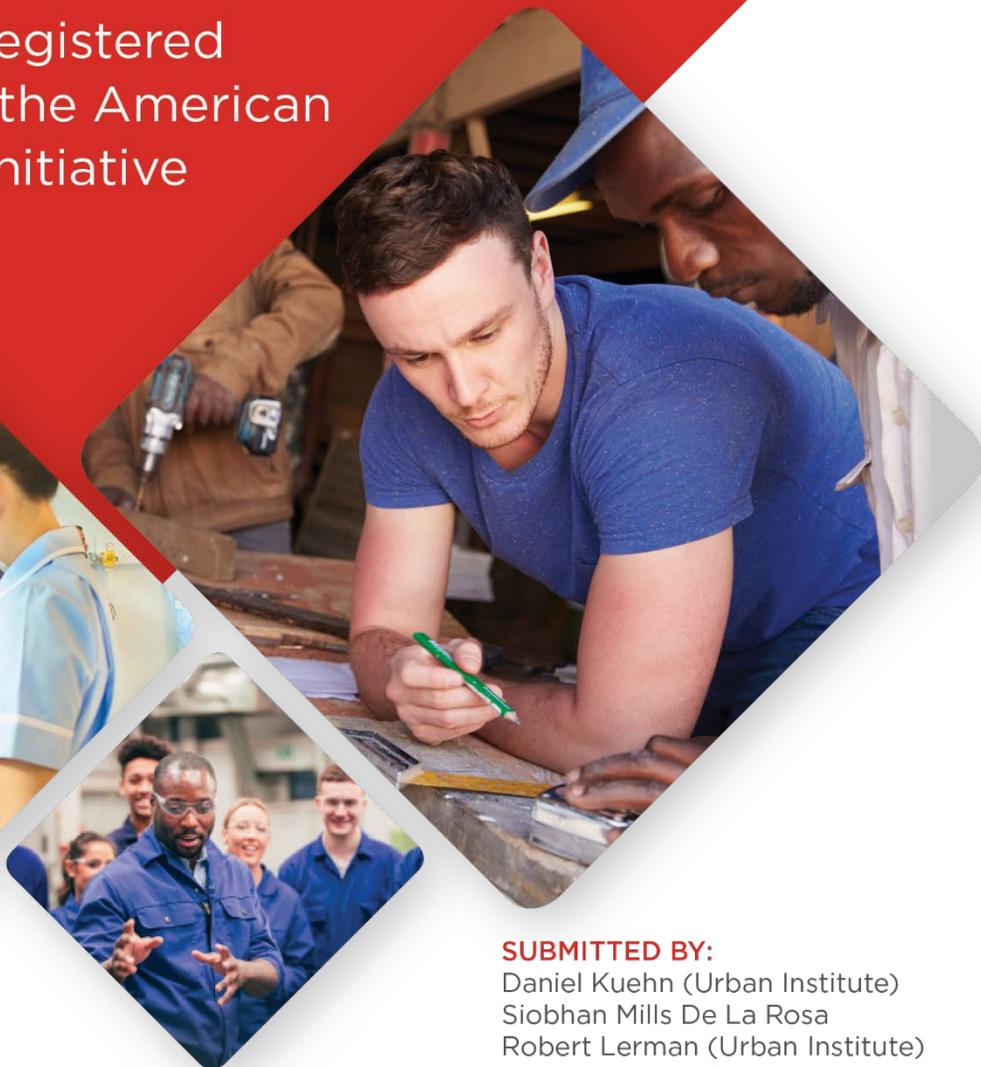


Do Employers Earn Positive Returns to Investments in Apprenticeship?

Evidence from Registered Programs under the American Apprenticeship Initiative



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About This Report

Funded by the H-1B visa program, the U.S. Department of Labor (DOL) American Apprenticeship Initiative (AAI) provided funding to 46 grantees across the country to expand registered apprenticeship into new sectors, such as healthcare, and to populations underrepresented in apprenticeships. DOL commissioned an evaluation of the AAI grants to build evidence about the effectiveness of registered apprenticeship for apprentices and employers. This report presents findings of the employer return-on-investment (ROI) sub-study. The primary data source is an Employer Survey administered to 68 employers that hired apprentices supported by an AAI grant. Each employer was asked to describe one of their apprenticeship programs in detail; all together, these programs represented 2,854 apprentices. The survey was deployed between March 2020 and October 2020, towards the end of the 5-year AAI grant period. The report documents the costs, benefits, net benefits, and ROI estimates that AAI employers experienced by investing in apprenticeship programs. The report includes information on costs and benefits during the apprenticeship program period, as well as projections of benefits for up to 5 years after apprentices completed their apprenticeship.

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Glossary of Terms

Apprenticeship agreement: Written agreement between an apprentice and the apprentice’s program *sponsor*, or sometimes an apprenticeship committee acting as agent for the program sponsor, that contains the terms and conditions of the employment and training of the apprentice.

Apprenticeship Training Representative (ATR): U.S. Department of Labor (DOL) staff chiefly concerned with promoting and advising on apprenticeship training and other occupational skill development programs for workers in industry.

Breakeven: The point when the accumulated costs of the apprenticeship are exactly offset by the accumulated benefits.

Direct benefits: Value of apprentices’ productivity.

Discount rate: Interest rate used to determine the present value of a future sum of money. We report results using a discount rate of 3 percent. Results using a 7 percent discount rate did not differ significantly from results using a 3 percent discount rate.

Grantee: Organization that received American Apprenticeship Initiative funds to expand apprenticeship.

Indirect benefits: Benefits the employer experiences from the apprenticeship program that are beyond the increased productive output from the apprentice. For example, reduced turnover and improved company culture are examples of potential indirect benefits that employers could experience by investing in an apprenticeship program.

In-program period: Time an apprentice spends working for an employer while in an active apprenticeship. Apprentices are receiving *on-the-job-learning* during this period.

Instructor: Provider of the *related technical instruction* (RTI) for an apprenticeship program. The RTI provider might be a community college instructor, but it could also be an instructor associated with other types of RTI partners.

Joint and non-joint apprenticeship programs: A joint apprenticeship program is jointly sponsored by representatives of an employer and workers under a collective bargaining agreement, also known as a “joint labor-management committee.” A non-joint apprenticeship program is sponsored by an employer or other entity besides a joint labor-management committee.

Mentor: Provider of *on-the-job learning* opportunities for apprentices. Mentors are other employees of the hiring employer.

Net benefits: Total of all benefits accrued to employers minus total of all costs incurred associated with the apprenticeship program.

Non-wage benefits: Any compensation or benefits provided by an employer to an employee besides wages. Typical non-wage benefits might include health insurance, retirement benefits, or paid leave.

Occupation, occupational field: The specific job associated with an apprenticeship program. DOL’s Employment and Training Administration’s Office of Apprenticeship or a State Apprenticeship Agency (SAA), which assigns the job a distinct occupational code, must approve occupational fields. *Grantees* can operate multiple apprenticeship programs within an occupational field, and *sponsors* can operate multiple programs across different fields.

On-the-job learning (OJL): Hands-on training from an experienced *mentor* at the job site, typically for at least one year. Structured OJL experiences are developed by mapping the skills and knowledge that the apprentice must learn over the course of the program in order to be fully proficient at the job.* Every apprenticeship program includes OJL.

Partner organization: Any partner of the grantee, besides an employer or a union, that provides support for grant activities. Partner organizations can include public agencies, community colleges, non-profits, and industry associations.

Post-program period: Any time after the apprentice has completed their apprenticeship program, whether they are still working with the same employer or not.

Pre-apprenticeship program: Preparation of individuals to enter and succeed in an apprenticeship program through an approved training curriculum based on industry standards. Can include educational and pre-occupational services (e.g., career and industry awareness workshops, job readiness courses), hands-on training in a simulated lab experience or through volunteer opportunities, and assistance in applying to apprenticeship programs. Pre-apprenticeship programs involve formal partnerships with at least one apprenticeship program *sponsor*.

Productivity: Output generated by productive labor.

Projection: Estimate of a future trend based on a study of current metrics. In this case, we make a projection of future *return on investment* based on current returns.

Registration Agency: Entity responsible for evaluating an apprenticeship program's *Standards of Apprenticeship* and for ongoing evaluation of apprenticeship programs to determine whether they comply with federal regulations related to program design, worker protections, and other requirements. Programs that comply are "registered." Registered programs can access federal resources, state tax credits where available, and technical assistance. Some states register their apprenticeship programs with the U.S. Department of Labor's Office of Apprenticeship; others register with their State's federally recognized State Apprenticeship Agency (SAA).

Registered apprenticeship program: Structured program of work-based learning under *mentors*, providing both value to employers and formal technical instruction to workers, and culminating in an industry-recognized credential that meets standards for registration by a Registration Agency. An apprenticeship sponsor for a specific *occupation* runs the training program. *Sponsors* are responsible for registering individual apprentices and determining whether they have successfully completed the apprenticeship program.

Registered apprenticeship program addition, expansion, maintenance, or revision: Changes to an existing registered apprenticeship program, including the development of programs in additional *occupational fields* by an existing apprenticeship *sponsor*. Maintenance or expansion may also entail transitioning from a time-based apprenticeship to a competency-based or a hybrid apprenticeship.

Related technical instruction (RTI): Instruction that complements the apprentice's on-the-job learning, delivering the technical concepts and workforce and academic competencies needed to succeed on the job. A community college, a technical school, an apprenticeship training school, or the employer itself can provide the instruction. Education *partners* collaborate with employers to design the curriculum to deliver the skills and knowledge needed by apprentices. All partners work together to identify how to pay for the RTI, including the cost to the employer and other funds that can be leveraged.

* For information on components of registered apprenticeship, including OJL, see DOL's *Quick-Start Toolkit* at https://www.doleta.gov/oa/employers/apprenticeship_toolkit.pdf.

Return on investment (ROI): Metric used to measure the overall return resulting from an investment. In this context, the ROI is the ratio of the *net benefits* employers gain from investing in hiring and training an apprentice to the cost of that investment.

Sponsor: Entity responsible for the overall operation of the *registered apprenticeship program*, working in collaboration with the *partners*. Sponsors can be a single employer or a consortium of employers. Alternatively, the sponsor can be any of a range of workforce intermediaries including an industry association or a joint labor-management organization. Community colleges and community-based organizations can also serve as sponsors.

Standards of Apprenticeship: Document describing all apprenticeship components for a specific job role. Comprises individual standards that include the purpose of the proposed apprenticeship program, the term of the apprenticeship, the provision of *related technical instruction*, wage progression for the apprenticeship, supervision of apprentices, safety, registration of apprentices, work process schedule, probation period, periodic evaluation of apprentices' performance, completion requirements, and apprentice/*mentor* ratio.

Total return: The yield employers can expect on apprenticeship (costs versus benefits) over the long term, from the onset of the apprenticeship through 5 years after the apprenticeship completion date.

Wage progression: Refers to the regular increases in wages apprentices experience as they move from wage step to wage step.

Wage step: Level of pay for an employee based on their experience and years of service. An apprentice may start at a low wage step and increase to a higher (or several higher) wage step(s) over the course of the apprenticeship program. The number and duration of wage steps varies from program to program and is outlined in the Standards of Apprenticeship.

Wastage cost: Cost of wasted time and materials associated with the apprenticeship program above normal levels of wastage due to mistakes made during the training period.

Work process schedule: Description in the Standards of Apprenticeship of the skills learned by the apprentice during the on the job learning portion of their program and the number of hours allocated to learning the skill.

Executive Summary

Introduction

The U.S. Department of Labor (DOL) launched the American Apprenticeship Initiative (AAI) in October 2015 to expand registered apprenticeship into high-growth occupations and industries and to increase apprenticeship opportunities for all Americans. Apprenticeship is a structured, work-based training program that combines classroom instruction (“related technical instruction,” or RTI) with on-the-job learning (OJL) provided by a mentor at the employer’s worksite. An apprenticeship provides training in a specific occupation and delivers occupational skills that are recognized and transferable across employers. Apprentices are employed and contribute to production during their training and earn progressively higher wages. Because employers hire apprentices, pay their wages, and commit to developing their technical skills through OJL from mentors and RTI, their buy-in to apprenticeship is essential to expand apprenticeship in the United States (Lerman 2018; Gardiner et al. 2021).

Although apprenticeship is a common training and career entry model in other countries, it is historically underused in the United States (Gardiner et al. 2021).

With funding from the H-1B visa program, DOL’s Employment and Training Administration (ETA) awarded \$175 million to 46 AAI grantees to expand registered apprenticeship into sectors with few apprenticeships (such as healthcare and information technology (IT)) and to populations traditionally underrepresented in apprenticeship, including women, people of color (Black, Hispanic, and Other Races), and veterans (DOL/ETA 2014). Registered apprenticeship programs are those in which sponsors register with DOL’s Office of Apprenticeship (OA) or with a federally recognized State Apprenticeship Agency (SAA); adhere to standards for OJL and RTI; result in an industry-recognized credential; and incorporate structured wage progression. The Standards of Apprenticeship documents these details of the program. A sponsor—often but not always an employer—oversees the program and maintains the Standards of Apprenticeship.

AAI Evaluation Sub-studies

- An **implementation study** of the grantee apprenticeship programs
- A study of apprentice employment and earnings **outcomes**
- A study measuring the **return on investment** to employers
- An **employer engagement demonstration** that explores the impacts of training grantee staff to market apprenticeships to employers

In 2016, DOL commissioned an evaluation of the AAI grants to build evidence about the effectiveness of registered apprenticeship for apprentices and employers. The AAI evaluation includes four sub-studies. This report presents results from the employer return-on-investment (ROI) sub-study. The key finding is two-thirds of employers interviewed for the study at least recoup their apprenticeship investments, and that the median return on investment is \$1.44, or \$144 for every \$100 invested.

Study Design

The employer ROI sub-study answers the following research questions:

- What are the benefits to employers during and soon after the registered apprenticeship periods in their organizations? What are the costs? What are the implied returns on investment?
- What is the value of the production generated by apprentices during the registered apprenticeship period?
- Do employers save on employee recruitment, employee retention, hiring and training costs; increase workplace safety and improve product quality (reduced defect or error rates); and/or experience better customer outcomes?

- Do employers experience indirect benefits beyond the direct productivity increases experienced by apprenticeship, such as improved talent pipelines or improved corporate culture?

Assessing Costs and Benefits to Employers

This study estimates the returns using two measures—net benefits and return on investment:

- **Net Benefits:** Net benefits (or net present values at the time of the investment) are equal to the benefits accruing to the employer minus employer’s costs, discounting both costs and benefits to account for the time value of money. A *positive* (+) net benefit suggests that the program generated a larger benefit over the specified time frame than it cost, whereas a *negative* (–) net benefit suggests that the program generated a larger cost over the specified time frame than its benefits.

Net benefits change over time. For registered apprenticeship, net benefits may be negative at the beginning of a registered apprenticeship program due to large early investments (e.g., registering the program, the cost of apprentice wages while they are not fully productive, the cost of mentor wages while they are supervising apprentices). Over time, registered apprenticeship programs may yield positive net benefits as apprentice and mentor productivity improve and employers incur fewer RTI or supply and wastage costs.

Measures of costs and benefits cover the registered apprenticeship (“in-program” period) and the 5 years following its completion (“post-program” period).

- **Return on Investment:** The return on investment (ROI) of a program is calculated by subtracting the costs of a program from the benefits of the program and then dividing that value by the costs. Return on investment is typically presented as a percentage of the investment, but it can also be expressed as how much money in dollars employers can expect for every dollar of investment. For example, employers with an ROI of 1.3 earn cumulative net benefits equal to \$130 for every \$100 invested.

Data Source

The data source for this report is a survey of employers affiliated with AAI grantees. The evaluation team administered the survey to 68 employers between March 2020 and October 2020. To be included, the employer had to have at least one AAI “reference apprentice” who had completed their registered apprenticeship prior to survey administration; this ensured that employers could respond to questions regarding each step of the registered apprenticeship program identified in the Standards of Apprenticeship. The survey collected information about the following:

- Employer characteristics (e.g., industry, recruitment practices, size, training costs for the registered apprenticeship);
- Registered apprenticeship program characteristics (e.g., occupational focus, number of apprentices, duration, number of wage steps);

Assessing Employer Costs and Benefits

Costs

- Paid wages and benefits to the apprentice
- Training costs associated with RTI
- Reduced productivity of some experienced staff while they are mentoring or training the apprentice
- Costs of supplies and wastage
- Costs related to registering the program (usually in staff time to complete the accompanying paperwork)

Direct Benefits

- Value of the output or service produced by the apprentice
- Reduced costs of hiring and filling a skilled labor position

Some Indirect Benefits

- Employer engagement and loyalty
- Reductions in turnover
- An enhanced pipeline of skilled workers
- Development of future managers
- Improved company culture

- In-program apprentice information (e.g., hourly wage at each step, paid hours worked, value of non-wage benefits, apprentice productivity at each step);
- In-program mentor information (e.g., hourly wage at each wage step, hours spent supervising, mentor productivity at each step);
- Post-program information (e.g., apprentice retention, wage at program completion, current wage, hours worked per week, information about a similarly qualified non-apprentice worker); and
- Presence and value of indirect benefits (benefits the employer receives other than those coming from the productivity of the apprentice, the value of those benefits relative to the apprentice’s direct productivity benefits).

Information collected on the reference apprentice pertains only to the apprenticeship itself and the post-apprenticeship period. Some reference apprentices may have participated in a pre-apprenticeship program but information on pre-apprenticeships was not collected in the survey.

Calculating Net Benefits

The main cost of registered apprenticeships is the compensation paid to apprentices. Other costs include spending on RTI, lost productivity of mentors, costs of wastage and supplies, and costs of registering the program. Some of these costs may be covered by AAI grant funds. The survey collects information on financial support from AAI grantees, and these are incorporated as benefits (i.e., deducted from the costs) of the registered apprenticeship program. The direct benefit of the registered apprenticeship program to an employer is the value of the productivity contributed by the apprentice. To measure direct benefits, the evaluation team asked employers to estimate the value to the employer of the apprentice’s productivity as a percentage of the productivity of a fully qualified worker in the relevant occupation. Employers reported this relative productivity number at each wage step of the apprenticeship.

Because employers may have interpreted the productivity of the “fully qualified worker” in various ways, the team used three estimates to calculate the value of the apprentices’ productivity:

1. a **low estimate**, using the compensation rate that the employer would pay an individual who is “qualified” in the apprentice’s occupation. This estimate is likely to produce, and in practice did produce, the lowest return because apprentice wages were closer to, and sometimes higher than, the fully qualified worker’s wages than anticipated;
2. a **medium estimate**, using the compensation rate of an individual qualified in the apprentice’s occupation (i.e., the rate from item 1, above) **or** the compensation rate earned by the apprentice immediately after completing the registered apprenticeship, whichever is greater; and
3. a **high estimate**, using the mentor’s compensation rate. This estimate produced the highest return because mentors tend to earn substantially more than workers who have recently completed their registered apprenticeship, in part due to the mentor’s additional experience.

To estimate the value of indirect benefits, the evaluation team asked employers about how valuable the registered apprenticeship program’s contributions were on selected benefits besides the productivity of the reference apprentice (e.g., reduced turnover, improved productivity of co-workers, and improved pipeline of skilled employees) relative to the benefit of the apprentice’s increased productivity. Since the question dealt with additional benefits of the overall program, the team estimated the indirect benefit per apprentice by dividing the total indirect benefit by the number of apprentices.

The net benefit (also known as the net present value) of the registered apprenticeship investment is equal to the sum of each period’s benefits minus costs. To account for the time value of money, each period’s

net benefits are discounted at 3 percent back to the base year. The net benefits to employers can occur because of the apprentice's productive contributions both during and after the registered apprenticeship. This study estimates the in-program net benefits and projects post-program net benefits up to 5 years after the registered apprenticeship.

Findings

In-program Net Benefits

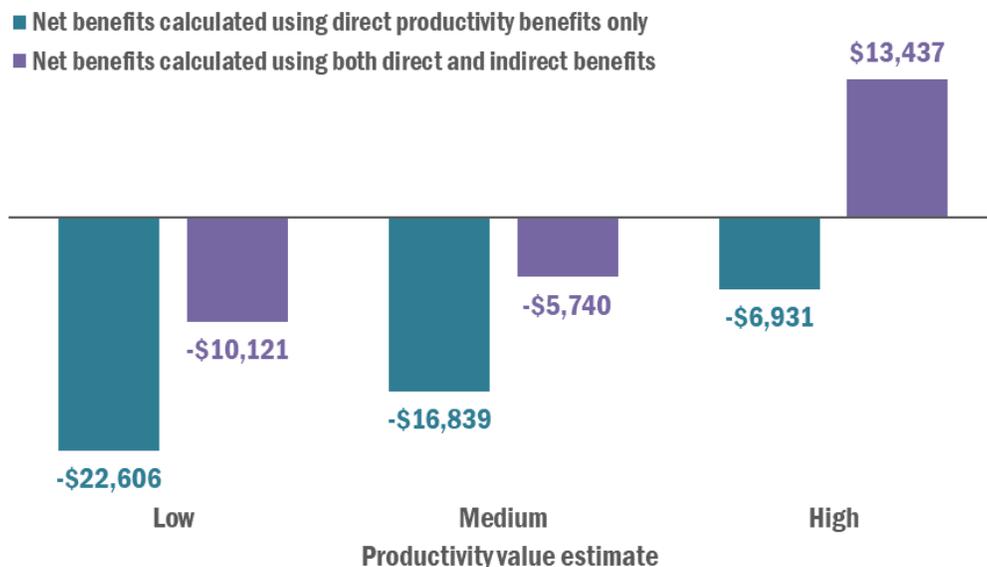
- ***During the registered apprenticeship program, the typical employer does not recoup all costs of the registered apprenticeship.***

Median per apprentice net benefits accruing to employers during the registered apprenticeship period varies depending on which of the three productivity valuation assumptions is used and whether indirect benefits are or are not included (Exhibit ES-1). The median in-program net benefits, counting only the direct benefits of the increased productivity of the apprentice, are negative regardless of which estimate is used, ranging from $-\$22,606$ to $-\$6,931$. For the medium estimate, only 13.2 percent of employers can recoup their investments during the apprenticeship when only costs and direct benefits are counted.

- ***Employer net benefits are higher when indirect benefits of registered apprenticeship are counted in addition to direct benefits.***

Employers gain indirect benefits from registered apprenticeship investments, even during the registered apprenticeship period. These include reducing turnover, improving work culture, enhancing co-worker productivity, and having a pipeline of skilled workers. Taking these indirect benefits into account along with the direct benefits during the registered apprenticeship program, the median employer still experiences negative net benefits during the registered apprenticeship program, based on the medium estimate. The median employer experiences a positive net benefit during the registered apprenticeship program when the high estimate is used. Indirect benefits raise the share of employers recouping their investments during the registered apprenticeships from 13.2 percent to 38.2 percent for the medium estimate and from 45.6 percent to 63.2 percent for the high estimate.

Exhibit ES-1. Median Net Benefits during the Program Period



Source: AAI Employer Survey. $N=68$.

Note: Benefits and costs are in 2020 dollars and discounted at 3 percent per year.

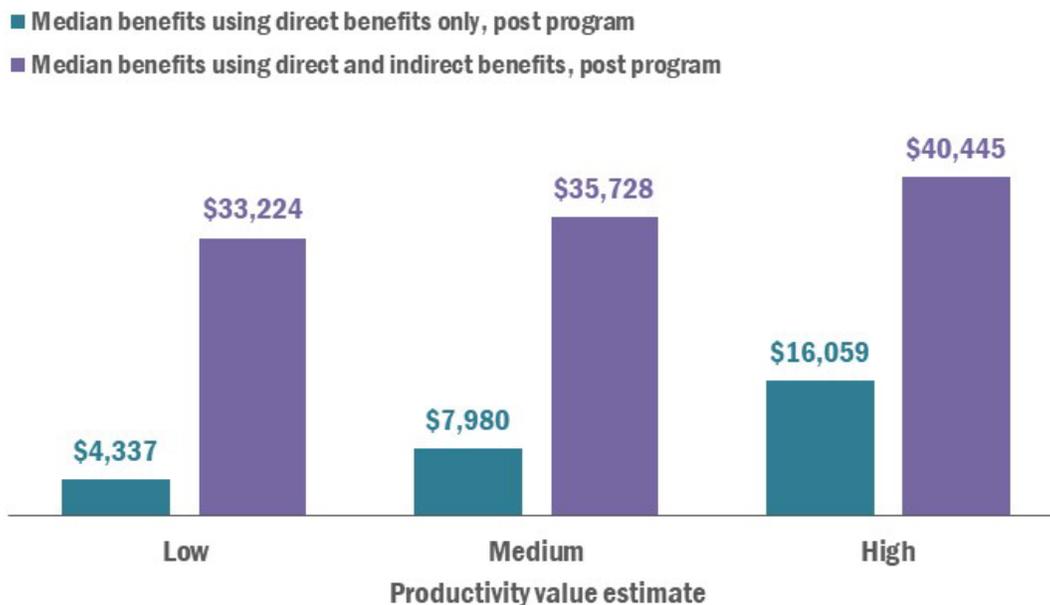
Post-program Direct and Indirect Benefits

The evaluation team estimated employer benefits for a period of 5 years after the end of the registered apprenticeship. The direct benefits accruing to the employer from the increased productivity of the apprentice (less compensation) in the post-program period were estimated through a combination of observed data from the year immediately after the registered apprenticeship ended and projected data for the ensuing 4 years. The projected benefits build on in-program net benefits estimates using the same three alternative productivity valuations. There are no costs to the employer associated with the registered apprenticeship program in the post-program period because training is completed.

- **Employers experience positive direct and indirect benefits in the post-program period of between \$25,000 and \$30,000 from each registered apprenticeship.**

The median post-program benefits using only direct benefits are all positive, ranging from about \$4,300 for the low estimate to about \$16,000 for the high estimate (Exhibit ES-2). Adding indirect benefits adds about \$25,000 to \$30,000 to the median employer's post-program benefits.

Exhibit ES-2. Median per Apprentice Benefits in the Post-program Period



Source: AAI Employer Survey. N=68.

Note: Benefits comprise productive value minus compensation and are in 2020 dollars and discounted at 3 percent per year.

Total Net Benefits and Return on Investment

Combining the net benefits during the registered apprenticeship program and the benefits experienced in the post-program period yields the net benefits to employers for the total analysis period—from the start of the registered apprenticeship until 5 years after its completion. These total net benefits are the best guide to the payoff of investing in registered apprenticeship, as they reflect the full costs of the registered apprenticeship program and the benefits employers experience during and after the registered apprenticeship.

- **The typical employer experiences a 44.3 percent return on their investment in registered apprenticeship if both direct and indirect benefits are counted.**

The median estimate of the employer's ROI in registered apprenticeship is 44.3 percent; that is, for every dollar invested in the apprentice, the employer ultimately earns \$1.44 in benefits. Although this finding is consistent with prior research on individual registered apprenticeship programs, there is substantial

variation in the estimated ROI for individual AAI employers; the ROI of the 25th percentile employer was -7.4 percent using the medium estimate; the ROI of the 75th percentile employer was +120.7 percent. In dollar terms, the typical employer earns positive net benefits from registered apprenticeship for the apprenticeship and post-apprenticeship periods.

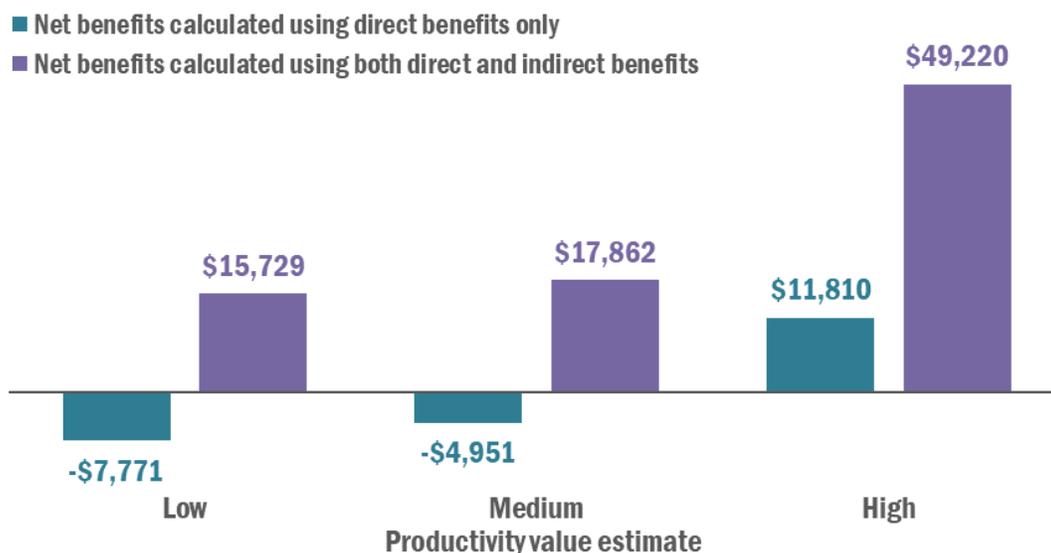
When including only the direct productivity benefits of the apprentice, the share of employers recouping their investments ranges from 38 to 44 to 54 percent for the three valuation methods. Median per apprentice net benefits using only direct benefits is negative for the low (-\$7,700) and medium (-\$4,900) estimate, and positive (almost +\$12,000) for the high estimate (Exhibit ES-3).

However, when including indirect benefits, registered apprenticeship investments yield positive returns for two-thirds or more of AAI employers. Indirect benefits are especially important in the post-program period. Even using the low estimate of apprentice productivity, 66 percent of employers more than recoup their investment when both indirect and direct benefits are included, with the median employer gaining about \$15,700 per apprentice. The results are similar for the medium estimate, with a median net benefit of more than \$17,800 per apprentice. With the high estimate, the median net benefit is even larger, more than \$49,000, and 78 percent of employers experience positive returns.

- **Using the medium estimate, the typical employer experiences more than \$17,800 in net benefits per apprentice, or an annualized return on investment of 6.3 percent.**

Employers invest in registered apprenticeship training to increase the productivity of their workers and to enhance the long-term value of their companies. The evaluation team estimates that the median employer experiences over \$17,800 in cumulative net benefits for the full period, including both the registered apprenticeship program period and the 5-year post-program period. The annualized return on investment in apprenticeship for the typical employer is 6.3 percent.

Exhibit ES-3. Median per Apprentice Net Benefits for the Full Period



Source: AAI Employer Survey. *N*=68.

Note: Benefits and costs are in 2020 dollars and discounted at 3 percent per year.

Lessons Learned

The study has important lessons for employers with registered apprenticeships, employers considering registered apprenticeships, policymakers, and other stakeholders. Although the estimates apply only to AAI employers, many of which are new to registered apprenticeship, these are the types of employers that must offer registered apprenticeships if the U.S. registered apprenticeship system is to expand significantly. Findings in this study suggest that employers are likely to do well when they emphasize apprentice productivity and use registered apprenticeship to infuse their company with cultural and organizational changes that provide indirect benefits beyond productivity.

- First, the finding that most employers gain from registered apprenticeship investments adds to the compelling case for scaling up registered apprenticeships in the United States. This result is especially notable because registered apprenticeship programs are often a new component of their talent recruitment policies for many employers.
- Second, employers would experience greater returns to their registered apprenticeship investments if the direct productivity benefits provided by the apprentice were higher. Greater returns could potentially be accomplished if they take full advantage of the productivity of apprentices during and soon after their training. Cost-effective programs begin giving apprentices productive tasks to accomplish right away. For example, industrial maintenance technicians could conduct as much OJL as feasible directly on machines that are in use, rather than on simulators or by shadowing mentors who do machine maintenance.
- Third, the findings show that registered apprenticeships bring a range of benefits beyond the apprentice's productivity. Especially valuable is the improvement in the pipeline for skilled workers. Nearly 60 percent of employers ranked this benefit as more valuable than the productivity gain of the apprentice. One reason is the "option value" of having additional skilled workers in times of uncertainty in demand for the employer's products or services. Employers cannot know what business conditions will be like at the end of an apprentice's training, but a reliable pipeline of apprentices gives them the option of retaining a skilled workforce in the future. A related benefit reported by employers is more on-time deliveries, although only 30.9 percent of employers identified more on-time deliveries as more valuable than the productivity gain of the apprentice. Other important indirect benefits are reduced turnover (48.6 percent identified the benefit as more valuable than the productivity gain of apprentices), employee engagement and loyalty (55.8 percent), and improved firm culture (50 percent).
- Fourth, the costs of RTI can be substantial for many employers, reducing their returns on their investments. Higher RTI costs borne by employers are negatively correlated with net benefits during the registered apprenticeship. For the 42 of 68 employers paying for RTI tuition and fees, the median cost is \$3,600 (the median for all 68 employers, including those not paying any RTI tuition and fees, is \$1,100). Gardiner et al. (2021) report that AAI grantees who provide financial support to employers to pay for RTI made more progress towards their registered apprenticeship targets than grantees who did not. Together, these findings suggest that employer incentives to pay for RTI could improve employers' returns to apprenticeship investments and contribute to robust registered apprenticeship expansion. Financial support to employers for registered apprentices would also boost the employer returns to apprenticeship investments during the registered apprenticeship program, when those returns are lowest.
- Fifth, the wide range of estimates of employer returns may narrow as employers learn how to improve their programs and minimize costs. Additional research could help determine the key factors that drive differences in direct and indirect benefits. A limited follow-up to clarify estimates for selected employers found that even some employers with estimated negative returns are planning to continue and, in some cases, to expand their apprenticeship programs. The findings in this report indicate

somewhat counterintuitively that positive returns are more difficult to achieve for larger employers, registered apprenticeship programs in healthcare occupations, and longer registered apprenticeship programs. This report discusses possible explanations for these findings and future research needs. Finally, employers operating registered apprenticeship programs, policymakers, and other stakeholders could publicize the ability of most employers to achieve positive returns to apprenticeship investments. If more employers recognized the high likelihood of recouping their registered apprenticeship investments, more employers would likely adopt registered apprenticeship as a talent recruitment tool.

This report expands the evidence base on the costs and benefits of registered apprenticeship in the U.S., but it has limitations. The respondents to the Employer Survey were not randomly selected and are distributed across many occupations, so it is difficult to infer anything about the experiences of specific occupational programs. Although findings cannot be generalized to all employers that operate registered apprenticeships generally, they are particularly valuable for understanding the experiences of employers in nontraditional occupations new to registered apprenticeship, such as healthcare and IT, and where apprenticeship is expanding. Almost 60 percent operated in either the healthcare and social assistance industry (24 percent) or the manufacturing industry (35 percent). The occupational distribution of apprentices described in the AAI Employer Survey is similar to the distribution of all AAI apprentices across occupational categories, although apprentices nationally are more concentrated in the building trades (Gardiner et al. 2021).

Certain costs and benefits are also difficult to measure, including the value of the apprentice's productivity and the indirect benefits of registered apprenticeship. Finally, the direct productivity benefits of registered apprenticeship are projected into the future rather than directly measured, since even the earliest AAI apprentices had only recently completed their registered apprenticeship programs at the time of the survey.

1. Introduction

The U.S. Department of Labor (DOL) launched the American Apprenticeship Initiative (AAI) in October 2015 to expand registered apprenticeship into high-growth occupations and industries and to increase registered apprenticeship opportunities for all Americans. DOL awarded \$175 million to 46 grantees to expand *registered apprenticeship* into sectors with few apprenticeships, such as healthcare and information technology (IT), and to populations traditionally underrepresented in registered apprenticeship, including women, young men and women of color, adults with low skills, and veterans.

In 2016, DOL commissioned an evaluation of the AAI grants to build evidence about the effectiveness of registered apprenticeship for apprentices and employers. The AAI evaluation includes four sub-studies (Box 1). This report presents results from the employer return-on-investment (ROI) sub-study.

1.1 Registered Apprenticeship

Registered apprenticeship is a structured work-based training program that combines classroom instruction (*related technical instruction*, or RTI) with on-the-job learning (OJL) provided by a mentor at the employer's worksite. A registered apprenticeship provides training in a specific occupation and delivers occupational skills that are recognized and transferable across employers. Apprentices are employed during their training, contribute to production, and earn progressively higher wages.¹

AAI supports efforts to expand apprenticeships that are registered either with DOL's Office of Apprenticeship (OA) or with a federally recognized State Apprenticeship Agency (SAA). A *registered apprenticeship* adheres to guidelines around the duration of RTI and OJL. A sponsor is responsible for the program and maintains the Standards of Apprenticeship, which documents the RTI, OJL, wage steps, and other aspects of the registered apprenticeship. Sponsors can be a single employer; a consortium of employers; or any of a range of community colleges, workforce agencies, and community-based organizations. Those apprentices who complete their registered apprenticeship training receive an industry-recognized credential (see Box 2 below).²

Box 1: AAI Evaluation Sub-studies

- An **implementation study** of the grantee apprenticeship programs
- A study of apprentice employment and earnings **outcomes**
- A study measuring the **return on investment** to employers
- An **employer engagement demonstration** that explores the impacts of training staff to market apprenticeships to employers

Because employers hire apprentices, pay their wages, and commit to developing their technical skills through OJL from mentors and RTI, their buy-in to registered apprenticeship is essential to expand registered apprenticeship in the United States. However, except for the building trades, American employers have not adopted registered apprenticeship in large numbers as a workforce development strategy. Reasons for this phenomenon include employer assumptions that their current training is sufficient for their business needs; that colleges will bear the main responsibility for career preparation; that the limited occupational range of existing registered apprenticeships is limited; that developing and

¹ For example, wage increases can be tied to demonstration of skills mastery, completion of specified components, and time in the program (e.g., increases annually). Wage increases are documented in the Standards of Apprenticeship for the particular occupational program. See <https://www.apprenticeship.gov/employers/registered-apprenticeship-program> for further details on registered apprenticeship.

² More information on registered apprenticeship is located here: <https://www.apprenticeship.gov/employers/registered-apprenticeship-program>.

registering an apprenticeship is onerous; or that employers are unfamiliar with how to start and register an apprenticeship program (Lerman 2012).

Many AAI grantees dedicate staff to employer outreach to promote registered apprenticeship as a viable training option for a range of industries and occupations and to address uncertainty about burden associated with developing and operating a registered apprenticeship program (Gardiner et al. 2021). The present research is designed to examine two factors that could help expand registered apprenticeship: (1) demonstrating that investments in registered apprenticeship are in line with employers' business goals, and (2) the benefits of registered apprenticeship outweigh the costs.

1.2 Assessing Employer Costs and Benefits

During the registered apprenticeship, **employer costs** include paid wages and benefits to the apprentice, training costs associated with RTI, potentially reduced productivity of some experienced staff while they are mentoring or training the apprentice, and costs related to registering the program (usually in staff time to complete the accompanying paperwork).

Benefits that may accrue to employers include **direct benefits** such as the value of the output or service produced by the apprentice and the reduced costs of hiring and filling a skilled labor position from the labor market. **Indirect benefits** include reductions in turnover, improved morale, and an enhanced talent pipeline. In the evaluation team's experience designing and fielding the Employer Survey and the experience of other researchers studying employer ROI (e.g., Helper et al. 2016) indirect benefits are particularly difficult to quantify and monetize.

Some research suggests positive returns to employer registered apprenticeship investments in the United States (Lerman, Eyster, and Chambers 2009; Helper et al. 2016; Payne 2020; North Carolina Apprenticeship Program Survey Report 2020), but most quantitative studies consist of individual case studies.³ Much of the literature describing the costs and benefits employers can experience by investing in apprenticeship focuses on employers in other countries, where apprenticeship is well integrated into the workforce training and education system and is more commonly used to train potential workers than it is in the United States (Lerman 2016). The institutional differences in apprenticeship and the labor market between the United States and other countries make it difficult to generalize results. Dionisius et al.

Box 2: Elements of Registered Apprenticeship

- **Approval** by DOL's Office of Apprenticeship or a State Apprenticeship Agency, or sometimes both
- **Related technical instruction** (RTI) of at least 144 hours in a physical or virtual classroom
- **On-the-job learning** (OJL) of at least 2,000 hours overseen by a mentor at the employer's job site
- **Wage increases** over the course of the apprenticeship (wage progression), which can be tied to time in the program or to demonstration of skill competency
- An **industry-recognized credential** upon completion of the apprenticeship
- A **Standards of Apprenticeship** document that describes the work process schedule (skill standards) and specifies the RTI, OJL, and wage progression for the registered apprenticeship program
- A **sponsor** to oversee the program and maintain fidelity to the Standards of Apprenticeship and collect basic data on apprentices; sponsors can be employers, consortia of employers, unions, community colleges, state or local workforce agencies, or non-profits
- A **written apprenticeship agreement** between an apprentice and either the program sponsor or an apprenticeship committee acting as an agent for the sponsor

Source: Gardiner et al. (2021)

³ The only ROI study on apprentices in the United States identified with a larger sample size than the current study is one conducted on AAI employers as a part of the South Carolina Technical and Community College System's AAI grant. Although the results of that analysis have not been released (as of the writing of this report), the authors of the study publicly shared preliminary results showing a 5-year cumulative net return of \$0.41 for every dollar invested in apprenticeship, and a 7-year cumulative net return of \$1.35 for every dollar invested in apprenticeship.

(2009) and Muehleman et al. (2010) show that even relatively similar national apprenticeship systems, such as those of Germany and Switzerland, differ considerably in their employer costs and benefits.

This study estimated the returns using two measures—net benefits and return on investment:

- **Net Benefits:** Net benefits (or net present values) were calculated by subtracting the costs of a program for the employer from the benefits of the program for that employer and discounting the net benefits to adjust for the time value of money. A *positive* (+) net benefit suggests that the program generated a larger benefit over the specified time frame than it cost. A *negative* (–) net benefit suggests that the program incurred a larger cost over the specified time frame than its benefit. In this report, net benefits estimates are provided in 2020 dollars.

Net benefits evolve over time. For registered apprenticeship, net benefits may be negative at the beginning of a registered apprenticeship program due to large early investments in it (e.g., registering the program, the cost of apprentice wages while they are not fully productive, the cost of mentor wages while they are supervising apprentices). Over time, registered apprenticeship programs may yield positive net benefits as apprentice and mentor productivity improve and employers incur fewer RTI or supply and wastage costs.

- **Return on Investment:** The return on investment of a program was calculated by subtracting the costs of a program from the benefits of the program and then dividing that value by the costs. Return on investment is typically presented as a percentage of the investment, but it can also be converted so employers will understand how much money in dollars they can expect for every dollar of investment. For example, employers with a 10 percent return on investment could say that they earn \$110 for every \$100 invested.

This report systematically measures the employer costs and benefits from investing in registered apprenticeships across a wide range of industries. Using an **Employer Survey**, the evaluation team documented employer characteristics, program characteristics, costs, benefits, and other information for 68 employers affiliated with AAI grantees.⁴

1.3 Research Questions and Study Limitations

The study answered the following research questions about employers of registered apprentices associated with an AAI grantee:

- What are the benefits to employers during and soon after the registered apprenticeship periods in their organizations? What are the costs? What are the implied returns on investment?
- What is the value of the production generated by apprentices during the registered apprenticeship period?

Box 3: Difference between Net Benefits Estimates and Return-on-Investment (ROI) Estimates?

- **Net benefits estimates** provide an average dollar value of the per-apprentice benefits that employers can expect by investing in apprenticeship. This number is not scaled by the employer investment so it may seem like a large benefit to some employers and a small benefit to others.
- **ROI estimates** provide a ratio value. For example, a ROI estimate of .07 would suggest that an employer would receive a 7% return on its apprenticeship investment. This estimate can then be turned into a dollar value estimate using the specific dollar investment that any particular employer plans to make.

⁴ The Paperwork Reduction Act requires that agency information collections minimize duplication and burden on the public, have practical utility, and support the proper performance of the agency's mission. The Information Collection Review for the AAI Employer Survey is available at: https://www.reginfo.gov/public/do/PRAViewICR?ref_nbr=201903-1290-003. The OMB Control Number is 1290-0028.

- Do employers experience indirect or other benefits from registered apprenticeship beyond the direct productivity increases, such as recouping the costs of employee recruitment, hiring and training costs; employee retention?
- Do employers experience indirect or other benefits beyond the direct productivity increases experienced by apprenticeship, such as improved talent pipelines or improved corporate culture?

Though this study is an important expansion of previous literature, it does have limitations.

- The employers were not necessarily representative of all employers of apprentices. The study included only employers connected with the AAI, including employers that started their registered apprenticeship programs during the grant period.
- Although 68 employers completed the AAI Employer Survey, relatively few of the surveyed employers operated registered apprenticeship programs in the same occupation. For example, though many employers were training apprentices in healthcare occupations, only a few were training pharmacy technicians or medical assistants. Due to the diversity in occupational programs operated by surveyed employers, the evaluation team did not report estimates for specific occupations, but instead produced estimates for four broad industries: healthcare, IT, advanced manufacturing, and “other” occupations. If registered apprenticeship is associated with different net benefits across occupational titles, these broad occupational categories may inadequately capture the variation.
- Estimates for most of the period after the end of the registered apprenticeship are projections using statistical modeling. These estimates reflect what the evaluation team thinks is likely to occur based on a set of assumptions grounded in the literature, reported data for the registered apprenticeship period and the first year after the registered apprenticeship, and subject matter expertise. These models are described in the Appendix.
- The analysis did not capture the “option value” of having an already trained worker on hand if skilled workers are difficult to obtain in the context of an uncertain future, due to labor shortages, or other difficulties (Lerman 2017). The option value of apprenticeship could be explored in future research efforts.
- Finally, monetizing indirect benefits is challenging (Helper et al. 2016). Survey questions asked employers to compare a set of indirect benefits to the value of the apprentice’s productivity gain, which can be difficult to answer. Also, linking the value of benefits for the entire program to a specific apprentice’s productivity might not fully capture the gains for employers, especially employers with large numbers of apprentices.

1.4 Organization of the Report

The remainder of this report is divided into six chapters. **Chapter 2** describes the data and estimation methods used to support the study. **Chapters 3** describes employer and program characteristics of surveyed employers. **Chapter 4** describes employer investments and returns during the registered apprenticeship program period. **Chapter 5** provides estimates of employer returns after the apprentice has completed their registered apprenticeship. **Chapter 6** provides estimates of the total returns employers can expect by investing in registered apprenticeship across the total program period. **Chapter 7** summarizes the findings and provides some insights on future research. The **Appendix** provides full details of the estimation methods used for the net benefits and ROI estimates.

2. Study Data and Methodology

As described in Chapter 1, this study estimated employer returns using net benefits and ROI. An important element driving these estimates was the timing of when employers sustained costs and when benefits accrued. The Employer Survey aimed to capture all the costs and benefits comprising a registered apprenticeship investment and their timing. This chapter first describes the Employer Survey and then outlines methods used to calculate employer net benefits and ROI.

2.1 Employer Survey

The evaluation team fielded the AAI Employer Survey from March 2020 through October 2020. Employers can be difficult to interview due to competing demands on their time and their often indirect connection to the AAI grantee. To facilitate survey administration and attain higher response rates, the evaluation team asked each grantee to identify two or three employers as candidates for the survey. Grantees nominated employers for a variety of reasons, such as their perceptions of an employer's willingness to respond to the survey, the strength of the relationship the grantee had with the employer, and the industry or occupation represented by the employer's registered apprenticeship program.

Employers were not randomly selected, but they represented a broad cross section of employers affiliated with AAI grantees. Employer participation in the survey was voluntary, and of the 100 employers contacted, 68 employers, affiliated with 40 grantees, completed it for a response rate of 68 percent.⁵ Chapter 3 provides more information on the characteristics of these employers and their registered apprenticeship programs.

For the survey, each participating employer select one AAI "reference apprentice" who completed their program and whose individual experience the employer would use in answering the survey items. Limiting responses to this reference apprentice ensured that employers could respond to questions regarding each step of the registered apprenticeship program. It also allowed employers to pull compensation information directly from their human resources systems. Reporting on a reference apprentice also helped employers to accurately characterize the experiences of a real program participant, rather than an idealized one.

Box 4: Selecting the "Reference Apprentice"

The survey asked employers to provide information about a "reference apprentice" who already had completed the employer's apprenticeship program. Employers then reported the wages, productivity, and retention information of this specific apprentice.

To prevent employers from reporting on their most successful apprentice instead of a typical one, the evaluation team had employers select from their first cohort of AAI apprentices the apprentice whose name appeared first alphabetically and had completed the program. If the employer did not hire in cohorts, it was to select from its earliest AAI apprentice hires.

Selecting the reference apprentice from the first cohort meant employers would have had as much time as possible to accumulate post-program benefits.

As Exhibit 2-1 shows, the Employer Survey collected information on employer characteristics, registered apprenticeship program characteristics, apprentice productivity and compensation during the registered apprenticeship program and after completion, mentor productivity and compensation during the registered apprenticeship program, the compensation of a fully qualified worker, and the indirect benefits that

⁵ The Employer Survey fielding period coincided with operational changes related to the COVID-19 pandemic. Some employers saw significant changes to their business operations because of the pandemic, and this may have been a factor in nonresponse. Many employers, particularly in healthcare and IT, were still operating during the pandemic even if their operations were disrupted, however. Because the Employer Survey primarily covered prior experiences of the employer or experiences early in the COVID-19 pandemic, the pandemic was unlikely to have had a major impact on findings.

employers experienced by investing in registered apprenticeship. Because not all apprentices completed their programs, the survey also asked employers about retention rates at each wage step and attrition after the end of the program. The team used these retention rates to deflate net benefits, to appropriately account for the fact that some of the apprentices that employers invested in left before the employer might fully realize the return on their investment.

Two-person teams conducted surveys by phone or videoconference, with one member leading the call and the second filling out the survey in real time as the employer answered questions. A more detailed description of these data is provided in the appendix.

Exhibit 2-1. Summary of AAI Employer Survey Categories

Category	Survey collected information on...
Employer Characteristics	Industry, recruitment practices and costs, size, training costs for the apprentice occupation
Program Characteristics	Name, occupational focus, program type, cohort size, cohort retention, duration (months), number of wage steps
In-program Information	<p><i>Apprentice-level:</i> hourly wage at each wage step, paid hours worked at each wage step, value of apprentice non-wage benefits, apprentice productivity at each wage step</p> <p><i>Mentor-level:</i> hourly wage at each wage step, hours spent supervising apprentices at each wage step, mentor productivity while supervising apprentices at each wage step</p> <p><i>Other:</i> value of training supply wastage, tuition for related technical instruction, financial assistance provided by the grantee to the employer</p>
Post-program Information	<p><i>Apprentice-level:</i> retention at the company, number of months apprentice has worked at the company since beginning of the registered apprenticeship, wage at program completion, current wage, number of weekly hours worked</p> <p><i>Similarly qualified non-apprentice worker:</i> hourly wage, number of weekly hours worked, productivity as a percentage of apprentice productivity</p>
Other Costs and Benefits	<p>Program registration cost</p> <p><i>Value of indirect benefits</i> including reduced turnover, improved pipeline of skilled employees, development of future managers, improved productivity of co-workers, improved company or organization culture, product or process innovation, employee engagement and loyalty, reduced use of overtime or temporary workers, reduced downtime, more on-time delivery</p>

Source: AAI Employer Survey.

2.2 Estimation Methods

This section describes how the evaluation team valued some of the more intangible employer costs and benefits. The Appendix provides details on the methodology.

2.2.1 Valuing Employer Costs

To generate cost estimates, the evaluation team first examined a complete list of employer costs related to registered apprenticeship investments. The total employer cost for an apprentice was the sum of the apprentice’s total compensation including their non-wage benefits; the cost of the mentor’s reduced productivity while supervising the apprentice; the employer-paid costs of RTI; the cost of training materials, tools, and supply wastage; and per-apprentice program registration costs. Any subsidies employers received from the AAI grantees, such as payments to cover RTI, were allocated to individual apprentices and then subtracted from the dollar value of total costs in calculating estimates.

Though some costs (e.g., tuition for RTI) were easily incorporated in the net benefits and ROI estimates, other costs had to be calculated. The following sections briefly describe how the evaluation team calculated apprentices' total compensation as well as how the team valued the monetary cost of lost mentor productivity.

- **Apprentices' Total Compensation:** Apprentices' total compensation over all steps of a registered apprenticeship program was the largest cost employers experienced when investing in registered apprenticeship. Apprentices' total compensation was measured as the sum of the wage and non-wage costs spent on one apprentice during the apprenticeship program. Most employer programs (47 out of 68) had more than one wage step. Apprentice wages increased as apprentices progressed to each new wage step, and the number of hours apprentices spent in paid OJL or RTI often varied from step to step.
- **Lost Mentor Productivity:** When mentors trained and supervised apprentices, they may have been less productive than when they were doing their regular work. Reduced mentor productivity while supervising apprentices was therefore a potentially important cost for employers. The Employer Survey asked for mentors' wages, hours spent mentoring, and *relative productivity* (see Box 5) while mentoring for each wage step of the registered apprenticeship program. The team calculated lost productivity by multiplying the mentor's wage by 100 percent minus the reported relative productivity of the mentor and the hours spent mentoring. Mentor wages did not typically vary by apprentice wage step, but their productivity and time spent mentoring could change over time.⁶

Box 5: Calculating "Relative Productivity"

The survey asked employers to estimate both apprentices' and mentors' relative productivity.

- For apprentices, this meant that the employers reported the apprentices' productivity as a percent of the productivity of a fully qualified worker doing the same job.
- For mentors, this meant that the employers reported the mentors' productivity as a percent of their productivity when not supervising or training apprentices.

Apprentice compensation and lost mentor productivity, along with tuition and fees for RTI and supply and wastage costs, were either reported or calculated for each wage step. The evaluation team allocated these costs to each week within the wage step outlined in the Standards of Apprenticeship so costs could be adjusted to reflect retention rates reported by the employer, inflation, and a discount rate. These adjustments accounted for the fact that not all registered apprentices remain with the employer for the whole program (the retention rate), the value of the dollar changes over time (the inflation rate), and for the time value of money (the discount rate). Allocating these costs on a weekly basis meant reporting could be consistent across registered apprenticeship programs, as wage steps were not of standard durations across employers or apprentices. The team then summed values across wage steps to generate the apprentice's total compensation across wage steps.

The Employer Survey also asked about the cost of registering an apprenticeship program. This cost was divided by the number of apprentices in the program, but it was not allocated to each week of the program, nor was it adjusted for retention, inflation, or a discount rate. This method overestimated the per-apprentice registration costs because more apprentices will likely participate in the future.

⁶ Some mentors might have become more productive by enhancing their understanding of various tasks as they taught apprentices. Employer respondents might or might not have taken this possibility into account in reporting on lost mentor productivity.

2.2.2 Valuing Employer Direct and Indirect Benefits

As described above, employers experienced two types of benefits by investing in registered apprenticeship programs:

- Direct Benefits:** One component of direct benefits was the value of the apprentices' productivity during the registered apprenticeship itself. In most apprenticeships, an apprentice initially works at tasks that may have low productivity relative to the apprentice's wage. As the registered apprenticeship proceeds, the apprentice undertakes tasks of increasing value, ultimately at the productivity level of fully qualified workers in the occupation. The apprentice becomes trained in the occupational skills demanded by the employer and does so in the context of the employer's specific policies, procedures, and equipment. Survey respondents provided estimates of apprentice productivity relative to a fully qualified worker at each wage step of the registered apprenticeship. For the post-program period, the team projected the value of the apprentice's post-program contribution to production minus the post-program compensation of the apprentice, yielding a direct net benefit calculation.
- Indirect Benefits:** These include 10 benefits, such as reduced turnover, improved work culture, and improvements in other workers' productivity (Box 6). Indirect benefits of registered apprenticeship are measured and monetized using a two-question sequence in the AAI Employer Survey. The first question asked employers whether any of the 10 possible indirect benefits have improved their company's performance in the short-run or long-run. The second question asked about the importance of these benefits for the apprenticeship program relative to the benefit of the apprentice's increased productivity. Employers' reports on the value of each indirect benefit relative to the value of the apprentice's increased productivity was then multiplied by the value of the apprentice's increased productivity to determine the value of the indirect benefits for the program. Dividing these total net benefits by the number of apprentices in the occupation yielded an estimate of the indirect effects per apprentice.⁷ Additional details are provided in the Appendix.

Box 6: Indirect Benefits of Apprenticeship Included in the AAI Employer Survey

- Reduced turnover
- Improved pipeline of skilled employees
- Development of future managers
- Improved productivity of co-workers
- Improved workplace culture
- Product or process improvement
- Employee engagement and loyalty
- Reduced use of overtime
- Reduced downtime
- More on-time delivery

To monetize the reference apprentice's productivity, the employers estimated that apprentice's productivity as a percentage of the productivity of a fully qualified worker at each wage step.⁸ The team multiplied this relative productivity level by the wage of a fully qualified worker.

The team discovered while administering the survey that different employers interpreted the concept of a *fully qualified worker* differently, depending on their industry and their registered apprenticeship program (Box 7). Some employers reported apprentices' productivity relative to a peer holding the same job who was paid a wage similar to the apprentice's. Other employers reported productivity relative to a worker in the same job with more advanced skills that the apprentice aspired to learn.⁹ Because each employer's fully qualified worker could have had different levels of skills, experience, and hourly wage relative to the

⁷ Post-survey attempts to clarify the employers' reports indicated that for large programs, dividing the total indirect benefits by the number of apprentices understated the indirect benefits per apprentice.

⁸ An approach used by Gambin and Hogarth (2016) and Payne (2020).

⁹ These interpretations of the survey question became clear only because the AAI Employer Survey was administered as a structured interview, with employers and evaluation team members discussing the employers' answers. The evaluation team's experiences suggest that complicated ROI concepts are best studied through active methods of data collection, rather than passive administration of surveys.

apprentice's, the evaluation team calculated three estimates of the value of the apprentice's productivity to capture the uncertainty of the benefit estimates. The team used these estimates, each of which reflected a different fully qualified worker with different levels of skill and experience, in the calculations of net benefits and ROI. More details on the calculation of these estimates are provided in the Appendix:

- High estimate of the value of the apprentice's productivity:** The team assumed that the reported relative productivity of the reference apprentice referred to the value of the mentor's productivity. Mentors typically have more skills and years of tenure than apprentices and are often highly experienced and highly paid. Estimates that compared the value of mentor productivity to apprentice productivity would be the highest estimates, because mentors are typically paid a higher hourly wage than other estimates of qualified workers.¹⁰
- Medium estimate of the value of the apprentice's productivity:** The medium estimate of the value of the reference apprentice's production was set equal to the higher of (1) the wage of the apprentice after completion of the program or (2) the wage of a qualified worker that the employer would have hired in the absence of the registered apprenticeship program.
- Low estimate of the value of the apprentice's productivity:** The low estimate of the value of the reference apprentice's production was the wage of the qualified worker that the employer reported it would have hired in the absence of the registered apprenticeship program. The low estimate differed from the medium estimate when the wage of the apprentice after the completion of the program was higher than the wage of this hypothetical qualified worker.

Box 7: The "Fully Qualified Worker"

Employers described the relative productivity of their reference apprentice compared to a "fully qualified worker" – an employee doing similar work to the reference apprentice who was not in the apprenticeship program.

Different employers, however, interpreted "fully qualified worker" differently, with some choosing more- or less-qualified comparison employees.

To account for this variability, the evaluation team calculated three different estimates of the value of the reference apprentice's productivity.

The Employer Survey only collected information on costs and benefits shortly after the reference apprentice completed the program. Because employers continue to benefit from a well-trained employee, estimating and including post-apprenticeship benefits is appropriate. To project net direct benefits into the future, the team used a statistical model that captured how adjusted net benefits¹¹ changed as a function of time through the first year after the apprenticeship. The evaluation team used this model to project net benefits 5 years beyond the end of the registered apprenticeship program. Details of the statistical model appear in the Appendix.

Although indirect benefits were not directly observed, the evaluation team recognized their potential importance and developed an approach to monetize them. It first asked employers whether they experienced each of the indirect benefits listed in Box 6. If an employer answered yes for any particular benefit, the interviewer then asked the employer to estimate the value of that benefit compared to the value of the apprentice's gain in productivity over the program period. Employers could report that, compared to the value of the benefit of increased productivity, the indirect benefit was not important, 50 percent as important, 100 percent, 150 percent, or 200 percent as important as the value of the apprentice's gain in productivity. For example, if an employer noted that reduced turnover was 100 percent as valuable as the apprentice's gain in productivity, the evaluation team valued that benefit as

¹⁰ This high estimate is similar to the value used for Payne's (2020) ROI analysis of the second industrial manufacturing technician sponsor included in his study, which used a journeyperson's wage to value the apprentice's productivity.

¹¹ The adjusted net benefits already accounted for inflation and the discount rate.

being equal to the dollar value of the reference apprentice's productivity gain from the beginning of the registered apprenticeship to its completion.

The survey asked employers to consider the value of these indirect benefits from hiring apprentices (not just the reference apprentice) and in both the short and long run, so these benefits were not associated with individual wage steps or individual apprentices. The evaluation team divided total indirect benefits by the number of apprentices in the cohort to obtain a per apprentice benefit that can be added to other benefits specific to an individual apprentice. Dividing by the total apprentices in a cohort may deflate the indirect benefits experienced by employers with many apprentices in the cohort.¹² The per apprentice indirect benefit was allocated to each week of the study period for that apprentice, including the post-program period. After allocating indirect benefits to weeks, these benefits were adjusted by the discount rate.¹³

¹² Follow-up clarification calls with a few large employers indicated that in some cases, dividing by all apprentices in the cohort understates indirect benefits per apprentice.

¹³ Indirect benefits were not adjusted by the retention factor because they were associated with the whole program, not the individual apprentice. Indirect benefits were also not adjusted for inflation because the value of the growth in the apprentice's productivity, which was used to attach a monetary value to the indirect benefit, was already adjusted for inflation.

3. Employer and Registered Apprenticeship Program Characteristics

This chapter describes the characteristics of the employers and their registered apprenticeship programs included in the study. Both provide important context for interpreting findings. For example, employer size could affect the costs and benefits employers might experience if there were economies of scale associated with registered apprenticeship training. Registered apprenticeship duration could also affect costs and benefits. Shorter programs could reduce compensation costs as the apprentice was paid for a shorter time, but if shorter programs provide less robust training, they could have fewer direct productivity benefits.

The employers that responded to the survey are not representative of all employers associated with AAI grantees or all employers involved in registered apprenticeship generally. All but one AAI grantee focused on expanding registered apprenticeship into industries and occupations that have not traditionally used registered apprenticeship as a training model. Employers affiliated with AAI grantees most often used registered apprenticeship programs in advanced manufacturing, healthcare, and IT sectors. Similarly, employers that responded to the survey were much less likely to participate in group joint apprenticeship programs than is typical in the registered apprenticeship system. Thus, though findings cannot be extrapolated to employers that operate registered apprenticeships generally, they are valuable for understanding the experiences of employers in nontraditional occupations new to registered apprenticeship and where apprenticeship is expanding.

3.1 Employer Characteristics

- ***Almost 60 percent of surveyed employers operated in advanced manufacturing and healthcare industries.***

Employers responding to the AAI Employer Survey represented a broad range of industries (Exhibit 3-1). Fifty-nine percent engaged in either the healthcare and social assistance industry (24 percent) or the manufacturing industry (35 percent). The remaining employers were widely distributed across other industries. Historically, apprenticeship in the United States has been concentrated in the construction industry and, at much lower levels, in manufacturing (Gardiner et al. 2021). One goal of the AAI grant program was to expand registered apprenticeship into other industries that have not substantially used the apprenticeship model. Although two apprentices in the same occupation may have similar experiences across industries, the profit margins and cost structures of employers are determined in part by their industries. Because profit margins and cost structures vary across industries, it was important for the AAI Employer Survey to have strong representation of a range of industries in addition to a variety of occupations.

One reason for the wide distribution of employer-reported programs across many industries is that IT apprentices are employed in multiple industries, including but not limited to the information industry itself (which included publishing, data processing, telecommunications, etc.). For example, employers that trained apprentices in IT occupations operated computer support specialist programs (3 employers), IT generalist programs (1 employer), and software engineer programs (2 employers), among others. An apprentice training in an IT occupation, for example, could be employed by a manufacturing company, a public school system, or an insurance company. These employers would not be in the information sector, but they did have demand for IT professionals. ROI and net benefits estimates reported here by broad occupational category therefore reflect the experiences of employers across multiple detailed industry categories.

Exhibit 3-1. Distribution of Surveyed Employers across Industries

Employer industry	Number of employers	Percentage of employers
Manufacturing	24	35
Healthcare and Social Assistance	16	24
Transportation and Warehousing	6	9
Educational Services	4	6
Finance and Insurance	3	4
Information	3	4
Professional, Scientific, and Technical Services	3	4
Utilities	3	4
Construction	2	3
Arts, Entertainment, Recreation	1	2
Other (Not Specified)	1	2
Other Services	1	2
Real Estate, Rental, and Leasing	1	2
Total	68	100%

Source: AAI Employer Survey. N=68.

Note: Total percentages do not add to 100% because of rounding.

■ **Employer respondents represented the full geographic range of the AAI grantees.**

Earlier research on costs and benefits associated with registered apprenticeship was limited in geographical scope (e.g., Hollenbeck and Huang’s (2016) research on Washington state or Reed et al.’s (2012) analysis of ten states) or by focus on single employers (Helper et al. 2016) and thus not representative of apprenticeship programs registered with DOL’s OA. Additionally, registered apprenticeship expansion efforts varied across states (Rosenberg and Dunn 2021). For these reasons, the evaluation team sought employer respondents from all DOL OA regions. As Exhibit 3-2 shows, each region is represented in the Employer Survey, with the largest number of employers (32 percent) operating in Region 5. The concentration of employers in the Midwest was due in part to the high concentration of AAI grantees in that region. The net benefits and ROI results may be more generalizable to employers located in similar regions of the country that have more significant representation in the Employer Survey.

Exhibit 3-2. Distribution of Surveyed Employers across Office of Apprenticeship Regions

Office of Apprenticeship Region	Number of employers	Percentage of employers
Region 1 (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Puerto Rico, Rhode Island, Vermont, Virgin Islands)	11	16
Region 2 (Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, West Virginia)	9	13
Region 3 (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee)	5	7
Region 4 (Arkansas, Colorado, Louisiana, Montana, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, Wyoming)	2	3
Region 5 (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, Ohio, Wisconsin)	22	32
Region 6 (Alaska, Arizona, California, Guam, Hawaii, Idaho, Nevada, Northern Mariana Islands, Oregon, Washington)	19	28
Total	68	100

Source: AAI Employer Survey. N=68.

Notes: Total percentages do not add to 100% because of rounding.

■ **Almost three-quarters of AAI employers surveyed were mid-sized or large.**

Employer costs and benefits per apprentice may be related to the employer’s size due to economies of scale. Larger employers operate at a larger scale, so they may have better staffed human resources departments or they may be able to distribute administrative and other overhead costs over a greater number of apprentices. Furthermore, larger employers could have broader, better developed career ladders to accommodate a more regular flow of apprentices through a registered apprenticeship program. In the United Kingdom, some larger employers train apprentices for smaller employers in “over-training” arrangements to take advantage of these types of economies of scale (Lewis 2014). Larger employers also pay higher wages than smaller employers, on average, a phenomenon known as the “employer size wage effect” (Brown and Medoff 1989; Bloom et al. 2018), which could raise apprentice and mentor compensation costs.

Seventy-four (74) percent (almost three-quarters) of employers surveyed employed more than 100 full-time equivalents (FTEs) at the reference apprentice’s place of employment (Exhibit 3-3). Nine businesses with fewer than 50 FTEs were included in the sample. As such, net benefits and ROI estimates may be more generalizable to mid- and large-sized employers than small employers.

Exhibit 3-3. Surveyed Employers’ Full-time-equivalent Employees at the Apprentice’s Place of Employment

Employer Size	Number of employers	Percentage of employers
Fewer than 50 full-time equivalents	9	13
50 to 99 Full-time equivalents	9	13
100 to 500 Full-time equivalents	29	43
More than 500 full-time equivalents	21	31
Total	68	100

Source: AAI Employer Survey. N=68.

3.2 Registered Apprenticeship Programs

In addition to collecting information on employers’ registered apprenticeship programs, the AAI evaluation documented the occupations of all registered apprentices supported by AAI grant funds. Grantees aimed to register apprenticeship programs in high-growth, non-traditional occupations and industries, including healthcare, IT, and advanced manufacturing. The employers responding to the Employer Survey reflected these AAI priorities.

A larger proportion of AAI Employer Survey respondents than AAI apprentices generally were associated with a registered apprenticeship program in healthcare or IT occupations, and a lower proportion were affiliated with a construction occupation. Registered apprenticeship programs varied in duration, but AAI apprenticeship programs were typically shorter than registered apprenticeship programs nationally (Gardiner et al. 2021). Most respondents to the Employer Survey participated in “non-joint” apprenticeship programs; that is, the sponsoring organization was not a joint labor-management organization. Only 10 percent of survey respondents participated in multi-employer programs sponsored by joint labor-management organizations. Finally, apprentice starting wages varied widely, ranging from \$8.50 per hour to \$48 per hour. The mean hourly wage of reference apprentices at surveyed employers was \$18.89, or about \$40,000 annually.

■ **The occupations reported in the AAI Employer Survey were like the occupations of all AAI apprentices.**

Employer Survey respondents reported the specific occupations for which they offered registered apprenticeships. Given the large number of occupational titles employers reported for their programs, the

evaluation team aggregated occupations into broad categories. Thirty-four percent of programs reported by employers were advanced manufacturing occupations; healthcare and IT occupations each accounted for approximately one-sixth of programs (18 percent). The remaining programs were a mix of other occupations (Exhibit 3-4).

Exhibit 3-4. Distribution of Surveyed Employers across Broad Occupational Categories

Category	Number of employers	Percentage of employers
Advanced manufacturing occupations	23	34
Healthcare occupations	12	18
Information technology occupations	12	18
Other occupations	21	31
Total	68	100

Source: AAI Employer Survey. *N*=68.

Note: Total percentages do not add to 100% because of rounding.

This distribution of apprentices was similar to the distribution of all AAI apprentices across occupational categories (Gardiner et al. 2021), although apprentices nationally are far more concentrated in the building trades.^{14,15} Most registered apprenticeship programs lasted 2 years or less. The average cohort size for registered apprenticeship programs was 10 apprentices.

Employers reported how long their registered apprenticeship program usually took to complete (Exhibit 3-5). The duration of a registered apprenticeship program is a potentially substantial factor in the costs and benefits experienced by employers. Longer registered apprenticeship programs are likely to incur more significant training costs than shorter registered apprenticeship programs, but the more intensive training provided by longer programs could be more effective at raising the productivity of completers than shorter programs. The duration of registered apprenticeship training was closely tied to the occupation and industry of the program. Gardiner et al. (2021) reported that for programs supported by AAI grantees, program duration was longest for construction programs (3.4 years, on average), the shortest for healthcare and IT programs (1.4 years), with advanced manufacturing in between (2.5 years). Kuehn (2019) found that longer registered apprenticeship programs (lasting 2 to 4 years) paid higher hourly completion wages, on average, than did shorter programs (1 to 2 years).

Employers responding to the AAI Employer Survey reflected this variation in program durations. Almost two-thirds (65 percent) of programs in the survey lasted 24 months or less, reflecting the large number of healthcare and IT programs in the sample. Programs lasting 4 years were also relatively common, with 22 percent of employers' programs lasting 37 to 48 months, and most of those exactly 4 years.

Regulations require that registered apprenticeship programs include at least 2,000 hours of OJL,¹⁶ but some registered apprenticeship programs provided credit for prior RTI or OJL. It is possible that the four employers (6 percent) that reported their program took less than a year to complete awarded prior credit.

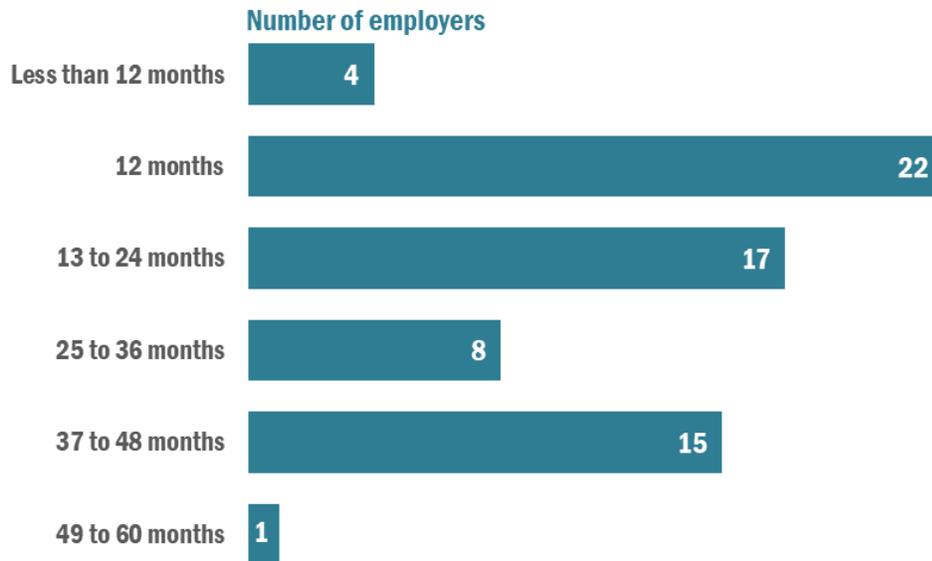
¹⁴ Gardiner et al. (2021) showed that for all AAI apprentices, a somewhat higher share was registered in construction programs and somewhat lower share in healthcare and IT than programs employers described in the survey.

¹⁵ In the 25 states where DOL's Office of Apprenticeship manages program registration, 68 percent of active apprentices were registered in the building trades in 2020. Authors' calculations from data reported at <https://www.dol.gov/agencies/eta/apprenticeship/about/statistics/2020>.

¹⁶ Labor Standards for the Registration of Apprenticeship Programs (Title 29, CFR Part 29).

Awarding prior credit sometimes occurs in registered apprenticeship programs that target incumbent workers, and over half (53 percent) of AAI apprentices were incumbent workers (Gardiner et al. 2021).¹⁷

Exhibit 3-5. Distribution of Surveyed Registered Apprenticeship Program Duration



Source: AAI Employer Survey. N=68.

A single employer could participate in multiple registered apprenticeship programs, each training apprentices in a different occupation. The Employer Survey asked employers how many AAI apprentices¹⁸ the employer hired cumulatively in its largest registered apprenticeship program at the time of the survey, and how many apprentices it hired in the typical cohort.¹⁹ The average number of AAI apprentices hired by the time of the survey was 42, with a median of 17 and a range between 1 and 398 apprentices. The median cohort size was smaller. Employers reported an average cohort size of 10 apprentices, with a median cohort of 7 apprentices and a range between 1 and 100 apprentices.

Most but not all AAI apprentices completed their registered apprenticeships, and not all apprentices who completed their registered apprenticeships remained with the employer that operated the apprenticeship after completing. The average completion rate reported for programs in the Employer Survey was 86 percent; the median was 93 percent. Walton et al. (2022) estimate that among all AAI registered

¹⁷ Almost a quarter (23.5 percent) of apprentices nationally received credit for prior experience or learning, based on authors’ calculations from the Registered Apprenticeship Partners Information Data System (RAPIDS) for apprentices registered between 2015 and 2018 who had an expected completion date of 2020 or earlier. Restricting the expected completion date ensured that apprentices had an opportunity to complete their programs, so that the completion rates were comparable to those reported in the Employer Survey.

¹⁸ An AAI grantee’s grant agreement determined when an apprentice was identified as an “AAI apprentice.” For example, a grant agreement might stipulate that an apprentice was considered an AAI apprentice only if their RTI was paid for out of the grant. In their initial conversations with employers, the survey interviewers determined what each employer’s agreement stipulated, to ensure that employers understood which apprentices to report as AAI apprentices.

¹⁹ Some employers did not hire apprentices in cohorts. They were asked to group apprentices in the way that made the most sense for their program. If apprentices were hired individually, employers might report the usual cohort size as being one apprentice. If apprentices were not hired at the same time in a cohort but were hired within a defined time period (e.g., a quarter or a year) and typically proceeded through training as a group, the employer might report the size of that group.

apprentices who were not currently registered at the time they were surveyed, the completion rate 70 percent.²⁰ Nationally, apprentices hired during the same period had an average completion rate of 51 percent at the time of the Employer Survey.²¹ Surveyed employers' high completion rates may reflect the possibility that grantees recommended especially successful employers for the survey. The percentage of reference apprentices who completed their registered apprenticeships and stayed at the firm was 90 percent. In other words, about 9 out of 10 AAI registered apprenticeship completers were retained by and chose to remain with their employer after completing their training.

■ **More than two-thirds of employers reported that their registered apprenticeship programs were offered on a non-joint basis.**

In the United States, registered apprenticeship programs are classified based on the sponsor (Box 8) along two dimensions: joint/non-joint and independent/group. Registered apprenticeship program type may be important for employers if the type has implications for employer costs and benefits. For example, a group program might reduce registration and program management costs, which are distributed over multiple employers. Joint programs may experience higher apprentice and mentor compensation costs if unionized workers are better paid or receive higher benefits; but unions may support important indirect benefits such as employee loyalty, reduced turnover, or improved company culture. Understanding how employers' net benefits varied across occupational program types can help policymakers, intermediaries such as industry associations, and other stakeholders tasked with increasing registered apprenticeship in the United States.

Box 8: Types of Apprenticeship Programs

- **Joint program:** sponsored by a joint labor-management organization, consisting of a labor organization (e.g., a union) and a management committee
- **Non-joint program:** sponsored without a labor organization
- **Independent program:** involving only one employer
- **Group program:** involving multiple employers

Source: 29 CFR § 29.2

Almost two-thirds of Employer Survey respondents (63 percent) operated as independent programs. For joint or group apprenticeship programs, employers were unlikely to be the sponsor. In a joint program, the employers often still would be represented on the labor-management organization. Most Employer Survey respondents (69 percent) reported that their registered apprenticeship programs were offered on a non-joint basis.

As shown in Exhibit 3-6, the least common type of program was a group joint program (10 percent). The most common program type was an independent non-joint program, which accounted for 43 percent of employers responding to the Employer Survey. During the same period, 59 percent of apprentices nationally were registered with group joint apprenticeship programs.²²

²⁰ At the time that the AAI Participant Survey was administered, 33 percent of the responding apprentices were still registered, and 67 percent were not registered. Out of all responding apprentices, 47 percent had successfully completed their program, 5 percent had been cancelled or suspended, and 15 percent left before completing. The 70 percent completion rate for apprentices who were not currently registered comes from dividing the 47 percent of apprentices who completed by the 67 percent of apprentices who were not registered.

²¹ Authors' calculations from the Registered Apprenticeship Partners Information Data System (RAPIDS) for apprentices registered between 2015 and 2018 who had an expected completion date of 2020 or earlier. Restricting the expected completion date ensured that apprentices had an opportunity to complete their programs, so that the completion rates were comparable to those reported in the Employer Survey.

²² Authors' calculations from RAPIDS data for apprentices registered between 2015 and 2018.

Exhibit 3-6. Distribution of Surveyed Employers across Registered Apprenticeship Program Type

Program Type	Number of employers	Percentage of employers
Independent non-joint program	29	43
Group non-joint program	18	26
Independent joint program	14	21
Group joint program	7	10
Total	68	100

Source: AAI Employer Survey. N=68.

Note: Group programs include multiple employers while independent programs include only one employer. Joint programs are sponsored by joint labor-management organizations while non-joint programs are not.

■ Reference apprentice wages varied considerably, with starting wages ranging from \$8.50 per hour to \$48 per hour.

The mean starting hourly wage for the reference apprentice was \$18.89, somewhat higher than the median hourly wage of \$16.93 for the reference apprentice. On an annual basis, average earnings for the AAI reference apprentice, not including non-wage benefits, worked out to approximately \$40,000, which was higher than the typical registered apprentice’s starting annual earnings nationally.²³ This may be attributable to the fact that AAI grants are H-1B funded and are required to target jobs that are high wage and in high demand. The minimum starting hourly wage in the sample was \$8.50, for a help desk technician, not far above the statutory federal minimum wage of \$7.25. The highest starting hourly wage in the sample was an outlier, \$48 for a software engineer. Most apprentices, though, had starting wages that fell within a narrower range. Starting hourly wages were \$14.50 for the 25th percentile employer and \$22.21 for the 75th percentile employer. The relatively high starting wages may reflect the fact that many apprentices were already working at the employer and were not newly hired workers.

The average hourly wage at completion of the registered apprenticeship for the reference apprentice was \$22.67, almost \$4 per hour higher than the average starting wage (\$18.89). As with the starting hourly wage, the completion wage varied considerably, from \$10.60 to \$70.80, with the highest wage going to a financial services professional paid on commission.

²³ The average starting earnings for an apprentice is frequently quoted as \$60,000 (e.g., Hanks, McGrew, and Zessoules 2018), although the source of this figure is unclear. Using RAPIDS data for all apprentices registered between 2015 and 2018 who had an expected completion date of 2020 or earlier, the authors calculated that the average apprentice starting wage was \$17.18, or about \$35,000 annually. To calculate this average, the authors removed wages that were less than the federal minimum wage (inmates registered in apprenticeship programs may be paid less than the federal minimum wage) and wages greater than \$100 per hour, which appeared to be erroneously recorded.

4. Employer Investments and Returns during the Registered Apprenticeship Program

Employers participating in registered apprenticeship programs make investments in individual apprentices (e.g., wages, tuition for RTI) and in the registered apprenticeship program (e.g., the compensation of one or more mentors, registration costs). Employers that hire apprentices pay these costs while the apprentice is being trained in anticipation of earning a *return*. Such a return is expected as the value of the apprentice’s contributions to production from the beginning of the apprenticeship and as an increasingly skilled employee with occupational- and employer-specific skills. This return can emerge during the registered apprenticeship program or in the years after the program. Because registered apprenticeship training is provided on the job, apprentices are productively employed throughout their program, and employers benefit from the value of this production. This chapter begins by reporting the **costs** employers incur and then turns to estimates of the **benefits and net benefits** that employers experience **during the training period**.

4.1 Registered Apprenticeship In-program Costs

The AAI Employer Survey collected data on five categories of costs paid by employers of AAI apprentices **during the registered apprenticeship** (“in-program”): (1) apprentice compensation (including wages and non-wage benefits), (2) tuition and associated costs for RTI, (3) the cost of mentors’ lost productivity, (4) registration costs, and (5) the costs of supplies and wastage (Box 9).

Box 9: Costs of Apprenticeship during the Apprenticeship Program

Apprentice compensation, including both wage or salary payments and non-wage benefits such as health insurance or employers’ share of payroll taxes. In the Employer Survey, employers could choose whether to report annual non-wage benefits in dollars or as a share of wages. Apprentice compensation includes both wages paid for OJL hours and, if applicable, for paid RTI hours.

Related technical instruction (RTI) tuition or fees paid by the employer, including community or technical college tuition and fees or payments made for RTI to a different training provider.

Mentor lost productivity while training the apprentice is measured in the Employer Survey as the reported reduced mentor productivity while mentoring the apprentice, multiplied by the total compensation of the mentor during the hours that they are with the apprentice.

Registration costs for the apprenticeship program, including the costs of staff time spent registering the program and any fees paid to partners or intermediaries.

Costs of supplies and wastage associated with training, but not including supplies used in production for sale.

All these costs, except the cost of registering, can change over the course of the registered apprenticeship program. The compensation of most apprentices increases during a registered apprenticeship program as they demonstrate competence in occupational skills and advance through the program’s wage steps.²⁴ As apprentices become more skilled, mentors may spend less time supervising them and wastage costs associated with mistakes may decrease. RTI tuition and fees could also decline over the course of the registered apprenticeship if RTI is frontloaded; that is, occurring at the start of the registered

²⁴ All registered apprentices must have a wage increase included in their Standards of Apprenticeship. Sometimes the program itself has only one wage step, and the required wage increase comes at the completion of the program rather than during the program.

4. EMPLOYER INVESTMENTS AND RETURNS DURING THE REGISTERED APPRENTICESHIP PROGRAM

apprenticeship. The AAI Employer Survey allowed employers to report different costs for each apprentice wage step, so that these increases or decreases in costs over time could be accurately captured.

- ***By far the largest cost incurred by employers was apprentice compensation, including both wages and non-wage benefits.***

The first two columns of Exhibit 4-1 show the mean and median costs incurred by surveyed employers. As indicated in the first row, the mean annual total compensation of apprentices during their registered apprenticeship program was \$87,369; the median was lower (\$52,530) reflecting a somewhat skewed distribution of a small number of highly compensated apprentices. Compensation costs varied with the duration of the registered apprenticeship program, the wage level at each step, and the package of non-wage benefits (e.g., health and other insurances, paid leave) and other benefits.

The last two columns show the minimum and maximum total compensation costs incurred by surveyed employers. The minimum cost reported, \$5,985, corresponded to a three-month certified nursing assistant registered apprenticeship program.²⁵ That cost reflected the low wages paid to those apprentices in combination with a short duration over which those wages were paid.²⁶ The maximum compensation cost incurred was \$455,384. This employer operated a 4-year lineman program to train workers to install and maintain power transmission lines. Work as a lineman is well compensated. Nationally, the median salary for a lineman is \$68,030 annually, and these workers typically receive generous non-wage benefits that are included in registered apprenticeship compensation.²⁷ The lineman apprentice reported on in the survey had an even higher annual salary during the program: more than \$154,000 a year. Median net benefits are reported throughout this report so that these types of extreme values do not distort the experiences of the typical employer of registered apprentices.

Exhibit 4-1. Costs Incurred by Employers during the Registered Apprenticeship Program

Cost	Mean	Median	Minimum	Maximum
Total apprentice compensation	\$87,369	\$52,530	\$5,985	\$455,384
Total related technical instruction (RTI) tuition and fee costs	\$4,488	\$1,100	\$0	\$61,000
Total mentor lost productivity costs	\$11,010	\$147	\$0	\$83,735
Per apprentice registration costs	\$1,217	\$240	\$0	\$12,500
Total supply and wastage costs	\$731	\$0	\$0	\$15,000

Source: AAI Employer Survey. N=68.

Notes: Total apprentice compensation, RTI tuition and fees, mentor lost productivity, and supply and wastage costs are totaled over all registered apprenticeship wage steps. These costs are reported for a registered apprenticeship completer and have not been adjusted for attrition, inflation, or discounting. The average duration of apprenticeship programs described in the AAI Employer Survey was 24.4 months.

- ***Non-compensation costs during a registered apprenticeship were generally lower but varied considerably by employer.***

Non-compensation costs including RTI tuition and fees, mentoring, apprenticeship registration costs, and supplies and wastage were lower than compensation costs on average but varied significantly across

²⁵ Registered apprenticeship programs must include at least 2,000 hours of paid OJL, which should take much longer than three months to complete. However, as noted above, apprentices can earn credit for prior training and experience, which reduces the actual program duration. Furthermore, competency-based apprenticeship programs can be shorter than 2,000 hours in practice if an apprentice masters the competencies quickly.

²⁶ See Lerman, Eyster, and Kuehn (2014) for more details on the pay and experiences of certified nursing assistant apprentices and apprentices in other low-wage healthcare occupations.

²⁷ Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, Line Installers and Repairers, at <https://www.bls.gov/ooh/installation-maintenance-and-repair/line-installers-and-repairers.htm> (visited September 8, 2021).

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employers associated with the AAI grantees. For example, although RTI tuition and fees cost \$4,488 per apprentice on average, 38 percent of employers (26 employers) paid no RTI costs during the registered apprenticeships; one employer reported paying \$61,000 in RTI costs, reflecting its role as a partner in a 4-year joint apprenticeship program that operated its own training center. One reason why these costs may have varied is that employers were asked to report the costs that they paid, not costs paid by AAI grantees.

Gardiner et al. (2021) report a strong, non-causal association between an AAI grantee's provision of financial support for RTI and the grantee's success in meeting its registered apprentice targets. This result might seem incongruent with the finding in Exhibit 4-1 that RTI costs are relatively low compared to apprentice compensation costs, but the two results can be reconciled if grantees that provide RTI incentives are successful for reasons other than the direct cost reduction that they provide to employers. In some cases, grantees that provided financial support for RTI offered these incentives to employers as part of a broader employer engagement effort (Copson et al. 2021), and were therefore successful in registering more apprentices because of the organization of their employer outreach activities.

Mentor costs also varied. The average cost associated with the lost productivity of mentors per apprentice was \$11,010 over the course of the registered apprenticeship. However, 19 percent of employers (13 employers) reported no mentor costs because mentors were reported as fully productive while they trained apprentices. One employer reported mentor costs of \$83,735. This mentor was paid somewhat less per hour than the average mentor in the sample (\$30 compared to \$33) but reported supervising the apprentice for more hours per week (40 compared to 17 hours, on average) and being less productive while supervising (50 percent productive, compared to 72 percent on average).

Per apprentice registration costs and supply and wastage costs were lower than the costs of registered apprenticeship compensation, tuition and fees, and mentorship.

■ **Employers incurred registration costs when starting new registered apprenticeship programs.**

Registration costs are fixed costs, incurred at one point in time, possibly many years before an apprentice is hired.²⁸ For the purposes of this analysis, the evaluation team distributed registration costs across all AAI apprentices hired by the employer as of the time of the survey. The team did this, rather than just attributing them to the reference apprentice, because registration costs supported every apprentice in the program. Although this study included registration costs allocated to each AAI apprentice, one could argue that such costs did not represent what the employers pay on an ongoing basis. The estimates likely overestimated the true per-apprentice cost of registration, as apprentices hired in the future (i.e., after administration of the survey, as well as after the AAI grant ends) and previous apprentices not associated with the AAI grant could also be registered in the program.

The average per apprentice registration cost was \$1,217 and ranged from \$0 to \$12,500 (Exhibit 4-1 above). Of the 68 employers, 13 (19 percent) did not pay any registration costs, either because another organization paid them or because the employer signed on to an existing group apprenticeship program thus avoiding them.

²⁸ Employers might also pay ongoing costs to maintain the apprenticeship program, including the cost of continued management of partnerships, revisions to the Standards of Apprenticeship, and other costs of continued compliance with registration requirements and other regulations. These costs were not collected in the AAI Employer Survey.

4.2 Registered Apprenticeship In-program Benefits

Apprentices are productive employees during their training, allowing employers to experience direct productivity benefits **during the registered apprenticeship program** (“in-program”). The Employer Survey measured the value of apprentices’ production by asking employers to compare the reference apprentice’s productivity to the productivity of a fully qualified worker doing the same job. The value of the apprentice’s production was then estimated as the fully qualified worker’s compensation adjusted by the relative productivity of the apprentice. As described in Section 2.2, the evaluation team calculated three estimates of the value of the apprentice’s productivity to capture the uncertainty of the benefit estimates and provide a range of plausible values for the direct benefits. The team used these estimates, each of which reflected a different fully qualified worker with different levels of skill and experience, to produce low, medium, and high estimates of the value of the apprentice’s production.

As noted above, the value of an apprentice’s production, after subtracting out their compensation, was the direct benefit of the registered apprenticeship program. The value of the apprentice’s productivity before subtracting compensation could be thought of as the *gross value of productivity*. Using the medium estimate of the value of the reference apprentice’s production, the median employer experienced \$52,551 in the gross value of the apprentice’s production during the registered apprenticeship program (Exhibit 4-2). Because the total value of an apprentice’s production depended on the duration of the program and the productivity of the apprentice, this gross value ranged widely. At the 25th percentile of apprentice productivity, employers experienced a gross value of \$36,396; at the 75th percentile, employers experienced a gross value of \$105,555.

Using the low estimate of the value of the apprentice’s productivity, the median gross value was somewhat lower, at \$49,011. Using the high estimate, the median gross value was \$71,458. The mean estimated gross values were consistently higher than the medians, ranging from \$81,875 for the low estimate to \$116,440 for the high estimate.

Exhibit 4-2. Gross Value of Productivity Experienced by Employers during the Registered Apprenticeship Program

Productivity valuation	Mean	Median	25 th Percentile	75 th Percentile
Low estimate of productivity value	\$81,875	\$49,011	\$32,013	\$392,084
Medium estimate of productivity value	\$95,091	\$52,551	\$36,396	\$105,555
High estimate of productivity value	\$116,440	\$71,458	\$46,810	\$162,771

Source: AAI Employer Survey. N=68.

Notes: Gross value of the apprentice’s productivity is the value of the apprentice’s productivity without subtracting out apprentice compensation and totaled over all registered apprenticeship wage steps. These benefits are reported for a registered apprenticeship completer and have not been adjusted for attrition, inflation, or discounting.

Before incorporating the direct benefits of a reference apprentice’s productivity into the total net benefits estimate, the evaluation team subtracted the compensation of the apprentice from the gross value of their production. The financial benefit gained by the employer is reflected in the value of the apprentice’s production, which exceeded the wages and benefits paid to the apprentice. When the apprentice’s compensation exceeded the dollar value of the apprentice’s productive contribution, this direct benefit was negative during the registered apprenticeship program. However, the direct benefit could be positive after the apprentice completed the registered apprenticeship if the value of the former apprentice’s productive contribution increased more rapidly than their earnings did.

Using the medium estimate of the value of the reference apprentice’s production, the median employer experienced -\$11,273 in direct productivity benefits (i.e., a loss) during the registered apprenticeship program after netting out compensation from the gross direct productivity benefits (Exhibit 4-3). In other words, the median employer paid the apprentice \$11,273 more than the value of the apprentice’s production during the training itself. Though the \$11,273 represents a net investment, this median cost of

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the apprenticeship investment is far smaller than the gross costs of over \$50,000. Depending on the duration of the program and the productivity of the apprentice, this direct productivity benefit ranged widely. At the 25th percentile, the employer experienced -\$74,500 in direct benefits; at the 75th percentile, the employer experienced direct benefits of -\$1,499.

When the low estimate of the value of the apprentice’s productivity was used, the median employer’s direct benefit was -\$18,400. Using the high estimate, it was -\$1,777. The mean estimated direct productivity benefits were lower than the medians, ranging from -\$48,163 for the low estimate to -\$13,598 for the high estimate.

Exhibit 4-3. Direct Productivity Benefits Experienced by Employers during the Registered Apprenticeship Program

Productivity valuation	Mean	Median	25 th Percentile	75 th Percentile
Low estimate of productivity value	-\$48,163	-\$18,400	-\$37,409	-\$6,958
Medium estimate of productivity value	-\$34,946	-\$11,273	-\$74,500	-\$1,499
High estimate of productivity value	-\$13,598	-\$1,777	-\$18,157	\$19,318

Source: AAI Employer Survey. N=68.

Notes: Direct productivity benefits are the value of the apprentice’s productivity minus their compensation and are totaled over all registered apprenticeship wage steps. These benefits are reported for a registered apprenticeship completer and have not been adjusted for attrition, inflation, or discounting.

4.3 Registered Apprenticeship’s Indirect Benefits during Training

The AAI Employer Survey inquired about 10 types of indirect benefits (Exhibit 4-4) and monetized them by asking employers how valuable the benefit was relative to the value of the reference apprentice’s increased productivity. The value of each indirect benefit was divided by the number of apprentices employed and then top-coded, to eliminate extreme reported values of indirect benefits.²⁹ This section reports the value of the indirect benefits.

- **Nearly all employers reported gaining indirect benefits; the most valued benefits were from an improved pipeline of skilled employees and employee engagement and loyalty.**

Exhibit 4-4 shows the employer-reported value of each indirect benefit relative to the value of the increased productivity of the reference apprentice. The most highly valued indirect benefits were an “improved pipeline of skilled employees” and “employee engagement and loyalty,” with about 28 percent of employers saying these benefits were very valuable and only about 9 percent saying these benefits were not important. In particular, 57 percent of employers reported that “improved pipeline” was very valuable or more valuable than the value of the reference apprentice’s increased productivity; 56 percent reported “employee engagement and loyalty” was very or more valuable. Although the AAI Employer Survey did not directly ask employers whether apprenticeship improved the diversity and inclusivity of their workplace, access to apprenticeship for underrepresented populations may have been bolstered by an improved pipeline of skilled employees. Kuehn et al. (2021) interviewed employers of apprentices about their experiences with programs inclusive of people with disabilities, and some interviewed employers

²⁹ As noted, the evaluation team distributed indirect benefits across all apprentices in the program because employers responded to a question regarding how the program provided indirect benefits, not the reference apprentice’s marginal contribution to those indirect benefits. Each indirect benefit was individually top-coded at the 90th percentile for that benefit. Top-coding means that whenever an observation had a value greater than the 90th percentile for that benefit, the value was set at the 90th percentile for that observation. AAI Employer Survey clarification calls with a few large employers suggests that the procedure may understate their indirect benefits per apprentice.

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reported that inclusive apprenticeships were perceived by coworkers as high-quality jobs, which improved the pipeline and retention for all participants.

“Reduced use of overtime” was least important, with more than half of employers reporting it was not a benefit of registered apprenticeship at all. This finding contrasts with Helper et al. (2016), which found reduced overtime was particularly important for one of the two employers they examined in detail. The contrast highlights that although indirect benefits are important for employers of apprentices, the circumstances of every employer are different, and an indirect benefit that is valuable to one employer may not be valuable to another.

Exhibit 4-4. Indirect Benefits Experienced by Employers during the Registered Apprenticeship Program

Indirect benefit	Compared to the Benefit of Increased Productivity				
	Very valuable (200% of the value of increased productivity)	More valuable (150%)	Equally valuable (100%)	Somewhat valuable (50%)	Not important (0%)
Improved pipeline of skilled employees	27.9%	29.4%	30.9%	2.9%	8.8%
Employee engagement and loyalty	27.9%	27.9%	32.4%	2.9%	8.8%
Reduced turnover	22.1%	26.5%	27.9%	4.4%	19.1%
Improved company culture	19.1%	30.9%	30.9%	14.7%	4.4%
Reduced downtime	14.7%	11.8%	32.4%	8.8%	32.4%
Development of future managers	14.7%	14.7%	26.5%	20.6%	23.5%
Improved productivity of co-workers	8.8%	22.1%	52.9%	2.9%	13.2%
More on-time delivery	8.8%	22.1%	33.8%	8.8%	26.5%
Product or process improvement	8.8%	25.0%	26.5%	17.7%	22.1%
Reduced use of overtime	4.4%	7.4%	26.5%	10.3%	51.5%

Source: AAI Employer Survey. N=68.

Note: Row totals may not sum to 100 due to rounding.

To estimate the *dollar value of the indirect benefits* included in the Employer Survey, the evaluation team multiplied the percentage value the employer assigned to each indirect benefit relative to the value of the *reference apprentice’s* increase in productivity (e.g., the employer valued employee loyalty at 150 percent of the value of the increased productivity) by the dollar value of the apprentice’s productivity gain. In this example, if the employer estimated the increase in productivity at \$1,000, then the value of employee loyalty to that employer was 150 percent of \$1,000, or \$1,500.

To estimate the *dollar value of the indirect benefits per apprentice*, the evaluation team first estimated the total value of each indirect benefit for the employer’s *entire apprenticeship program*. Then the team divided the total value of each indirect benefit by the total number of AAI apprentices in the program.

4.4 Net Benefits during Registered Apprenticeship

The *net benefits* that employers received during the registered apprenticeship from an individual apprentice combined the benefits and costs described above. Net benefits during the registered apprenticeship program were defined as the value of the production of the apprentice and the indirect benefits of the registered apprenticeship program minus the costs incurred by the employer, which included apprentice compensation, employer share of RTI, mentor costs, training supplies and wastage, and the per apprentice registration cost. Because apprentices engaged in productive work for the employer during their registered apprenticeship training, they could produce positive net benefits while still training. However, because an employers’ investment costs were borne during training, many employers did not experience positive net benefits while their apprentice was still registered. Finally, most

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employers experienced indirect benefits that offset at least some of the costs of the registered apprenticeship.

- ***The median employer did not recoup its investment during the registered apprenticeship because costs exceeded benefits.***

Employers experienced different levels of net benefits during apprentices' training, mostly depending on the costs of employers' training investment and the productivity of the apprentices. Exhibit 4-5 reports net benefits during the registered apprenticeship by quartile using two different calculations for low, medium, and high productivity values: using direct productivity benefits only (first three columns) and using direct and indirect benefits (second three columns).

As shown, in-program per apprentice net benefits were negative for most employers under most assumptions about the value of the apprentice's productivity, even after including indirect benefits. Most employers experienced positive net benefits during the registered apprenticeship only if the highest valuation of an apprentice's productivity was used and if both direct productivity and indirect benefits were counted (last column).

Take the example of the medium apprentice productivity estimate. Including both direct and indirect benefits in the calculation, the 25th percentile employer experienced -\$23,934 in net benefits during the registered apprenticeship program, the 75th percentile employer experienced +\$10,934 in net benefits, and the median employer experienced a -\$5,740 net benefit. When indirect benefits were not included, the 25th percentile employer's net benefits were almost \$20,000 lower (-\$43,006), whereas the median and 75th percentile employers' in-program net benefits decreased, but not by the same margin.

Exhibit 4-5. Net Benefits to Employers during Registered Apprenticeship, by Quartile

Productivity valuation	Net benefits calculated using direct productivity benefits only			Net benefits calculated using both direct and indirect benefits		
	25 th Percentile employer	Median employer	75 th Percentile employer	25 th Percentile employer	Median employer	75 th Percentile employer
Low estimate of productivity value	-\$47,117	-\$22,606	-\$7,215	-\$32,568	-\$10,121	\$382
Medium estimate of productivity value	-\$43,006	-\$16,839	-\$2,815	-\$23,934	-\$5,740	\$10,934
High estimate of productivity value	-\$26,109	-\$6,931	\$13,201	-\$10,346	\$13,437	\$58,648

Source: AAI Employer Survey. N=68.

Notes: Exhibit entries are in 2020 dollars and discounted at 3 percent per year.

Exhibit 4-6 shows the proportion of employers that at least broke even during the registered apprenticeship program, that is, they reached the point where cumulative costs were offset by cumulative benefits. The proportion of employers who at least break even vary by types of benefits included in the calculation. Nearly 4 in 10 employers (38 percent) broke even during the registered apprenticeship itself if the medium estimate of the value of the apprentice's productivity was used and both direct and indirect benefits were counted. Fewer employers broke even when the low estimate was used, although even in this case, 25 percent of employers broke even before the end of the registered apprenticeship. When the high estimate of the apprentice's productivity was used, almost two-thirds of employers broke even before the end of the registered apprenticeship.

Exhibit 4-6. Employers Who Reached Breakeven in Net Benefits during Registered Apprenticeship

Productivity valuation	Benefit types included in calculating net benefits	Percentage of employers breaking even during the registered apprenticeship
Low estimate of productivity value	Direct benefits only	7.4
	Direct and indirect benefits	25.0
Medium estimate of productivity value	Direct benefits only	13.2
	Direct and indirect benefits	38.2
High estimate of productivity value	Direct benefits only	45.6
	Direct and indirect benefits	63.2

Source: AAI Employer Survey. N=68.

These net benefits estimates demonstrate that registered apprenticeship represent genuine investments and that many employers experience negative net benefits during the registered apprenticeship period. On the other hand, many employers experience positive net benefits during the program itself. The estimates show that employer gains were highly sensitive to the approach to valuing the apprentice’s productivity. In any event, the value of apprentices’ production and indirect benefits during the registered apprenticeship laid a foundation for potential positive net benefits after the apprentice completed the program.

Longer registered apprenticeship programs and programs operated by larger employers had lower in-program benefits, which may be related to the positive empirical relationship between employer size and wages (Brown and Medoff 1989; Bloom et al. 2018). Employers who pay higher wages experience lower net benefits to apprenticeship if those higher wages are not accompanied by higher apprentice productivity. Group non-joint programs had higher net benefits than other program types.

Although in-program net benefits were typically negative, they varied based on employer characteristics (Exhibit 4-7). Employers with more than 500 full-time-equivalent (FTE) employees had the lowest median net benefits (using direct and indirect benefits) during the registered apprenticeship program (-\$21,841), followed by employers that operated registered apprenticeship programs in healthcare (-\$20,939).

Longer programs had the most negative net benefits during the registered apprenticeship program because they had higher average apprentice compensation and hours worked per week, resulting in lower direct benefits and because those lower direct benefits were experienced over a longer registered apprenticeship period. Put differently, longer programs experienced larger losses during the registered apprenticeship program, and they experienced those larger losses over a longer period.³⁰

³⁰ Average weekly net benefits were calculated by dividing the direct in-program net benefits by the number of weeks in the program, which accounted for discounting and attrition. Measured in this way, employers operating programs lasting more than 36 months had average weekly direct net benefits of -\$532 during the apprenticeship program, compared to -\$389 for programs that were 12 months or less and -\$356 for programs between 12 and 36 months.

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Exhibit 4-7 Median Net Benefits during the Registered Apprenticeship, by Employer and Program Characteristics

Characteristic	Percentage of employers	Median net benefits using direct benefits only	Median net benefits using direct and indirect benefits
Total apprentice and non-apprentice employment			
Fewer than 100 full-time equivalents	26.5	-\$9,772	-\$5,276
100 to 500 Full-time equivalents	42.6	-\$17,518	\$1,212
More than 500 full-time equivalents	30.9	-\$27,168	-\$21,841
Broad occupational category			
Healthcare	17.7	-\$24,924	-\$20,939
Information technology	17.7	-\$8,187	-\$2,393
Advanced manufacturing	33.8	-\$16,161	\$7,826
Other	30.9	-\$19,580	-\$9,544
Registered apprenticeship program type			
Group joint program	10.3	-\$23,704	-\$3,336
Group non-joint program	26.5	-\$3,983	\$5,180
Independent joint program	20.6	-\$38,113	-\$8,252
Independent non-joint program	42.7	-\$17,520	-\$9,702
Usual duration of registered apprenticeship			
12 months or less	39.7	-\$7,454	-\$1,812
12 to 36 months	36.8	-\$23,704	-\$9,544
More than 36 months	23.5	-\$41,110	\$1,609

Source: AAI Employer Survey. N=68.

Notes: Table entries are in 2020 dollars and discounted at 3 percent per year. Group programs include multiple employers while independent programs include only one employer. Joint programs are sponsored by joint labor-management organizations while non-joint programs are not. Percentages may not add to 100 due to rounding.

■ **Employers who experienced in-program net benefits required taking account of both the direct and indirect benefits.**

Even in the two cases where an employer subgroup experienced positive total in-program net benefits, the median in-program net benefits were negative when the indirect benefits were excluded (Exhibit 4-7 above). For example, employers partnering with advanced manufacturing programs had median total in-program net benefits of +\$7,826, indicating that the median advanced manufacturing employer recouped all its costs and experienced additional positive benefits before the end of the registered apprenticeship program. If the indirect benefits of registered apprenticeship were excluded in the net benefit calculations, the median advanced manufacturing employer had -\$16,161 in net benefits (a loss). Without counting indirect benefits, the median advanced manufacturing employer failed to recoup its costs during the registered apprenticeship.

These findings highlight the wide variability in net benefits across employers, the value of the apprentice's productivity, and the importance of indirect benefits in determining the costs and benefits of registered apprenticeship programs. They also highlight the possibility for many employers of recouping their costs before the end of the registered apprenticeship (38.2 percent of surveyed employers), even after accounting for apprentice turnover.

5. Employer Benefits after Completion of the Registered Apprenticeship

The previous chapter described employer returns during the registered apprenticeship period, a time when employers were still paying training costs and apprentices were still building occupational competencies. This chapter focuses on benefits that employers may reap from their apprenticeship investments after the registered apprenticeship ends (“post-program”), and the apprentice becomes a regular employee. These may be direct benefits—that is, if the productive value of the registered apprenticeship completers’ work exceeds their compensation—and they may be indirect benefits.

The Employer Survey collected data about the reference apprentice’s wage and productivity during the first year after the registered apprenticeship relative to another employee in the same occupation with approximately the same job tenure. The team projected the reference apprentice’s relative productivity and wage for the ensuing 4 years based on the benefits observed during the registered apprenticeship itself and the first year after completion. Thus, the direct benefits to employers in the post-program period are a hybrid estimate that includes benefits calculated from data reported in the survey for the first year after the registered apprenticeship and benefits that are projected for 4 additional years.

In estimating the direct benefits to employers in the second through fifth years after apprentices complete their training, the evaluation team extrapolated from the time series of direct productivity benefits during the registered apprenticeship and in the first year after completion (Box 10). These projected values are adjusted for the estimated attrition of the apprentice (10.3 percent) and discounted to reflect the time value of money (3 percent).³¹ The estimated attrition rate for the post-program period came from the fact that 7 out of 68 reference registered apprenticeship completers, or 10.3 percent, did not remain with the employer in the first year after the registered apprenticeship. The indirect benefits accruing to the employer continue during the projection period. They are discounted only to reflect the time value of money; they are not adjusted by the attrition rate.³²

Box 10: Forecasting Post-program Direct Benefits

To forecast direct productivity benefits, the evaluation team used predicted values from **a regression that estimated the trend in the reference apprentice’s direct productivity benefits** from the start of the apprenticeship through the first year post-program as a function of the natural logarithm of weeks elapsed since the start of the apprenticeship.

This specification ensured that the direct productivity benefits **grow on trend, but gradually flatten over time**. These projected values were then adjusted for the estimated attrition of the apprentice and a discount rate.

These projections were developed mechanistically. The regression equation was **not causal**; it was only used to estimate a **line of best fit** to the observed data.

The underlying assumption was that direct benefits produced by the apprentice during the projection period, which were not observed in the survey, will not substantially deviate from their trend as long as the apprentice remains with the employer.

Because the methods of estimation differed between the first post-program year and the remaining 4 years of analysis, the first section of this chapter documents the former, followed by a discussion of the full 5-year post-program period.

³¹ The evaluation team followed practice set by OMB Circular A-4 to calculate the present value of costs and benefits using two discount rates: 3 percent and 7 percent. The results were not highly sensitive to the discount rate, and 3 percent was used as the preferred specification here.

³² Indirect benefits were not adjusted for job separation because they were broader benefits to the company and company culture that persisted after a given apprentice had left.

5.1 Short-term Direct Benefits in the First Post-Program Year

- ***The average direct productivity benefits in the first year after the registered apprenticeship were +\$2,113 and the median was \$0.***

If the reference apprentice remained with the employer after the registered apprenticeship ended, the Employer Survey asked the employer about the reference apprentice's employment and earnings at the time of the survey.³³ Employers compared the productivity of the reference apprentice (who had completed their registered apprenticeship) to another employee in the same occupation with approximately the same job tenure from hire date.

For these reference apprentices who stayed on the job, the mean hourly wage at the time of the survey was \$27.75 per hour, an increase from \$22.67 per hour during the final step of their registered apprenticeship and higher than the mean hourly wage of non-apprentices in the same position (\$25.02). Employers also reported the relative productivity of the reference apprentice compared to the non-apprentice in the same occupation with the same tenure.

On average, employers rated the apprentice's relative productivity as 117 percent of the non-apprentice's, meaning that the value of the output produced by the apprentice completer was 17 percent higher than that of the non-apprentice. Approximately two-thirds of employers (42 out of 68) reported that the apprentice was more productive than the non-apprentice; 25 employers reported that the apprentice and non-apprentice were equally productive. Only one employer reported that the apprentice was still less productive than a non-apprentice in the first year after the program.

Using the wage and productivity data for reference apprentices and non-apprentices, the evaluation team calculated the direct benefit that accrued to the employer for the apprentice completer in the first year after completion. On average, this benefit was +\$2,113, with a range from -\$2,524 for the 25th percentile employer to +\$9,539 for the 75th percentile employer. For more than one-quarter of the sample (19 employers), this direct benefit was equal to zero in the first year after the program, either because the reference apprentice was not employed with the employer in the year after the program (7 employers) or because the reference apprentice earned the same wages and had the same productivity as the non-apprentice (12 employers). The median net benefit was \$0 in the first year after the registered apprenticeship program, reflecting the 25 employers for which the value of the apprentice's productivity was equal to their compensation.

5.2 Long-term Post-Program Benefits

In theory, employers can benefit from the increased productivity of employees who completed a registered apprenticeship for as long as that employee remains with the employer. However, in this study, projections of net employer benefits were limited to 5 years after the end of the registered apprenticeship. Even a 5-year estimate must rely on projections of the observed data pertaining to the registered apprenticeship program period itself and the first year after the registered apprenticeship. Such projections are required especially for AAI, as few apprentices in the program had several years of post-apprentice experience. The three projections for post-program benefits used the low, medium, and high productivity valuations.

³³ If the reference apprentice separated from the employer after completing the apprenticeship, the post-program direct benefits for the employer were zero. This occurred for seven employers, or about 10 percent of the sample. There did not seem to be any systematic relationship between the employer or apprenticeship characteristics and job separation by the completers.

- **The 5-year post-program direct productivity benefits accruing to employers have a median value of +\$7,980 per apprentice, using the medium estimate of apprentice productivity.**

The direct productivity benefits accruing to employers in the 5-year post-program period are modest but positive. Depending on the valuation assumption, the median direct benefits accumulated across the full 5-year post-program period range from \$4,337 to \$16,059. Adding the indirect benefits over the projection period yields larger increases in employer returns; these range from \$33,224 to \$40,445 per apprentice, again depending on the productivity valuation assumption.

Exhibit 5-1 displays the median estimates of the total benefits accruing to employers after the registered apprenticeship period. As in earlier exhibits, it shows three levels of estimates. Some employers may pay more in apprentice compensation than the value of the apprentice’s productivity and thus experience negative direct benefits during the 5 years after the registered apprenticeship. But even these employers might have positive returns if the indirect benefits exceed the net direct costs.

In fact, the median employer achieved post-apprenticeship benefits, with the level depending on the estimate of productivity. Using the medium estimate of the value of an apprentice’s production, the median employer experiences \$7,980 per apprentice in post-program direct productivity benefits; the median gain from indirect benefits is \$17,534. Counting both direct and indirect benefits yields median post-program net benefits of \$35,728 per apprentice. As Exhibit 5-1 shows, differences in valuing the apprentice’s productivity generated differences in post-program net benefits. The median total net benefits varied only modestly, however, from \$33,224 for the low valuation to \$40,445 for the high valuation.

Exhibit 5-1. Benefits Accumulated over 5 Years after the Registered Apprenticeship Program

Productivity valuation	Median benefits using direct productivity benefits only, post program	Median benefits using indirect benefits only, post program	Median benefits using direct productivity and indirect benefits, post program
Low estimate of productivity value	\$4,337	\$14,049	\$33,224
Medium estimate of productivity value	\$7,980	\$17,534	\$35,728
High estimate of productivity value	\$16,059	\$23,298	\$40,445

Source: AAI Employer Survey. N=68.

Notes: Direct productivity benefits are the value of the apprentice’s productivity minus their compensation and are totaled over all post-program years. Table entries are in 2020 dollars and discounted at 3 percent per year. Median benefits using direct productivity and indirect benefits do not, in general, equal the sum of median benefits using only direct benefits and median benefits using only indirect benefits.

The medians mask considerable variability across employers. For example, using the middle estimate, the net benefits using both direct and indirect benefits range from \$6,668 for the 25th percentile employer to \$103,305 for the 75th percentile employer.

- **The share of employers able to break even, recouping their investments, increases sharply in the post-program period, relative to the share who break even during the registered apprenticeship program.**

Employers do not pay any training costs in the post-program period, but their accumulated training costs from the registered apprenticeship period still factor into whether they break even in the post-program period. Exhibit 5-2 displays the percentage of employers that reach the break-even point for the reference apprentice only after the end of the registered apprenticeship. An additional 29.4 percent of employers break even when including the post-apprenticeship period, assuming the medium estimate of the value of the apprentice’s productivity and counting both direct and indirect benefits. If these employers are added to the 38.2 percent of employers that broke even during the registered apprenticeship program (see

5. EMPLOYER BENEFITS AFTER COMPLETION OF THE REGISTERED APPRENTICESHIP

Exhibit 4-6), the share of employers breaking even by 5 years after the registered apprenticeship ended rises to approximately two-thirds (67.6 percent). When counting only direct benefits, the post-apprenticeship period raises the share of employers at least breaking even from 13.2 percent to 44.1 percent (see Exhibits 4-6 and 5-2).

Exhibit 5-2. Employers Reaching Breakeven during and after the Registered Apprenticeship

Productivity valuation	Benefit types included in the net benefit calculation	Percentage of employers breaking even only after the registered apprenticeship	Percentage of employers breaking even by 5 years after the registered apprenticeship
Low estimate of productivity value	Direct benefits only	30.8	38.2
	Direct and indirect benefits	41.2	66.2
Medium estimate of productivity value	Direct benefits only	30.9	44.1
	Direct and indirect benefits	29.4	67.6
High estimate of productivity value	Direct benefits only	8.8	54.4
	Direct and indirect benefits	14.7	77.9

Source: AAI Employer Survey. N=68.

Notes: Table entries are calculated break-even rates using net benefits that are in 2020 dollars and discounted at 3 percent per year.

As in the apprenticeship period, indirect benefits are important in determining whether employers break even through the post-program period. When including indirect benefits, two-thirds of employers (67.6 percent) at least break even over the full in-program and post-program periods. Excluding indirect benefits, and using the medium productivity assumption, only 44 percent reached the break-even point by 5 years after the registered apprenticeship ended.

- **Post-program benefits are highest among mid-sized employers (100 to 500 FTEs), employers with apprentices in advanced manufacturing occupations, and in group non-joint programs.**

The benefits experienced by employers during the post-program period vary across employer and registered apprenticeship characteristics as shown in Exhibit 5-3. The exhibit shows the median benefits using the middle estimate of apprentice productivity.

Exhibit 5-3. Median Post-program Benefits, by Employer and Program Characteristics

Characteristic	Percentage of employers	Direct benefits only	Direct and indirect benefits
Total apprentice and non-apprentice employment			
Fewer than 100 full-time equivalents	26.5	\$2,748	\$42,376
100 to 500 Full-time equivalents	42.6	\$14,058	\$70,800
More than 500 full-time equivalents	30.9	\$8,291	\$25,967
Broad occupational category			
Healthcare	17.7	\$1,481	\$20,912
Information technology	17.7	\$15,281	\$53,902
Advanced manufacturing	33.8	\$25,809	\$96,713
Other	30.9	\$0	\$13,298
Registered apprenticeship program type			
Group joint program	10.3	\$7,669	\$54,335
Group non-joint program	26.5	\$23,428	\$70,422
Independent joint program	20.6	\$21,558	\$33,252
Independent non-joint program	42.7	\$80	\$9,623
Usual duration of registered apprenticeship			
12 months or less	39.7	\$14,906	\$30,708
12 to 36 months	36.8	\$25,809	\$58,000
More than 36 months	23.5	-\$4,594	\$24,008

Source: AAI Employer Survey. N=68.

Notes: Table entries are in 2020 dollars and discounted at 3 percent per year. Group programs include multiple employers while independent programs include only one employer. Joint programs are sponsored by joint labor-management organizations while non-joint programs are not. Percentages may not sum to 100 due to rounding.

Employers with between 100 and 500 FTE employees accrued a higher median level of direct benefits after the registered apprenticeship program (\$14,058) than either employers with fewer than 100 (\$2,748) or employers with more than 500 FTE employees (\$8,291). This remains true of the median employer after indirect benefits are added to their total benefits.

A third of employers responding to the AAI Employer Survey operated advanced manufacturing registered apprenticeship programs, and these employers experienced the highest median benefits in the post-program period. Advanced manufacturing employers experienced the highest median net benefits in the post-program period both when direct benefits alone were included and when direct and indirect benefits were included. Recall that employers of IT apprentices had the highest median net benefits during the registered apprenticeship program (-\$8,187) when only direct benefits were included (see Exhibit 4-7).

Employers in group non-joint apprenticeships experience greater median post-program direct and indirect benefits than do employers in independent programs or employers in group joint apprenticeships. Median benefits for programs that are 36 months or less are higher than longer programs, and programs that last 12 to 36 months have the highest post-program benefits (\$30,708, \$58,000, and \$24,008, respectively).³⁴

³⁴ The team explored using multivariate regressions to explain the interrelationships between these variables and employer net benefits, but the employer survey's sample size was too small. Although the sample used in this study is larger than in prior research such as the North Carolina Apprenticeship Program Survey Report (2020), Payne (2020), and Helper et al. (2016), it is insufficient for conducting extensive multivariate analysis.

6. Total Returns to Registered Apprenticeship during and after the Program

This chapter presents the total returns to employers from the start of a registered apprenticeship to 5 years after it ended. It combines the estimates of employer net benefits during the registered apprenticeship (Chapter 4) with estimates of employer net benefits after the registered apprenticeship ended (Chapter 5). This chapter also reports ROI estimates.

6.1 Total Employer Net Benefits

- **Most employers experience a net benefit from their registered apprenticeship investments when incorporating both direct and indirect benefits from both the in-program and post-program periods.**

The median employer experiences net benefits of nearly \$16,000 per apprentice, using the medium productivity valuation assumption. Much of the gain comes from adding indirect benefits to the direct productivity benefits. Even using the low estimate, the median employer achieves a positive return on the investment in registered apprenticeship.

Exhibit 6-1 shows the wide variability in estimates of employer total returns, depending on the valuation of the apprentice's productive contributions and on the inclusion or exclusion of indirect benefits. For example, for the middle productivity valuation, the median employer goes from losing about \$5,000 when only direct benefits are counted to gaining about \$18,000 when indirect benefits were added. For employers at the medians of each valuation estimate, all the net benefits are positive, ranging from about \$16,000 to nearly \$50,000 per apprentice. The differences within valuation categories between employers at the 25th and 75th percentiles are larger, even within a single valuation category. Within the medium category and including indirect benefits, for example, the gap between employers at the 25th and 75th percentiles is more than \$100,000 per apprentice.

Exhibit 6-1. Total Net Benefits to Employers (during and after the Registered Apprenticeship)

Productivity valuation	Net benefits using only direct benefits			Net benefits using both direct and indirect benefits		
	25 th Percentile employer	Median employer	75 th Percentile employer	25 th Percentile employer	Median employer	75 th Percentile employer
Low estimate of productivity value	-\$59,746	-\$7,771	\$11,987	-\$15,531	\$15,729	\$81,830
Medium estimate of productivity value	-\$47,838	-\$4,951	\$16,761	-\$6,809	\$17,862	\$104,731
High estimate of productivity value	-\$25,613	\$11,810	\$59,100	\$1,885	\$49,220	\$180,299

Source: AAI Employer Survey. N=68.

Notes: Table entries are in 2020 dollars and discounted at 3 percent per year. Net benefits are calculated by subtracting the present value of all costs from the present value of all benefits.

- ***For all productivity valuation assumptions, when both direct and indirect benefits are included, two-thirds or more employers reach or exceed breakeven; that is, they recoup or more than recoup their investments.***

Employers break even (i.e., recoup their investments) when the accumulated benefits fully offset the accumulated costs of the registered apprenticeship.

Exhibit 5-2, above displays the percentage of employers that recoup their investments or do better during or after the registered apprenticeship period. Even when only the direct benefits of the apprentice's productivity are included, the share of employers reaching or exceeding their break-even point ranges from 38 percent (for the low estimate) to 54 percent (for the high estimate). However, when both direct and indirect benefits are included, two-thirds or more employers recoup or more than recoup the cost of their investments, for all valuations of the apprentice's productivity.

- ***Total net benefits vary inversely with employer size; despite their ability to spread fixed costs over more employees, employers with more than 500 FTEs have lower per-apprentice net benefits than employers with fewer FTEs do.***

Exhibit 6-2 displays median net benefits based on the medium productivity valuation assumption. Net benefits vary inversely with employer size. As first described in Chapter 4, employers of more than 500 FTE employees have lower per-apprentice net benefits, despite their ability to spread fixed costs over more employees. Organizations with fewer than 100 FTEs benefit most. The median employer with fewer than 100 workers achieves positive returns when counting only the direct productivity benefits (\$5,443), and it nets the highest benefits when including indirect costs (\$38,612). For the median organization with 100 to 500 FTEs, the registered apprenticeship returns more than \$26,000 in net benefits when both direct and indirect benefits are included.

Net benefits also vary substantially by occupational category. Only IT registered apprenticeship programs attain positive median net benefits when including only direct benefits. The other standout is advanced manufacturing occupations, with a net return of about \$100,000 per apprentice at the median when counting both direct and indirect benefits. Although advanced manufacturing occupations had a higher net benefit to employers than IT occupations do, IT occupations employers were more likely to break even than advanced manufacturing occupations employers are. This difference between IT and advanced manufacturing occupations suggests that though IT employers are operating their registered apprenticeship programs on smaller margins, those margins are more likely to be positive. Healthcare registered apprenticeships and registered apprenticeships in other occupations have lower net benefits, although all occupational groups have positive average net benefits when both direct productivity benefits and indirect benefits are included.

Turning to program type and program duration, registered apprenticeships in group non-joint programs and registered apprenticeships of 12 to 36 months are associated with the highest net returns when counting both direct and indirect benefits.

6. TOTAL RETURNS TO REGISTERED APPRENTICESHIP
DURING AND AFTER THE PROGRAM

Exhibit 6-2. Median Total Net Benefits (during and after the Registered Apprenticeship), by Employer and Program Characteristics

Characteristic	Percentage of employers	Counting direct benefits only	Counting direct and indirect benefits	Percentage of employers breaking even, counting direct and indirect benefits
Total apprentice and non-apprentice employment				
Fewer than 100 full-time equivalents	26.5	\$5,443	\$38,612	72.2
100 to 500 Full-time equivalents	42.6	-\$7,445	\$26,269	79.3
More than 500 full-time equivalents	30.9	-\$6,975	-\$282	47.6
Broad occupational category				
Healthcare	17.7	-\$4,408	\$7,787	50.0
Information technology	17.7	\$11,846	\$30,192	83.3
Advanced manufacturing	33.8	-\$13,213	\$100,106	78.3
Other	30.9	-\$7,459	\$1,290	57.1
Registered apprenticeship program type				
Group joint program	10.3	-\$2,004	\$45,755	71.4
Group non-joint program	26.5	\$14,603	\$73,470	88.9
Independent joint program	20.6	-\$2,020	\$18,501	71.4
Independent non-joint program	42.7	-\$7,458	\$1,081	51.7
Usual duration of registered apprenticeship				
12 months or less	39.7	\$11,141	\$16,868	70.4
12 to 36 months	36.8	-\$6,276	\$63,568	72.0
More than 36 months	23.5	-\$56,283	\$8,277	56.3

Source: AAI Employer Survey. N=68.

Notes: Table entries are in 2020 dollars and discounted at 3 percent per year. Group programs include multiple employers while independent programs include only one employer. Joint programs are sponsored by joint labor-management organizations while non-joint programs are not. Percentages may not add to 100 due to rounding.

6.2 Total Employer Return on Investment

Return on investment (ROI) is a metric that is often used to guide investment decisions. It is the ratio of the net benefits (i.e., benefits minus costs) that accrue to an investment divided by the cost of the investment:

$$ROI = \frac{\text{Benefits} - \text{Costs}}{\text{Costs}}$$

Costs include those described in Chapter 4: tuition, mentors' lost productivity, training supplies and wastage, and program registration costs. The study analysis includes apprentice compensation during the registered apprenticeship program as a cost, but not the compensation paid to a completer after the end of the registered apprenticeship program.³⁵

³⁵ Sometimes the appropriate costs and benefits for an ROI study can be ambiguous. For example, an apprentice's wages and benefits during the apprenticeship program could arguably be excluded because they are not training costs and are instead compensation for the apprentice's production that would have been paid if the worker were not an apprentice. We include compensation here to be consistent with studies by Helper et al. (2016) and Payne (2020), both of which include apprentices' compensation as a cost.

6. TOTAL RETURNS TO REGISTERED APPRENTICESHIP DURING AND AFTER THE PROGRAM

As displayed in Exhibit 6-3, the median ROI for the medium estimate of the apprentices' productivity is 44.3 percent, which means that for every \$100 an employer invests in the registered apprenticeship program generates \$144.30 in total benefits, or a net benefit of \$44.30 over the entire period, i.e., during the registered apprenticeship program and in the 5 years after the program ended. Individual employers' ROIs varied substantially; the ROI of the 25th percentile employer was -7.4 percent using the medium productivity valuation assumption; the ROI of the 75th percentile employer was +120.7 percent.

Exhibit 6-3. Return on Investment for the Apprenticeship Period and 5 Years after the Registered Apprenticeship Associated with Hiring an AAI Apprentice

Productivity valuation	Both direct and indirect benefits included		
	25 th Percentile	Median	75 th Percentile
Low estimate of productivity value	-20.9%	39.4%	112.1%
Medium estimate of productivity value	-7.4%	44.3%	120.7%
High estimate of productivity value	6.1%	91.4%	165.0%

Source: AAI Employer Survey. *N*=68.

Notes: Table entries are derived from estimates in 2020 dollars that are not discounted.

The interpretation of an ROI is affected by the time period during which the benefits and costs are measured. To derive comparable ROIs for registered apprenticeship programs of different durations, the evaluation team also calculated an annualized version of the ROI.³⁶ Annualization provides the average investment return throughout the analysis period, although in reality these returns are unlikely to be constant over time. Annualized ROIs can also be easily compared to the annual rates of return on other investments.

- ***Using the medium productivity valuation assumption, the annualized ROI is 6.3 percent for the median employer.***

Annualized ROIs are presented in Exhibit 6-4. For the full 5-year study period, counting both direct productivity benefits and indirect benefits and using the medium valuation of the apprentice's productivity, the median employer experienced an annual ROI of 6.3 percent. This median annualized ROI declines, but only to 4.9 percent, using the low valuation of the apprentice's productivity; it increases to 10.4 percent using the high valuation.

Just as different employers experienced different net benefits, they also experienced different ROIs. Using the medium valuation of the apprentice's productivity, the 25th percentile employer had an annualized ROI of -1.3 percent, whereas the 75th percentile employer had an annualized ROI of +13.3 percent. At the high estimate, even employers with programs at the 25th percentile manage to achieve a positive return (1.1 percent).

³⁶ Annualized returns were calculated as $(1 + r)^{1/n} - 1$, where r is the ROI estimate and n is the number of years over which the investment costs are paid and benefits earned. For example, if an apprenticeship lasted 2.5 years, the analysis period for estimating the total direct and indirect benefits is 7.5 years (2.5 years for the apprenticeship and 5 years for the post-program period). Then the annualized ROI is 1 plus the ratio of net benefits to total costs raised to the 1/7.5 power, minus 1.

6. TOTAL RETURNS TO REGISTERED APPRENTICESHIP DURING AND AFTER THE PROGRAM

Exhibit 6-4. Annualized Return on Investment Associated with Hiring an AAI Apprentice

Productivity valuation	Both direct and indirect benefits included		
	25 th Percentile	Median	75 th Percentile
Low estimate of productivity value	-2.6%	4.9%	12.6%
Medium estimate of productivity value	-1.3%	6.3%	13.3%
High estimate of productivity value	1.1%	10.4%	16.6%

Source: AAI Employer Survey. N=68.

Notes: Table entries are in 2020 dollars but are not discounted.

■ Like net benefits, annual ROI estimates vary inversely with employer size.

Employers with more than 500 FTEs have a lower median ROI than employers with fewer FTEs.

Median annualized ROIs for employers during the analysis period vary across employer and registered apprenticeship characteristics as shown in Exhibit 6-5. As with the previous analyses, these median annualized ROIs use the medium productivity valuation. The annualized ROIs are calculated using the net benefit results reported in Exhibit 6-1. Smaller employers have higher annualized ROI. Employers with less than 100 FTEs have a 7.1 percent annualized ROI, and employers with 100 to 500 FTEs have an 8.8 percent annualized ROI, on average. Employers supporting IT and advanced manufacturing registered apprenticeships also have high rates of return (7.8 percent and 9.8 percent, respectively) compared to healthcare registered apprenticeships and other registered apprenticeships (2.0 percent and 0.8 percent, respectively). Group programs have higher median annualized ROIs than independent programs did, regardless of whether the group was joint or not.

Exhibit 6-5. Median Annualized Return on Investment, by Employer and Program Characteristics

Characteristic	Percentage of employers	Median annualized ROI
Total apprentice and non-apprentice employment		
Less than 100 full-time equivalents	26.5	7.1%
100 to 500 Full-time equivalents	42.6	8.8%
More than 500 full-time equivalents	30.9	-0.4%
Broad occupational category		
Healthcare	17.7	2.0%
Information technology	17.7	7.8%
Advanced manufacturing	33.8	9.8%
Other	30.9	0.8%
Registered apprenticeship program type		
Group joint program	10.3	8.5%
Group non-joint program	26.5	12.8%
Independent joint program	20.6	5.2%
Independent non-joint program	42.7	0.5%
Usual duration of registered apprenticeship		
12 months or less	39.7	6.6%
12 to 36 months	36.8	8.5%
More than 36 months	23.5	1.2%

Source: AAI Employer Survey. N=68.

Notes: Table entries are based on estimates in 2020 dollars that are not discounted. Group programs include multiple employers while independent programs include only one employer. Joint programs are sponsored by joint labor-management organizations while non-joint programs are not. The annualized return on investment is the average ROI experienced in a single year. Percentages may not total 100 due to rounding.

7. Summary of Findings

The U.S. Department of Labor (DOL) funded the American Apprenticeship Initiative (AAI) grants to expand registered apprenticeship in high-growth industries and extend the range of occupations using registered apprenticeship, including such occupational fields as advanced manufacturing, healthcare, and IT. This report describes the economic returns experienced by employers that hired apprentices with assistance from AAI grantees. It offers new evidence on the costs and benefits of employer investments in registered apprenticeships and some innovations in measuring economic returns.

Though the study collected information on registered apprenticeship occupations from a diverse set of 68 employers, that sample of employers is not representative of all registered apprenticeship employers or even all AAI employers. Because many of the AAI employers are new to registered apprenticeship, the study's findings may not capture the economic returns of an ongoing program in which employers improve operations over time. The Employer Survey provides details on the characteristics of the registered apprenticeship programs described in this report, which provides insights into the representativeness and scope of the results:

Registered apprenticeship occupations ranged widely from advanced Computer Numerical Control (CNC) operator to IT project manager to medical assistant. The 68 employers surveyed reported on 58 distinct occupations. Grouped by occupational category, one-third were manufacturing occupations, about 18 percent were healthcare occupations, and 18 percent were IT occupations. The remaining 30 percent were “other” occupations, a disparate mix that included insurance agent, landscape technician, and electrician. Estimates of economic returns do not generally capture the full experiences of employers with all their registered apprenticeship, but rather the employer experience with one occupation. Representation of a variety of apprenticeable occupations is important for documenting how net benefits vary by occupation. Occupations are characterized by different wage rates, productivity rates, and training requirements, all of which influence the net benefits experienced by the employer.

Registered apprenticeship programs vary in program type. The most common for AAI Employer Survey respondents was independent programs, either non-joint (43 percent) or joint (21 percent). Representation of multiple program types is important because these program types may affect the costs and benefits of registered apprenticeship. For example, registration costs and other costs could be distributed over multiple employers in a group apprenticeship program. Joint apprenticeship programs typically pay higher wage and non-wage benefits than non-joint programs.

AAI employers used relatively short duration registered apprenticeship programs. Nearly two in five of the surveyed AAI programs were only about one year. Only one in four programs was expected to last 3 years or more. Although these program durations are shorter than what is typical for registered apprenticeship programs nationally, they reflect the experiences of registered apprenticeship programs operating in nontraditional occupations with prospects for future expansion of registered apprenticeship. Program length affects the costs and benefits of registered apprenticeship because the apprentice's wages and benefits are by far the largest cost of the apprenticeship program. Shorter programs may lower the wage bill, although longer programs may raise the productivity of the apprentice by building more robust occupational skills.

This chapter first summarizes the findings concerning the net benefits accruing to employers from their registered apprenticeship investments. It then offers suggestions for further inquiry and analysis.

7.1 The Economic Returns to Employers

Finding and retaining workers with strong occupational and employability skills can be difficult.³⁷ Achieving a good fit between worker and employer means ensuring the former is able to use their skills effectively in the context of the latter’s organization. Employers vary in how they pursue that goal, often framed as “buy or build.” The employer using the buy approach hires workers with the required skills from the labor market. The employer using the build approach hires workers who initially may lack the required capabilities but trains them (whether in-house or through an outside provider) to become fully competent in the skills the employer needs. ***The estimates developed in this study capture the economic returns to employers choosing to build their own workforce through an AAI registered apprenticeship program.***

Like all investments, the costs of registered apprenticeship primarily are incurred at the start; in this case, during the registered apprenticeship itself. The main cost is the compensation paid to the apprentice, followed by the lost value of production of the mentor during the registered apprenticeship period. Other costs include the costs of RTI, supplies and wastage, and registration costs. Once the registered apprenticeship period begins (i.e., worker is hired as an apprentice), the benefits of the registered apprenticeship flow, some during and some for several years after the registered apprenticeship ends, and the apprentice becomes a regular employee.

During the registered apprenticeship, the main benefit is the contribution of the apprentice to the employer’s productivity. If the benefits outweigh the costs, employers can recoup some of their investment during the registered apprenticeship itself. After the registered apprenticeship ends, the value contributed by the registered apprenticeship completer ideally exceeds their compensation as a regular employee. Even though the value to the employer of the worker who has completed a registered apprenticeship is greater than their compensation, workers are not likely to leave the employer, due to the cost of changing jobs, due to imperfect information about the apprentice outside the employer, and due to the fact that it may be employer-specific knowledge that makes the apprentice more valuable to the training employer than to other employers (Wolter and Ryan 2011). Added to the former apprentice’s own productive contributions are indirect benefits, such as improved employee loyalty and engagement, pipeline of skilled workers reduced downtime, and process or product innovations.

Chapters 4, 5, and 6 presented estimates of the costs and benefits during the registered apprenticeship (“in-program”), the costs and benefits over 5 years after the registered apprenticeship ended (“post-program”), and the net benefits for the two periods combined, respectively. Key estimates of net benefits follow, using the medium productivity valuation assumption unless noted otherwise.³⁸

Most employers more than recoup their investments in registered apprenticeship. Of the 68 employers surveyed, 46 (68 percent) achieved a positive net return over the 5 years since the registered apprenticeship ended, counting both direct and indirect benefits. Even when using the *low* valuation of apprentice productivity, two-thirds of employers gained financially from their registered apprenticeship investment. During the registered apprenticeship, 60 percent of employers recouped at least 80 percent of their costs, and almost 40 percent recouped their full costs. Thus, most apprenticeship investments yield a positive return at least by the fifth year after the apprenticeship and often sooner.

³⁷ Eighty-eight percent of employers responding to the AAI Employer Survey reported that hiring skilled workers was either “somewhat difficult” or “very difficult.”

³⁸ As explained in Chapter 2, the *medium* estimate of the value of the reference apprentice’s production is set equal to the higher of (1) the wage of the apprentice after completion of the program, or (2) the wage of a fully qualified worker that the employer would have hired in the absence of the apprenticeship program.

The median estimate of the employer’s return on investment in registered apprenticeship is 44.3 percent. This means that for every dollar invested in the apprentice, the employer ultimately earns \$1.44 in benefits. This finding is consistent with prior research on individual registered apprenticeship programs.

Total net benefits to employers varied widely, but the median employer experienced an almost \$18,000 gain. For employers at the 75th percentile, total net benefits exceeded \$100,000 per apprentice, whereas employers at the 25th percentile lost nearly \$7,000 per apprentice. The median employer gained almost \$18,000 per apprentice.

Indirect benefits are important in generating positive returns to registered apprenticeships. The median value of benefits to the employer increases over \$22,000 per apprentice (from -\$4,951 to \$17,862) when indirect benefits are added to the direct benefit of the apprentice’s own productivity (Exhibit 6-1). Several indirect benefits are especially important, including improved pipeline of skilled employees, improved productivity of co-workers, improved firm culture and employee engagement and loyalty, reduced turnover, and even process or product innovation. For 16 of the 68 companies, or 24 percent, these indirect benefits are enough to turn the returns to the registered apprenticeship investment positive.

Net returns to employers are higher when levels of productivity of apprentices are higher. Among the employers able to recoup their investments during the registered apprenticeship, the average productivity of apprentices was nearly 80 percent of the productivity of a fully qualified worker. Apprentices with employers with losses during the registered apprenticeship period averaged about 57 percent.

7.2 Opportunities for Future Inquiry

The findings from this study should be situated within an understanding of the sample of employers that provided data for the analysis and the information collected in the AAI Employer Survey. The survey expands our understanding of the costs and benefits of registered apprenticeship for employers beyond prior studies, and it opens new opportunities for future inquiries. Important considerations and opportunities for future research include:

The employer sample came from grantee recommendations and included only AAI employers with at least one AAI apprentice who completed the program. The goals were to ensure employer cooperation in sufficient scale to provide meaningful findings and capture the full costs and benefits of training an apprentice, and to evaluate the AAI grant program. Focusing on AAI employers recommended by grantees helped to make sure the ROI findings reported here are relevant to the high-growth apprenticeable occupations where registered apprenticeship is new and expanding. Future research could improve on this approach by randomly sampling employers of apprentices in these high-growth occupations.

Most employers in the study were medium or large; 50 of the 68 employers had at least 100 employees and 21 had more than 500 employees. Manufacturers represented more than one-third and healthcare employers about one-fourth of all employers in the study. AAI grantees often targeted larger employers that could reliably register larger numbers of apprentices. Future research could focus on the experiences of smaller employers to better understand the benefits of the experience and any barriers to their registering apprenticeship programs.

Several of the employer registered apprenticeship programs are new, so the estimated returns may not capture the gains to registered apprenticeships as programs mature. Grantees reached out to many employers to help them design and register new programs, especially in non-traditional occupations. A follow-up study would reveal whether and how employers adjust their programs to limit costs, increase the contribution of apprentices, and achieve high productivity gains for apprentices. Such a

study would also reveal whether employers are retaining their programs and thus indicates that employers believe their programs are worth the investment.

Employers' reported difficulties in finding qualified candidates for skilled positions might underlie their decision to implement a registered apprenticeship program. Nearly all (88 percent) Employer Survey respondents reported having at least some difficulty finding qualified candidates, and one in four said it was very difficult. A future study could examine how the employer take-up of registered apprenticeships varies with the perceived difficulties in hiring skilled workers.

Most apprentice occupations examined in the study are shorter in duration than registered apprenticeships in general. Only in 24 of the 68 employers were registered apprenticeships designed to last more than 2 years. The relatively short durations may be the result of choosing employers with at least one apprentice completer. They could also reflect the fact that nontraditional occupations new to registered apprenticeship, such as healthcare and IT, often have shorter registered apprenticeship programs. A future ROI study could employ longer follow-up periods to incorporate estimates for longer registered apprenticeship programs.

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Appendix

This appendix documents the procedures the evaluation team used to estimate the return to the investment that employers make when engaging apprentices supported by the American Apprenticeship Initiative (AAI). The analysis treats registered apprenticeships as investments by employers. For any given apprentice, the employer makes an investment prior to and during the registered apprenticeship and earns some return (positive or negative) from the investment during and after the registered apprenticeship. To analyze the employer's investment, the team surveyed 68 employers participating in AAI grants that had at least one apprentice who had completed their registered apprenticeship. The survey asked employers to provide wage and productivity information for a specific ("reference") apprentice who had completed their registered apprenticeship in a specific occupation (OCC). It also asked for company-level information.³⁹ Most of the survey data yield estimates of the costs and benefits of engaging this reference apprentice, both during and after the registered apprenticeship.⁴⁰

Employer outlays during the registered apprenticeship include the wages of the apprentice, the cost of the lost productivity of a supervisor/mentor, the costs of related technical instruction (RTI), and other costs such as tools and materials. Employers can recoup some of these costs during the registered apprenticeship based on the value of the apprentice's productivity. The returns to the employer for any given reference apprentice will not necessarily be representative of returns earned for all apprentices the employer hired.

Registered apprenticeships require one or more wage increases or wage steps during the registered apprenticeship, although in some shorter registered apprenticeship programs this increase could be from the hiring wage to the completion wage. The survey collected detailed information about these costs and benefits, especially the reference apprentice's productivity and employment and earnings within each wage step. In addition to the data on the reference apprentice, the survey collected other information about the employer, including hiring and/or promotion costs and a range of indirect benefits that might accrue to employers, such as reduced turnover and reduced downtime.

Employers may accrue benefits after the registered apprenticeship when the apprentice has become a regular employee and their productivity value exceeds the wages paid to them. Therefore, we estimate net benefits associated with the reference apprentice for up to 5 years after the registered apprenticeship ended. The model used for this projection is based on the survey-measured time series of net benefits during and immediately after the registered apprenticeship. The projections are adjusted for expected retention.⁴¹

All costs and benefits that occur during a wage step are assumed to be constant during all the weeks of the step. Using information on the apprentice's start date, we can assign costs and benefits to specific calendar quarters. All costs and benefits are converted to 2020 dollars. Furthermore, because we are

³⁹ The evaluation team asked for information on a specific reference apprentice rather than a typical apprentice so that employers could provide detailed and accurate information from their payroll systems rather than rough estimates. The evaluation team also asked for information on completers in order to collect data about the reference apprentice after the completion of their apprenticeship.

⁴⁰ When employers had multiple apprentices who had completed their apprenticeships, we instructed employers to select an apprentice from the earliest cohort of completers whose last name appeared first alphabetically. Given the duration of many programs, many employers had just one completer at the time of survey fielding. All in all, the sample is best described as a convenience sample.

⁴¹ Each year's projection of the net benefits is adjusted by probability that the apprentice will not experience an employment separation.

treating registered apprenticeships as an investment, all the costs and benefits are discounted. We use two alternative (real) discount rates: 3 percent and 7 percent.

Estimating Costs and Benefits during the Registered Apprenticeship Period

Cost Estimates

The registered apprenticeship costs borne by the employer before and during the registered apprenticeship period include registration costs, apprentice wages and benefits (e.g., healthcare insurance) incurred during the registered apprenticeship, unsubsidized tuition and fees for RTI, training supplies including wastage, and the mentor's lost productivity resulting from training the apprentice.⁴² Some of these costs may have been offset by funding from the AAI grantee.

The overall cost estimate for the reference apprentice ($COST_a$) is:

$$COST_a = REG_a + TC_a + RTI_a + SUPP_a + MPRODL_a - SUB_a$$

where REG_a is the per apprentice registration costs, TC_a is the total compensation paid to the reference apprentice during their registered apprenticeship, RTI_a is the related technical instruction, $SUPP_a$ is training supplies, $MPRODL_a$ is the value of the lost productivity of the mentor, and SUB_a is the per apprentice subsidy received by the employer from the AAI grantee.

To capture REG —the costs employers incur to become a registered apprenticeship program—the survey asked employers to estimate the total cost of registering their apprenticeship program including the cost of staff time spent in planning, setting up, and getting approval for it and one-time payments or fees paid to partner organizations or contractors helping to set it up. Survey respondents were instructed to exclude from their estimate costs that were covered or reimbursed by a partner organization that assisted in developing the program. The costs of registration are fixed, independent of the number of apprentices. To allocate these costs to the reference apprentice, we divide REG by the total number of AAI apprentices hired in occupation OCC (N_{OCC}) yielding $REG_a = REG / N_{OCC}$, where REG_a is the registration costs assigned to apprentice a . Note that REG_a will be an overestimate of the registration cost for the reference apprentice if the registration cost covers current and future non-AAI apprentices and if some of the registration costs cover apprentices in other occupations. Registration costs are assigned to the first week of the registered apprenticeship. If the registration cost item is missing, we assume that $REG_a = \$1,663$ (median for non-missing responses).

To estimate compensation costs for the reference apprentice, we begin by obtaining the reference apprentice's wages earned during the registered apprenticeship, based on each wage step in the registered apprenticeship. The wage payments may include both hours worked and hours participating in RTI. For each step of the registered apprenticeship, employers were asked to provide the reference apprentice's hourly wage (not including benefits, overhead, or indirect costs), total hours worked, and total hours paid while in RTI. For wage step j , these are denoted as w_{aj} , hw_{aj} , and $hrti_{aj}$. The earnings (before tax) paid (E) to the reference apprentice in step j are $E_{aj} = w_{aj} * (hw_{aj} + hrti_{aj})$. $NWEEKS_j$ is the number of weeks in step j . Then weekly earnings for each week k during step j for the reference apprentice $E_{ajk} = E_{aj} / NWEEKS_j$.

To convert earnings to total compensation, we asked survey respondents to provide the cost of the reference apprentice's non-wage benefits, such as insurance premiums for healthcare and workers' compensation and employer's share of payroll taxes, not including payments for RTI or supplies. The

⁴² In some apprenticeship programs, it is possible or likely that apprentices will have multiple mentors over the duration of their apprenticeship. The survey accounted for this and asked respondents to provide an average weekly wage and productivity across mentors if more than one mentor was used.

evaluation team denotes this variable as BENEPT. In a few cases, non-wage benefits significantly exceeded wages. If so, we top-coded BENEPT at 90.0 percent; that is, $BENEPT = \min(BENEPT, 90.0)$. If the non-wage benefit percentage item is missing, then we use $BENEPT = 68.0$ percent for unionized employers (apprenticeship is joint program) or 40.0 percent for nonunionized employers (apprenticeship is non-joint program). We selected these percentages because they are the ratios of the means of non-wage benefits to the means of wages and salaries for unionized and nonunionized workers from a compensation survey conducted by the Bureau of Labor Statistics.⁴³ The non-wage benefit percentage was assumed to be constant over the entire registered apprenticeship. Then the reference apprentice's total compensation during each week k of step j of the registered apprenticeship is $TC_{ajk} = E_{ajk} * (1 + BENEPT)$; and the reference apprentice's total compensation during each step j of the registered apprenticeship is $TC_{aj} = E_{aj} * (1 + BENEPT)$.

Survey respondents reported the unsubsidized employer cost for RTI for the reference apprentice in each step of the registered apprenticeship. We denote this cost for step j as RTI_{aj} . The survey respondents were asked to exclude tuition and fees or instruction expenses paid by the apprentices themselves or by a partner organization. Total RTI costs for the reference apprentice during week k of step j is $RTI_{akj} = RTI_{aj} / N WEEKS_j$.

The costs of training supplies or supply wastage for the reference apprentice in step j , $SUPP_{aj}$, was also reported by employers in the survey. The specific definition used in the survey was supplies that were used only for training rather than for sale or supplies or products that were wasted because of apprentices' mistakes. Total training supply or wastage costs for the reference apprentice during week k of step j is $SUPP_{akj} = SUPP_{aj} / N WEEKS_j$.

The survey captured the lost productivity of the reference apprentice's mentor(s) in each step of the registered apprenticeship. Respondents were queried about how many hours in a typical week the reference apprentice's mentor spent in training or supervision. Respondents were asked to approximate an average if the reference apprentice had more than one mentor. The mentors' usual weekly hours spent in training or supervising during the j -th step was denoted mh_{aj} . The survey also asked for the mentors' productivity during the time they were supervising the reference apprentice. Again, respondents were asked to approximate an average productivity if there was more than one mentor. The mentors' relative productivity during the j -th step was denoted $mprod_{aj}$. Finally, the mentors' (base, without non-wage compensation) average weekly wage (or average weekly wage for multiple mentors) during the j -th step was denoted mw_{aj} . Then the weekly mentor productivity loss during each week of the reference apprentice's j -th step valued at total compensation is $MPRODL_{ajk} = mh_{aj} * (1 - mprod_{aj}) * mw_{aj} * (1 + BENEPT)$. The mentor productivity loss during step j is $MPRODL_{aj} = MPRODL_{ajk} * N WEEKS_j$. Note we assumed that the non-wage benefit percentage for the mentor(s) is the same as for the apprentice.

Several survey respondents reported that they had received financial assistance from the AAI grantee. For those responses, we prorated the subsidy, denoted SUB_a , over the course of the registered apprenticeship. Thus, the subsidy received by the employer for the reference apprentice in week k , SUB_{ak} , = $SUB_a / N WEEKS$, where $N WEEKS$ is the duration of the entire registered apprenticeship. The subsidy received by the employer for step j , $SUB_{aj} = SUB_{ak} * N WEEKS_j$.

Next, we adjust for the fact that some apprentices in the reference apprentice's cohort may not complete their registered apprenticeship. For each wage step, we multiply the components of the costs that are specific to the reference apprentice (total compensation, RTI, supplies and wastage, and lost mentor

⁴³ The average wage for unionized workers is \$28.91 per hour and the average non-wage benefits for union workers are \$19.65 (68 percent of wages). The average wage for nonunionized workers is \$24.45 per hour, and the average non-wage benefits are \$9.71 (40 percent). *Source:* <https://www.bls.gov/news.release/eccc.t05.htm>.

productivity) by the step-specific retention rates (RET_{aj}) reported for a typical cohort of apprentices employed by the employer. The total costs for the reference apprentice are summed across steps as follows:

$$\begin{aligned} TC_a &= \sum_j RET_{aj} * TC_{aj} \\ RTI_a &= \sum_j RET_{aj} * RTI_{aj} \\ SUPP_a &= \sum_j RET_{aj} * SUPP_{aj} \\ MPRODL_a &= \sum_j RET_{aj} * MPRODL_{aj} \end{aligned}$$

Bringing these components together, we estimate the total costs to the employer for the reference apprentices for the entire registered apprenticeship period as:

$$COST_a = REG_a + TC_a + RTI_a + SUPP_a + MPRODL_a - SUB_a$$

Estimates of Benefits before and during the Registered Apprenticeship

The benefits that the employer receives before or during the registered apprenticeship period from having hired the reference apprentice are reductions in hiring or promoting costs and the apprentice's value of production during that period. We employ three alternative valuations for the latter.

The survey asked employers whether, in the absence of apprentices in the occupation of the reference apprentice, they would be more likely to hire a qualified individual from the labor market or promote a current employee into the occupation. The survey went on to ask the employer to estimate the cost of hiring a qualified individual or promoting a current employee to become qualified. The respondents who reported that they would hire a qualified individual were asked to include both hiring costs and firm-specific training costs. $ALTCOST_a$ denotes the total costs of placing someone into the reference apprentice's occupation that employers would have borne in the absence of the registered apprenticeship. Avoiding those costs is a benefit that was allocated to the first week of the registered apprenticeship.

The analysis uses the assumption that the value of the productive contribution of apprentices is equal to the wage of a fully qualified worker multiplied by the apprentice's productivity relative to a fully qualified worker's productivity. Because the apprentice's relative productivity increases over the period of the registered apprenticeship, the survey recorded this measure during each step of the registered apprenticeship. The survey asked for the reference apprentice's productivity compared to the value produced by a fully qualified worker during each step of the registered apprenticeship. The survey provided a definition for survey respondents to use in gauging the reference apprentice's productivity. The survey instructed employers to value the apprentice's productivity compared to that of a fully qualified worker. The evaluation team denoted each step's relative productivity for the reference apprentice as $RELPROD_{aj}$.

The team calculated three alternative estimates for the wage of the fully qualified worker representing low, medium, and high estimates:⁴⁴

⁴⁴ The choice to use three alternative estimates was empirically driven. In their responses to the wage rate they would have paid to an individual hired or promoted in lieu of the apprentice, many employers reported wage levels that were similar to the reference apprentice's starting wage. Thus, we believe $ALTWAGE$ likely underestimates the productive value of the reference apprentice. The second estimate assumes that at the completion of the apprenticeship, the apprentice has become a fully qualified worker. The third estimate assumes that mentors best represent fully qualified workers; however, some mentors were very highly compensated workers. Thus, we believe that the third alternative likely overestimates the productive value of the apprentice.

1. ALTWAGE, the hourly wage rate of the worker that the employer indicated they would hire or promote in lieu of the apprentice.
2. COMPWAGE_a, the hourly wage of the reference apprentice immediately after the completion of the registered apprenticeship. (If the apprentice is no longer with the employer at the time of the survey, COMPWAGE_a is the reference apprentice's hourly wage in the final step. If this completion wage is less than ALTWAGE, then we set COMPWAGE_a = ALTWAGE).
3. The mentor's wage at each step, mw_{aj}.

The implicit assumption is that for the “replacement worker,” marginal productivity equals total compensation. Thus, the direct net benefits estimate is both an absolute and a relative benefit because we have implicitly set the net benefit of the counterfactual worker to 0. To the extent this assumption is incorrect, the apprentice direct benefit estimate is still a valid estimate of the net benefit of the apprentice *relative* to the counterfactual.

The three estimates of the productive value of the reference apprentice's work in step j are the hours worked multiplied by the assumed hourly compensation of a fully qualified worker multiplied by the reference apprentice's relative productivity:

1. $PROD1_{aj} = hw_{aj} * (1 + BENEPT) * ALTWAGE * RELPROD_{aj}$
2. $PROD2_{aj} = hw_{aj} * (1 + BENEPT) * COMPWAGE_a * RELPROD_{aj}$
3. $PROD3_{aj} = hw_{aj} * (1 + BENEPT) * mw_{aj} * RELPROD_{aj}$

Just as we did for apprentice-specific costs, we adjust the direct productivity benefits for expected retention. For each wage step, we multiply the productivity contributions of the reference apprentice times the step-specific retention rates (RET_{aj}) reported for a typical cohort of apprentices employed by the employer.

The reference apprentice's total productive value during the registered apprenticeship is then the sum of the retention-adjusted values for each step:

1. $PROD1_a = \sum_j RET_{aj} * PROD1_{aj}$
2. $PROD2_a = \sum_j RET_{aj} * PROD2_{aj}$
3. $PROD3_a = \sum_j RET_{aj} * PROD3_{aj}$

The total benefits (TB) prior to and during the registered apprenticeship are:

$$TB_a = PROD_a + ALTCOST_a$$

for each of the three assumptions of productivity of the apprentice.⁴⁵

Net benefits prior to and during the registered apprenticeship are:

$$NBINPROG_a = TB_a - COST_a$$

⁴⁵ Recall that ALTCOST_a are hiring costs that are *avoided* by engaging the reference apprentice, so they are added into the total benefits.

for each of the three assumptions of the productivity of the apprentice.

Indirect and Post-apprenticeship Benefits

Indirect Benefits

Registered apprenticeships generate indirect benefits for employers beyond those associated with the productivity of the apprentice. Such indirect benefits are hard to quantify, but employers often cite them as primary motivations for using registered apprenticeship. The survey asked employers to report the extent to which their registered apprenticeship program allowed them to experience indirect benefits and to place a value on them. The survey asked employers whether they had experienced any of the following additional benefits from hiring apprentices:

- Reduced turnover
- Improved pipeline of skilled employees
- Development of future managers
- Improved productivity of co-workers
- Improved company or organization culture
- Product or process innovation
- Employee engagement and loyalty
- Reduced use of overtime or temporary workers
- Reduced downtime
- More on-time delivery

Furthermore, for the benefits that had been experienced, the employers were asked to value them compared to the benefit of increasing the productivity of the reference apprentice from when they started the registered apprenticeship to its completion. The response categories were 200 percent as valuable; 150 percent as valuable; 100 percent as valuable; 50 percent as valuable; and not important relative to the benefit of increasing the productivity of apprentices.

For the i -th indirect benefit, we created the variable IB_{ai} as follows:

$IB_{ai} = 2.0, 1.5, 1.0,$ or 0.50 if the responses to the valuation question were 5, 4, 3, 2, or

$IB_{ai} = 0$, if the relevant indirect effect value were 1 (not important) for reference apprentice a 's employer

To value the indirect benefits, we use the three valuations, v , described above. Then the total values of indirect benefit I are $IBEN_{vai} = IB_{ai} * PROD_{va}$, $v = 1, 2,$ or 3 . Because some of these values were empirically extreme, we top-coded each at the 90th percentile of its respective distribution. The total indirect benefits are $IBEN_{va} = \sum_i IBEN_{vai}$, $v = 1, 2,$ or 3 .

These total values were assumed to hold over the duration of the registered apprenticeship, $NWEEKS$, plus the 5-year projection period of 260 weeks, so the weekly value per apprentice, $IBEN_{vak} = IBEN_{va} / [(260 + NWEEKS) * N_{occ}]$; the annual value per apprentice, $IBEN_{vay} = 52 * IBEN_{vak}$.

Post-apprenticeship Net Benefits

Some net benefits accrue to the employer after the registered apprenticeship ends. To estimate these net benefits, denoted as $POSTNB_a$, we use survey data about the reference apprentice during the registered

apprenticeship and in the year after the registered apprenticeship, and then project net benefits for the next 4 years. The 5-year post-apprenticeship follow-up is used because 5-year registered apprenticeship programs (10,000 OJT hours) are typically the longest duration registered apprenticeship programs, so a 5-year follow-up will allow for equal periods during and after the longest duration registered apprenticeship. We first discuss the calculation of the net benefits in the first year after the registered apprenticeship, and then discuss how these net benefits are projected 4 years into the future.

To develop a net benefits estimate during the first post-program year, we use data on the reference apprentice's post-completion experiences at the time of the survey, which occurred within the first year after the registered apprenticeship ended. These data include information on the completer's post-program wage rate and usual weekly hours of work. The next step is to calculate the value of the completer's productivity. This is calculated as described in the following paragraphs.

Productivity in the first year after the registered apprenticeship is estimated by comparing the apprentice completer to a worker with a similar job and tenure. In addition to the post-program experiences of the completer, the survey collects information about another employee, who is not an apprentice, in the same or similar occupation with the same or similar tenure as the apprentice completer. If the employer has not hired another employee closely matched on occupation and tenure, the survey asks the respondent to imagine a scenario where they have a non-apprentice worker in the occupation with similar tenure as apprentice after the registered apprenticeship is over. The employer is asked to rate the reference apprentice's productivity relative to the non-apprentice. We denote this as $COMPRELPROD_a$ for completer's relative productivity.

If the reference apprentice is no longer at the company or organization, then the projected net direct benefits are 0; that is, $POSTNB_{ay} = 0$, $y = 1, \dots, 5$.⁴⁶ If the reference apprentice is still with the company or organization, then their annual total compensation for the first year after completing the registered apprenticeship is $COMPTC_{a1} = COMPWAGE_a * COMPHRS_a * 52 * (1 + BENEPC)$, where $COMPWAGE_a$ = hourly wage of the reference apprentice at the time of the survey and $COMPHRS_a$ = usual weekly hours of the reference apprentice at the time of the survey. A measure of the reference apprentice's productive value in the first year after the registered apprenticeship equals the non-apprentice's total compensation multiplied by the apprentice's relative productivity; that is, $COMPPROD_a = NAWAGE * NAHOURS * 52 * (1 + BENEPC) * COMPRELPROD_a$, where $NAWAGE$ = non-apprentice's hourly wage and $NAHOURS$ = non-apprentice's usual weekly hours.

The reference apprentice's net direct benefits in the first year after completing the registered apprenticeship is retention adjusted and is derived by subtracting total compensation from the productivity measure; that is, $POSTNB_{a1} = RET_{a,NSTEPS} * (COMPPROD_a - COMPTC_{a1})$.

Although the completers had varying post-program periods at the time of the survey, most occurred within a year of the end of the registered apprenticeship, so we use the initial post-program period as one observation and project forward for 4 additional years to obtain net benefits for 5 years after the registered apprenticeship ended. We project the reference apprentice's post-program net benefits for year y as $POSTNB_{ay}$, $y = 2, \dots, 5$. The projection uses the predicted values from a regression that estimates the trend in weekly direct productivity benefits from the start of the registered apprenticeship through the first year post-program as a function of the natural logarithm of time in weeks elapsed since the start of the registered apprenticeship. The predicted values of the estimated regression for weeks after the first year post-program are used as the projected values of the weekly benefits. $POSTNB_{ay}$, for $y = 2, \dots, 5$ are the

⁴⁶ Indirect benefits are still allocated to the employer.

predicted net benefit values from this regression. The projection assumes a continuation of those trends over the subsequent 4 years.⁴⁷

These projected values are then adjusted for the estimated attrition of the apprentice and discounted to reflect the time value of money. We assume annual job separation by a constant factor α (0.1029, which is the job separation rate observed in the survey for completers) and are discounted by discount rate δ (0.03 or 0.07):

$$\text{POSTNB}_{v_{ay}} = \text{POSTNB}_{v_{ay-1}} * (1 - \alpha) / (1 + \delta), v = 1, 2, 3$$

Return on Investment (ROI) of the Registered Apprenticeship Investment

Recall that the equation for net benefits during the registered apprenticeship excluding indirect benefits is:

$$\text{NBINPROG}_a = \text{TB}_a - \text{COST}_a$$

for each of the three assumptions of the productivity of the apprentice.

We have assumed that for each employer, indirect benefits accrue weekly at a level of IBEN_{ak} . Therefore, all net benefits (ANBINPROG) during the registered apprenticeship are as follows:

$$\text{ANBINPROG}_a = \text{NB}_a + \text{IBEN}_{ak} * \text{NWEEKS}_a$$

for each of the three assumptions of the productivity of the apprentice.

The entire stream of costs and benefits over the entire registered apprenticeship plus 5-year projection period is derived by adding post-program net benefits. Thus, total net benefits that exclude indirect benefits (NBTOT) is equal to:

$$\text{NBTOT}_a = \text{NBINPROG}_a + \text{POSTNB}_a$$

for each of the three assumptions of the productivity of the apprentice.

The total net benefits over the entire registered apprenticeship plus 5-year projection period (ANBTOT) is equal to:

$$\text{ANBTOT}_a = \text{ANBINPROG}_a + \text{IBEN}_a$$

for each of the three assumptions of the productivity of the apprentice.

The return on investment (ROI) to the employer for engaging the reference apprentice is the ratio of the net benefits of the registered apprenticeship to the costs. For the total net benefits, this ratio is:

$$\text{ROI}_a = \text{ANBTOT}_a / \text{COST}_a$$

Note that we also present in this report the ROI that excludes indirect benefits:

$$\text{NBTOT}_a / \text{COST}_a$$

The duration of the registered apprenticeships varies across employers, so the ROIs are not comparable. For example, for a 4-year registered apprenticeship, the ROI is calculated over a 9-year period. For a 1.5-

⁴⁷ The natural logarithm specifications ensures that benefits grow on trend, but gradually “flatten” over time.

year registered apprenticeship, the ROI is calculated over a 6.5-year period. To normalize the ROIs, we calculate an annualized return on investment (ROI_{ay}) as follows:

$$YEARS_a = N WEEKS_a / 52$$

$$ROI_{ay} = ROI_a * (1/YEARS_a) - 1.0$$

The annualized ROI assumes that each year's ROI is constant.