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Ludger Woessmann

Facing the life-cycle trade-off between vocational and general education in apprenticeship systems: An economics-of-education perspective

Abstract

This paper discusses the role of vocational education, and in particular apprenticeship education, in preparing students for the labor market, with a particular focus on a life-cycle perspective in changing economies. The basic idea is that vocational education may facilitate entry into the labor market but hurt employment opportunities later in life because of limited adaptability to changing economic environments. We summarize evidence on the changing effects of vocational education over the life cycle from the international adult achievement tests IALS and PIAAC and country-specific evidence. We then discuss policy implications for elements of future-oriented education systems, especially apprenticeship programs.

Keywords

Vocational education; Apprenticeship; Labor market; Life cycle

Die Abwägung berufsspezifischer und allgemeiner Bildung über den Lebenszyklus: Eine bildungsökonomische Perspektive

Zusammenfassung

Dieser Beitrag befasst sich mit der Rolle berufsspezifischer Bildung, insbesondere im Rahmen der dualen Berufsausbildung, in der Vorbereitung von Schülern auf den Arbeitsmarkt unter besonderer Berücksichtigung einer Lebenszyklusperspektive in einer sich verändernden Wirtschaft. Die Grundidee besteht darin, dass berufsspezifische Bildung den Einstieg in den Arbeitsmarkt erleichtert, im späteren Leben aber aufgrund von begrenzter Anpassungsfähigkeit an das sich wandelnde wirtschaftliche Umfeld die Beschäftigungsmöglichkeiten behindern kann. Wir fassen Evidenz über die sich verändernden Effekte berufsspezifischer

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Bildung über den Lebenslauf aus den internationalen Erwachsenentests IALS und PIAAC sowie länderspezifische Ergebnisse zusammen. Darauf aufbauend werden Politikimplikationen für Elemente eines zukunftsorientierten Bildungssystems diskutiert, mit einem besonderen Fokus auf die duale Berufsbildung.

Schlagworte

Berufsbildung; duale Ausbildung; Arbeitsmarkt; Lebenszyklus

1. Introduction

Vocational education programs have attracted particular interest in many countries in recent years (see, e.g., Zimmermann et al., 2013 and Hanushek, Schwerdt, Woessmann, & Zhang, 2017b for references). Advocates praise apprenticeship systems that are particularly common in German-speaking countries for the way they facilitate the youth's transition from school to work, thereby apparently combating youth unemployment. Other countries have school-based vocational programs that also prepare for a specific occupation, but without the close link to work experience within firms. Still other countries – such as the United States – have mostly abandoned vocational programs, relying on general education programs in the hope of providing the basis for later learning on the job.

An aspect that is of particular relevance to understand the relative merits of vocational and general education programs is economic change. In a static economy, the occupation-specific skills obtained in vocational education programs will be just as relevant towards the end of one's working life as they were at the beginning of one's career. But in reality, our economies are constantly changing. Two major trends are globalization and technological change. First, the integration of the former Eastern Bloc and China into the world economy has meant that many sectors of Western economies have been relocated to Eastern Europe and East Asia. This process of globalization has been further facilitated by technological developments in global communication and logistics. Second, technological progress has been particularly pronounced in information and communication technologies. Broadly speaking, computerization, automation, industrial robots, and digitalization have led to skill-biased and routine-biased technological change, replacing many tasks that specific occupations used to perform by machines, robots, and computer networks (e.g., Katz & Autor, 1999; Autor, Levy, & Murnane, 2003; Akerman, Gaarder, & Mogstad, 2015).¹

In a constantly changing knowledge-based economy, the facilitated labor-market entry due to vocational skills may have to be weighed against reduced later employability when specific skills become obsolete and workers lack the ability to adjust to the changed economic environment (Krueger & Kumar, 2004; Hanushek

¹ This paper was originally prepared as a background report for Finland's Economic Policy Council. I would like to thank Franziska Hampf and an anonymous referee for constructive comments.

et al., 2017b). Much of the recent discussion about the disappearance of formerly middle-class jobs in many Western societies due to technological advance is related exactly to the theme of adapting to changed conditions. Therefore, conveying skills that allow workers to adapt to changing environments must be a central aspect in evaluating the extent to which vocational and general education programs prepare students for lifetime opportunities on the labor market.

This paper discusses the role of vocational education, and in particular apprenticeship education, in preparing students for the labor market, with a specific focus on a life-cycle perspective in changing economies. The next section outlines the basic idea that vocational education facilitates entry into the labor market but may hurt employment opportunities later in life because of limited adaptability to changing economic environments. Section 3 presents evidence on the changing effects of vocational education over the life cycle, summarizing findings from the international adult achievement tests IALS and PIAAC as well as additional country-specific evidence. On this basis, section 4 discusses policy implications for elements of future-oriented education systems, and in particular apprenticeship programs.

2. Vocational education: The basic trade-off over the life-cycle

To highlight the trade-off involved in different types of education programs, it helps to distinguish two types of skills.² On the one hand, there are *general* skills such as broad knowledge and basic skills in language, communication, math, science, and any other cognitive, social, or personal skills that are valuable on the labor market in many different occupations. These skills serve as the foundation for further learning on the job. They can thus be used to enter different jobs. Moreover, at a later age, general skills that facilitate continuous learning such as basic cognitive skills, transversal skills, adaptability, creativity, problem solving, and critical thinking skills may provide a useful basis to adapt to changing labor-market requirements and facilitate the learning of a different set of job-related skills.

On the other hand, there are *job-specific* skills that are required only in a specific occupation. Learning these job-related skills prepares students well to work in the specific occupation, but they are less relevant in other occupations. Being equipped with the relevant job-specific skills makes students productive right when they enter the labor market, as they have the skills that employers require now. But if demand for these skills dissipates on the labor market, these skills become mostly obsolete.

As a stylized depiction, we can distinguish two types of education programs: general education programs and vocational education programs (see Table 1). For

2 See, e.g., Psacharopoulos (1987), Ryan (2001), and Zimmermann et al. (2013) for general discussion of aspects of vocational and general education curricula.

the argument here, the assessment of specific education programs depends on the extent to which the education program conveys general and/or job-specific skills. We will refer to programs that mostly convey general skills as general education programs and to programs that mostly convey job-specific skills as vocational education programs.

Table 1: Stylized depiction of types of education programs

	General education	School-based vocational education	Apprenticeship-type vocational education
Focus on skill type	General skills (language, communication, math, science, ...)	Occupation-/industry-specific skills	Occupation-/firm-specific skills
Entry into labor market	Not directly prepared, needs substantial learning on the job	Job-specific skills facilitate labor-market entry, but limits due to missing experience	Easy entry as education included direct labor-market experience
Labor market at later age	General skill base facilitates adaptation to changing economy	Job-specific skills may become obsolete in changing economy; low adaptability due to limited general skill base	Job-specific skills may become obsolete in changing economy; low adaptability due to focus on firm and limited general skill base

The indicated characteristics of the two types of skills imply that a basic trade-off exists between general and vocational education programs when it comes to their implications for labor markets over the life-cycle. Vocational education programs have the particular advantage of helping young people master the transition from school to work because the job-specific skills directly prepare students for the tasks that firms require them to perform (e.g., Shavit & Müller, 1998; Ryan, 2001; Zimmermann et al., 2013). As a consequence, they may result in reduced youth unemployment.

But there is another side to the same coin: If the skills conveyed by vocational programs are particularly useful in a specific occupation, they will be subject to increasing risk of becoming obsolete when the structure of the economy – and hence the specific occupation – changes. Furthermore, if the acquired general skill base is limited, vocationally educated people may find it hard to learn different job-specific skills. That is, over the life-cycle, vocational programs may lead to lower adaptability to technological and structural change (cf. Krueger & Kumar, 2004). As a consequence, they may come with the disadvantage of reduced employment opportunities at older ages. The main point is that there is a basic trade-off between vocational and general education in that any relative labor-market advantage of vocational over general education decreases with age.

Among the vocational education programs, there are two main stylized subtypes. On the one hand, there are school-based vocational programs that focus on skills that prepare for work in a specific occupation. On the other hand, there are

apprenticeship-type vocational programs that partly take place within firms so that industry is directly involved in the educational process. These combined school and work-based apprenticeship programs tend to provide a high intensity of industry-based vocational experience (cf. Wolter & Ryan, 2011). In addition, part of the skills acquired during the work experience will be specific to the particular firm in which they are obtained, rather than to the occupation or industry in general. This may further facilitate the school-to-work transition, but lead to additional skill obsolescence as soon as the worker is required to change firm. A particular advantage of apprenticeship systems over school-based systems is that they usually do not educate too many youth in areas without demand in the economy. Because apprenticeship places have to be offered by employers, there are limits to the extent to which youth are educated in occupations for which there is not enough demand on the labor market – limits that may be much less strict in school-based vocational systems.

3. Evidence on the effects of vocational education over the life-cycle

In recent years, an increasing body of evidence confirms the basic trade-off between vocational and general education programs over the life-cycle.

3.1 Initial evidence from IALS

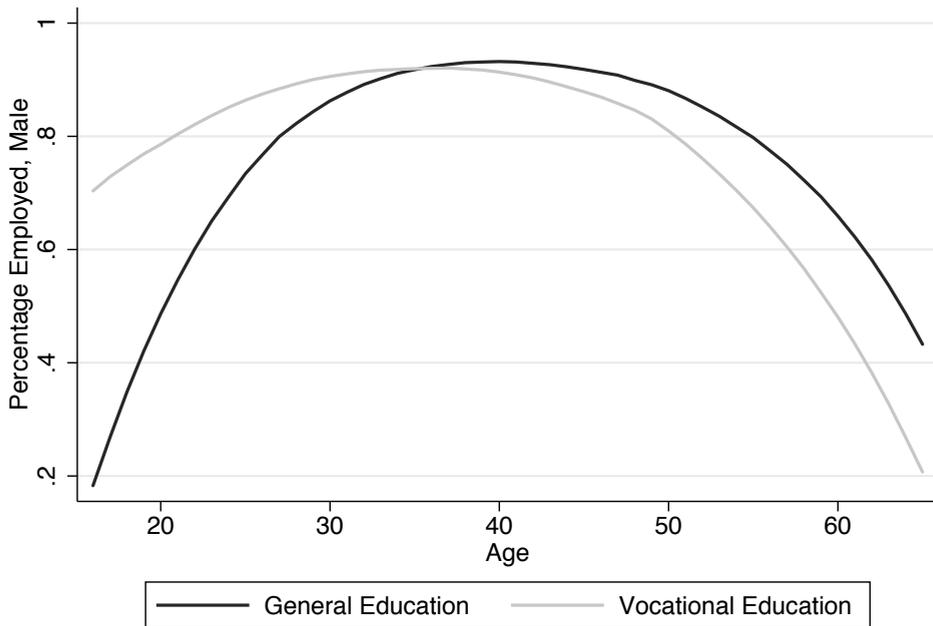
To test the labor-market effects of vocational and general education over the life-cycle, Hanushek et al. (2017b) use the data of the International Adult Literacy Survey (IALS). Coordinated by the Organisation for Economic Co-operation and Development (OECD) in the mid-1990s, IALS provides data for 15,000 individuals aged 16 to 65 years in 18 countries. The basic analysis compares the labor-market experience of people who attended vocational and general education programs at different ages.³ In the *prime age* (roughly age 30 to 45), people with the different types of education have very similar (and high) employment rates, indicating that there are no fundamental differences in labor-market attachment between these two groups (see Figure 1). However, there are strong differences both at labor-market entry and at older ages.

The key finding is the following trade-off in employment patterns over the life-cycle: At the beginning, individuals with a job-specific vocational education have better employment chances than those who completed general education. At older ages, it is the other way around, with individuals with a general education having

3 The analysis is restricted to males who historically show stable aggregate labor-force participation patterns during prime age. Cohort-specific selection into work by females raises concerns for this type of analysis.

better employment chances. This age-employment pattern is consistent with vocational education improving the transition from school to work but reducing adaptability of older workers to economic change. On the one hand, the skills generated by vocational education appear to facilitate the start into the labor market. On the other hand, vocationally educated people are at a higher risk of losing their jobs later in life if demand for their occupation-specific skills fades over time due to technological and structural change. The initial advantage of vocational education thus seems to turn into a disadvantage over the life-cycle. Short-term benefits have to be traded off against long-term costs.

Figure 1: Employment over the life-cycle with vocational and general education in IALS



Notes. Sample includes males who completed at least secondary education and are currently not students in the three “apprenticeship countries” (Denmark, Germany, and Switzerland). Smoothed scatterplot using locally weighted regressions (Stata *lowess*). Source: Hanushek et al. (2017b).

The life-cycle employment pattern – both the initial advantage and the later disadvantage – is particularly pronounced in those countries with extensive apprenticeship programs that combine school and work-based training – Denmark, Germany, and Switzerland in the IALS data. In these countries, the emphasis on industry-based education seems to provide the strongest treatment intensity of vocationalization. The results are robust to conditioning on observed background characteristics such as years of schooling, literacy scores, and parental education and occupation.

A key element of the empirical approach – called a “difference-in-differences” approach as it compares two differences in the employment rates: between vocational and general education and between young and old workers – is to confirm that today’s older workers provide a good approximation for what we can expect today’s younger workers to look like a few decades from now. This is a standard requirement of approaches that use cross-sectional data for life-cycle comparisons. To test this, Hanushek et al. (2017b) provide deepened analyses that make use of specific aspects of the IALS data, in particular the literacy and numeracy test produced by IALS. Among others, they match individuals within each country so that each individual with a vocational education is compared to an individual with a general education who is very similar in terms of skill scores as well as age, years of schooling, and parental education levels. Results are very similar in this sample of observationally comparable individuals, indicating that results are not driven by differences in these characteristics between vocationally and generally educated individuals. In their regression analyses, they can also hold constant any change in the overall shares of individuals entering vocational or general programs in a country over time. Furthermore, they show that while both literacy scores and parental education predict whether an individual has chosen a vocational or general education program, these predictions do not change significantly with the age of the individual. In other words, older people with a specific education type seem to be a good proxy for future expectations of younger people with the same education type.

The trade-off between education types over the life-cycle is visible not only in employment patterns, but also in income. Furthermore, at least in apprenticeship countries, there is some indication that as people get older, generally-educated individuals become increasingly likely to participate in adult career-related education. This increasing participation in adult education may be one mechanism by which generally-educated individuals maintain their employability given their updated knowledge and skills. The initial general education may decrease the costs of subsequent educational investments, and the updated skills may raise adaptability to technological change.

It is hard to come up with a full assessment of how life-time earnings compare between vocational and general education, which would allow for a judgement of whether the advantage of early employment is sufficient to make up for the later period of less employment for those with vocational education. But back-of-the-envelope calculations suggest that the present values of earnings (discounted at 3 %) is larger for the vocationally educated in Switzerland, but larger for the generally educated in Denmark and Germany. This cross-country pattern is consistent with the idea that those with general education are more capable to adapt to changing economic demands, as Denmark and Germany had noticeably higher growth rates of their economies over the relevant period than Switzerland.

3.2 New evidence from PIAAC

A significant drawback of the IALS analysis is that the results relate to the period of the mid-1990s. Across countries, labor markets have seen substantial transformations since then. As indicated above, globalization and technological change such as automation and digitalization have led to significant structural changes in Western economies (e.g., Autor, Dorn, & Hanson, 2015). These changes may have made the obsolescence of occupation-specific skills over the life-cycle even more pronounced in recent decades. However, there are also trends that may have weakened the differences in life-cycle implications across education types. In particular, reforms of the social security systems such as reduced options of generous early retirement schemes may have dampened the incidence of reduced employment at older ages,⁴ thereby lowering the scope for differential employment patterns by education type at older ages. Furthermore, education programs may have changed over time, with an altered extent to which the curricula of vocational programs contain general material.

To revisit the differential effects of vocational education in a more recent economic environment, Hampf and Woessmann (2017) use the data of the Programme for the International Assessment of Adult Competencies (PIAAC), conducted by the OECD in 2011/12. The dataset covers 29,000 adults in 16 countries. Apart from the larger sample size, the PIAAC data also provide a much richer testing of skills than IALS and further measures of family background, allowing for richer analyses to confirm that results are not driven by individual differences in literacy and numeracy skills and in family environments during youth.

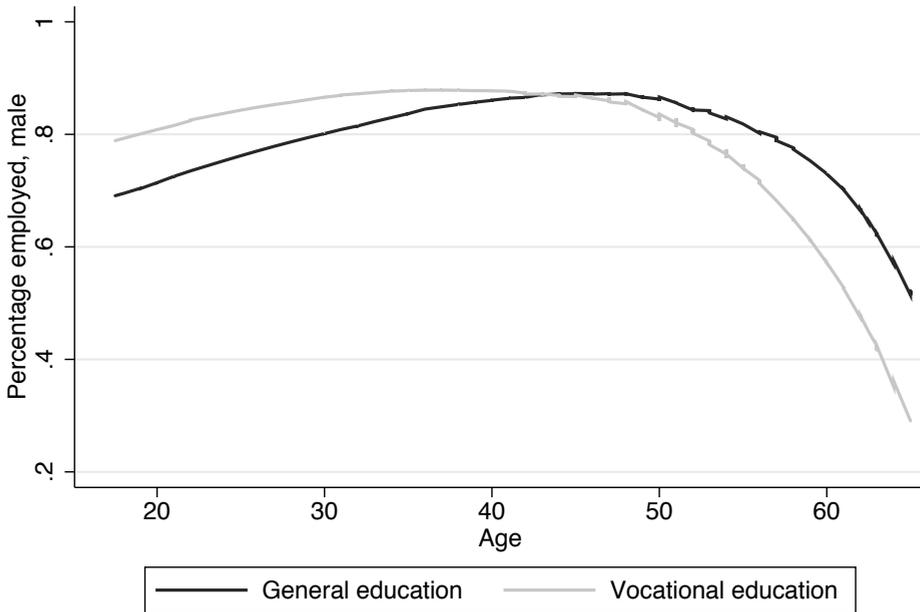
As is apparent from Figure 2, they find the same basic employment pattern of vocational and general education over the life-cycle: While vocationally educated individuals initially have better employment opportunities than generally educated individuals, this pattern turns around at older ages. Again, results are particularly strong in countries that have extensive apprenticeship systems – Austria, Denmark, and Germany in the case of the PIAAC data. As in the earlier study, results are robust to controlling for observed background characteristics including years of schooling, literacy and numeracy scores, parental education, and the share of the respective country cohort that has obtained a general education.

The estimates for the early 2010s are surprisingly similar in size to the prior estimates for the mid-1990s, although they tend to indicate a slightly earlier cross-over age by which individuals with a general education have higher employment probability than individuals with a vocational education. In the recent data, the cross-over age is around 50, and somewhat earlier around 45 in the apprenticeship countries. Thus, also after the significant transformation of labor markets due to globalization, digitalization, and pension reforms, vocational education seems to

4 For example, in Germany the share of those retiring before age 61 among all retirees has declined from 56 % in 1995 to 25 % in 2012 after reforms made the terms of early retirement less generous and raised the entitlement age for early retirement after a one-year unemployment spell from 60 to 63 years.

facilitate the school-to-work transition, but at the same time reduce the adaptability of older workers to changing environments.

Figure 2: Employment over the life-cycle with vocational and general education in PIAAC



Notes. Sample includes males who completed at least secondary education and are currently not students in the three “apprenticeship countries” (Austria, Denmark, and Germany), based on a matched sample that uses propensity-score matching to ensure common support between persons with a vocational and a general education in each country. Smoothed scatterplot using locally weighted regressions (Stata *lowess*). Source: Hampf and Woessmann (2017).

3.3 Further country-specific evidence

Several complementary country-specific investigations reinforce the general finding of a trade-off of vocational education over the employment life-cycle. To begin with, Hanushek et al. (2017b) provide two additional sets of analyses that strengthen the interpretation that the distinct age pattern reflects depreciated skills rather than other forces inducing people to leave employment. Using the much larger sample of the German Microcensus data, they show that the differential age-employment pattern by education type also holds when restricting the analysis to variation within tightly defined occupation groups and when excluding occupations in which brawn is important. This finding indicates that the differential movement out of employment is not simply a matter of physical wear and tear of people in specific vocationally intensive occupations.

In further analysis, they use the large administrative database of Austrian Social Security to identify job losses that occur due to plant closures. After such involuntary displacements, for workers of young ages the relative employment rates of displaced blue-collar workers (used as a proxy for vocational education in these data) are above those of white-collar workers. By contrast, when aged above 50, the relative employment rates of displaced blue-collar workers are below those of white-collar workers. Again, this pattern is consistent with an overall life-cycle trade-off between vocational and general education. More importantly, while the general results might in principle be partly affected by differences in unobserved retirement preferences between different types of workers, the exogenous nature of the employment shock in the plant closure analysis removes such concerns.

A number of additional recent country-specific studies show a similar age pattern of labor-market outcomes by education type over the life-cycle.⁵ Cörvers, Heijke, Kriechel, and Pfeifer (2011) provide life-cycle earnings patterns in vocational and general education for Germany, the Netherlands, and Great Britain. Consistent with the pattern described above, they show that earnings of vocationally educated individuals are higher at labor-market entry, but are overtaken by those of generally educated individuals with increasing age. The pattern is particularly pronounced in Germany, the country with a widespread apprenticeship system.

Relatedly, Weber (2014) estimates human capital depreciation rates for Switzerland and finds that depreciation rates are higher for vocational education than for academic education. Analyzing training programs for the unemployed in Sweden, Stenberg and Westerlund (2015) find that in the short run, specific training is related to higher earnings, but that the earnings of those who attended general training converge after a few years. By contrast, Hall (2016) is an exception that does not find a significant pattern based on the pilot of a Swedish reform in 1988-1993 that extended upper-secondary vocational programs by one year and increased their general content.

Two additional studies are of particular interest because they have longitudinal data to observe individual labor-market outcomes by education type over the life-cycle. Focusing on two-year programs at the upper secondary school level in Sweden, Golsteyn, and Stenberg (2017) show that vocational education is related to higher short-term earnings whereas general education is related to higher long-term earnings. Similarly, using British data, Brunello and Rocco (2017) find evidence of a trade-off between short-term advantages and long-term disadvantages of vocational education over the life-cycle for wages of individuals with lower secondary vocational education. The fact that these studies confirm a trade-off of labor-market outcomes by education type over the life-cycle with longitudinal data in Britain and Sweden indicates that the age differences analyzed by the studies above

5 In a contemporaneous study similar to Hampf and Woessmann (2017), Forster, Bol, and van de Werfhorst (2016) also find similar patterns with the PIAAC data. Brunello and Rocco (2015) use the PIAAC data to look at the effects of vocational education on adult skills and wages.

reflect actual age effects rather than cohort effects that are specific to different education types.

4. Policy implications for future-oriented apprenticeship systems

The consistent evidence on a life-cycle trade-off of vocational education provides the basis for a number of policy implications about how education systems can prepare students for lifetime work. In the following conclusions, we will place a particular focus on apprenticeship systems, their advantages and limitations, future reform requirements, and possibilities to emulate them from other countries.

4.1 Some general policy implications

At the most basic level, the findings indicate that in dynamic economies, policy needs to consider the full working life-cycle. They raise caution about policies that focus just on the current employment situation and ignore the dynamics of growing economies. Focusing just on the labor-market entry phase and youth unemployment is too narrow, as it ignores important countervailing effects later in life.

The crucial point is that no-one knows which specific skills will be demanded in the economy in, say, 30 years from now. The only thing that we can be sure of is that the economy will look very different from today's due to continuous technological and structural change. But today's secondary-school graduates will not even be 50 years old at that time, and they will want to strive on the labor market for at least another 15 years. This requires a strong educational foundation that provides workers with the ability to adapt as demands change.

As a consequence, neither vocational education nor general education are uniformly *good* or *bad*. There are pros and cons of both types of education programs. An advantage of the focus of vocational education programs on job-specific skills is that it may facilitate the transition from school to work. But focusing on job-specific skills also entails the risk of reducing the adaptability of workers to changing economic conditions. By contrast, general education programs may make it harder for graduates to find their way into the labor market, but foster their capability to adapt to change later in life. This insight implicates a number of further conclusions for the design of future-oriented education systems.

4.2 Securing a basis for adaptability

A key factor for education policy is to recognize the importance of the ability to adapt to changing economic conditions (cf. Nelson & Phelps, 1966; Welch, 1970;

Schultz, 1975 for early contributions). Education systems need to promote the kind of general skills that pay off in dealing with new economic processes. Recent cross-country evidence based on the PIAAC data suggests that labor markets strongly reward cognitive skills, and that these returns are particularly high in countries that have grown rapidly (see Hanushek, Schwerdt, Wiederhold, & Woessmann, 2015, 2017a). General skills are important to be able to cope with dynamic economic change.

This insight points to the importance of a high-quality school system. Many general skills that form the basis for further learning and adaptation are basic skills that are learned during childhood and adolescence. It is very hard to compensate failures of the primary and secondary school system later on. In particular, the lack of basic general skills cannot simply be replaced by learning job-specific skills in an apprenticeship. It is the strong general skill base that is required to strive on the labor market when things change.

One of the most significant labor-market problems facing many Western societies today is the number of workers whose middle-class jobs are slipping away and who are not prepared to adjust to a rapidly moving labor market. Societies are struggling to find ways of dealing with this problem. But expanding programs that focus on job-specific skills cannot substitute for the failure of the school system to provide the required general skill base. Failing to provide basic skills to the next generation would lock in the current middle-class malaise for the future and would likely make the long-run skill problems worse, as it would reproduce the current skill mismatch for future generations.

4.3 Providing the institutional frameworks required in apprenticeship systems

Beyond securing the general skill base, the hope of a smoothed school-to-work transition and ensuing reduced youth unemployment has enticed many countries to consider emulating the type of apprenticeship systems most common in German-speaking countries that combine learning at school and in the workplace. It is important to be aware, however, that the implementation of a functioning apprenticeship system requires many specific details of a strong institutional and regulatory framework that supports its success (cf., e.g., Wolter & Ryan, 2011).

A key element is that these labor markets put a strong emphasis on certification. For this, the degrees obtained from an apprenticeship need to send credible signals about students' acquired skills to potential employers. This requires not only a broad prevalence and publicity of the apprenticeship programs, but also clear certification requirements. An employer who considers hiring an applicant who received the apprenticeship training in another firm needs to be sure that the apprenticeship degree credibly certifies that the applicant has obtained the most important skills that will be required for performing the job. This is usually

achieved by a strong involvement of employers' associations in curriculum development and, in particular, final examinations.

More generally, successful apprenticeship systems tend to require strong involvement of both social partners – employers' associations and employees' unions – as well as the state. Apart from employers, the unions usually contribute to defining the apprenticeship curriculum and training requirements for firms and enforce restrictions and regulations on the labor market that facilitate the implementation of apprenticeships. There is also strong government involvement, as the state tends to coordinate the apprenticeship regulations with the social partners. Even more, the state tends to run and pay for the schools that apprentices have to attend for usually 1–2 days per week – the second part of the “dual” vocational system apart from the work-based training. In that sense, the financing of apprenticeship education is split between employers (who pay apprentice wages), apprentices (who accept lower wages during apprenticeship), and the state (which pays for schools).

Cost-benefit analyses of the German and Swiss apprenticeship systems indicate that the willingness of firms to train apprentices also depends on the extent to which they entail net benefits (production motive) or net costs (investment motive) during the apprenticeship phase (Muehleemann, Pfeifer, Walden, Wenzelmann, & Wolter, 2010). That is, the more likely it is that firms can recoup their training costs already during the apprenticeship phase and the more likely they are to retain apprentices in whom they have invested, the more likely it is that apprenticeship positions are in fact offered by the firms. Simulations of different scenarios of implementing apprenticeship programs in Spain based on the Swiss experience suggest that the expected net costs of offering apprenticeships for Spanish firms strongly differ by the specific occupation, training scenario, and firm size (Muehleemann & Wolter, 2017). For any country that considers emulating an apprenticeship system, this suggests that finding a particular balance between benefits and costs for each stakeholder – employers, apprentices, and the state – is an intricate part of a successful apprenticeship system.

The consideration of stakeholder tasks, financial structures, and certification requirements indicates that apprenticeship systems require institutional and regulatory frameworks that often took decades to emerge and consolidate. The German-speaking countries can build on a specific tradition that allows for the functioning of their apprenticeship systems. Emulating these systems requires the implementation of institutions and regulations that similarly make the apprenticeship system worthwhile both for school graduates and for employers.

4.4 “Generalizing” apprenticeship education

For countries that have an apprenticeship system in place or are considering implementing one, it is important to take into consideration what is required to make graduates fit for employment over their full life-cycles. The presented evidence sug-

gests that reducing the early specialization of students on specific occupational skills may be conducive to their long-run prospects on the labor market. Based on observations of the German apprenticeship system, it may be worthwhile to consider designs and reforms that reduce the early specialization of apprentices. This could entail initiatives to lower the number of specific apprenticeships, expand the share of general educational content, and modularize apprenticeship components.

Countries with extensive apprenticeship systems differ substantially in the number of specific apprenticeships offered. While Germany has substantially more than 300 specific apprenticeship occupations, Switzerland gets by with much fewer specific apprenticeships, despite an otherwise quite similar system. For example, Germany has more than 30 specific apprenticeships in the commercial area, from special programs for commercial apprentices working in the courier and mail business to special programs for commercial apprentices working in the logistics business. By contrast, Switzerland has moved away from such an especially fine-grained system and offers one apprenticeship for all commercial trainees. They follow the same school curriculum for the first two years of their apprenticeship and specialize in their specific sector only during the third year. From the point of view of adaptability to changing economic environments, the latter system seems more likely to equip apprentices with skills that make them employable over their full life-cycle which often requires changing sectors. More generally, lowering the number of specific apprenticeships is likely to raise the chances that graduates obtain skills that are demanded in broader sections of the labor market.

Another means to ensure that apprenticeship graduates also obtain general skills that facilitate adaptability to change is to ascertain that the curriculum of the vocational schools contains a sufficient share of general educational content. Apart from teaching job-specific skills, these schools should also convey a basis of general skills that go beyond narrow occupational areas and facilitate later learning. Such skills may help graduates also later on when the requirements of the economy have changed. The “generalization” of skills obtained during an apprenticeship might also entail the modularization of apprenticeship components, so that apprentices in different occupations in part take the same training modules. Such a setup could facilitate the movement of graduates into different occupations later on.

Thus, there are a number of options to reduce the early specialization of apprentices and increase their general skills when implementing an apprenticeship system or reforming it to make graduates fit for the future.

4.5 Strengthening lifelong learning

Finally, an important aspect for the long-term employability of vocationally educated workers is a strong focus on lifelong learning. Considering the specificity of the skills obtained during an apprenticeship, graduates of vocational programs are in particular need to retrain when the economy changes. Unfortunately, quite to the contrary, data from several apprenticeship countries suggest that apprenticeship

graduates are less likely to participate in adult education than graduates from general education programs as they become older (Hanushek et al., 2017b). This may be partly due to the fact that general education programs develop skills that facilitate later learning throughout one's career. In addition, as long as an employee stays with the same company, the company is likely to offer the kind of job-specific courses that update the worker's skills in the particular profession. However, companies obviously do not have an incentive to provide the kind of training courses that would prepare their employees to work in a different profession, something that is increasingly needed in changing economies.

As a consequence, it may be worth considering the establishment of a system for lifelong learning that does not only update workers' skills within their occupation but also conveys skills that facilitate their flexibility if changing labor-market conditions require occupational change. That is, it is important to strengthen lifelong learning for graduates of vocational education programs on a broader scale. These requirements will become increasingly severe as we move more into being a knowledge economy and as digitization and automation of routinized job tasks require adaptability to change.

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