

## A ROAD MAP TO VOCATIONAL EDUCATION AND TRAINING IN INDUSTRIALIZED COUNTRIES

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Young people have been among those most affected by the recent financial crisis. Vocational education and training (VET) is often viewed as the silver bullet for the youth joblessness problem. In this article, the authors provide a better understanding of VET in industrialized countries, proposing a typology with three types of vocational systems: 1) vocational and technical schools, 2) formal apprenticeships, and 3) dual apprenticeship systems that combine school training with a firm-based approach. They first describe the strengths and challenges of each system. They subsequently review the evidence of the effectiveness of VET versus general education and the relative effectiveness of the different VET systems. Results indicate that VET is a valued alternative beyond the core of general education and that the use of apprenticeships combined with institutional learning tends to be more effective than school-based VET.

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Unemployment rates among youth have soared since the Great Recession of 2008, doubling the adult unemployment rate in many developed countries. While many young people have responded to sluggish labor market prospects by continuing tertiary education and investing in their human capital, others have withdrawn from education, training, and employment. According to OECD (2013) data, youth unemployment rates are now above 35% in countries such as Portugal and Italy and are above 50% in Spain and Greece, while they are still below 10% in countries such as Germany, Switzerland, and Austria. The share of youth (aged 15 to 24) in neither employment nor education (NEET) in 2012 ranged from 4 to 7% in the Netherlands, Denmark, and Switzerland and up to 18% or more in

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Greece and Italy.<sup>1</sup> Regarding the situation of young labor market entrants, the 2008 crisis and its aftermath clearly highlighted the interaction of a cyclical development with long-standing institutional features governing the transition from school to work. The situation deteriorated particularly in those countries where young people had difficulty entering the labor market even before the crisis, while other countries succeeded in maintaining low youth unemployment rates by a variety of means.

Against this background, we look at the role of various types of vocational education.<sup>2</sup> Vocational education and training (VET) is frequently perceived as *the* solution to improve the opportunities of youth who lack the resources, skills, or motivation to continue with higher education. For example, in countries such as the United States, the recent economic crisis has reignited an earlier discussion of building up a larger and more effective apprenticeship system (Harhoff and Kane 1997; Lerman 2012).<sup>3</sup> In particular, researchers, policy advisors, and other experts often argue that VET provides useful skills to prepare youth for a smooth entry into the labor force (Quintini and Martin 2006) by aligning initial education more closely to particular vocations and tasks demanded in the labor market.

After classifying VET in industrialized countries into distinct systems, we review the evidence on their effectiveness in facilitating transitions into employment and in raising earnings, and highlight the relevant institutional features that support the effectiveness.<sup>4</sup> With this, we aim to provide evidence that can be crucial in designing programs to counteract the labor market problems exacerbated by the Great Recession.

### A Typology of VET Provision

This section provides a typology of VET provision, reflecting the various VET models found in practice among a range of countries. This topology focuses on two dimensions. First, differences in provision may be viewed along a continuum, reflecting the relative importance of institutional learning and workplace training. At one extreme, vocational schools can provide VET that is not complemented by work-based training; at the other, older

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<sup>1</sup>NEET rates are taken from the OECD employment database and are based on national labor force surveys.

<sup>2</sup>In this article, we use the term “vocational education and training” (VET) to refer to qualifying education paths that provide individuals with occupation-specific knowledge and practical skills, independent of the place, content, and educational provider. Our focus is on *initial* VET, in contrast to vocation-specific education and training as part of life-long learning (see Arulampalam, Booth, and Bryan 2004; Bassanini et al. 2007 for workplace training in Europe). A related study (Zimmermann, Biavaschi, Eichhorst, Giulietti, Kendzia, Muravyev, Pieters, Rodríguez-Planas, and Schmidl 2013) connects vocational training with youth unemployment around the world, including developing countries. The novel feature of our paper is the systematic and updated review of the major types of vocational training systems from a policy perspective.

<sup>3</sup>Of course, VET is complementary to the various policies boosting labor demand (typically industrial policies) in its goal to improve youths’ transition into employment.

<sup>4</sup>In medium-income countries and in the developing world, an alternative classification is appropriate; see Zimmermann et al. 2013 and Eichhorst, Rodríguez-Planas, Schmidl, and Zimmermann 2013.

union-dominated apprenticeships did not include formal theoretical institutional learning. A second dimension is whether institutional-based learning is provided within formal secondary school frameworks (part of the education system) or at vocational training centers (which often have close ties to industry). Below we review these three systems.

### **Vocational and Technical Secondary Schools**

Many countries maintain a large vocational schooling system as part of their upper secondary education. In these countries, the initial schooling system is characterized by the duality between general and vocational education. While the former aims to provide youth with general, often academically oriented knowledge as the basis for further (higher) education and training, VET provides youth with practice-oriented knowledge and skills that are required in specific occupations. VET typically follows a formal curriculum that combines general and occupation-specific knowledge. Compulsory schooling integrates VET as an alternative to an academically oriented schooling track, or as part of several post-compulsory education options. Similar to academic education, the skills that vocational schools provide are mostly general in the sense that they are transferable between employers (Becker 1964); however, there might be differences in the degree of transferability across occupations. While some countries have a VET system that transmits skills that are not restricted to one particular occupation, others provide vocational schooling for specific types of occupations (Shavit and Müller 1998).

#### *Why Do Governments Offer School-Based Vocational Training?*

The supply of VET by governments through the educational system can be justified as a means to improve the opportunities of youth who lack the skills demanded in the labor market, the ability or motivation to continue with higher education, or the funding to pursue higher education. Furthermore, individuals might prefer this option to academic education as it implies a shorter human capital investment and facilitates earlier entry into the labor market. Many countries that provide a vocational schooling option during compulsory schooling perceive this as an alternative for poor academic performance or at-risk youths (Neuman and Ziderman 1999), as well as a safety net for early school dropouts and those who are less academically inclined. The close link to work tasks and hands-on practical experience may motivate practically oriented youths to continue training and to remain in school longer. Furthermore, researchers have argued that establishing a vocational education track during school is a means to reduce the influence of parental background on educational choices, thereby increasing intergenerational mobility. Given that the educational decisions of youths are often linked to the educational attainment level of their parents, participation in a vocational track might allow those from working-class backgrounds

to pursue educational attainment beyond the compulsory level, hence increasing their chances of attaining skilled rather than unskilled employment (Shavit and Müller 1998).

In most cases, participation in either vocational or academic courses during school is operationalized by tracking students in the two respective pathways. The benefits of such a tracking system are not clear, as leaving school with vocational qualifications often translates into reduced options of further post-compulsory education, particularly the academic type. The incentive effect of learning more practice-oriented skills might therefore be mitigated by high costs of later switching to academic education. Although the technical possibility of transferring to academic education might exist, earlier tracking will lead to strongly divergent levels of skills and competences (Woessmann 2008). Furthermore, through separating higher and lower performing students, VET might counteract the equalizing potential of vocational education (Shavit and Müller 2000). Given that very few youth manage to enter academic education after vocational schooling (Kogan 2008), populations in many countries often have a low regard of the vocational schooling option since they perceive it as a dead-end track and a second-choice education.

### *Southern European Countries*

Most of the vocational training in Spain takes place in school instead of within a firm: Only 4% of those in vocational upper-secondary education in Spain combine school- and work-based training (CEDEFOP 2010). Similarly, three in four young people in vocational training in France participate in school-based vocational training as opposed to the apprenticeship alternative. In Italy, firm-level vocational training is not widespread since it is used only in crafts, retail, and large manufacturing companies, and is based on fixed-term employment contracts.

Youth in these countries face particular difficulties when trying to enter the labor market, especially since the recent economic crisis has aggravated these long-standing problems. In addition to having above-average NEET rates, labor market entry is difficult for both low- and high-skilled young people. One major factor is the deep labor market segmentation between permanent and fixed-term contracts, which can be attributed to strict dismissal protection and largely liberalized temporary employment. Another issue is wage compression in low-skilled occupations by collective bargaining. For instance, collective bargaining in Spain, which is centralized at the province and industry level, sets “entry minimum wage” above the legal minimum wage, inflating the lower part of the wage distribution and resulting in relatively high earnings for young workers and those least qualified. Together, employment protection and wage compression make it difficult in Spain for youth to become established in the labor market and to transition to a permanent position. Such effects on youth employment have been found in previous international work such as Bertola, Blau, and Kahn (2007) and Kahn (2007).

In some of these countries, the relatively marginal role of vocational training can be explained not only by a limited interest of employers in more formal vocational training (given the dual-employment structure) but also by strong expectations of upward social mobility on behalf of young people and their families, which creates strong preference in favor of academic training (Planas 2005). Moreover, a long tradition in these countries is to subsidize temporary employment and training contracts as part of Active Labor Market Policies (ALMP). The effectiveness of these measures is questionable, however, as explained by Felgueroso (2010) in Spain, Roger and Zamora (2011) in France, and Tattara and Valentini (2009) in Italy.

Evidence from cross-country comparisons in Europe, which have attempted to implement vocational schooling systems, points to the necessity of several systematic elements to ensure success, as described below (Woessmann 2008; Gambin 2009):

1. **Ensure curricula relevance:** All stakeholders (government, employers, social partners, educational institutions) need to be involved in curriculum development, with a clear assignment of responsibilities. The weight of the respective voices might differ across countries.
2. **Maintain close labor market contact:** A system of continuous feedback from employers and private-sector institutions allows for adaptation of the training content to labor market needs. This element requires a high degree of employer involvement.
3. **Ensure high-quality training:** Sufficient funding is required to guarantee the appropriate teaching material and the availability of well-trained teachers. A decentralized system of quality assurance and local competition among training centers, in combination with output-based funding and licensing, needs to be established.
4. **Establish qualification frameworks:** Centralized accreditation of training curricula creates transparency and promotes acceptance among employers.
5. **Limit the risk of creating a dead-end vocational schooling track:** The competences and qualifications acquired should be comparable and creditable to academic qualifications to promote transferability between the two and to avoid stigmatization of vocational schooling participants.

### **Formal Apprenticeship**

In some countries, VET is provided through formal apprenticeships, with institutional instruction complementing workplace training. This arrangement occurs primarily in the United Kingdom, the United States, and Australia.

#### *The United Kingdom*

In the 1980s, traditional apprenticeships lost their appeal in the United Kingdom because of “the recession, the removal of supports and the introduction of cheaper, less-valued alternative training schemes such as the

Youth Training Scheme (YTS) and its successors” (McIntosh 2007: 4). With the relative shortage of intermediate (Level 2 and Level 3) vocational skills in the mid-1990s, however, apprenticeships were reintroduced as Modern Apprenticeships at Level 3 and National Traineeships at Level 2. Despite considerable public interest in their expansion, the overall participation rates remained rather low during the early 2000s. Possible explanations for this modest involvement include 1) the lack of a central and rigorous assessment of the apprentices’ qualification obtained; 2) the high costs of apprentices to employers, relative to other countries such as Austria, Germany, or France, among others (Steedman 2010); and 3) a shift toward offering apprenticeships to older youths who had previously worked at the company (Wolf 2011).

The 2009 reform—the Apprenticeship, Skills, Children and Learning Act—addressed some of these issues, in particular tightening the link between the apprenticeships and employers and offering larger incentives for employers to increase training activities. Subsequently, the number of youth below the age of 25 who participated in apprenticeships increased from 387,000 in 2007–2008 to about 460,000 in 2011–2012. In 2010, the UK government implemented the Specification of Apprenticeship Standards for England (SASE), harmonizing the qualifications of the various apprenticeships and increasing transparency in training activities. In addition, the United Kingdom offered employers a grant of 2,500 pounds per apprentice aged 16 to 17 years old. In 2012, they extended the grant to incentivize training of those up to 24 years old. Moreover, they started the National Apprenticeship week, a yearly public event to draw media attention to the benefits of offering and learning in apprenticeships, as well as to increase the acceptance of apprenticeships. Further government reforms are currently underway to improve training quality and transferability and to ensure continuous adaptation of the qualifications and skills to align with economic demand (Department for Education, Department for Business and Skills 2013).

### *The United States of America*

In the United States, formalized apprenticeships have a limited role and are largely confined to adult education in so-called Registered Apprenticeships in the construction industry (e.g., electricians, carpenters, plumbers, and others). Through the combination of time spent in theoretic instruction and work-based training, the apprenticeship system imparts both general and occupation-specific knowledge; however, the place of training is concentrated in the firm, as the apprenticeship system operates without any close links to formal education.<sup>5</sup>

The Office of Apprenticeship (OA) in the U.S. Department of Labor (DoL) is in charge of the registration and evaluation of VET. Thereby, the

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<sup>5</sup>Alternatives to apprenticeships in the United States are specific programs targeting at-risk youth and training students for careers in specific sectors, combining high-school classes, training, and work experience (see Holzer 2012 for a thorough review).



Advisory Committee on Apprenticeship (ACA) supports the OA. Across 26 states, State Apprenticeship Agencies (SAAs) are responsible for the apprenticeship programs, including the provision of technical assistance. Currently, around 21,000 apprenticeship programs are registered in the United States. Participation numbers from the DoL count approximately 290,000 active apprentices in 2012. Since 2008, the number of active apprentices has been steadily decreasing, largely because of a steep decline in the number of new apprentices. This figure accounts only for apprenticeships not offered by the military (currently around 70,000) and for those registered with the labor office. Lerman (2012) suggested that the actual number of total apprentices is higher, given that not all apprenticeships have to be registered. Contrary to the European model, U.S. apprentices are in their mid-to late-20s and have most likely already gained some work experience.

### *Australia*

Although the majority of VET participation is school-based (80% in 2011), a comprehensive Australian Apprenticeship system also exists. This system differentiates between two types of contracts: apprenticeship contracts and traineeship contracts. Apprenticeships refer to technical occupations and the traditional trades, whereas traineeships apply to all other occupations (Karmel, Blomberg, and Vnuk 2010). These traineeships are comparable to further qualifying training that occurs in other countries because of their short duration (typically less than one year). The contracts are structured in both work-based learning with an employer and school-based education with certified training providers. Contrary to apprenticeships, which have a long tradition in Australia, traineeships were introduced in 1985 to counteract unemployment of those aged 15 through 19 with low levels of schooling. The participation in apprenticeships and traineeships has significantly increased across *all* age groups over the past years due to supportive policies, such as financial hiring incentives, part-time training, minimum training wages, and waived age restrictions (*ibid.*). Specialized subsidies have encouraged the training of workers aged 25 and over as well as mature workers (45 and above); thus, the share of adults among participants increased to one-third and two-thirds, respectively, of all new entries into apprenticeships (traineeships).

### **Dual System**

In Austria, Denmark, Germany, and Switzerland, the dual VET accommodates between 40% (Austria) and 80% (Switzerland) of all school leavers. The dual apprenticeship systems in these four countries share the following four key institutional elements.

1. **A high degree of formalization:** They provide training in centrally accredited occupational qualifications, and the training content is continuously adapted to meet the changing labor market requirements.

2. **Strong involvement of social partners:** Representative advisory boards assist in developing and maintaining curricula at the governmental and federal level. Regional trade or occupational committees, or a combination of the two, undertake implementation and monitoring.
3. **Vocational colleges provide the school-based part of dual apprenticeships:** Colleges cover both general and occupation-specific education. The government bears the costs of training in the schools.
4. **Firms must meet certain technical standards:** A training firm will not obtain accreditation if standards are not met. Offering apprenticeships is optional for companies, but those who choose to offer them follow standard application procedures to match the firm with trainees. The training companies cover the training costs within the firm.

#### *Why Would Firms Invest in General Training?*

While dual training exhibits several advantages from societal and individual perspectives, establishing an efficient dual apprenticeship system crucially depends on the willingness of firms to participate. To ensure post-apprenticeship skill transferability across firms, the training should provide a sufficient amount of general schooling. As Becker (1964) noted, however, in a perfectly competitive labor market, in which workers are paid according to their marginal productivity, firms have no incentives to invest in general schooling because workers could leave directly after the training period in order to reap all the benefits of their acquired general skills.<sup>6</sup> Hence, for firms to provide both specific and general training, the worker must bear the general training costs. Implementation would include state-funded school-based general education or firm-based general training, along with workers paying for their training costs. Alternatively, firms could be incentivized to participate, if they were able to recoup part of their investments by contractual arrangements ensuring that either 1) apprentices accept a wage lower than their marginal productivity during the training period, or 2) apprentices continue to work for the firm beyond the training period (Malcomson, Maw, and McCormick 2003). In fact, what we see in countries such as Germany, Switzerland, and Austria is a specific collective agreement reached between unions and employer associations, or wage recommendations issued by professional associations, setting a generally applied rate for apprentice remuneration. This wage is significantly below the earnings of a full-time low-paid job and thus can be seen as a part-time wage or some basic income support during the training period.

In practice, this model seems to explain firms' incentives to offer training. In some countries, such as Switzerland, the low level of wages and the strong involvement of apprentices in the productive activities during the

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<sup>6</sup>As discussed below, many firms do invest in their employees' general training. Some reasons that explain this are informational asymmetries regarding workers' productivity, search costs and market frictions, or monopsony power.



apprenticeship allow firms to incur a net benefit during the training period (Lerman 2014). In other countries, such as Germany, some firms are found to incur a net cost during the training period (Harhoff and Kane 1997; Dionisius et al. 2009).

Several theories attempt to find alternative explanations of the training activities of firms (for an excellent overview, see Wolter and Ryan 2011). In particular, Acemoglu and Pischke (1998, 1999, 2000) developed and extended the framework of Katz and Ziderman (1990) in which informational asymmetries regarding the abilities of workers and the quality of training received can lead to sufficient incentives for firms to invest in general training. Given that firms are able to learn the ability of the worker during the training period, the additional presence of a compressed market wage allows firms to pay high-ability workers less than their marginal product, hence reaping part of the benefit of training. A compressed wage structure might arise because of 1) information asymmetries and complementarity between ability and training in the production function (Acemoglu and Pischke 1998); or 2) search costs combined with market frictions such as collective bargaining, minimum wages, and firing costs, which are higher for high-skilled workers (Dustmann and Schönberg 2009). Booth and Zoega (2004) pointed out that wage compression is not a necessary condition for the emergence of firm-based training, but suggested that all setups resulting in a situation in which training increases the worker's productivity more than their wage are expected to stimulate the investment in training. In particular, factors reducing the apprentice's propensity to quit after the apprenticeship increase the willingness to invest in training.

Another set of models explores the deterring effect of poaching, a practice in which firms not investing in training might hire apprentices from the training firm by offering them higher wages. Hence, firms are more likely to engage in training if they are able to enjoy some monopsony power arising from industry- and occupation-specific skill requirements, dispersed regional location of firms, and lower product market competition (Gersbach and Schmutzler 2006; Smits 2007; Lazear 2009). While the incidence and relevance of poaching is difficult to measure, recent evidence from Germany suggests that 3% of training firms in Germany are poaching victims. Firms in bad economic situations that are unable to make counter offers are particularly affected (Mohrenweiser, Zwick, and Backes-Gellner 2013).

A further potential reason to participate in training might be that firms prefer to ensure their own future skill supply by providing such training themselves. Some countries, however, such as Switzerland, maintain a large dual system and have a high turnover rate after training (Wolter and Schweri 2002). It may be that firms train apprentices to use them in current production, and although firms might incur a net cost for the average productive apprentice, some high-productivity apprentices might also be paid less than their marginal productivity, given that the overall wage level for apprentices tends to be low (Mohrenweiser and Zwick 2009). In particular, if few outside

options exist for youth, they might be willing to engage in such a payment scheme since they would benefit afterward from the acquired skills.

*Why Is the Dual System Not Readily Transferable?*

The dual VET depends on some essential preconditions. For instance, it relies on strong cooperation between government and employers to develop the VET institutional framework, to design and adjust curricula, to certify competences, and to co-fund the plant-based and school-based elements. In addition to these regulatory and budgetary issues, the dual system depends on sustained and active support from a sufficiently large number of actors, such as:

1. **Trade unions** must accept that apprenticeship contracts have lower payments compared to regular contracts;
2. **Employers** must be willing to provide training (not in an informal manner but according to occupational curricula), to send apprentices to vocational school leading to certified occupational qualification, and to provide them with a credible prospect of sustainable employment;
3. **Government** must provide for vocational schools and teachers and also for preparatory training for young people who fail to enter apprenticeships; and
4. **Youth and parents** must accept VET as a solid alternative to academic education.

These elements tend to be mutually reinforcing. As they have developed over a long time, these conditions cannot be readily transplanted across different institutional and historical contexts. However, many countries have tried to develop dual VET programs. For example, in the United States, both the National Youth Apprenticeship Act under the administration of George H. W. Bush and the School-to-Work Opportunities Act under President William Clinton were attempts to implement the dual system. According to Lerman and Rauner (2012), however, widespread participation in the youth apprenticeship could not be reached because of 1) the inability of employer organizations to coordinate long-term training plans; 2) the federalist division of responsibilities that impedes a binding national framework for the training systems; 3) a general mistrust in the idea of imparting specific human capital, as it is likely perceived to lose its value more quickly in a continuously changing labor market (Krueger and Kumar 2004); and 4) a lack of employer interest in participating in this exchange. Despite the futile efforts at the federal level, some states were able to establish and maintain a functioning small-scale dual apprenticeship system, particularly in the construction industry (Bilginsoy 2003).

Complementary to the previous analysis outlining the incentives of firms to provide training, the quality of the training must be of a sufficiently high level to ensure that students are willing to participate in apprenticeship training. Acemoglu and Pischke (2000) highlighted the existence of external certification of training content that increases the value of training in

the overall labor market, and hence the willingness of students to invest a high level of effort during the apprenticeship. At the same time, Dustmann and Schönberg (2012) pointed out that the external certification and occupation-specific binding standards for the content of training are important commitment devices for firms to invest in high-quality training. In the absence of these two conditions, firms may exploit students as cheap laborers, which thus reduces the willingness of students to participate in training and lowers the reputation of apprenticeship training in general. Dustmann and Schönberg (2012) suggested that the abolishment of mandatory, external training boards in the United Kingdom in the 1980s, which centrally decided on the training content, was responsible for the decline of the relevance of the UK apprenticeship system. This trend further highlights the need for a specific institutional framework when aiming to establish a mainstream dual VET system, since it is not easy to replicate its complexity.

## Empirical Evidence

### Identification Problems

Is school-based vocational training as effective as general-based education? How useful are apprenticeships in helping youth transition into the labor market? How does the dual system compare with general-based education or other types of vocational training? Which type of VET best prepares workers for the labor market? Researchers have attempted to answer some of these questions for different countries and here we summarize the findings. As will become apparent, no easy answers resolve these questions given variation across and within countries and studies. Countries' institutional and cultural differences, as well as the available amount of information on workers, jobs, and labor market characteristics in the data sets used explain some differences, yet several identification problems within the literature are difficult to overcome.

Most of the literature compares the employment outcomes of VET students with an alternative group, namely general-based education students, other VET tracks, school dropouts, or college graduates in the same country, after controlling for all observable characteristics available. However, we acknowledge that unobserved heterogeneity may still prevail given that youth deciding to study VET may have different abilities, tastes, and preferences about work from those who choose an alternative education system or no education. If unobserved quality differences occur between both types of youth, results from cross-sectional studies will reflect an omitted variable bias. For instance, given that VET is frequently intended for youth with lower motivation and ability than those who pursue general-based education, non-causal estimates of the returns to vocational education relative to general-based education will be downward biased (Willis and Rosen 1979; Tuma 1994; McCormick, Tuma, and Houser 1995). By contrast, the opposite is likely to be true when comparing students from vocational education to school dropouts. Furthermore, a related concern arises due to different

occupations requiring diverse mixes of academic and practical skills. If youth self-select into various occupations based on their skills, evaluating the effectiveness of the differing systems becomes a difficult task given that the employment patterns, payment structures, and union coverage in the occupations themselves may not be comparable.

Unable to exploit exogenous changes in the institutional setting, the majority of country studies conduct descriptive analyses controlling for students' characteristics; this is to capture the expected opportunity cost of the alternative forms of schooling, including grades and test scores achieved prior to accessing VET or remaining in general education, family background, and local economic conditions. Additional confounders include subjective statements of preferences for VET or academic studies (Bishop and Mane 2004), subjective self-assessments of ability (Hotchkiss 1993), and information concerning the vocational orientation of the school captured by full-time vocational teachers and the schooling choice of previous cohorts (Meer 2007).

In addition to the aforementioned problems, one has to add measurement issues in studies comparing the effectiveness of two types of VET systems across countries. Indeed, the covariation of other relevant institutional factors, the absence of a unified framework for defining the respective training options, as well as the difference in data collection and quality frequently bias cross-country studies analyzing the relative effectiveness of school-based VET and the dual system (Hoeckel 2008). In an attempt to avoid this problem, some studies exploited the two systems' coexistence within countries to evaluate their relative effectiveness. However, in most countries one system prevails over the other, and the reason for that is likely correlated with the labor market structure, thus adding yet another source of endogeneity.

One way to address the selection problem is to exploit some exogenous change that lengthens or shortens one educational system compared to the other. For instance, several researchers have exploited institutional changes increasing the duration of general schooling in the vocational schooling tracks of those respective countries (Oosterbeek and Webbink 2007; Pischke and von Wachter 2008; Hall 2012; Felgueroso, Gutiérrez-Domènech, and Jiménez-Martín 2014), whereas others have used an instrumental variable approach (Fersterer, Pischke, and Winter-Ebmer 2008). Furthermore, an alternative way to address the endogeneity is to use propensity score matching that addresses the selection problem (Lee and Coelli 2010) or, even better, conduct randomized controlled experiments designed before the VET program implementation (Díaz and Jaramillo 2006; Attanasio, Kugler, and Meghir 2011; Card et al. 2011). The concerns with randomized controlled experiments are their external validity and their costs.

### **Evidence of Vocational and Technical Secondary Schools**

Rigorous quantitative evidence on the returns to school-based vocational education is scarce primarily due to the lack of informative data. Most countries experience a negative selection into vocational schooling tracks,

leading to a systematic underestimation of vocational training effects when the selection issue is unaccounted. Here we review some of the existing evidence on the relative benefits of participating in vocational schooling relative to general schooling. We thereby focus on studies that aim to control for the selection. Clearly, however, the lack of evidence based on random variation is quite unfortunate and raises accountability concerns, as discussed earlier.

Overall, the evidence described below indicates that youth completing school-based VET do as well (and sometimes better) than if they had instead remained in purely academic studies (Tansel 1994, 1999; Mane 1999; Tunali 2002; Bishop and Mane 2004, 2005; Meer 2007). Some evidence found that school-based VET is most efficient when the area of vocational training is matched with the occupation of employment, whereas no significant differences arise for unmatched groups (Neuman and Ziderman 1991, 1999). Additionally, it is efficient when offered to low-ability individuals and to those who work in lower skilled jobs (Dearden, McIntosh, Myck, and Vignoles 2002).

A number of studies provided evidence on labor market returns to vocational curricula in the United States, showing a positive effect in the short to medium run. They also found that for later cohorts, returns to attending technical schooling have increased over time. While Hotchkiss (1993) found no return to vocational schooling on employment and wages of high school graduates in 1980, even after controlling for training-related occupation choice, Mane (1999) identified differences in the returns to vocational training of high school graduates who do not attend college during the 1970s, 1980s, and 1990s, finding a positive trend over time. Whether this trend was due to increasing quality in education or to increasing demand for these skills remains unclear. The positive wage and employment effects of participating in the vocational track were confirmed by Bishop and Mane (2004) using data from the National Education Longitudinal Survey of 1988, and by Bishop and Mane (2005) using high-school transcripts. They noted that a growing need for these types of skills during the 1980s and 1990s most likely explained the increasing returns to vocational training in the United States. They used a multinomial logit selection model to account for self-selection in track choice, and found that those on the technical or academic track are best off following the path they chose, suggesting that VET provides a valuable alternative for youth aiming to work in technical occupations.

Using data on high-school qualifications in Israel, Neuman and Ziderman (1991, 1999) found that school-based VET yielded higher returns than general schooling, but only when the occupation of the VET and the occupation of employment are matched. For cases in which the occupation of training and employment are matched, the authors estimated that vocational high school graduates earned between 8 and 10% more than those with solely academic qualifications. No significant earnings differences arose between vocational high school graduates with unmatched jobs and

academic high school graduates. The probability of finding a matching occupation varied substantially across occupations. Taking the average of 37.5% indicated that the overall wage gain of the vocational occupation was still at 3%.

Some studies provided evidence of the differential rates of return to vocational education. After using a variety of data sets, accounting for the time taken to acquire various qualifications and controlling (when possible) for ability bias and measurement error, Dearden et al. (2002) found that the returns to UK school-based vocational education varied with the type of qualification obtained. These authors found that the returns to academic qualifications were higher if individuals subsequently acquired a skilled rather than an unskilled job. Heterogeneity also occurred among individuals' ability. The returns to vocational qualifications were significantly higher for low-ability individuals. In a different setting, Tansel (1994, 1999) and Tunali (2002) found differential returns to vocational training (relative to general schooling) by gender in Turkey. Controlling for the differential selectivity into the choice of tracks, they found that women who participated in vocational education benefited from a higher employment probability, while men experienced higher wages. Furthermore, women seemed to benefit predominantly in urban areas, while males benefited in both rural and urban settings, suggesting that females faced participation constraints in addition to educational ones.

It is interesting to note that recent studies that exploited a reform to identify the effectiveness of school-based vocational training relative to general education did not find any effects of increasing the general education for students in the vocational training track by one year. Oosterbeek and Webbink (2007) investigated the increase in duration of the vocational schooling track in the Netherlands in 1975 by one year, with the additional year designated only to general schooling. Adopting a difference-in-difference strategy, they analyzed the effect of the change on wages 20 years later and did not find any effect. Most recently, Malamud and Pop-Eleches (2011) evaluated a Romanian reform that postponed the tracking of students into vocational and academic schools. Using a regression discontinuity design, they found no effects of this reform on university completion, labor market participation, or earnings. Pischke and von Wachter (2008) exploited the gradual adoption of a one-year increase in compulsory schooling in the lowest schooling track in Germany between the 1950s and 1970s to study its effects on long-term wages, and likewise found no effects of the policy.

Hall (2012) assessed a policy change in Sweden in 1991 that increased the duration of general education content of the vocational schooling at the upper secondary level by one year, after which students were eligible to enroll in tertiary education. Exploiting random differences in time and the regional implementation of a policy pilot, Hall did not find any effects on subsequent study take up, nor any increase in the wages earned up to 16 years after the beginning of upper secondary school. She found, however,



that low-achieving students were significantly more likely to drop out of upper secondary education.

Using an instrumental variable approach, Cappellari (2004) assessed differences in early labor market outcomes for participants in vocational or general secondary schooling in Italy. Observing that the selection into the respective tracks was strongly related to parental background and ability, he used grandparents' school participation as an instrument, arguing that this is exogenous to the pupil's labor market outcomes (after controlling for parental characteristics) but relates to the decision on whether to select into general or vocational schooling. He found that participating in the vocational track increased the early career employment and labor market participation rates, while general schooling increased the probability of attending university. Unfortunately, the study analyzed only short-term effects. An interesting French study estimated both short- and long-run effects of vocational versus general schooling tracks (Margolis and Simonnet 2003). Controlling for non-random selection using a Heckman selection correction model, these authors found that technical education had a similar effect as general education on the speed of entry into the first job. However, they found that five years after entering the labor market, youth with lower levels of vocational schooling earn less than those who graduated from the academic schooling track. They further found that one channel through which participants of the lower- or medium-level vocational schooling track experienced a fast entry into employment was the increased probability of finding the first job via social networks—although, this network effect faded over time.

### **Evaluating Apprenticeships**

Apprenticeships seem to improve both social and occupational skills of apprentices (Rose 2004; Halpern 2009), yet rigorous quantitative evidence on their effectiveness is meager, even in countries where apprenticeships are widespread (Lerman 2013). Overall, studies indicate apprenticeship effectiveness varies with the counterfactual to which they are compared. When compared to other types of VET or post-school study, it seems that apprenticeships work better than the alternative (Bonnal, Mendes, and Sofer 2002; McIntosh 2004, 2007; Lee and Coelli 2010; Alet and Bonnal 2011).

McIntosh (2004) analyzed the returns to apprenticeships in the United Kingdom prior to the 2004 reform. Using the 1996–2002 Labour Force Survey (LFS), he found that while completing an apprenticeship increased males' wages by around 5 to 7% (controlling for other qualifications held and personal characteristics), it had no effect for women. He also found sectoral differences, with higher returns among men working in manufacturing industries rather than in the service sector. Most recently, McIntosh (2007) evaluated the government-funded apprenticeships established in the United Kingdom in 2004. Using Labor Force Survey and OLS estimates,

he compared the effectiveness of these apprenticeships to other types of vocational qualifications in the United Kingdom. He found that in 2004–2005, individuals who completed apprenticeships earned around 18% more at Level 3 and 16% more at Level 2 than individuals whose highest qualification is at Level 2, or at Level 1, respectively. As McIntosh acknowledged, however, these estimates may be biased because employers may select the best applicants, as there is excess demand for apprenticeships.

According to Lerman (2013: 12), “few rigorous studies have examined how entering and completing apprenticeships in the United States affects the education, job skills, non-academic skills, and job market outcomes of young people.” Orr (1995) analyzed the effects of participating in a Wisconsin youth apprenticeship in printing and found that apprentices earned substantially higher earnings than those of a similar age. Ethnographic evidence from 24 programs involving nearly 500 apprentices—with more than 300 hours of observation and more than 90 interviews with adult mentors, staff, program directors, and students—suggested that apprentices learn both noncognitive and occupational skills (Halpern 2009). Noncognitive skills included problem solving, self-confidence, teamwork, discipline, and the ability to take direction and take initiative, among others. Similarly, Rose (2004) found that apprentices learn from their mentors and aim at mastering an occupation and becoming part of a community practice.

Lee and Coelli (2010) analyzed the labor market returns to vocational education in Australia using propensity score matching methods and found substantial differences for individuals who completed 12 years of schooling and those who did not. While the effect of participating in VET on wages and employment probability was zero or even negative for the first group, it was significantly positive for the latter group. This finding is in line with previous literature, suggesting that vocational education options seem to provide a safety against low labor market attachment.

Bonnal et al. (2002) studied the relative performance of apprenticeship training versus school-based training in France. Correcting for the negative selection of youths into apprenticeships, they found that apprenticeships perform significantly better in integrating youths into their first employment relationship. This advantage faded over time and was not associated with higher wages. In addition, a recent study by Alet and Bonnal (2011) showed that young people integrated into the apprenticeship system rather than vocational schooling in France were more likely to successfully complete their final exam and undertake further education.

One of the first studies to use an instrumental variables (IV) approach to measure the returns of apprenticeships was that of Fersterer et al. (2008) using Austrian data from 1975 to 1998. These authors exploited the different lengths of apprenticeship periods completed for a group of apprentices in failed firms. Perhaps surprisingly, they found that the estimated returns for apprentices affected by the firm failure were low, at around 2.6%. These returns were not very different from the OLS returns in the same sample, suggesting that the selection problem was not particularly important in this case.

## Evaluating the Dual System

As with apprenticeships, the dual system seems to outperform other types of vocational schooling; but in this case, the benefits focus on employment opportunities, as opposed to earnings, and are concentrated at the beginning of individuals' professional lives (Winkelmann 1996; Plug and Groot 1998; Parey 2009). In addition, recent causal estimates of the returns to dual training find no differences in wage returns relative to the academic track (Krueger and Pischke 1995; Winkelmann 1996; Fersterer and Winter-Ebmer 2003; Pischke and von Wachter 2008).

An extensive area of research exploits the coexistence of the dual VET system and other types of vocational schooling within countries to infer their relative effectiveness, and more specifically, the relevance of firm-specific skills. For the case of Germany, studies by Winkelmann (1996) and more recently Parey (2009) showed that participation in the dual VET had a particular advantage compared with other options of the vocational schooling system since it improved early labor market attachment and showed a faster and more structured integration into the labor market. This advantage faded over time though as other education participants found a foothold in the labor market. Furthermore, these studies showed that the fast initial transition did not hinge on finding employment in the training firm, suggesting that firm-specific skills did not play a major role in the German apprenticeship system. Investigating wage differentials, Parey (2009) did not find any significant differences in return to the training options in the early working life. Studies regarding the performance of apprenticeship training versus school-based training by Plug and Groot (1998) showed similar results for the Netherlands.

When comparing the dual system with purely academic studies, several papers have found that wage returns to apprenticeship training on wages in Germany and Austria range between 15 and 20%, based on ordinary least squares (OLS) estimates (see Krueger and Pischke 1995; Winkelmann 1996; Fersterer and Winter-Ebmer 2003). Given that dual vocational training lasts around three years on average, this implies a return of approximately 5% a year, which is not far from other forms of school-based education. Selection into the dual system, however, once again raises concerns that OLS wage estimates will be biased (Soskice 1994). In particular, Soskice found that much heterogeneity was due to firm size, given that the wages for apprenticeship-trained workers strongly increase along with the training firm size.

Recently, Adda, Dustmann, Meghir, and Robin (2006) used a structural approach to compare the career path of apprentices relative to unskilled workers (pure on-the-job training). They modeled the entire career path, starting with the original apprenticeship choice and following period-by-period employment transitions, job mobility, and wages. Using 15 years of German data, they found that apprenticeships led to more wage growth upfront, while wages in the pure on-the-job (unskilled) training grew at a lower rate but for a longer time. Overall, they found that wages were higher

following an apprenticeship qualification, with the job arrival rates very high and destruction rates very low after some years of experience. These findings contrast with Heckman's (1993) suggestions that qualified apprentices were harder to reallocate following a job loss.

Hanushek, Woessmann, and Zhang (2011) also analyzed the life-cycle employment patterns of people with varying educational backgrounds using data on the labor market experiences of individuals at various ages in 18 OECD countries, collected in the mid-1990s as part of an OECD-sponsored venture. They found a higher initial employment rate for vocational education participants at labor market entry, which reversed by the age of 50. These results suggest that occupation-specific knowledge quickly becomes outdated and thus leads to lower employment opportunities later in life. Nonetheless, we need more reliable evidence concerning the perceived trade-off since both occupation-specific labor market segregation as well as limited long-term panel data impede the causal interpretation of these findings.

### **Conclusion and Policy Perspectives**

In this article, we have classified vocational education and training (VET) in industrialized countries into three distinct systems: 1) vocational and technical schools, 2) formal apprenticeships, and 3) dual apprenticeship systems combining school training with a firm-based approach. After reviewing the particular strengths and weaknesses of these distinct types, we evaluated the empirical evidence on their effectiveness. Beyond the general education core, youth completing school-based VET do as well (and sometimes better) than if they had instead remained in purely academic studies, especially when a match can be made between the vocational training and the future occupation of employment. Rigorous studies evaluating the effectiveness of vocational training show that vocational training makes the transition to gainful employment easier and may improve wage and employment outcomes, in particular for low-ability youths and those working in low-skill jobs. In several settings, an extension or prolongation of the academic schooling for these youth does not result in additional gains in terms of labor market entry, but instead may entail an increased risk of dropout. Comparing across types of VET, the dual system, which is most prominent in a number of continental European countries, is more effective than alternative academic or training education at helping youth transition into employment, though no wage differences are observed. Hence, it seems fair to say that vocational training elements generate some added value both to training employers and to the trainees, and facilitate the timely entry into more stable and better-paid jobs at the beginning of the working life.

Yet, given that economic and institutional conditions are highly diverse across industrialized countries, when it comes to furthering vocational education and training, policymakers need to take into account the resources available and to build on them. The ideal type of a dual VET model relies on three preconditions:

1. **Support from employers (and their associations).** Employers and their associations would benefit from considering training to be an investment in favor of competitiveness, productivity, and sustainable employment prospects, and thus could offer vocational training in a systematic and certifiable fashion.
2. **Support from young people, their families, and trade unions.** Young people, their families, and trade unions would benefit from accepting apprenticeships as a phase of lower earnings in exchange for skill acquisition. This perspective would ensure that apprenticeships are not seen as a second-best alternative to tertiary education.
3. **Support from the government.** The government would benefit, even if indirectly, from providing vocational schooling, including funding, a binding regulatory training framework (agreed with employers), and external monitoring. Such an approach would ensure the timely adaptation and labor market relevance of the curricula, and that the quality standards of training provided within firms are met.

Governance and the involvement of core actors—in particular government at different levels, employers' associations, and unions—play a crucial role in implementing dual VET. The organizational capacities of governments and social partners are essential, given that a critical mass of supply and demand of dual VET cannot be created artificially and needs time to develop.

This level of buy-in and involvement explains why a complex system such as the dual vocational training has not been transplanted at a significant scale outside continental Europe. But given that most countries have some forms of vocational training—school-based, firm-based, or mixed—governments and social partners can in principle start with those elements and reform their systems to bring VET closer to employer and labor market needs. Experiences with pilot projects, regional or sectoral clusters of employers, or traditional apprenticeships can be instructive. The main challenge is to make on-the-job learning more systematic and to bring school-based vocational training or general education closer to labor market needs. In this respect, employer participation and an increase in systematic vocational training are crucial. Hence, elements of dual VET closer to employers' demand and real-work experience can be developed within other types of VET.

For example, if a number of employers in a given region or sector are able to identify a joint interest in dual VET as a way to promote the productivity of their workforce, it could be realistic to start with a dual VET cluster. This would probably entail support from the government, which would need to take a supporting role regarding vocational schooling parts and initial employer investment in training capacities. The government would partake in such an exchange for the expectation of lower youth unemployment. A basic agreement regarding funding, management, and curricula could be a good starting point in such a case.

Vocational education and training, however, should not be seen as a panacea to combat high youth unemployment. Keep in mind that VET systems

are appropriate to prepare young workers for only certain types of jobs. VET may be less appropriate for specific high-tech sectors and to access the highest managerial level positions in both the public and private sectors. Here, general academic training is certainly relevant. To address the problem of rising youth unemployment rates since 2008, VET is complementary to structural reform policies that help revive the economy and reduce entry barriers to employment such as dismissal protection or minimum wages. Improving VET systems remains relevant even if structural and institutional changes need to interact with attempts to increase certain types of job opportunities (Cahuc, Carcillo, Rinne, and Zimmermann 2013).

But other elements may be equally important to creating labor market conditions that are more conducive to a smooth transition from school to work. In this context, along with the strengthening of vocational training, the highly dualized structure of labor markets observed in countries such as Italy, Spain, and France needs to be addressed. Where a strong divide occurs between employment protection for permanent contracts on the one hand, and the regulation of temporary contracts or self-employment on the other, young people typically remain stuck in fixed-term employment spells or in other forms of flexible employment. Employers are very reluctant to hire youth on a permanent basis, particularly in the absence of vocational training. In this respect, reducing the rigidity of dismissal protection while increasing employment security for labor market entrants according to tenure could be a solution. Practical work experience and training could then further ease the successful integration of young people into stable jobs.

Finally, a recent line of research has focused on studying the life-cycle impact of vocational education, motivated by the returns to vocational training potentially varying at labor market entry compared to returns after spending several years in the labor market. The differences lie in the fact that skills have to adapt to technological change and to be mobile across time, firms, occupations, and space. While some studies so far support the conjecture that general education still provides a more solid base for such adjustments (Hanushek et al. 2011), others suggest that vocational training is better than pure on-the-job (unskilled) training (Adda et al. 2006). However, the long-term counterfactuals of low-skilled individuals with general or vocational education considering the risk of early unemployment have not yet been well investigated. Future evaluations need to study the long-run consequences, a challenge that also has to do with the (non-)availability of long-term panel data.

## References

- Acemoglu, Daron, and Jörn-Steffen Pischke. 1998. Why do firms train? Theory and evidence. *Quarterly Journal of Economics* 113(1): 78–118.
- . 1999. Beyond Becker: Training in imperfect labour markets. *Economic Journal* 109(453): 112–42.
- . 2000. Certification of training and training outcomes. *European Economic Review* 44(4): 917–27.



- Adda, Jérôme, Christian Dustmann, Costas Meghir, and Jean-Marc Robin. 2006. Career progression and formal versus on-the-job training. IZA Discussion Paper 2260. Bonn, Germany: IZA-Institute for the Study of Labor.
- Alet, Elodie, and Liliane Bonnal. 2011. Vocational schooling and educational success: Comparing apprenticeship to full-time vocational high-school. Mimeo. Toulouse School of Economics.
- Arulampalam, Wiji, Alison L. Booth, and Mark L. Bryan. 2004. Training in Europe. *Journal of the European Economic Association* 2(2–3): 346–60.
- Attanasio, Orazio, Adriana Kugler, and Costas Meghir. 2011. Subsidizing vocational training for disadvantaged youth in Colombia: Evidence from a randomized trial. *American Economic Journal: Applied Economics* 3(3): 188–220.
- Bassanini, Andrea, Alison L. Booth, Giorgio Brunello, Maria De Paola, and Edwin Leuven. 2007. Workplace training in Europe. In Giorgio Brunello, Pietro Garibaldi, and Etienne Wasmer (Eds.), *Education and Training in Europe*, pp. 143–323. New York: Oxford University Press.
- Becker, Gary S. 1964. *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*. New York: National Bureau of Economic Research; distributed by Columbia University Press.
- Bertola, Giuseppe, Francine D. Blau, and Lawrence M. Kahn. 2007. Labor market institutions and demographic employment patterns. *Journal of Population Economics* 20(4): 833–67.
- Bilginsoy, Cihan. 2003. The hazards of training: Attrition and retention in construction industry apprenticeship programs. *Industrial and Labor Relations Review* 57(4): 54–67.
- Bishop, John H., and Ferran Mane. 2004. The impacts of career-technical education on high school completion and labor market success. *Economics of Education Review* 23(4): 381–402.
- . 2005. Raising academic standards and vocational concentrators: Are they better off or worse off? *Education Economics* 13(2): 171–87.
- Bonnal, Liliane, Sylvie Mendes, and Catherine Sofer. 2002. School-to-work transition: Apprenticeship versus vocational school in France. *International Journal of Manpower* 23(5): 426–42.
- Booth, Alison L., and Gylfi Zoega. 2004. Is wage compression a necessary condition for firm-financed general training? *Oxford Economic Papers* 56(1): 88–97.
- Cahuc, Pierre, Stéphane Carcillo, Ulf Rinne, and Klaus F. Zimmermann. 2013. Youth unemployment in old Europe: The polar cases of France and Germany. *IZA Journal of European Labor Studies* 2: 18.
- Cappellari, Lorenzo. 2004. High school types, academic performance and early labour market outcomes. IZA Discussion Paper 1048. Bonn, Germany: IZA-Institute for the Study of Labor.
- Card, David, Pablo Ibarraán, Ferdinando Regalia, David Rosas-Shady, and Yuri Soares. 2011. The labor market impacts of youth training in the Dominican Republic. *Journal of Labor Economics* 29(2): 267–300.
- [CEDEFOP] European Centre for the Development of Vocational Training. 2010. Employer-provided vocational training in Europe: Evaluation and interpretation of the third continuing vocational training survey. Research Paper No. 2. Luxembourg: Publications Office of the European Union.
- Dearden, Lorraine, Steven McIntosh, Michal Myck, and Anna Vignoles. 2002. The returns to academic and vocational qualifications in Britain. *Bulletin of Economic Research* 54(3): 249–74.
- Department for Education, Department for Business and Skills. 2013. The future of apprenticeships in England: Next steps from the Richard Review, Department for Education, Department for Business and Innovation and Skills. London. March.
- Díaz, Juan J., and Miguel Jaramillo. 2006. Evaluation of the Peruvian youth labor training program—ProJoven. OVE Working Paper 1006. Washington, DC: Inter-American Development Bank, Office of Evaluation and Oversight (OVE).
- Dionisius, Regina, Samuel Mühlemann, Harald Pfeifer, Günter Walden, Felix Wenzelmann, and Stefan C. Wolter. 2009. Costs and benefits of apprenticeship training. A comparison of Germany and Switzerland. *Applied Economics Quarterly* 55(1): 7–37.
- Dustmann, Christian, and Uta Schönberg. 2009. Training and union wages. *Review of Economics and Statistics* 91(2): 363–76.

- . 2012. What makes firm-based vocational training schemes successful? The role of commitment. *American Economic Journal: Applied Economics* 4(2): 36–61.
- Eichhorst, Werner, Núria Rodríguez-Planas, Ricarda Schmidl, and Klaus F. Zimmermann. 2013. A roadmap to vocational education and training systems around the world. IZA Discussion Paper 7110. Bonn, Germany: IZA-Institute for the Study of Labor.
- Fersterer, Josef, and Rudolf Winter-Ebmer. 2003. Are Austrian returns to education falling over time? *Labour Economics* 10(1): 73–89.
- Fersterer, Josef, Jörn-Steffen Pischke, and Rudolf Winter-Ebmer. 2008. Returns to apprenticeship training in Austria: Evidence from failed firms. *Scandinavian Journal of Economics* 110(4): 733–53.
- Felgueroso, Florentino. 2010. Reforma Laboral y Empleo Juvenil. El Comercio.es, June 25.
- Felgueroso, Florentino, Maria Gutiérrez-Domenech, and Sergi Jiménez-Martín. 2014. Why school dropout remained so high in the last two decades? The role of the educational law (LOGSE). *IZA Journal of Labor Policy* 3(May 9): 9.
- Gambin, Lynn. 2009. Initial vocational education and training (IVET) in Europe: Review. Thessaloniki: CEDEFOP (European Centre for the Development of Vocational Training).
- Gersbach, Hans, and Armin Schmutzler. 2006. A product-market theory of industry-specific training. SOI Working Papers 0610. Zurich: Socioeconomic Institute, University of Zurich.
- Hall, Caroline. 2012. The effects of reducing tracking in upper secondary school: Evidence from a large-scale pilot scheme. *Journal of Human Resources* 47(1): 237–69.
- Halpern, Robert. 2009. *The Means to Grow Up: Reinventing Apprenticeship as a Developmental Support in Adolescence*. New York: Routledge.
- Hanushek, Eric A., Ludger Woessmann, and Lei Zhang. 2011. General education, vocational education and labor market outcomes over the life-cycle. IZA Discussion Paper 6083. Bonn, Germany: IZA-Institute for the Study of Labor.
- Harhoff, Dietmar, and Thomas J. Kane. 1997. Is the German apprenticeship system a panacea for the US labor market? *Journal of Population Economics* 10(2): 171–196.
- Heckman, James. 1993. Assessing Clinton's program on job training, workfare, and education in the workplace. NBER Working Paper No. 4428. Cambridge, MA: National Bureau of Economic Research.
- Hoeckel, Kathrin. 2008. Costs and benefits in vocational education and training. OECD Education. EDU/EDPC/CERI 3.
- Holzer, Harry J. 2012. Good workers for good jobs: improving education and workforce systems in the US. *IZA Journal of Labor Policy* 1(November 6): 5.
- Hotchkiss, Lawrence. 1993. Effects of training, occupation, and training-occupation match on wage. *Journal of Human Resources* 28(3): 482–96.
- Kahn, Lawrence M. 2007. The impact of employment protection mandates on demographic temporary employment patterns: International microeconomic evidence. *Economic Journal* 117(521): F333–F356.
- Karmel, Tom, Davinia Blomberg, and Monika Vnuk. 2010. The effectiveness of the traineeship model. Occasional Paper. Adelaide: National Centre for Vocational Education Research (NCVER).
- Katz, Eliakim, and Adrian Ziderman. 1990. Investment in general training: The role of information and labour mobility. *Economic Journal* 100(403): 1147–58.
- Kogan, Irena. 2008. Education systems of Central and Eastern European countries. In Irena Kogan, Michael Gebel, and Clemens Noelke (Eds.), *Europe Enlarged: A Handbook of Education, Labour and Welfare Regimes in Central and Eastern Europe*, pp. 7–34. Bristol: Policy Press.
- Krueger, Alan B., and Jörn-Steffen Pischke. 1995. A comparative analysis of East and West German labor markets: Before and after unification. In Lawrence F. Katz and Richard B. Freeman (Eds.), *Differences and Changes in Wage Structures*, pp. 405–46. Chicago: University of Chicago Press.
- Krueger, Dirk, and Krishna B. Kumar. 2004. Skill-specific rather than general education: A reason for US-Europe growth differences? *Journal of Economic Growth* 9(2): 167–207.
- Lazear, Edward P. 2009. Firm-specific human capital: A skill-weights approach. *Journal of Political Economy* 117(5): 914–40.
- Lee, Wang-Sheng, and Michael B. Coelli. 2010. The labour market effects of vocational education and training in Australia. *Australian Economic Review* 43(4): 389–408.

- Lerman, Robert I. 2012. Can the United States expand apprenticeship? Lessons from experience. IZA Policy Paper 46. Bonn, Germany: IZA-Institute for the Study of Labor.
- . 2013. Are employability skills learned in U.S. youth education and training programs? *IZA Journal of Labor Policy* 2: 6.
- . 2014. Do firms benefit from apprenticeship investments? IZA World of Labor 2014: 55. doi: 10.15185/izawol.55.
- Lerman, Robert I., and Felix Rauner. 2012. Apprenticeship in the United States. In Antje Barabasch and Felix Rauner (Eds.), *Work and Education in America: The Art of Integration*, pp. 175–93. Netherlands: Springer.
- Malamud, Ofer, and Cristian Pop-Eleches. 2011. School tracking and access to higher education among disadvantaged groups. *Journal of Public Economics* 95(11–12): 1538–49.
- Malcomson, James M., James W. Maw, and Barry McCormick. 2003. General training by firms, apprentice contracts, and public policy. *European Economic Review* 47(2): 197–227.
- Mane, Ferran. 1999. Trends in the payoff to academic and occupation-specific skills: The short and medium run returns to academic and vocational high school courses for non-college-bound students. *Economics of Education Review* 18(4): 417–37.
- Margolis, David N., and Véronique Simonnet. 2003. Educational track, networks and labor market outcomes. IZA Discussion Paper 699. Bonn, Germany: IZA-Institute for the Study of Labor.
- McCormick, Alexander C., John Tuma, and James Houser. 1995. Vocational course taking and achievement: An analysis of high school transcripts and 1990 NAEP assessment scores. Statistical Analysis Report. Washington, DC: National Center for Education Statistics.
- McIntosh, Steven. 2004. The impact of vocational qualifications on the labour market outcomes of low-achieving school-leavers. CEP Discussion Paper No. 621. London: Centre for Economic Performance, London School of Economics and Political Science.
- . 2007. A cost-benefit analysis of apprenticeships and other vocational qualifications. Research Report RR 834. Sheffield, UK: Sheffield University Management School.
- Meer, Jonathan. 2007. Evidence on the returns to secondary vocational education. *Economics of Education Review* 26(5): 559–73.
- Mohrenweiser, Jans, and Thomas Zwick. 2009. Why do firms train apprentices? The net cost puzzle reconsidered. *Labour Economics* 16(6): 631–37.
- Mohrenweiser, Jans, Thomas Zwick, and Uschi Backes-Gellner. 2013. Poaching and firm-sponsored training: First clean evidence. ZEW Discussion Papers, 13-037.
- Neuman, Shoshana, and Adrian Ziderman. 1991. Vocational schooling, occupational matching, and labor market earnings in Israel. *Journal of Human Resources* 26(2): 256–81.
- . 1999. Vocational education in Israel: Wage effects of the VocEd-Occupation Match. *Journal of Human Resources* 34(2): 407–20.
- [OECD] Organisation for Economic Co-operation and Development. 2013. All in it together? The experience of different labour market groups following the crisis. *OECD Employment Outlook 2013*. Paris: OECD Publishing.
- Oosterbeek, Hessel, and Dinand Webbink. 2007. Wage effects of an extra year of basic vocational education. *Economics of Education Review* 26(4): 408–19.
- Orr, Margaret T. 1995. Wisconsin youth apprenticeship program in printing: Evaluation 1993–1995. Boston: Jobs for the Future.
- Parey, Matthias. 2009. Vocational schooling versus apprenticeship training—Evidence from vacancy data. Mimeo. University College London and Institute for Fiscal Studies.
- Pischke, Jörn-Steffen, and Till von Wachter. 2008. Zero returns to compulsory schooling in Germany: Evidence and interpretation. *Review of Economics and Statistics* 90(3): 592–98.
- Planas, Jordi. 2005. Vocational training in Spain: Changes in the model of skill production and management modalities. Working Paper. Barcelona: Universitat Autònoma de Barcelona.
- Plug, Erik, and Wim Groot. 1998. Apprenticeship versus vocational education: Exemplified by the Dutch Situation. Unpublished manuscript.
- Quintini, Glenda, and Sébastien Martin. 2006. Starting well or losing their way? The position of youth in the labour market in OECD countries. OECD Social, Employment and Migration Working Papers 39. Paris: OECD.
- Roger, Muriel, and Philippe Zamora. 2011. Hiring young unskilled workers on subsidized open-ended contracts: A good integration programme? *Oxford Review of Economic Policy* 27(2): 380–96.

- Rose, Mike. 2004. *The Mind at Work: Valuing the Intelligence of the American Worker*. New York: Viking Penguin Books.
- Shavit, Yossi, and Walter Müller. 1998. *From School to Work: A Comparative Study of Educational Qualifications and Occupational Destinations*. Oxford: Clarendon Press.
- . 2000. Vocational secondary education. *European Societies* 2(1): 29–50.
- Smits, Wendy. 2007. Industry-specific or generic skills? Conflicting interest of firms and workers. *Labour Economics* 14(3): 653–63.
- Soskice, David. 1994. Reconciling markets and institutions: The German apprenticeship system. In Lisa M. Lynch (Ed.), *Training and the Private Sector*, pp. 25–60. Chicago: University of Chicago Press.
- Steedman, Hilary. 2010. The State of Apprenticeship in 2010. International Comparisons: Australia, Austria, England, France, Germany, Ireland, Sweden, Switzerland: A report for the Apprenticeship Ambassadors Network. Centre for Economic Performance special papers, CEPSP22. London: Centre for Economic Performance, London School of Economics and Political Science.
- Tansel, Aysit. 1994. Wage employment, earnings and returns to schooling for men and women in Turkey. *Economics of Education Review* 13(4): 305–20.
- . 1999. General versus vocational high schools and labor market outcomes in Turkey. Economic Research Forum Working Paper 9905. Cairo: Economic Research Forum.
- Tattara, Giuseppe, and Marco Valentini. 2009. Can employment subsidies and greater labour market flexibility increase job opportunities for youth? Revisiting the Italian on-the-job training programme. *Business and Economics* 42(3): 197–212.
- Tuma, John. 1994. Measuring enrollment and participation in secondary vocational education with high school transcript records. *Journal of Vocational Education Research* 19(3): 3–22.
- Tunali, Insan. 2002. General vs. vocational secondary school choice and labor market outcomes in Turkey. In Ismail Abdel-Hamid Sirageldin (Ed.), *Human Capital: Population Economics in the Middle East*, pp. 258–72. Cairo: American University in Cairo Press.
- Willis, Roben J., and Sherwin Rosen. 1979. Education and self-selection. *Journal of Political Economy* 87(5): 7–36.
- Winkelmann, Rainer. 1996. Employment prospects and skill acquisition of apprenticeship-trained workers in Germany. *Industrial and Labour Relations Review* 49(4): 658–72.
- Woessmann, Ludger. 2008. Efficiency and equity of European education and training policies. *International Tax and Public Finance* 15(2): 199–230.
- Wolf, Alison. 2011. Review of vocational education: The Wolf Report. London: UK Department of Education, Department for Business, Innovation & Skills.
- Wolter, Stephen C., and Paul Ryan. 2011. Apprenticeship. In Eric A. Hanushek, Stephen Machin, and Ludger Woessmann (Eds.), *Handbook of Economics of Education*, Vol. 3, pp. 522–76. Amsterdam and London: Elsevier.
- Wolter, Stephen C., and Jürg Schweri. 2002. The cost and benefit of apprenticeship training: The Swiss case. *Applied Economics Quarterly* 48(3–4): 347–67.
- Zimmermann, Klaus F., Costanza Biavaschi, Werner Eichhorst, Corrado Giulietti, Michael J. Kendzia, Alexander Muravyev, Janneke Pieters, Núria Rodríguez-Planas, and Ricarda Schmidl. 2013. Youth unemployment and vocational training. *Foundations and Trends in Microeconomics* 9(1–2): 1–157.