Vocational Education: An International Perspective*

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Abstract

Vocational education is formal education about work, and vocational programs of study typically target a narrow subset of middle-income or middle-skilled occupations. In this chapter, we trace vocational education from competing 20th century education philosophies to its varied structures throughout the 21st century world. We then review the body of economic research on vocational education, focusing on estimated labor-market returns for participating students. Three emerging themes from this literature are that (1) workers with a vocational education background tend to have a flatter age-employment profile than workers with an academic education, (2) quasi-experimental shifts into secondary vocational education lead to equivalent or better attainment and labor market outcomes for students; and (3) vocational postsecondary education is associated with improved individual labor-market outcomes, particularly for multi-year programs. We close by highlighting promising areas for future empirical research, which include long-term and inter-generational effects of vocational education on stability and growth in earnings, the individual effects of vocational education in developing countries, the substitutability versus complementarity of applied occupational learning, and the effect of vocational education on non-cognitive engagement with school.

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I. Introduction

For any society, the question of who should provide occupational training and how they should do it is answered by what that society views as the philosophical and practical purposes of education itself. Prevailing philosophies of education are impermanent, and so the form and purpose of vocational education is rarely the same from one time and place to another. Therefore, much of what we know about the economic effects of vocational education comes from the study of diverse programs and policies, and changes in how students or cohorts interact with vocational programs. Our understanding of the economic effects of vocational education is multiplying rapidly – but not yet coalescing – as data become more suited to the task of causal inference.

With this chapter, we take a snapshot of the evolving literature on vocational education and start to connect the constellation of results from a variety of international contexts. The dominant intent of today's vocational education is to improve economic opportunities for students after they leave formal schooling. The literature has focused on whether vocational education fulfills this purpose, and likewise, most of our review focuses on employment and wage returns to vocational education. Where possible, we reconcile the picture that emerges with the core philosophies of vocational education that led to such diversity in the mode and content of vocational curricula.

First, we develop a definition for vocational education that is grounded in basic human capital theory and flexible enough to accommodate the wide variety of vocational programs and structures available to students in practice.

What is vocational education? Three features

Vocational education is formal learning devoted to the development of occupational skills. The occupational focus of vocational education is its first defining feature, whether for the explicit purpose of developing workforce skills, for complementing general skills with hands-on or real-world applications, or for developing non-cognitive virtues such as citizenship and ethics.

Because any academic subject can conceivably relate and contribute to productivity outside of school, we wish to qualify this binary, jobs-focused feature of vocational education in order to better differentiate it from general education. As a starting point, we can draw from Becker's (1962) model of human capital and think of vocational education as building up human capital that is specific to particular firms or occupations, rather than generally applicable across firms. The implication for education and training is that firms have a stake in providing firm-specific, but not general, human capital, obligating individuals to attain general skills on their own. Lazear (2009) enriches this model with the idea that firm-specific human capital is more like a weighted combination of skills, some of which may be very general. A software firm providing tax optimization products, in Lazear's example, needs workers who know an idiosyncratic blend of accounting, economics, and computer science. The skill-weights concept extends from the firm to the occupation. A good communications specialist will draw from education, training, or experience in graphic arts, writing, marketing, as well as their firm's particular industry.

However, a typical firm does not place positive weight on *all* secondary and higher education subjects. Some subjects are inherently narrower than others. With this in mind, we propose a second feature of vocational education to be an abstract, continuous measure of broad to narrow applicability across jobs. Vocational education falls non-uniformly on this spectrum, tending to be (but not always) narrower. If we were to map vocational subjects to occupations, the alignment would be one-to-few more often than one-to-many, one-to-one, or one-to-all.

A jobs-focused curriculum, typically relevant to a subset of jobs, is an inclusive conceptual framing for vocational education, but it also describes many subjects that are not thought of as vocational: theology, art, music, engineering, or law, to give a few examples. To tighten this framing further and bring it closer to vocational education as it appears in practice and research, we add a third feature, characteristic more so than defining, based on socioeconomic class and aptitude. Typically, programs of study in vocational subjects develop human capital tailored to middle-skilled or middle-income occupations. Leading and popular examples include construction, manufacturing, office administration, and agricultural science. The class-based stratification of vocational and general studies is most apparent in countries where students enter secondary schooling on either a college preparatory track or a vocational track, and where the vocational track ends in a terminal diploma that cannot serve

as a stepping stone to elite universities.[1] Even in more integrated school systems, educators, governments, and families tout vocational coursework as a pathway to financial security (or better) that does not need to involve college or university.

Of course, vocational education is not limited to secondary schooling. Much of the learning that happens in colleges and universities is vocational in nature, both in terms of the specificity of skills and the socioeconomic class of jobs where those skills are needed.

Our working definition of vocational education thus has three parts:

1. Students learn about work.
2. What students learn is (usually) relevant to a limited number of jobs.
3. What students learn is (usually) less relevant to the highest ability, highest income jobs.

The strict intersection of these three features describes the plurality of vocational education programs today, and over the course of history, but certainly not the complete set. Information technology programs are notable exceptions to item 2, since they develop fairly general skills and are commonly situated within vocational programs. A prominent exception to item 3, the class-based characteristic feature of vocational education, is found in the current-day United States. There, a negative stigma was attached to vocational education throughout most of the 20th century, and by the late 1990s most state education agencies dropped the phrase "vocational education" in favor of "career and technical education" (CTE).[2] A typical CTE system in today's United States is organized around "career clusters" that encompass almost any occupation one could have, inclusive of those with the highest pay or highest degree requirements.[3]

[1] Some countries, such as Germany, offer "second chance" options for individuals to switch tracks in order to attend university (Biewen and Tapalaga, 2017). For more information on tracking, see Betts (2011).
[2] We use these terms interchangeably in this chapter.
[3] There are currently 16 career clusters recognized by Advance CTE, a consortium of state CTE leaders across the United States that dates back to 1920. These clusters include: Agriculture, Food, and Natural Resources; Architecture and Construction, Arts, Audio/Visual, & Communications; Business, Management, and Administration; Education and Training; Finance; Government and Public Administration; Health Science; Hospitality and Tourism; Human Services; Information Technology; Law, Public Safety, Corrections and Security; Manufacturing; Marketing, Sales, and Service; Science, Technology, Engineering, and Math; Transportation, Distribution, and Logistics.

Chapter overview and related work

We begin this chapter with a discussion of the historical trends and attitudes regarding vocation education, highlighting the tensions between general (or academic) and vocational education that have existed for over a century. Next, we look at descriptive statistics on the participation in vocational education, looking separately at secondary and postsecondary education. Much of the available data is limited to the United States and continental Europe, although to the extent possible, statistics are provided for different countries around the world.

We then turn to the main focus of the chapter and the research literature we review, which estimates any attainment or labor-market effects associated with vocational education. This section starts with a discussion of vocational secondary schools. Here, the discussion notes the different techniques used, from analyses of country policy reforms changing the number of years of general and / or vocational schooling, to regression discontinuity methods that exploit cut-offs for admission to vocational education programs. Again, evidence on benefits is presented for multiple countries, including a nontrivial research base on developing countries.

We then turn to postsecondary vocational education, starting with the vast research on U.S. community colleges. Although these institutions provide the majority of postsecondary vocational education in the country, they also provide up to two years of academic coursework. Students often start at a community college and then transfer to a four-year college or university. Early work in this area mainly used survey data sets such as the National Longitudinal Survey of Youth (NLSY). More recent research relies on large administrate data sets of community college students, usually collected at the state level, linked with administrative earnings data collected for the Unemployment Insurance program.

Following the U.S. evidence is a section summarizing the evidence on labor-market benefits from postsecondary education around the globe. Here, it should be noted that the institutions in most countries, unlike in the U.S., are separate institutions devoted to vocational postsecondary education. Some offer lower levels of vocational education comparable to the certificates offered in community colleges, whereas others provide longer programs comparable to bachelor's degrees – in fact, some are called bachelor's degrees – but with a

vocational focus. Recently, some countries such as Finland have started offering vocational master's degrees.

Not all research on postsecondary vocational education focuses on labor-market outcomes. Thus, we also provide an overview of research on specific attributes of these vocational postsecondary institutions. First is a look at the attributes of community colleges, such as advising, and how they affect persistence and completion. Second is a look at the financial side of these institutions. Specifically, how does financing affect attendance (and, in some cases, labor-market outcomes)? The final section summarizes the chapter and contains suggestions for further research,

Throughout our framework and review, we focus on formal classroom-based vocational programs, which can have components outside of the traditional classroom. We will say little about apprenticeships, and we refer readers to Wolter and Ryan (2011) for the necessary depth on that topic. Similarly, McCall, Smith and Wunsch (2016) review research and several case studies on public vocational training for adults in more detail than we do here. Cellini (this handbook) discusses for-profit postsecondary education, much of which is oriented toward specific occupations.

Previewing our synthesis of the literature, several studies have found that the age-employment profile of vocationally educated workers is flatter than that of workers with a more academic education. Looking across and within cohorts, vocational students may have higher employment and earnings than academic students early in their careers, but the ranking switches to favor general education later in their careers. This life-cycle pattern is consistent with human capital theory predicting that workers with more idiosyncratic skills are more vulnerable to market fluctuations and shifting technology. And yet, for secondary students who are quasi-experimentally shifted into a more general education as part of national reforms, there are no evident long-term benefits. Secondary students who seek a more vocational education and gain admission to career academies, randomly or as good as randomly, realize gains in attainment and earnings. Postsecondary adults who attend vocational programs tend to have better outcomes than students who do not enroll, and there are significant returns to completing such programs. Studies that are able to isolate exogenous sources of variation in vocational education at the individual level, such as admission lotteries for over-subscribed vocational programs, are more apt to find positive effects on attainment

or earnings, although long-term effects are currently beyond the scope of available data. Despite the rapidly growing volume this body of research, many unanswered questions remain regarding vocational education. For example, what are the inter-generational effects of vocational education concerning labor-market outcomes? Due to data constraints, the econometric rigor applied to studies of vocational education in developing countries is not as high as in developed countries. Looking within particular programs of study – vocational or otherwise – little is known about whether vocational and general components of the curriculum are substitutes versus complements.

II. History and Philosophies of Vocational Education

The known history of vocational education and apprenticeship stretches back to ancient times, and has ebbed, flowed, and evolved under countless societal purposes and formal structures. In this section, we highlight themes from the global history and philosophies of education that are interwoven throughout the policies and programs examined by modern-day vocational education research.[4]

Vocational *versus* general education

One recurring theme from the history of formal education over the last 150 years is a tension between philosophies of education in work-oriented skills versus more general, academic skills. This tension over curriculum is rooted in a broader, longstanding debate about the aims of formal education, which asks: should students become, foremost, conscientious and curious learners who can think and debate critically, or skilled workers capable of sustaining themselves and contributing to the economy? Or, are these complementary objectives? John Dewey, America's leading 20th century educational philosopher, held the complementary view, writing in 1915 that:

> I object to regarding as vocational education any training which does not have as its supreme regard the development of such intelligent initiative,

[4] For a more detailed treatment of the history of vocational and general education, we refer the interested reader to Gordon (2014) for the United States development of what is now called career and technical education, Horner et al. (2015) and Berner et al. (2016) for reviews and comparative analyses of European systems, Cleverley (1992) for the evolution of Chinese education from traditional to modern models, as well as Johanson and Adams (2004) and Lauglo (2009) for reviews of vocational education in Sub-Saharan Africa.

> ingenuity and executive capacity as shall make workers, as far as may be, the masters of their own industrial fate. (quoted in Larrabee, 2010)

Long before Dewey's prominence, the 19th century Swedish slöjd system (or sloyd, which remains a compulsory part of Swedish education) integrated paper, textile, and wood craftwork into general education in a complementary way, with the intent of developing a student's learning capacities more so than their technical skills. A contemporaneous system in Russia's Imperial Technical School of Moscow (today's Bauman University) provided students with tool instruction side by side with technical theory. Inspired by the Russian system, the president of the Massachusetts Institute of Technology paired the school's existing theoretical curriculum with new laboratories for engineering students to apply what they learned, in hopes that they would no longer need to complete an apprenticeship between graduation and work (Gordon, 2014).

Rivaling Dewey and the slöjd's "executive capacity" view of vocational education was the idea that education's chief goal was to produce productive citizens. This economically-oriented aim of education was typically joined with the theory that curriculum content directly influenced knowledge, as opposed to the traditional "faculty psychology" view that the mere act of learning new material enhanced a student's mental faculties for all sorts of purposes. The psychologist Edward Thorndike popularized the formal link between curriculum, knowledge, and skills in the early 20th century United States. Accompanying this link was an elevated purpose for teaching occupational skills through vocational education, preferably in strict separation from academic subjects (Larrabee, 2010). Thorndike's model of curricular learning is also responsible for introducing standardized testing as a scientific tool in the evaluation of students and their schools. Dewey's legacy as a philosopher is more revered, but Thorndike's practical view of education is far more prevalent among public school systems today (Lagemann, 1989; Tomlinson, 1997).

The arguments of the Thorndike-Dewey debates were not unique to the United States. Around the world in the first half of the 20th century, national efforts to grow or import vocational education were not always successful, in part because of this tension between vocational and academic education and the empirically well-founded belief that students who attain an academic education earn more over the course their careers. See case studies from Ghana (Foster, 1965) and China prior to World War II (Schulte, 2013). To this day, the

question is rarely settled as to whether there is enough vocational education for students who want it, or too much for those who do not.

Tracked versus integrated vocational education

Even among those who share the view that formal education serves economic purposes, and vocational education a part therein, there is disagreement as to the most productive way to teach about work. The oldest form of vocational education, apprenticeship, is indistinguishable from work. An apprenticeship arrangement matches a student to a professional, typically under formal contract and sometimes lasting for many years. The traditional apprenticeship can be modified to include class instruction, such as in Germany's dual system where apprentices divide their time between work and school.

Other vocational education structures are entirely based in schools, but with a curriculum that is distinct and separate from what is offered to general education students. This form is common throughout the world today, where separate schools or tracks are offered for vocational and academic education, typically beginning in secondary grades.

The tracked model of vocational education aligned with what was known as the social efficiency doctrine, which was led in the early 1900s by David Snedden in the United States (Doolittle and Camp, 1999). Snedden was the first Commissioner of Education in Massachusetts, and, along with his deputy commissioner and former student Charles Prosser, was one of the more influential figures in the development of 20th century vocational education. Snedden held society and education systems liable for providing students with the tools to be economically self-sufficient, and in the spirit of Thorndike's vision of learning, advocated for vocational education programs that were separate from general education. His view was that some students were meant to be producers, and others the utilizers of what was produced, and that the two should ideally be educated in separate institutions and under separate curricula suited to their comparative advantage (Larrabee, 2010).

Against the backdrop of America's second industrial revolution, rapid growth in high school access and enrollment, and class stratification in burgeoning urban centers, adherents to social efficiency claimed that most secondary students (many of whom would not have persisted into high school if they had been born in an earlier generation) would benefit from a

fundamentally vocational education that prepared them for work. In response to Snedden's call to "closely correlate theoretical instruction to this practical work" (Snedden, 1914), Dewey contended that "a separation of trade education and general education of youth has the inevitable tendency to make both kinds of training narrower, less significant and less effective …" (Dewey, 1915).

After apprenticeship and tracked systems, a third major form of vocational education integrates occupational learning with general education, within schools and even within courses or specific topics of study. Such an integrated education system is more aligned with Dewey's thinking, the slöjd system, and the early 20th-century US movement in "manual education," which viewed vocational and academic education as strongly complementary. Lauglo's (2009) description of "light dosage" vocational secondary education in sub-Saharan Africa fits this model as well.

Vocational education and upward mobility

Vocational education as a ticket to sustained or upward economic mobility amidst technological and cultural change is implicit in the social efficiency doctrine, its forbearing philosophies, and its legacy. The rhetoric of vocational education routinely connects work-focused learning to the idea that narrow skill development can do a better job than academic training at lifting an individual, race, or even a nation out of poverty.

Consider Booker T. Washington's 1895 "Atlanta Compromise" speech on the topic of black economic progress in the U.S., addressed to a largely white audience at the Cotton States and International Exposition: "No race can prosper till it learns that there is as much dignity in tilling a field as in writing a poem. It is at the bottom of life we must begin, and not at the top" (Harlan, 1974). W. E. B. DuBois criticized Washington's philosophy of black progress through "adjustment and submission" as paradoxical. He painted Washington's industrial education philosophy as "unnecessarily narrow," advocating instead for "[t]he education of youth according to ability," more resources for black colleges and postsecondary training, and equality in civil and voting rights (DuBois, 1903).

More recently, a 2015 UNESCO publication reviews the state of vocational education in developing economics, and opens with the following:

> Technical and vocational education and training (TVET) is steadily emerging as a winner in the "race to the top" of global debates and government priorities for education and national development agendas (Marope, Chakroun, and Holmes, 2015).

Disruption: Demand for vocational education in the wake of technology shocks and war

A fourth theme evident from the global history of vocational education is the effect of economic shocks from technology, or political shocks from war, on the demand for and structure of vocational education.

Technological advancements that automate or economize labor tasks threaten workers with skills invested in fading technologies while simultaneously intensifying demand for expanded education in newer methods. The onset of the industrial revolution, in Europe and later the U.S., increased the need for low-skilled and medium-skilled production workers beyond what existing apprenticeship systems could supply. This shock coincided with the Morrill Acts in the U.S., which established land-grant universities and federally subsidized their development of agricultural and industrial postsecondary programs. Vocational education was introduced in U.S. public secondary schools somewhat later, in part as a response to industrial demands for workers adept in new technologies. These demands co-moved with Snedden's and Prosser's advocacy, World War I-era reductions in immigrant craftsmen, as well as the Smith-Hughes Act of 1917 that established a federal funding stream for vocational secondary education.

At various points in recent history, the outcome of war has shifted the importance of vocational education to favor the educational philosophy of the victors. Following World War I and the subsequent overthrow of the Ottoman state, the new Turkish Republic promoted a more economic purpose for formal education (as well as a more political one), secularized the education system, and grew the vocational education sector (Ozelli, 1974). China, following World War II and the civil war, expanded vocational education in a tracked, dual system under political and economic justifications (Bush and Haiyan, 2000). Also following World War II, West Germany redeveloped a tracked secondary system whereas Soviet-controlled East Germany adopted a general polytechnic model for all students.

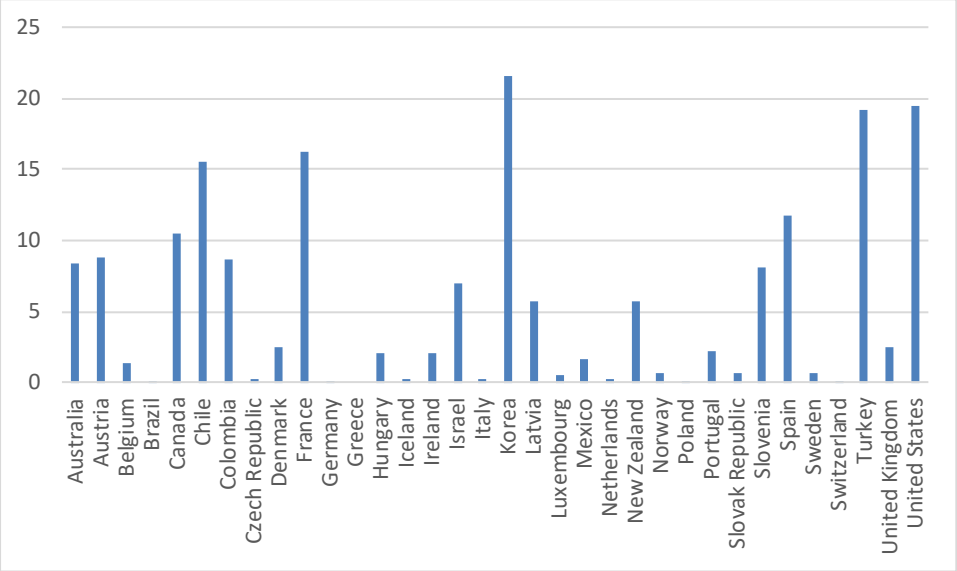
III. Who Attends Vocational Education?

The 2019 edition of the OECD's report *Education at a Glance* provides a nice overview of vocational education enrollment (OECD, 2019). Among OECD countries, approximately 40 percent of students ages 17 to 18 were in academic secondary schools, 30 percent were in vocational schools, and 30 percent were not in secondary school. However, this overall averages masks substantial heterogeneity in attendance rates, with some countries such as Finland and Slovenia having more than two thirds of secondary school students in vocational education.

Due to the lack of tracking in U.S. primary and secondary schooling, Kreisman and Stange (2019) suggest that the best measures of vocational education course-taking is the number of credits taken rather than the number of students in dedicated vocational education programs. They find that 95 percent of high school students take at least one vocational education class.

The OECD report provides more detail on postsecondary education, particularly for what they term "short cycle" programs like U.S. community college certificate and associate's degree programs. In most countries, enrollment in such programs peaks at ages 19 to 20, implying that most students who enroll in short-cycle programs do so soon after completing secondary education. Figure 1 illustrates the enrollment rates for OECD countries with non-missing data. The overall average is five percent, but a few countries have enrollment of 15 percent or more: Chile, France, Korea, Turkey, and the United States. At the same time, several countries report zero percent of students enrolled in short-cycle programs: Brazil, the Czech Republic, Germany, Iceland, Italy, the Netherlands, Poland, and Switzerland.

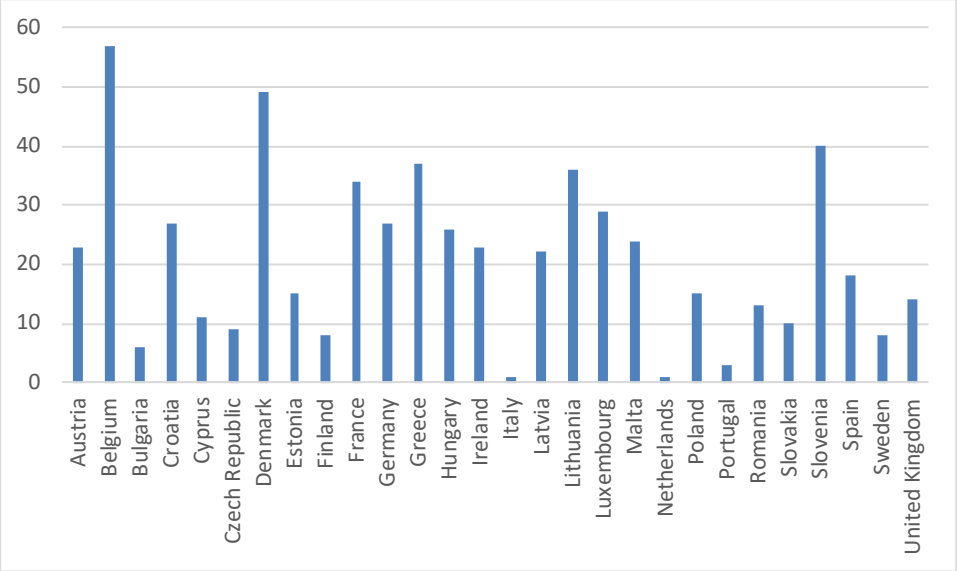
Figure 1: Individuals Ages 19-20 Attending Short Cycle Postsecondary Programs (%), OECD



Source: OECD (2019)

One challenge in comparing vocational education across countries, as noted by Ulicna, Messerer, and Auzinger (2016), is that the definition of vocational education programs varies from country to country in the European Union (EU). Examples of vocational education options in the EU but not counted as short cycle programs are the vocational bachelor's programs in Denmark and elsewhere. Instead, Ulicna et al. (2016) take a broader definition of vocational education at the postsecondary level. Using that definition, Figure 2 shows the percentage of postsecondary students in vocational education in both short-cycle and longer programs.

Figure 2: Postsecondary Students Attending Vocational Education (%), EU



Source: Ulicna, Messerer, and Auzinger (2016)

The EU average is 20 percent, although there is great variation in vocational education participation. Under five percent of students attend vocational education in Italy, the Netherlands and Portugal, whereas 40 percent or more attend in Belgium, Denmark, and Slovenia.

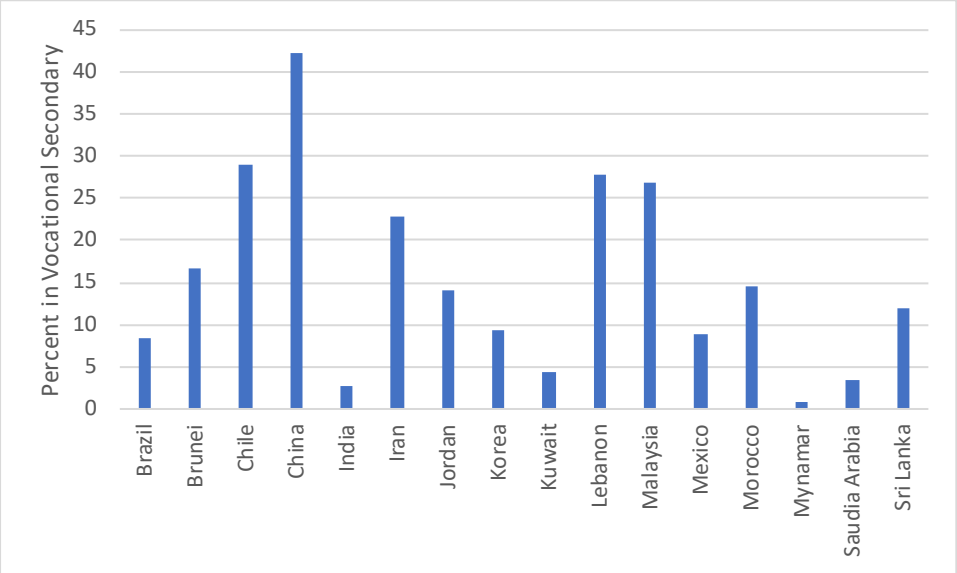
In the U.S., Zhang and Oymak (2018) provide a detailed analysis of students pursuing an undergraduate degree of any type (including certificates, associate's degrees, or bachelor's degrees) using national survey data from the 2011-2012 National Postsecondary Student Aid Study (NPSAS).[5] They report that 38 percent of students pursue a vocational degree. Among these students, the most popular field of study by far is health sciences at 36 percent, with business and marketing second at 17 percent. No other field of study has more than 10 percent. 60 percent of students pursuing vocational degrees are women, although there is great disparity by gender in field of study.

Figure 3 illustrates the percentage of upper secondary school students who attend vocational (as opposed to general) education for developing and intermediately developed countries. The data for the figure come from United Nations Educational, Scientific, and Cultural

[5] As mentioned in Jepsen, Mueser, and Jeon (2016) and elsewhere, survey and administrative data from the U.S. Department of Education, including the NPSAS, are limited to students attending schools that receive federal funding from the Title IV program. Nearly all public institutions receive such aid, but a nontrivial share of private schools, particularly for-profit schools, do not receive such aid.

Organization (UNESCO) UNEVOC country profiles from 2018 and 2019.[6] As the figure illustrates, there is substantial variation in the mix of students attending vocational upper secondary education. Over 40 percent of students in China attend vocational education. Elsewhere in Asia, less than five percent attend vocational education in India or Mynamar. In the Middle East, 28 percent attend vocational education in Lebanon, compared to 14 percent in Jordan, 4 percent in Kuwait, and 3 percent in Saudi Arabia. Of the 16 countries sampled, 5 have over 20 percent in vocational attendance, 4 have between 10 and 20 percent, and 7 have under 10 percent.

Figure 3: Upper Secondary Students Attending Vocational Education (%)



Source: UNESCO-UNEVOC Country Profiles, 2018-2019.

IV. The Labor Market Benefits of Vocational Education

Secondary vocational education

Table 1 provides a brief summary of several estimated returns to secondary vocational education from diverse policies, reforms, and identification strategies.

[6] Unfortunately, country profiles prior to 2018 do not contain these data. Furthermore, although Kenya, Nigeria, and the Philippines have country profiles in 2018 or 2019, these profiles do not contain data on the percentage of upper secondary students attending vocational education.

Table 1. Secondary Vocational Education Literature for U.S. and Europe

	Location	Identifying variation in vocational education	Sketch of major findings
A. National Reforms and Pilots			
Oosterbeek and Webbink (2017)	Netherlands	1 additional year of general education prior to tracking	No significant effects on log wages.
Hall (2012, 2016)	Sweden	1 year of additional, and more academic upper secondary study, in vocational programs	No significant effects on university attendance, earnings, or unemployment.
Malamud and Pop-Eleches (2010, 2014)	Romania	2 additional years of general education prior to tracking	No significant effects on university attendance, unemployment, or earnings.
Zilic (2018)	Croatia	2 additional years of general education prior to tracking	No significant effects on labor-market outcomes.
B. Vocational versus general education (tracked)			
Hanushek et al. (2017)	11 Countries	Intercohort age-earnings profiles by type of education; plant closures	For workers with vocational education, higher youth employment but lower employment later in working life.
Brunello and Rocco (2017a)	Europe	Cross sectional, regression adjusted	Higher probability of current employment and lower hourly earnings.
Brunello and Rocco (2017b)	UK	Intracohort age-earnings profile by type of education	Similar employment profile over the life cycle. Higher wages initially but lower wages later in working life.
Golsteyn and Stenberg (2017)	Sweden	Within-family differences in type of education across siblings	Higher wages initially but lower wages later in working life.
C. Admission to school-based CTE			
Kemple and Willner (2008)	United States	Lottery-based admission to 1 of 9 career academies	11% increase in earnings; 17% increase for young men.
Hemelt, Lenard, and Paeplow (2019)	North Carolina	Lottery-based admission to 1 career academy	Raises secondary school graduation and college enrollment by 8 percentage points
Dougherty (2018)	Massachusetts	Marginal admission to oversubscribed CTE secondary school	Raises secondary school graduation by 7-10 percentage points
D. Vocational versus general education (integrated systems)			
Kreisman and Stange (2019)	U.S. (NLSY97)	1 additional year in an advanced CTE program	Earnings rise by 2%.
Kreisman and Stange (2019)	U.S. (NLSY97)	Graduation requirements in non-vocational courses	No significant change in earnings

Secondary vocational education typically takes one of two forms, either whole-school based systems as is common in much of Europe (although occurs in some settings in the U.S.) or integrated, class-based systems (how most U.S. students participate in vocational education).

The bulk of the literature on the labor-market benefits to the tracked system use difference-in-difference type models to study the tradeoff between vocational and general education. Often, these studies exploit policy experiments that extend the number of years of general education.

Oosterbeek and Webbink (2007) study the effects of an increase in compulsory schooling for vocational students. Hall (2012, 2016) exploits a reform in Sweden that extends the amount of general education in vocational upper secondary school. Malamud and Pop-Eleches (2010, 2011) and Zilic (2018) utilize reforms in Romania and Croatia, respectively, that increased the amount of general education. Despite different time periods and countries, these studies are consistent in their findings: little correlation between these reforms and subsequent labor-market outcomes.[7]

Another approach is to use survey data across countries to compare labor-market outcomes for individuals with vocational education versus those with general education. Note that these studies typically do not distinguish between upper secondary and postsecondary education, so the results here should be interpreted as a combined effect of secondary and postsecondary education. Regarding employment, multiple studies find that, compared to academic or general education, vocational education is associated with higher employment at younger ages, but equal if not lower employment at older ages (Hanushek et al., 2017; Brunello and Rocco, 2017a, 2017b; Hampf and Woessmann, 2017). For earnings, Golsteyn and Stenberg (2017) find a similar pattern for vocational upper secondary education in Sweden. In Brunello and Rocco (2017a, 2017b), vocational education is associated with slightly lower earnings This broad pattern of results holds both for multi-country studies with cross-sectional data (Hanushek et al., 2017; Brunello and Rocco, 2017a), as well as panel data from the UK (Brunello and Rocco, 2017b) and Sweden (Golsteyn and Stenberg, 2017).[8] Looking at

[7] Several papers look at a reform in Finland that extended the number of years of compulsory general education (Pekkarinen, 2008; Pekkarinen, Uusitalo, and Kerr, 2009; Kerr, Pekkarinen, and Uusitalo, 2013), but these papers focus on outcomes other than earnings or employment.

[8] Similarly, Varhaest et al. (2018) look at the relationship between vocational versus general education (at both secondary and postsecondary levels) and educational and skill mismatches.

secondary tracks rather than years of schooling, Meer (2007) finds higher log income for the academic track relative to other tracks.

A third technique exploits admissions rules for vocational schools. Kemple and Willner (2008) use random assignment to evaluate the effectiveness of career academies, a type of vocational secondary school in the U.S. They find that being randomly assigned to a career academy boosted annual earnings by 11 percent, with most pronounced effects for young men. More recently, Hemelt, Lenard, and Paeplow (2019) use an admissions lottery for career academies in one U.S. school district. They find that career academies raise high school graduation rates by eight percentage points. College enrollment is also increased, but only for males. Dougherty (2018) uses regression discontinuity analysis for oversubscribed career academies to estimate the effect of attending a career academy for the marginal student, finding a significantly higher likelihood of high school graduation.[9]

In many countries, assignment to vocational versus general secondary school is based largely on admissions scores (usually grade point average, a standardized test score, or a combination of the two). Silliman and Virtanen (2019) use the discontinuity in assignment of students to secondary schools in Finland to study the relationship between vocational education and labor-market outcomes. They find that, for students at the margin of acceptance into vocational education versus general education, vocational education is associated with a seven percent increase in earnings. Employment (measured in months) is similar between the two groups.

In many locations, secondary school students access vocational education in schools that provide both general and vocational instruction. Kreisman and Stange (forthcoming) use survey data to study the relationship between vocational course taking and labor-market outcomes in the U.S. They find that students positively select into vocational course work, in contrast to conventional wisdom that vocational education is primarily for low-achieving students. Second, they find no relationship between basic vocational education and earnings, but they find that an additional year of advanced vocational coursework is associated with an increase in earnings of two percent. In the shorter run, Bonilla (2019) provides preliminary

[9] Dougherty (2018) finds similar results for OLS models on a larger sample of career academies.

evidence that districts who received a large grant to create aligned pathways between general and vocational education saw substantial declines in the high school dropout rate.

Although most of the literature on vocational secondary education focuses on North America or Europe, numerous studies look at other countries. Psacharopoulos (1994) provides a global perspective on returns to schooling generally. Due to data limitations, most studies use survey data and ordinary least squares (OLS) models to compare individuals with vocational education versus general education. The results are mixed.

For Asia, Olfindo (2018) finds similar labor-market outcomes between individuals with vocational education and those without in the Philippines. For Singapore, vocational secondary education is associated with a higher private rate of return relative to no secondary education (Sakellariou, 2003). Newhouse and Suryadarma (2011) find mixed results when comparing academic to vocational high schools in Indonesia. Vocational high schools provide some benefits for women, but they are associated with a wage penalty for men. In contrast, Moenjak and Worswick (2003) and Tangtipongkul (2015) find higher earnings in Thailand for vocational versus general secondary education. For Vietnam, earnings gains are around five percent for general secondary and vocational secondary relative to primary education (Moock, Patrinos, and Ventataraman, 2003). In a randomized evaluation in India for low-income women, Maitra and Mani (2017) find sizable employment and earnings effects from a vocational education program.

Elsewhere in the world, the results from sub-Saharan Africa and South America find that vocational education has lower returns than general education in Suriname (Horowitz and Schenzler, 1999), Rwanda (Lassibille and Tan, 2005); and Tanzania (Kahyarara and Teal, 2008). However, in Egypt, the results are mixed. El-Hamidi (2006) finds sizable earnings gains to vocational upper secondary education relative to no upper secondary or to general secondary education, whereas Krafft (2018) finds similar returns between the two secondary school sectors. Salehi-Isfahani, Tunali, and Assaad (2009) find that general secondary education has higher earnings than vocational in their sample of urban men. Vocational education has higher earnings than no upper secondary education, a finding that is echoed in their analysis of Iran and Turkey (again for urban men). The results concerning vocational versus general upper secondary are inconclusive for Iran and vary by survey year; for Turkey,

earnings gains are marginally higher for vocational secondary compared to general secondary.

The literature on secondary vocational education produces some common themes. First, when compared generally to general (or academic) education, vocational education is associated with similar if not better short-run outcomes and worse long-run outcomes. Policy reforms that change a country's education structure, usually adding more general education or increasing the amount of compulsory schooling, have no systematic relationship with subsequent labor-market outcomes. However, when looking more closely at specific populations and using causal techniques such as random assignment or regression discontinuity, a different picture emerges. For students at the margin between vocational and general education, vocational education is associated with better educational attainment and higher earnings, at least in the short run.

Postsecondary vocational education – U.S.

Early work on the labor-market returns to community colleges, the main provider of postsecondary vocational education in the U.S., estimated OLS regression models on national surveys such as the National Longitudinal Study of 1972 (NLS72). Table 2 summarizes the results from these surveys, relying heavily on summaries by Grubb (2002a) and Bailey and Belfield (2011). The reported estimates are log points.

For an associate's degree, the returns[10] for men are between 0.073 (Kane and Rouse, 1995) and 0.198 (Leigh and Gill, 1997). The returns for women are higher, ranging from 0.165 (Marcotte, 2019) to 0.339 (Marcotte et. al, 2005). Although the point estimates vary, the results from survey data consistently suggest positive returns to associate's degrees, with all but one study finding higher returns for men than for women.

[10] For simplicity, we refer to the increase in earnings associated with a level of education as returns. However, Heckman, Lochner, and Todd (2008) point out that calculating the internal rate of return is a much more complicated endeavor.

Table 2: Selected Published Results for Survey Data, Log Annual Earnings

		Associate's Degree		Certificate		Credits Earned	
	Dataset	Women	Men	Women	Men	Women	Men
Kane and Rouse (1995)	NLS72	0.256	0.073			0.066	0.057
		(0.050)	(0.046)			(0.026)	(0.019)
Grubb (1997)	SIPP	0.205	0.166	0.219	0.063		
		(0.037)	(0.030)	(0.044)	(0.042)		
Leigh and Gill (1997)	NLSY79	0.253	0.198				
		(0.057)	(0.055)				
Marcotte et al. (2005)	NELS88	0.339	0.158	0.066	0.182	0.083	0.055
		(0.062)	(0.065)	(0.060)	(0.062)	(0.032)	(0.022)
Marcotte (2010)	NELS88	0.338	0.137	0.184	0.059	0.114	0.051
		(0.063)	(0.063)	(0.061)	(0.046)	(0.027)	(0.030)
Marcotte (2019)	ELS2002	0.165	0.193	-0.235	0.362	-0.030	0.009
		(0.114)	(0.123)	(0.133)	(0.150)	(0.030)	(0.030)
Scott-Clayton and Wen (2017)	NLSY97	0.25		0.00		0.05	
		(0.05)		(0.08)		(0.04)	

Notes: For consistency, the reported results are for the preferred model specification in the first table of results. For credits earned, Marcotte (2010, 2019) report the returns for 1 credit, so we multiplied the coefficient and standard error by 30 to create the return to 30 credits to facilitate comparison with other studies. The results for 'Some 2yr college' in Scott-Clayton and Wen (2017) is reported in the '30 Credits' section. The results are as follows: Kane and Rouse (1995), Table 2, Column 6; Leigh and Gill (1997), Table 4, Column 4; Grubb (1997), Table 3 for 1990 earnings; Marcotte et. al (2005), Table 3, Columns 5 and 7; Marcotte (2010), Table 3, Columns 5 and 7; Marcotte (2019), Table 4; Scott-Clayton and Wen (2017), Table 3, Column 4 (for the combined sample of men and women).

The temporal pattern in returns to certificates is unclear in the survey data. For high school graduates in the 1970s and 1980s, the returns are positive, although the range of estimates is substantial. In Grubb (1997) and Marcotte (2010), the returns are approximately six percent for men and 20 percent for women, whereas Marcotte et al. (2005) report returns of 18 percent for men and six percent for women. More recently, the returns for the ELS2002 reported in Marcotte (2019) are imprecisely estimated.

Many studies report the returns to a year of full-time coursework, 30 credits, holding constant any sheepskin effects of completing an associate's degree or a certificate. Again, data from

high school graduates in the 1970s and 1980s have consistent results: returns around five percent for men and slightly higher returns of 7-11 percent for women. ELS 2002 data show no evidence of higher returns for credits conditional on highest degree (Marcotte, 2019).

In the last decade, researchers have primarily used state administrative data sets linking community college attendance data with state Unemployment Insurance (UI) earnings data.[11] The first, and one of the most comprehensive, studies using UI data is the work of Jacobson, LaLonde, and Sullivan (2005a). Using panel data on displaced workers in the state of Washington, they use person fixed effects models to account for time-invariant differences between displaced workers who attend community college and those who do not. In addition, they use person time trends to account for time-varying differences between students and non-students, and they allow for the returns to community college to vary with time since enrollment. Overall, they find that a year of community college attendance corresponds with higher earnings of nine percent for men and 13 percent for women, concentrated in more technically-oriented coursework. In follow up work, Jacobson, LaLonde, and Sullivan (2005b) show that the returns are about three percent lower for workers over age 35.

Since then, several studies have used state-specific administrative data to study labor-market returns to community colleges. Table 3 provides a summary of recent results from administrative data, building on the summary in Belfield and Bailey (2017a).[12] In general, these studies use person fixed effects and compare community college completers to non-completers, as UI data contain essentially no covariates on which to build a comparison group of workers who did not attend community college. Because the fixed effects model uses pre-enrollment as well as post-enrollment earnings data, the studies focus on mature students who are at least 20 years old at the time of enrollment. The estimates in Table 3 are reported in log points for studies of log earnings and as percentages of mean earnings for studies reporting earnings levels.

[11] The Unemployment Insurance program requires states to collect individual-level quarterly earnings data for nearly all private sector employees.
[12] For a survey of previous results using administrative data, see Grubb (2002b).

Table 3: Selected Results Using Administrative Data, Log / Percentage Earnings

		Associate's		Long Certificate		Short Certificate	
Study	State	Women	Men	Women	Men	Women	Men
Belfield (2015)	AR	0.138	0.059	[a]	[a]	[a]	[a]
		(0.004)	(0.006)	[a]	[a]	[a]	[a]
Stevens, Kurlaender, and Grosz (2019)	CA	0.351	0.198	0.321	0.128	0.118	0.126
		(0.016)	(0.017)	(0.029)	(0.023)	(0.026)	(0.021)
Jepsen, Troske, and Coomes (2014)	KY	0.557	0.242	0.451	0.206	0.032	0.048
		(0.019)	(0.024)	(0.026)	(0.030)	(0.018)	(0.026)
Bahr et al. (2015)	MI	0.327	0.118	0.132	0.036	0.004	0.084
		(0.025)	(0.025)	(0.048)	(0.037)	(0.057)	(0.075)
Liu, Belfield, and Trimble (2015)	NC	0.339	0.159	0.278	0.079	0.028	0.067
		(0.005)	(0.006)	(0.005)	(0.012)	(0.006)	(0.008)
Zeidenberg, Scott, and Belfield (2015)	NC	0.167	0.423	0.014	0.386	0.006	-0.017
		(0.029)	(0.018)	(0.028)	(0.017)	(0.032)	(0.024)
Turner (2016)	CO	1.222 [c]		0.386		0.231	
		(0.164)		(0.124)		(0.074)	
Bettinger and Soliz (2016)	OH	0.264	0.212	0.217	0.180	0.055	0.411
		(0.020)	(0.024)	(0.069)	(0.107)	(0.087)	(0.213)
Minaya and Scott-Clayton (2017)	OH	0.481	0.267	0.329	0.179	0.021	0.028
		(0.013)	(0.019)	(0.021)	(0.048)	(0.031)	(0.025)
Pan (2017)	OH	0.208[b]					
		(0.010)					
Carruthers and Sanford (2018)	TN			0.173[b]		0.017[b]	
				(0.011)		(0.017)	
Dadgar and Trimble (2017)	WA	0.063	0.021	0.149	0.013	-0.028	-0.003
		(0.008)	(0.009)	(0.016)	(0.019)	(0.014)	(0.016)

[a]Belfield (2015) estimates returns for long and short certificates combined. The estimated returns are 0.013 (with a standard error of 0.003) for women and -0.031 (with a standard error of 0.004) for men.

[b]Results reported for combined sample of men and women.

[c]Results limited to women; specifically, single mothers entering Colorado's welfare system.

Notes: Standard errors are in parentheses. The results are as follows: Belfield (2015), Table 2 (full sample); Stevens, Kurlaender, and Grosz (2019), Table 5 (top panel), where short certificates are assumed to be 18-30 credits and long certificates are >30 credits; Jepsen, Troske, and Coomes (2014), Table 5 (columns 4 and 8); Bahr et al. (2015), Table 4; Liu, Belfield, and Trimble (2015), Table 6; Zeidenberg, Scott, and Belfield (2015), Table 2 (fixed effects); Bettinger and Soliz (2016), Table 3 (columns 1-2); Turner (2016), Table 2 (column 3) results converted to percentages using Table 1 means for pre-welfare earnings of mothers who enrolled in

college; Minaya and Scott-Clayton (2017), Table 2 (columns 3-4); Pan (2017), Table 3 (column 4); Carruthers and Sanford (2018), Table 2 (column 2); Dadgar and Trimble (2015), Table 2 (column d).
Bahr (2016) and Xu and Trimble (2016) are excluded because they do not report average earnings, so we cannot calculate returns as a percentage of average earnings.

The table illustrates substantial heterogeneity in returns by award and gender. In most, but not all, studies, the returns are highest for associate's degrees, followed by long certificates (called diplomas in some states), and then by short certificates, consistent with higher returns for a longer duration of study. Most studies find higher returns for women than for men.

The returns for associate's degrees are between 0.063 and 1.222 for women, with roughly half the estimates between 0.20 and 0.36. For men, the range is 0.021 to 0.423, with most estimates between 0.10 and 0.25.

For certificates, most of the estimates for long certificates are statistically significant at the five percent level (two-sided test). At the same time, a couple of studies contain estimated returns near or in excess of 0.40 for women, whereas only two studies have estimated returns above 0.20 for men. For short certificates, most of the estimates are not statistically significant from zero at five percent, with the exception of Turner's (2016) study of Colorado welfare recipients. That population realized higher returns to completing community college credentials than any other group represented in Table 3, suggesting that the benefits of postsecondary education may be especially pronounced for the neediest.

Thus, the results from the administrative data suggest that, for mature students, associate's degrees are associated with substantial earnings gains, whereas the results for certificates are less clear. More often than not, the completion of a long certificate results in higher earnings. These findings are broadly consistent with the findings from survey data, where most studies also find higher earnings for individuals completing vocational postsecondary awards.

Along with variation by state, the literature on returns to community colleges also contains substantial variation in methods. As mentioned previously, Jacobson, LaLonde, and Sullivan (2005a, b) allowed for the returns to community college to vary with time since enrollment.

Much of the most recent work, including Jaggars and Xu (2016),[13] Minaya and Scott-Clayton (2017), Carruthers and Sanford (2018), and Bahr (2016) also allow for time-varying returns to community colleges, although each study uses a different functional form for the time-varying effect. For example, Minaya and Scott-Clayton (2017) assume that the time-varying return is linear, whereas Bahr (2016) assumes that it is quadratic.

Another contribution from Jacobson, LaLonde, and Sullivan (2005) that has been adopted in more recent studies is the use of person time trends to add flexibility to the fixed effects model. For example, Dynarski, Jacob, and Kreisman (2018) discuss the advantages of including the person time trends, and they even show results from models with three different types of person time trends. They show that the earnings gains are sensitive to the inclusion or not of person time trends. In a sample of five community colleges in Michigan, the returns to associate's degrees are noticeably lower in the model that excludes person time trends. On a related note, Belfield and Bailey (2017b) discuss the appropriateness of fixed effects models, as well as testing their robustness to the definition of the sample (such as the length of the post-schooling period) and the treatment of time and potential interactions between time variables and student demographic variables. Recently, Turner (2016), Carruthers and Sanford (2018) and Stevens, Kurlaender, and Grosz (2019) include person time trends.

The student fixed effects model used in most studies of administrative data is a type of difference-in-difference model. Multiple papers in progress note potential limitations of difference-in-difference models when the timing of treatment varies across time (Abraham and Sun, 2019; de Chaisemartin and D'Haultfoeuille, 2019; Goodman-Bacon, 2019; and citations therein) These concerns are not directly applicable because the model introduced by Jacobson, LaLonde, and Sullivan (2005) and used extensively defines treatment as the quarter of enrollment or completion rather than by the calendar quarter. A useful avenue of future work is to investigate concerns of timing in this model. Jepsen, Mueser, and Jeon (2016) point out a very specific concern with models of returns to schooling when the post-schooling measure does not vary with time since schooling.

[13] Because Jaggars and Xu (2016) use a piecewise linear function, they do not report an overall or average returns and therefore are not included in Table 2.

In terms of sample, Carruthers and Sanford (2018) extend the use of administrative data to include a matching analysis involving workers who are not students, allowing them to quantify the earnings gain from enrolling without necessarily completing a certificate program. Cellini and Turner (2019) also use this technique in their study of for-profit colleges, and Turner's (2016) study of welfare recipients in Colorado similarly evaluates the return to enrolling in community college at all alongside any additional premium from attaining a credential. These three studies come to notably different conclusions about three very different populations of students. Turner (2016) finds no significant return to college credits in the absence of attaining a credential for welfare recipients, Cellini and Turner (2019) likewise find that for-profit students do not outperform those who do not enroll at all, whereas Carruthers and Sanford (2018) find evidence of significant returns for non-completers in certificate programs at public technical colleges.

Finally, it is worth noting recent developments in this literature. For example, Carruthers and Sanford (2018) look at the relationship between vocational postsecondary education and industrial mobility, finding that postsecondary certificates facilitate entrée to new and growing industries, particularly health. Similar, ongoing work by Pan (2017) studies firm-specific pay premia in community colleges.

Although we have focused our U.S. results on community colleges, for-profit colleges also provide vocational postsecondary education. For more information on for-profit colleges, including an overview of their labor-market returns, see the chapter in this handbook devoted to for-profits (Cellini, forthcoming).

International evidence on benefits to vocational education

Although Europe has institutions offering vocational education similar to certificate programs, little research has been done on these programs. Instead, the research typically focuses on one of two areas. As mentioned previously, one approach compares general education with vocational education, sometimes combining secondary and postsecondary education (Hanushek et al., 2017; Brunello and Rocco, 2017a, 2017b; Hampf and Woessmann, 2017). Focusing more on postsecondary vocational education, Dearden et al. (2002) use cross-sectional survey data for the UK. They point out that the higher wages for academic qualifications than for vocational ones can be explained by the longer duration of

study for academic qualifications; the wage gain per year of study is similar in the two sectors. McIntosh (2006) looks at multiple cohorts and finds similar wage differentials. Glocker and Storck (2014) use German Census data and a financial assets approach to compare earnings across fields of study. Although the highest returns are often for academic degrees, some vocational bachelor's degrees also have high returns.

The second approach uses detailed, individual data to compare labor-market outcomes between individuals with vocational postsecondary education and individuals with no postsecondary education. In Finland, researchers exploited an education reform upgrading vocational postsecondary education into vocational bachelor's degrees. Böckerman, Hämäläinen, and Uusitalo (2008) and Hämäläinen, and Uusitalo (2008) generally find short-run improvements in employment and earnings for graduates of the new program relative to the old system, using a difference-in-difference model based on the timing of the reform. Böckerman, Haapanen, and Jepsen (2018) apply matching and individual fixed effects models to show higher earnings of around 10 percent and employment of five percentage points for vocational bachelor's degrees relative to no postsecondary education. Using similar techniques, Böckerman, Haapanen, and Jepsen (2019) find that attending a vocational master's program in Finland is associated with an increase of earnings of seven percent for vocational bachelor's degree recipients. Hallsten (2012) and Rzepka (2018) find earnings and employment gains for individuals attending postsecondary education (academic or vocational) later in life in Sweden and Germany, respectively.[14]

In Canada, several studies report differences in earnings by education level, typically using OLS regressions on Census data (Boothby and Drewes, 2006; Caponi and Plesca, 2009; Boudarbat, Lemieux, and Riddell, 2010; Foley and Green, 2016). The two main findings from this literature are: (1) the receipt of postsecondary certificates or diplomas below the bachelor's level is associated with higher earnings of 10 to 15 percent compared to a high school degree, and (2) the gains have grown by as much as one third since 1980. Ferrer and Riddell (2002) find positive returns to both years of schooling as well as postsecondary vocational credentials.

[14] In each study, the author does not distinguish between academic and vocational postsecondary attendance (Rzepka, 2018) and degrees (Hallsten, 2012). Although Hallsten (2012) provides separate analyses for academic versus vocational *secondary* schooling, students often attend vocational postsecondary after attending academic secondary schooling.

The labour-market returns for vocational postsecondary education in Australia are mixed. Using OLS, Coelli and Wilkins (2009), Borland and Coelli (2016), and Polidano and Ryan (2016) find higher earnings and employment for individuals who receive vocational postsecondary credentials compared to high school graduates.[15] Lee and Coelli (2010) use matching estimators and show that diplomas are associated with higher earnings for men but not women, whereas certificates are unrelated to earnings for men or women. Using panel data with individual fixed effects, Coelli and Tabasso (2015) find little if any improvement in labor-market outcomes for mature students, but Polidano and Ryan (2016) find small increases in earnings and more substantial gains in full-time employment.

In contrast, the evidence for New Zealand is less promising. Using panel data and person fixed effects models (as in work with administrative data for Finland and the U.S.), Crichton and Dixon (2011) conclude that the receipt of certificates and diplomas below the bachelor's level do not lead to overall increases in employment or earnings. They find substantial heterogeneity by field of study and gender, with some fields associated with improved labor-market outcomes and others with declines. For individuals aged 15 to 21 who drop out of secondary school, Tumen, Dixon, and Crichton (2018) look at the relationship between labor-market outcomes and postsecondary education. Completing a certificate is associated with increases in employment, but earnings are not affected. Potential explanations for these findings are the high level of earnings for individuals without postsecondary education and the high percentage of individuals in postsecondary education relative to OECD countries (Norgrove and Scott, 2017)

The literature in Africa, Asia, and South America on returns to postsecondary vocational education is not very extensive. For Taiwan, van der Meulen Rodgers, Zveglich, and Wherry (2006) show that the earnings of community college graduates are 20 percent higher earnings than high school graduates and 20 percent lower than university graduates. In Thailand, Tangtipongkul (2015) finds higher earnings for vocational certificates and diplomas relative to secondary education. For Singapore, Sakellariou (2003) reports high private rates of return for vocational postsecondary education relative to lower levels of education. Kanjilal-Bhaduri

[15] For brevity, we limit the results on Australia to recent academic studies. See Polidano and Ryan (2016) for a review of earlier OLS results concerning vocational postsecondary education and labor-market outcomes in Australia.

and Pastore (2018) find high returns to both vocational and technical education beyond the secondary level relative to no postsecondary education in India.

Across many countries, time periods, and econometric techniques, vocational postsecondary education is often – but not always – associated with better labor-market outcomes relative to individuals without postsecondary education. The relationship is stronger in Canada and Europe, and it is weaker in New Zealand and Australia. One potential explanation for the relatively weaker labor-market benefits in New Zealand and Australia is that these two countries have income-contingent student loan schemes for vocational postsecondary education.

V. Other Research Areas for Vocational Education

Although the focus of this chapter has been on labor-market outcomes, there is a substantial literature on other aspects of vocational education. Here we highlight two areas of research. The first concerns the determinants of completion or progression. In the U.S., completion rates for community colleges are well under 50 percent. For students required to take remedial or developmental education, courses that do not count towards completion but merely prepare students to take college-level courses, the completion rates are much lower (Scrivener et al., 2015). Two recent random-assignment evaluations of a multi-faceted student support system called The Accelerated Study in Associate Program (ASAP) almost doubled the 2-3 year degree completion rate in studies in both New York (Gupta, 2017) and Ohio (Sommo et al., 2018), although even the improved rate is only 40 percent in New York and 19 percent in Ohio.

Other programs improve student success in community colleges, albeit not as dramatically. MDRC (2018) summarizes several studies of programs to improve completion rates. For example, advising programs such as InsideTrack or Opening Doors appear to be most effective when advisers are the ones initiating the contact with students as opposed to waiting for students to contact them. Another beneficial attribute of advising programs is when the students and the adviser form a cohort rather than having students working with different advisers. Encouraging students to take courses throughout the year, such as summer courses and, if available, the intersession between fall and spring terms, is associated with increased persistence and completion. The preliminary results from programs to change teaching

practices, such as Dana Center's Mathematics Pathways and CUNY Start, are promising in terms of improving student outcomes. In contrast, providing students with computers has no discernable effect on earnings (Fairlie and Bahr, 2018).

A complementary body of research looks at specific elements of the education system (as opposed to additional supports). For example, Xu and Jaggars (2013), Hart, Friedmann, and Hill (2018) and Kozakowski (2019) study the relationship between on-line course-taking and student achievement in community colleges, where they find similar if not worse outcomes for students taking courses on-line. Similarly, Bettinger et al. (2017) find no benefits to smaller classes in online courses. The relationship between remedial education and educational achievement is mixed. Martorell and McFarlin (2011) and Boatman and Long (2018) find no relationship between remedial education and either academic or labor-market outcomes for students at the margin of needing remediation. For lower achieving students, Boatman and Long (2018) find some evidence of a positive relationship between remediation and achievement, a finding similar to Bettinger and Long (2009) in an analysis using instrumental variables based on differences in remediation policy across colleges as well as proximity to college.

Outside the U.S., Colding (2006) looks at determinants of dropout from vocational secondary schools in Denmark. The focus is on difference between natives and the children of immigrants. Family background variables and field of study do not explain the gap in dropout rates between the two groups. Stratton et al. (2018) look at the determinants, with a focus on non-cognitive as well as cognitive skills, of enrollment and completion in vocational education in Denmark.

The second area of research is the role of financing and debt. Elsewhere in this volume, Ionescu (forthcoming) looks at student loans and repayment. Page and Scott-Clayton (2016) also provide an overview of the role of financial aid in college access, although most of the studies reviewed are for academic rather than vocational institutions. Utilizing geography-based variation in community college costs, Denning (2017) finds that lower cost is associated with increased enrollment.[16] Liu (forthcoming) finds that extending Pell Grant

[16] In ongoing work, McFarlin, Martorell, and McCall (2017) and McFarlin, McCall, and Martorell (2018) also find increased college attendance and attainment when students face lower costs.

eligibility is associated with increased summer enrollment as well as increased completion rates. Anderson and Goldrick-Rab (2018) find no increase in completion for community college students randomly assigned to a grant program. Similarly, Welch (2014) finds no relationship between merit aid and academic outcomes or earnings for community college students at the margin of receiving aid. Scott-Clayton and Schudde (forthcoming) highlight an understudied feature of aid programs, namely the requirement that, to continue receiving aid, students have to make adequate academic progress. They note that the short-run effects are heterogeneous, with some positive and some negative, but that the long-run effects of failing to meet adequate progress, and therefore losing access to aid, are negative.

A related area is the recent rise of promise programs in the U.S., where public or private funders provide a promise of making postsecondary education free for students in a certain geographic area. For example, Carruthers and Fox (2016) and Bartik, Hershbein, and Lachowska (forthcoming) show improvements in enrollment in response to the decrease in costs resulting from the promise programs. As of 2018, there were 15 active and 16 proposed statewide promise programs, and there are even more local level programs (Jones and Berger, 2018).

Finally, a few programs have tried alternate ways to provide community college students with financial assistance. For example, Aid Like a Paycheck is a program that disbursed financial aid every two weeks rather than a lump sum payment. Although the program reduced short-term debt among students, long-run outcomes for debt and student achievement were similar to the control group (Weissman, Cerna, and Cullinan, 2019). Another randomized experiment provided performance-based scholarships of up to $1,500 per term. These scholarships reduced debt and had modest improvements in five-year completion rates (Mayer et al., 2015).

Aside from the two studies for Denmark mentioned above, we are unaware of other studies outside the U.S. focusing on non-labor-market outcomes for vocational education.

VI. Synthesis

Is vocational education out of balance with general academic education? Is vocational education better as an integrated or segregated program? The answers are not obvious from

our review, and likely differ by time and place. One common thread connecting several studies is the idea that endogenous take-up of vocational education benefits the students who select into it. The default model of economic choice holds that people generally make good choices, provided they have enough information about the alternatives and enough resources to access the alternatives. Although educational choices are rife with exceptions to these priors, our review of research on vocational education indicates that they may have merit in this context. Given the opportunity to deepen knowledge in a given CTE program, students who chose to do so appeared to benefit (Kreisman and Stange, forthcoming). Given the random or as-good-as-random opportunity to attend a vocational school, students who chose to do so likewise saw higher graduation rates and higher earnings (Kemple and Willner, 2008; Dougherty, 2018; Hemelt, Lenard, and Paeplow 2019; Silliman and Virtanen, 2019). Nontraditional adults choosing to go back to college to pursue predominantly vocational certificates or degrees saw higher earnings than similar workers who did not re-enroll (Turner, 2016; Carruthers and Sanford, 2018).

Yet, students who attained more or less vocational education because of quasi-experimental changes in graduation requirements (Kreisman and Stange, forthcoming) or national policies that shifted time spent in vocational versus general education (Oosterbeek and Webbink, 2007; Malamud and Pop-Eleches, 2010, 2014; Hall, 2012, 2016; Zilic, 2018) saw earnings on par with the counterfactural, or worse (Hanushek et al, 2017). In that light, students may benefit from choosing what subjects they wish to study, whether they have the opportunity to do so within an integrated high school system or a dedicated vocational or academic school.

At the postsecondary level, most studies find a positive relationship between obtaining an award such as a certificate or degree relative to not obtaining degree or, in some cases, not attending postsecondary education at all. The finding that longer programs have more benefits than shorter programs is consistent with the returns to program depth documented in secondary schools (Kreisman and Stange, forthcoming).

Yet completion rates in U.S. community colleges are quite low, and several studies investigate potential mechanisms to improve retention and completion. Comprehensive student support programs such as ASAP show substantial improvements, whereas programs that target specific mechanisms show more modest increases. Other factors, such as on-line course taking or providing computers to students, do not appear to increase completion rates.

Thus, the research base implies that, to make dramatic improvements in community college completion rates, multi-faceted approaches are needed.

VII. Conclusions and Areas for Future Research

Despite the extensive and burgeoning literature on vocational education, many fruitful areas for future research remain. Data and empirical methods are better suited than ever to revisit early 20th century debates on the merits and modes of vocational education that have persisted to this day. One concern, now over a century old, is that an education in narrow skills leaves a student vulnerable to future technology shocks. In Lazear's (2009) model of skill-weighted human capital, more idiosyncratic skill mixes result in larger wage losses when the labor market thins. On this topic, Dewey (1915/1977) wrote that:

> The mobility of the laboring population in passing from one mode of machine work to another is important. Such facts cry aloud against any trade-training which is more than an incidental part of a more general plan of industrial education. They speak for the necessity of an education whose chief purpose is to develop initiative and personal resources of intelligence. The same forces which have broken down the apprenticeship system render futile a scholastic imitation of it.

These "forces" were technological advancements from the U.S. industrial revolution and increasingly low-skilled, specialized labor tasks, alongside the need for employers to mobilize or turn over their workers to meet successive technologies. Today's disruptive technology – automation in particular – resembles the disruption created by the industrial revolution, which contributed to the demand for vocational education in public schools as well as the expansion of high school enrollment.

Indeed, the intervening hundred years between Dewey's time and ours have been filled with several new waves of automation and technological efficiencies that required workers and schools to keep up in what has been called a "race between education and technology," which technology has dominated since the 1970s (Goldin and Katz, 2009). In response to a perceived "skills gap" between the supply of and demand for new technical skills, there are renewed calls for vocational education suited to today's technology and echoes of Snedden's

social efficiency doctrine holding schools (and to a lesser extent, firms) responsible for producing workers who can dive right in and re-tool as needed (e.g., see Tyagarajan, 2019). Echoing Dewey's counterpoint to this urgency, however, are sentiments such as this:

> [T]here are no short cuts to cultivating the habits of the mind and heart that, over time, enable people to deepen their learning, develop resilience, transfer information into action, and creatively juggle and evaluate competing ideas and approaches. (Kuh, 2019)

The answerable research question at the heart of this debate is: Are short-term gains from learning a narrowly applicable mix of skills offset by longer-term losses and vulnerabilities to economic or technological shocks? More research in the vein of that by Hanushek et al. (2017) would shed light on this critical issue and help to guide education and labor policy through the economic transitions to come.

Another debate of a similar vintage is about the form rather than the volume of learning about work. How is vocational education most effective: as a complement to general education, or as a distinct program? At the secondary school level, many studies have exploited national or regional changes in years of compulsory schooling or the age at which tracking begins as a way to identify exogenous changes in dedicated vocational schooling. That literature shows that such expansions have weak if any effects on subsequent labor-market outcomes, although it is not yet clear if these findings will generalize to less sweeping, more individual shifts between vocational education structures. New and promising insights on this question come from recent studies of plausibly exogenous circumstances where students are offered the chance to pursue vocational study in a dedicated environment (Kemple and Willner, 2008; Dougherty, 2018; Hemelt, Lenard, and Paeplow 2019; Silliman and Virtanen, 2019). This small and growing literature has generally found that students benefit from such an environment, although it bears repeating that results are limited to students who indicated interest in vocational education by applying to specialized schools.

In systems where most students choose between general and vocational subjects in the same secondary school, more research is needed. Kreisman and Stange (2019, forthcoming) provide a valuable starting point with a careful analysis of individual transcripts, using

extensive control variables and econometric techniques to compare selection on observables versus unobservables. Ideally, future work can continue to draw causal inferences from exogenous changes in vocational education, perhaps at the school or district level, to advance what we know about the effects of vocational education on educational and labor-market outcomes.

As we think about how to adopt vocational and general education in an ever-faster changing technological environment, policymakers will perpetually re-evaluate the purpose of vocational education. Is the primary goal for students to grow their intellect and capacity to meet new technologies *without* retraining? Or is that an impractical aspiration? Would students be better served by learning specific skills for the current and projected job market? Future research, especially given recent advances in data quality and quantity, should be able to address which style of learning benefits students more, in both the short term and over the course of their careers.

Perhaps the most fruitful area for further research on vocational education is in developing countries. Data availability in developing countries lags behind that of the U.S. and Europe, but public and economic interest in vocational education is high. International organizations such as UNESCO lift up vocational education is a needed tool for economic growth and development, although the causal evidence base for this hypothesis is thin. There are great opportunities for new work on vocational education, attainment, and labor-market returns in a developing economy. The extent of research in the development economics literature more broadly has increased dramatically, largely due to an explosion in the use of randomized control trials. Again, in an ideal world, the outcomes of some of these experiments in primary education could be linked to data on secondary education, including the choice of vocational, general, or no secondary schooling. In other words, could these experiments generate exogenous variation in secondary school choice allowing researchers to study the effects of vocational secondary schooling in a developing economy context?

An alternative, although also unlikely to occur anytime soon, is to apply some of these methods to study effects of vocational education. An example is a school construction project for vocational secondary schools (assuming there is a shortage), akin to construction projects in Indonesia (Mazumder, Rosales-Rueda, and Triyana, 2019; Duflo, 2001, 2004) and Burkina Faso (Kazianga et al., 2013). However, as noted in Filmer (2007), benefits of school

construction are often small, particularly if the quality of the new school and of existing schools is low. Another example is to utilize lotteries if vocational secondary schools are oversubscribed, although the data requirements for such a study are substantial.

At the postsecondary level, at least two promising areas of future research exist. The first is to see more high-quality studies using administrative data outside the U.S. A few studies exist for data in Northern Europe, but even these studies focus on high levels of vocational schooling, namely vocational bachelor's and master's degrees. However, most countries offer lower-level degrees analogous to community college certificates, yet little is known about them.

A second, and related, area of future research is to better understand the determinants of completion for vocational postsecondary programs. Although, as mentioned previously, there are several high-quality studies, often using randomization, on areas such as advising, student support, and financial incentives, most of the participants are pursuing associate's degrees, often in academic subjects. Much less is known about ways to improve completion rates for certificates and vocational associate's degrees, despite low completion rates in these areas. For example, Carruthers and Sanford (2019) report a completion rate of 10 percent for certificates and 26 percent for diplomas (known as long certificates in some states), whereas completion rates for certificates and diplomas are even lower in Kentucky (Jepsen, Troske, and Coomes, 2014) and Michigan (Dynarski, Jacob, and Kreisman, 2018).

Finally, circling back to the economic and non-economic aims of education, more research is needed on the effect of vocational education on outcomes other than one's own attainment and earnings. Does vocational education affect engagement with school at the secondary level, for example, as measured by absences, grades in other subjects, discipline, peers, or extra-curricular activity? Does vocational education at any level affect financial and employment stability, family formation, health and disability, or the take-up of public benefits from the social safety net? We are just beginning to understand how a more narrow, targeted, and middle-skilled education can affect an individual relative to their cohort, but the promise of vocational education for long-term, intergenerational upward mobility remains largely untested. For students on the bottom rungs of the socioeconomic ladder, can vocational education propel them (and their children) upward, or hold them in place?

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