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Patterns around the world from 1950-2010**

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New Variables for Vocational Secondary Schooling: Patterns around the World from 1950-2010*

Alison Cathles[†]

Abstract

Projections in Europe and the United States suggest job vacancies will soon be concentrated in positions that require vocational training. This has spurred policy discussions about how vocational education can optimally complement or substitute for general education and highlighted the need to understand more precisely how the mix of skills in a workforce impacts economic growth. Macroeconomic growth literature has traditionally incorporated measures for human capital based on the length of time spent in educational institutions. The need to measure the skills acquired through different kinds of education has been appreciated. Specifically, the insights that might be obtained by comparing the macroeconomic growth of countries with different amounts of vocational education has been apparent, but the long-time series of internationally comparable data required has not been readily available. This paper fills this need by presenting consistent data on Vocational Secondary Schooling at five-year intervals from 1950-2010 for 129 countries. These data are constructed on the basis of existing UNESCO enrolment data and measures of secondary schooling from Barro and Lee. This paper describes both the methods used to construct the internationally comparable vocational secondary education variables and regional trends over the past 60 years. Separating education by type, vocational and general, is a first step toward better linking the *educational purpose*, at least in terms of workplace skill development, with *economic results*. The data are fully presented in the Annexes in tables ([available here](#)), so that they can be used by others to empirically investigate questions related to vocational education and economic growth.

Keywords: Vocational Education • Education and Economic Development • Human Capital • Skills

JEL Classification Codes: I25 • J24 • 010

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Introduction

Despite recent projections of job and wage growth in occupations that require vocational education¹ and general assumption in policy circles that vocationally trained workers play an important role in the economy², empirically, little is known about the contribution of this type of educational formation to macroeconomic growth. This gap in the macroeconomic literature stems from data constraints – which, among others, include the lack of a long-time series that are comparable across countries (Sianesi and Van Reenen, 2003). We do not know whether vocational education formation is more (or less) important at different stages of economic development.

From the *catching-up* angle, vocational formation is acknowledged as important for absorptive capacities and technology diffusion (Toner, 2010; Tether, 2005). Absorptive capacities are conditions for the successful adoption and diffusion of a new technology (Cohen and Levinthal, 1990). Absorptive capacities are also related to the social capabilities and conditional convergence as described by Abramovitz (1993), both of which are particularly critical for developing economies. In matched plant studies in advanced economies, vocationally trained mid-level technicians on the shop floor have been identified as important for manufacturing innovation. Mid-skill technicians who had a mixture of general theoretical and applied training in Germany could be trusted to work the kinks of the new technology out on the job; whereas British managers had to introduce new technology that was ‘bug free’ because of weaknesses on the shop floor (Tether et al., 2005). From this perspective, vocational education may be particularly relevant after the introduction of a new technology.

From the *employment* angle, the influence of technological change could have a ***dynamic effect*** on the demand and supply of mid-skill vocationally educated workers and current measures of human capital are not sufficiently disaggregated along the distribution of tasks in the workforce to assess how skills contribute to productivity (Acemoglu and Autor, 2010). Distinguishing between *types* of educational formation in human capital in cross country comparisons may better capture the ‘educational skill’ to ‘workplace task’ relationship and have important implications for our understanding of international variations in economic output.

From the *relative skill mix* angle, Empirical evidence at the national and sub-national levels finds that returns to government support for different types of human capital development (vocational versus academic) vary with mobility of the graduates and distance to the technological frontier (Moretti, 2012; Vandenbussche, Aghion & Meghir. 2006). These findings are important for considering how to frame the analysis of relative contributions of different types of education; the benefits may depend on how far the country is from the technological frontier and could be couched by the relative allocation of public investment in each type of education.

¹ In 2010, the European Centre for the Development of Vocational Training (CEDEFOP) determined that, in Europe, ‘Technicians and Associate Professionals’ are expected to experience the highest amount of real growth (expansion demand) from 2010-2020. Similar projections have been released by the Occupational Outlook Handbook by Bureau of Labor Statistics in the United States, where the agency anticipates hundreds of thousands of jobs openings that require Vocational Education and Training (VET) and the salaries posted are generally higher than average per capita income.

² Several reports have been generated calling for ‘the right skill mix’ in the population so that employers and society will benefit. Often - vocational, technical or middle skills are the centre of attention in skill-mix (UNESCO, 2013; OECD, 2010; CEDEFOP, 2010; European Commission, 2010; Brookings, 2009).

The aim of this paper is to construct a dataset of Vocational Secondary Schooling variables that can be used to empirically investigate the role of vocational education in economic growth from all of the angles described above. The time series builds on existing measures of Secondary Schooling and Vocational Enrolment data to create a proxy for vocational education at the secondary level for 129 countries more than half a century³ (from 1955 to 2010). The data are presented at 5-year intervals for the population aged 25 and over. Before introducing the variables, Section 1 briefly defines vocational education and outlines measurement challenges. Section 2 describes the construction of the Vocational Secondary Schooling variables, the data sources that were used, and caveats with respect to the consistency and validity of the constructed measure. Section 3 presents a descriptive assessment of changes over time in vocational secondary schooling around the world focusing on differences between and within regions. The full data by country and year are included in Annexe 5 and can be used to explore how the share of vocationally trained human capital interacts with other variables affecting economic growth and diffusion of frontier technology at different stages of economic development.

Section 1. Defining and Measuring Vocational Education Training (VET)

The following definition provided by the OECD, will be used in this paper: “*Vocational education and training (VET) includes education and training programmes designed for, and typically leading to, a particular job or type of job.*” (2010, page 26). VET may include general theory as part of the curriculum, but it is distinct from academic education that is broadly applicable to many different kinds of jobs. Although educational training for doctors or lawyers meets the definition above, training for those occupations is usually not regarded as VET (OECD, 2010). One empirical issue that immediately arises in a cross-country assessment of VET is that education systems and VET programmes vary in terms of their organisation and structure as well as the distribution of general and specialized training (Kuczera, 2008). Some countries have separate institutions for vocational training, while in other countries general and vocational education are delivered at the same institution, and some countries have a mixture of separated and combined educational institutions.⁴ Bridging these differences for the purposes of gathering internationally comparable data is the International Standard Classification of Education (ISCED), which works to establish internationally agreed upon definitions and classifications which are then carefully implemented through a standardized data collection process that is guided by detailed operational instructional manuals (ISCED, 1997).

³ Recent empirical research on the effects of secondary education on economic growth at the macro level reveal long time horizons are important for capturing societal returns to education (Marconi, 2015).

⁴ These structural differences in vocational education delivery systems in different countries poses a challenge, because if administrative tracking of the two types of education at the national level differs widely from international standards, it could influence how the data are reported to UNESCO. For example data on vocational education at the secondary level for the United States are reported as missing, but this does not mean that there is no vocational secondary education at the secondary level. Furthermore, the distinction is not merely an administrative distinction, but typically can imply distinction between: institutions, teachers, coursework and/or curricula. It is fair to say that countries with more financial capacity to support two types of systems might be more likely to do so, and that may indeed be why we see that advanced economies have the greatest proportion of vocational education in both 1955 and 2010 (see Table 8 on pages 17 and 18). These results, however, may have been different if we could have included data for the United States and Canada (in 2010). Comparisons between countries within regions (see the maps on pages 23 & 24) show that countries that have greater proportions of vocational education can be wealthier and/or poorer (measured by GDP per Capita in PPP) than neighbouring countries with smaller proportions of vocational education, indicating that proportions of vocational education is not *strictly* a function of the wealth of a nation.

Annexe 1 illustrates the demarcation and educational trajectories at different levels of schooling according to the ISCED 1997 classification which includes programme orientation (general, vocational, pre-vocational) and programme duration.^{5,6} UNESCO is the institution that maintains and follows the ISCED statistical framework. Although the classification changes that occurred in 1997 provided new demarcations between general versus pre-vocational and vocational education, fortunately, the pre-1997 data used in this paper were collected and reported separately by type of education (see pages 3-4 for definitions of vocational and general enrolment measures used in the 1969 UNESCO Statistical Yearbook). As can be seen from the UNESCO 1969 definition of vocational education and from the ISCED 1997 classification in Annexe 1, the main distinction between vocational and general education is related to subsequent destination, or educational pathway. In the case of vocational education, the next destination is usually the labour market or, possibly a higher level of educational training. The vocational pathway to the labour market is usually more direct than the general pathway. Under the definitions being used in this paper, technical education is then a sub-set of vocational education. The proportion of technical to vocational education may vary by country.⁷

The vocational variables introduced in this paper are at the **Secondary level of education**. Although vocational education clearly extends beyond secondary to tertiary education levels, very low levels of tertiary attainment across all countries and regions in the early part of the period covered in these data⁸ led to a focus on vocational education at the secondary level. Future work could involve the construction of a similar set of vocational variables at the tertiary level.

Section 2. Construction of the Vocational Secondary Schooling Variables

Data Sources: The sources of data that were used in the construction of the Vocational Secondary Schooling variables were as follows: UNESCO's 1969 and 1999 Statistical Yearbooks and the online UNESCO Institute for Statistics (UIS) database⁹ were used to build a ratio of vocational to total secondary enrolment for each country at 5 year intervals. This ratio was then applied to the proportion of each country's population with secondary attainment¹⁰ and the corresponding component of years of schooling attributed to secondary education for each period using data from Barro and Lee (2013).

The following enrolment data from the **UNESCO 1969 and 1999 Statistical Yearbook**¹¹ were digitalized:

⁵ UNESCO has done the groundwork to maintain the ISCED statistical framework in a consistent manner over time. The ISCED 1997 maps onto ISCED 1976, which maps onto the ISCED 1958. It is important to bear in mind that although these classification systems map onto each other, there may be some differences in the data (reporting or recording) due to changes in the classifications.

⁶ The most recent ISCED classification is 2011, but this classification was not in place for the data used in this paper, which end in 2010.

⁷ An example of the distribution of VET between technical and all other vocational education for the Netherlands is highlighted in section 2.2.

⁸ In 1950 the proportion of the population who attained tertiary levels of education is, on average, less than 0.5% in South Asia, less than 0.3% in Sub-Saharan Africa, and only a little over 3% in Advanced Economies.

⁹ Accessed October, 2015.

¹⁰ This broad attainment category does not represent completed secondary education. This is the fraction of the population that reached secondary school (i.e., did not terminate education after primary school).

¹¹ Table 2.10: 'Education at the second level: general, vocational and teacher training: Teachers and pupils'.

- (a) The total number of pupils in General Education at the second level for all of the years available (most commonly: From the 1969 Yearbook - 1950, 1955, 1960, 1965, 1966, and 1967; from the 1999 Yearbook - 1970, 1975, 1980, 1985, 1990, and 1995).
- (b) The total number of pupils in Vocational education at the second level (most commonly: From the 1969 Yearbook - 1950, 1955, 1960, 1965, 1966, and 1967; from the 1999 Yearbook - 1970, 1975, 1980, 1985, 1990, and 1995).

For both of these types of education at the secondary level, these data include both public and private education (UNESCO, 1969). UNESCO defined the separation of the two types of education as follows:

“General education. Data presented under this heading cover academic secondary schools and academic secondary classes attached to institutions at other levels. Some vocational education may be included since a number of schools in certain countries offer courses combining the academic and vocational types of education...¹²”

“Vocational education. Data presented under this heading cover all vocational education at the second level, e.g. technical, industrial, arts and crafts, trade, commercial, agriculture, fishery, forestry, domestic science, music, fine arts, etc., provided in vocational schools as well as in departments and classes attached to institutions whose main concern is education of other types and/or levels. Correspondence courses have generally been excluded, but various part-time course, sometimes of very short duration, are included...¹³.¹⁴ Teacher training is not included.¹⁵

Since the borders of some countries have changed since the 1950s, detailed notes about the decisions made regarding data entry have been recorded in Annexe 2.

From 2000 onward, the **online UNESCO Institute for Statistics (UIS)** data are used:

- (a) Enrolment in total secondary. Public and private. General programmes. Total
- (b) Enrolment in total secondary. Public and private. Technical/vocational programmes. Total

¹² “...Primary classes attached to secondary schools have been excluded as well as evening schools and correspondence courses whenever this is feasible. While the enrolment figures refer in principle to full-time students only, the number of teachers includes both full-time and part-time teachers, excluding, however, instructional personnel, etc.). For international comparisons, this table should only be consulted in conjunction with Table 2.1 (Compulsory education and range of education at the first and second levels...) as the data presented here are affected by the duration of general education at the second level, which varies from country to country depending on the criteria applied by each in classifying education as first or second.”

¹³ “...It should be kept in mind that the proportion of part-time teachers as well as part-time students is particularly important here and the available information does not allow a clear delimitation in this respect. Generally it can be stated that in most cases where the number of teachers in relation to the number of students enrolled seems disproportionately high, or vice versa, this is due to the fact that either the figures referring to teachers or those referring to students concern mainly or wholly part-time tuition.”

¹⁴ Figure 1 presents a diagram for the Netherlands illustrating the country’s educational pathways in 1950. Table 9 in Annexe 3 presents the Netherlands 1971 census data and these numbers have been summarised in Table 2 to show the distribution of VET versus general education in the country in 1971.

¹⁵ Although the third education type ‘Teacher training’ also recorded in UNESCO 1969 would definitely be considered by the definition being used in this paper as vocational education, the enrolments recorded under teacher training have not been added to the vocational enrolments. This is because of the complication, that over time most of the offering for teacher training at the second level shifted to the third level and was discontinued at the second level (UNESCO 1969). Since this transition was happening at different times for different countries (described in footnotes UNESCO (1969 and other statistical yearbooks)), including enrolments in teacher training at the secondary level seems to risk violating internal consistency and has therefore been excluded.

The **Barro and Lee 2013 data set** of educational attainment in the world from 1950 to 2010 relies almost exclusively on UNESCO data,¹⁶ which draws on respective country's National census data as a primary source. From the Barro and Lee 2013 data set the following variables are used:

- (a) The proportion of the population over age 25 that has attained secondary schooling (called `ls` in the data set). This is the broadest Barro and Lee data category for the secondary level, because it includes both lower and upper secondary school (completed and incomplete).
- (b) The contribution of the fraction of the population that attained secondary schooling to the overall average years of schooling in the whole population over the age of 25¹⁷ (called `yr_sch_sec` in the data set).

The advantage of using Barro and Lee's dataset as a starting point is threefold. First, because they draw primarily from UNESCO data, the international standardisation of the distribution of education attainment and the type of enrolments has been conducted by the same entity (UNESCO) using UNESCO's International Standard Classification of Education (ISCED). Second, the Barro and Lee data set builds on the available data in UNESCO statistical yearbooks by filling in missing values with forward and backward extrapolations on attainment by age group (when available) and adjusts for completion rates and different mortality rates among more or less educated populations in countries at different stages of economic development (Barro and Lee, 2013). Third, Barro and Lee's measure for years of schooling is widely used in empirical research at the macro level.

Using the existing measures has advantages, but clearly, any measurement errors in either the enrolment or schooling data are incorporated in the vocational variables presented here.

2.1 Building the Vocational Secondary Schooling variables

Variable 1 - Vocational to Total Secondary Enrolment Ratio¹⁸: The first variable was created by building a simple ratio of vocational to total secondary enrolments at the secondary level using data from UNESCO (1969, 1999 and UIS) at 5-year intervals. To fill in missing data, linear interpolation and extrapolation were used. For some countries that were missing a lot of data over the full time period (1950-2010), these extrapolations and interpolations could stretch over long-time periods. Therefore, a decision rule was introduced to limit the number of years over which the data could be extrapolated or interpolated. The maximum threshold was set at 2 time periods, which represents 10 years at the beginning or end of the time period for extrapolation, or 15 years in the middle of

¹⁶ With the exception of Slovenia and Taiwan, the secondary source in Barro and Lee's data appendix is listed as UNESCO Statistical Yearbook (from various years) UN Demographic Yearbook (from various years) or UNESCO Global Education Digest (from 2005).

¹⁷ Once Barro and Lee (2013) determine the distribution of educational attainment at 4 broad levels (no formal schooling, primary, secondary and tertiary) for each 5 year age cohort (i.e., 25-29, 30-34...70-74 and 75+) they calculate the fraction of the cohort that attained each educational level and multiply that fraction by the duration (in years) for schooling at that level in that country. They sum these years of schooling for each cohort and then weight it by the cohort's population. This is done for each of the cohorts for which they are able to have information about educational attainment and finally summed to equal the total years of schooling in the population for a particular year.

¹⁸ Bertocchi and Spagat (2004) constructed a similar ratio [although their ratio is Vocational to General secondary, not Vocational to Total secondary] using UNESCO data from 1950-1991. They touch on the potential role of this variable in its relation to technological change, wages and economic development, but as they admit, they move quickly to the issue they are more interested in researching, which was socio-political in nature (Bertocchi and Spagat, 2004). To check the comparability between the Bertocchi and Spagat ratio and the ratio constructed here, the data they present from Italy, follow a very similar pattern although when calculating their ratio with the UNESCO data used here, in 1990, they report a ratio of 0.71 and my calculations of vocational/general (using the UNESCO data from the 1999 Statistical yearbook, I arrive at 0.65), as mentioned the overall pattern in their plot from 1950 to 1990 is almost an exact match with the pattern I find if I calculate the ratio following their methodology.

the time period for interpolation. After the threshold was reached, the data were then treated as missing and were not used for any further calculations.¹⁹

Variable 2 - Vocational Secondary Attainment: The ratio at time (t) was then applied to the share of the population 25 years or older with secondary level educational attainment (from the Barro and Lee data) in the subsequent time period (t+5). The enrolment ratio data are available starting in 1950, so the first period in which the ratio can be used to infer vocational attainment at the secondary level is in 1955. Since Barro and Lee's secondary school attainment²⁰ data are not disaggregated by vocational education, this is one approach to inferring vocational attainment based on the proportion of enrolments in the previous period.²¹

Variables 3 and 4 - Vocational Secondary Years of Schooling: The Vocational to Secondary Enrolment ratio has also been applied to the secondary component of years of schooling (also from the Barro and Lee data). This calculation may be less accurate. Barro and Lee have spent years adjusting completion ratios and mortality rates (which differ (a) among countries and (b) with education levels and age) for the variable 'Years of schooling'. So, by inferring the ratio vocational enrolments onto the component of years of schooling attributed to the secondary level²² a big assumption is being made; namely, that there are no unobservable differences (for example in commonly cited attributes that might affect education attainment - either in ability or family background (Hanushek et al.,2013)) that would systematically alter either (a) the completion rates of vocational versus general education and (b) the mortality rates of people with vocational versus general education. Bearing in mind these caveats, two potential approaches have been tried. The first uses the same method implemented to calculate the proportion of Vocational Secondary Attainment, and simply applies the Vocational / Total Secondary Enrolment Ratio from the prior period (i.e. 5 years prior) to the component of 'years of schooling' that Barro and Lee attribute to Secondary Education. The second approach involves the incorporation of a uniform duration of 3 years for vocational training for all countries for all time periods which is then applied to the proportion of the population with vocational Secondary Attainment. The second approach follows the method used in Barro and Lee (2013) who applied a standard duration of 4 years for higher education to the proportion of the population with that level of attainment.

In order to check the validity of the construction of the Vocational Secondary Schooling variables, an illustrative example will be described in detail with just one country - the Netherlands.

¹⁹ In the country tables in Annexe 5, the Vocational to Total Secondary enrolment ratio is presented with a column immediately to the right which indicates whether the data have been extrapolated or interpolated. In addition 2 alternatives for filling in data over the entire time period are presented in the columns at the far right of the table; the first of which is the fully extrapolated / interpolated values for the Vocational to Total Secondary ratio, which are then only removed (and presented as missing) if the extrapolations went to zero or became negative.

²⁰ The educational attainment data in the UNESCO tables (which were used by Barro and Lee as primary sources) are also not disaggregated by vocational education at the secondary level.

²¹ In fact, Barro and Lee (2013) mention in their appendix A.1.2 that they do this for the younger age groups (15-19 and 20-24), since they have missing attainment data, they use the "...enrolment data to estimate missing attainment data. [They] assume that the change in enrolment leads to a proportional change in attainment over time" (Barro and Lee, 2013, pg. 194).

²² As you can see, in Tables 6, Barro and Lee use the distribution of educational attainment to generate 3 components; Primary ('yr_sch_pri'), Secondary ('yr_sch_sec') and Tertiary ('yr_sch_ter') which are then summed to determine the overall years of schooling 'yr_sch' for a given country in a given year. Only the Secondary component will be used in the calculations in this paper.

2.2. Illustrative Example, the Netherlands

Checking the validity of the construction of the Vocational Secondary Schooling variables entails recovering the data behind the data. The Netherlands is a good example to use, because the census data have detailed breakdown of vocational attainment at the secondary level. The year 1970/71 is used because, that was the last year for which census data were collected in the Netherlands.²³

This example is intended to elucidate (1) how UNESCO constructed the data found in their tables from the Netherlands Census data, and (2) how Barro and Lee constructed their data on the distribution of educational attainment from the data tables found in UNESCO Statistical Yearbooks. Checking these two elements with the educational attainment reported by the Netherlands census data will help verify whether the constructed variable is measuring what we actually want to measure.

Matching Data from UNESCO with Netherlands Census Data

The data on Educational Attainment in the Netherlands in 1970 that appear in UNESCO's 1991 Statistical Yearbook^{24,25} are exactly as follows:

Table 1. UNESCO Educational Attainment Data: Netherlands 1971, Population 25+

<i>Highest Level Attained (%)</i>					
No Schooling	First Level		Entered Second Level		Post- Secondary
	Incomplete	Complete	S-1	S-2	
-	47	----->	36.7	9.1	7.2

Source: UNESCO (1991).

Notes: S-1 = First Stage; S-2 = Second Stage; '----->' means that the figure to the immediate left includes the data for the column(s) in which this symbol appears. The data signify the proportion of the population that reached a particular level of schooling and do not make it possible to distinguish between complete and incomplete.

Table 2 shows how the Netherlands census data reports the education levels attained for the population over the age of 25 in the Netherlands in 1971. The percentages in the grey column 'MF% of Pop 25+' are calculated for each level (in bold) and sub-level (in italics) and the sub-levels sum to the total of the level.^{26,27} At the Extended Lower Level and Secondary Level, there is a sub-level indicating general education and several sub-levels indicating vocational education. The black column 'Vocational' shows the sum of the sub-levels by each broad level (Extended Lower Level and Secondary Level) and provides an overall total at the secondary level in the bottom right corner. As noted, these calculations exclude the population that was listed in the census data as 'level

²³ Due to citizen resistance, 1971 was the last year for which census data were collected in the Netherlands: http://www.volkstellingen.nl/nl/onderzoek_literatuur/new_0/powerpoints/powerpoint_luuk_iassist2003/index.ppt.

²⁴ From Table 1.4 'Percentage distribution of population 25 years of age and over, by educational attainment and sex' for the Netherlands in 1971.

²⁵ Although these data are from 1971, the UNESCO Statistical Yearbooks from 1970-1980 were checked at the Royal Library in the Hague and none of those yearbooks report these data; the 1991 yearbook in the UNU-MERIT library was the first accessible yearbook that reports the 1970 data from the Netherlands.

²⁶ This is true except for the 'Higher Level' for women - the sum of the sub-levels is off by 10, but these numbers are not used for the purposes of this paper. There were some other instances in the Netherlands census data where the sub-totals did not sum exactly to the totals that were recorded in the census tables, but there was never a difference that was greater than 20 people and most of the time the numbers were just off by 5.

²⁷ For example, for Men, the 'Extended Lower Level' is the sum of the subsequent 'w.v. general education', agricultural education, technical, and other vocational.

unknown'. For reference, the full census tables for these Netherlands data can be found in Annex 3.

Table 2. Education Levels for the Population 25+ in the Netherlands in 1971

Men		Women		MF (% of Pop 25+)		Vocational
Basic Level	1,207,980	Basic Level	1,563,290	47.3%		
Lower Level	213,535	Lower Level	294,665	8.7%		
Extended Lower Level	903,890	Extended Lower Level	686,360	27.2%		
<i>w.v. general education</i>	224,305	<i>w.v. general education</i>	286,460		8.7%	} 18.44%
<i>agricultural education</i>	98,735	<i>domestic science</i>	326,600		7.3%	
<i>technical</i>	553,840	<i>other vocational</i>	73,300		10.7%	
<i>other vocational</i>	27,010				0.5%	
Secondary Level	271,515	Secondary Level	252,835	9.0%		} 6.6%
<i>w.v. general education</i>	75,345	<i>w.v. general education</i>	64,240		2.4%	
<i>agricultural education</i>	22,495	<i>domestic science</i>	46,085		1.2%	
<i>technical</i>	74,380	<i>other vocational</i>	142,510		3.7%	
<i>other vocational</i>	99,295				1.7%	
Semi-higher level	171,870	Semi-higher level	119,850	5.0%		
<i>w.v. non-university</i>	155,830	<i>w.v. non-university</i>	115,185		4.6%	
<i>university</i>	16,040	<i>university</i>	4,665		0.4%	
Higher level	101,830	Higher level	17,935	2.0%		} Total Secondary Vocational
<i>w.v. non-university</i>	21,910	<i>w.v. non-university</i>	4,710		0.5%	
<i>university</i>	79,920	<i>university</i>	13,215		1.6%	
Day-time attendance	32,250	Day-time attendance	16,820	0.8%		
Population 25+	2,902,870	Population 25+	2,951,755	100%		25.01%

Source: Own calculations based on 1971 Netherlands Census data: Volkstelling A5A Annex 1 woningtelling, 28 februari, 1971: Het genoten onderwijs en het volgen van onderwijs.

Notes: Calculations exclude the population listed in the census data with education 'Level unknown'.

MF stands for 'Male and Female'; w.v. ("waarvan" in Dutch) means "whereof" or "of which". The sum of vocational education looks like it is off by 0.1%, but that is because rounding. For example, 'other vocational' is really 0.46%, but because of rounding, it is presented as 0.5%. The number

These census data are already a simplification of the many pathways available to people in the Netherlands at the time. Figure 1 presents the diagram for the Netherlands from the UNESCO's 1950 World Survey of Education to facilitate the subsequent description of the distribution between VET and other forms of education in the country.²⁸ At the top of the diagram the ages when people would typically enter each educational trajectory are provided and the black blocks under each education trajectory listed are associated with the duration of the programme.

²⁸ This diagram can also be useful in distinguishing Technical Education from other forms of Vocational Education. It can be calculated from the detailed separation of types of education at the secondary level presented in Table 2, that **technical education** was only for men in 1971 and that it represented about **70% of vocational education** (the other two vocational sub-levels were 'agricultural education' and 'other vocational education', although it represented a much higher proportion at the Extended Lower Level (~80%) than in the Secondary Level (where it was only about 40%).

Reviewing the educational pathways in Figure 1 from top to bottom, pathways 1 (Grammar school), 2 (Modern secondary school) and 3 (Intermediate general secondary...) lead to degree granting, or non-degree granting higher education institutions, which are listed as follows: **Degree-Granting Institutions of Higher Education:** Theology (Protestant); Law; Sociology; Medicine; Dental surgery; Science; Psychology and social geography; Physical geography; Literature; Economics; Political and social science; Veterinary; Engineering; Agriculture; Theology (Roman Catholic). **Non-Degree Granting Institutions of Higher Education:** Senior seminary (Roman Catholic); Social Work; Teacher training for secondary education; Notary; Tax administration academy; Academy of arts; Military academy; Actuary; Training for foreign trade and diplomacy. Educational trajectory 4 (Advanced elementary) appears to serve as a bridge to vocational educational pathways 6-14. Vocational trajectories 6-9 lead to higher education institutions (either degree or non-degree granting) and the rest of the trajectories 10-20 terminate in labour market. Since trajectories 7-20 mention vocational in the title of the educational pathway, it is assumed that these are pathways are simplified to the four categories listed in the census data (See Table 2). Individuals in the Netherlands who started their education in 1950 will show up in the enrolment ratios in 1965 (rough approximation) and in the attainment data in 1970.²⁹

²⁹ If they are ~ 12-19 in 1965 they will only show up in the youngest cohorts in the attainment data. Although the census data begin with the population over the age of 14, the proportions used above and have been calculated using only the population 25 and older; so anyone under the age of 25 would be excluded.

Table 3 shows a reconstruction of how UNESCO (middle column) must have ascertained the distribution of educational attainment from the Netherlands census data. Table 3 can be read from left to right and shows that the UNESCO distribution is a simplification of the census data, whereby:

- UNESCO's 'Second Level 1' combines the Netherlands census categories 'Lower Level' plus 'Extended Lower Level' + 'Day-time attendance';
- UNESCO's 'Second Level 2' (*representing upper secondary*) is almost an exact match with the Netherlands census category of 'Secondary Level'.
- UNESCO's 'Post-Secondary' is almost an exact match for the combination of the Netherlands census category 'Semi-higher level' and 'Higher level'.

Since we can rather easily interpret how UNESCO most probably determined the educational distribution it lends some credence to the supposition that if they had included vocational education in the attainment distribution, they would have followed a similar method. Since the vocational tracks are subsumed under the overall levels, we can also make an educated guess as to which levels they would have been attributed and we can assume that the percentages would have been calculated in the same manner (excluding the population under 25 and where education level is unknown). This educated guess is presented in the furthest right column 'Estimated Vocational Secondary, Pop 25+' and matches the illustration of the calculations using the census data (recall the furthest right column (in black) 'Vocational' in Table 2). It is calculated by separating the percentage of the population at the Extended Lower Level and Secondary Level that were indicated by the census data to have attained vocational education at each respective level (i.e., not in the sub-level 'w.v. general education' in Table 2). Total secondary school is comprised of both lower secondary (Second Level S-1) and upper secondary (Second Level S-2).

Table 3. Comparing Netherlands Census with UNESCO Data

UNESCO Distribution of Educational Attainment (c.f. Table 1)		Match UNESCO with NLD 1971 Census	Netherlands Census 1971 (c.f. Table 2)		
Education Level	Pop 25 +		Education Level	Pop 25 +	Estimated Vocational Secondary, Pop 25+
Primary	47	≈ Basic Level	Basic Level	47.3	
Second Level S-1	36.7	= Lower Level + Extended Lower Level + Day-time attendance	Lower Level	8.7	18.44
			Extended Lower Level	27.2	
			Day-time attendance	0.8	
Second Level S-2	9.1	≈ Secondary Level	Secondary Level	9.0	6.57
Post-Secondary	7.2	≈ Semi-higher level + Higher level	Semi-higher level	5.0	
			Higher level	2.0	
Total	100		Total	100	Secondary Vocational = 25.01

Sources: UNESCO (1991) and own calculations based on 1971 Netherlands Census data³⁰ Volkstelling A5A Annexe woningtelling, 28 februari, 1971: Het genoten onderwijs en het volgen van onderwijs.

Notes: S-1 = First Stage; S-2 = Second Stage; 8.7 (NLD Lower Level) + 27.2 (NLD Extended Lower Level) + 0.8 (NLD Day-time attendance) = 36.7

³⁰ <http://www.volkstellingen.nl/nl/volkstelling/jaarview/1971/index.html>

Under these assumptions, the total attainment of vocational secondary education in 1971 in the Netherlands could be said to be 25% of the population over the age of 25. Since this type of education is a subset of total secondary education (which is the combination of lower, extended lower, day-time attendance and secondary) it represents a little more than half (or 55%) the total secondary education attainment. This proportion of attainment in Vocational secondary education in 1970/71 is fairly well aligned with the proportion of vocational to total secondary **enrolment ratio** for the Netherlands in 1965, which works out to be 51%.

This is the critical check, because it is ultimately the constructed Vocational enrolment ratio (51%) that will be applied to the secondary attainment and years of schooling data reported by Barro and Lee (based on UNESCO data), to determine the Vocational Secondary Attainment and Vocational Secondary Years of Schooling variables. So, it is important to know that our constructed vocational ratio comes close the actual vocational attainment data reported in the census. The next step is to check how Barro and Lee constructed their data from the tables in the UNESCO statistical yearbooks.

Matching Data from UNESCO with Attainment and Years of Schooling from Barro and Lee

The data observed in the Barro and Lee data set for educational attainment in the Netherlands in 1970³¹ in the population 25 years of age and older are as follows:

Table 4. Barro and Lee Educational Attainment Data: Netherlands 1970, Population 25+

Variable	Variable Name	Value	Unit
lu	No Formal Education	2.86	%
lp	Primary	44.14	%
ls	Secondary	45.8	%
lh	Tertiary Education	7.2	%
yr_sch_pri	Years of Primary Schooling	5.71	Years
yr_sch_sec	Years of Secondary Schooling	2.08	Years
yr_sch_ter	Years of Tertiary Schooling	0.24	Years
yr_sch	Years of Schooling	8.03	Years

Source: Barro and Lee (2013).

Notes: The percentages reported in the 4 educational attainment categories (No Formal Education, Primary, Secondary and Tertiary Education) are a distribution and sum to 100. The years of primary, secondary and tertiary schooling are calculated based on the fraction of age group that attained that educational level multiplied by the duration of that level of school (correcting for completion and mortality rates). The sum of the relative contributions at each level is equal to the total years of schooling for that country for that year.

How do the numbers correspond to the UNESCO data? Table 5 compares the two sources and finds almost an exact match between the two. The only difference between the two sources is that Barro and Lee report that 2.86% of the population in the Netherlands in 1970 had 'No schooling'.³² This number for 'No schooling' does not match with the proportion of the population listed in the Netherlands census data as 'Level unknown', which was 16% for the entire population and ranged from 4 to 26% among the different age cohorts. The good news is that the sum of 'No schooling' and 'Primary' for Barro and Lee is an exact match with the data reported by UNESCO for 'First level'

³¹ They round to the nearest 5 year interval.

³² This 2.86% is a bit puzzling, Barro and Lee (2013) state that they sometimes use literacy data as a basis for 'No schooling', but in the 1991 UNESCO Statistical Yearbook where the attainment data were found, there are no data for the Netherlands in the Illiteracy Table.

which was earlier determined to be almost an exact match with the Netherlands census data. This means that, having reconstructed the way in which UNESCO obtained this educational distribution from the underlying Netherlands Census data from 1971, it will be possible to check whether the 1965 Vocational enrolment ratio imputed on the secondary educational attainment distribution data from Barro and Lee for 1970 is close to the actual vocational attainment distribution data found in the census data and thus facilitates checking the validity of the application of the ratio to other measures of schooling.

**Table 5. Comparing Barro and Lee and UNESCO:
Distributions of Educational Attainment Data for the Netherlands, Population 25+**

Barro and Lee (2013)		UNESCO (1991)		Exact Match?
Netherlands 1970		Netherlands 1971		
No Formal Education	2.86	No Schooling	-	No
Primary	44.14	First Level	47	No, but*
Secondary	45.8	Entered Second Level (S-1 + S-2)	36.7 + 9.1 = 45.8	Yes
Tertiary Education	7.2	Post-Secondary	7.2	Yes

Sources: UNESCO (1991) and Barro and Lee (2013).

Notes: *44.14 (B&L Primary) + 2.86 (B&L No Formal Education) = 47.

Given the reasonable match between the distribution of attainment for the Netherlands in the UNESCO and Barro and Lee data, it is possible to roughly reconstruct the components of each level of schooling that sums to the total variable 'Years of Schooling' which is perhaps the most frequently used Barro and Lee variable in empirical research.

Table 6 walks us through the reconstruction. The left hand panel is exactly what we observe in the Barro and Lee data set as the distribution of educational attainment in the Netherlands in 1970. The right hand panel shows an approximate reconstruction of how the attainment data translate to each level's componential contribution to total years of schooling in the Barro and Lee data set. The simplified calculation is based on the methodology described by Barro and Lee (2013) and is result of multiplying the percentage of the population with at least a given educational attainment by the corresponding level's duration of schooling and then summing the three components (primary, secondary and higher) to reach and average number of years of schooling.

The duration used in Table 6 for the reconstructed calculation was based on information from the diagram that illustrates the duration of different levels of schooling in the Netherlands (Figure 1 on page 9) for primary and secondary levels and the standard 4 years for higher education that Barro and Lee use (2013). The years of education in the reconstructed calculation are a relatively close approximation of the Barro and Lee figure, but they are not identical, because Barro and Lee's numbers account for completion ratios and mortality rates (which, as mentioned earlier, differ (a) among countries and (b) with education levels and age).

A similar reconstruction was also done for 1960 for the Netherlands where it was possible to make use of different attainment distributions for 3 distinct age cohorts³³. Again the final results are fairly similar to those of Barro and Lee, but it was not clear whether Barro and Lee made use of the additional cohort data in 1960. It is more likely that if they used that data, they used it to fill in missing data in subsequent periods. The data from the Netherlands census were separated by 5 year age cohorts and these data were also used to approximately reconstruct the Barro and Lee components and years of schooling. Close approximations were also reached, but only in the case of the tertiary component were the results a closer approximation than the ones presented in Table 6.

These rough reconstructions are useful to check whether applying the imputation of the Vocational / Total Secondary enrolment ratio (from UNESCO) to the component of secondary schooling in the total years of schooling (Barro and Lee) is a valid approach.

Table 6. Approximate Reconstruction of the Components of 'Years of Schooling', Population 25+: Educational Attainment Distribution Combined with Duration to Create Respective Components

Variable Name	B&L Value	Unit		B&L Value	Unit	Reconstructed Calculation
No Formal Edu.	2.86	%				
Primary	44.14	%	Translates to	5.71	Years of Primary Schooling	$\approx 6 * .97 = 5.83$
Secondary	45.8	%	Translates to	2.08	Years of Secondary Schooling	$\approx 4 * .53 = 2.12$
Tertiary Education	7.2	%	Translates to	0.24	Years of Tertiary Schooling	$\approx 4 * .07 = 0.29$
			Sums to	8.03	Years of Schooling	8.24 Yrs of Schooling

Sources: UNESCO and Barro and Lee (2013).

Notes: .97 is the sum of the percent of the population with primary or more educational attainment: .53 is the sum of the percent of the population with secondary or more educational attainment. The duration for Secondary was adjusted (Barro and Lee did something similar (2013, page 188)) for the different durations of lower and upper secondary school (~ 80% of secondary attainment was at the lower level which and ~ 20% of secondary attainment was at the upper level for an adjusted duration of 4 years (rounded up)).

The Barro and Lee (B&L) secondary years of schooling component –which represents the portion that secondary attainment contributes to overall years of schooling - will be used to generate an approximate sub-component of years of vocational secondary schooling with two different approaches. The first approach (labelled M1 in Table 7 and the country data in Annexe 5) is to use the Vocational Secondary Enrolment ratio from the previous period (t-5) and apply it to the secondary component of years of schooling from Barro and Lee (in time t) in the same fashion as it was applied to the share of secondary attainment. The second approach (labelled M2 in Table 7 and the country data in Annexe 5) would be to multiply the share of secondary attainment attributed to vocational education (on the basis of the ratio from the preceding period) by the duration of the vocational programming. Given that the duration of the different vocational tracks varies and that it could have changed over the years, another method could be to do what Barro and

³³ The 1971 UNESCO Statistical Yearbook reports educational attainment data for the overall population 25+ as well as 3 cohorts: 25-34; 35-64 and 65+. The reconstruction of the different education level's componential contribution to years of schooling works out to be roughly the same and actually the overall population 25+ yields the closest approximation to the numbers reported by Barro and Lee for 1960.

Lee do for higher education and use a standard duration for all countries. As a starting point, the same duration of 3 years³⁴ for all countries for all time periods was used in the second approach.

From Table 7, we can see that the ratio of Vocational / Total Secondary enrolments in 1965 in the Netherlands was 51%. This 51%³⁵ was then applied to the share of Secondary Attainment in the Netherlands in 1970 as reported by Barro and Lee (45.80) and results in an approximate figure of 23.4% of the population 25 years of age and older with vocational secondary attainment. This represents a difference of 1.6 percentage points between the actual vocational attainment figure from the census data (namely 25%, see Tables 2 and 3). This seems like an acceptable difference, but there are a couple of assumptions and potential issues that should be noted. The first major assumption is that all of the calculations embedded in the Barro and Lee data for Secondary attainment (forward and backward extrapolations for years with missing data; calculations that correct for completion or mortality rates) will be carried forward into the data for 3 of the 4 Vocational Secondary Schooling Variables. To the extent that it is a reasonable assumption that the Vocational enrolment ratio will show up in the attainment data five years later, it is assumed that the vocational programme is always less than 6 years long. This may not always be the case.

Table 7. Applying the Vocational Enrolment Ratio to the Secondary Attainment for the Netherlands

Year	B&L Total Secondary Attainment	Ratio: Vocational / Total Secondary	Vocational Secondary Attainment	B&L Secondary Years of Schooling	Vocational Secondary Years of Schooling M1	Vocational Secondary Years of Schooling M2	B&L Years of Schooling	Highest Concentration of Educational Level
1950	8.21	0.57		0.39			6.03	Primary
1955	9.67	0.52	5.48	0.45	0.26	0.19	6.17	Primary
1960	11.1	0.50	5.80	0.50	0.26	0.20	6.22	Primary
1965	26.66	0.51	13.39	1.23	0.62	0.47	7.04	Primary
1970	45.80	0.41	23.40	2.08	1.06	0.82	8.03	Secondary
1975	50.87	0.40	20.76	2.65	1.08	0.73	8.64	Secondary
1980	55.46	0.40	22.06	3.15	1.25	0.77	9.25	Secondary
1985	60.56	0.50	24.52	3.65	1.48	0.86	9.91	Secondary
1990	62.05	0.51	31.22	3.95	1.99	1.09	10.34	Secondary
1995	62.3	0.48	31.91	4.14	2.12	1.12	10.63	Secondary
2000	62.14	0.34	29.82	4.38	2.10	1.04	10.98	Secondary
2005	60.38	0.51	20.35	4.44	1.50	0.71	10.98	Secondary
2010	60.71	0.47	31.23	4.69	2.41	1.09	11.60	Secondary

Sources: Own calculations based on UNESCO and Barro and Lee (2013).

Note: M1 Method based on actual duration, M2 based on a standard duration of three years

From Table 7, we can see that the first approach³⁶ to calculating Vocational secondary schooling yields a contribution of 1.06 years of education per person and the second approach³⁷ yields 0.82

³⁴ For the Netherlands, the diagram from UNESCO's World Survey of Education in 1950 was used to determine whether this was a reasonable approximation of the average duration for vocational secondary programmes. The calculated average duration was 3.6 years (see Annex 4).

³⁵ Recall that this is a difference of about 4 percentage points between the actual attainment calculated on the basis of the Netherlands census data in 1971 – which yielded 55%.

³⁶ Multiplying the Vocational Enrolment ratio from 1965 by the total Secondary Schooling Component from Barro and Lee.

³⁷ Vocational Secondary Attainment multiplied by a standard duration of 3 years.

years; these figures both represent relatively small shares of the total years of schooling. We have decided not to divide primary schooling on the basis of vocational secondary enrolments. This means that even though primary school is almost always a requisite for entering secondary vocational schooling and thus the proportion of the population who attained vocational secondary schooling also includes a fraction of the population with primary schooling, the primary school data has been kept as a contribution to general years of schooling (not added to the contribution of vocational years of schooling).

Section 3. Vocational Secondary Schooling around the World

The same methodology used to create the 4 variables and described in detail for the Netherlands (Table 7) was applied to all the countries for which both data on the distribution of Secondary Attainment and the Component of Years of Schooling at the Secondary level were available in Barro and Lee and enrolment data on Vocational and General Education were available in UNESCO 1969, 1999 and UIS).

The Vocational / Total Secondary enrolment ratio was calculated for 167 countries at 5 year intervals from 1950-2010 and resulted in 1,428 'real observations'. The 1,428 'real observations' represent 66% of the total possible observations (2,171) for the 167 countries for 13 different 5 year time periods between 1950 and 2010. After this process, 19 countries³⁸ were dropped because there were no (or not sufficient) vocational data available for the time period under consideration leaving 144 countries with the Vocational / Total Secondary enrolment ratio was calculated, however not all 144 countries were present in the Barro and Lee data set. In total, there are 129 countries for which both Barro and Lee educational attainment data and UNESCO vocational secondary enrolment ratio data were available, resulting in 1,233 'real observations' which represent 74% of the total possible observations for all countries over the time period (5 year intervals from 1950-2010).

Table 8 presents an overview of the regions and countries for which the Vocational Secondary Schooling variable has been calculated. It also shows the regional averages for the Vocational / Total Secondary Enrolment Ratio and the Vocational Secondary Schooling Attainment and as a benchmark indicates the level of schooling that had the greatest concentration of attainment in the population over the age of 25 at the beginning of the period (1955) and at the end of the period (2010). **Table 8 also defines the regions that are then used for the rest of the paper and lists the countries that are considered part of each region.**³⁹ Regional averages are calculated for each year only with the countries from that region that have data for that year. This means that from year to year the subset of countries in the regional averages may differ. These averages were also calculated using the fully extrapolated and interpolated data (therefore a rectangular dataset) and the averages are nearly the same. The regional averages as they are presented here are meant to report the 'real data' that are not distorted by extrapolations or interpolations. Another option would be to calculate the regional averages with only the countries that have 'real' data for the

³⁸Countries with less than 4 'real observations' were dropped: Afghanistan, Algeria, Barbados (data were only available for 1955, 1960 and 2005), Cuba, Guyana, Haiti, Libyan Arab Jamahiriya, Maldives (data were only available for 2000), Myanmar, Namibia (data were only available for 1990 and 1995), Nepal Nicaragua, Papua New Guinea, Reunion, Sri Lanka (data were only available for 1970 and 2010), Tonga, United States of America, and United Arab Emirates,

³⁹ These regions follow the regions set by the Barro and Lee dataset.

entire time period (1950-2010), but there are very few countries in any region that fit these criteria. The tables in Annexe 5 provide the Vocational to Total Secondary variables (partially and fully extrapolated) as well as the inferred Vocational Secondary Attainment variable and the two variables for vocational years of schooling at the secondary level (Methods 1 and 2) by country over the entire time period.

Table 8: Overview of the New Vocational Secondary Schooling Variable and Trends in Education Attainment Levels, by Region

Region	# of Countries	List of Countries	Mean Enrolment Ratio: Vocational / Total Secondary		Mean Vocational Secondary Attainment (% of 25+ population)		Greatest Concentration among Education Levels in the Population 25+	
			1955	2010	1955	2010	1955	2010
Advanced Economies	23	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain Sweden, Switzerland, Turkey, United Kingdom.	37.8	26.4	4.7	13.8	Primary (66%)	Secondary (49%)
East Asia and the Pacific	16	Brunei Darussalam, Cambodia, China, Hong Kong SAR, Macao SAR, Fiji, Indonesia, Lao People's Democratic Republic, Malaysia, Mongolia, Philippines, South Korea, Singapore, Taiwan, Thailand, Viet Nam.	14.9	10.4	1.3	3.5	No Formal Education (59%)	Secondary (45%)
Europe and Central Asia	20	Albania, Armenia, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Poland, Republic of Moldova, Romania, Russian Federation, Serbia, Slovakia, Slovenia, Tajikistan, Ukraine.	51.0	21.2	6.6	13.8	Primary (58%)	Secondary (71%)
Latin America and the Caribbean	20	Argentina, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Rep., Ecuador, El Salvador, Guatemala, Honduras, Jamaica, Mexico, Panama, Paraguay, Peru, Trinidad and Tobago, Uruguay Venezuela.	29.9	12.4	2.2	5.1	Primary (52%)	Primary (40%)

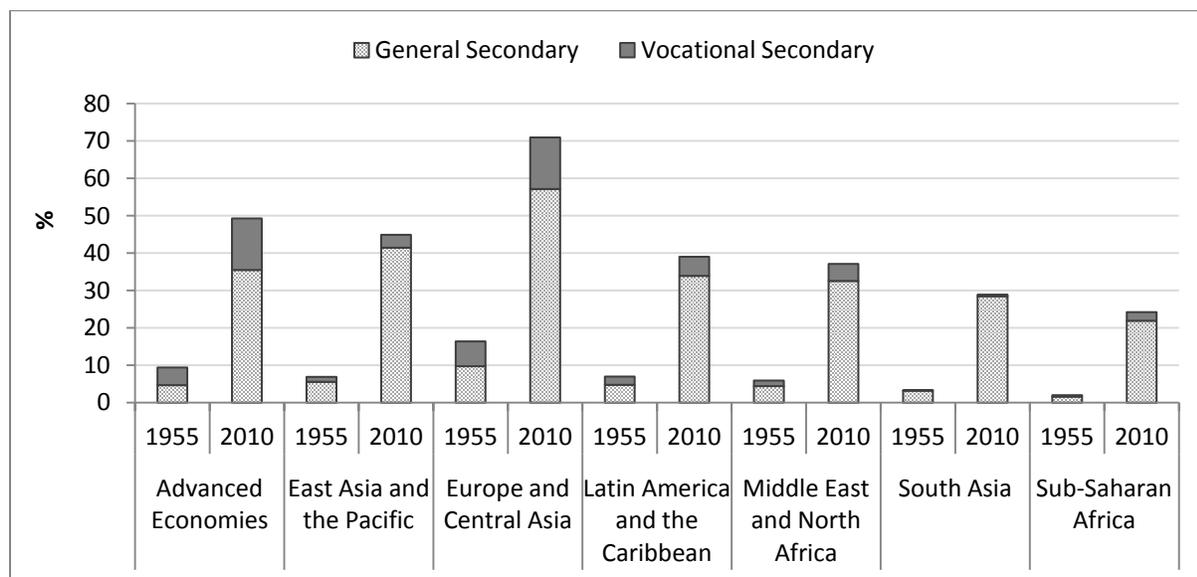
Region	# of Countries	List of Countries	Mean Enrolment Ratio: Vocational / Total Secondary		Mean Vocational Secondary Attainment (% of 25+ population)		Greatest Concentration among Education Levels in the Population 25+	
			1955	2010	1955	2010	1955	2010
Middle East and North Africa	15	Bahrain, Cyprus, Egypt, Iran (Islamic Republic of), Iraq, Israel, Jordan, Kuwait, Malta, Morocco, Qatar, Saudi Arabia, Syrian Arab Republic, Tunisia, Yemen.	12.1	7.3	1.5	4.6	No Formal Education (76%)	Secondary (37%)
South Asia	4	Bangladesh, India, Nepal, Pakistan, Benin.	4.3	3.6	0.1	0.4	No Formal Education (85%)	No Formal Education (47%)
Sub-Saharan Africa	31	Benin, Botswana, Burundi, Cameroon, Central African Republic, Congo, Cote d'Ivoire, Democratic Republic of the Congo, Gabon, Gambia, Ghana, Kenya, Lesotho, Liberia, Malawi, Mali, Mauritania, Mauritius, Mozambique Niger, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Swaziland, Togo, Uganda, United Republic of Tanzania, Zambia, Zimbabwe.	27.6	6.6	0.4	2.3	No Formal Education (81%)	No Formal Education (42%)

Sources: Own calculations based on UNESCO and Barro and Lee (2013).

Notes: In 1955, the following countries from the following regions were missing data and, therefore were not included in the regional average: **Advanced Economies:** New Zealand, Switzerland, and the United Kingdom. **East Asia and the Pacific:** Malaysia and Mongolia. **Europe and Central Asia:** Armenia, Croatia, Estonia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Serbia, Slovakia, Slovenia, Tajikistan, and Ukraine. **Latin America and the Caribbean:** Costa Rica, Dominican Republic, Guatemala, and Honduras. **Middle East and North Africa:** Egypt, Malta, Qatar, and Yemen. **South Asia:** Bangladesh and Nepal. **Sub-Saharan Africa:** Benin, Burundi, Central African Republic, Liberia, Mauritania, South Africa, Tanzania, and Zimbabwe. In 2010, the following countries from the following regions were missing data and, therefore were not included in the regional average: **Advanced Economies:** Canada. **East Asia and the Pacific:** Cambodia, Fiji, Philippines, Singapore, Taiwan, and Viet Nam. **Europe and Central Asia:** Kazakhstan, and Russian Federation. **Latin America and the Caribbean:** Bolivia, Honduras, Jamaica, and Trinidad and Tobago. **Middle East and North Africa:** Egypt, Iraq, and Saudi Arabia. **South Asia:** India and Nepal. **Sub-Saharan Africa:** Benin, Botswana, Cameroon, Central African Republic, Congo, Cote d'Ivoire, Gabon, Gambia, Ghana, Kenya, Liberia, Malawi, Mauritania, Mauritius, Rwanda, Sierra Leone, Swaziland, Togo, Zambia, and Zimbabwe.

Figure 2 looks at the average shares of vocational and general education at the secondary level by region in 1955 and in 2010 (roughly at the beginning of the dataset and at the end). From this graph we can easily see that in every region of the world there have been vast increases in the proportion of the population attaining secondary schooling. The proportion of vocational secondary schooling at the secondary level has similarly increased in advanced economies, both in absolute and relative terms. Whereas in Europe and Central Asia, the proportion of vocational secondary schooling has increased in absolute terms, in relative terms in that region, it has actually decreased. We can see that for most of the world's developing regions the proportions of vocational secondary vis-à-vis general secondary education are quite small.

Figure 2. Vocational Education as a Subset of Attainment at the Secondary Level in the Population (25+) in 1955 and 2010

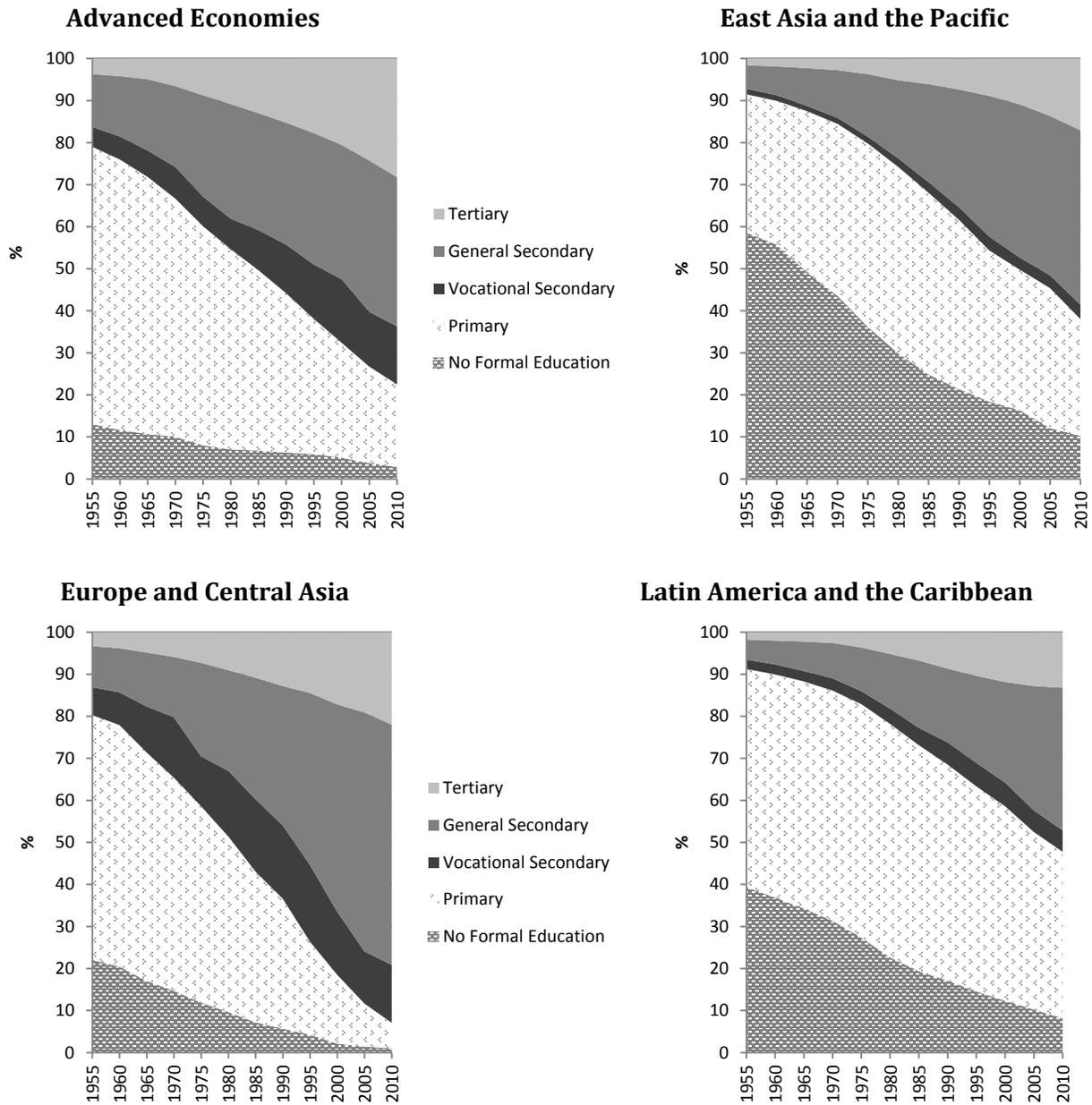


Sources: Own calculations based on UNESCO and Barro and Lee 2013.

Figure 3 shows the trends in vocational and general secondary attainment relative to the other levels of education (primary and tertiary) in the regions as they have been defined. The picture that unfolds is quite revealing. In advanced economies, there is clearly a greater proportion of vocational secondary education, but there is also the largest concentration of tertiary education compared to other regions. In Sub-Saharan Africa, although the trends in schooling are improving consistently throughout the time period, a striking proportion of the population still remains without formal education and there is very little vocational education at the secondary level. The differences between East Asia and the Pacific and Latin America and the Caribbean require a more nuanced understanding. Although, the share of the population with at least primary school attainment in Latin America and the Caribbean has been greater than in East Asia and the Pacific over the entire time period, the expansion of the share of the population with higher levels of education (secondary and tertiary) appears to have been slower in Latin America and the Caribbean. In all regions, the share of the population with Vocational secondary schooling appears to be relatively stable over time or even increasing, but it does not keep up with the overall

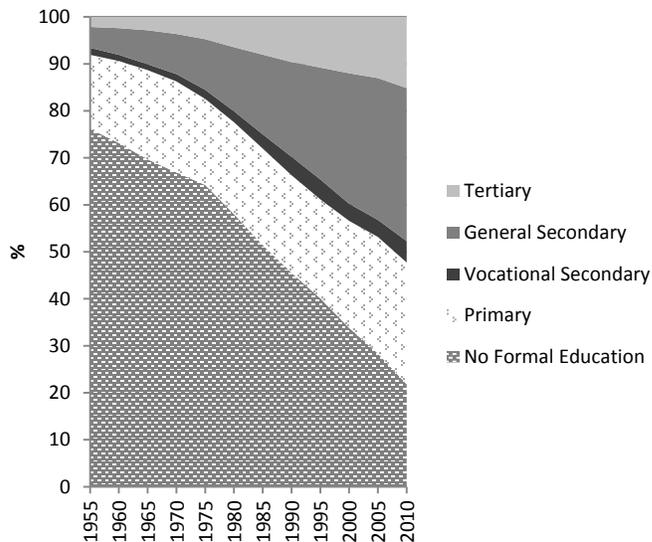
increases in secondary schooling; therefore the share of vocational secondary schooling in total secondary schooling decreases in relative terms over the last 55 years.

Figure 3. Regional Trends in Vocational Secondary Schooling Framed by other Levels of Educational Attainment, 1955 to 2010

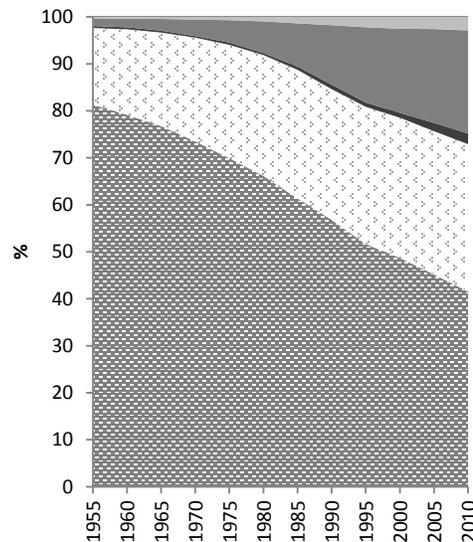


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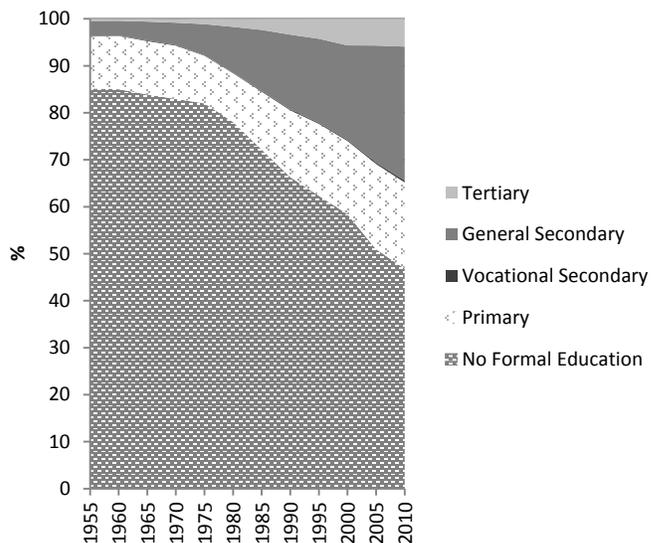
Middle East and North Africa



Sub-Saharan Africa



South Asia



Sources: Own calculations based on UNESCO and Barro and Lee (2013).

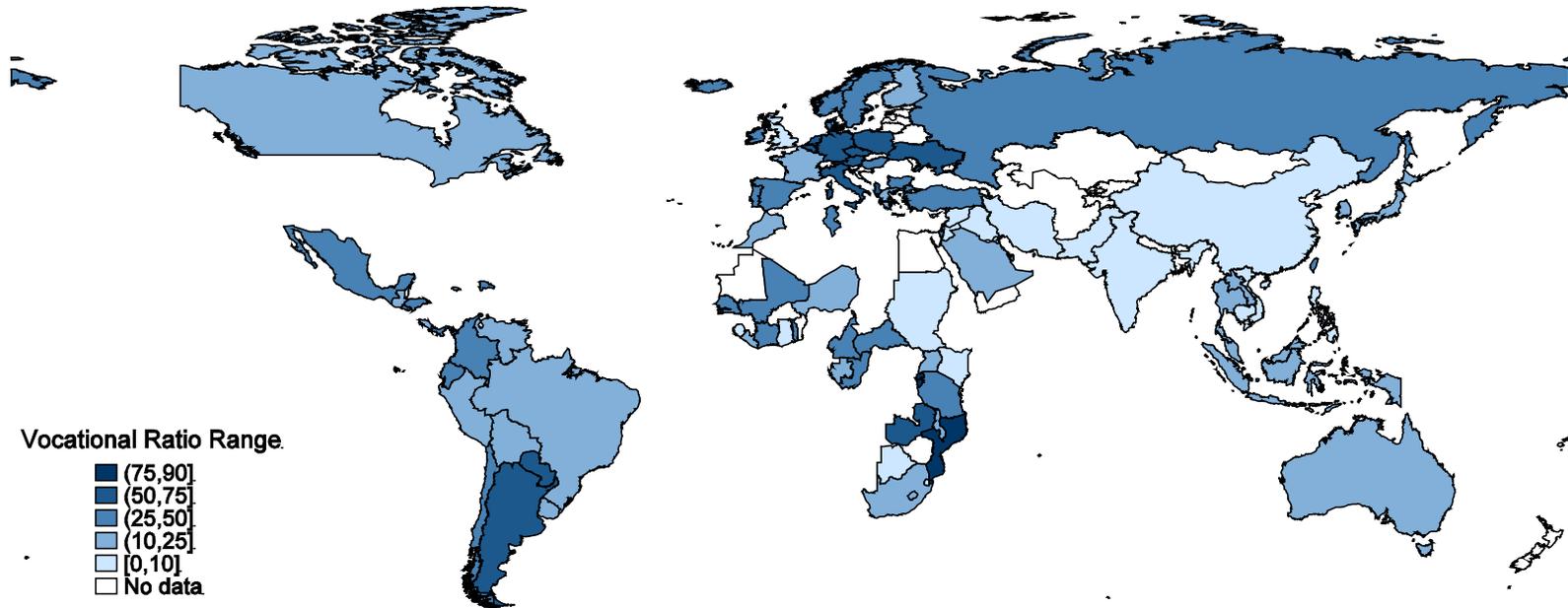
One of the most striking conclusions emerging from figure 3 is that of the de-vocationalisation of education in developing countries and emerging economies. As a percentage of secondary education, vocational education is systematically declining. This is also true for Advanced Economies as a whole, with some notable exceptions such as Finland and Australia.

Variation within Regions

Just as there appear to be stark regional differences with respect to vocational schooling at the secondary level, there is also a lot of variation within the regions. The regional averages presented

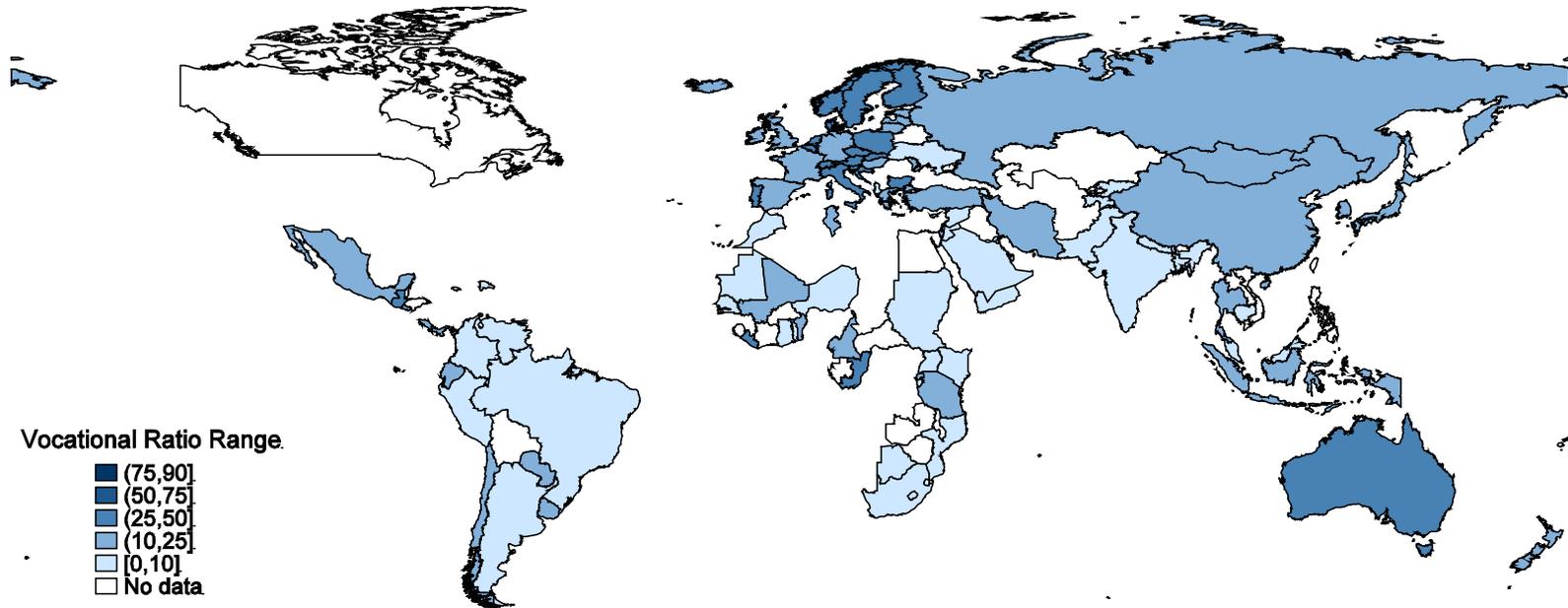
thus far, do not always allow us to distinguish which countries are driving the regional averages, nor can we discern the variation between different countries within the same region. Figure 4 maps the Vocational Secondary Enrolment ratio for all the countries that had data available in 1955 and maps the ratio again in 2010. The borders of several countries in the world have changed since 1955, for information on data-entry decisions the reader is referred to the notes in Annexe 2.

1955 Vocational / Total Secondary Education



Sources: Own calculations based on UNESCO and Barro and Lee

2010 Vocational / Total Secondary Education



Sources: Own calculations based on UNESCO and Barro and Lee

While we could already notice a worldwide trend of de-vocationalisation of secondary education in Figure 3, we can observe in the maps that some countries have had comparatively stable proportions of vocational secondary education over the time period. For example, Chile in South America began and ended the period with nearly the same proportion of vocational secondary education (~ 26% in 1955 and ~ 24% in 2010). Consulting the Country Tables in Annexe 5, it is clear that there was variation within the country over the time period, dropping as low as 19% and reaching 40% in 1995; but it is more stable than Argentina (a neighbouring country in the same region) where the proportion of vocational secondary education decreased from 70% in 1955 to 7% in 2010.

Conclusions

In the pursuit of economic growth, policymakers have increasingly become interested in vocational education as a type of educational formation that is more linked to the skills demanded by the labour market than general education. Although there have been calls for macro level economic growth analysis that can distinguish between types of education (vocational versus general), these calls have gone unanswered due to a lack of data. This paper takes a step toward creating a set of vocational secondary schooling variables so that these data may be used for empirical exploration of the role that vocational education plays in macro-economic growth at different stages of development. The paper describes how each variable was constructed and provides detailed information about the data sources and decisions that were made in the construction process.

Around the world, since 1950, greater and greater shares of the population have been reaching secondary school. Perhaps surprisingly, vocational secondary attainment has not kept pace with the increases in secondary attainment. Despite a relatively stagnant (or slightly increasing) proportion of overall vocational attainment, there is a consistent pattern of a steadily declining ratio of vocational to total secondary school attainment in all regions in the world. These regional declines in the ratio of vocational to total secondary schooling are not necessarily driven by one or two countries within a region. The maps from 1955 and 2010 show that in most countries secondary schooling has de-vocationalised over the last half of the century; some notable exceptions are Australia, China and Finland. What cannot be seen from the descriptive analysis presented here, but can be seen in the tables of data in Annexe 5, is that there is often quite a bit of fluctuation in the ratio over the time period within countries. These data offer promising potential for empirically exploring variation in shares of vocational education schooling and economic output at different stages of economic development.

References

- Abramovitz, M. (1993). "The Search for the Sources of Growth: Areas of Ignorance: Old and New" *Journal of Economic History*, Vol. 53, No. 2, 217-243.
- Acemoglu, D. & D. Autor (2010). "Skills, Tasks and Technologies: Implications for Employment Earnings." In *Handbook of Labor Economics, Volume 4b*, edited by David Card and Orley Ashenfelter, 1043-1171. Elsevier: San Diego and Amsterdam, North Holland.
- Barro, R. & J.W. Lee. (2013). "A New Data Set of Educational Attainment in the World, 1950-2010." *Journal of Development Economics*. Vol. 104. Pgs 184-198.
- Bertocchi, G. and M. Spagat (2004), "The evolution of modern educational systems: Technical vs. academic education, distributional conflict, and growth", *Journal of Development Economics*, Elsevier, Vol. 73 (2), pp. 559-582.
- CEDEFOP (European Centre for the Development of Vocational Training). (2010). *Skills Supply and Demand in Europe: Medium-term forecast up to 2020*. Luxembourg Publications Office of the European Union.
- Cohen, Wesley and Daniel Levinthal. (1990). "Absorptive capacity: A new perspective on learning and innovation", *Administrative Science Quarterly*, vol. 35, No. 1, Special Issue: Technology, organization and innovation, pp. 128-152.
- Hanushek, E.A., G. Schwerdt, S. Wiederhold and L. Woessmann. (2013). 'Returns to Skills Around the World: Evidence from PIAAC'. NBER Working Paper Series. Working Paper 19762. Cambridge, MA.
- International Standard Classification of Education (ISECD) (1997). United Nations Educational, Scientific and Cultural Organization (UNESCO). (<http://www.uis.unesco.org/Library/Documents/isced97-en.pdf>).
- International Standard Classification of Education (ISCED) (2011). United Nations Educational, Scientific and Cultural Organization (UNESCO). (<http://www.uis.unesco.org/Education/Documents/isced-2011-en.pdf>).
- Kuczera, M. (2008). *The OECD International Survey of VET Systems: First Results and Technical Report*.
- Marconi, G. (2015). *Higher Education in the National and Global Economy*. PhD Thesis. ROA Dissertation Series. Canon, Maastricht.
- Moretti, Enrico. (2012), *The New Geography of Jobs*, New York: Houghton Mifflin Harcourt.
- Netherlands Census Data. (1971). *Volkstelling A5A Annexe woningtelling, 28 februari, 1971* [Accessed April 2015 at: <http://www.volkstellingen.nl/nl/volkstelling/jaarview/1971/index.html>]
- OECD (The Organization for Economic Co-operation and Development). (2010). *Learning for Jobs: Synthesis Report of the OECD Review of Vocational Education and Training*. ISSN 2077-7736.
- Sianesi, B. and J. Van Reenen. (2003). The Returns to Education: Macroeconomics. *Journal of Economic Surveys*, Vol. 17, pp. 157-200, April 2003. Available at SSRN: <http://ssrn.com/abstract=416649>
- Silverberg, G. & B. Verspagen. (1994). *Learning, Innovation and Economic Growth: A Long-run Model of Industrial Dynamics*. Oxford University Press.

- Tether, B., M., Consoli, and D. Gagliardi. (2005). A literature review on skills and innovation. How does successful innovation impact on the demand for skills and how do skills drive innovation? ESRC Centre on Innovation and Competition, University of Manchester, Manchester.
- Toner, P. (2010). Innovation and Vocational Education, *The Economic and Labour Relations Review*, 2010, Vol. 21 No.2, 75-98.
- United Nations Educational, Scientific and Cultural Organization (UNESCO). 1950. World Survey of Education.
- United Nations Educational, Scientific and Cultural Organization (UNESCO). (1969). Statistical Yearbook.
- United Nations Educational, Scientific and Cultural Organization (UNESCO). (1970). Statistical Yearbook.
- United Nations Educational, Scientific and Cultural Organization (UNESCO). (1991). Statistical Yearbook.
- United Nations Educational, Scientific and Cultural Organization (UNESCO). (1999). Statistical Yearbook.
- UNESCO Institute for Statistics (UIS). <http://data.uis.unesco.org/> Accessed October, 2015.
- Vandenbussche, J., Aghion, P. & C. Meghir. (2006). "Growth, distance to frontier and composition of human capital" *Journal of Economic Growth* 11: 97–127.

Annexes

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