Vocational high school graduates wage gap:

the role of cognitive skills and firms

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Research Questions

- What are the differences in life-cycle wages profile between individuals receiving vocational and general education?
- What's the role of age, cohort and year?
- What's the role of worker and firm in the explanation of the vocational wage gap?

Roadmap

- **Introduction/Motivation**
- Some evidence from Portugal
- Aim
- Related Literature
- Data
- Selection
- Data Analysis
- Empirical Model Results
- Concluding Remarks

Motivation - Vocational vs. General

- School systems usually differentiate among vocational and general (or academic) tracks.
- Vocational education will prepare rather directly for specific occupations and train the students in the skills needed in these occupations.
- General education teaches more general, more basic abstract skills not directly related to tasks in particular occupations.

Motivation - Vocational vs. General

- One of the most striking differences between countries educational systems lies in their emphases on vocational/specific and theoretical/general education.
- In some European countries (e.g., Austria, Germany, Slovakia, the Netherlands) students are tracked as early as age 10 or 12 and complete apprenticeships at the upper secondary level.
- In southern Europe, the US and the UK, modest shares of the student population attend vocational schools before age 18
- These differences have historical and cultural reasons, but may also partially reflect our incomplete understanding of the expected relative returns of vocational and general education.

Motivation - Human Capital Theory

- The dominant paradigm in the economics of education is Human Capital Theory (Becker)
- which suggests that education is an investment that make individuals genuinely more productive
- They will potentially have higher earnings and be more employable. Detail

Motivation - Vocational vs. General

- Becker (1964) distinguished between general and firm-specific human capital, where the latter is non-transferable between firms.
- We consider both vocational/specific skills and general/theoretical skills to be transferable between employers, but we recognize that there are differences in the degree of transferability.
- Although not formalized into a model, it is often claimed that the relative earnings impacts of vocational and general educations are different in the short and long term.

Vocational vs. General - short-term

- It is often argued that vocational education has a relative advantage in the short term as it may simplify the transition from school to work
- General skills have, by definition, no obvious link to a labor market niche.
- In the short term, this may slow the transition from school to work, with a higher degree of job-hopping before the individual finds her career path.
- In the short term, vocational education is associated with an earnings advantage relative to general education.

Vocational vs. General - long-term

- General education is instead presumed to enhance both flexibility and the ability to acquire new skills.
- In the long term, this may generate a relative advantage compared with vocational education
- Work experience (and possibly technological changes) could generate a long-term relative skill advantage for individuals with general education.
- In addition, a risk associated with vocational education is that the demand for a specific skill may decline at some future point in time and diminish long-run earnings returns.
- In sum, the long-term annual earnings of individuals with general education may catch up to or exceed those of individuals with vocational education.

Underlying Mechanisms

1. Many times the quality of the vocational students is perceived has lower (negative social stigma).
2. Firms may pay less to vocational workers because they carry a negative signal (discrimination?)
3. Weight of cognitive in the Curriculum might help students to integrate better in the labor market and therefore become more productive. A good curriculum in high school could enhance the ability of the worker and help to achieve a better match.

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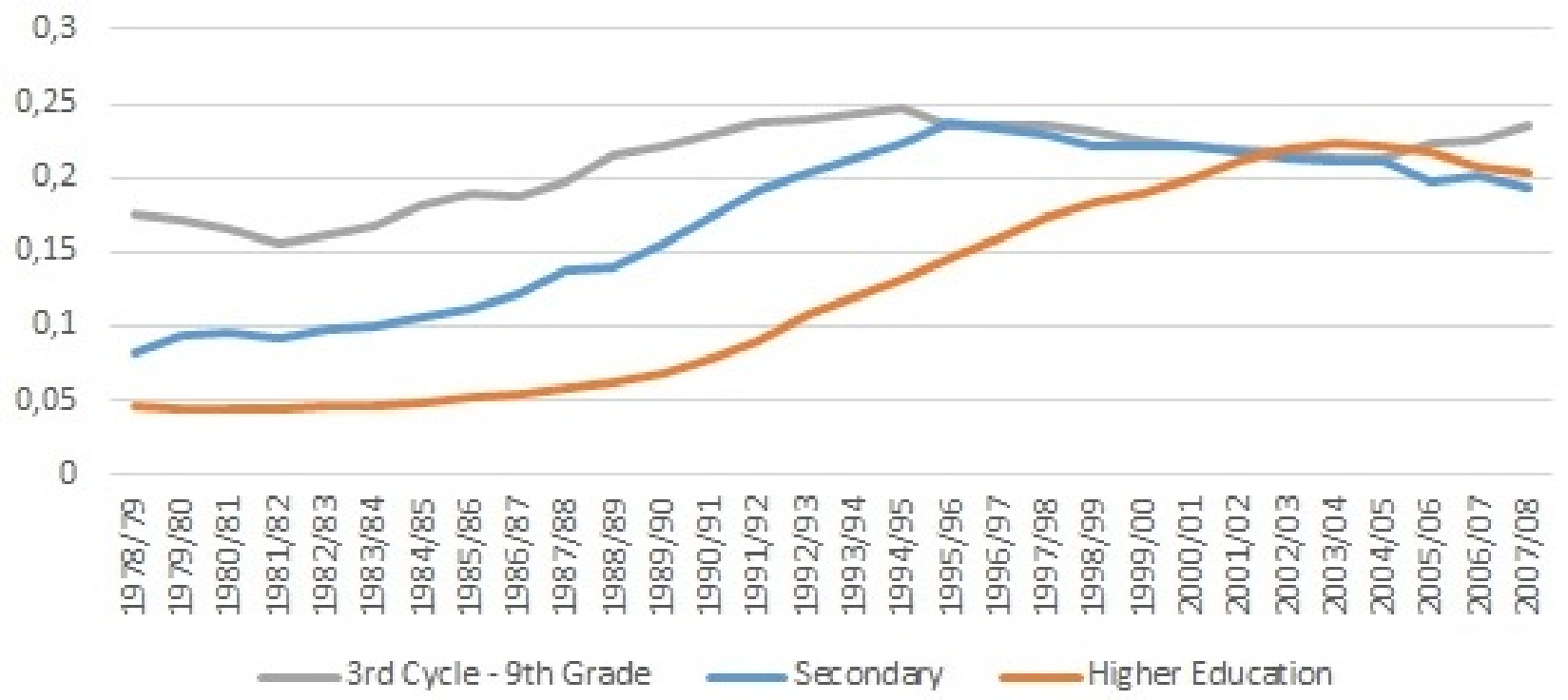
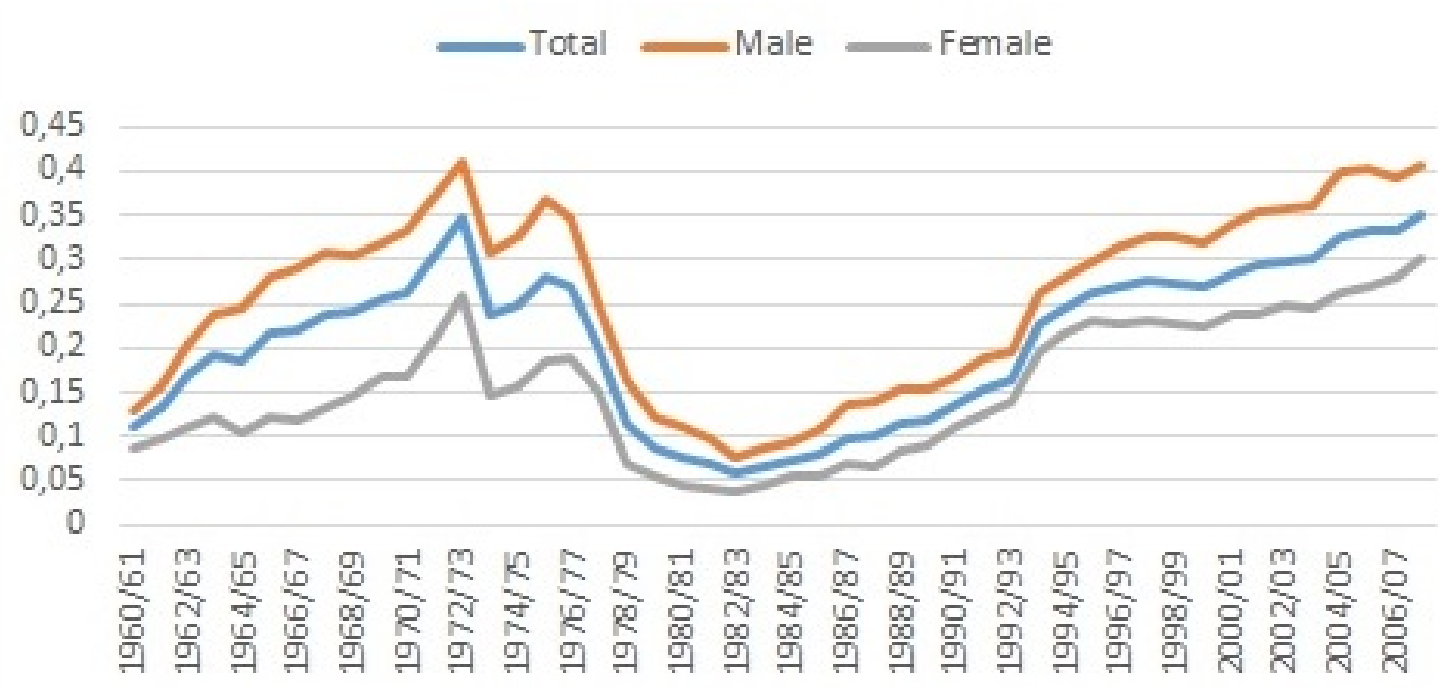
Some evidence from Portugal

Figure: **Share of total number of students enrolled**



Some evidence from Portugal

Figure: **Share of the Vocational within Secondary Education**



Some evidence from Portugal

Table: Labour Force share by completed level of education - individuals born in those year intervals

	1950-1961	1962-1967	1968-1995	
	(1)	(2)	(3)	(3)-(1)
Less than Upper Secondary	75	72	49	-26
Upper Secondary	11	15	27	16
More than Upper Secondary	14	13	23	9

Source: Labour Force Survey

Some evidence from Portugal

Figure: Returns to education by cohort

	Cohort 1	Cohort 2	Cohort 3	
	1951-1961	1962-1967	1968-1995	Dif (Cohort3- Cohort1)
Higher Education	102	102	79	-23
Secondary Education	55	47	31	-24
9th Grade	32	19	14	-18

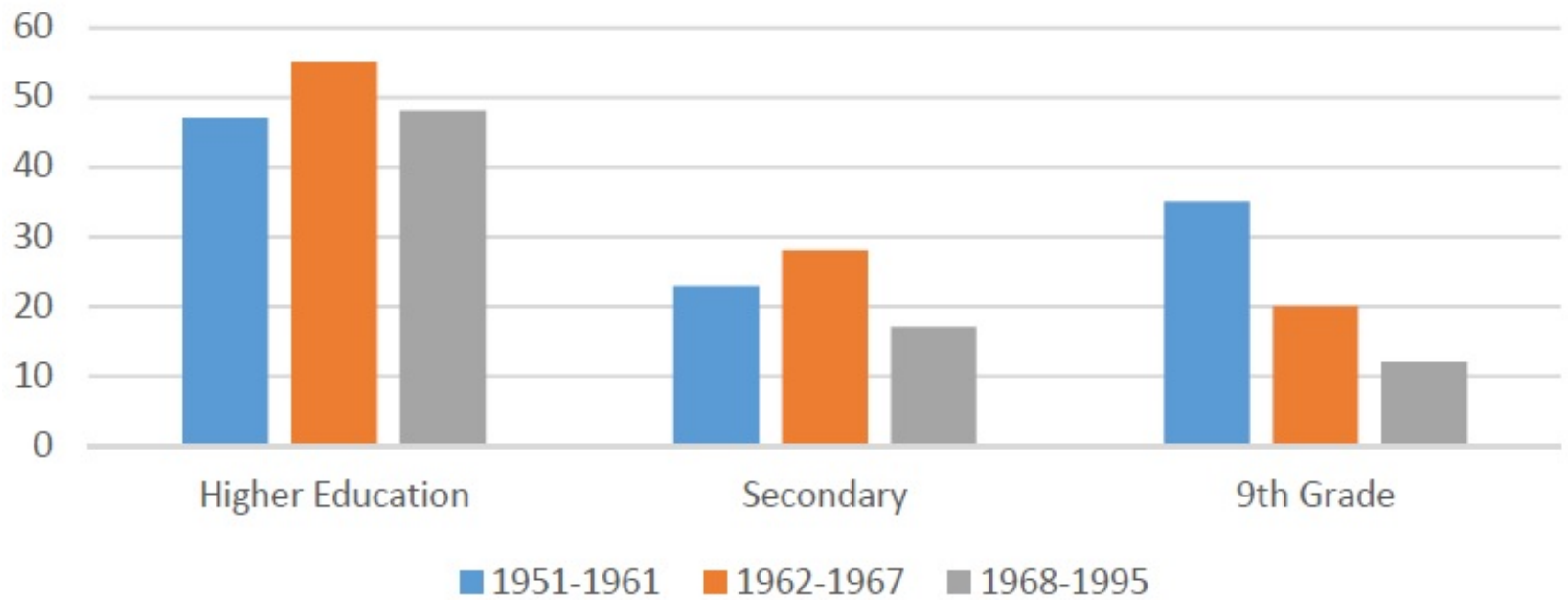
Note: Premium to the less than 9th Grade individuals (Coefficients).

	Cohort 1	Cohort 2	Cohort 3	
	1951-1961	1962-1967	1968-1995	Dif (Cohort3- Cohort1)
Higher Educ. vs. Secondary	47	55	48	1
Secondary Educ. vs. 9th Grade	23	28	17	-6
9th Grade vs. Less than 9th Grade	35	20	12	-23

Note: Premium to previous highest education level (Difference in the coefficients)

Some evidence from Portugal

Figure: Returns to education by cohort



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Aim

- This paper studies the vocational high school graduates wage gap.
- The paper disentangles the effect of year, age, and cohort (curriculum and/or ability) on the wages.
- The paper assesses the determinantes of the gap - role of quality of the worker, and firms.

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Related Literature

- Carneiro et al (2012) - Survey on VET (Vocational Education and Training).
- In countries where there are well developed vocational education systems in schools and well established apprenticeships systems returns to vocational education are high (e.g. Steedman 1993, Acemoglu 2001, Acemoglu and Pischke 1999) (or indeed where there is a competitive market for apprentices (e.g Heckman (2000)).
- This is not however, universally the case. In Australia, for example, the returns to VET are positive but vary by qualification level and mode of study (Ryan, 2002).
- In countries where there is a less developed vocational system the proliferation of vocational qualifications both in the schooling system and beyond has weakened the signal of what the vocational education is providing and returns are less (Woβmann (2008); Machin and Vignoles (2005)).

Related Literature

- Hanushek (2017) -cross-country - International Adult Literacy Survey (IALS)
- Malamud and Pop-Eleches (2010) - Reform in Romania
- Dustmann et al. (2014) - West Germany
- Brunello and Rocco (2017) - UK
- Golsteyn and Stenberg (2017) - Sweden

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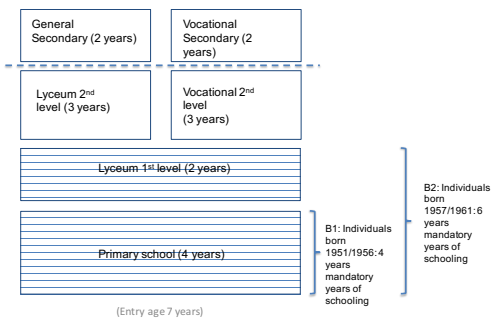
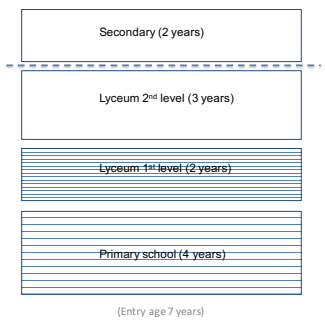
The Portuguese system of education in our sample period

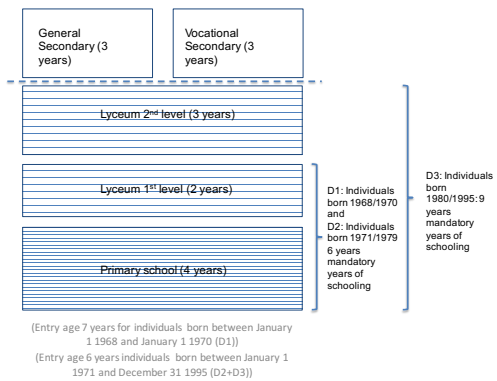
Figure: **Changes in the structure of the Portuguese Education System**



(a) Cohort class 1951-1961 Details



(b) Cohort class 1962-1967 Details



(c) Cohort class 1968-1995 Details

Notes:
Panel (a): Secondary school entry year between 1967 and 1977
Panel (b): Secondary school entry year between 1978 and 1983
Panel (c): Secondary school entry year between 1984 and 2011

Details1 Details2

Data used

- Quadros de Pessoal - Ministry of Labour, Solidarity and Social Security
  - wage gap analysis
- Observatory of Student Pathways in Secondary Schools (OTES) - Ministry of Education (DGEEC)
  - selection issues

Data used: Quadros de Pessoal

- Rich set of information available in the longitudinal matched employer-employee dataset for Portugal, on:
  - The collective agreement that regulates the employment contract applicable to each worker (300 negotiated per year, on average)
  - Detailed occupational categories defined for each collective agreement (100 categories defined by each collective agreement, on average)
- All the population - covers all personnel working for an establishment
- Very rich in worker and firm specific information (gender, age, schooling, region, industry, firm size)
- Period: 1994-2013

Data used: Sample

- Full-time wage earners in the private non-farm sector
- Individuals whose highest completed degree is the upper secondary level
- Aged between 18 and 62 years
- Born between 1951 and 1995.

Data used: Variables and definitions

- $Logwage_{ift}$: Reports the real hourly wages in log terms. The hourly wage is measured in euros and it is the ratio between total regular and non-regular payroll (base wage, regular payments, non-regular benefits, and overtime payments) in the reference month and total hours of work (normal and overtime). It was deflated using the Consumer Price Index.

- *Job Separation Probability*: Reports the probability for a worker to separate between t and t+1. A worker is considered to be separated from the firm if he changes employer or leaves the firm.

- $VocationalHS_i$: Dichotomous variable indicating whether the individual highest completed degree is the upper secondary level in the Vocational education track. The employer reports the education of the worker following the instructions according to the portuguese official classification of education.

Descriptive Statistics - General versus Vocational

			N	Hourly wage (log)	Male (%)	Age (in years)	Tenure (in years)	Firm size (log)
Panel a: General versus Vocational								
		General	5,314,533	0.59	0.50	33.64	6.77	2.37
		Vocational	951,792	0.54	0.54	33.61	6.95	2.39
			6,266,325					
Panel b: 3 Cohorts in detail								
cohort 1	1951-1961	General	766,290	0.95	0.56	46.23	13.19	2.92
		Vocational	173,604	0.91	0.63	47.46	14.24	2.93
cohort 2	1962-1967	General	953,471	0.79	0.52	39.27	9.20	2.52
		Vocational	117,846	0.69	0.52	40.10	9.12	2.48
cohort 3	1968-1995	General	3,594,772	0.47	0.48	30.13	4.76	2.14
		Vocational	660,342	0.42	0.53	29.47	4.64	2.13
			6,266,325					
Panel c: 6 Cohorts in detail								
cohort 1a	1951-1956	General	268,428	1.03	0.60	49.26	14.73	3.06
		Vocational	78,324	0.98	0.68	49.92	15.97	3.09
cohort 1b	1957-1961	General	497,862	0.91	0.53	44.60	12.35	2.84
		Vocational	95,280	0.84	0.59	45.44	12.81	2.80
cohort 2	1962-1967	General	953,471	0.79	0.52	39.27	9.20	2.52
		Vocational	117,846	0.69	0.52	40.10	9.12	2.48
cohort 3a	1968-1970	General	596,902	0.66	0.49	35.22	7.24	2.28
		Vocational	78,464	0.59	0.51	35.82	7.30	2.33
cohort 3b	1971-1979	General	1,984,013	0.49	0.48	30.92	5.01	2.14
		Vocational	336,514	0.46	0.51	31.01	5.37	2.14
cohort 3c	1980-1995	General	1,013,857	0.30	0.46	25.61	2.81	2.00
		Vocational	245,364	0.30	0.55	25.31	2.80	1.99
			6,266,325					

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Selection

$$Y_{it} = \alpha_1 Vocational_{it} + \alpha_2 X_{it} + \epsilon_{it}$$

- The data are from the Ministry of Education, Observatory of Student Pathways in Secondary Schools (OTES).
- Y_{it} represents different outcomes (math and reading final grades, retention in different stages, and age of completion of the 3rd cycle) for students, at the 10th grade in academic years (2007/08, 2010/11, and 2013/14).
- The variable X_{it} includes individual and family characteristics: gender, household composition, mothers education and mothers employment status.
- Students choosing the general track score barely better on reading and math. The differences are about 0.05, this comes down to 1/20th of a grade point (1-5 point scale).

Selection

$$Y_{it} = \alpha_1 Vocational_{it} + \alpha_2 X_{it} + \epsilon_{it}$$

Table: Selection - Students reporting no intention to proceed to higher education

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Reading	Math	Retention	Retention 1st cycle	Retention 2nd cycle	Retention 3rd cycle	Age at 3rd cycle graduation
2007/2008							
Panel A1 - Specification without controls							
Vocational	-0.0503***	-0.00398	0.228***	0.0831***	0.0524***	0.148***	0.406***
	(0.0131)	(0.0218)	(0.0133)	(0.00880)	(0.00689)	(0.0126)	(0.0257)
Observations	7,825	7,796	8,032	8,058	8,058	8,058	7,799
R-squared	0.002	0.000	0.041	0.011	0.005	0.017	0.033
Panel B1 - Specification with controls							
Vocational	-0.0475***	-0.00103	0.229***	0.0729***	0.0520***	0.155***	0.405***
	(0.0135)	(0.0222)	(0.0136)	(0.00864)	(0.00719)	(0.0130)	(0.0266)
Observations	7,126	7,102	7,291	7,312	7,312	7,312	7,095
R-squared	0.021	0.011	0.051	0.033	0.007	0.023	0.042

Notes: The data are from the Ministry of Education, Observatory of Student Pathways in Secondary Schools (OTES). Details

Selection

$$Y_{it} = \alpha_1 Vocational_{it} + \alpha_2 X_{it} + \epsilon_{it}$$

- In 2007/2008, the difference in math scores is not significant. Retention rates are substantially lower for general graduates, with the gap somewhat higher in the third cycle.
- Its essential to compare vocational students with general students that have no intention to continue: the gap in reading and math would be 10 times as large, i.e. amount to half a point, if we include students that do continue to tertiary education.
- As the difference in math and reading scores between our general and vocational scores is modest, we may speculate that the differences in graduation and retention rates may have other causes than ability differences (e.g. interests and work life ambitions).

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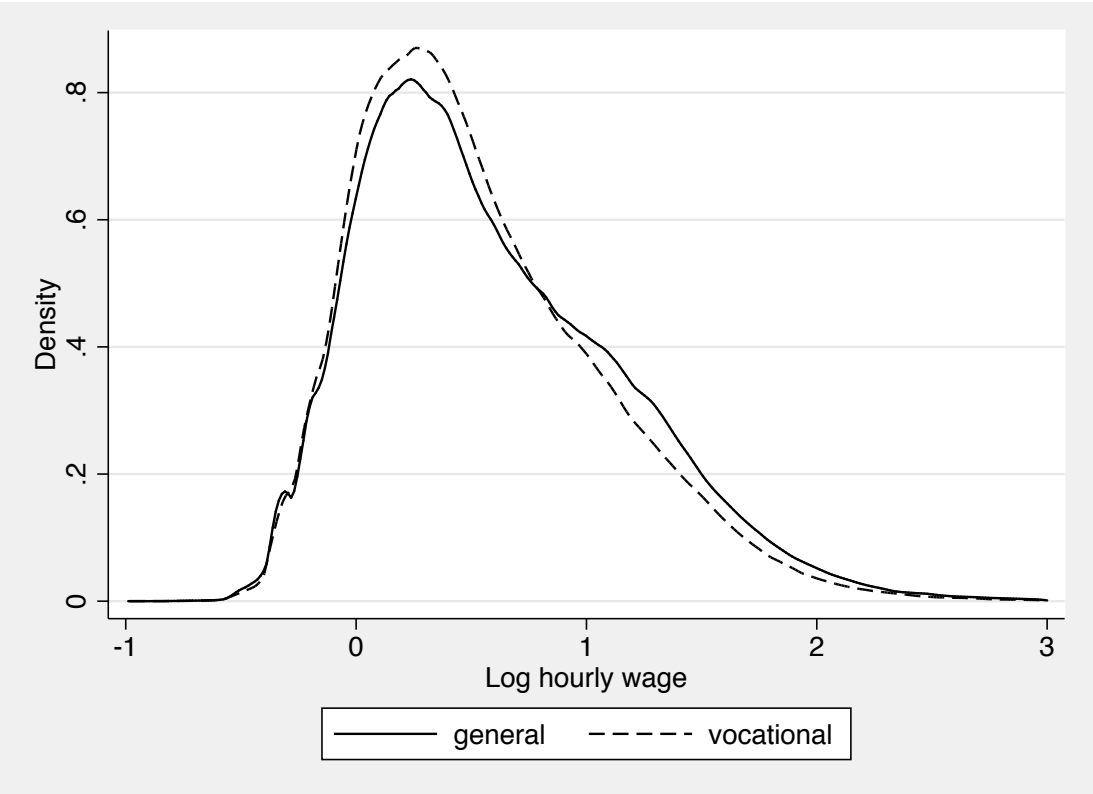
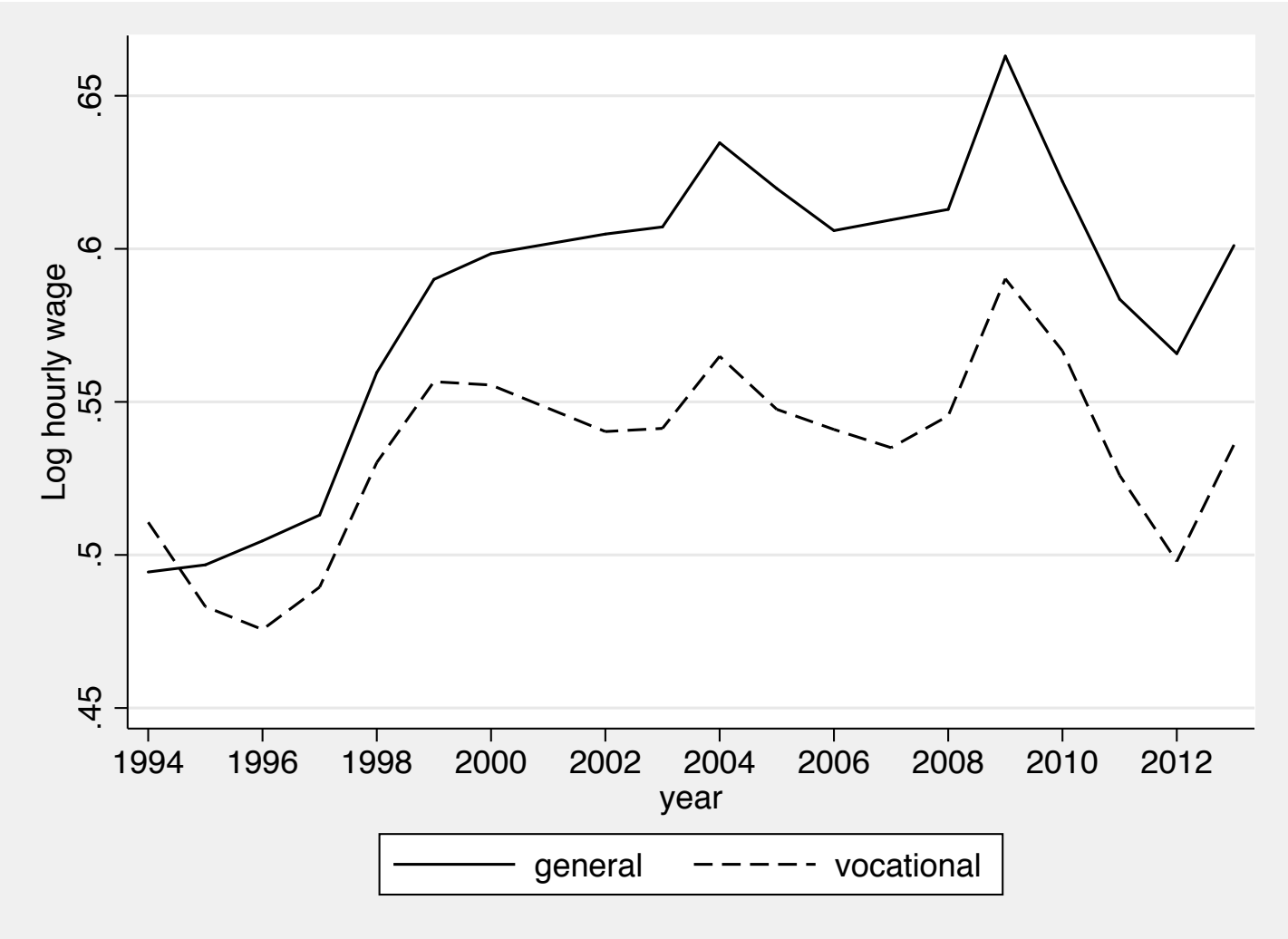
Vocational wage premium

Figure: **Log hourly wages - Vocational vs General education**

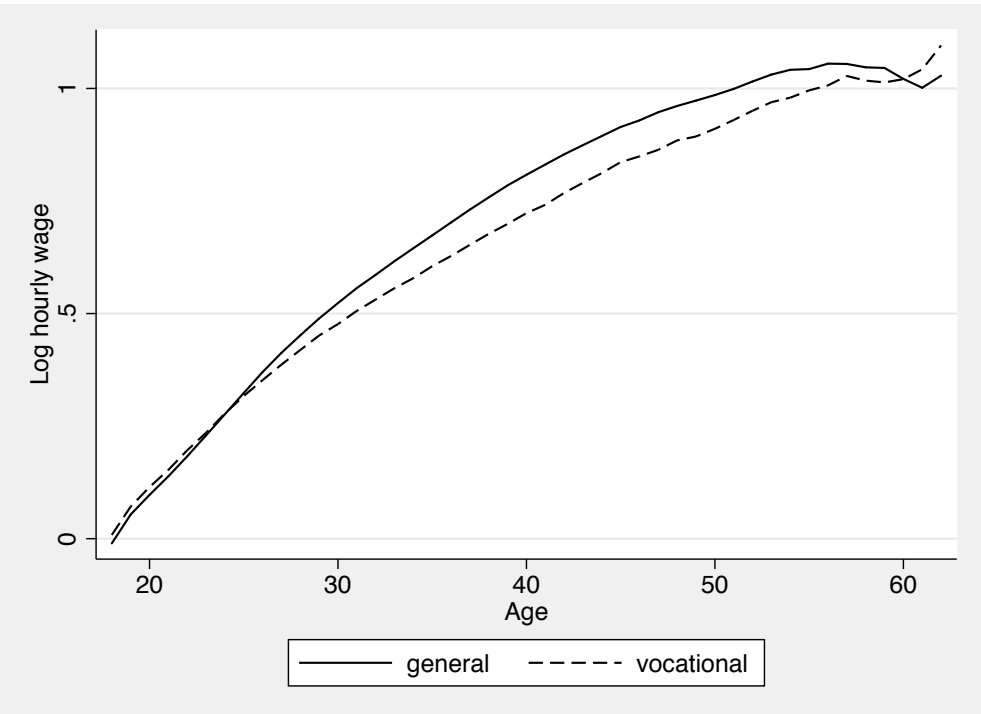


Vocational wage premium over time



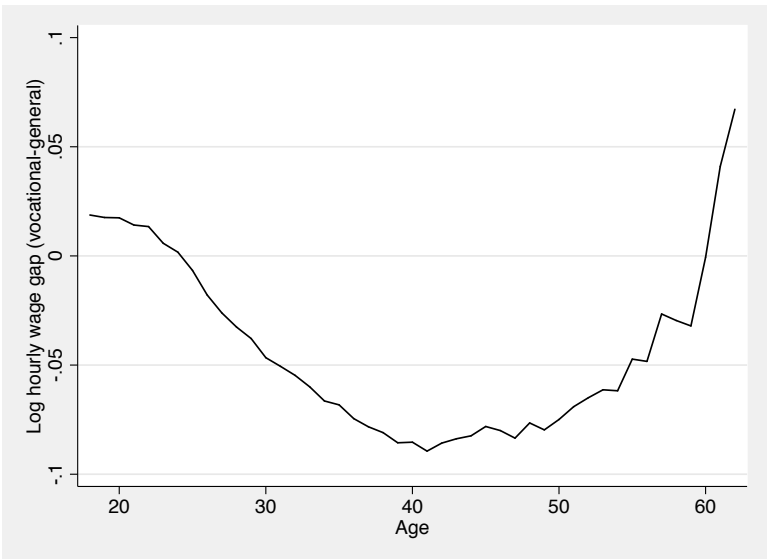
Vocational wage premium by age

Figure: **Log hourly wages - Vocational vs General education - By age**

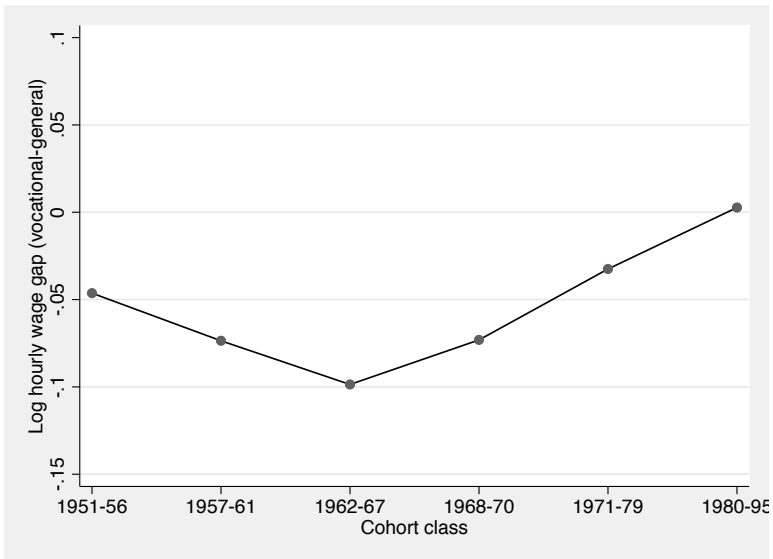


U-Shape - Vocational wage premium by age and by cohort

Figure: **Log hourly wages gap - (vocational - general)**

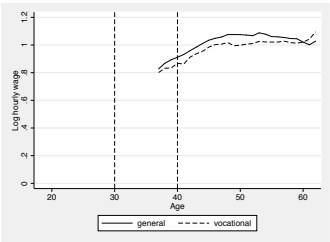


(a) age

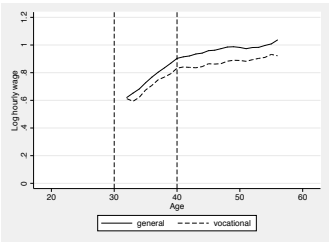


(b) cohort class

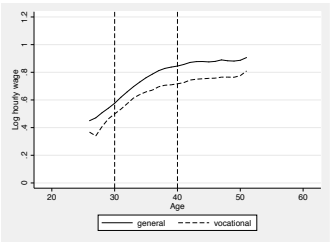
Vocational wage premium by cohort groups



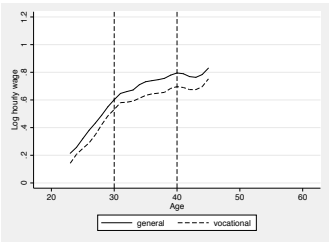
(a) Cohort class 1951-1956



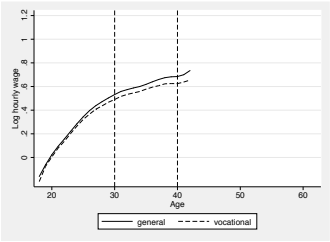
(b) Cohort class 1957-1961



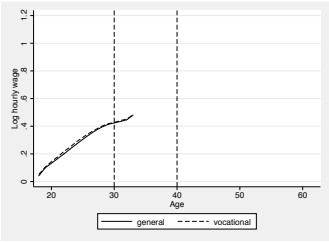
(c) Cohort class 1962-1967



(d) Cohort class 1968-1970

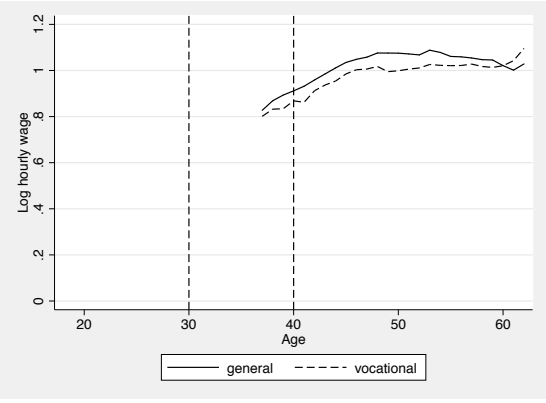


(e) Cohort class 1971-1979

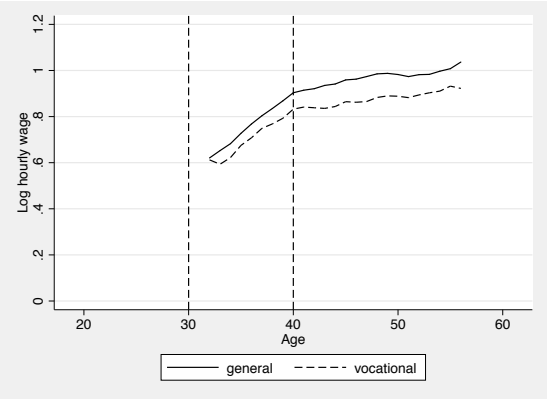


(f) Cohort class 1980-1995

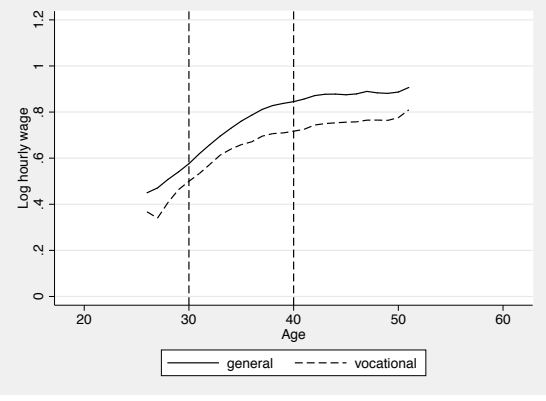
Vocational wage premium by cohort groups



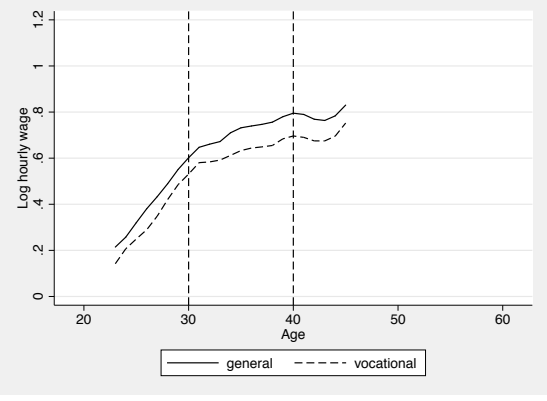
(a) Cohort class 1951-1956



(b) Cohort class 1957-1961

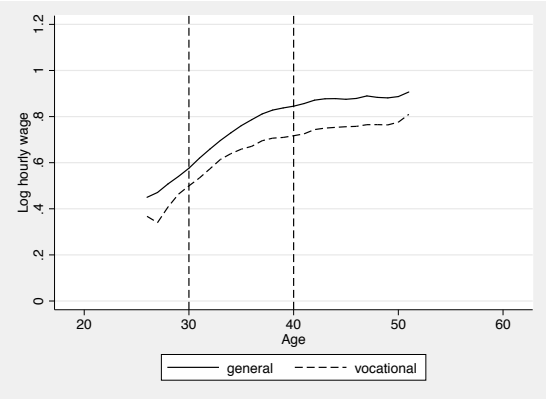


(c) Cohort class 1962-1967

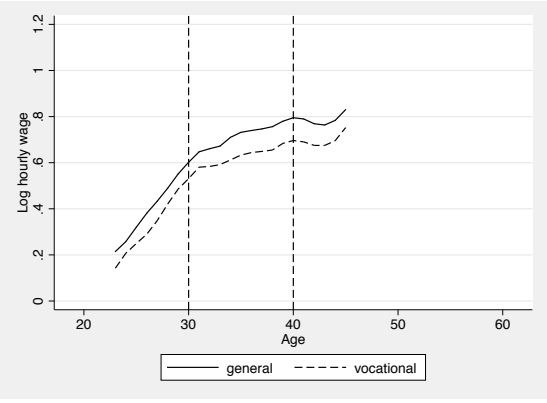


(d) Cohort class 1968-1970

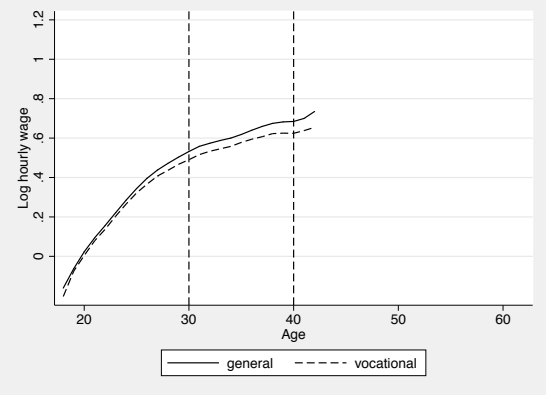
Vocational wage premium by cohort groups



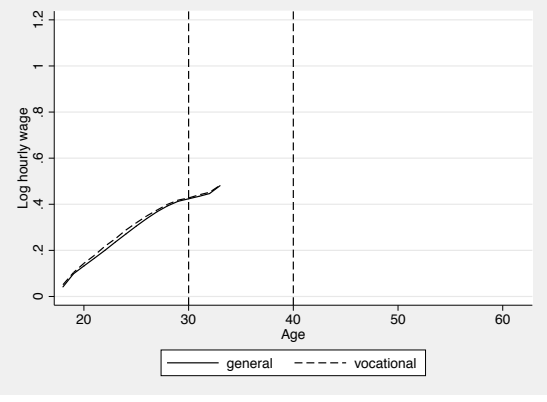
(c) Cohort class 1962-1967



(d) Cohort class 1968-1970



(e) Cohort class 1971-1979



(f) Cohort class 1980-1995

Vocational wage premium by cohort groups

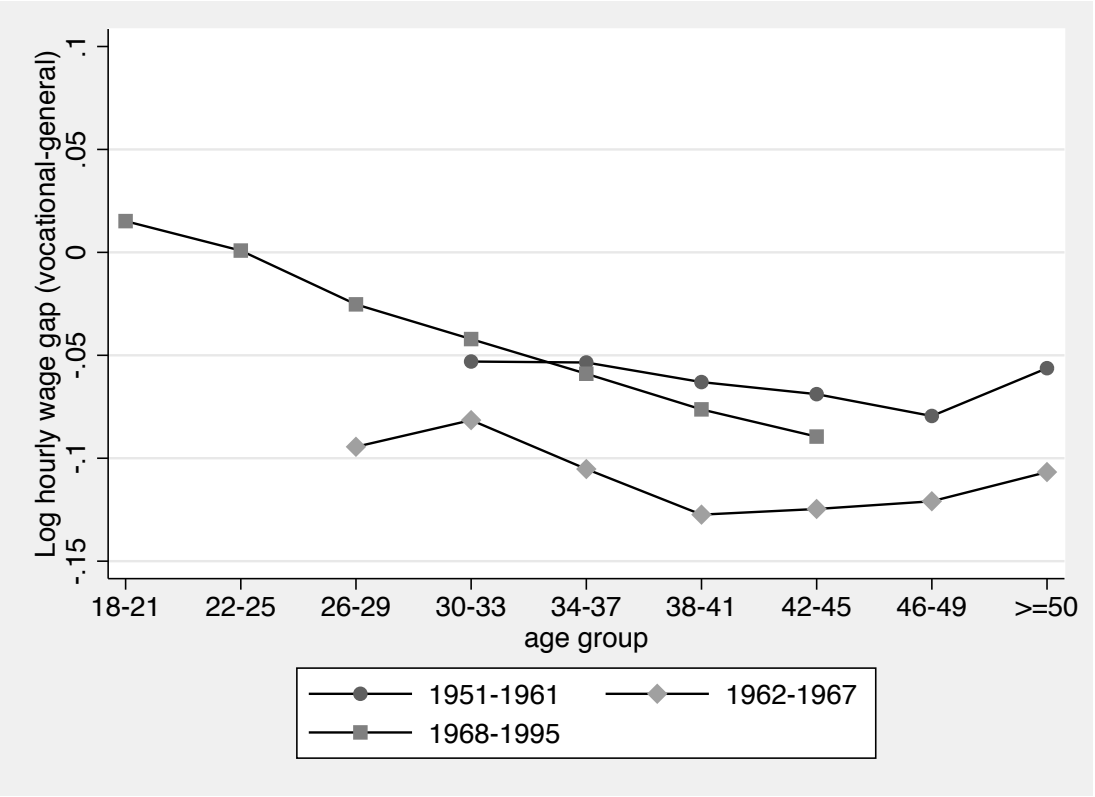
Table: Wage gap (Vocational - General) at ages 0 and 40

		Age 18	Age 30	Age 40
Cohort 1a	1951-1956	-	-	-0.043
Cohort 1b	1957-1961	-	-	-0.071
Cohort 2	1962-1967	-	-0.077	-0.128
Cohort 3a	1968-1970	-	-0.071	-0.099
Cohort 3b	1971-1979	-0.043	-0.042	-0.060
Cohort 3c	1980-1995	0.010	0.004	-

Note: This table reports the wage difference between vocational and general at ages 18, 30 and 40, by the six cohort classes. These are back of the envelope calculations from the previous figure.

U-Shape - more cohort than age

Figure: **Log hourly wage gap (vocational - general) - By Cohort class and age group)**



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- Concluding Remarks

Empirical Specification - Vocational wage gap

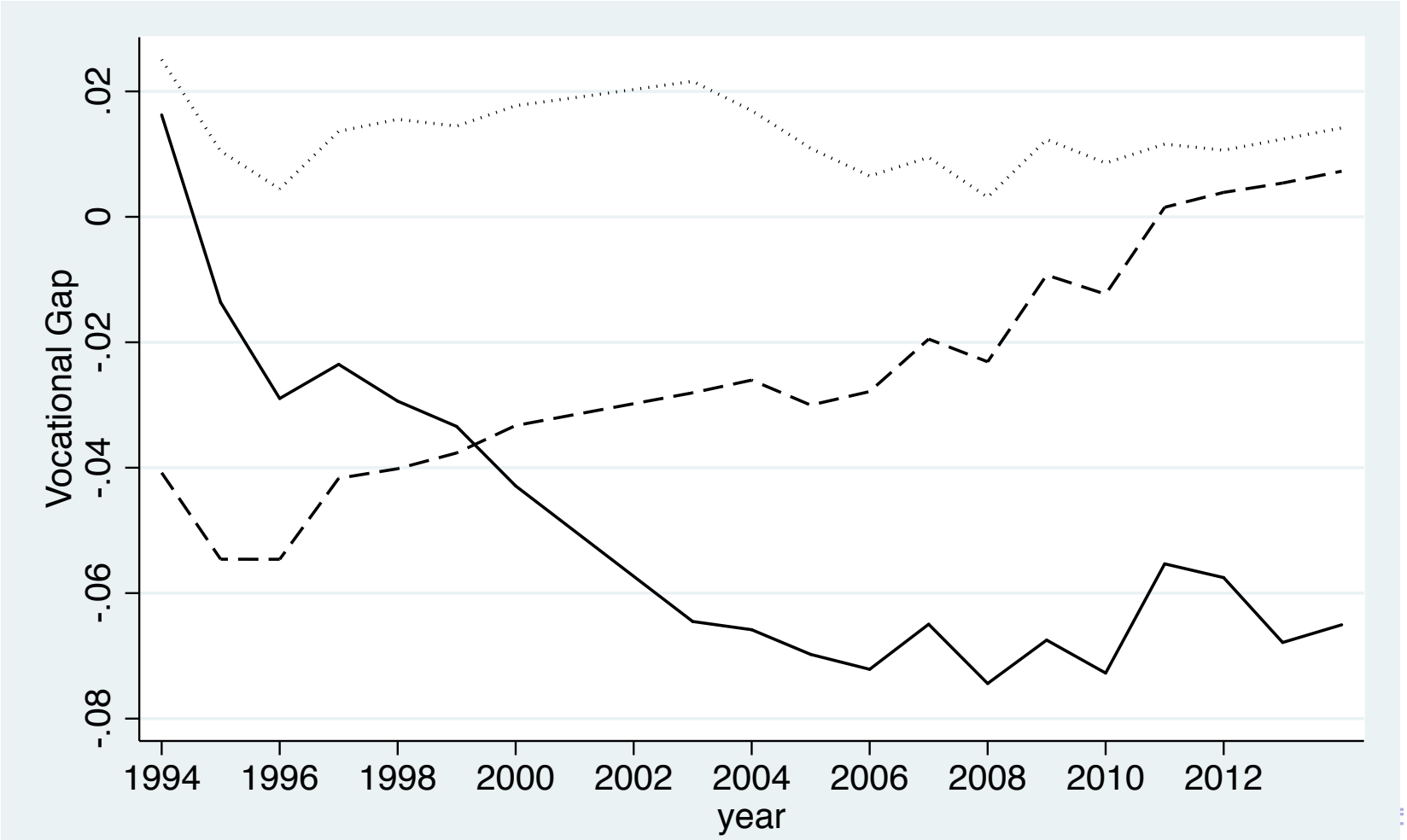
$$Logwage_{ift} = \alpha_1 VocationalHD_i + \alpha_2 Male_i + \gamma_1 Age_{it} + \gamma_2 Age_{it}^2 +$$
$$+\gamma_3 Tenure_{ift} + \gamma_4 Tenure_{ift}^2 + \beta_1 firmsize_{ft} + \theta_f + \phi_t + \epsilon_{ift}$$

Vocational wage gap (Log of the total hourly wage)

VARIABLES	(1)	(2)	(3)	(4)	(5)
VocationalHS	-0.0550***	-0.0583***	-0.0588***	-0.0174***	0.0119***
	(0.000627)	(0.000627)	(0.000524)	(0.000497)	(0.000450)
Age			0.0358***	0.0367***	0.0240***
			(8.92e-05)	(8.42e-05)	(6.82e-05)
Age^2			-0.000514***	-0.000483***	-0.000262***
			(2.40e-06)	(2.27e-06)	(1.81e-06)
Tenure			0.0303***	0.0232***	0.0214***
			(8.28e-05)	(7.86e-05)	(6.63e-05)
$Tenure^2$			-0.000334***	-0.000317***	-0.000352***
			(3.21e-06)	(3.03e-06)	(2.44e-06)
Male			0.276***	0.245***	0.170***
			(0.000376)	(0.000357)	(0.000315)
Year dummies		YES	YES	YES	YES
Firm size				YES	YES
Firm fixed effects					YES
Observations	6,266,325	6,266,325	6,266,325	6,266,325	6,266,325
R-squared	0.001	0.006	0.307	0.382	0.680

Firm Fixed Effects absorves also the year effects

Figure: Vocational wage gap

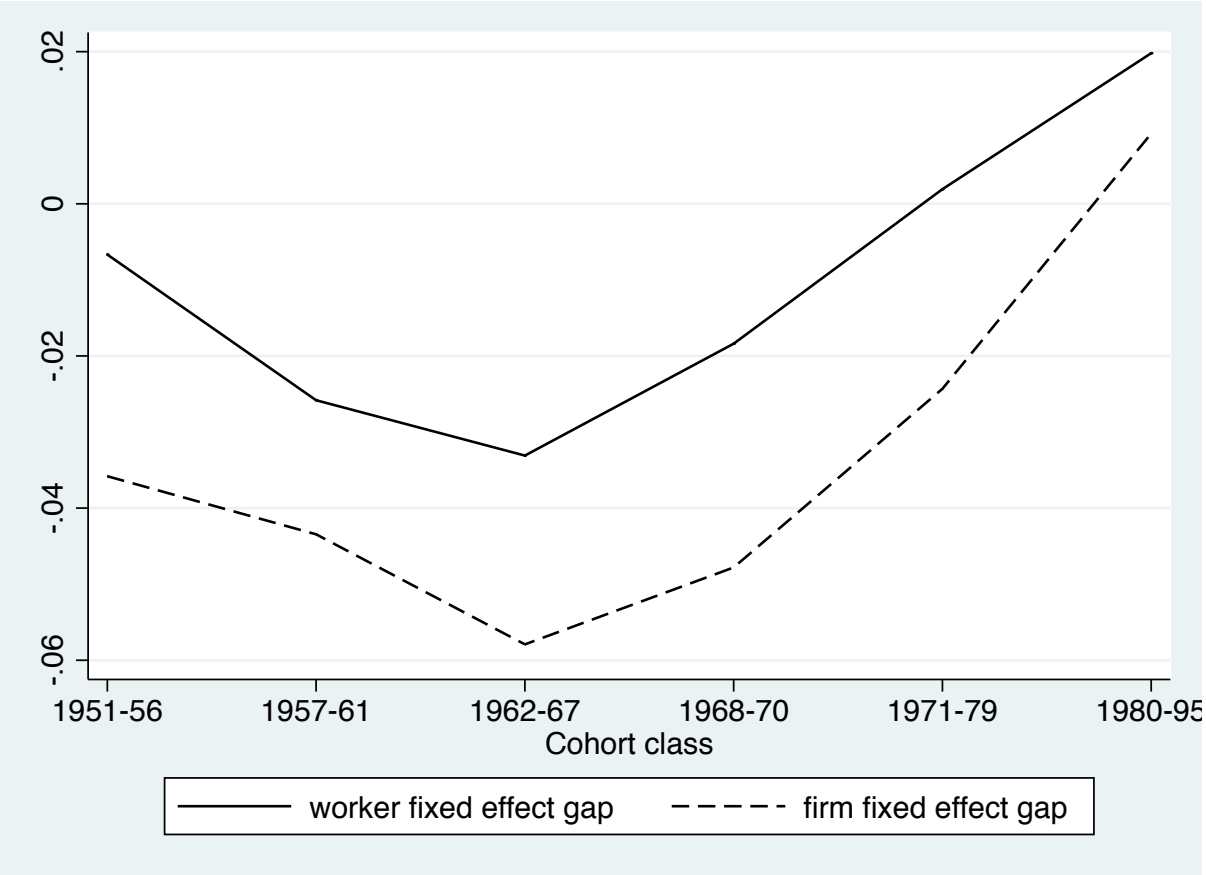


Empirical Specification - worker and firm fixed effect (fixed unobserved and observed heterogeneity)

$$Logwage_{ift} = \tilde{\gamma}_1 Age_{it}^2 + \tilde{\gamma}_2 Tenure_{ift} + \tilde{\gamma}_3 Tenure_{ift}^2 + \\ + \tilde{\beta}_1 firmsize_{ft} + \tilde{\alpha}_i + \tilde{\theta}_f + \tilde{\phi}_t + \tilde{\epsilon}_{ift}$$

Mainly Firm Fixed Effect

Figure: **Worker and Firm Fixed Effect - Vocational Gap - by cohort class**



Empirical Specification - Job Separability

$$y_i^* = g(VocationalHS_{it}.Logwage, X_{it}, u_{it}; \beta)$$

$$y_i = \begin{cases} 1 \text{ if } y_i^* > 0 \\ 0 \text{ otherwise} \end{cases}$$

where y^* is the underlying process (job separation), which cannot be observed.

Job Separation Probability - specification with logwages

Table: Job Separation Probability - specification with logwages

	(1)	(2)	(3)	(4)	(5)
Panel A					
VocationalHS	-0.0134***	-0.0116***	-0.0106***	-0.0125***	-0.00821***
	(0.00201)	(0.00208)	(0.00165)	(0.00152)	(0.00158)
VocationalHS*Logwage	0.00955**	0.00894**	0.00881**	0.00712**	0.00388**
	(0.00410)	(0.00414)	(0.00351)	(0.00300)	(0.00165)
Logwage	-0.0929***	-0.0926***	-0.0580***	-0.0491***	-0.0245***
	(0.00365)	(0.00370)	(0.00349)	(0.00259)	(0.00187)
Observations	5,565,672	5,565,672	5,565,672	5,565,672	5,565,672
R-squared	0.017	0.019	0.031	0.032	0.128

Roadmap

- Introduction/Motivation
- Some evidence from Portugal
- Aim
- Related Literature
- Data
- Selection
- Data Analysis
- Empirical Model Results
- **Concluding Remarks**

Concluding Remarks

- High School Vocational wage gap: about 5% lower wage rates.
- Cohort (U-Shape): unconditional wage gaps of 4, 10 and 5%.
  - There were Curriculum changes
  - But we cannot rule out the differences in ability
- Our results indicate that employers are aware of the relevance of the curricula of secondary education and adjust their allocation
  - Correcting for firm fixed effects the wage gap among general and vocational graduates is constant.
  - If we were able to randomly allocate individuals across firms the wage gap would turn slightly positive across all cohort classes

Concluding remarks I - GAP and U-Shape (cohort)

- GAP: In our data from Quadros Pessoal covering the years 1994-2013, graduates from vocational secondary education have about 5% lower wage rates than graduates with general secondary education as their highest degree.
- Cohort (U-Shape): When we split the sample by cohorts matching the institutional history of secondary education, as the traditional system before the Carnation Revolution of 1974, the fuzzy situation during that Revolution and the modern system thereafter, we find crude, unconditional wage gaps of 4, 10 and 5%.

Concluding remarks II -system and curriculum changes

- The increase in the wage gap from the traditional system (cohorts born 1951-1961), to the cohorts educated during the Revolution period (born 1962-1967) is explainable by a change in selection:
  1. the distinction between general and vocational secondary education was formally abolished;
  2. attendance of general education was strongly stimulated, in particular so for students from low socio-economic background

Concluding remarks III -system and curriculum changes

- The reduction of the wage gap between the traditional (cohorts born 1951-1961) and the modern school system, pre- and post-Revolution, is in line with a smaller gap in curriculum between vocational and general education:
  1. fewer school years with differentiated curriculum
  2. smaller share of specific voc courses in the voc track and
  3. Wider range of jobs than the traditional focus on blue-collar craft.
- The reduction in the wage gap is not a composition effect: it also happened within occupations and industries.
- The reduction is in line with an increase in the relative return to cognitive skills that has been observed in several labour markets, to the extent that the curriculum change in the vocational track would involve greater emphasis on development of cognitive skill.

Concluding remarks IV Cohort effect: Curriculum or ability?

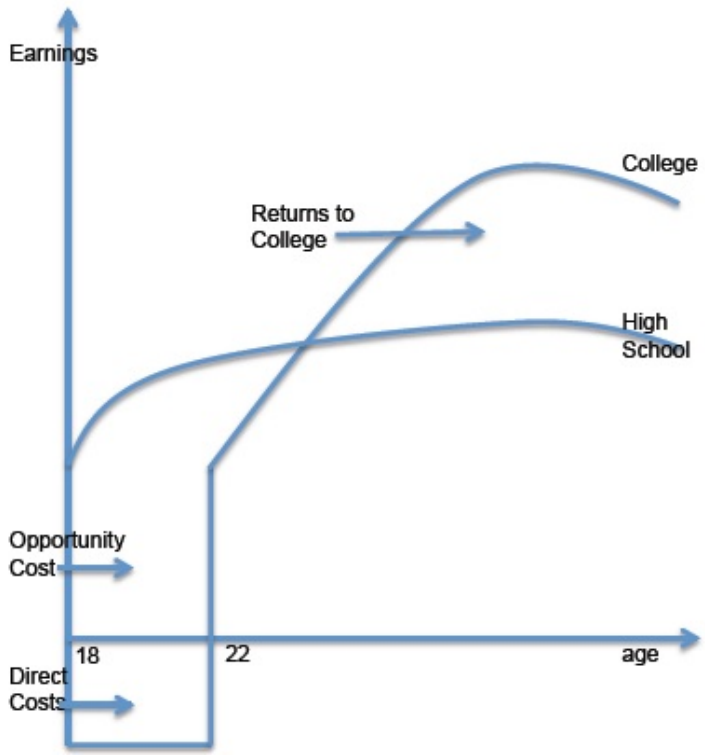
- We know that the U-shape result is a cohort effect:
- No composition effect
- There were Curriculum changes
- But we cannot rule out the differences in ability

Concluding remarks IV - The key role of firms

- Our results indicate that employers are aware of the relevance of the curricula of secondary education and adjust their allocation:
- Correcting for firm fixed effects the wage gap among general and vocational graduates is constant.
- If we were able to randomly allocate individuals across firms the wage gap would turn slightly positive across all cohort classes

Motivation - Human Capital Theory

Figure: **Human Capital Theory**



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