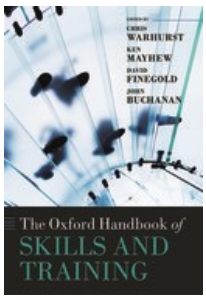

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CHAPTER

9 Skill Development in Middle-level Occupations: The Role of Apprenticeship Training

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Abstract

Concerns about the polarization of the labor market are widespread. However, countries vary widely in strategies for strengthening jobs at intermediate levels of skill. This paper examines the role of apprenticeship in training and upgrading for middle-level occupations. The first section defines and describes middle-skills occupations, largely in terms of education and experience. The next step is to examine skill requirements and alternative approaches to preparing and upgrading the skills of individuals for these occupations. Programs of academic education and apprenticeship programs emphasizing work-based learning have often competed for the same space but with significant complementarities. Third, we consider the evidence on the costs and effectiveness of apprenticeship training in several countries from the employer, worker, and government perspectives. The final section highlights the advantages of apprenticeship training for intermediate level skills, jobs, and careers.

Keywords: Apprenticeship, middle class, occupation, skill, training

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Introduction

HUMAN resources are central to the performance of every economy. In the short-run, the framing of the skills issue is how best to reduce unemployment. Skill mismatches may hinder the return to full employment and slow economic recovery (Puri 2012). The case of Marlin Steel Wire Products in Baltimore is an example (Weitzman and Harding 2011). In 2011, when the US unemployment rate was over 8%, the company of 30 employees reported that it could not find sufficient qualified workers to maintain high levels of growth. It is hard to blame wages, since Marin offered a compensation package of more than $80,000 per year. Data from a 2011 Manpower Group survey indicated that more than half of employers had difficulty filling jobs and nearly half blame the lack of hard technical job skills. Moreover, the hardest jobs to fill in 2011 were for workers qualified in skilled trades, including machinists and machine operators.

Jobs are the short-run focus, but in the long-run, the central issue is whether a country's human resources are of sufficient quality to promote or even accommodate high rates of economic growth. Although reading, writing, and maths skills and degrees are critical indicators of human capital, so too are competence and mastery in occupational skills and such behavioural skills as listening, communication, problem-solving, and dealing well with superiors and peers (Heckman and Rubinstein 2001; Heckman et al. 2006; Lerman 2008; Almlund et al. 2011). All advanced economies rely on universal primary education to teach verbal and
p. 181 maths literacy. But they differ in how they ↳ expect people to learn and use occupational and other workplace skills, especially for intermediate- or middle-level occupations.

In nearly all countries, technical and vocational education and training (TVET) systems play a central role in occupational training. But the governance, timing, delivery, location, and experience of TVET vary widely across and often within countries (OECD 2009). In some countries, the government dominates TVET, whilst others involve private employers extensively. Serious TVET begins by age 14 in some countries and not until a student's late teens and early 20s in other countries. Most TVET programmes focus on initial vocational education but some include continuing vocational education to upgrade the skills of workers already in an occupation (Cedefop 2011a). The duration of TVET programmes ranges from less than a year to over four years. Training systems vary in their use of work-based vs. classroom-based learning. Some countries rely almost exclusively on academic subjects, leaving occupational and firm-based training entirely to employers. The range of occupations within the scope of TVET varies widely as well.

Apprenticeship training is common. Apprenticeships usually involve formal agreements under which employers provide workers with structured work-based learning alongside classroom learning. Apprentices participate in the production process, work with a trainer/mentor, and ultimately gain sufficient occupational mastery to become certified by an external body. The scale of apprenticeship programmes varies widely, reaching 4% of the workforce in Germany and Australia but only 0.2% in the United States.

A critical distinction between apprenticeship and other TVET is the way training positions are created. Vocational schools provide openings based on administrative decisions concerning available teachers, budgets, and potential enrolment. Although administrators take some account of market demands, the schools are largely insulated from the job market. In contrast, apprenticeship slots only arise when employers create them. Because employers invest their own money when providing apprenticeship opportunities, their perception of demand is generally better informed than that of school administrators. But, training positions are pro-cyclical, with too many openings in boom periods and too few during trough periods.

This paper examines the diversity of approaches to apprenticeship and related training for intermediate- or middle-level occupations. We begin by defining and describing middle-skills occupations, largely in terms of education and experience. The next step is to describe skill requirements and alternative approaches to preparing and upgrading the skills of individuals for these occupations. Programmes of academic education

and apprenticeship programmes emphasizing work-based learning have often competed for the same space but the full picture reveals significant numbers of complementarities. Third, we consider the evidence on the costs and effectiveness of apprenticeship training in several countries. The final section highlights empirical and policy research results concerning the advantages of apprenticeship training for intermediate-level skills jobs and careers.

What Are Middle-Level Occupations?

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Classifying occupations or jobs by skill is complicated because of the multi-dimensional character of skills. The middle of a single distribution (say, by educational attainment) fails to capture the variety of skills required to master specific jobs or occupations. Should the skills required to play professional baseball be considered 'middle-skill' positions even if education beyond high school is not necessary for the position? Are the skills required for a master carpenter in some sense *lower* than those required of elementary school teachers with Batchelor's degrees?

One solution is to employ wages as a proxy for skill. Wages may be viewed as incorporating skill levels along various dimensions together with the market valuation of those skills. Just as home prices reflect housing characteristics, along with 'hedonic prices,' one might argue that wages capture the diverse mix and value of skills required for jobs. However, several problems arise with wages as classifying jobs and occupations by skills. Wages reflect not only skill but also the riskiness, job satisfaction, responsibility, status, and flexibility of jobs and occupations. Skill requirements and expertise required in an occupation may not change but the wage return on the occupation may. Wages sometimes are a reward for tenure on the job; seniority often matters. Wage differences can come about from differences in bargaining power. For example, the pay of a longshoreman depends on the high costs of strikes relative to wage increases. Wages for the same occupation often differ widely across geographic areas, partly because of rent differentials. Finally, classifying occupations by mean wages misses the wide wage variation within detailed occupations.

Autor (2010) ranks detailed occupations by their average wages in a base period. Middle-skill jobs are in occupations in the middle segment of the average wage distribution. This approach indicates that middle-skill occupations are declining rapidly relative to high- and low-skill positions. The reasons include the increased power of computers to automate routine tasks undertaken in middle-skill positions, expanding international trade, declining unionization, and the erosion of the minimum wage. Autor sees a 'hollowing out' of the job market. Goos et al. (2009) find that middle-wage occupations declined as a share of employment in all 16 countries that they studied, mostly offset by a rising share of high-wage occupations.

The Autor approach does not capture the wide distribution of wages within detailed occupations.[1] For all employees and across all occupations, hourly earnings at the 75th percentile of jobs were 2.48 times hourly earnings at the 25th percentile. But, the weighted 75:25 ratio *within* occupations was nearly 1.61, or 65% of the overall ratio. Wages overlap across occupations that do and not require a BA degree. In 2012 annual earnings at the 25th percentile of college occupations (defined as having over half of workers with a BA or higher degree) averaged about $53,500. For occupations where ↳ only 15–50% of workers have a BA or higher degree, average annual earnings at the 75th percentile of those occupations was nearly as high at about $52,000.[2]

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Many occupational positions not requiring a BA involve a considerable amount of work-based learning, experience, and other specialized talents (e.g. salesmanship, responsibility, creativity, and detailed expertise). Sub-BA occupations can generate high wages at the top levels of quality and productivity. For example, wage levels, skill, and status differ markedly between 'cook at a restaurant' and 'chefs and head cooks'. Cooks average only about half the hourly earnings level of chefs. Upgrading cooks to high quality and productivity would allow them to compete with the earnings of many college occupations. Occupations with

above average earnings and with a majority of workers without a BA include construction managers, buyers and purchasing agents, lodging managers, appraisers, court reporters, various types of technicians, aircraft mechanics, police officers, supervisors of police, and operators of gas plants.

One scheme for classifying occupations into low-, middle-, and high-skills categories relies on educational attainment and training. According to this classification (Holzer and Lerman 2009), middle-skill jobs still make up roughly half of all employment today, though their share of employment fell from about 55% to 48% between 1986 and 2006. Professional and related occupations rose from 17% in 1986 to more than 20% in 2006 and managerial positions increased from about 12% to 15% of total employment. Low-skill (service) jobs barely increased their share from 15% to 16% of total employment. Several intermediate-level occupations with good wages have increased jobs substantially since 1986; medical therapists increased by 30%, carpenters by 20%, heavy vehicle maintenance specialists by 25%, and heating and air conditioning positions by 21%.

In summary, definitions of intermediate-level jobs vary, depending on whether they use wage, occupation, and educational criteria. Generally, intermediate-level jobs are positions between jobs that require very little training and jobs that require a university degree. They are declining modestly as a share of total jobs, but still represent a large segment of the labour market.

Skills Required for Intermediate-Level Occupations

Whether 'middle-skill' occupations are modestly expanding or contracting, the key questions should be:
p. 184 what are the skills required to perform well in these occupations? ↳ What are the best approaches to educating and training workers to generate high productivity and high wages in these fields?

In determining the skill requirements for intermediate-level occupations, one must consider the appropriate mix of generic academic skills, specific occupational skills, and generic non-academic skills, such as communication, motivation, and responsibility. Mounier's (2001) classification distinguishes between cognitive, technical, and behavioural skills. Some of all three types of skills are required for nearly all jobs, but the levels of each type of skill vary across occupations.

Occupational and behavioural skills are more significant from the employer perspective than is exposure to upper level academic courses. A survey of a representative sample of US workers (Handel 2007) indicates that only 19% use the skills developed in Algebra I on the job, only 9% use the skills for Algebra II and less than 15% of workers ever write anything five pages or more. This does not imply that jobs not requiring certain academic courses are unskilled. Many occupations viewed as low- or middle-skill require a complex mix of cognitive and social skills (Rose 2004). Upper blue-collar and even lower blue-collar workers must know how to read and create visuals, such as maps, diagrams, floor plans, graphs, or blueprints, skills typically learnt in occupation-specific courses. Workers also report the importance of behavioural skills, including problem-solving and communication, teaching and training other workers, dealing with people in tense situations, supervising other workers, and working well with customers. Mastering these skills is cognitively challenging.

The 1992 Secretary's Commission on Achieving Necessary Skills in the United States confirmed the importance of behavioural skills, including allocating resources (time, money, and facilities), interpersonal skills (such as teamwork, teaching others, leadership), acquiring and using information, understanding systems, and working well with technology. Except for college graduates, non-cognitive skills (measured by indices of locus of control and self-esteem) exert as high an impact on job market outcomes as cognitive skills (word knowledge, paragraph comprehension, arithmetic reasoning, mathematical knowledge, and coding speed as measured by the Armed Forces Vocational Aptitude Battery) (Heckman et al. (2006).

Lindqvist and Vestman (2011) analyse data on a representative sample of the Swedish male population matched with education, earnings, and information on cognitive and non-cognitive skills obtained in the military enlistment process through interviews with psychologists. Persistence, social skills, and emotional stability are the non-cognitive/behaviour skills measured and coded from the interview. The study finds that within low to mid ranges of skills, non-cognitive skills exert a higher impact on wages than do cognitive skills.

The sociocultural approach provides some revealing examples of how skills are used in context and how non-academic skills are often developed and used as part of a 'community of practice' (Stasz 2001). Nelsen (1997) points out that workplaces not only require formal knowledge—facts, principles, theories, maths and writing skills—but also informal knowledge—embodied in heuristics, work styles, and contextualized understanding of tools and techniques.

p. 185 What about occupational skills? Occupational qualifications sometimes fit within a broad framework of national vocational qualifications running from basic to intermediate to advanced levels.[3] In the United Kingdom, the National Vocational Qualification (NVQ) system specifies requirements for proficiency that vary widely across types of occupations and over levels within occupations.[4] The ultimate goal is that employers place a value on attaining a qualification level, giving workers an incentive to learn on the job. Although the system has not worked out very well (e.g. Eraut 2001), NVQs have led to some added training in certain sectors (Cox 2007). In the United States, about one in five workers requires a state licence to practise their occupation, up from less than 5% in the early 1950s (Kleiner 2006). Licensing rules vary widely across states, with many states regulating occupations as varied as alarm contractor, auctioneer, manicurist, and massage therapists.

Often, training colleges—such as US community colleges and for-profit schools—decide themselves (sometimes in consultation with potential employers) what constitutes qualifications in quite detailed occupations, such as domestic air conditioner and furnace installer, medical receptionist, and medical coder.[5] Other standards directly involve employers and government entities.

Occupational standards are critical to well-functioning apprenticeship programmes. Australia has developed the national Training Package (collections of competency standards gathered into qualifications) for all industry areas, whilst previously qualifications were only available in a limited range of occupations and industries (Smith 2012). In Canada, the occupational standards in the Interprovincial Standards Red Seal Program allow for effective harmonization of apprenticeship training and assessment in each province and territory (Miller 2012). The Red Seal Program's standards incorporate essential skills (reading, document use, writing, numeracy, oral communication, thinking, digital technology, and lifelong learning), common occupational skills (that apply to a small range of occupations), and specific occupational skills.[6]

In England, the Sector Skills Councils and their employers design the content of each apprenticeship using the national Apprenticeship Blueprint (Miller 2012). As of 2012, there were 200 operating apprenticeship frameworks and another 118 under development. Employers have considerable flexibility in implementing the standards.

France uses Apprenticeship Training Centres (CFA) to help design and deliver the classroom-based components of apprenticeships, with skill standards often developed by Professional Consultative Committees (Dif 2012). They operate under frameworks established by the National Commission for Vocational Qualifications.

In Switzerland, the Federal Office for Professional Education and Technology, together with cantons,
p. 186 employers, trade associations, and unions participate in framing ↳ the occupational standards for about 250 occupations (Hoeckel et al. 2009). The canton vocational education programmes implement and supervise the vocational schools, career guidance, and inspection of participating companies and industry

training centres. Professional organizations develop qualifications and exams and help develop apprenticeship places.

In Germany, the 'social partners', including government, employer, and employee representatives, determine occupational standards (Hoeckel and Schwartz 2009). The chambers of commerce advise participating companies, register apprenticeship contracts, examine the suitability of training firms and trainers, and set up and grade final exams.

Skill requirements in apprenticeships include academic courses and structured work-based training aimed at helping apprentices learn and master a range of tasks. They often include general tasks that apply to a family of occupations (say, metalworking) and tasks that apply to a specific occupation (say, tool mechanics or metal construction and shipbuilding).

Overall, occupational standards for apprenticeships extend well beyond the traditional construction crafts. In the United Kingdom, for example, apprenticeships are available within business, administration and law; arts, media, and publishing; health and public services; retail and commercial enterprise; and information technology and communication. Common apprenticeships in Switzerland include information technology specialist, commercial employee, pharmacy assistant, and doctor's assistant. German standards cover over 300 occupations, including lawyer's assistant, bank staff worker, industrial mechanic, industrial manager, retail worker, commercial sales, and computer networking. In nearly all fields, students learn skills in closely related occupations. But some apprenticeship programmes rely on an overall narrow approach to learning. Fuller and Unwin (2006) draw attention to the differences at the firm level between the more narrow 'restrictive' skill development and the broader approach used in 'expansive' work environments.

Apprenticeship and School-Based Approaches to Preparing Workers for Middle-Skill Jobs

Countries have developed various approaches to training workers for intermediate-level occupations. Systems differ with respect to the level and duration of general education, the timing of occupation-specific education and training, and the split between classroom-based and work-based learning. These differences can have important consequences. In articles comparing British and German companies in the same industries, Wagner and colleagues cited the higher vocational qualifications of German workers as giving German firms a productivity advantage (see, for example, Steedman and Wagner 1987; see also Prais 1995).
p. 187 Although discussions of skill preparation systems generally ↳ focus on the work-based vs school-based distinction, the quality, depth, and portability of what students or apprentices learn are at least as important.

A common concern about apprenticeship is the portability of skills learnt in occupation-specific programmes. However, as Geel and Backes-Gelner (2009, 3) point out, learning even a highly specific skill can yield benefits outside the narrow occupation:

> For example, an adolescent who wants to become a clockmaker should not necessarily be considered poorly equipped for future labor market requirements, even though his industry is small and shrinking. Rather, he is well equipped because his skill combination is very similar to skill combinations of other occupations in a large and growing skill cluster, which includes, for example, medical technicians or tool makers. Despite a seemingly very narrow and inflexible skill combination in his original occupation, he is nonetheless very flexible and well prepared for future labor market changes due to the sustainability of his acquired skills and his current skill cluster.

To operationalize skill specificity, Geel and Backes-Gelner (2009) and Geel et al. (2011) begin with an insight borrowed from Lazear (2009) that all skills are general in a sense and occupation-specific skills are various mixes of skills. The authors compile the key skills and their importance for nearly 80 occupations. They estimate how skills are grouped within narrow occupations, allowing for skills developed ostensibly for one occupation to become useful in other occupations. It identifies occupational clusters that possess similar skill combinations within a given cluster and different skill combinations between clusters. Next, indices for each narrow occupation measure the extent to which the occupation is relatively portable between occupations within the same cluster and/or relatively portable between the initial occupation and all other occupations. The authors use these indices to determine how portability affects mobility, the wage gains and losses in moving between occupations, and the likelihood that employers will invest in training.

Whilst only 42% of apprentices stay in their initial occupation, nearly two-thirds remain with either the occupation they learnt as an apprentice or another occupation in the cluster using a similar mix of skills. Those trained in occupations with more specific skill sets are most likely to remain in their initial occupation or move to occupations within the same cluster. Apprentices actually increase their wages when moving to another occupation within the same cluster but lose somewhat when moving to another cluster. As Geel et al. (2011) show, employers are especially likely to invest in apprenticeships with the most specific skill sets.

Other strong evidence of the high returns on and transferability of German apprenticeship training comes from Clark and Fahr (2001). The overall rates of return to each year of apprenticeship range from 8–12% for training in firms of 50 workers or more and from about 5.5–6.5% for firms of 2–49 workers. Although transferring to another occupation can offset these gains, the reduction is zero for those who quit and only
p. 188 about 1.7% for those who are displaced from their job and shift to another occupation. There ↳ is no penalty from displacement into a somewhat related occupation. Göggel and Zwick (2012) show the net gains or losses from switching employers and occupations differ according to the original training occupation, with apprentices in industrial occupations actually experiencing wage advantages whilst those in commerce, trading, and construction seeing modest losses. Finally, Clark and Fahr (2001) look at workers' views on their current use of skills learnt in apprenticeship training. Not surprisingly, 85% of workers remaining in their training occupation use many or very many of the skills they learnt during apprenticeship. This group constitutes 55% of the sample. But, even amongst the remaining 45%, about two out of five workers reported using many or very many of the skills from their apprenticeship and another 20% used some of the skills. Overall, only 18% of all former apprentices stated they used few or no skills learnt in their apprenticeships.

A key issue is whether the general training in apprenticeships (usually financed by the government and/or students) is taught at a level as high as in comparable subjects in school-based programmes. Some researchers see firm-based apprenticeship training as limiting mobility and adaptability (Hanushek et al. 2011). Yet, academic tracks in US secondary schools and community colleges may have no advantage for mobility. First, a high percentage of students drop out of both academic secondary and community college programmes. Second, many community college programmes are at least as specific as apprenticeship programmes. Many certificate programmes within community colleges are almost entirely devoted to learning a narrow occupational skill, such as courses to become a phlebotomist, child care assistant, and plastics processing worker. Some US school-based programmes in for-profit colleges also offer narrow programmes, such as truck driving, medical assistant, and medical insurance billing and coding. Third, skills often erode when they go unused.

Whilst community college and private for-profit students often take highly specific occupational courses, apprentices take some general, classroom courses. Thus, apprentice electricians learn the principles of science, especially those related to electricity. In most countries, collaboration takes place between vocational schools and apprenticeship programmes. In the United States, apprentices often take their

required ‘related instruction’ in classes at community colleges or for-profit colleges (Lerman 2010). From this perspective, US apprenticeship programmes should be viewed as ‘dual’ programmes that combine work-based and school-based learning.

In other OECD countries, the mix of school-based vs employer-based programmes used to prepare young people for careers varies widely. Secondary school students in Belgium and Sweden participate at high rates in vocational education but have very low rates of participation in work-based programmes. By contrast, most of the vocational education in Germany, Switzerland, and Denmark revolves around work-based learning, including apprenticeships (Cedefop 2012).

Apprenticeship training limits the gaps between what is learnt at school and how to apply these and other skills in the workplace. An extensive body of research documents the high economic returns for workers that result from employer-led training (Bishop 1997). Transmitting skills to the workplace works well with
p. 189 supervisory support, ↳ interactive training, and coaching, gives opportunities to perform what was learnt in training, and keeps the training relevant to jobs (Pellegrino and Hilton 2012). These are common characteristics of apprenticeships. Employer-based training like apprenticeships often leads to higher levels of innovation (Bauernschuster et al. 2009), net gains to firms that train during and soon after the training, and externalities, such as benefits for other employers and for the public when workers are well-trained to avoid the consequences of natural or man-made disasters. Under apprenticeships and other forms of employer-based training, the government generally gains by paying little for the training whilst reaping tax benefits from the increased earnings of workers.

Methodological Issues in Estimating the Costs and Benefits of Apprenticeship Training

Conceptual and practical issues arise in trying to estimate the costs and benefits of apprenticeship training (see also Gambin and Hogarth, Chapter 31). One is the variation in the structure and breadth of ‘apprenticeship’. The term encompasses a variety of occupations with varying levels of school-based learning at the secondary and the post-secondary levels, varying amounts of work-based learning, and heterogeneity in general vs occupation-specific training. A second issue is defining the counterfactual, or what would have taken place in the absence of apprenticeships. Even when comparing outcomes of apprenticeship participants and those of non-participants with the same observed characteristics, unobserved differences between groups (such as in the motivation to work or in the mode of learning that is most beneficial) may affect both entry into apprenticeship and post-programme earnings. Another issue is that apprenticeship programmes may work well for some occupations but not others. Generalizing in these contexts is difficult.

Uncertainty adds another twist to estimating benefits and costs. Given uncertainty about the productivity returns from irreversible investments in particular workers, the firm’s investment creates a real option. When the training is completed, the firm has the option but not the obligation to hire the trained worker. This option value raises the firm’s returns and increases the likelihood that they will invest in training.

Finally, several non-economic outcomes are difficult to quantify but do show some association with vocational education and training. One analysis (Cedefop 2011b) found that technical vocational education (including apprenticeship) is linked to higher confidence and self-esteem, improved health, higher citizen participation, and higher job satisfaction. These relationships hold even after controlling for income. Other studies have indicated that apprenticeships improve youth development (Halpern 2009) and vocational identity (Brown et al. 2007), but it is difficult to quantify the economic value of these social benefits.

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Estimates of Costs and Benefits for Workers

Notwithstanding the difficulties, researchers have generated estimates of apprenticeship benefits and costs. The OECD's *Learning for Jobs* (2009) cites a few studies dealing with benefits and costs. One US study examined the government costs as well as the worker and government benefits of three types of TVET—secondary vocational education, post-secondary vocational education (in community colleges) and apprenticeship programmes. Using data on individuals in the State of Washington, Hollenbeck (2008) identified groups that entered employment offices, had the same pre-programme earnings, but had different programme experiences. Absolute and relative gains in earnings from apprenticeship were highest, reaching about $2,000 per month compared to about $1,500 per month amongst participating in occupational programmes in two-year colleges.

A study of apprenticeship in ten US states also documents large and statistically significant earnings gains (Reed et al. 2012). It estimates how the length of participation in an apprenticeship affected earnings, holding constant for pre-enrolment earnings of apprenticeship participants. The estimated impacts are consistently and highly positive. At six years after starting a programme, earnings of the average apprenticeship participant (average duration in an apprenticeship) stood at 1.4 times the earnings of non-participants with the same pre-apprenticeship history. The gains were highly consistent across states. Overall, the study finds that apprenticeship returns nearly $28 in benefits for every dollar of government and worker costs.

Many studies have examined the earnings gains from apprenticeship training in European countries. They generally find high rates of return for the workers, often in the range of 15% (Clark and Fahr 2001; Fersterer et al. 2008; Geel and Backes-Gellner 2009). Clark and Fahr (2001) estimate wage gains in this range (about 6–8% per apprenticeship year with a duration of slightly less than three years). The studies of apprenticeship impacts are generally unable to account for possible selection bias that results from employer's selection of young workers who are more capable than their counterparts in ways that analysts cannot observe.

One recent study of the returns on apprenticeship training in small Austrian firms (Fersterer et al. 2008) overcomes much of the selection problem. It focuses on the interaction between apprenticeship duration and failing firms. A firm going out of business will generally cause a sudden and exogenous end to their apprenticeship training. More generally, the timing of firm failure will affect the duration of apprenticeship training and particular worker experiences. By looking at apprentices who obtained training in failed firms, one can examine a large number of trained workers with varying durations in their apprenticeships. The sample covers small firms, where the closing of the firm is likely to occur most suddenly. The results show a significant wage effect from longer durations of apprenticeship. For a 3–4-year apprenticeship, post-
p. 191 apprenticeship wages end up 12–16% higher than they otherwise would be. Since the worker's costs of ↳ participating in an apprenticeship are often minimal, the Austrian study indicates high overall benefits relative to modest costs.

Two Canadian analyses indicate a high wage premium for apprenticeships for men but not for women (Boothby and Drewes 2010; Gunderson and Krashinsky 2012). Apprenticeship completion is the highest educational attainment for only about 7% of Canadian men. However, for this group, earnings are substantially higher than the earnings of those who have only completed secondary school and nearly as high as those who have completed college programmes that are at a level less than a university BA. Overall, the gains for men from apprenticeship training are in the range of 17–20%. Even evaluated after 20 years of experience, apprenticeship training in most occupations yields continuing returns of 12–14%.

One Australian study shows very high rates of return to individuals undertaking TVET. Ryan (2002) finds that a male school leaver who completes a skilled vocational qualification whilst working part-time reaps a

return of about 24 %. This gain far exceeds the 3.9% return to a male who works part-time whilst obtaining an associates diploma (two-year college degree). Other researchers have highlighted the benefits of well-structured vocational and apprenticeship systems (Steedman 1993; Acemoglu and Pischke 1999; Ryan 2001; OECD 2010).

A sceptical view of returns to apprenticeship emerges in Hanushek et al. (2011). They argue that vocational education (including apprenticeships) improves employment and earnings outcomes of young people but the advantage erodes to a disadvantage at older ages. The erosion of gains at older ages is said to be clearest in countries that emphasize apprenticeship, such as Denmark, Germany, and Switzerland. Yet, according to the authors' estimates in the paper, the advantage in employment rates linked to vocational education in the apprenticeship countries remains through to approximately the age of 60. Moreover, in the apprenticeship countries, the advantage in employment rates is sizable, providing men with vocational education a 9-percentage point higher employment rate at age 40 and a 4-point advantage at age 50.

Costs and Benefits for Employers

For employers, the net costs depend on the mix of classroom and work-based training, occupation, skill and wage progression, and the productivity of the apprentice whilst learning to master the required skill. Direct costs include apprentice wages, the wages of trainer specialists for the time they oversee apprentices, materials, and the costs of the additional space required for apprenticeships (Wolter and Ryan 2011). The benefits depend on the extent to which apprenticeships save on subsequent hiring and training costs, lower turnover costs, and enhance productivity more than added wage costs. Also valuable is the employer's increased certainty that apprentice graduates know all relevant occupational and firm-specific skills and can work well alongside other skilled workers. In addition, having extra-well-trained workers, such as
p. 192 apprentice graduates, ↳ provides firms with a valuable option of expanding production without reducing quality in response to uncertain demand shocks and covering for sudden absences of skilled workers.

The most extensive studies of net costs of apprenticeships deal with German and Swiss employers. One analysis compares results from surveys of 1825 German firms and 1471 Swiss firms that refer to the year 2000 (Muehlemann et al. 2010). The study does not include the costs of school-based learning linked to apprenticeships. The firms' main gross costs are the wages of trainers and the wages of apprentices. The authors calculate gross costs and the benefits to employers derived from the productive contributions of apprentices only during the training period. On average, the gross costs per year amounted to €15,500 for German firms and about €18,000 for Swiss firms. Although Swiss firms spend more than German firms, they derive substantially higher benefits from the value added by apprentices. Swiss firms gain over €19,000 per year, more than double the €8,000 benefits that German firms attribute to the value of production generated by apprentices. For a three-year apprenticeship, Swiss firms recoup the €54,400 cost with benefits of €57,100 whilst German firms experience a €46,600 gross cost but only €24,000 in benefits. Whilst the wages paid to apprentices are higher in Switzerland than in Germany, apprentices are at work for more days per year in Switzerland than they are in Germany (468 vs 415 for a three-year apprenticeship). Further, when at workplaces, Swiss apprentices devote 83% of their time to productive tasks, compared to only 57% amongst German apprentices.

One striking feature of apprenticeships in both countries is how quickly apprentices ascend from taking on unskilled to skilled tasks. In Switzerland, the productivity of apprentices rises from 37% of a skilled worker's level in the first year to 75% in the final year; the increase in Germany is as rapid, increasing from 30% to 68% of a skilled worker's productivity over the apprenticeship period. Still, nearly all German firms with apprenticeships (93%) incur net costs whilst a majority of Swiss firms (60%) more than recoup their costs.

Are the higher in-programme net costs to German firms offset by any advantage after the apprenticeship period? The study indicates retention of apprentices within the firm is much higher in Germany than in Switzerland. Thus, whilst German firms bear much higher net costs than Swiss firms during the apprenticeship period, they reap higher returns during the post-apprenticeship period.

Evidence from the Germany surveys of employers offers some insight into post-programme benefits (Beicht and Ulrich 2005). Recruitment and training cost savings average nearly €6,000 for each skilled worker trained in an apprenticeship and taken on permanently. The report cites other benefits, including reduced errors in placing employees, avoiding excessive costs when the demand for skilled workers cannot be met quickly, and performance advantages favouring internally trained workers who understand company processes over skilled workers recruited from the job market. Taking all of these benefits into account makes the apprenticeship investment into a net gain for employers.

Not all recent studies indicate high net costs of apprenticeships in Germany. For example, Mohrenweiser and Zwick (2009) find that for many occupations, the gains to the firm during the apprenticeship period
p. 193 more than offset the costs. They draw their conclusions ↳ by estimating the impact of apprenticeships on company profits. For apprenticeships in trade, commercial, craft, and construction occupations, the estimates show a positive impact on profits. Moreover, the gains come from the higher productivity of apprentices (relative to unskilled or semi-skilled workers) and not from lower wages. Only in manufacturing is the effect on current profits negative, indicating a net cost during the apprenticeship period that is presumably offset by post-programme benefits. In another careful study of German apprenticeships, Rauner et al. (2010) finds that the majority of the 100 firms in the sample recouped their investment in apprenticeships during the training period. The same study finds that most firms experience low net costs or even net benefits from sponsoring apprenticeships. However, the net costs vary widely, with some firms gaining more than €10,000 and other experiencing net costs. High quality apprenticeships have higher gross costs but are much more likely than low quality apprenticeships to help employers recoup their investment during the training period.

An extensive study of Canadian employers sponsored by the Canadian Apprenticeship Forum (2006) estimated employer costs and benefits of four-year apprenticeships in 15 occupations. The study drew on responses from 433 employers. The average gross costs varied widely, ranging from about $78,000 for cooks to $275,000 for construction electricians. Average in-programme benefits—measured as the revenue generated by the apprentices—varied widely as well, ranging from $120,000 for cooks to $338,000 for construction electricians. For all 15 occupations, employers earned a positive return on their apprenticeship investments even without taking account of any post-programme benefits.

In a recent analysis of apprenticeships in the United Kingdom based on eight employers, Hasluck and Hogarth (2010) estimated that the average gross costs were higher than the average benefits during the apprenticeship period in all four industries. The gross costs were only modestly higher than the in-programme benefits in retail and business administration, but much higher in engineering and construction. Still, the authors estimate that employers at least break even during the early post-apprenticeship period, when the contributions to production of apprenticeship graduates are worth more than their wages.

No rigorous studies have estimated costs and benefits for US employers. However, evidence from surveys of over 900 employer sponsors of apprenticeships indicates that the overwhelming majority of sponsors believe their programmes are valuable and involve net gains (Lerman et al. 2009).

Government Costs and Benefits of Apprenticeship and Other Vocational Education

Government outlays per student are believed to be considerably higher for school-based vocational education than for academic education (Psacharopoulos 1993; Middleton 1988; Gill et al. 1999; Klein 2001).
p. 194 Yet, there are strikingly few detailed studies ↳ of government spending on vocational education and in many countries the cost differences are modest. A graph prepared by Cedefop (2012) indicates virtually identical expenditures per student in a number of European countries, though it shows that outlays are substantially higher for vocational education than general education in France and Germany. In a study of the Geneva canton of Switzerland as of 1994, government costs per student were about 50% higher in full-time vocational education than in general education but government costs per apprentice were only half the costs of general education (Hanhart and Bossio 1998).

Government costs are lower in apprenticeship programmes than in school-based TVET. Students spend less time in school during apprenticeships. Government spending on equipment is less necessary for apprenticeships because apprentices gain experience with relevant equipment at their work site. Successful dual systems reduce the need for government spending on university education or on second-chance training programmes.

The long-term benefits of apprenticeship accruing to governments are rarely estimated. In the United States, Reed et al. (2012) estimates that federal and state governments spent only about $715 per apprenticeship participant, or only about 7% of the amount governments spend per year on two-year college programmes. Hollenbeck (2008) finds a substantial gap between school-based post-secondary TVET and apprenticeships (about $7,600 vs $2,700) in Washington State.

The long-term benefits of apprenticeship accruing to governments are rarely estimated. Reed et al. projects that over the career of an apprentice, the tax returns are more than $27 for each dollar invested. According to Hollenbeck (2008), the government obtains about 20% of the overall net gains in earnings linked to apprenticeship earnings gains.

Investment in apprenticeship training is substantially larger in countries with large systems, such as Austria, Denmark, Germany, and Switzerland. Their governments are generally convinced that such investment bears fruit in the form of low youth unemployment, improving the school-to-work transition, insuring effective skills options for people who learn best by doing, increasing the share of people with a skill qualification, and improving the climate for manufacturing.

Conclusions

Skilled jobs and careers that do not require a BA or higher degree make up a significant share of employment in modern economies. The jobs range from construction crafts and construction management to skilled manufacturing positions, including machinists and laser welders, to police officers and fire fighters, to sales and purchasing positions, to health technicians and licensed practical nurses, to chefs and floral designers, and to legal secretaries. Although the current number and trend of intermediate-level jobs is subject to debate, new jobs plus replacement openings in these fields will continue to make up 40% or more of all jobs in advanced capitalist countries.

p. 195 Apprenticeships to train workers for intermediate-level careers work well. Skill development through apprenticeships is closely suited to the needs of employers and the job market, reinforces classroom learning with application in the workplace, involves trainees in the production process, makes for a

seamless transition from school to a career, provides trainees with a natural mentoring process, allows trainees to earn wages whilst gaining occupational mastery, applies to a wide range of occupations, requires less government spending than other education and training strategies, and generally raises the quality of the workforce. Countries with robust and well-structured apprenticeship programmes appear to outperform other countries in achieving low youth unemployment, raising the status of skilled and semi-skilled occupations, and maintaining more well-paid manufacturing jobs.

Notwithstanding these advantages, the apprenticeship strategy faces serious critiques. To some, employers have little incentive to create apprenticeships because they bear the costs whilst workers and other employers reap the benefits. It is also suggested that training for an occupation can be wasteful if workers often change careers, and this training may limit the ability of workers to shift to other fields without losing their earning power.

An expanding literature suggests that both arguments lack strong empirical support. Investment in apprenticeship training is often recouped during the training period itself. Most employers in Switzerland and many in Germany experience zero or low net costs (training, material costs, and wages minus the value of the apprentice's production). Reduced turnover and training costs and the certainty that the regular worker will meet skill standards are simply added benefits.

For workers, the skills learnt in apprenticeship are generally portable. Changing occupations within the same cluster of occupations often raises wages and those who leave their training occupations report they frequently use the skills learnt in their apprenticeships. The transferability of these skills should not be surprising since apprenticeships teach a range of tasks and include classroom training.

Most studies find high rates of return on apprenticeships generally; however, researchers have not produced definitive estimates of the relative returns to entering college vs entering apprenticeships. In addition, there are two particularly positive conclusions we can draw from the research: dual work-based and school-based apprenticeship programmes offer a way of diversifying routes to rewarding careers beyond the 'academic only' approach; and expanding apprenticeships can help deal with high youth unemployment, low youth skills, the rise in inequality, and the decline of middle-skill jobs.

The dual work-based and school-based apprenticeship programmes offer a way of diversifying routes to rewarding careers beyond the 'academic only' approach. Expanding apprenticeship can help deal with high youth unemployment, low youth skills, the rise in inequality, and the decline of middle-skill jobs. But it is important to learn more about the relative returns to entering college vs. entering apprenticeships for various subgroups, some of which thrive in college programmes while others would achieve far more in
p. 196 apprenticeship programmes. In addition, added evidence on the returns firms can ↳ expect from their investments in apprenticeship is vital for countries to scale up the number of apprenticeship slots employers offer.

The OECD (2009, 2010) has already concluded that apprenticeship training should play a much larger role. Several countries—notably Australia, England, and even France, are already pursuing major efforts to expand apprenticeship. Apprenticeship is taking hold and able to succeed in relatively regulated and unregulated labour markets (Muehlemann et al. 2010). Still, expanding the scope of programmes is challenging in several countries, as is building all the necessary components for a substantial and sustainable apprenticeship system. Success in developing and sustaining a major role for apprenticeship will likely help countries in their quest for a well-trained, productive, well-compensated, satisfied, and adaptable work force.

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Notes

1 The figures in this paragraph and the following paragraph come from data drawn from the occupational employment survey. See http://www.bls.gov/oes/current/oes_nat.htm.

2 These figures involved merging tables published on the Bureau of Labor Statistics website. The occupation and earnings data come from employer-based surveys under the Occupational Employment Statistics (OES) programme whilst the occupation and education data come from the American Community Survey (ACS) conducted by the US Bureau of the Census. See http://www.bls.gov/emp/ep_table_111.htm and the cross industry employment figures on occupations, http://www.bls.gov/oes/oes_dl.htm.

3 For a review of national qualification frameworks in Europe, see Cedefop (2012).

4 For an overview on NVQ and other qualification systems in the United Kingdom, see material provided by the Qualifications and Learning Authority. http://www.qca.org.uk.

5 Curricula for certificates in these occupations appear in the catalogue for the Kentucky technical college system. http://kctcs.edu/en/students/programs_and_catalog.aspx.

6 See the documents linked with http://www.red-seal.ca/tr.1d.2@-eng.jsp?tid=51 for examples.