Who wants to be a teacher? The selection of talent into the teaching profession in Sweden 1985-2013

Esteban Aucejo
Arizona State University

Michael Boehm
University of Bonn & UBC

Georg Graetz
Uppsala University

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Research question(s)

What kinds of people choose to work as teachers, and how does this change over time?

How have teachers' wages changed?

How do wages affect the selection of talent into teaching?

Why care about teachers?

Effect of teachers on students' test scores and earnings

Chetty, Friedman, & Rockoff (2014, AER): identifying teacher value added from teacher switches, strong effects; but see critique by Rothstein (2015, WP)

Association b/w test scores & economic growth

E.g. Hanushek & Woessmann (2012, JEG)

Tentative evidence that teacher quality has been declining

E.g. Bacolod (2007, REStat), Corcoran et al. (2004, AER P&P), Hoxby & Leigh (2004, AER P&P), Fredriksson & Öckert (2007, WP)

How is talent allocated to sectors?

Dal Bo et al (2013, QJE): higher wages attract more capable public sector workers in Mexico; Borjas (2002, WP) on returns to skill

Our paper—data

Overcome challenges faced by previous studies on decline in teacher quality and allocation of talent; take advantage of

- population-level skill measures (military scores, high school GPA, Swedish SAT)
- population-level longitudinal wage and workplace information
- precise information on teacher status
- long time series of 29 years
- sufficient number of observations to exploit regional variation

Our paper—contribution

Document striking decline of teacher talent in Sweden

Document novel wage evidence

- striking decline in relative teacher wages
- but teacher wage premia (worker FEs) are constant
- switching teachers switch to worse outside jobs over time

Argue that falling wages have caused weaker selection of teachers by

- ruling out other explanations
- using variation of teacher and non-teacher pay in panel of local labor markets

Outline

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Background on the Swedish school system

Decentralization

Shifting responsibility from central government to municipalities: hiring (1991), financing (1993), wage setting (1996); see Ahlin & Mörk (2008, EER), Fredriksson & Öckert (2008, SJE)

Entry of private schools

Voucher reform ensuring public funding of private primary (1992-) and secondary (1994-) schools; see Hensvik (2012, EJ)

Changes in performance over time

Around OECD average in PISA 2000, steady downward trend, significantly below average in 2012, see OECD (2015)

Data sources

LOUISE (LISA)

- education, industry, annual earnings, municipality of workplace

Wage structure registers

- standardized monthly wages for all public sector workers & sample of private sector workers

Teacher register

- job-level information on teachers—type of school, whether on leave

Military archives

- cognitive and non-cognitive skills for males who took an enlistment exam—about 60-80 percent of males born 1954-1987

High-school graduation register

- final high-school GPA for males and females born 1965-1990

Our talent measures

Cognitive and non-cognitive tests taken at males' military enlistment age 18-19

- standard IQ, more fluid than AFQT in US (which is achievement test, more crystallized)
- non-cognitive scores from interview to elicit willingness to assume responsibility, independence, outgoing character, persistence, emotional stability, power of initiative (related to Big 5, functioning in very demanding environment—combat)
- strongly predict private labor market outcomes: unemployment, earnings, manager/CEO (Erik Lindqvist and coauthors), family outcomes & health, elected into office (Dal Bo et al. 2016), patenting (Bell et al., Aghion et al., 2016)
- high school grades arguably a mixture of cog. and non-cog. (Almlund et al. 2011) and similar relationship to outcomes
- impute military scores for females using brothers

Highly predictive measures, even controlling for anything else! More general question of drivers of allocation of talent...

Do our skill measures predict teaching ability?

Evidence from the US

Among teachers in DC public schools, undergraduate GPA & college selectivity highly correlated with teaching performance, see Jacobs et al. (2016, WP); these measures would be strongly correlated with ours

Evidence from Sweden

Within-student estimates suggest heterogeneity matters: cognitive skills mainly benefit high-achieving students, the opposite for non-cognitive skills; GPA of male teachers positively correlated with student performance, female GPA negatively; see Grönqvist & Vlachos (2008, WP)

Interpretation?

Evidence relates to skill differences conditional on choosing to teach—different issue from changing the teacher pool

Data processing

Sample selection

Ages 26-55, drop observations with low earnings, extremely low or high monthly wages, drop individuals with less than 50 percent FTE

Dealing with incomplete coverage

Military scores

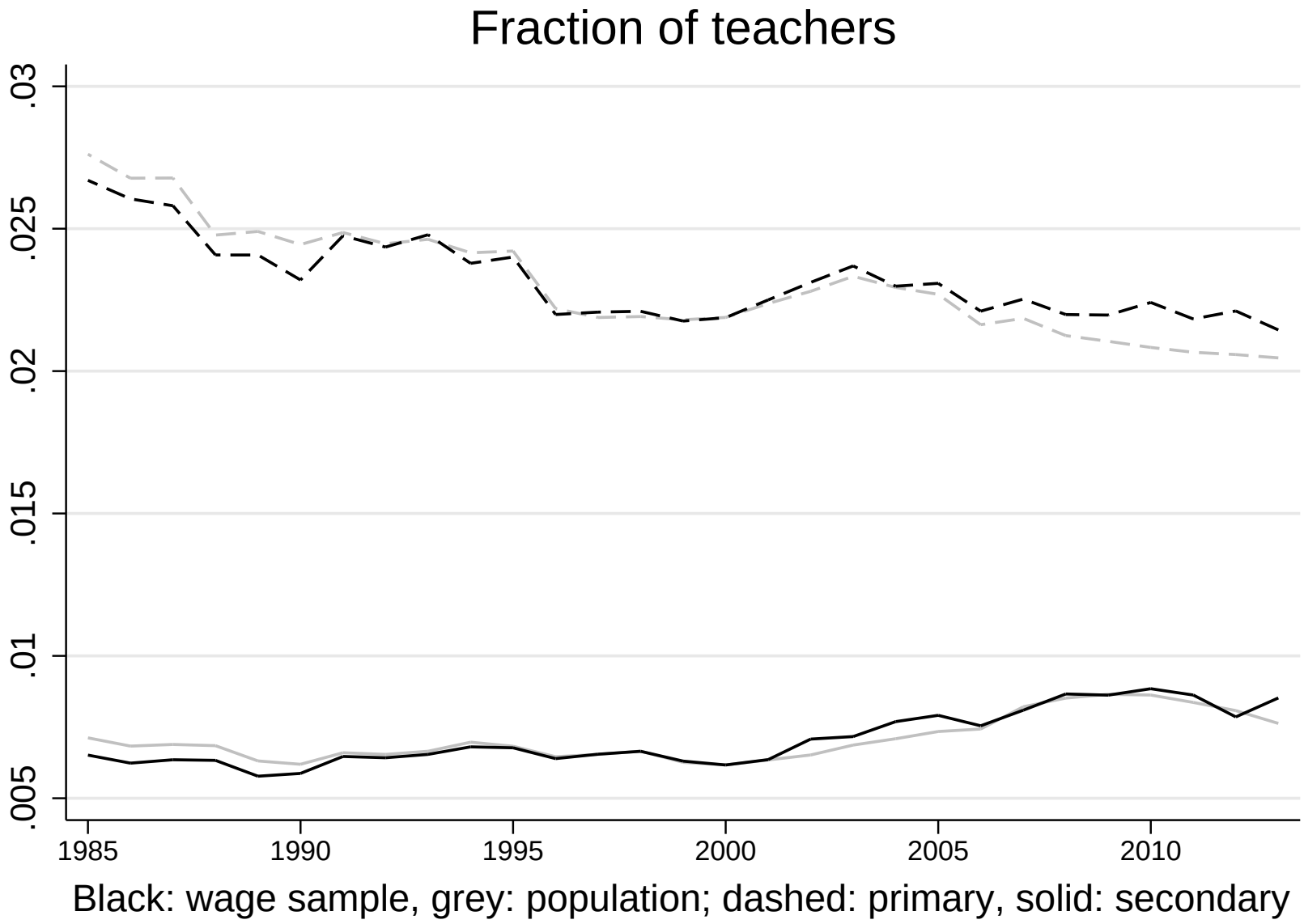
- males aged 26-31: track from 1985-2013
- males aged 32-43: track from 1995-2013
- imputation for females using brothers

High-school GPA

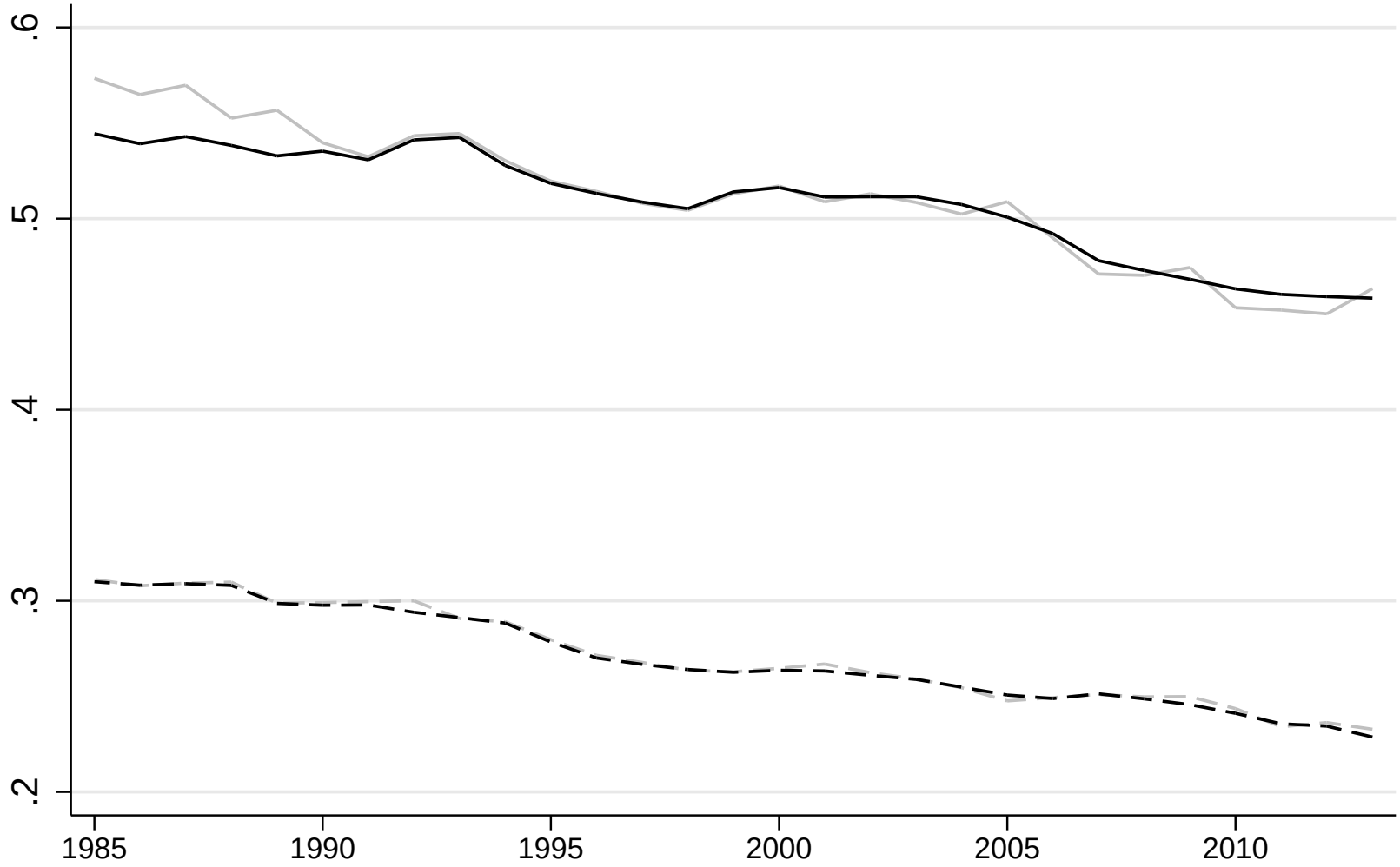
- females & males aged 26-31: track from 1998-2013

Teacher status

School type in teacher register and industry in LOUISE must agree; indicator for 'maybe-teachers'


Fraction of teachers
.03
.025
.02
.015
.01
.005
1985
1990
1995
2000
2005
2010
Black: wage sample, grey: population; dashed: primary, solid: secondary

Fraction of males among teachers



Black: wage sample, grey: population; dashed: primary, solid: secondary

Outline

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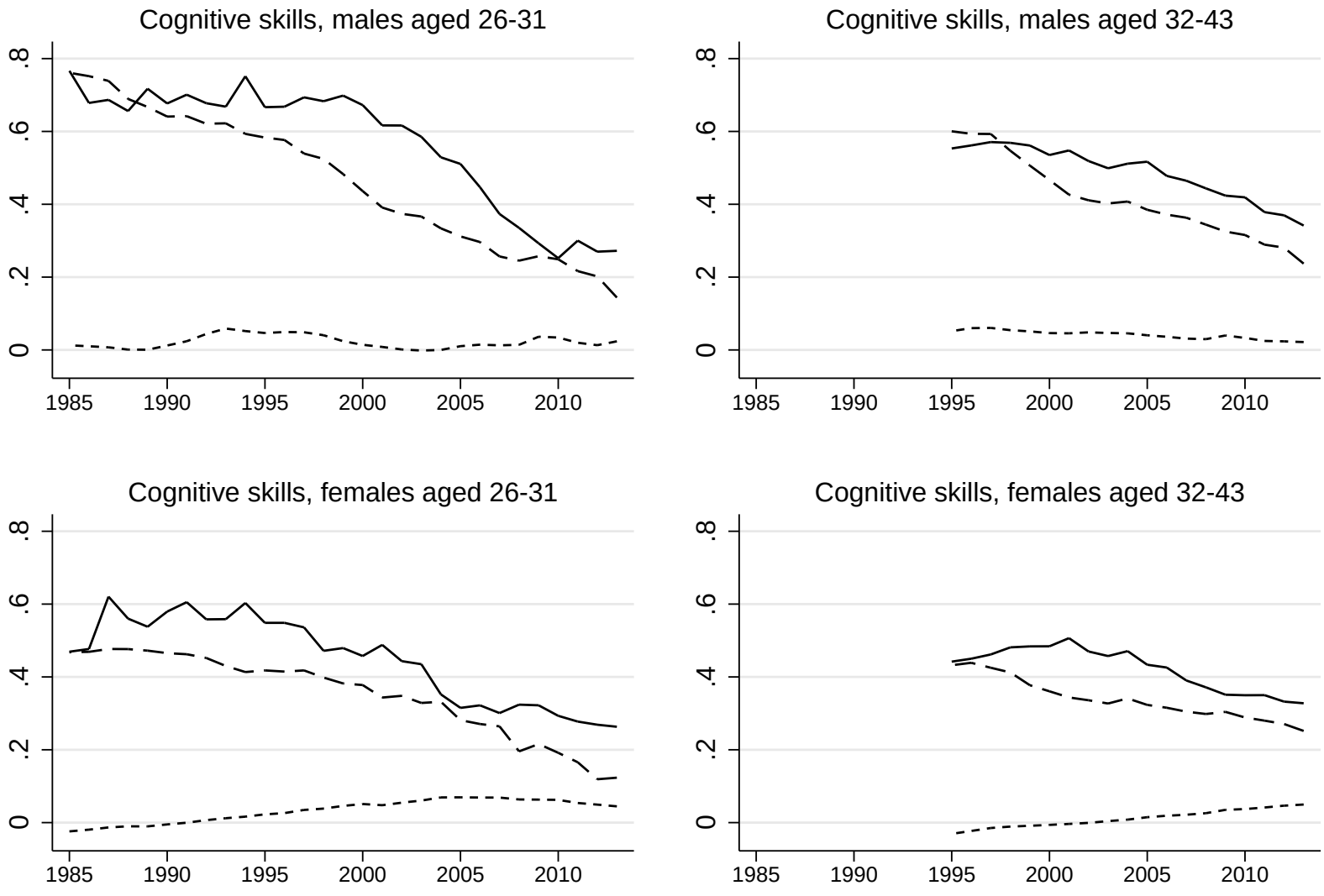
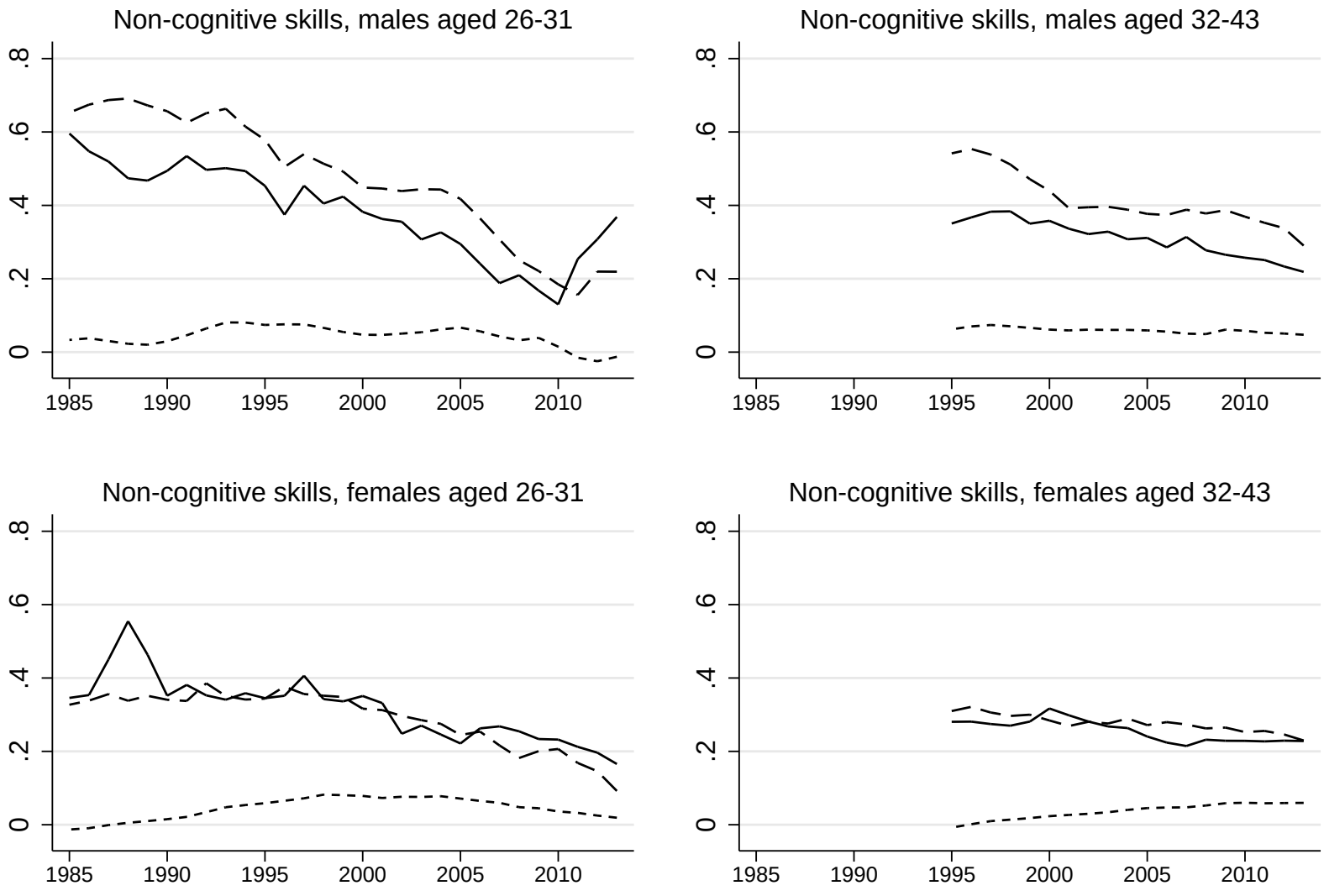


Short-dashed: non-teachers, dashed: primary, solid: secondary



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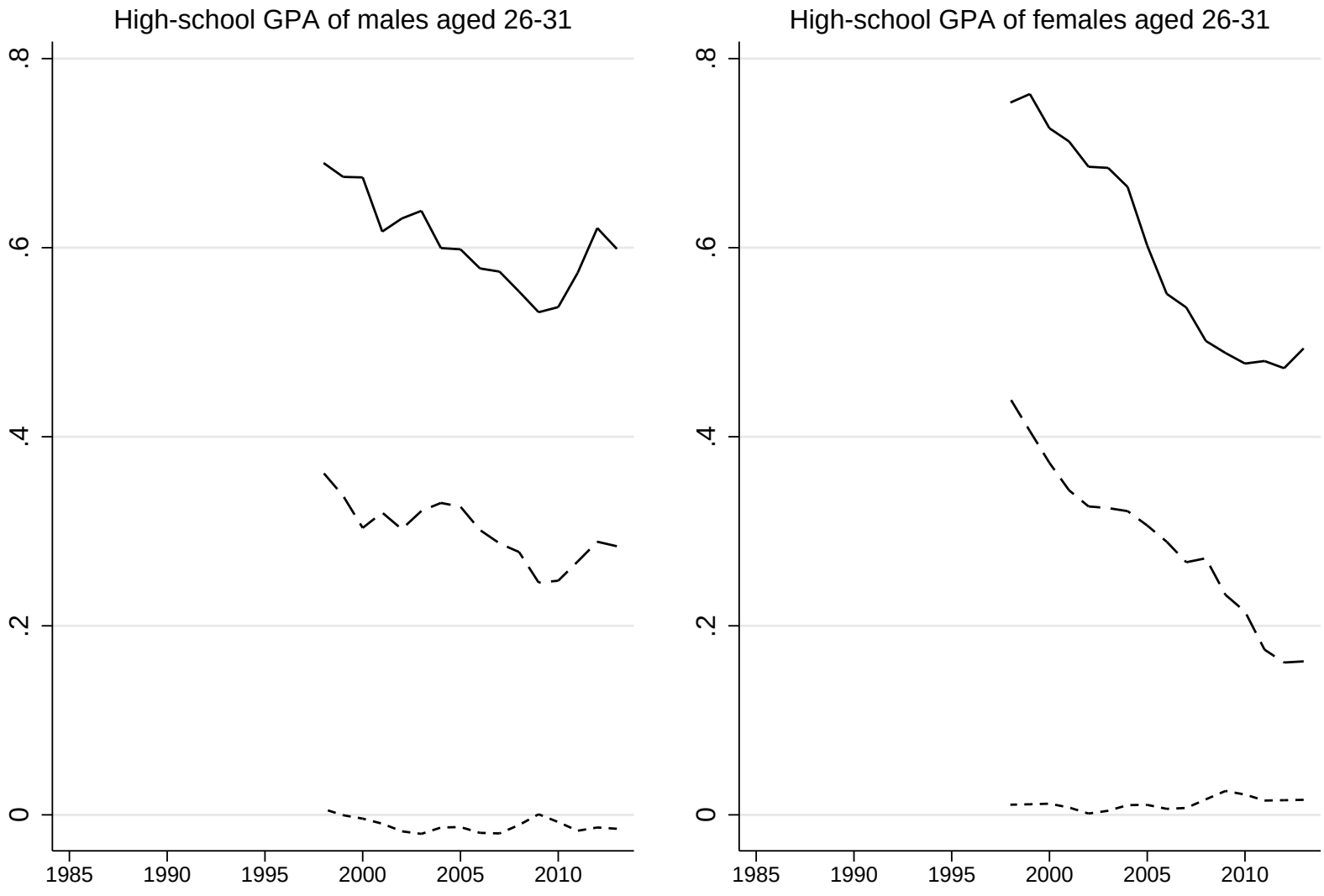


Short-dashed: non-teachers, dashed: primary, solid: secondary

Fact 1—summary

Declining teacher skills, mostly post-1995

- initially positive gap b/w skills of teachers and non-teachers, typically larger than half a standard deviation
- gap in both cognitive and non-cognitive skills decreases by at least 50 percent for young teachers
- decrease somewhat less dramatic for mid-career teachers
- for high school GPA, qualitatively similar results, but less dramatic decline

Outline

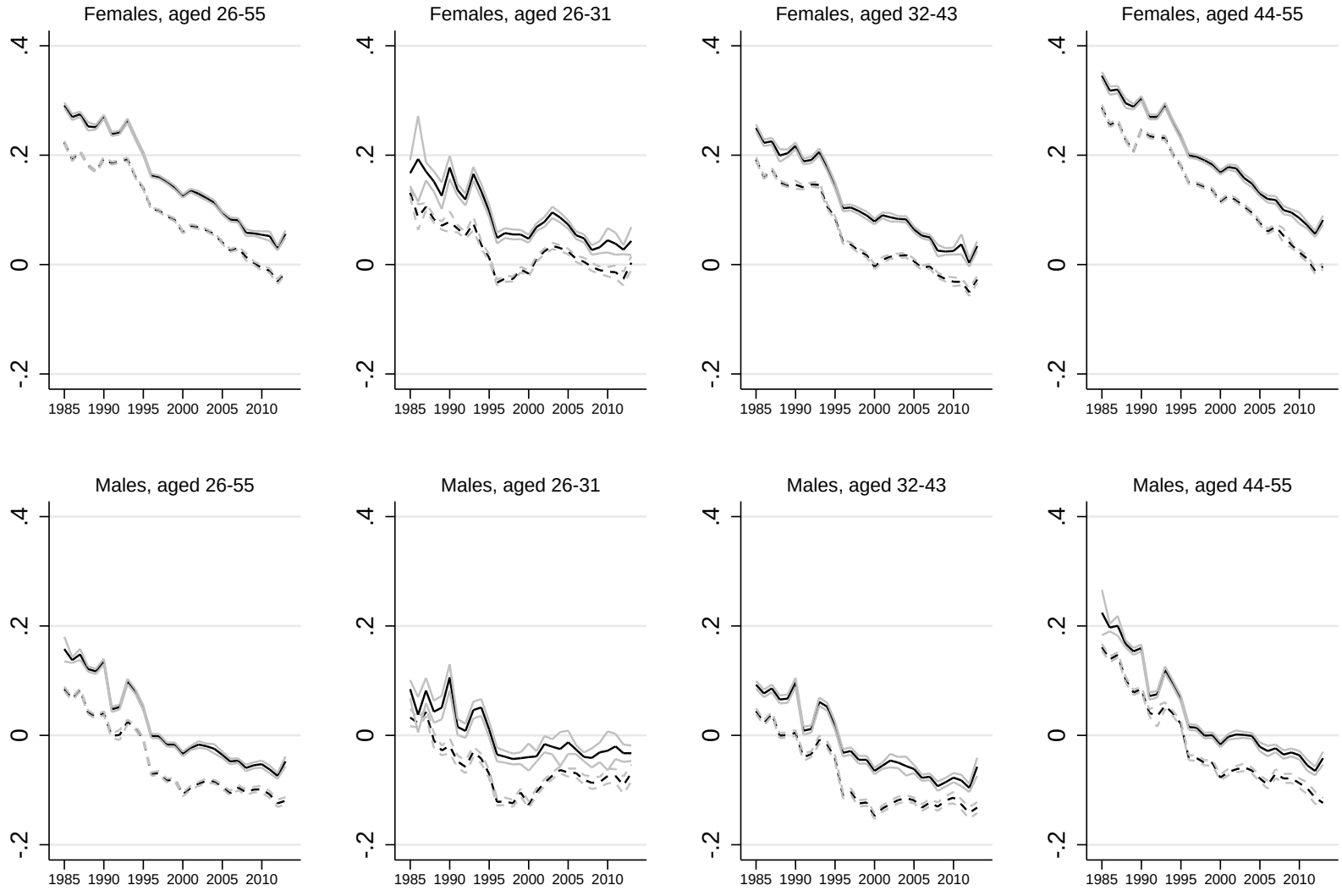
Measuring teacher wage gaps—OLS

Cross-sectional wage gaps (OLS) for primary (p) and secondary (s) school teachers

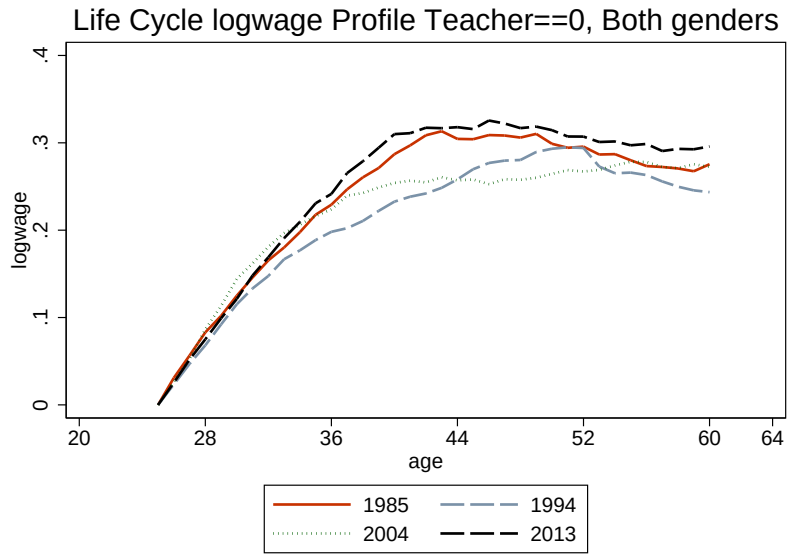
- separately for each gender, year
- controls: age dummies, indicator for uncertain teacher status

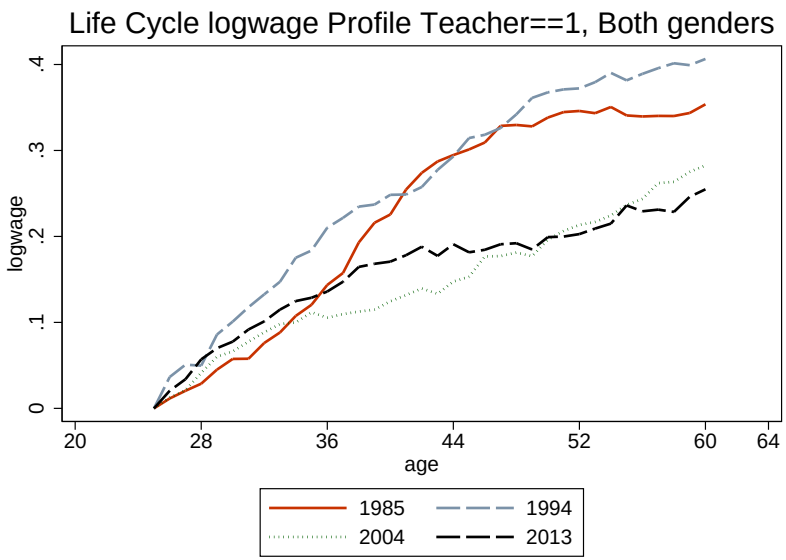
$$\log w_i = \beta^{\mathrm{p}}_{\mathrm{OLS}} D^{\mathrm{p}}_i + \beta^{\mathrm{s}}_{\mathrm{OLS}} D^{\mathrm{s}}_i + X_i' \gamma + \varepsilon_i$$

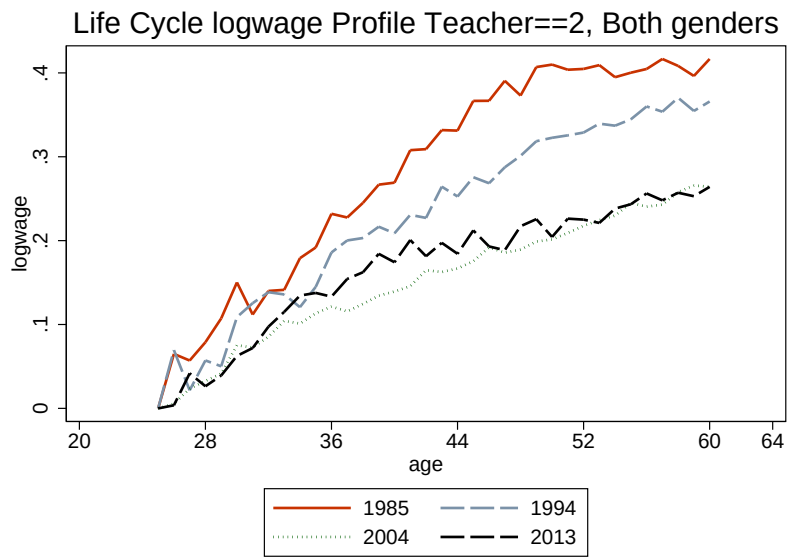
Wage premia of primary (dashed) and secondary (solid) school teachers



Implications for life-cycle wage profiles







Fact 2—summary

Steady decline in teacher wage gaps (cross-sectional)

- 20 log points for both female & male teachers
- smaller declines for young teachers, and mostly pre-1995 (life-cycle profiles!)
- stable difference b/w primary & secondary school teachers

Outline

Are teachers' skills rewarded? Changes over time?

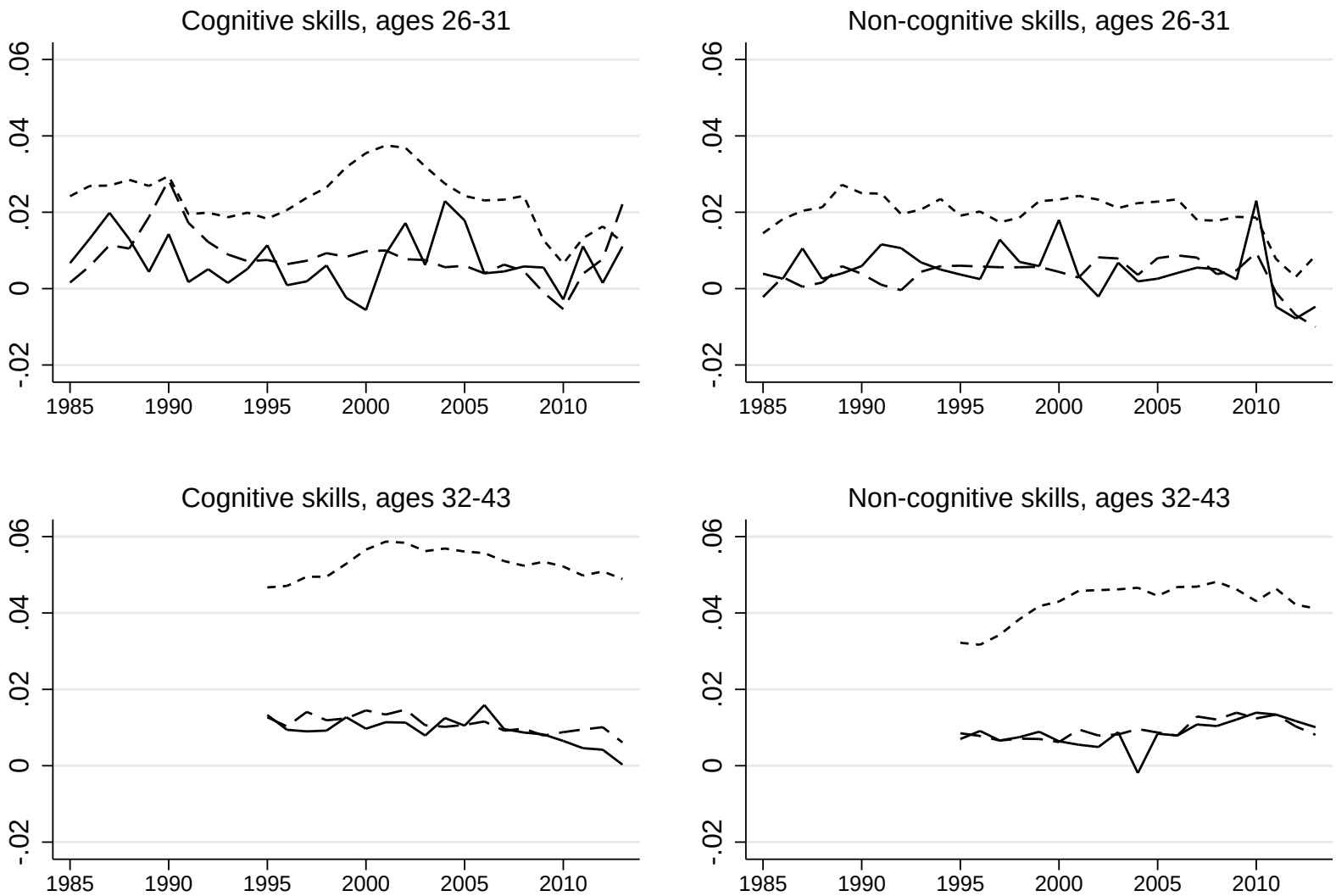
Obtain all quantities of interest from two-fold Oaxaca-Blinder decomposition of teacher wage gaps

- males only
- separately for each type of teacher, age group, year
- explanatory variables: skills, age

$$\overline{\log w}^{\text{tch}} - \overline{\log w}^{\text{n-tch}} = \left(\overline{X}^{\text{tch}} - \overline{X}^{\text{n-tch}}\right)' \beta^{\text{n-tch}} \quad \text{explained}$$

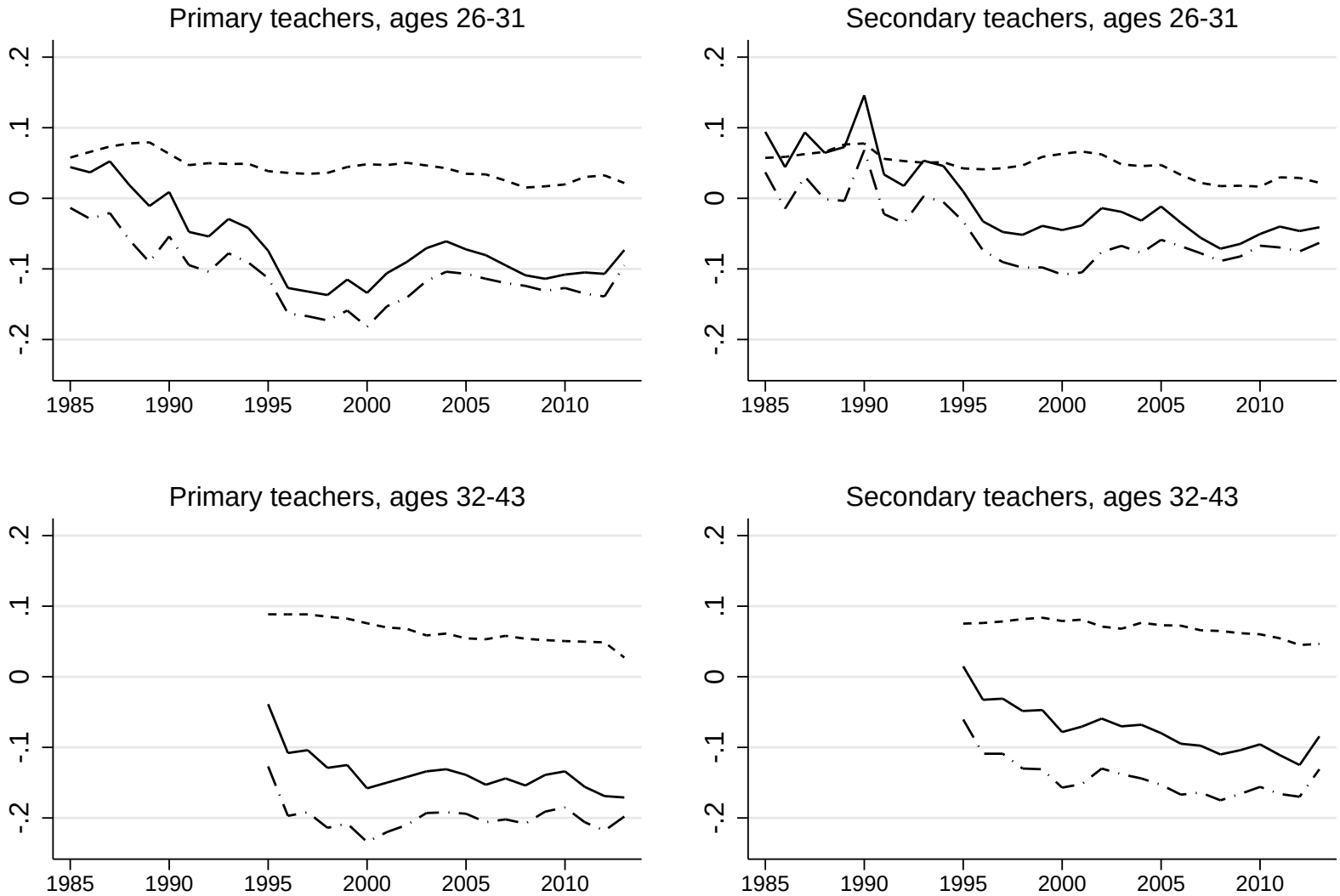
$$+ \ \overline{X}^{\text{tch}\prime} \left(\beta^{\text{tch}} - \beta^{\text{n-tch}}\right) \quad \text{un-explained}$$

Returns to skill



Short-dashed: non-teachers, dashed: primary, solid: secondary

Oaxaca-Blinder decomposition



Solid: wage gap, short-dashed: explained component, dash-dotted: unexplained component

Fact 3—summary

Cognitive and non-cognitive skills are rewarded less in teaching jobs, but the difference is stable over time

- teachers' predicted wages are higher than actual (since still more-skilled)
- hence, strong negative unexplained component, which has declined over time

Outline

Measuring teacher wage gaps—OLS & FE

Pool annual data into 5 overlapping 7-year samples

Cross-sectional wage gaps (OLS) for primary (p) and secondary (s) school teachers

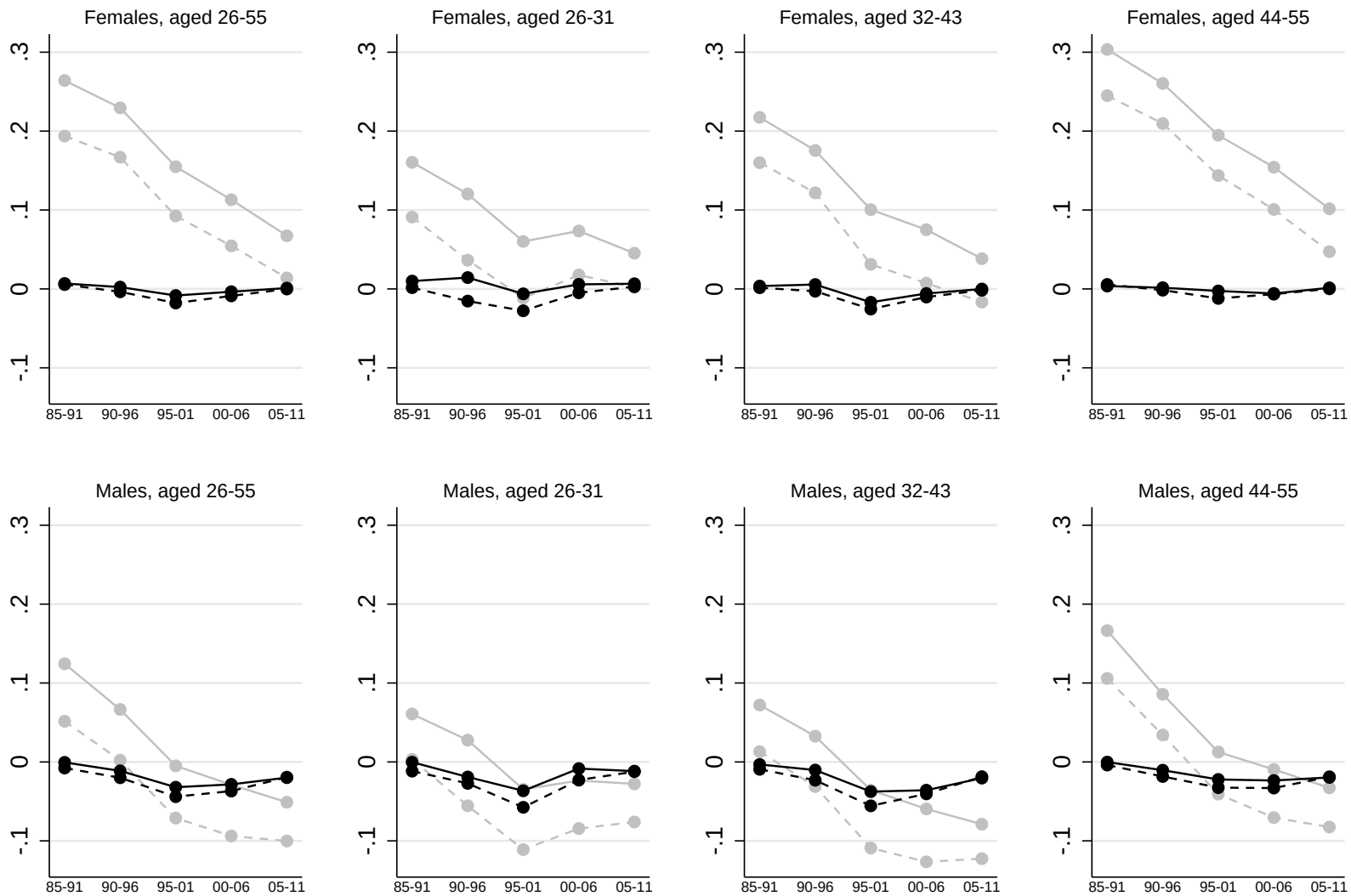
- separately for each gender, period
- controls: age dummies, year dummies, indicator for uncertain teacher status

$$\log w_{it} = \beta^{\mathrm{p}}_{\mathrm{OLS}} D^{\mathrm{p}}_{it} + \beta^{\mathrm{s}}_{\mathrm{OLS}} D^{\mathrm{s}}_{it} + X'_{it}\gamma + \varepsilon_{it}$$

Within-individual wage gaps (FE)

$$\log w_{it} = \beta^{\mathrm{p}}_{\mathrm{FE}} D^{\mathrm{p}}_{it} + \beta^{\mathrm{s}}_{\mathrm{FE}} D^{\mathrm{s}}_{it} + \alpha_i + X'_{it}\delta + u_{it}$$

Teacher wage premia from pooled samples - OLS (grey) and FE (black)



Understanding within-individual wage gaps

Need to reconcile

- large drop in cross-sectional teacher wage gap (from large & positive to zero or negative)
- no large changes in within-individual teacher wage gap (always small)

Further evidence that the type of worker who chooses teaching has changed dramatically: we investigate this by looking at **non-teaching wages and jobs of 'often-teachers'**

Understanding within-individual wage gaps (cont'd)

Define four different groups, within each 7-year period

- always-teachers
- never-teachers
- **often-teachers**: at least four years as teacher, at least one observation in non-teaching job
- remainder (get dropped)

Distribution of teachers over time

	85-91	90-96	95-01	00-06	05-11
Always-teachers	0.42	0.45	0.36	0.35	0.34
Often-teachers	0.04	0.04	0.04	0.04	0.04

Understanding within-individual wage gaps (cont'd)

Compare often- with never- and always-teachers, separately by gender and period (controls include age and year dummies)

$$\log w_{it} = \theta D_{it}^{\text{often}} + X_{it}'\kappa + \nu_{it}$$

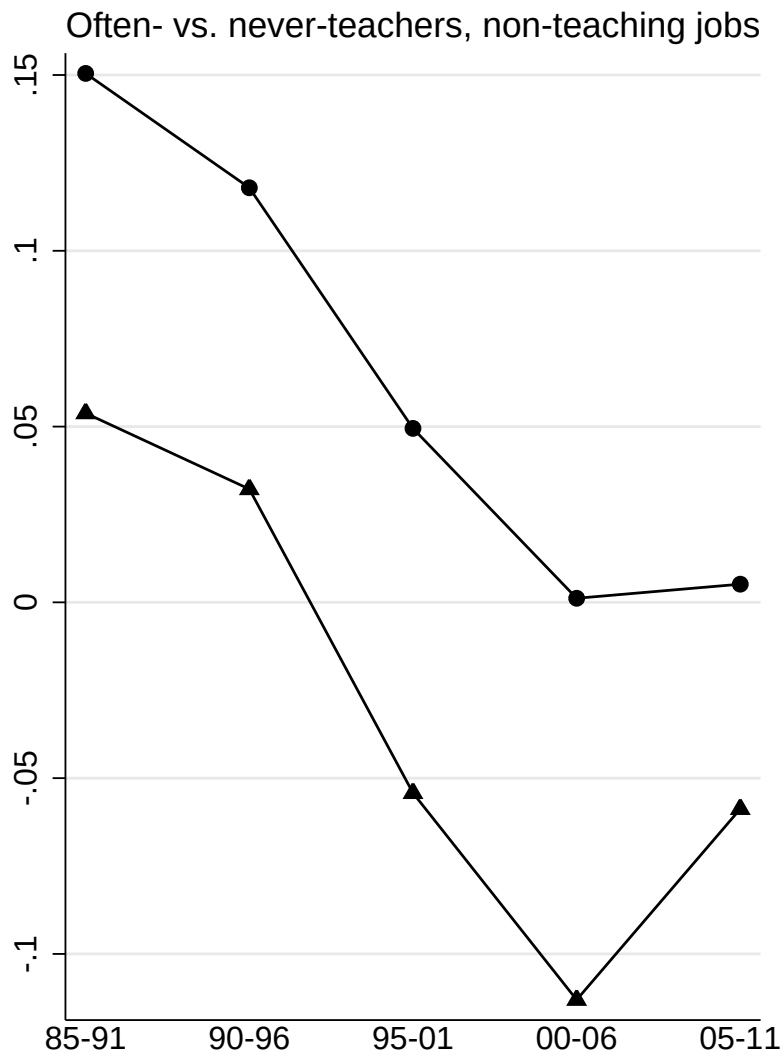
Run this regression twice

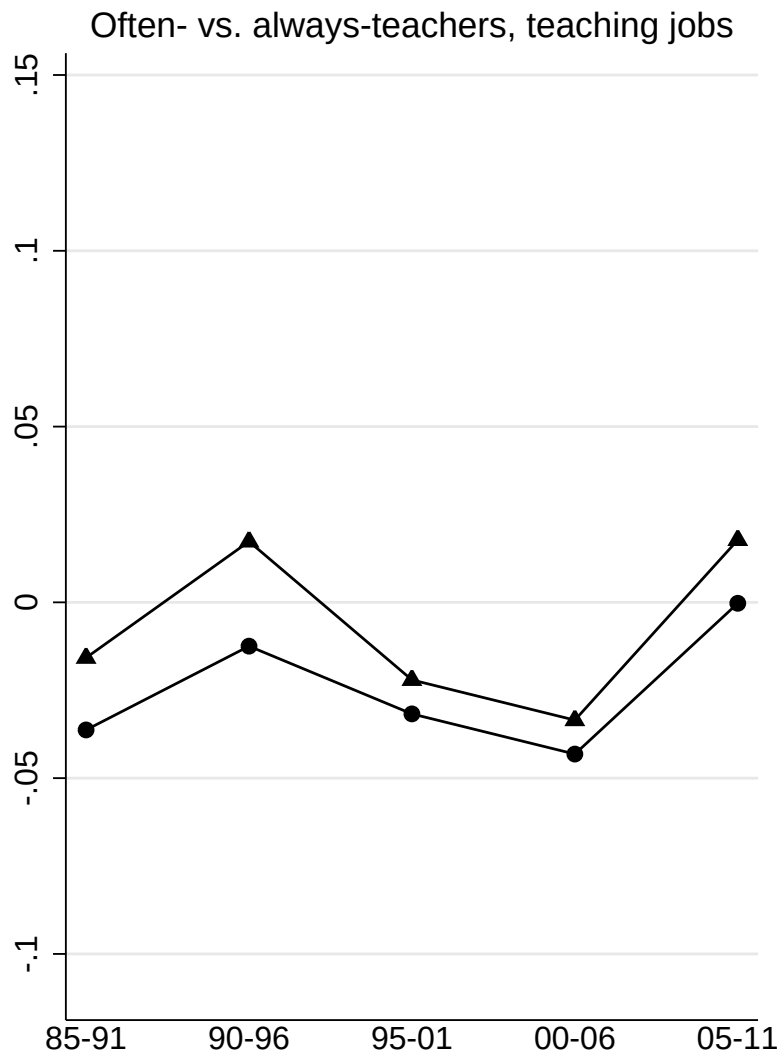
- non-teaching jobs (thus dropping always-teachers)
- teaching jobs (thus dropping never-teachers)

The second regression is a check for systematic differences (and changes over time) b/w often- and always-teachers

Also examine kernel densities by group

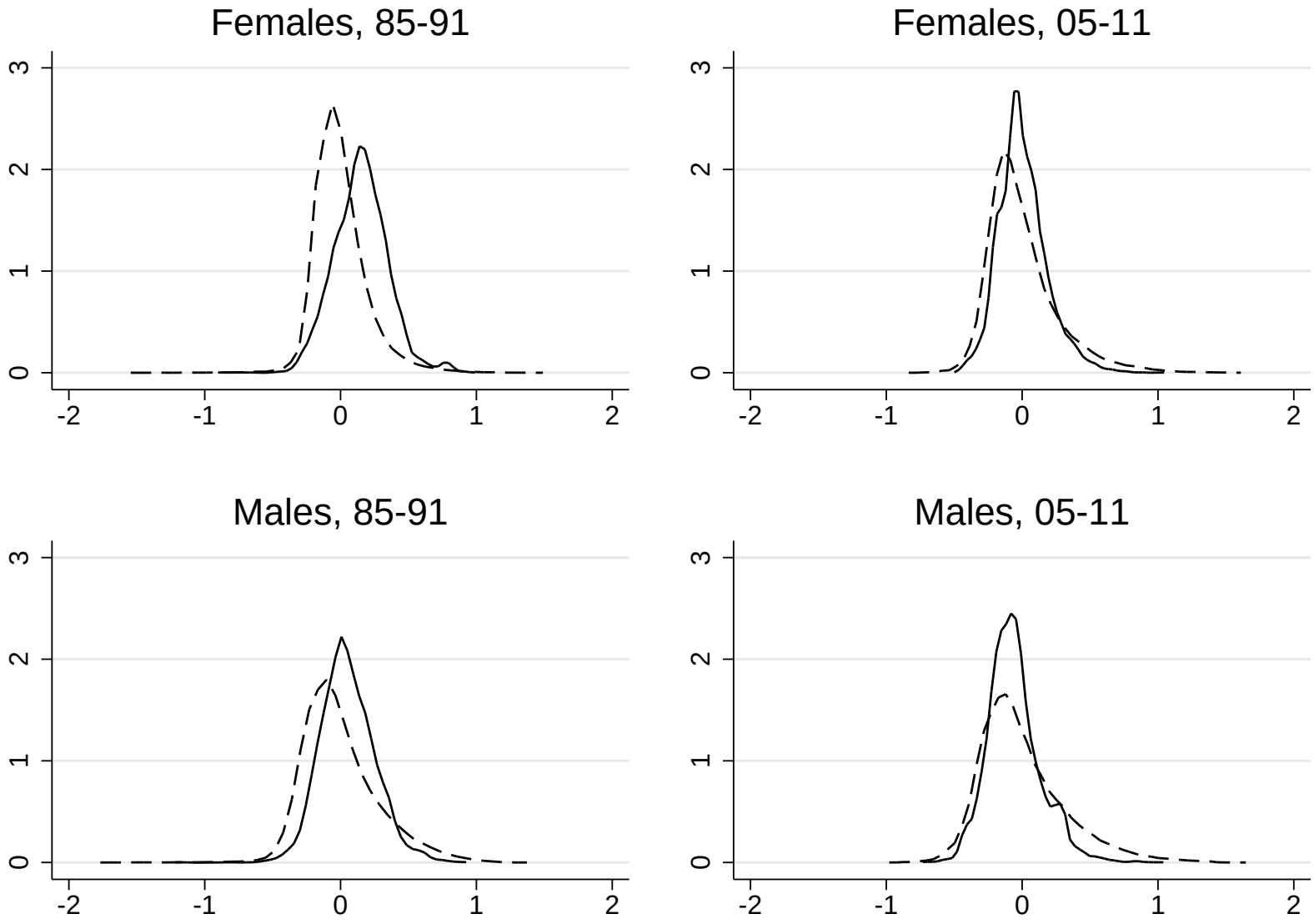
Wage gaps between often-, never-, always-teachers





Circles: females, triangles: males

Wage distributions of often-teachers (solid) and never-teachers (dashed) in **non-teaching jobs**



Sectoral choices of often- and never-teachers in **non-teaching jobs**

	Females		Males	
	Often	Never	Often	Never
1985-1991				
Education	16	1	14	1
Health, social work	35	25	11	3
Other public sector	8	6	11	6
Business services, finance	9	10	13	9
Other services	19	34	26	34
Primary, manufact., util.	13	23	26	48
2005-2011				
Education	42	8	21	2
Health, social work	15	32	10	5
Other public sector	14	7	12	5
Business services, finance	8	15	8	17
Other services	15	21	18	22
Primary, manufact., util.	6	17	30	49

Fact 4—summary

Declining quality of teacher pool in terms of non-teaching wages

- small and stable teacher wage gaps when controlling for FEs
- teachers who sometimes work in non-teaching jobs used to earn higher wages in these jobs

(Marginal) teachers are priced **within** teaching according to their market earnings **outside** teaching

- but outside wages are declining...
- ...while in teaching, the wage gap between marginal and infra-marginal teachers is small and constant
- more evidence that teachers got worse in terms of overall skill

Outline

Local labor market analysis

Are teachers more skilled in regions that pay teachers higher wages?

72 local labor markets (*funktionella analysregioner* defined by Tillväxtanalys). Collapse data to LLM/year level, run

$$\text{skill}_{lt}^{\text{tch}} = \lambda \log w_{lt}^{\text{tch}} + X_{lt}'\xi + \alpha_l + \theta_t + \eta_{lt}$$

Controls: non-teacher wages, LLM skills, LLM & year fixed effects, LLM trends

Caveat (apart from endogeneity concerns): mixes occupational and geographical choice

Local labor market analysis: males aged 26-31, 1985-2013

	Cognitive					Non-cognitive				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Log wage, teachers	1.47					1.45				
	(0.61)					(0.60)				
Log wage, non-teachers	-0.25					-0.93				
	(0.39)					(0.41)				
Log wage gap		0.71					1.12			
		(0.40)					(0.38)			
Log wage, teachers, ages 26-31			0.82					0.48		
			(0.26)					(0.27)		
Log wage, non-teachers, ages 26-31			-0.19					-0.41		
			(0.24)					(0.26)		
Log wage gap, ages 26-31				0.56	0.55				0.45	0.40
				(0.19)	(0.19)				(0.19)	(0.20)
Log wage gap, ages 32-43					-0.07					0.26
					(0.27)					(0.32)
Log wage gap, ages 44-55					0.30					0.44
					(0.29)					(0.29)
N	1911	1911	1911	1911	1911	1893	1893	1893	1893	1893

Standard errors, clustered by LLM, in parentheses. Regressions are weighted by LLM share in Swedish employment, averaged across years.

Fact 5—summary

When teachers are paid more in a region, they tend to be more skilled—robust to large set of controls

- estimates would imply wage change by 10 log points leads to change in skills by 7.5 percent of a sd—quite small
- but estimates confound occupational and geographical choices

Outline

What explains the fall in teacher skills?

Explanation 1: falling barriers to high-skill occupations

30 years ago, teaching was the most accessible skilled occupation for females, thus attracting highly skilled women. Then barriers in other occupations fell.

- does not explain wage and talent trends for male teachers
- does not explain why share of females in the profession is rising

Probably not main story

What explains the fall in teacher skills?

Explanation 2: falling (relative) returns to skills

- returns to skills in teaching have not changed
- interestingly, not much rising returns to skills outside teaching either
- no clear trends in (relative) wage dispersion ('returns to unobservables')

Probably not main story either

What explains the fall in teacher skills?

Explanation 3: shifting preferences (labor supply) for teaching

Teachers' reputation could have deteriorated, or working condition inside schools worsened (outside schools improved), or taste for teaching changed

- but compensating differences—contradicts stable within-individual wage gaps, no increase in unexplained component of wage gap in Oaxaca-Blinder
- state would have to be able to price (marginal) teachers exactly according to their market value

May still be part of the story (e.g., endogenous tipping point to new low-wage, low-reputation equilibrium)

What explains the fall in teacher skills?

Explanation 4: falling wages

Pressure on public finances in 1990s led to teacher pay not keeping up with private sector pay. So to fill teacher jobs (determined by number of children in region), schools had to lower their hiring standards.

- supported by changes in cross-sectional and within-individual teacher wage gaps
- supported by local labor market results

Outline

Towards a cost-benefit calculation

Hanushek & Woessmann (2012, JEG) find that an **increase in average cognitive skills by one standard deviation** is associated with an **increase in the rate of GDP growth by 2pp**

- how do teachers' wages affect teachers' skills?
- how do teachers' skills affect students' skills?
- i.e., you get what you pay for?
- if there is a policy failure, what is the friction responsible?

Conclusion

- Observable and unobservable teacher skills (in outside market) declined dramatically
- While wages are falling, (marginal) teachers seem to earn their outside market worth
- Suggestive evidence for 'causal' effect of wages on teacher skills

To-do list

- non-teaching **occupations** of often-teachers
- exogenous variation in teacher wages at regional level
- structural model of occupational choice to quantify wage-skill relationship, and for policy experiments
- ...