

SELF-SELECTION, UNIVERSITY COURSES AND RETURNS TO ADVANCED DEGREES

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August 31, 2023

EEA - ESEM – Barcelona School of Economics

MOTIVATION

1. Academic curricula at university cover a broad range of knowledge
 - ▶ E.g. a bachelor's in economics includes courses in calculus, statistics, law, and humanities.
 - ▶ **How does the combination of knowledge affect outcomes?**
2. More students worldwide enroll in master's degrees
66% Italy, 42% EU, 27% US
 - ▶ How do advanced degrees affect outcomes?
3. Policy and research attention on STEM education
Italy: 1.4 bln (2021), U.S.: 578 mln (2020), U.K.: 490 mln. (2022)
 - ▶ How does quantitative education affect outcomes?

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THIS PAPER

First systematic and large-scale analysis of **university courses**:

1. Novel approach to estimate **labor market returns to bachelor's + master's** (university careers).

- ▶ Detailed individual- and program-level data for Italy
- ▶ Identification exploits **exclusion restrictions** (access to programs) and **nested structure** (timing of choices)
Arcidiacono and Ellickson 2011

2. Relates returns to careers to university courses.

- ▶ **Timing:** Should certain disciplines be studied early?
- ▶ **Multidisciplinarity:** What combinations of bachelor's and master's do markets reward?
- ▶ **Quantitativeness:** What type of knowledge is associated with high returns?

BEFORE WE START: SOME VOCABULARY

- Field of study (FOS): economics, health, math, literature,...
- Course (field of study, credits)
- Credit: a unit of study (25h)
- Degree (bachelor's, master's, field of study)
 - ▶ Fully described by a vector of courses (FOS + credits).
- University Career (bachelor's + master's)

OVERVIEW

- 1 INTRODUCTION
- 2 INSTITUTIONAL BACKGROUND
- 3 THEORETICAL FRAMEWORK
- 4 RESULTS ON UNIVERSITY CAREERS AND COURSES
- 5 CONCLUSIONS

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HIGHER EDUCATION IN ITALY

- Italy belongs to the EHEA (48 countries)
 - ▶ comparability of higher education standards
 - ▶ fosters international mobility
 - ▶ public, geographically widespread

⇒ **Similar to most EU countries.**

- Degrees
 - ▶ Bachelor's (3 years, 180 credits)
 - ▶ Master's (2 years, 120 credits)
 - ▶ Content is highly regulated
- Admission
 - ▶ Students enroll in degrees
 - ▶ Access nationally or locally regulated
 - ▶ Bachelor's: entry exams
 - ▶ Master's: credit requirements, grades, interviews

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EMPIRICAL CHALLENGES

Objective: Estimating labor market returns to *university careers*.
But...

1. Students self-select into degrees
 - ▶ Need exogenous variations in access (exclusion restrictions)
2. Choice between several unordered alternatives
 - ▶ Excluded category is non-neutral:
Second-best choice or lack of treatment
(Kirkeboen et al. 2016, Heckman and Pinto 2018, Bhuller and Stigstad 2022)
3. *Many* endogenous choices:
 - ▶ Potential weak instrument problem in a 2SLS setting:
Must leverage reduced form
(Mikusheva, Sun 2022; Chernozhukov, Hansen 2007)

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CHOICE PROBABILITIES

- Probability of choosing bachelor j :

$$P_{ij} = \Lambda(X_i, Z_{ij}, \Theta)$$

- Probability of choosing master m having chosen bachelor j :

$$[P_{im} | j] = \Lambda(X_i, Z_{im}, \Theta | j)$$

X_i : observed individual characteristics

Z_{ij}, Z_{im} : observed characteristics which vary with individual and choice (exclusion restrictions)

Θ : fixed effects for year, macro-region and years since graduation.

RETURNS TO DEGREES

- Probability of choosing bachelor j and master m

$$P_{ijm} = P_{ij} \times [P_{im} | j]$$

- Labor market returns to $B \times M$ university careers

$$y_i = X_i \beta + \sum_{j=1}^B \sum_{m=0}^M P_{ijm} \alpha_{jm} + \Theta + u_i$$

$i \in \{I\}$ individuals, $j \in \{B\}$ bachelor degrees, $m \in \{M\}$ master degrees. X_i individual characteristics, P_{ijm} prob. of choosing career (j, m) .

INTERPRETATION OF α_{jm}

- **IV interpretation:**

α_{jm} is the **average effect** of choice jm (asymptotically)

- ▶ if α_{jm} are jointly strongly significant (Chernozhukov et al. 2008)
- ▶ if P_{ijm} uniquely affects choice jm (Bhuller et al. 2022)
- ▶ if the excluded category characterizes lack of treatment (Bhuller et al. 2022, Heckman et al. 2018)

- **Structural interpretation:**

α_{jm} is the **future utility term** of choice jm

- ▶ if the nested model accurately incorporates the determinants of choice (Arcidiacono et al. 2011)

- **Reduced form interpretation:**

α_{jm} is the labor market effect of shifts in the potential treatment P_{ijm} driven by changes in Z_{ij} and Z_{im} .

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SUMMARY OF INTERMEDIATE STEPS

- **Data:**

- ▶ 655,847 observations [▶ More on data](#)

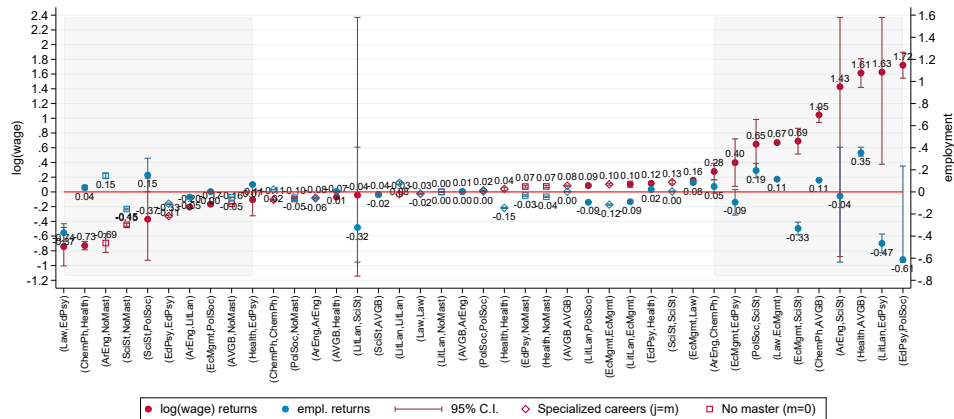
- **Model features:**

- ▶ relevant & significant exclusion restrictions
- ▶ good model fit [▶ More on model features](#)

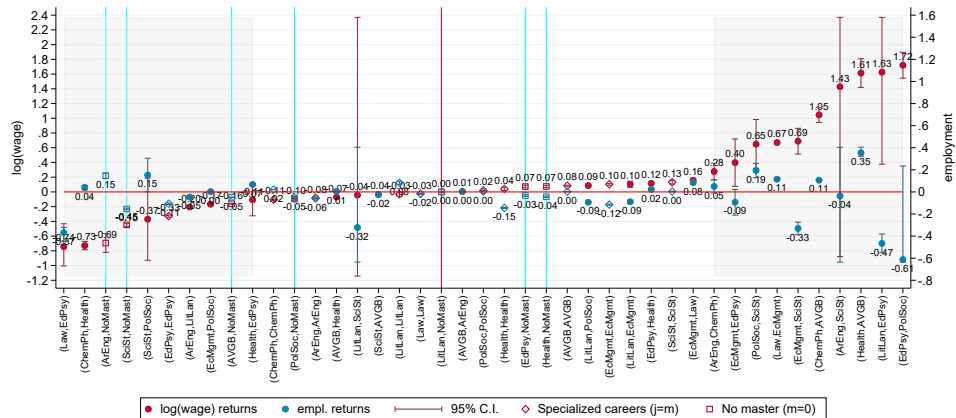
- **Model vs. OLS comparison**

- ▶ Positive self-selection bias (.27 log(wage), .07 employment) [▶ More on model vs. ols](#)

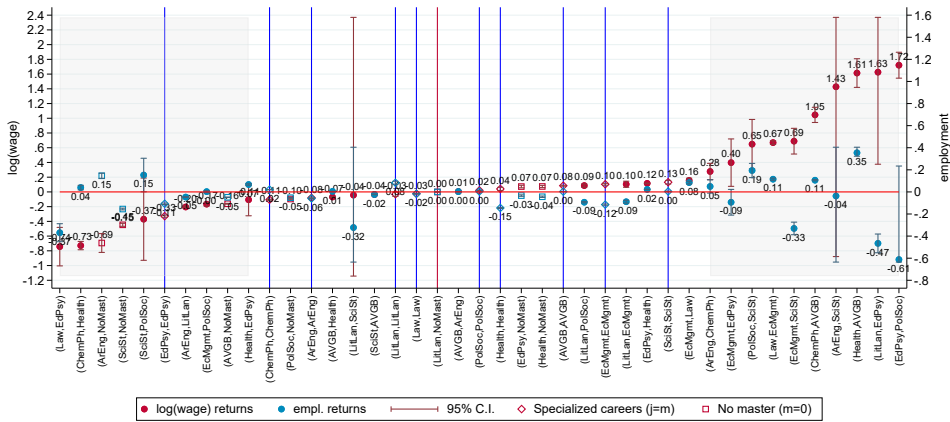
SANITY CHECKS AND MULTIDISCIPLINARITY



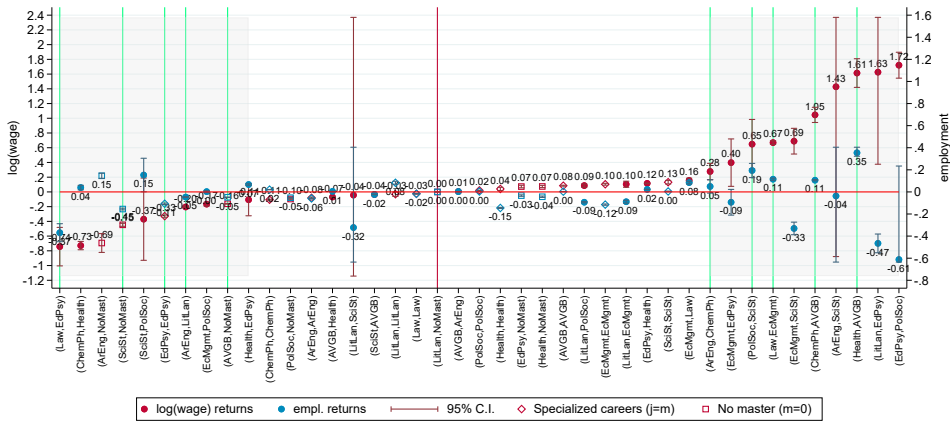
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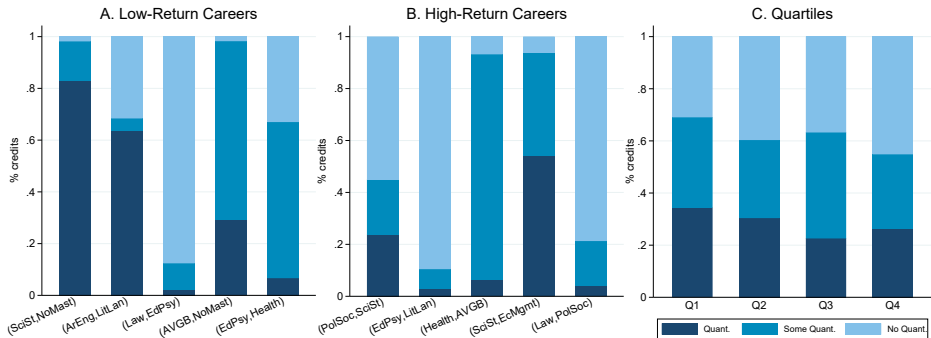
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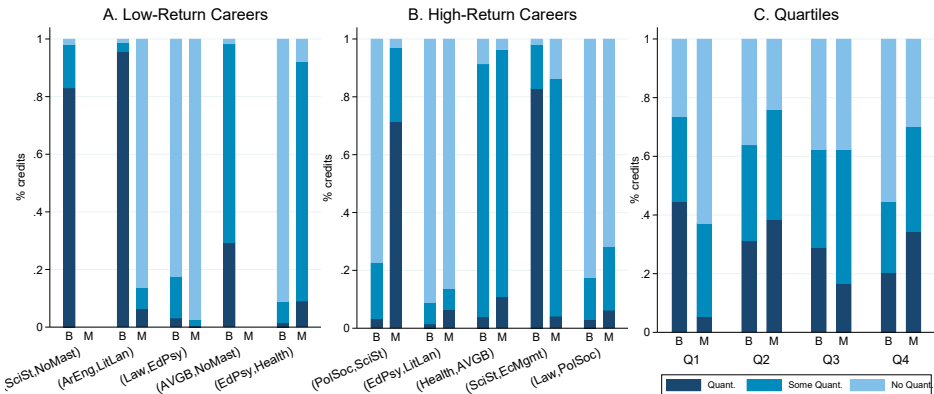


COMPARISON OF ACADEMIC CURRICULA



- **Quantitative:** Engineering, Chemistry, Science.
- **Some Quantitative:** Life Sciences, Economics, Health.
- **Non-Quantitative:** Education, Law, Humanities, other Social Sciences.

DISENTANGLING BACHELOR'S AND MASTER'S



► Symmetric Careers

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CONCLUSIONS

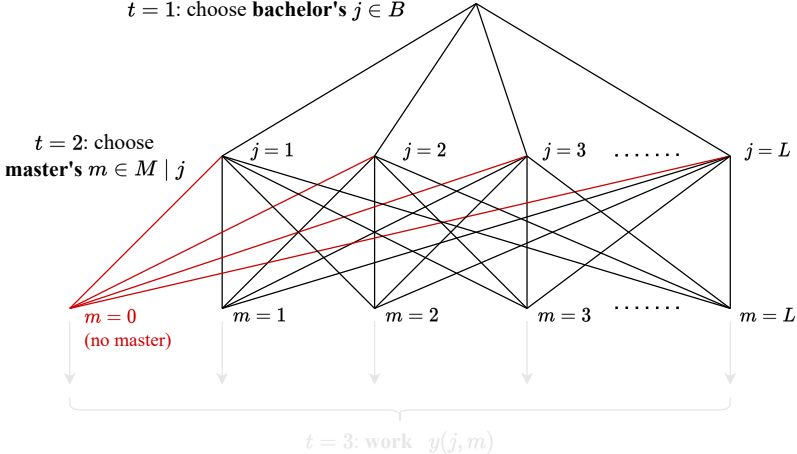
- I propose a method to causally estimate the labor market returns to a large number of university careers.
- I find that
 - ▶ Type of master's degree matters for outcomes,
 - ▶ Multidisciplinary careers can boost labor market outcomes,
 - ▶ Quantitativeness does not explain higher returns
 - ▶ Timing of courses matters.
 - Early: Humanities
 - Late: Quantitative + Technical

STEM DEFINITIONS

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Paper	Classification	Groups of Degrees Classified as STEM									
		Science	Arch. Eng.	Chem. Pharm.	Agr.Vet. Geo.Bio.	Econ. Stat.	Health	Educ. Psy.	Law	Lit. Lang.	Pol. Soc.
Adams and Kirchmaier (2016)	O*NET, authors	All	Most	Most	Some	Most	None	None	None	None	None
Ahn et al. (2019)	author	All	Most	Most	Some	All	None	None	None	None	None
Altonji et al. (2016)	author	All	All	All	All	All	All	None	None	None	None
Altonji and Zhong (2021)	author, NSCG, NSRCG	All	Most	None	All	None	None	None	None	None	None
Arcidiacono et al. (2016b)	author	All	All	All	Most	Some	None	Some	None	None	None
Arcidiacono et al. (2016a)	author	All	All	Most	All	None	Some	None	None	None	None
Bianchi and Giorelli (2020)	author	All	Most	Most	Most	Some	None	None	None	None	None
Biasi and Ma (2022)	ARC 2016	All	All	All	All	None	All	None	None	None	None
Buffington et al. (2016)	author	All	Most	All	Most	None	All	None	None	None	None
Canaan and Mouganie (2018)	author	All	All	All	All	Most	Most	None	None	None	None
Chise et al. (2021)	ISCED, MIUR, author	All	All	Most	Some	Some	None	None	None	None	None
Delaney and Devereux (2019)	ISCED, authors	All	All	All	Some	Some	All	None	None	None	None
Delaney and Devereux (2021b)	ISCED, authors	All	All	All	Some	Some	All	None	None	None	None
Deming (2017)	Autor and Dorn (2013)	All	All	Some	Some	Some	Some	None	None	None	None
Granato (2018)	MIUR	All	All	All	Some	Some	None	None	None	None	None
Kahn and Ginther (2017)	author	All	Most	All	Most	Most	None	Some	None	None	None
Maple and Stage (1991)	author	All	Most	None	None	None	None	None	None	None	None
Ng and Riehl (2020)	author	All	Most	Most	Most	Some	None	None	None	None	None
Porter and Serra (2020)	author	All	All	All	None	All	None	None	None	None	None
Rask (2010)	Anon. data provider	All	NA	All	Most	Some	None	Some	None	None	None
Schmeiser et al. (2016)	author	All	All	All	All	Some	Most	None	None	None	None
Uddin et al. (2021)	ARC 2016	All	All	All	All	None	All	None	None	None	None
Webber (2016)	author, NLSY, NSCG, ACS	All	Most	Most	Some	None	None	None	None	None	None
Winters (2014)	U.S. ICE	All	All	All	All	Some	Some	Some	None	None	None

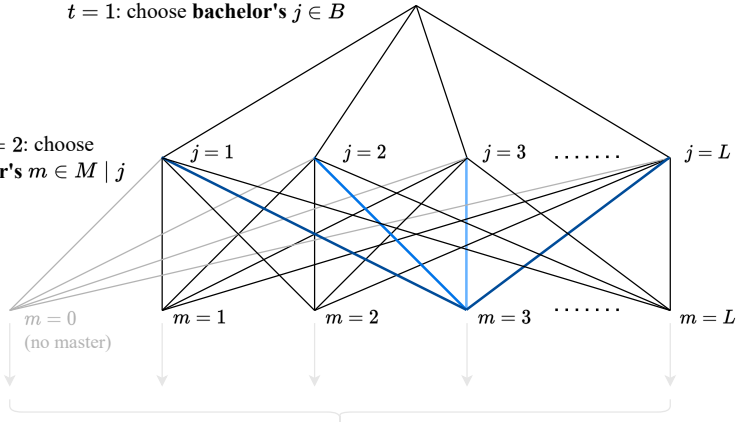
MODEL OVERVIEW



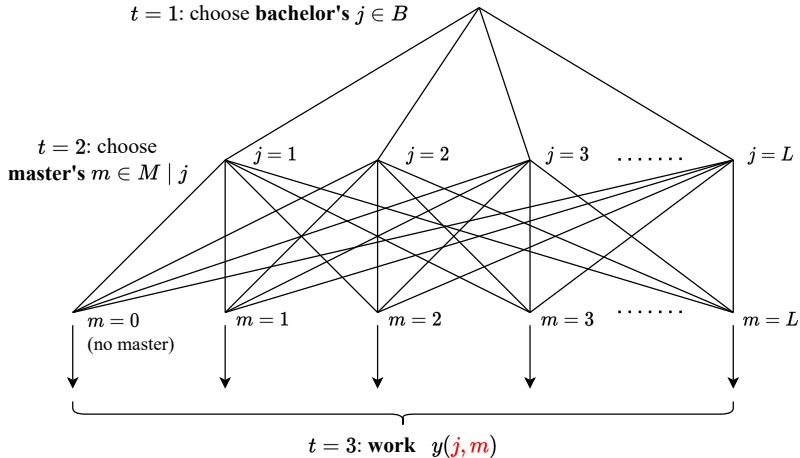
MODEL OVERVIEW

$t = 1$: choose **bachelor's** $j \in B$

$t = 2$: choose **master's** $m \in M \mid j$



MODEL OVERVIEW



DATA SOURCES

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1. **Students:** Administrative and survey data for university graduates (AlmaLaurea consortium)
 - ▶ 64/85 public/private universities (76% of universe)
 - ▶ Response rate: 80%
 - ▶ Cohorts of graduates from 2007 to 2014
 - ▶ family background, high school, university career, labor market outcomes 5 years later. [▶ \$X_i\$](#) [▶ \$y_i\$](#)

2. Programs:

- ▶ Degree and course content [▶ Degree Content](#)
 - 47 bachelor degrees, 99 master degrees. [▶ Degree description ex.](#)
 - 370 university courses.

- ▶ Admission requirements: 2296 university programs. [▶ Exclusion Restrictions](#)

⇒ Complete data for 655,847 graduates. [▶ Career Matrix](#)

L-33 Scienze Economiche

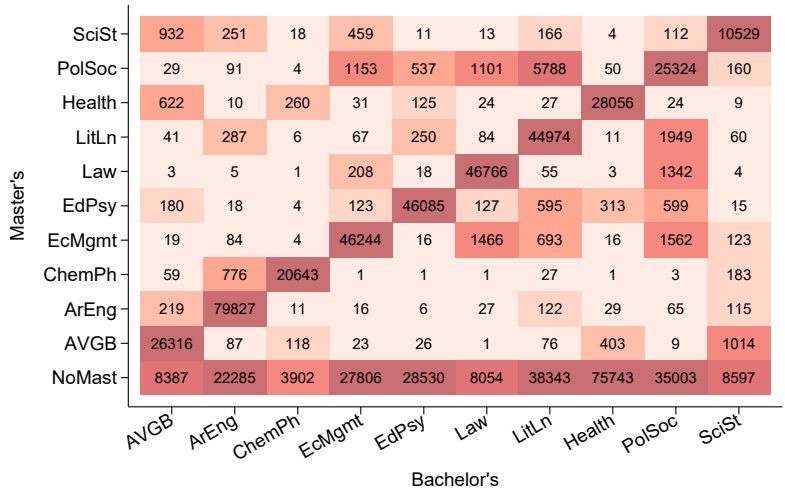
ATTIVITÀ FORMATIVE INDISPENSABILI				
Attività formative:	Ambiti disciplinari	Settori scientifico-disciplinari	CFU	Tot. CFU
Di base	Economico	SECS-P/01 - Economia politica SECS-P/02 - Politica economica SECS-P/12 - Storia economica	8	28
	Aziendale	SECS-P/07 - Economia aziendale SECS-P/08 - Economia e gestione delle imprese SECS-P/11 - Economia degli intermediari finanziari	8	
	Statistico-matematico	SECS-S/01 - Statistica SECS-S/03 - Statistica economica SECS-S/06 - Metodi matematici dell'economia e delle scienze attuariali e finanziarie	6	
	Giuridico	IUS/01 - Diritto privato IUS/04 - Diritto commerciale IUS/09 - Istituzioni di diritto pubblico	6	
Caratterizzanti	Economico	M-GGR/02 - Geografia economico-politica SECS-P/01 - Economia politica SECS-P/02 - Politica economica SECS-P/03 - Scienza delle finanze SECS-P/04 - Storia del pensiero economico SECS-P/05 - Econometria SECS-P/06 - Economia applicata	32	62
	Aziendale	SECS-P/07 - Economia aziendale SECS-P/08 - Economia e gestione delle imprese SECS-P/09 - Finanza aziendale SECS-P/11 - Economia degli intermediari finanziari	7	

Statistico-matematico	SECS-S/01 - Statistica SECS-S/03 - Statistica economica SECS-S/04 - Demografia SECS-S/06 - Metodi matematici dell'economia e delle scienze attuariali e finanziarie	14
Giuridico	IUS/05 - Diritto dell'economia IUS/06 - Diritto della navigazione IUS/07 - Diritto del lavoro IUS/09 - Istituzioni di diritto pubblico IUS/10 - Diritto amministrativo IUS/13 - Diritto internazionale IUS/14 - Diritto dell'unione europea	9

TOTALE	90
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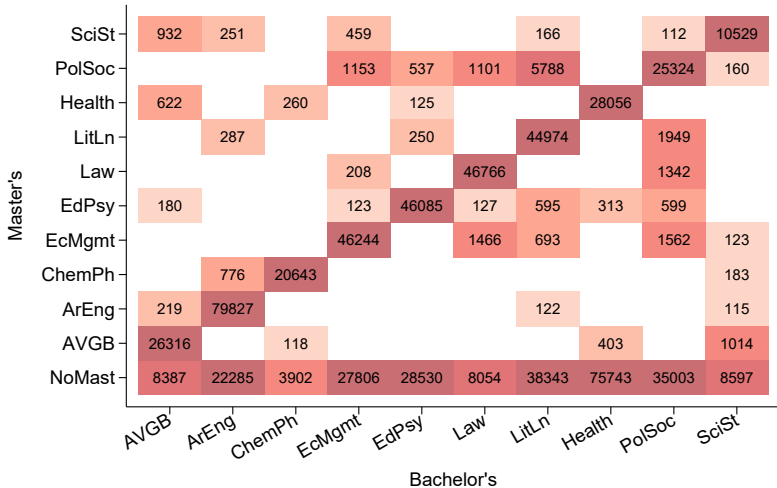
UNIVERSITY CAREERS

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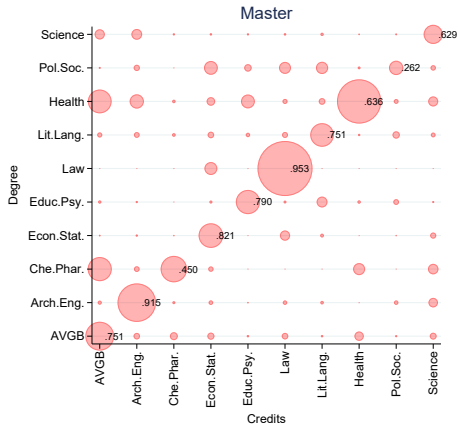
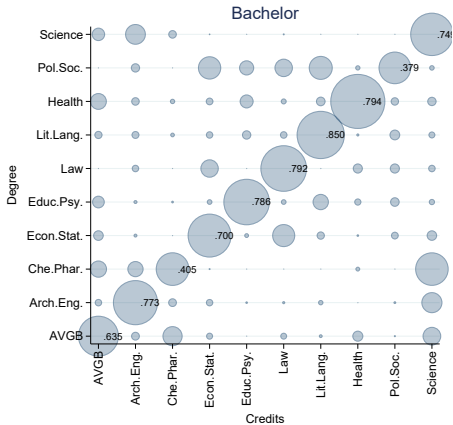


UNIVERSITY CAREERS

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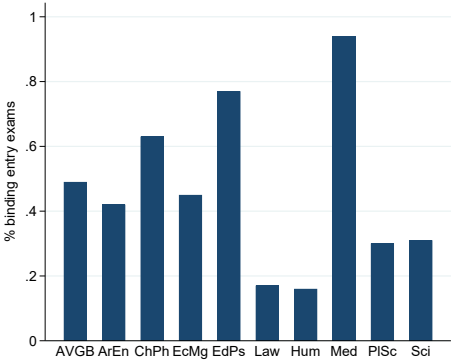


DEGREE CONTENT

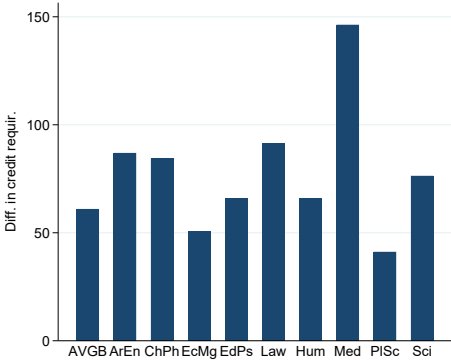


EXCLUSION RESTRICTIONS

A. Z_j : Entry Exam Variables



B. Z_m : Credit Requirement Variables



EXCLUSION RESTRICTIONS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	All	AVGB	Arch.Eng.	Chem.Ph.	Ec.Mg.	Ed.Ps.	Law	Lit.Lan.	Med.	Pol.Soc.	Sci.St
<i>Z_j – Exclusion restrictions for the bachelor</i>											
Entry Exam*	0.51 (0.500)	0.54 (0.499)	0.51 (0.500)	0.72 (0.451)	0.35 (0.477)	0.72 (0.448)	0.11 (0.314)	0.20 (0.403)	0.99 (0.106)	0.48 (0.499)	0.25 (0.433)
<i>Z_m – Exclusion restrictions for the master</i>											
Final grade (B)	-0.00 (1.000)	0.10 (0.917)	-0.11 (0.977)	-0.04 (1.029)	-0.53 (1.085)	-0.02 (0.923)	-0.20 (1.040)	0.38 (0.802)	0.38 (0.911)	-0.12 (0.944)	-0.09 (1.086)
ECTS requir.*	-5.12 (23.16)	-1.59 (12.78)	-19.20 (44.89)	-0.31 (3.023)	-0.35 (6.135)	-2.67 (11.84)	-1.07 (8.741)	-5.48 (22.35)	-1.79 (16.20)	-3.03 (13.02)	-3.75 (12.36)
log(distance)	10.03 (2.956)	9.94 (3.087)	10.21 (2.664)	9.82 (3.156)	10.23 (2.558)	10.03 (2.966)	9.85 (3.238)	10.12 (2.813)	9.91 (3.165)	9.82 (3.247)	10.07 (2.885)
Observations	651617	37179	106243	26175	75907	74731	59901	90434	96453	64243	20351

*These variables vary at degree level and consist of 10 distinct variables, one for every choice j or m . They are presented here as an average for descriptive purposes.

DEGREE CONTENT - BACHELOR

Total ECTSs in each field of study

AVGB Arch.Eng. Che.Pharm. Econ.Stat. Educ.Psy. Law Lit.Lang. Health Pol.Soc. Science

	AVGB	Arch.Eng.	Che.Pharm.	Econ.Stat.	Educ.Psy.	Law	Lit.Lang.	Health	Pol.Soc.	Science
AVGB	54.55	2.07	12.47	1.20	0.00	1.17	0.27	3.43	0.03	10.62
Arch.Eng.	1.40	66.81	2.03	1.38	0.08	0.15	0.63	0.00	0.11	13.75
Che.Pharm.	8.92	7.88	36.47	0.03	0.00	0.00	0.00	0.49	0.00	36.22
Econ.Stat.	3.13	0.27	0.00	63.04	0.49	16.62	1.78	0.08	1.54	3.05
Educ.Psy.	4.64	0.30	0.09	0.73	70.82	0.73	7.99	1.28	2.50	0.92
Law	0.00	1.40	0.00	10.30	0.00	71.30	0.00	2.80	2.80	1.40
Lit.Lang.	1.74	1.63	0.44	1.37	2.34	1.42	76.51	0.13	3.24	1.17
Health	8.57	1.92	0.63	1.52	5.72	0.81	2.51	100.13	1.84	2.34
Pol.Soc.	0.00	2.33	0.00	16.95	6.81	10.38	18.07	0.59	34.19	0.67
Science	5.26	13.32	1.93	0.01	0.00	0.03	0.00	0.00	0.00	61.53

DEGREE CONTENT - MASTER

		Total ECTSs in each field of study									
		AVGB	Arch.Eng.	Che.Pharm.	Econ.Stat.	Educ.Psy.	Law	Lit.Lang.	Health	Pol.Soc.	Science
Master	AVGB	54.76	2.13	3.38	2.61	0.14	2.19	0.14	4.98	0.10	2.42
	Arch.Eng.	0.69	99.30	0.29	0.90	0.02	0.86	0.45	0.00	0.85	5.11
	Che.Pharm.	37.82	1.56	45.57	1.33	0.00	0.00	0.00	8.56	0.00	6.37
	Econ.Stat.	0.04	0.12	0.01	39.42	0.00	6.00	0.57	0.00	0.01	1.83
	Educ.Psy.	0.37	0.11	0.00	0.30	37.89	0.25	6.91	0.40	1.60	0.07
	Law	0.00	0.00	0.00	10.00	0.00	206.00	0.00	0.00	0.00	0.00
	Lit.Lang.	1.18	1.59	0.50	2.15	0.81	1.72	36.10	0.13	2.82	1.00
	Health	36.68	12.46	0.44	4.04	11.71	1.14	2.26	132.35	1.01	5.75
	Pol.Soc.	0.07	1.91	0.00	11.55	2.93	8.53	8.85	0.23	12.58	1.35
	Science	6.02	6.74	0.11	0.14	0.09	0.15	0.38	0.03	0.05	23.25

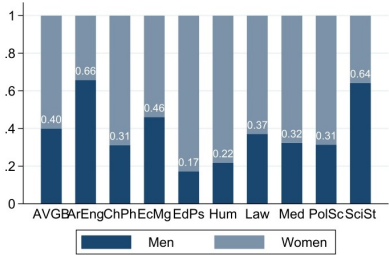
INDIVIDUAL CHARACTERISTICS X_i

	All	AVGB	Arch.Eng.	Chem.Ph.	Ec.Mg.	Ed.Ps.	Law	Lit.Lan.	Med.	Pol.Soc.	Sci.St.
HS: grade (st.)	0.00 (1.000)	0.02 (0.966)	0.29 (0.950)	0.09 (0.955)	0.04 (0.990)	-0.31 (0.958)	0.06 (0.980)	0.10 (0.984)	-0.18 (1.034)	-0.20 (0.982)	0.22 (0.992)
HS: hum.	0.16 (0.363)	0.13 (0.340)	0.08 (0.273)	0.18 (0.382)	0.07 (0.261)	0.14 (0.346)	0.34 (0.474)	0.24 (0.425)	0.14 (0.350)	0.16 (0.368)	0.06 (0.243)
HS: science	0.39 (0.488)	0.53 (0.499)	0.55 (0.497)	0.57 (0.495)	0.36 (0.481)	0.27 (0.446)	0.33 (0.469)	0.27 (0.442)	0.42 (0.494)	0.29 (0.453)	0.52 (0.499)
Gender (1=female)	0.62 (0.485)	0.60 (0.489)	0.34 (0.475)	0.69 (0.462)	0.54 (0.498)	0.83 (0.376)	0.63 (0.483)	0.78 (0.413)	0.67 (0.469)	0.68 (0.465)	0.36 (0.481)
Parents: grad.	0.27 (0.442)	0.28 (0.447)	0.32 (0.466)	0.34 (0.474)	0.23 (0.420)	0.18 (0.387)	0.37 (0.482)	0.27 (0.442)	0.24 (0.429)	0.23 (0.420)	0.27 (0.445)
Parents: high-rank occ.	0.22 (0.413)	0.21 (0.407)	0.25 (0.433)	0.27 (0.442)	0.22 (0.411)	0.16 (0.370)	0.31 (0.461)	0.21 (0.405)	0.19 (0.396)	0.20 (0.401)	0.18 (0.385)
Empl. rate (prov. birth)	61.57 (18.50)	60.69 (19.47)	67.47 (17.43)	57.79 (18.93)	63.85 (18.28)	57.61 (17.99)	57.97 (18.95)	60.08 (17.86)	60.47 (17.86)	60.81 (18.73)	68.05 (17.57)
Univ. Qual. Index	-0.00 (1.000)	-0.01 (1.050)	0.05 (0.966)	-0.04 (1.029)	0.02 (1.013)	0.01 (0.993)	-0.13 (1.027)	0.06 (0.973)	-0.06 (1.005)	0.00 (0.986)	0.09 (1.021)
Obs.	651617	37179	106243	26175	75907	74731	59901	90434	96453	64243	20351

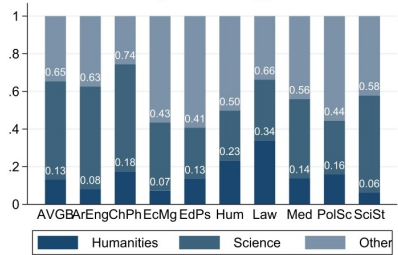
INDIVIDUAL CHARACTERISTICS

◀ BACK

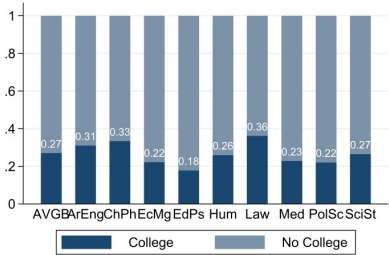
Gender



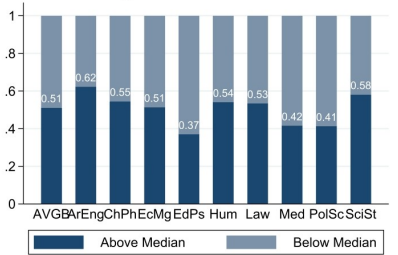
High School Type



Parent Education



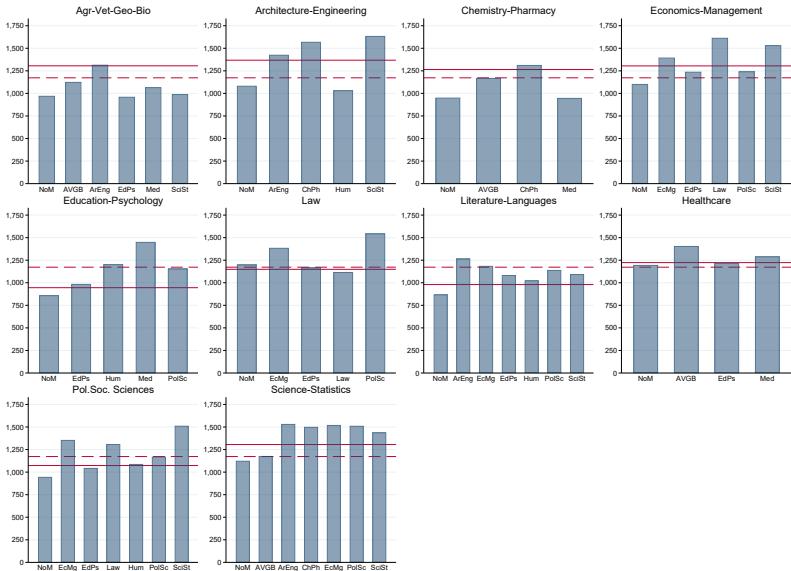
High School Final Grade



LABOR MARKET OUTCOMES: WAGES

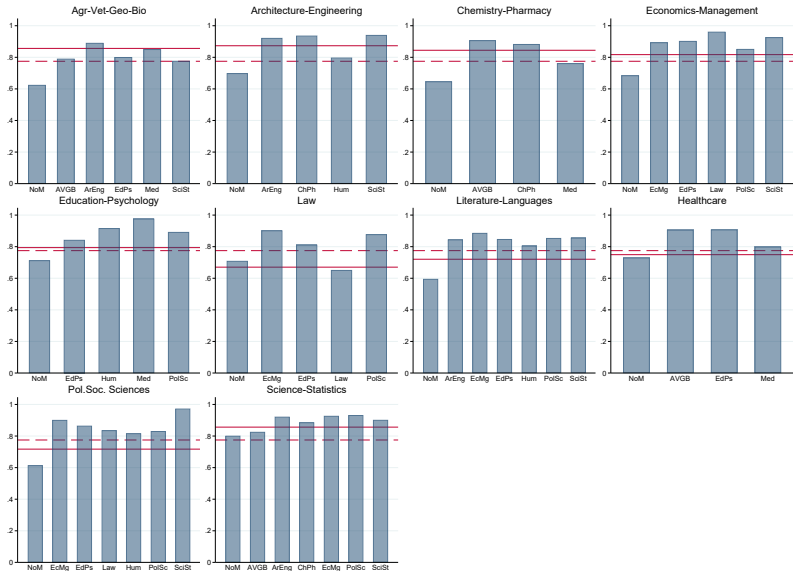
▶ EMPLOYMENT

◀ BACK



LABOR MARKET OUTCOMES: EMPLOYMENT

◀ BACK



LABOR MARKET OUTCOMES y_i

	(1) All	(2) AVGB	(3) Arch.Eng.	(4) Chem.Ph.	(5) Ec.St.	(6) Ed.Ps.	(7) Law	(8) Lit.Lan.	(9) Med.	(10) Pol.Soc.	(11) Sci
Employment	0.80 (0.396)	0.80 (0.398)	0.89 (0.313)	0.87 (0.335)	0.84 (0.369)	0.81 (0.393)	0.72 (0.450)	0.75 (0.435)	0.80 (0.402)	0.74 (0.439)	0.89 (0.314)
Wage (2015 Eur)*	1179.73 (580.9)	1093.19 (571.5)	1368.65 (597.2)	1264.96 (482.1)	1312.33 (544.1)	950.55 (466.7)	1143.33 (639.3)	985.35 (499.4)	1244.69 (625.6)	1080.98 (542.9)	1315.93 (582.2)
Log(wage)*	6.67 (1.447)	6.27 (1.989)	6.98 (1.106)	6.78 (1.455)	6.97 (1.029)	6.61 (1.029)	6.25 (2.064)	6.55 (1.277)	6.51 (1.836)	6.71 (1.103)	6.76 (1.550)
Observations	651617	37179	106243	26175	75907	74731	59901	90434	96453	64243	20351

* Calculated on sample of employed.

◀ Back

SUMMARY OF MODEL FEATURES

[◀ BACK](#)

$t = 1$: Choice of bachelor's

- Z_{ij} : strongly relevant and significant. [▶ Test of Excl. Restr.](#)

[▶ Policy Simulations](#)

- Good model fit.

[▶ Coefficients for \$Z_{ij}\$](#) [▶ Model fit](#)

$t = 2$: Choice of master's

- Z_{im} : strongly relevant and significant. [▶ Test of Excl. Restr.](#)

- Good model fit.

[▶ Model fit](#)

T=3: LABOR MARKET OUTCOMES

◀ BACK

Reduced form equation:

$$y_i = X_i \beta^{RF} + \sum_{j=1}^B \sum_{m=0}^M P_{ijm} \alpha_{jm} + \Theta + u_i^{RF}$$

OLS equation (endogenous):

$$y_i = X_i \beta^{OLS} + \sum_{j=1}^B \sum_{m=0}^M D_{ijm} \gamma_{jm} + \Theta + u_i^{OLS}$$

- X : Student and family background, university quality index, employment rate 25-34, additional controls for local labor markets and university quality.
- Θ : Year, macro-region, years since graduation FEs.

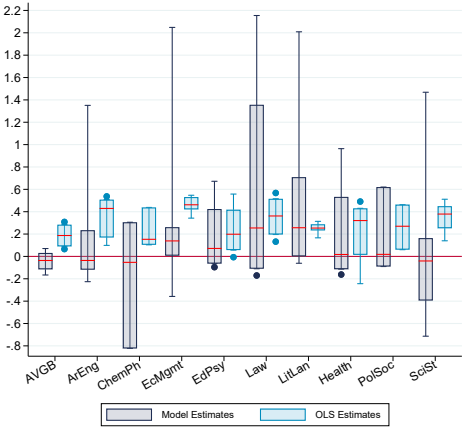
▶ Occupations

▶ β coefficients

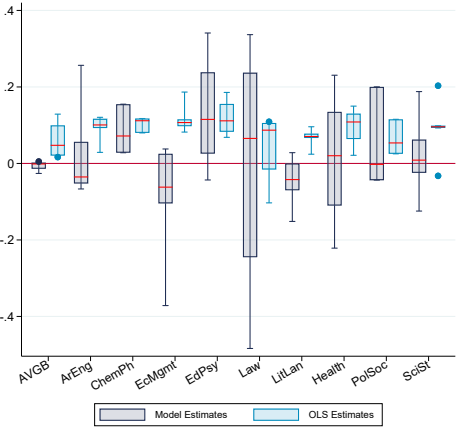
COMPARISON OF SELECTED COEFFICIENTS

◀ BACK

A. Log(wages)



B. Employment



Self-selection bias: log(wages) 0.27, employment 7p.p.

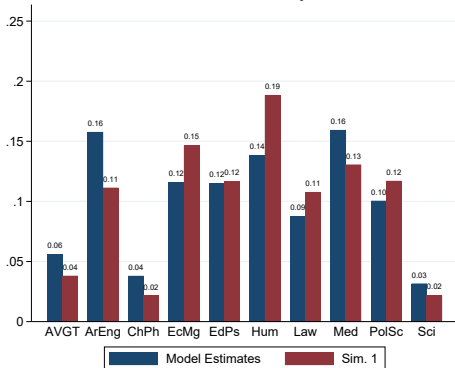
▶ All coefficients

T=1: EXCLUSION RESTRICTIONS Z_{ij}

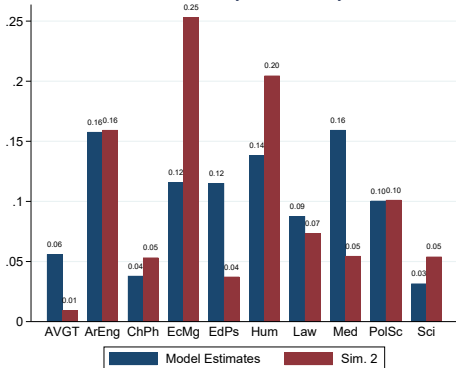
Tested Var.	χ^2	d.f.
All Z_{ij}	46572.6	90
AVGB	3557.03	9
Arc.Eng.	2672.36	9
Che.Pharm.	9441.17	9
Econ.Mgmt.	3155.64	9
Educ.Psyc.	5385.44	9
Hum.	2613.46	9
Law	7722.88	9
Health	6836.68	9
Pol.Soc.	2787.76	9
Sci.Stat.	1857.02	9

T=1: POLICY SIMULATIONS

Simulation 1: No Entry Exam



Simulation 2: Entry Exam Everywhere



T=2: EXCLUSION RESTRICTIONS Z_{im}

Conditional Choice of Bachelor	D.f.	χ^2	Observations
Agr.Vet.Geo.Bio.	20	3888.65	32,494
Architecture and Engineering	16	9225.68	79,817
Chemistry and Pharmacy	3	300.2	7,398
Economics and Management	5	12373.04	75,993
P.E., Teaching and Psychology	8	15935.39	62,741
Law	4	980.19	10,882
Literature and Languages	24	2765.93	90,681
Healthcare and Medicine	3	577.41	81,883
Political and Social Sciences	30	8343.32	65,798
Science and Statistics	12	1012.37	20,721

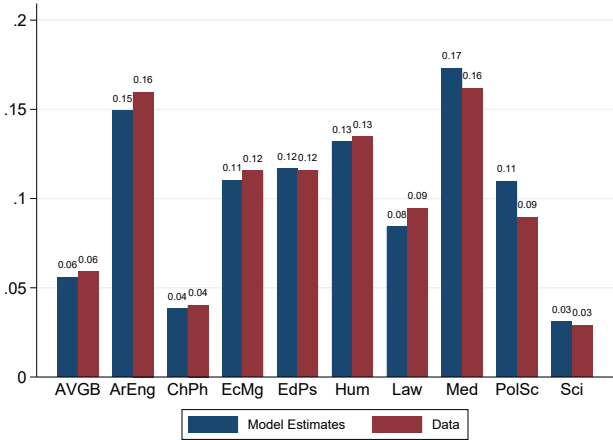
T=1: CHOICE OF BACHELOR

VARIABLES	AVGB (1)	Arc.Eng. (2)	Chem.Ph. (3)	Econ.Mg. (4)	Ed.Psy. (5)	Law (6)	Health (7)	Pol.Soc. (8)	Sci.Stat. (9)
<i>Z_j: Entry Exams</i>									
AVGB	-0.527*** (0.053)	-0.461*** (0.038)	-0.145** (0.063)	-1.331*** (0.039)	0.807*** (0.041)	0.539*** (0.045)	0.526*** (0.040)	0.300*** (0.041)	0.332*** (0.064)
Arc.Eng.	0.320*** (0.073)	0.637*** (0.054)	1.454*** (0.085)	-0.831*** (0.055)	-0.629*** (0.056)	-0.158*** (0.061)	1.428*** (0.054)	0.375*** (0.058)	1.141*** (0.094)
Chem.Ph.	0.282*** (0.047)	0.501*** (0.034)	-0.737*** (0.056)	-0.015 (0.034)	-0.890*** (0.036)	-0.301*** (0.039)	-2.508*** (0.035)	-0.333*** (0.037)	-1.444*** (0.057)
Econ.Mg.	-0.109*** (0.035)	-0.186*** (0.026)	-0.677*** (0.041)	-0.271*** (0.026)	-0.180*** (0.028)	-0.308*** (0.031)	-1.212*** (0.025)	-0.442*** (0.028)	-0.143*** (0.044)
Ed.Psy.	0.329*** (0.043)	0.924*** (0.031)	-0.145*** (0.050)	0.325*** (0.033)	0.887*** (0.032)	-0.103*** (0.034)	1.853*** (0.032)	0.020 (0.032)	0.848*** (0.055)
Law	1.848*** (0.059)	1.378*** (0.044)	1.043*** (0.066)	1.244*** (0.046)	0.813*** (0.047)	1.244*** (0.050)	1.873*** (0.044)	0.458*** (0.047)	0.736*** (0.071)
Hum	-4.569*** (0.096)	-0.499*** (0.064)	-2.914*** (0.103)	0.580*** (0.064)	-3.077*** (0.068)	-2.332*** (0.073)	-3.874*** (0.071)	-2.064*** (0.068)	-1.658*** (0.100)
Health	6.876*** (0.138)	2.693*** (0.102)	7.326*** (0.163)	4.235*** (0.103)	3.999*** (0.105)	2.987*** (0.113)	6.855*** (0.101)	1.795*** (0.108)	4.261*** (0.175)
Pol.Soc.	-1.297*** (0.101)	-2.262*** (0.073)	0.893*** (0.113)	0.130* (0.073)	-0.888*** (0.078)	-0.188** (0.085)	0.967*** (0.073)	0.674*** (0.079)	0.373*** (0.121)
Sci.Stat.	0.864*** (0.085)	-0.060 (0.062)	0.543*** (0.096)	-0.256*** (0.062)	1.245*** (0.064)	0.599*** (0.072)	-1.171*** (0.060)	0.436*** (0.066)	0.045 (0.102)
X					Yes				
Θ					Yes				
Observations	655,847	655,847	655,847	655,847	655,847	655,847	655,847	655,847	655,847

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Pseudo R² = 0.103.

Base category: AVGB. Year and macro-region FE, additional controls included.

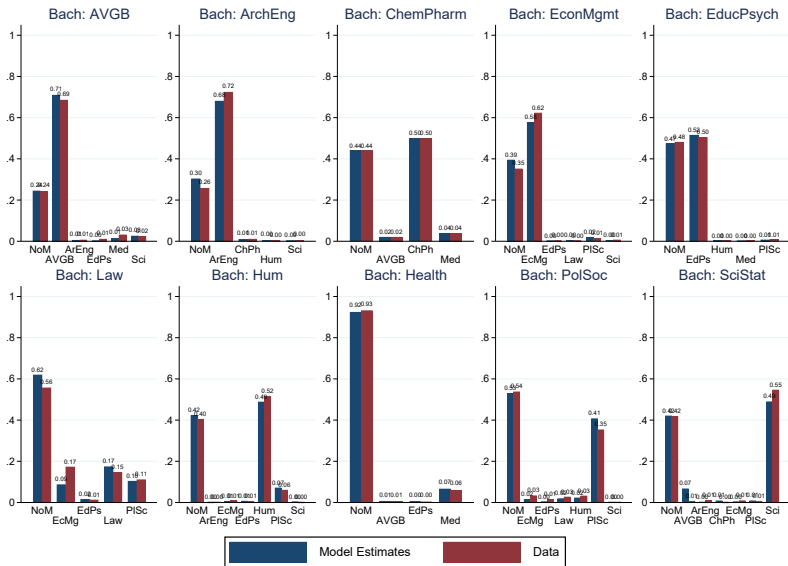
T=1: MODEL FIT



Fit on cohorts 2007-2011, estimates and data for 2012-2014.

T=2: CHOICE OF MASTER (CONDITIONAL)

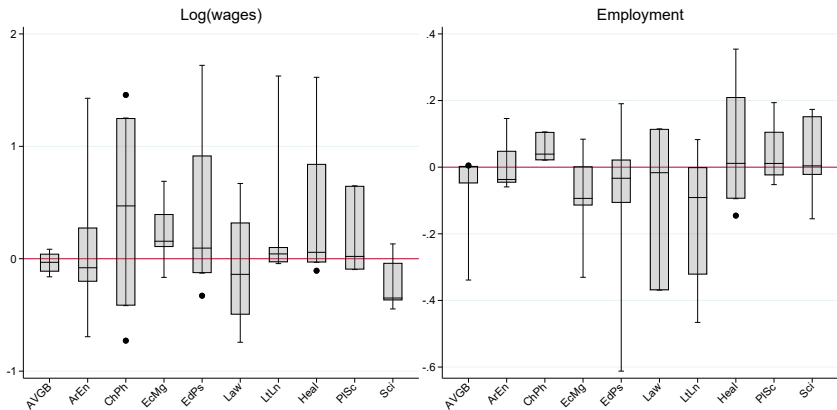
▶ BACK



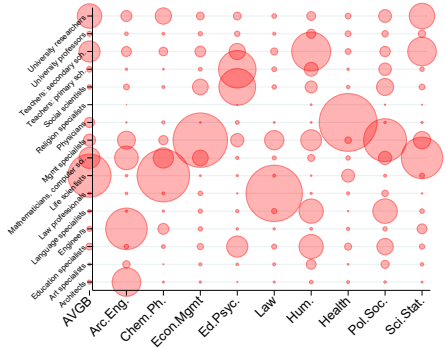
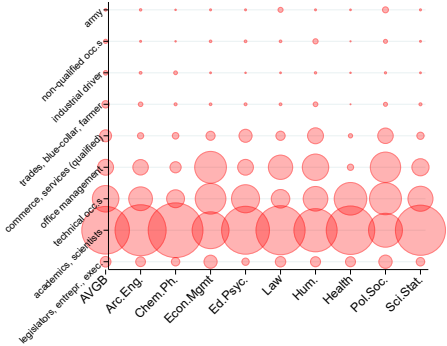
T=3: LABOR MARKET OUTCOMES β [← BACK](#)

VARIABLES	log(wage) employed		employment	
	OLS (1)	Red. Form (2)	OLS (3)	Red. Form (4)
X (selected)				
High School: grade (st.)	-0.018*** (0.001)	0.052 (0.447)	0.004*** (0.001)	0.226*** (0.087)
High School: humanities	-0.079*** (0.003)	-0.095 (0.519)	-0.032*** (0.002)	-0.001 (0.115)
High School: science	-0.048*** (0.002)	-0.232 (0.658)	-0.020*** (0.001)	0.514*** (0.149)
Gender (1=female)	-0.154*** (0.003)	-0.721 (1.884)	0.009*** (0.001)	0.134 (0.352)
Parents: graduate	-0.042*** (0.003)	-0.052 (0.663)	-0.027*** (0.001)	0.137** (0.07)
Parents: high-ranked occup.	0.004 (0.003)	0.096 (0.4)	0.002 (0.001)	0.157 (0.114)
Θ	Yes	Yes	Yes	Yes
D_{jm}	Yes		Yes	
P_{jm}		Yes		Yes
Observations	508,242	508,242	655,847	655,847
R-squared	0.101		0.125	
Mean y	6.887	6.887	0.775	0.775

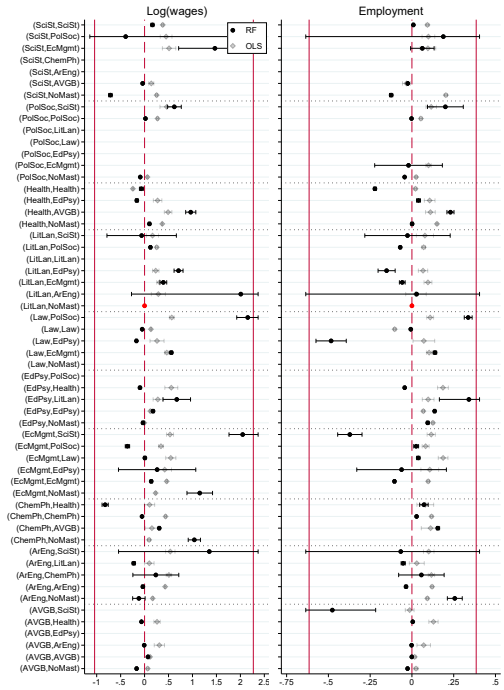
T=3: LABOR MARKET OUTCOMES: SELECTED TEs



MODEL SELECTION – OCCUPATIONS



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SYMMETRIC CAREERS

