Vocational vs. General Education and Employment Over the Life-Cycle: New Evidence from PIAAC

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Idea

- Some (esp. European) countries stress **vocational education**
  - ▶ Development of job-specific skills to prepare students to work in specific occupations
- Other countries (esp. US) emphasize **general education**
  - ▶ Provides students with broad knowledge and basic skills in math and communication and serves as foundation for further learning on the job
- **Advantage** of vocational education: help young people master the transition from school to work (Ryan JEL 2001)
- **Disadvantage** of vocational education: neglects life-cycle perspective in changing economies $\rightarrow$ lower adaptability to technological and structural change, reduced employment opportunities at old age

Hypothesis

Any relative labor-market advantage of vocational over general education decreases with age.

Literature

- Vocational education and school-to-work transition: e.g. Shavit and Müller (1998), Ryan (2001), Zimmermann et al. (2013), Malamud and Pop-Eleches (2010)

- Life-cycle perspective of vocational education: Hanushek et al. (2017), Cörvers et al. (2011), Weber (2014), Brunello and Rocco (2016), Hall (2016)

- Our study:
  - ▶ Aim: deeper understanding of the merits and limitations of different education types for employment in a globalized era
  - ▶ Method based on Hanushek et al. (2017): difference-in-differences model that compares employment rates across age for people with general and vocational education
  - ▶ Recent data, large sample of countries
  - ▶ Much richer testing of skills than IALS
  - ▶ Rich background questionnaire

The PIAAC Data: "PISA for Adults"

- OECD Programme for the International Assessment of Adult Competencies (2012)
- Individuals aged 16 to 65 years
- At least 5,000 participants per country (nationally representative), 24 countries in round 1
- Three skill domains (each measured on a 500-point scale): ICT skills, numeracy, literacy
- Rich background questionnaire: type of education, level of (highest) education, field of study, employment status, work sector/industry, dropout information, demographic data,...

Empirical Challenge and Approach

- Empirical challenges:
  1. People in vocational and general education are systematically different
  2. Life-cycle comparisons require comparability across cohorts
  3. Defining vocational education across countries is difficult

- International sample of workers across age spectrum $\rightarrow$ PIAAC micro data provide detailed information about education and skills

- Difference-in-differences approach:
  - ▶ To address concern of selection into different types of education $\rightarrow$ compare LM outcomes across different ages for people with general and vocational education
  - ▶ To address remaining concern that selectivity changed over time:
    - ⋆ Control for individual-level measures of ability and of family background
    - ⋆ Control for country-specific changes in size of types over cohorts
    - ⋆ Employ propensity score matching

Identification of the Impact of Education Type

Difference-in-differences approach:

$$emp_i = \alpha_0 + \alpha_1 age_i + \alpha_2 age_i^2 + \beta_1 gen_i + \beta_2 * gen_i * age_i + X_i\gamma + \mu_c + \epsilon_i$$

- emp_i: indicator equals 1 if individual is employed
- $\alpha_1 age_i + \alpha_2 age_i^2$: capture age-employment pattern in economy
- gen_i: indicator for general education
- X_i: vector of control variables (years of schooling, skills)
- μ_c: country fixed effects

Identifying assumption: (conditional) selectivity into education programs does not vary over time (i.e. today's old ind. are a good proxy for young ind. in 30 years)

Definition of Vocational Education

- Individual level:
  - ▶ Derived from background questionnaire (internationally harmonized)
  - ▶ Secondary education: indicator variable provided by PIAAC data
  - ▶ Tertiary education: classification according to ISCED levels (ISCED 5B vocational)
- Country level:
  - ▶ Vocational countries: more than 50% enrollment in vocational upper secondary programmes (EAG 2008), more than 40% in PIAAC
  - ▶ Non-school based vocational countries: more than 25% in combined school and work-based programs (EAG 2008)
  - ▶ Apprenticeship countries: more than 40% in combined school and work-based programs (EAG 2008)

Regression Sample

- 16 countries
  - Non-vocational countries: Ireland, Japan, Korea, Spain, UK, US
  - **Vocational countries:** Australia, Austria, Czech Republic, Denmark, Finland, France, Germany, Netherlands, Norway, Sweden
    - ★ **Apprenticeship countries:** Austria, Denmark, Germany
    - ★ Non-school based vocational countries: Austria, Czech Republic, Denmark, Germany
- Males aged 16 to 65 who completed at least secondary education
- Exclude individuals who are currently in education
- Baseline analysis focuses on group of vocational countries

Employment by Age and Education Type
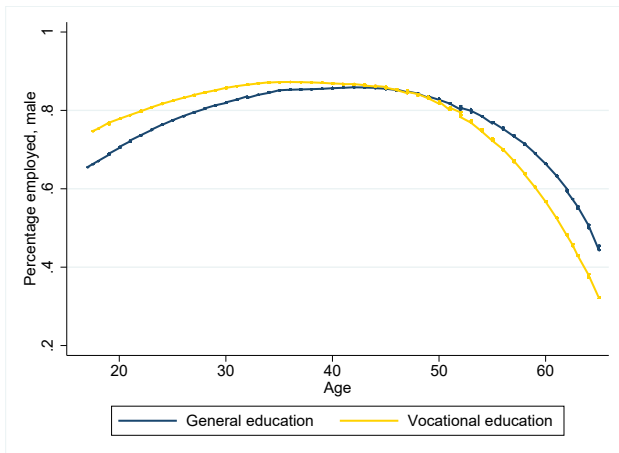
Notes: Sample includes males who completed at least secondary education and are currently not students in the vocational country group, based on a matched sample that uses propensity-score matching to ensure common support between persons with a vocational and a general education in each country. Smoothed scatterplot using locally weighted regressions (Stata lowess). Data source: PIAAC.

Vocational vs. General Educ. and Life-Cycle Employment

|	(1)	(2)	(3)	(4)	(5)	(6) Propensity-score matching	(7) 20+ age sample	(8) 30+ age sample
General education	-0.100***	-0.090***	-0.085***	-0.082***	-0.084***	-0.090***	-0.093***	-0.135***
	(0.017)	(0.018)	(0.018)	(0.019)	(0.018)	(0.018)	(0.018)	(0.026)
General education x Age	0.032***	0.024***	0.022***	0.021***	0.022***	0.027***	0.025***	0.034***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.009)	(0.006)	(0.008)
Age	0.270***	0.260***	0.257***	0.255***	0.260***	0.260***	0.252***	0.453***
	(0.013)	(0.013)	(0.013)	(0.015)	(0.013)	(0.015)	(0.013)	(0.027)
Age^2	-0.066***	-0.062***	-0.062***	-0.062***	-0.063***	-0.062***	-0.062***	-0.091***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.004)
Years of schooling	0.021***	0.016***	0.015***	0.015***	0.015***	0.020***	0.015***	0.017***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Literacy score		0.001	-0.002	-0.000	-0.003	0.028	-0.008	-0.017
		(0.009)	(0.017)	(0.017)	(0.017)	(0.022)	(0.017)	(0.025)
Literacy score x Age		0.014***	0.002	0.002	0.002	-0.007	0.004	0.007
		(0.003)	(0.006)	(0.006)	(0.006)	(0.008)	(0.006)	(0.008)
Numeracy score			0.006	0.003	0.007	-0.002	0.011	0.029
			(0.017)	(0.017)	(0.021)	(0.021)	(0.017)	(0.025)
Numeracy score x Age			0.014**	0.014**	0.014**	0.017**	0.012**	0.007
			(0.006)	(0.006)	(0.006)	(0.008)	(0.006)	(0.008)
Share of country cohort with general education					-0.133**	-0.125	-0.144**	0.178*
					(0.066)	(0.080)	(0.066)	(0.093)
Mother's education (2 indicators and their interaction with age)				yes				
Country fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	18,938	18,938	18,938	18,372	18,938	12,374	18,745	15,691
Countries	10	10	10	10	10	10	10	10
R^2 (adj.)	0.138	0.146	0.149	0.148	0.149	0.122	0.150	0.175

Notes: Linear probability model. Dependent variable: individual is employed. Sample includes males aged 16 to 65 with at least secondary education in the 10 vocational countries. Age variable subtracted by 16 and divided by 10. Regressions weighted by sampling weights, giving same weight to each country. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Data source: PIAAC.

# Heterogeneity across Country Groups with Different Vocational Intensity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All countries	Non-vocational countries	Vocational countries	Non-school based vocational countries	Apprenticeship countries			
					All	Austria	Denmark	Germany
General education	-0.063***	-0.001	-0.084***	-0.123***	-0.134***	-0.083	-0.110**	-0.201***
	(0.014)	(0.024)	(0.018)	(0.032)	(0.035)	(0.062)	(0.046)	(0.067)
General education x Age	0.019***	-0.000	0.022***	0.041***	0.049***	0.064***	0.036**	0.043*
	(0.005)	(0.009)	(0.006)	(0.011)	(0.012)	(0.022)	(0.015)	(0.022)
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	29,452	10,514	18,938	8,040	6,004	1,719	2,365	1,920
Countries	16	6	10	4	3	1	1	1

Notes: Linear probability model. All models include the same controls as column 5 of Table 2. Dependent variable: individual is employed. Sample includes males aged 16 to 65 with at least secondary education. See section 2 for country groups. Age variable subtracted by 16 and divided by 10. Regressions weighted by sampling weights, giving same weight to each country. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Data source: PIAAC.
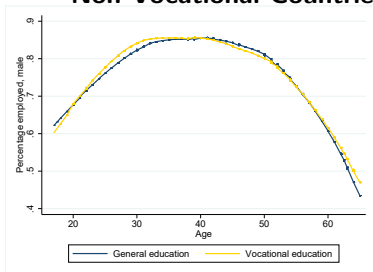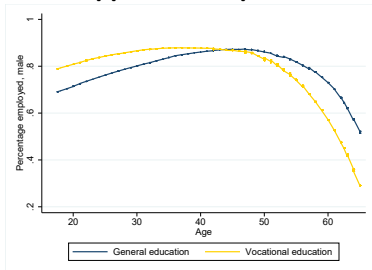
Vocational Countries
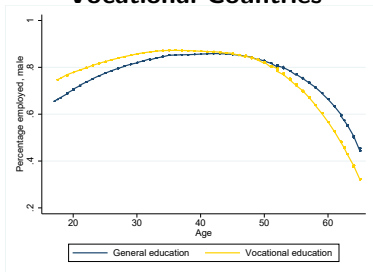
Non-school Based Voc. Countries
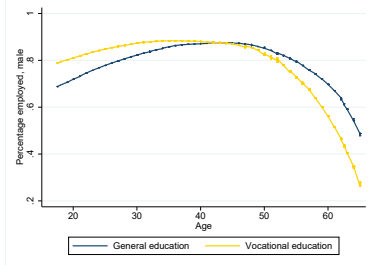
Non-Vocational Countries

Apprenticeship Countries

Conclusion

- Aim: provide a deeper understanding of the merits and limitations of different education types for employment in a globalized era
- Results show a continuing trade-off for vocational education between the ease of LM entry and limited adaptability at later ages
- Results are very similar to Hanushek et al. (2017) for the mid-1990s
  $\rightarrow$ International results which refer to two decades ago also hold on today's labor markets!
- Caution about policies that concentrate just on the current employment situation and ignore the dynamics of growing economies

BACKUP

Summary Statistics

Table 1: Descriptive Statistics

	(1)	(2)	(3)	(4)	(5)
	Full sample			Individuals with	
	Mean	Min	Max	Vocational education	General education
Employed	0.793	0	1	0.769	0.836
	(0.405)			(0.421)	(0.371)
General education	0.358	0	1	0	1
	(0.479)				
Age	44.36	17	65	44.64	43.86
	(12.62)			(12.73)	(12.40)
Years of schooling	13.97	9	22	12.95	15.81
	(2.309)			(1.51)	(2.36)
Literacy score	282.8	51.5	445.1	271.5	303.2
	(44.9)			(42.3)	(42.2)
Numeracy score	289.1	48.2	467.0	277.5	310.0
	(48.7)			(45.9)	(46.6)
Observations	18,938			12,164	6,774
Countries	10			10	10

Notes: Means, standard deviations (in parentheses), minimum, and maximum. Sample includes males aged 16 to 65 with at least secondary education in the 10 vocational countries. Data weighted by sampling weights, giving same weight to each country. Data source: PIAAC.

Share of Individuals with General Education, by Cohorts
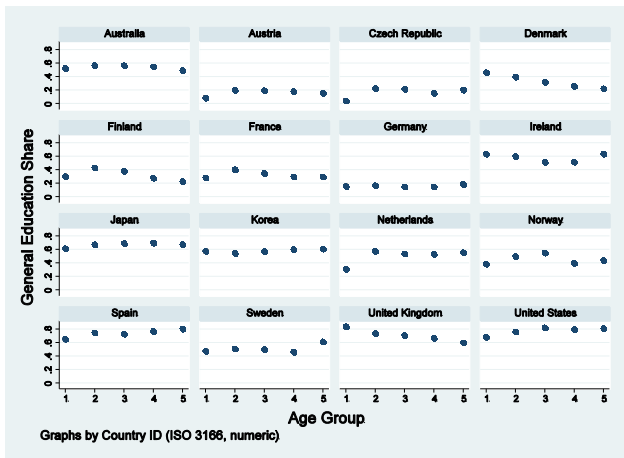
Table R-1: Vocational vs. General Education and Employment over the Life-Cycle in PIAAC: Excluding the Netherlands and Sweden

	(1)	(2)	(3)	(4)	(5)	(6) Propensity-score matching	(7) 20+ age sample	(8) 30+ age sample
General education	-0.096*** (0.019)	-0.081*** (0.020)	-0.074*** (0.020)	-0.073*** (0.021)	-0.062*** (0.020)	-0.075** (0.031)	-0.074*** (0.021)	-0.115*** (0.029)
General education x Age	0.033*** (0.007)	0.023*** (0.007)	0.020*** (0.007)	0.020*** (0.007)	0.017** (0.007)	0.023** (0.011)	0.020*** (0.007)	0.031*** (0.009)
Age	0.283*** (0.014)	0.273*** (0.014)	0.269*** (0.014)	0.268*** (0.017)	0.284*** (0.014)	0.272*** (0.014)	0.271*** (0.014)	0.438*** (0.030)
Age^2	-0.069*** (0.003)	-0.065*** (0.003)	-0.065*** (0.003)	-0.065*** (0.003)	-0.069*** (0.003)	-0.066*** (0.003)	-0.067*** (0.003)	-0.092*** (0.005)
Years of schooling	0.021*** (0.002)	0.016*** (0.002)	0.014*** (0.002)	0.014*** (0.002)	0.014*** (0.002)	0.021*** (0.003)	0.014*** (0.002)	0.016*** (0.002)
Literacy score		-0.002 (0.010)	-0.001 (0.018)	0.003 (0.018)	-0.001 (0.018)	0.019 (0.023)	-0.008 (0.018)	-0.003 (0.028)
Literacy score x Age		0.016*** (0.003)	0.001 (0.007)	-0.000 (0.007)	0.001 (0.007)	-0.007 (0.008)	0.003 (0.007)	0.002 (0.009)
Numeracy score			0.000 (0.018)	-0.004 (0.018)	0.004 (0.018)	-0.000 (0.023)	0.010 (0.018)	0.012 (0.027)
Numeracy score x Age			0.018*** (0.007)	0.019*** (0.007)	0.017** (0.007)	0.019** (0.008)	0.015** (0.007)	0.014 (0.009)
Share of country cohort with general education					-0.452*** (0.084)	-0.426*** (0.102)	-0.486*** (0.086)	-0.306** (0.121)
Mother's education (2 indicators and their interaction with age)				yes				
Country fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	16,084	16,084	16,084	15,556	16,084	10,535	15,899	13,287
Countries	8	8	8	8	8	8	8	8
R^2 (adj.)	0.145	0.154	0.158	0.157	0.161	0.125	0.161	0.186

Notes: Linear probability model. Dependent variable: individual is employed. Sample includes males aged 16 to 65 with at least secondary education in the 10 vocational countries except for the Netherlands and Sweden. Age variable subtracted by 16 and divided by 10. Regressions weighted by sampling weights, giving same weight to each country. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Data source: PIAAC.

Correlates of Educational Decision

Table 2: Correlates of general education type

	(1)	(2)	(3)
Literacy score	0.047***		0.054***
	(0.009)		(0.017)
Literacy score x Age	-0.001		-0.003
	(0.003)		(0.005)
Numeracy score		0.036***	-0.008
		(0.009)	(0.017)
Numeracy score x Age		-0.001	0.001
		(0.003)	(0.005)
Books at home at age 15	0.038***	0.041***	0.039***
	(0.010)	(0.010)	(0.010)
Books at home at age 15 x Age	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
Mother has high-school education	0.032	0.034	0.032
	(0.028)	(0.028)	(0.028)
Mother has high-school education x Age	-0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)
Age	-0.008***	-0.008***	-0.008***
	(0.001)	(0.002)	(0.002)
Age^2	0.015***	0.014***	0.015***
	(0.002)	(0.002)	(0.002)
Years of schooling	0.120***	0.121***	0.121***
	(0.001)	(0.002)	(0.002)
Country fixed effects	yes	yes	yes
Observations	18,340	18,340	18,340
Countries	10	10	10
R^2 (adj.)	0.436	0.434	0.436

Notes: Linear probability model. Dependent variable: 1 = education type of individual is general; 0 = vocational.