.9	5.6	-2.6
Average time in RA (hours)				
Completers	7,978	8,015	7,229	786
Noncompleters	3,730	3,683	4,450	-767
Percent completed				
0 to 33 percent	21.0	21.1	20.4	0.7
34 to 66 percent	11.5	11.5	11.1	0.4
67 to 99 percent	5.3	5.2	7.4	-2.2
100 percent	62.2	62.2	61.1	1.1
Average percent completed	75.1	75.0	76.6	-1.5
Sample Size	**975**	**921**	**54**	

Source: RAPIDS.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. For noncompleters, the share of the program completed is based on the following calculation: the calendar time (measured as 40 hours per week) between enrollment and program cancellation, divided by the hours of on-the-job training required by the program (with a cap of 100 percent). The share with 100 percent completed exceeds the share of completers because some participants had active enrollments for long enough to complete the required hours, but did not complete the program (e.g., they did not earn a certificate of completion).

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

Table B.17. Outcomes and Time in RA of the 2000 Maryland Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women
Outcome				
Completed	37.8	37.2	50.8	-13.6
Cancelled	57.7	58.4	44.5	13.8
Active	4.5	4.5	4.7	-0.2
Average time in RA (hours)[a]				
Completers	2,696	2,692	2,788	-97
Noncompleters	2,483	2,524	1,690	834
Percent completed				
0 to 33 percent	25.3	26.0	11.7	14.3
34 to 66 percent	11.5	11.1	19.5	-8.4
67 to 99 percent	6.7	6.8	4.7	2.2
100 percent	56.4	56.0	64.1	-8.1
Average percent completed	71.9	71.5	79.6	-8.1
Sample Size	**2,655**	**2,527**	**128**	

Source: State administrative records for RA.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. For noncompleters, the share of the program completed is based on the following calculation: the calendar time (measured as 40 hours per week) between enrollment and program cancellation, divided by the hours of on-the-job training required by the program (with a cap of 100 percent). The share with 100 percent completed exceeds the share of completers because some participants had active enrollments for long enough to complete the required hours, but did not complete the program (e.g., they did not earn a certificate of completion).

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

[a] The hours estimates for Maryland are unusually low. In the analysis sample for Maryland (made up of apprentices for whom UI wage records were identified), the average hours for completers and noncompleters was 4,821. The results suggest a problem with this variable in the sample of all apprentices in the 2000 enrollment cohort.

Table B.18. Outcomes and Time in RA of the 2000 Missouri Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women	
Outcome					
Completed	44.1	44.2	41.9	2.4	
Cancelled	55.2	55.1	58.1	-3.1	
Active	0.7	0.7	0.0	0.7	
Average time in RA (hours)					
Completers	7,414	7,403	7,702	-299	
Noncompleters	4,060	4,041	4,490	-449	
Percent completed					***
0 to 33 percent	23.1	23.2	19.2	4.0	
34 to 66 percent	16.9	17.2	9.3	7.9	
67 to 99 percent	7.2	6.9	15.1	-8.2	
100 percent	52.9	52.7	56.4	-3.7	
Average percent completed	71.1	70.9	76.0	-5.2	*
Sample Size	**4,478**	**4,306**	**172**		

Source: RAPIDS.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. For noncompleters, the share of the program completed is based on the following calculation: the calendar time (measured as 40 hours per week) between enrollment and program cancellation, divided by the hours of on-the-job training required by the program (with a cap of 100 percent). The share with 100 percent completed exceeds the share of completers because some participants had active enrollments for long enough to complete the required hours, but did not complete the program (e.g., they did not earn a certificate of completion).

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

Table B.19. Outcomes and Time in RA of the 2000 New Jersey Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women	
Outcome					**
Completed	58.3	58.8	48.6	10.3	
Cancelled	40.2	39.8	47.8	-8.0	
Active	1.5	1.4	3.6	-2.2	
Average time in RA (hours)					
Completers	8,031	8,071	7,015	1,056	
Noncompleters	5,109	5,090	5,431	-341	
Percent completed					
0 to 33 percent	13.2	13.2	13.8	-0.6	
34 to 66 percent	8.3	8.5	5.1	3.4	
67 to 99 percent	6.7	6.6	7.2	-0.6	
100 percent	71.8	71.7	73.9	-2.2	
Average percent completed	83.7	83.7	84.7	-1.0	
Sample Size	**2,983**	**2,845**	**138**		

Source: RAPIDS.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. For noncompleters, the share of the program completed is based on the following calculation: the calendar time (measured as 40 hours per week) between enrollment and program cancellation, divided by the hours of on-the-job training required by the program (with a cap of 100 percent). The share with 100 percent completed exceeds the share of completers because some participants had active enrollments for long enough to complete the required hours, but did not complete the program (e.g., they did not earn a certificate of completion).

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

Table B.20. Outcomes and Time in RA of the 2000 Ohio Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women	
Outcome					***
Completed	50.6	51.4	37.2	14.3	
Cancelled	48.5	47.7	62.1	-14.4	
Active	0.9	0.9	0.8	0.2	
Average time in RA (hours)					
Completers	7,196	7,184	7,473	-289	
Noncompleters	4,922	4,930	4,821	109	
Percent completed					**
0 to 33 percent	18.3	17.9	23.9	-6.0	
34 to 66 percent	9.9	9.9	9.9	-0.0	
67 to 99 percent	6.5	6.4	7.6	-1.2	
100 percent	65.4	65.8	58.5	7.3	
Average percent completed	78.9	79.1	74.0	5.2	***
Sample Size	**6,957**	**6,564**	**393**		

Source: RAPIDS.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. For noncompleters, the share of the program completed is based on the following calculation: the calendar time (measured as 40 hours per week) between enrollment and program cancellation, divided by the hours of on-the-job training required by the program (with a cap of 100 percent). The share with 100 percent completed exceeds the share of completers because some participants had active enrollments for long enough to complete the required hours, but did not complete the program (e.g., they did not earn a certificate of completion).

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

Table B.21. Outcomes and Time in RA of the 2000 Pennsylvania Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women
Outcome				
Completed	61.0	60.7	64.7	-3.9
Cancelled	38.3	38.6	34.8	3.8
Active	0.7	0.7	0.6	0.1
Average time in RA (hours)				
Completers	6,802	6,891	5,505	1,386
Noncompleters	4,322	4,392	3,118	1,274
Percent completed				
0 to 33 percent	14.0	13.9	15.2	-1.4
34 to 66 percent	10.7	10.7	10.6	0.0
67 to 99 percent	5.2	5.3	3.7	1.6
100 percent	70.2	70.2	70.4	-0.2
Average percent completed	82.0	82.1	81.0	1.0
Sample Size	**5,759**	**5,411**	**348**	

Source: RAPIDS.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. For noncompleters, the share of the program completed is based on the following calculation: the calendar time (measured as 40 hours per week) between enrollment and program cancellation, divided by the hours of on-the-job training required by the program (with a cap of 100 percent). The share with 100 percent completed exceeds the share of completers because some participants had active enrollments for long enough to complete the required hours, but did not complete the program (e.g., they did not earn a certificate of completion).

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

Table B.22. Outcomes and Time in RA of the 2000 Texas Cohort (Percentages, Unless Otherwise Noted)

	All	Men	Women	Men - Women
Outcome				
Completed	27.0	27.0	27.7	-0.7
Cancelled	72.6	72.6	72.3	0.3
Active	0.3	0.4	0.0	0.4
Average time in RA (hours)				
Completers	7,546	7,684	4,499	3,185
Noncompleters	2,760	2,759	2,778	-18
Percent completed				
0 to 33 percent	47.0	47.1	44.2	2.9
34 to 66 percent	14.5	14.6	12.9	1.7
67 to 99 percent	6.2	6.1	8.4	-2.3
100 percent	32.3	32.2	34.5	-2.3
Average percent completed	51.1	51.0	53.7	-2.7
Sample Size	**5,893**	**5,644**	**249**	

Source: RAPIDS.

Note: The calculations were based on apprentices for whom there were no missing data for the specified characteristic. For noncompleters, the share of the program completed is based on the following calculation: the calendar time (measured as 40 hours per week) between enrollment and program cancellation, divided by the hours of on-the-job training required by the program (with a cap of 100 percent). The share with 100 percent completed exceeds the share of completers because some participants had active enrollments for long enough to complete the required hours, but did not complete the program (e.g., they did not earn a certificate of completion).

*/**/*** Estimate is significantly different from zero at the .10/.05/.01 level using a two-tailed test.

APPENDIX C

PROTOCOLS FOR STRUCTURED DISCUSSIONS

In this appendix, we provide the protocols used for structured discussions with state directors, women RA participants, and WANTO grantees..

STATE DIRECTORS

Discussion Protocol
(approximately 90 minutes)

Good *[morning, afternoon, evening]*. This is *[name]* and *[name]* from Mathematica Policy Research. Thank you for taking the time to talk with us.

A. Introduction

- Introduce everyone on the call and thank them for taking the time to talk to us.
- Main purpose of the study: to measure costs and benefits of RA. The study seeks to understand the value of expanding RA as a workforce development strategy and to identify strategies for improving the program, such as the participation of women.
- Today's focus – to understand the key features of the program in your state. The final report will include a discussion of the RA program in your state.
- Confidentiality – in the report, we will mention we learned about your state from you and may use quotes. Is that okay?
- We'd like to record this interview for the purpose of completing our notes. The recording will not be shared beyond the Mathematica project team. Is that okay?

B. Major Activities and Staffing

1. Major Activities

1. How many staff (state and federal) work on RA in your office? What fraction of time do they spend working on RA?

2. Can you please talk about the major activities of you and your staff? Do you provide technical assistance or training to sponsors/employers? Do you certify completion or set standards for completion? Do you monitor or audit programs? Do you conduct marketing or outreach?

3. How do you and your staff divide your time among these activities? How is money divided among the major activities? Aside from staff, do you spend any other resources on RA?

2. Unique Features and Changes Since 2000

4. Are there any special activities that set you apart from RA in other states?

5. In our study of the RA data, we will be examining the period since 2000. Have there been any major changes to your activities or staffing over this period?

C. Sponsors and Employers

1. Recruitment

6. Please describe the process for recruiting sponsors and employers. How do sponsors/employers typically hear about RA? Do you face any challenges in developing programs in non-traditional industries or trades, such as healthcare, energy, and hospitality? Are there any financial incentives to encourage registration? [Probes: tax subsidies, tuition assistance]. Who pays for these incentives, and how much are they? Are there any recruitment targets? What recruitment strategies or incentives are most effective? Does it vary for different types of sponsors/employers?

2. Registration

7. Please walk us through the process of creating a Registered Apprenticeship in your state. Are there any targets or performance measures? [Probe: New apprenticeships, new industries? Success rate?].

3. Benefits and Costs

8. When you talk to sponsors, what do they say is the best thing they get out of RA? What is the primary reason for participation? What activities do they pay for? [Probe: RTI]. What is their largest expense?

4. Unique Features and Changes Since 2000

9. Are there any differences in the way sponsors/employers are involved in RA compared to other states?

10. What is the biggest difference over the last ten years in the kinds of sponsors you work with and how you work with them?

D. Role of Partnerships

1. Education and Instruction

11. Can you describe how post-secondary schools are involved in Registered Apprenticeship? What do you work together on? [Probes: RTI, recruitment, use of school space]. Are they involved in related technical instruction? Do you share staff, money, or other resources? What activities do they pay for? What activities do you pay for? How much per apprentice? What makes these relationships successful? What is most important to the success of the relationship? How important is this partnership?

12. Can you describe how high schools or vocational schools are involved? What do you work together on? [Probes: RTI, recruitment, use of school space]. Are they involved in related technical instruction? Do you share staff, money, or other resources? What activities do they pay for? What activities do you pay for? How much per apprentice? What makes these relationships successful? What is most important to the success of the relationship? How important is this partnership?

2. Workforce Development System (if applicable)

13. Please tell us about any partnerships with the workforce development system. What do you work together on? [Probes: referrals, recruitment]. Who takes the lead? Do you share staff, money, or other resources? What activities do they pay for? What activities do you pay for? How much per apprentice? What do you think makes this relationship successful? What is most important to the success of the relationship? Have there been any challenges in working with Workforce Development? How important is the partnership to your office functions?

3. Other Partners

14. Other than workforce and educational institutions, do you partner with any other stakeholders? [Probe: Advisory Committees, Community Based Organizations, Faith-Based Organizations, Veterans groups, pre-apprenticeship programs]. What do you work together on? [Probes: referrals, recruitment, training, use of their space]. Do you share staff, money, or other resources? What activities do they pay for? What activities do you pay for? How much per apprentice? What is most important to the success of the relationship? How important is this partnership?

4. Unique Features and Changes Since 2000

15. What is special about your partnerships compared to other states?

16. How have these partnerships changed since 2000?

E. Apprentices

1. Recruitment

17. What are the main ways people learn about Registered Apprenticeship? Are there any incentives besides wages to encourage enrollment? [Probes: tax subsidies, tuition assistance]. Who pays for these incentives, and how much are they? Are there any recruitment targets? What recruitment strategies or incentives are most effective? Does it vary for different types of people?

2. Benefits and Costs

18. What do apprentices say is their biggest benefit to participating in RA? What is the primary reason for participation? Primary reason for non-completion? What activities do they pay for?

3. Unique Features and Changes Since 2000

19. Does your office recruit apprentices in any ways that other states do not?

20. From the point of view of an apprentice, is there anything special about RA in your state compared to other states that enhances the experience?

21. Have the reasons for becoming an apprentice or the experience of a typical apprentice changed in the last ten years?

F. Women in Apprenticeship

1. Recruitment and Participation

22. What do you, your partners, or sponsors/employers do to target women for recruitment? Do you require sponsors/employers to reach out to women? Do you partner with any organizations to recruit women? Do you recruit sponsors in specific industries to recruit women? Are there any quotas or recommendations on the percent of women apprentices? What recruitment strategies are most effective?

23. Do you, your partners, or sponsors/employers do anything special to help women complete apprenticeship programs? [Probes: Training, mentoring, support for child care or transportation, referrals to partner agencies, guides or materials for establishing a non-threatening work environment]. What strategies are most effective? Do you provide guidance or requirements to sponsors or employers in providing any of these services?

24. What barriers do women face in completing a program? What about in enrolling? Are these different for men? [Probes: Difficulty obtaining adequate child care, reliable transportation, lack of appropriate workplace attire or tools, unrealistic expectations about the nature of the work or the working conditions, gender discrimination]. What else can be done to increase women participation? [Probe: Anything else ETA, state government, your office, or your partners can do?].

2. Equal Opportunity Monitoring Activities

25. Programs with 5 or more apprentices are required to have Equal Opportunity plans. What do you do to conduct equal opportunity monitoring? [Probes: calls or in-person visits to worksites, feedback from apprentices, monitoring reports]. Which activities are most effective? How do you address issues or violations? [Probes: Punitive measures, additional supports]. Do you have any recommendations for making equal opportunity monitoring a stronger tool for promoting women apprentices?

3. Unique Features and Changes Since 2000

26. From the point of view of women – either women apprentices or women interested in becoming an apprentice – are there special features of RA in your state that might enhance their experience relative to other states?

27. How have women's experiences with RA changed since 2000? What brought about these changes?

G. Allocation of Additional Funds (10 Minutes)

1. ARRA Funding Program Changes [If Received ARRA]

28. Turning now to recent ARRA funding, has your state directed any ARRA funds to Registered Apprenticeship? How much did RA receive and how have the funds been allocated? How many any of the RA programs that you service received ARRA funds? What industries are they? Do sponsors receive funding? Do apprentices receive funding? Has it been used to expand existing programs? [Probes: increase number of

participants, increase payments, expand services, hire staff]. Has it been used to expand into green jobs? Other than green jobs, has it been used to expand into new industries or occupations? Has it resulted in any new partnerships? How have these changes affected the number of women and minority apprentices? What have you learned that could help direct future investments?

2. Future Directions

29. If you could get additional funding, how would you direct it? What direction would you like to see RA moving towards in the future?

H. Wrap- Up

- Thank you!
- [SAA] We'd also like to collect some more detailed information on program costs. Can you please suggest a budget expert in your office that we can follow-up with?
- We'll send out a follow-up shortly with our contact information if you have any further comments or questions.

WOMEN WHO PARTICIPATED IN REGISTERED APPRENTICESHIP

Discussion Protocol
(approximately 30 minutes)

Good *[morning, afternoon, evening]*. This is *[name]* and *[name]* from Mathematica Policy Research. We are doing research on women's experiences with the Registered Apprenticeship program and understand that you *[are currently doing an apprenticeship, recently completed an apprenticeship, participated in the Registered Apprenticeship program]*. Do you have a few minutes to speak with us about your experience in the program?

The purpose of the discussion is to learn (1) how you heard about the program and why you decided to participate, (2) what your training and worksite are/were like, (3) what the most challenging aspects of the program are/were, and to (4) get your thoughts on how apprenticeship programs for women could be improved. This discussion should take about 30 minutes.

We'll be talking about your personal background and experiences. You don't have to discuss anything that makes you uncomfortable. If you feel uncomfortable discussing a particular topic, please just let us know and we'll move on.

A. Background Information

1. Participant Information [all respondents]

1. If you don't mind, please confirm that you are in your [*20s, 30s, etc*]?
2. Please confirm that your education level is [*high school, GED, some college, etc*]?
3. Our records indicate that you [*are currently enrolled in, completed, started but did not complete and are no longer enrolled in*] an apprenticeship program. Is that correct?
4. What kinds of jobs did you have before entering the apprenticeship program?
    i. Were the positions typically full-time, part-time, both?
    ii. Did any include health or other fringe benefits?
    iii. If you don't mind answering, what was the pay range of these jobs?

2. Recruitment and Enrollment [all respondents]

5. How did you hear about the registered apprenticeship program? [Probes: From a job training program? From a flyer or pamphlet? From a friend or family member?]
6. What was the application process like? *[Probes: Was it pretty easy to figure out the requirements and to ask questions if something was confusing? Was it easy to gather your materials?]*
7. Why did you decide to participate in the program? *[Probes: To have a steady career? Did you need training to get a new job and/or earn more money?]*
8. Were your family and friends supportive of your enrolling in the program?

B. Experiences in the Registered Apprenticeship Program

1. Apprenticeship Activities [all respondents]

9. What is/was the general structure of your apprenticeship? For example, how many hours a week of classroom instruction, how many of work? How long (months, years) will/did the apprenticeship last?
10. How challenging is/was the classroom instruction? *[Probes: Harder than you thought, easier than you thought, about what you expected]*
11. How were you matched to your apprenticeship employer/site?
12. Do/did you have a mentor?
    i. If so, how did you choose/become assigned to your mentor?
    ii. What kinds of things do/did you talk about and do with this person? *[Probes: Do/did you have formal meetings or training sessions? Or, do/did you shadow this person on the job site? Neither? Both?]*
13. How much do/did you spend out-of-pocket for your apprenticeship? *[Probes: Do/did you have to purchase tools? A uniform? Text books?]*
14. Did/will you earn a certificate or credential upon completion of the program?

2. Barriers and Challenges [all respondents]

15. What are/were the most challenging aspects of being enrolled in an apprenticeship program? *[Probes: Is/was the work itself hard? Physically demanding? Is/was it hard to be one of the only/the only woman on the worksite (only applies for construction)?]*
16. Are/were there other non-program aspects that are challenging? *[Probes: For example, do you have a hard time finding adequate child care? Getting to and from your work site?]*
17. Do/did you receive any additional services from the program? *[Probe: Does/did the program help you with things like transportation? Uniforms and tools?]*
18. Is/was there anything about being a woman at your worksite that is particularly challenging? [Probes: Do/did your coworkers think you might not be physically strong enough to do some of the work? Do/did you get the opportunity to do the same work as other (male) apprentices?]
19. Can you recall a particularly challenging experience that you have faced in the apprenticeship program?
20. Is/was the experience at your work site about what you expected it would be?

3. Post-Program Activities [only completers]

21. What is your current job?
22. Do you feel like the apprenticeship program adequately prepared you for your current job? Is your work environment similar to your apprenticeship work environment?

23. Have you been able to address the barriers and challenges you mentioned earlier at your current job? [Probe: Review the challenges/barriers mentioned earlier in the discussion.] If so, how? Are some things still difficult?
24. Overall, do you like your current job?

4. Reasons for Non-Completion [only non-completers]

25. What was the main reason that you did not finish the program? Are there any additional reasons?
26. What could the program have done to help you be able to complete it?
27. Are you currently employed? What is your current job? How is your current work environment different from your apprenticeship work environment?
    i. Did the apprenticeship program help prepare you for your current job? If so, how?
    ii. Have you been able to address these barriers and challenges during your apprenticeship? [*Probe: Review the challenges/barriers mentioned earlier in the discussion.*] If so, how?
28. Are some things still difficult?

C. Suggestions for Improving Registered Apprenticeship for Women [All Respondents]

1. Is there anything you think apprenticeship programs could do to more effectively recruit women?

29. Is there anything you think the programs could do help more women successfully complete the program?
30. Do you have any other thoughts before we close?

WANTO GRANTEES

Discussion Protocol
(approximately 60 minutes)

Good *[morning, afternoon, evening]*. This is *[name]* and *[name]* from Mathematica Policy Research. You have recently received a letter of introduction from the federal Office of Apprenticeship and the Women's Bureau about our study of Registered Apprenticeship. Thank you for taking the time to talk with us.

The purpose of this discussion is to learn more about your work with women apprentices. We would like to hear about (1) the organization and activities of your office, (2) your work with employers and/or women apprentices, (3) barriers and challenges facing women in apprenticeship programs, and (4) suggestions for addressing those barriers and challenges. This discussion should take about an hour.

Grantee Background

1. What is the mission of your organization?
2. How long have you been operating?
3. Briefly describe what your organization does. *[Probes: Do you primarily provide technical assistance and training to employers? Do you do outreach to women, provide them with supportive services, or match them with employers? Both? Other?]*
    i. If you provide technical assistance and/or training to employers, what is the nature of that training?
    ii. If you work directly with women (outreach, supportive services, employer matching, etc.), what is the nature of that work?
    iii. Are there specific industries or occupations that your organization focuses on?

A. Technical Assistance/Training to Employers

1. Employer Recruitment

4. How many employers do you work with?
5. How do you select which employers to work with? *[Probes: For example, do they typically contact you to request assistance? Do you get referrals from OA and/or the Women's Bureau? Do you cold call, distribute flyers, or solicit referrals from community partners?]*
    i. Which of these strategies is most successful? Which is least successful? *(Probe: How do employers typically hear about the program?)*
6. Why do employers typically need your help? *[Probes: For example, do they need help tailoring the program so that it best serves women? Do they need help with establishing mentoring programs or a supportive work environment, etc.]*
7. Do you target particular industries and/or occupations?
    i. Are employers from certain industries more apt or reluctant to participate in the program than others? If so, why?

8. If you recruit employers to participate, what is the most challenging aspect of employer recruitment? *[Probe: Are any employers resistant to participate because their work may be too physically demanding for women? Do you encounter stereotypes about women in non-traditional industries?]*
    i. Do these challenges vary by industry?

2. Technical Assistance to Employers

9. Describe the Technical Assistance you provide to employers. [Probes: Do you provide programming, aid in recruitment, marketing, etc.]
10. Describe any other services you provide to employers

B. Working Directly with Women

1. Characteristics of Apprentices

11. How many women do you serve?
12. What is the rough age and racial composition of the women? *[Probes: For example, what proportion of women are under 30? Over 50? What proportion are minorities?]*
13. What is the typical educational attainment of the women? *[Probes: Do most have a high school diploma? GED? Have any been to other occupational skills training?]*
14. What are the main reasons women initiate contact with your organization? *[Probes: For instance, are they looking for a career change or to "start over"? Are they working for the first time?]*

2. Recruitment and Enrollment of Women in Apprenticeship Programs

15. What are your strategies for recruiting women to participate in apprenticeship programs? *[Probes: For example, do you distribute flyers or pamphlets with program information, or solicit referrals from community partners? Word of mouth? Information sessions?]*
16. Which of these strategies is most successful? Which is least successful? *[Probe: How do women typically hear about apprenticeship programs and about your organization?]*
17. If the organization offers its own pre-apprenticeship program:
    i. How many women enroll in the program each year? How many complete it?
    ii. What are the requirements for program completion? *[Probes: Are women required to complete a certain number of classroom hours? Work site hours? Assessments?]*
18. How do you match women to Registered Apprenticeships (or other formal apprenticeships, if applicable)?

3. Barriers and Challenges Facing Women in Apprenticeship Programs

19. What are the common barriers that women face to enrolling in and completing their apprenticeships? *[Probes: For example, do women have a difficult time finding and paying for adequate childcare? Do they have difficulty obtaining reliable transportation to and from their work sites? Do they lack appropriate workplace attire, such as steel-toed boots, and/or tools?]*

20. Does your organization provide help to women to address these barriers? *[Probes: For example, do you provide help with childcare or transportation? Do you refer them to partner agencies for services?]*
21. In your experience, do apprenticeship sponsors and/or employers provide help to women to address these barriers?
22. Can you give us a brief description of a female apprenticeship candidate whom you would expect to successfully complete the program?

C. Barriers and Challenges Facing Women in Non- Traditional Occupations Post- Apprenticeship

23. What are the common challenges that women face working in non-traditional industries/occupations? *[Probes: For example, do they contend with stereotypes? Hostile work environments? Or physical barriers and limitations? Long or difficult work hours?]*
    i. Are the challenges different than those encountered during the apprenticeship program itself?
    ii. Do these challenges vary by industry?
24. What are ways in which women are able to successfully address these challenges?
    i. Do these strategies vary by industry?
    ii. Does your organization provide help to address these challenges?
    iii. Do employers provide help to address these challenges?

D. Suggestions for Registered Apprenticeship Improvement

25. How can RA and employers more effectively recruit women into apprenticeship programs?
26. How can RA and employers more effectively address the challenges we discussed earlier so that woman can successfully complete the program?
    i. Based on your experience, do you think these approaches need to vary by industry?
27. Do you have any additional suggestions for making RA more effective and successful?

THANK YOU AND CLOSING REMARKS

Thank you for discussing your organization and Registered Apprenticeship with us today. Please do not hesitate to contact *[name]* or me should you have any questions or if you recall additional information that you think would help our research. *[Provide phone numbers.]*

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