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

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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)

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)

Our paper

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

- population-level skill measures (military scores & high school GPA)
- 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

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

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)

Outline

Data

Five facts about teachers in Sweden 1985-2013

- Fact 1: declining skills
- Fact 2: declining wage gaps in the cross-section
- Fact 3: stable within-individual wage gaps
- Fact 4: stable differences in returns
- Fact 5: wages & skills correlate within regions over time

Explanations & policy implications

Conclusions & to-do list

Outline

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

Data processing

Sample selection

Ages 26-55, drop observations with low earnings, extremely low or high monthly wages, drop individuals with less than 2/3 FTE

Dealing with incomplete coverage

Military scores

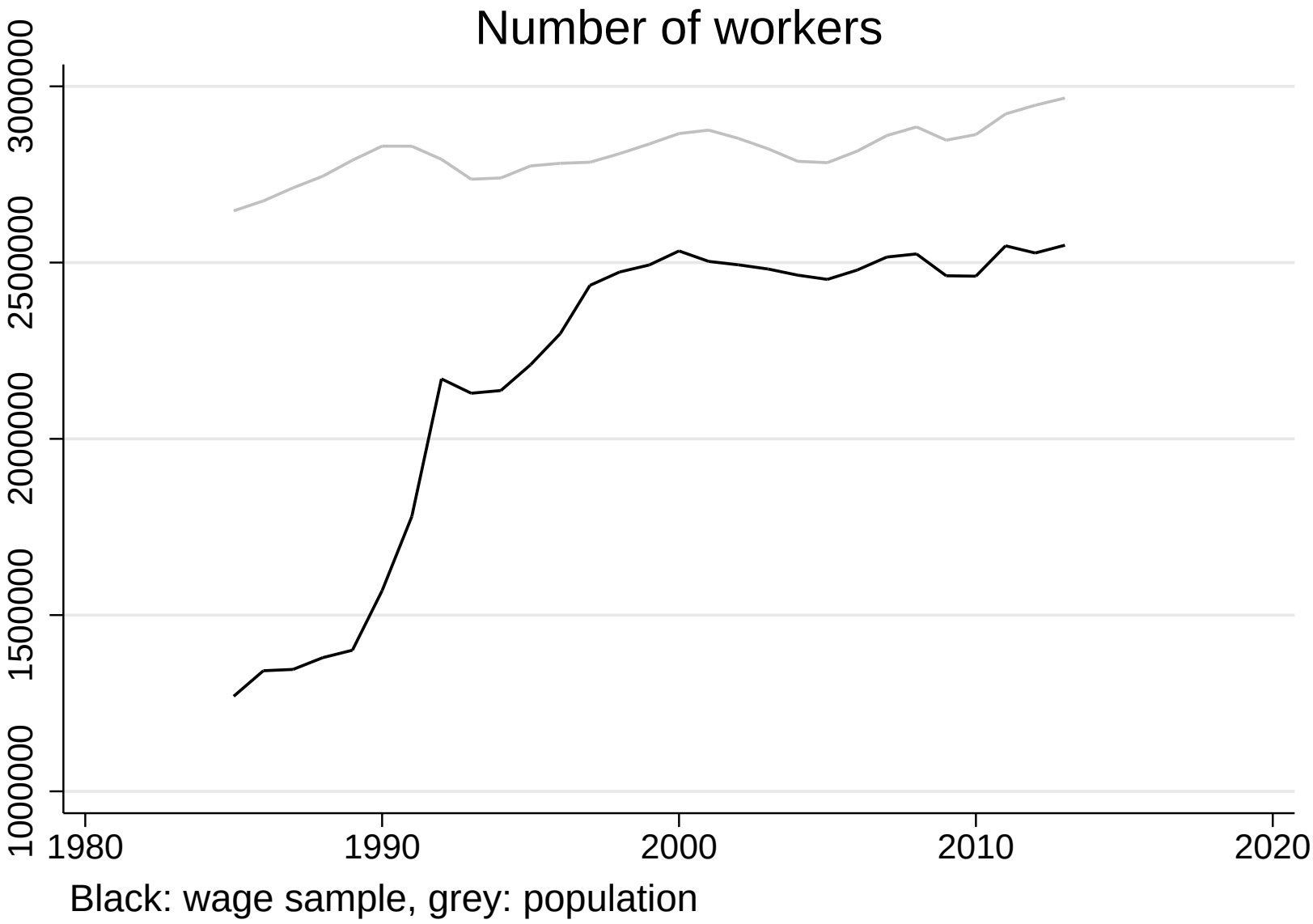
- males aged 26-31: track from 1985-2013
- males aged 32-43: track from 1995-2013

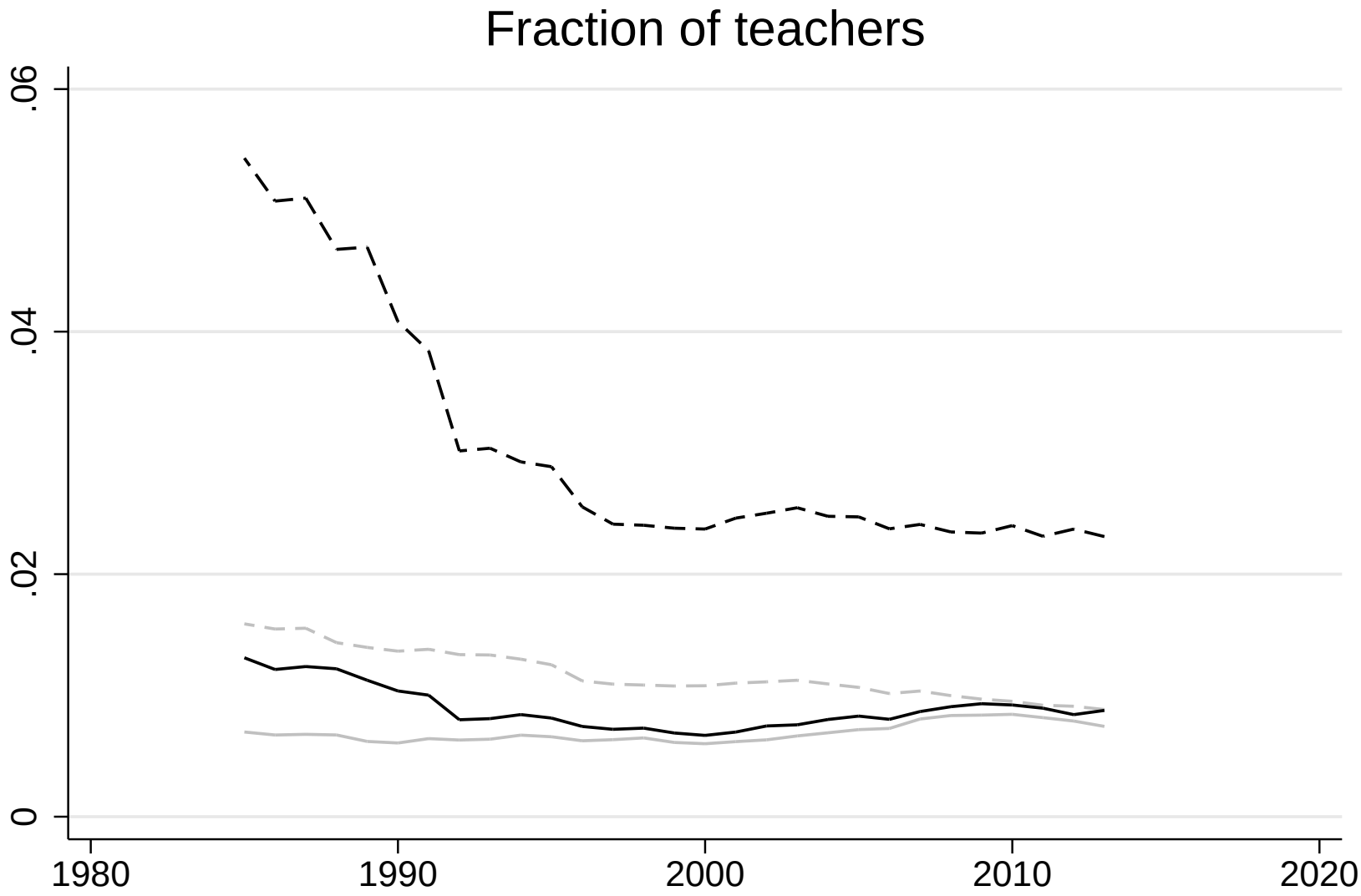
High-school GPA

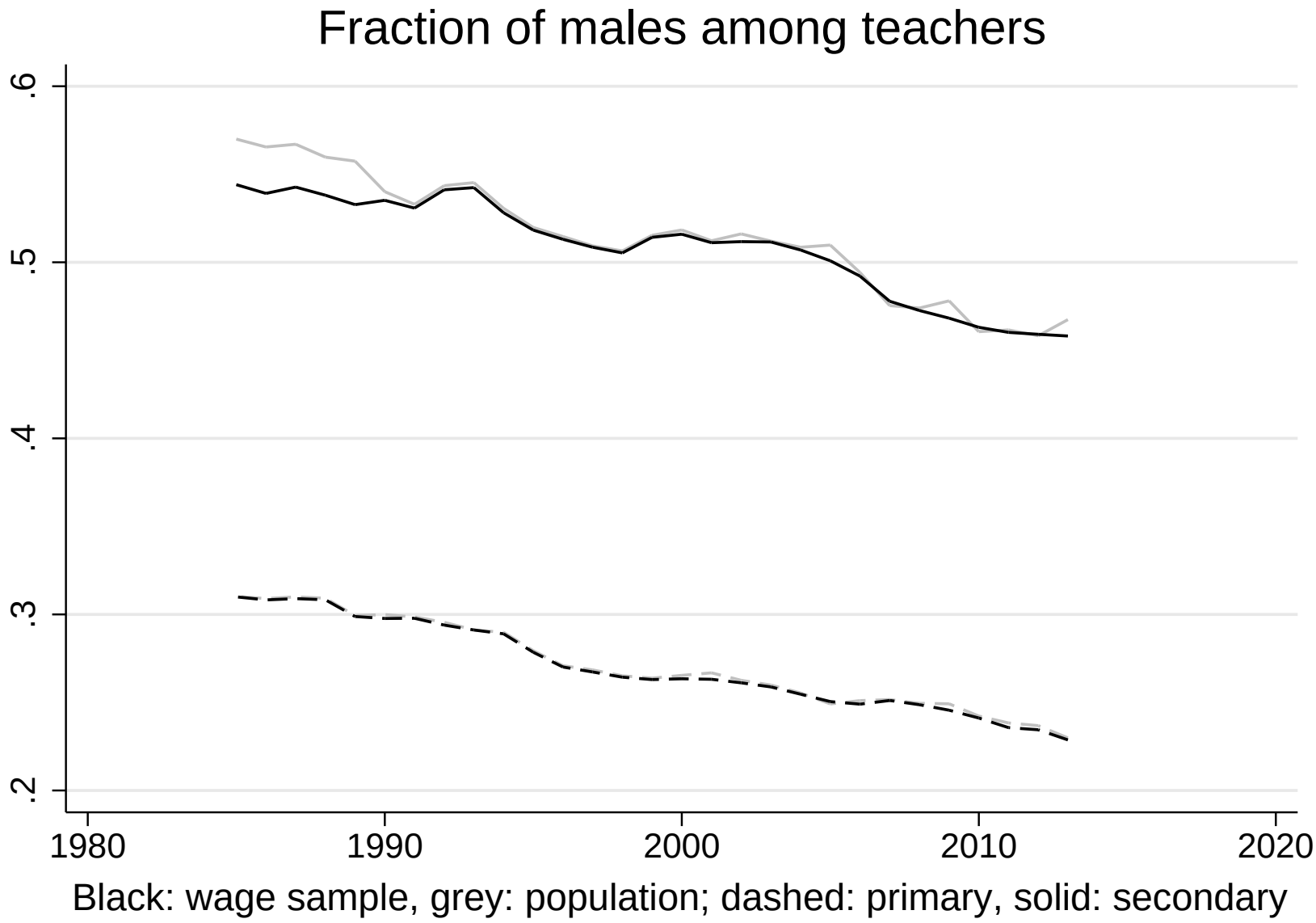
- females & males aged 26-31: track from 1998-2013

Teacher status

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

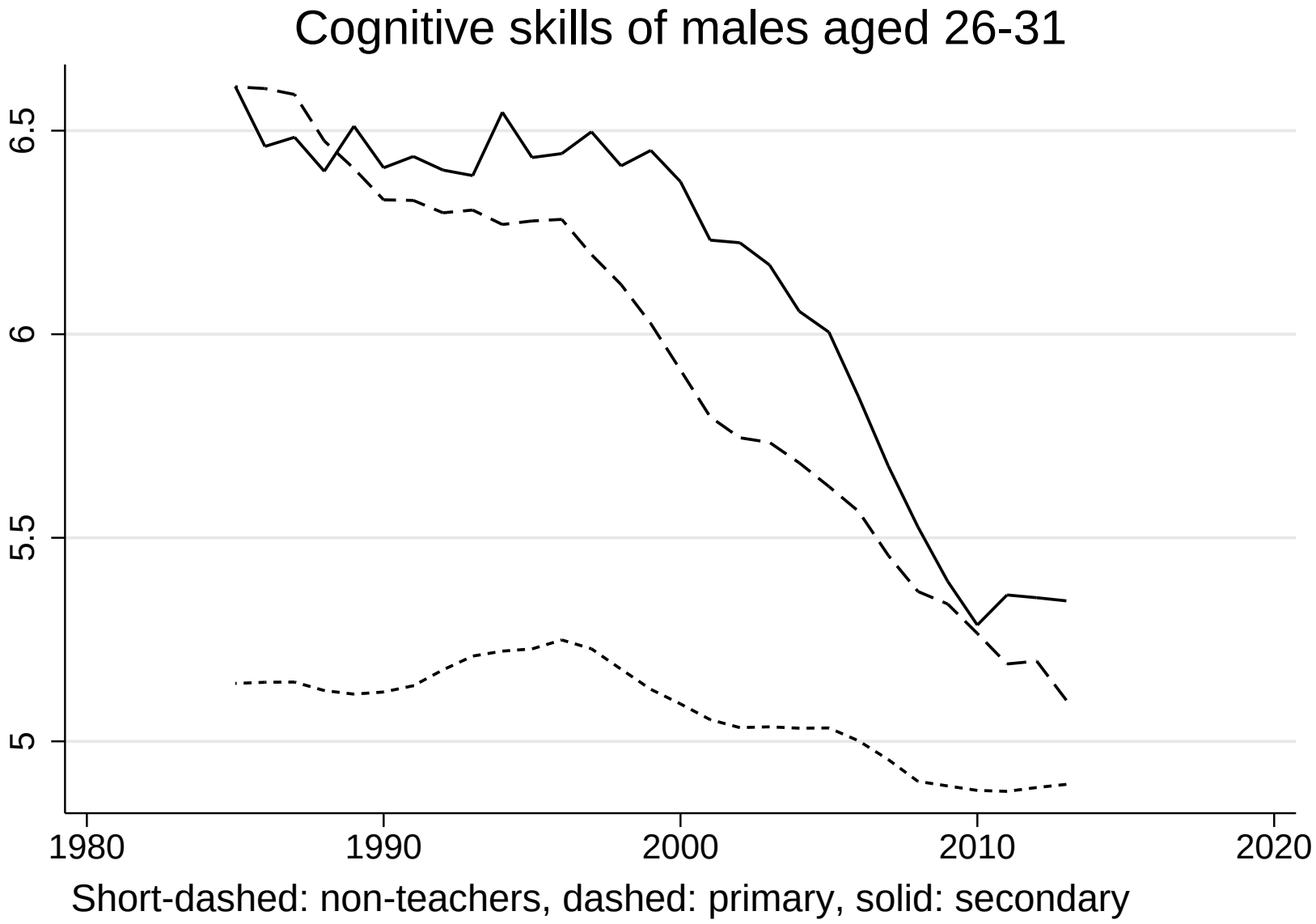

Number of workers
3000000
2500000
2000000
1500000
1000000
1980
1990
2000
2010
2020
Black: wage sample, grey: population

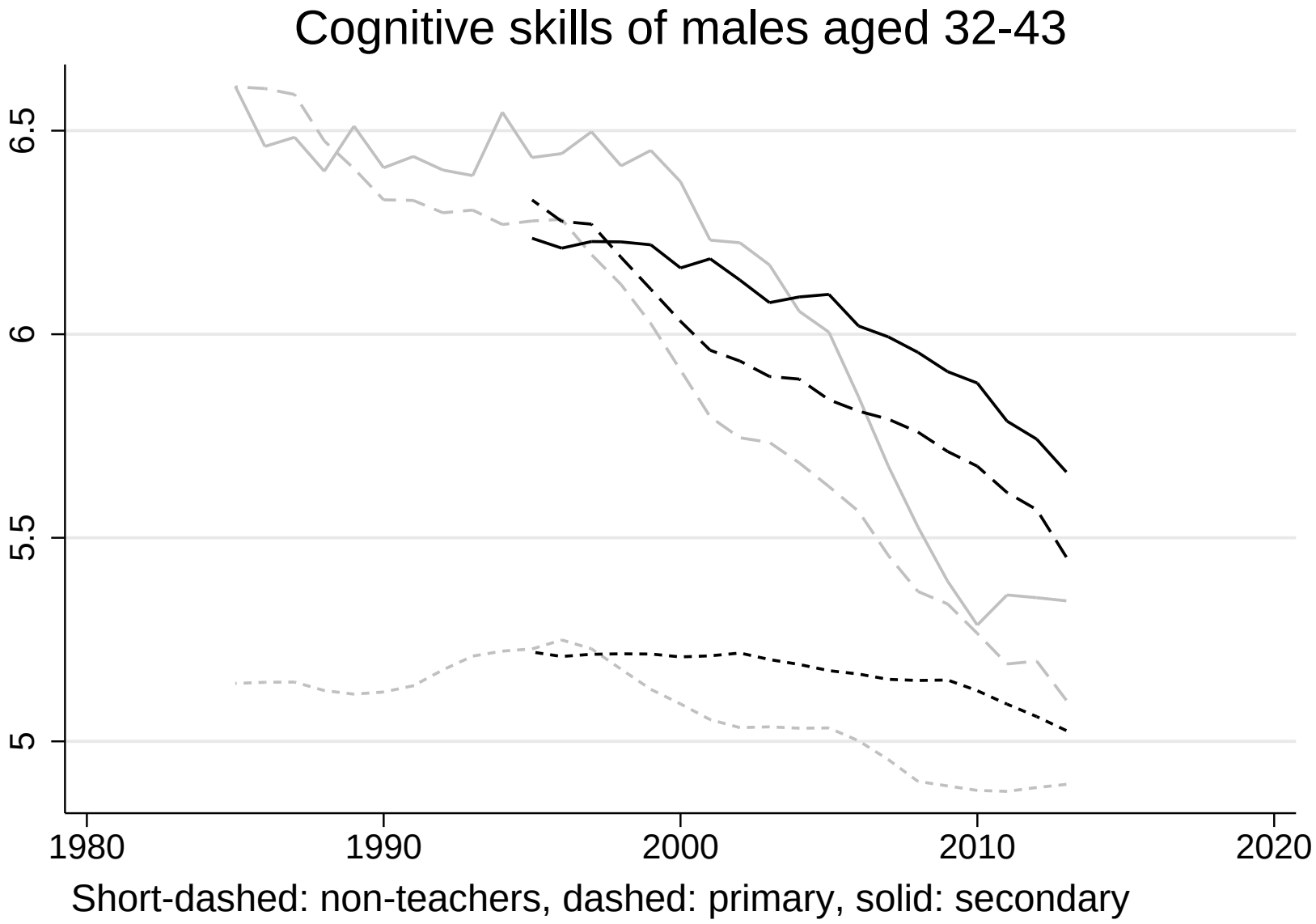

Fraction of teachers
.06
.04
.02
0
1980
1990
2000
2010
2020
Black: wage sample, grey: population; dashed: primary, solid: secondary


Fraction of males among teachers
.6
.5
.4
.3
.2
1980
1990
2000
2010
2020
Black: wage sample, grey: population; dashed: primary, solid: secondary

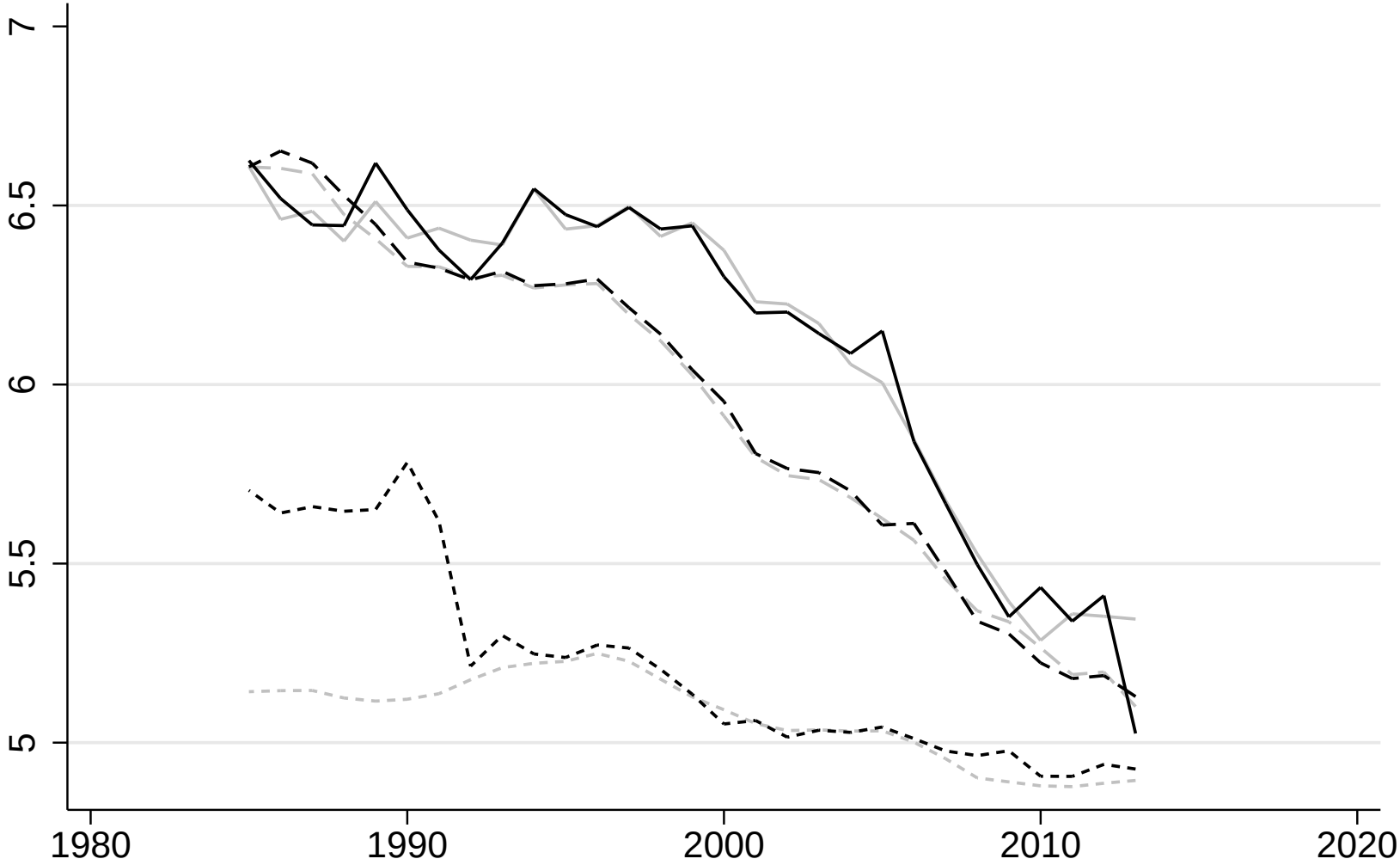
Outline

Outline

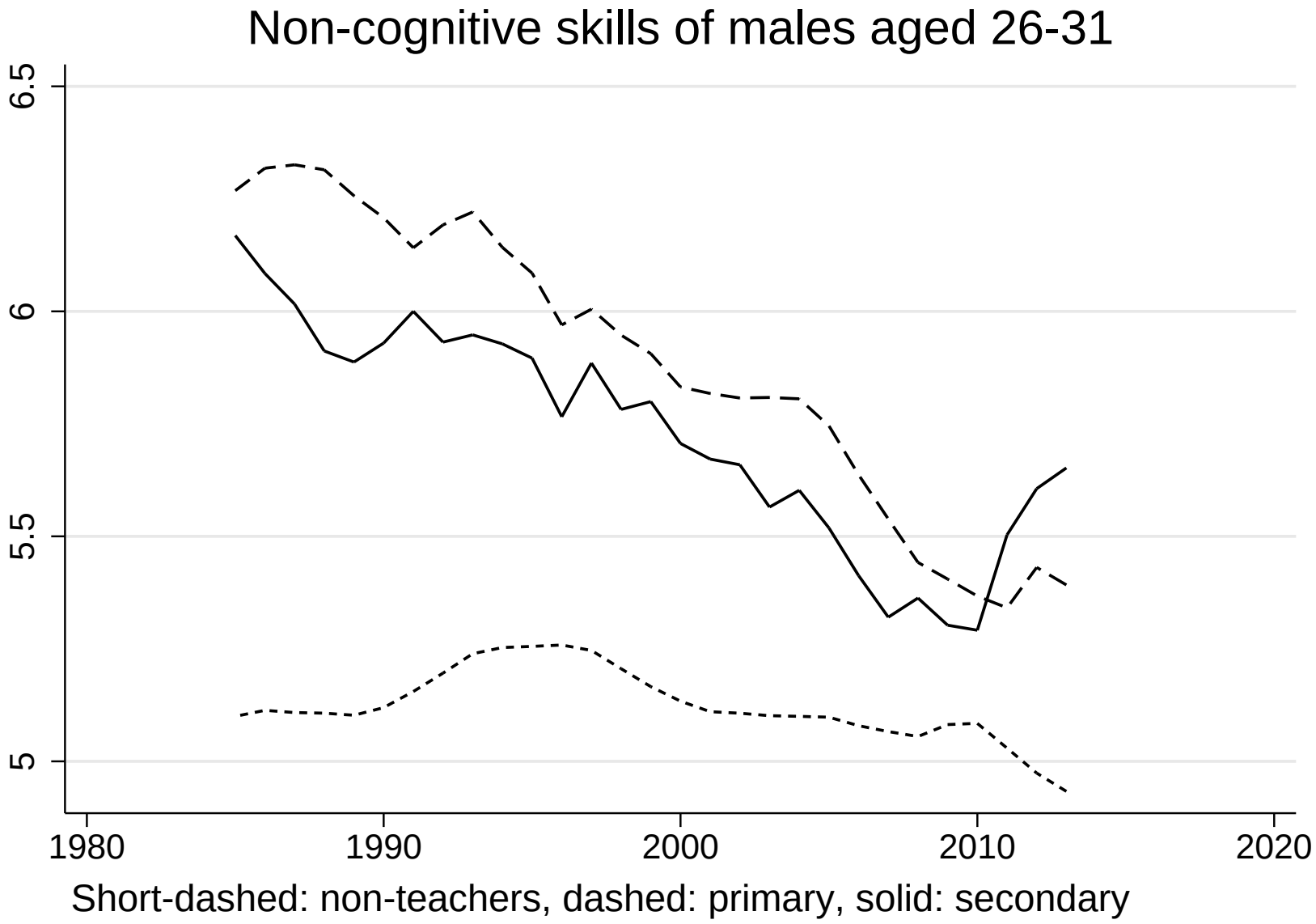

Cognitive skills of males aged 26-31
6.5
6
5.5
5
1980
1990
2000
2010
2020
Short-dashed: non-teachers, dashed: primary, solid: secondary

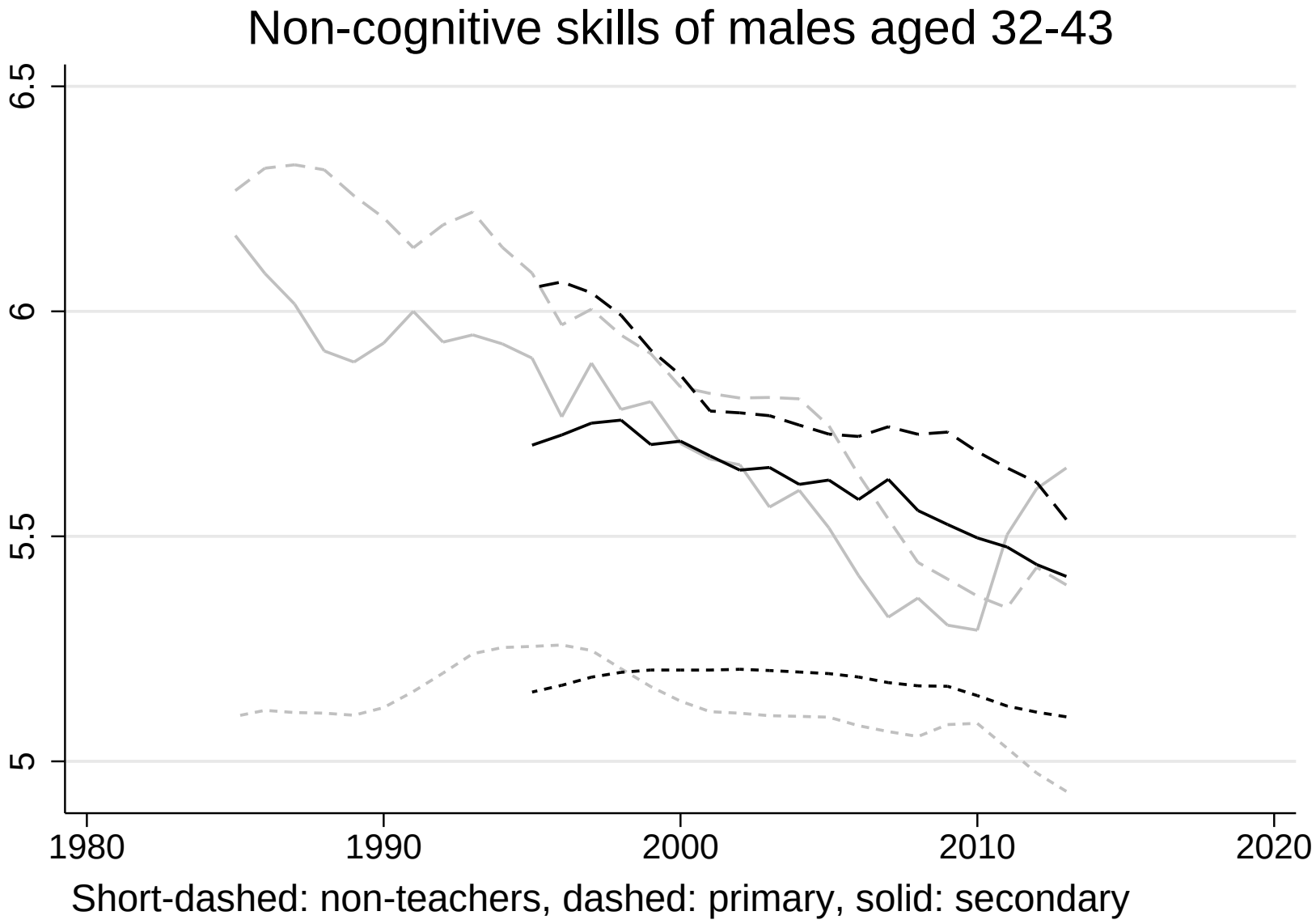

Cognitive skills of males aged 32-43
6.5
6
5.5
5
1980
1990
2000
2010
2020
Short-dashed: non-teachers, dashed: primary, solid: secondary

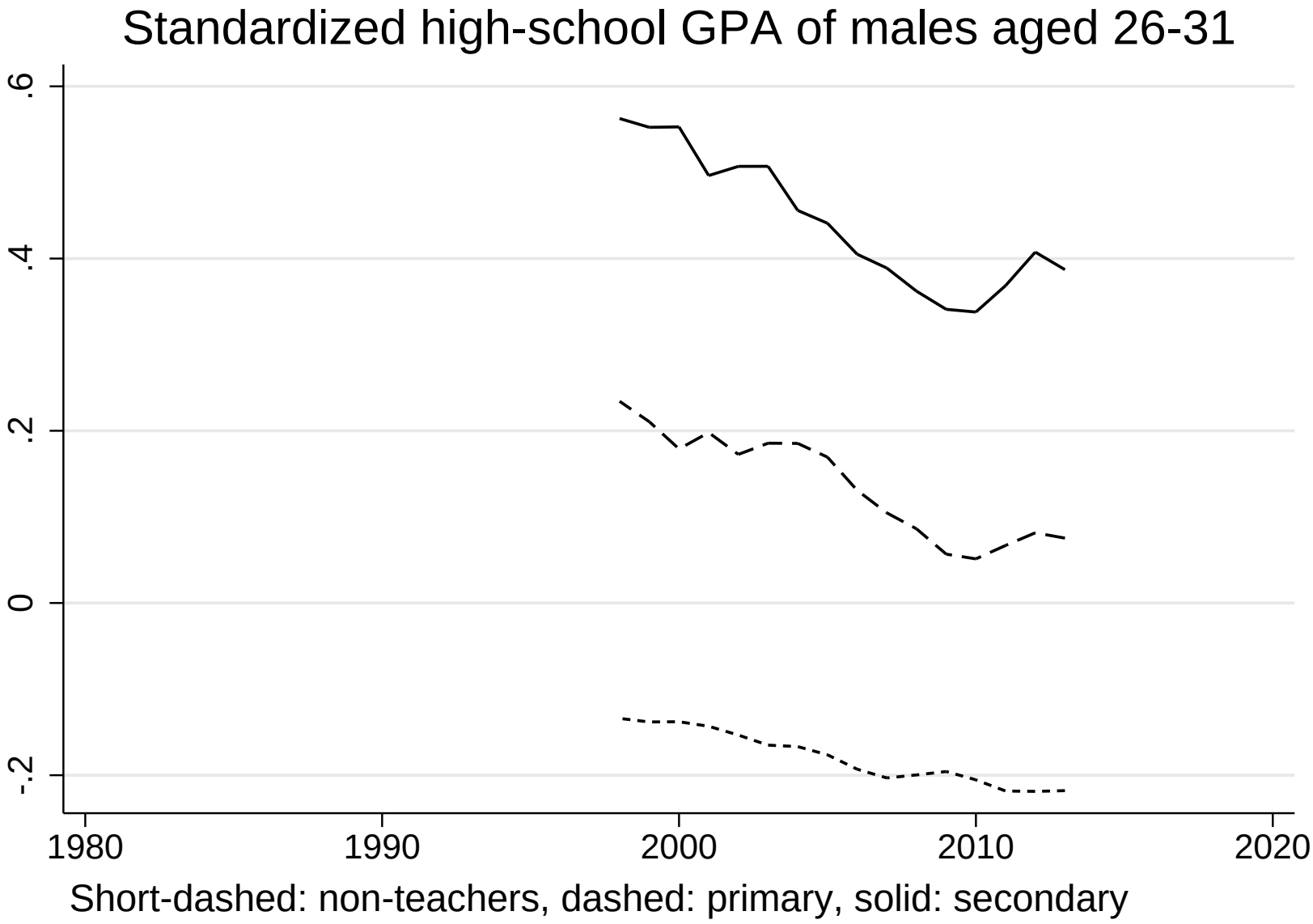
Cognitive skills of males 26-31: wage sample vs. population

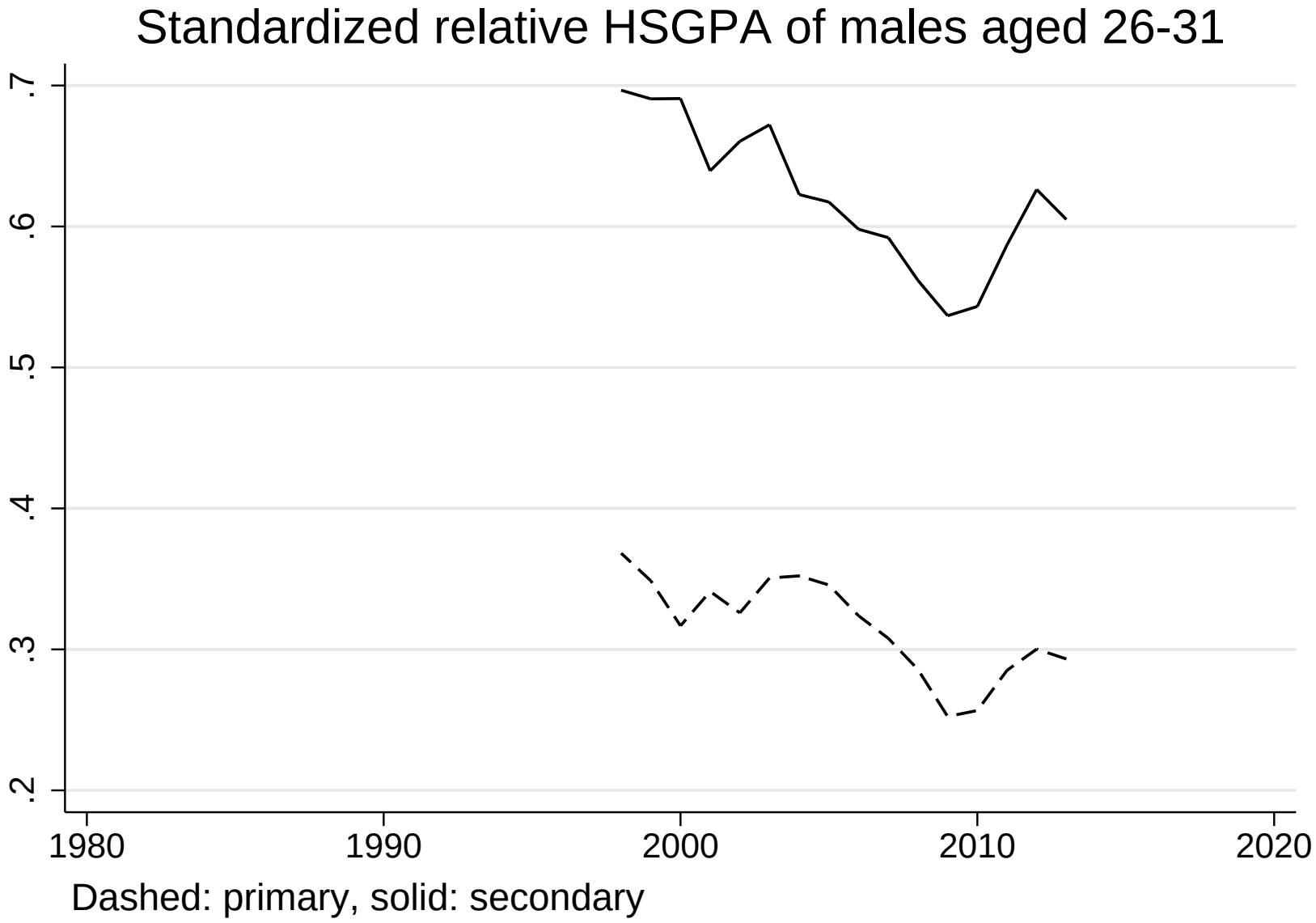


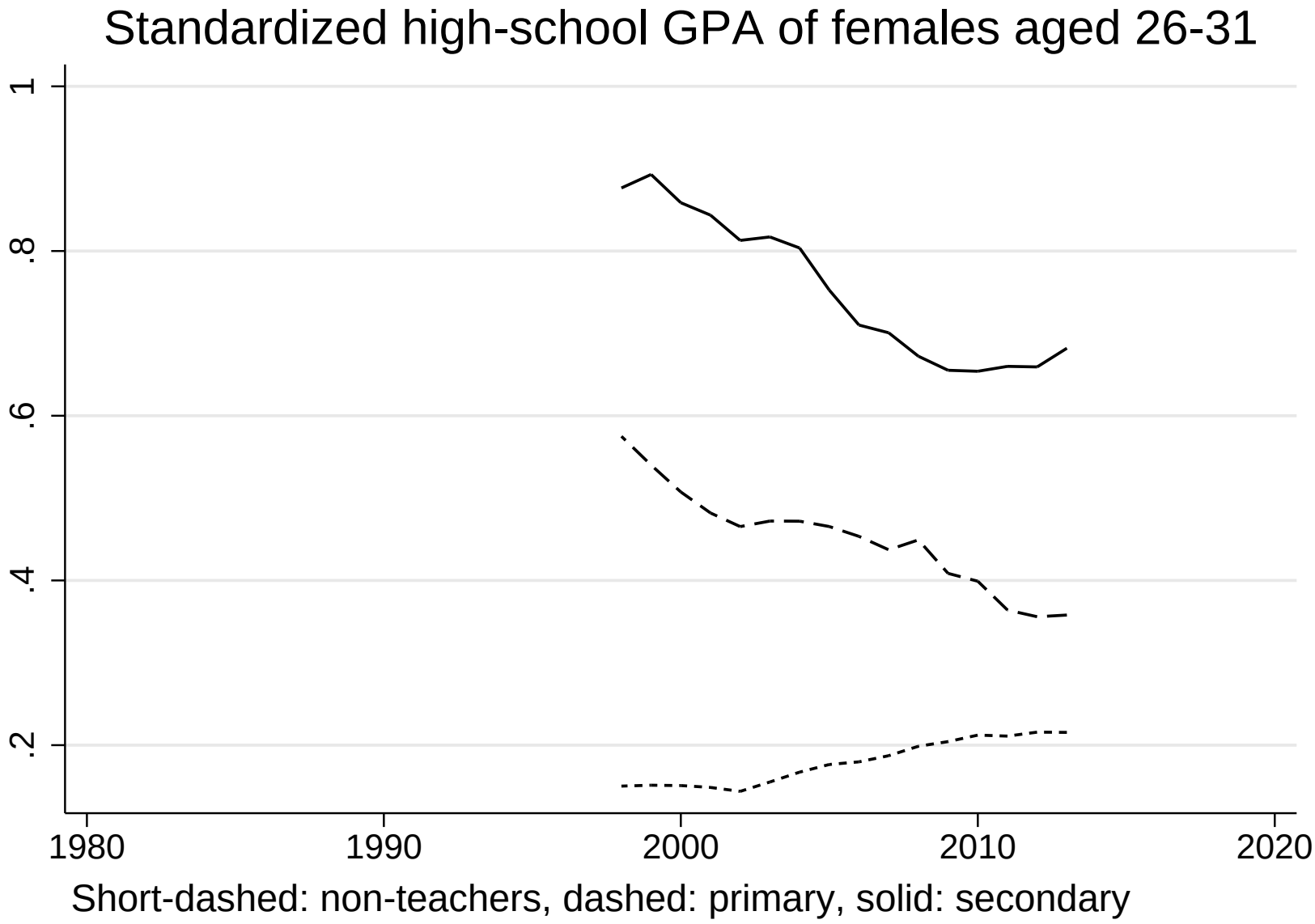
Black: wage sample, grey: population; short-dashed: non-teachers, dashed: primary, solid: secondary

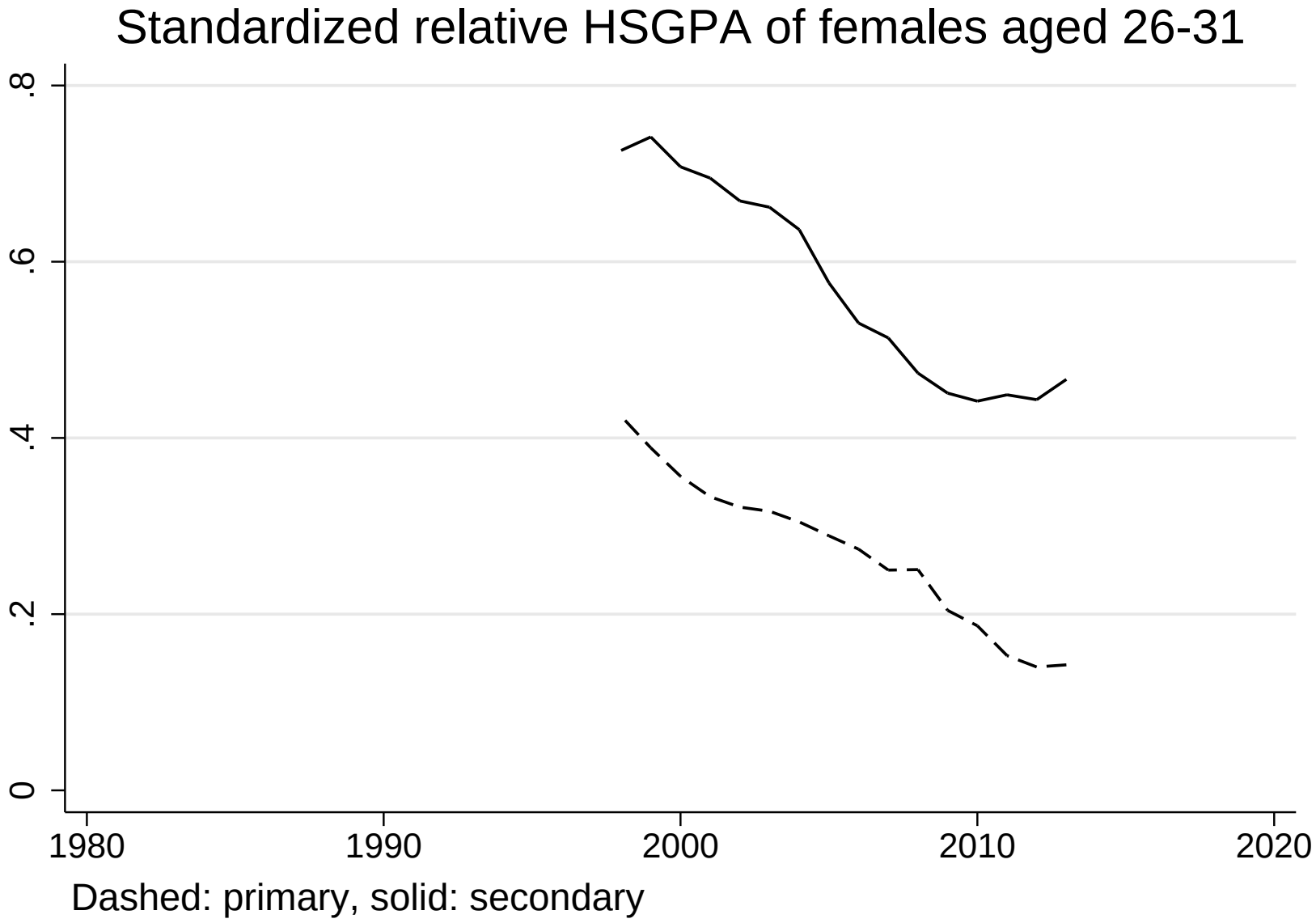

Non-cognitive skills of males aged 26-31
6.5
6
5.5
5
1980
1990
2000
2010
2020
Short-dashed: non-teachers, dashed: primary, solid: secondary


Non-cognitive skills of males aged 32-43
6.5
6
5.5
5
1980
1990
2000
2010
2020
Short-dashed: non-teachers, dashed: primary, solid: secondary


Standardized high-school GPA of males aged 26-31
.6
.4
.2
0
-.2
1980
1990
2000
2010
2020
Short-dashed: non-teachers, dashed: primary, solid: secondary


Standardized relative HSGPA of males aged 26-31
.7
.6
.5
.4
.3
.2
1980
1990
2000
2010
2020
Dashed: primary, solid: secondary


Standardized high-school GPA of females aged 26-31
1
.8
.6
.4
.2
1980
1990
2000
2010
2020
Short-dashed: non-teachers, dashed: primary, solid: secondary


Standardized relative HSGPA of females aged 26-31
.8
.6
.4
.2
0
1980
1990
2000
2010
2020
Dashed: primary, solid: secondary

Fact 1—summary

Declining teacher skills, mostly post-1995

- 0.5 to 0.75-sd fall in cognitive skills of young male teachers
- 0.5-sd fall in cognitive skills of middle-aged male teachers
- 0.5-sd fall in non-cognitive skills of young male teachers
- 0.25-sd fall in non-cognitive skills of middle-aged male teachers
- 0.1-sd fall in relative HSGPA of young male teachers
- 0.25-sd fall in relative HSGPA of young female teachers

Outline

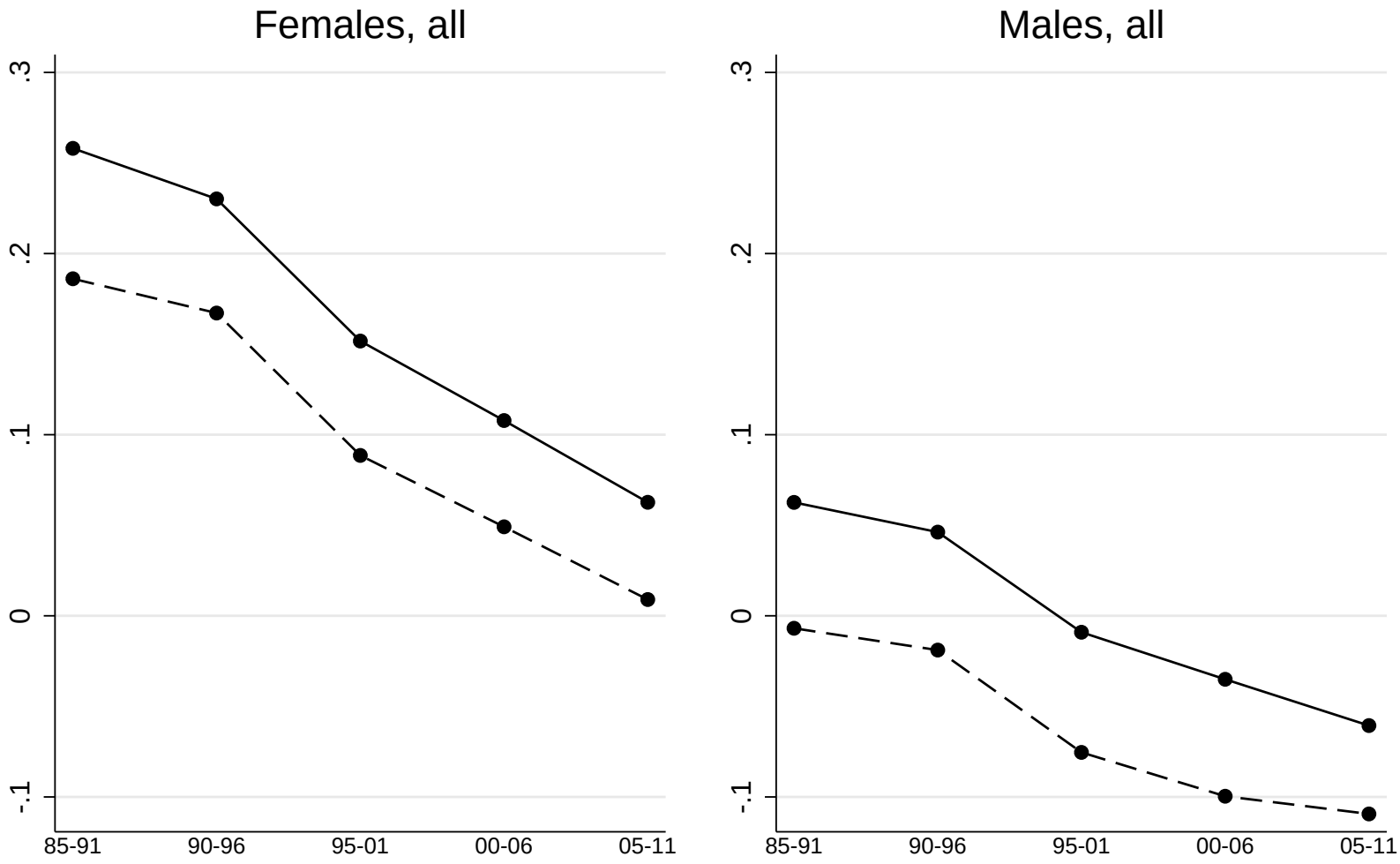
Measuring teacher wage gaps—OLS

Cross-sectional wage gaps (OLS) for primary (p) and secondary (s) school teachers, separately for each gender, time period. Controls: age dummies, year dummies, indicator for uncertain teacher status

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

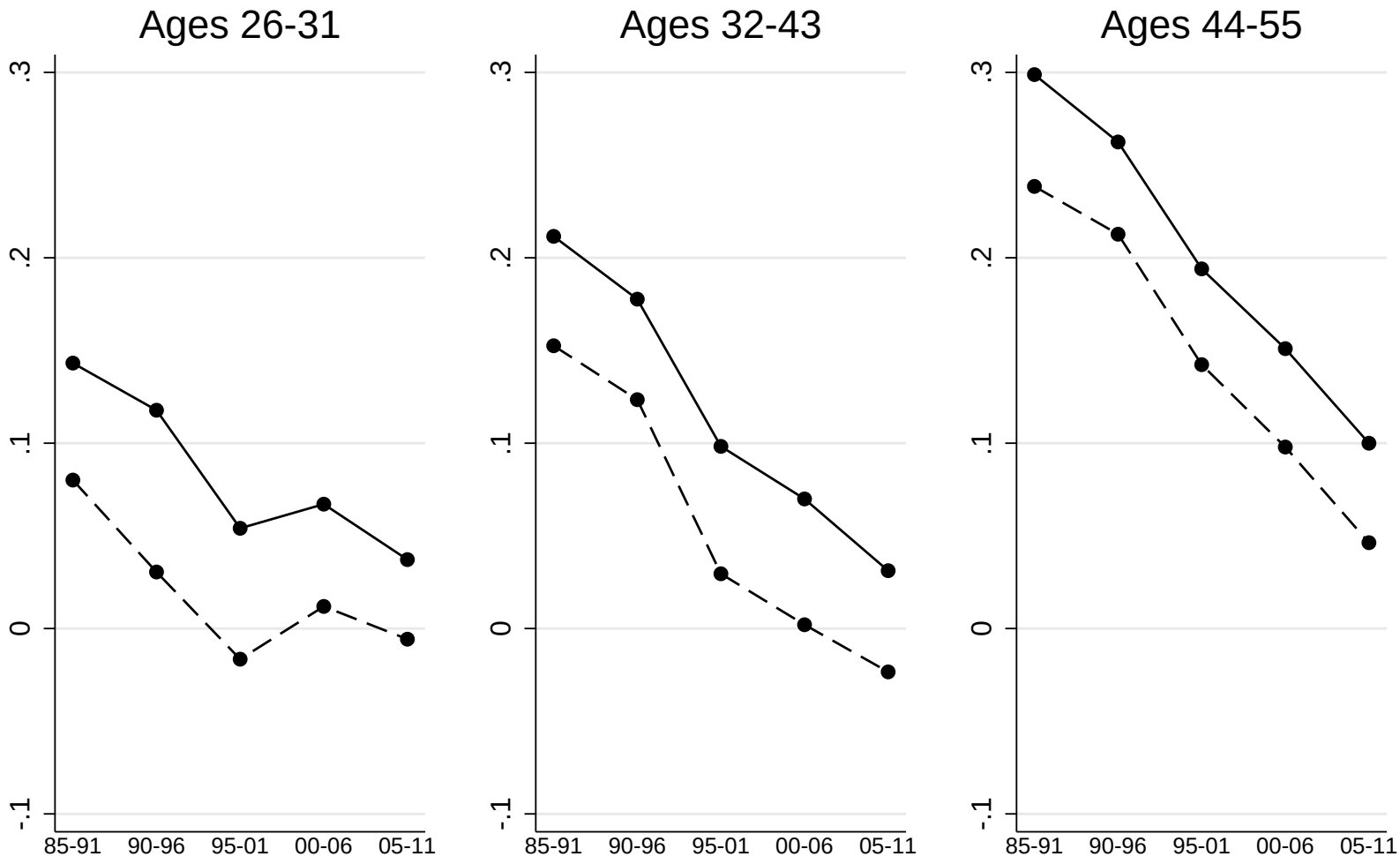
Pool annual data into 5 overlapping 7-year samples

Teacher wage gaps - OLS



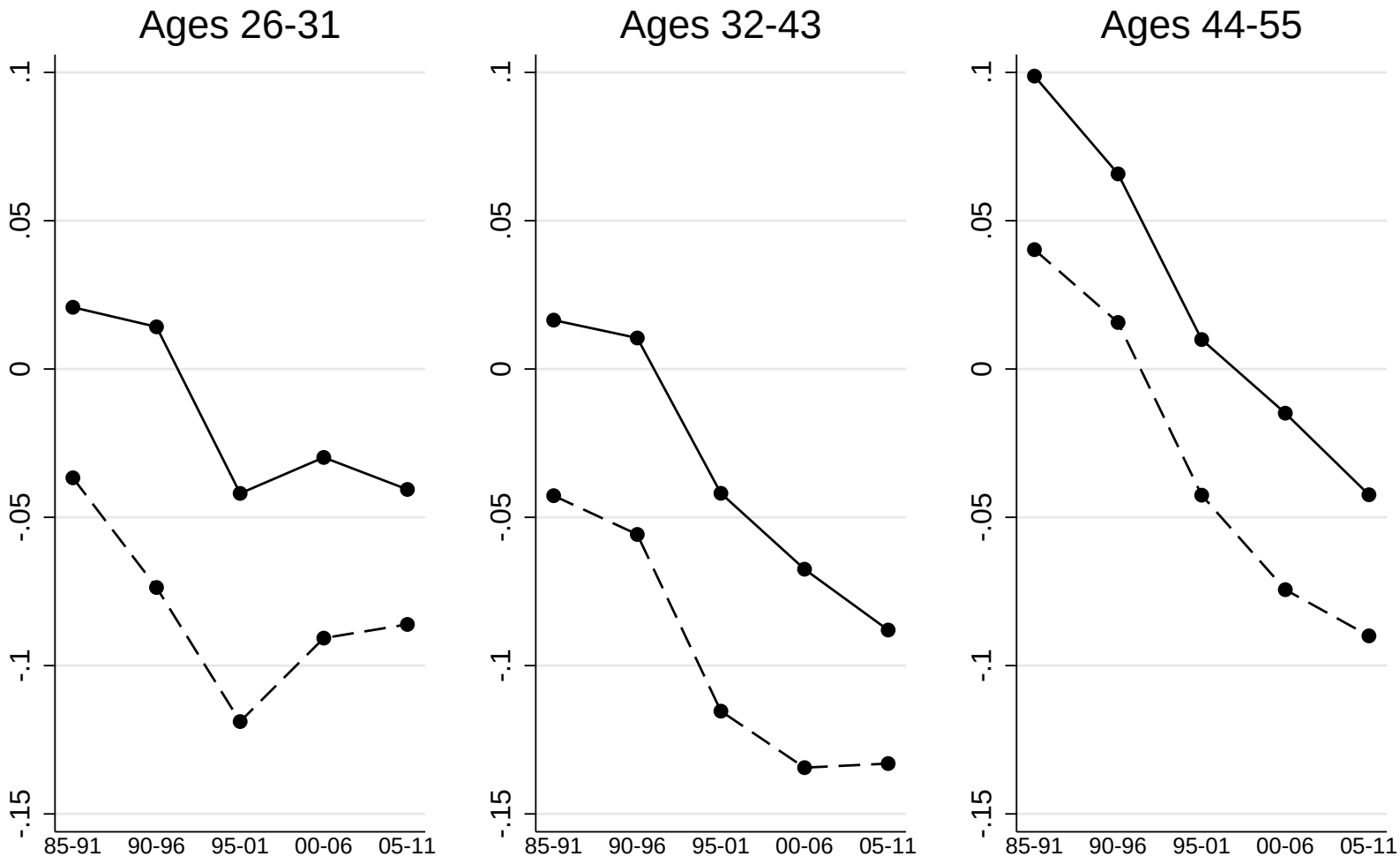
Dashed: primary, solid: secondary.

Teacher wage gaps, females - OLS



Dashed: primary, solid: secondary.

Teacher wage gaps, males - OLS



Dashed: primary, solid: secondary.

Fact 2—summary

Steady decline in teacher wage gaps (cross-sectional)

- 20/10 log points for female/male teachers
- smaller declines for young teachers, and mostly pre-1995
- stable difference b/w primary & secondary school teachers

Outline

Measuring teacher wage gaps—OLS & FE

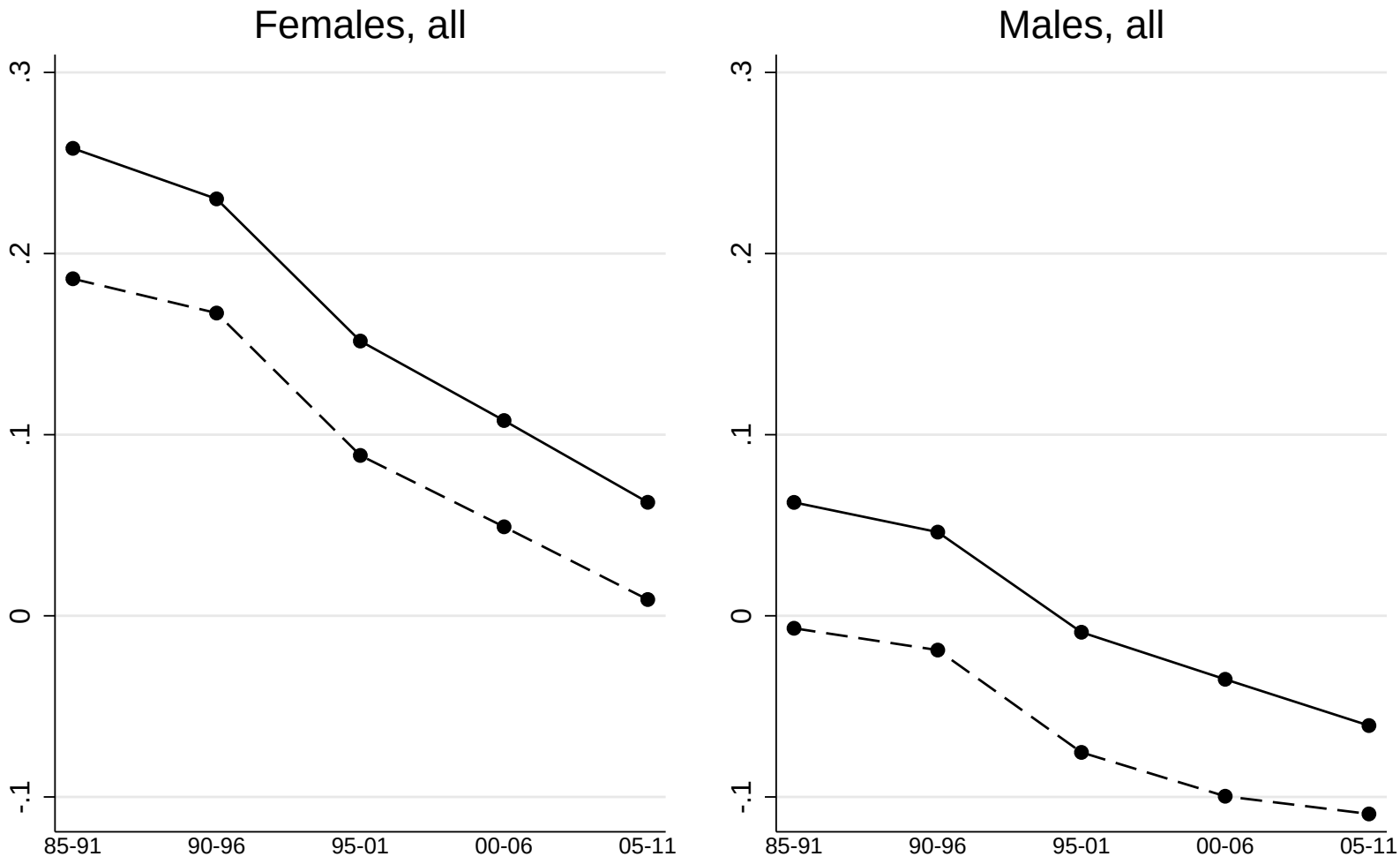
Recall: **cross-sectional** wage gaps (OLS) for primary (p) and secondary (s) school teachers, separately for each gender, time period. Controls: age dummies, year dummies, indicator for uncertain teacher status

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

Within-individual wage gaps (FE) separately for each gender, time period. Controls: year dummies, indicator for uncertain teacher status

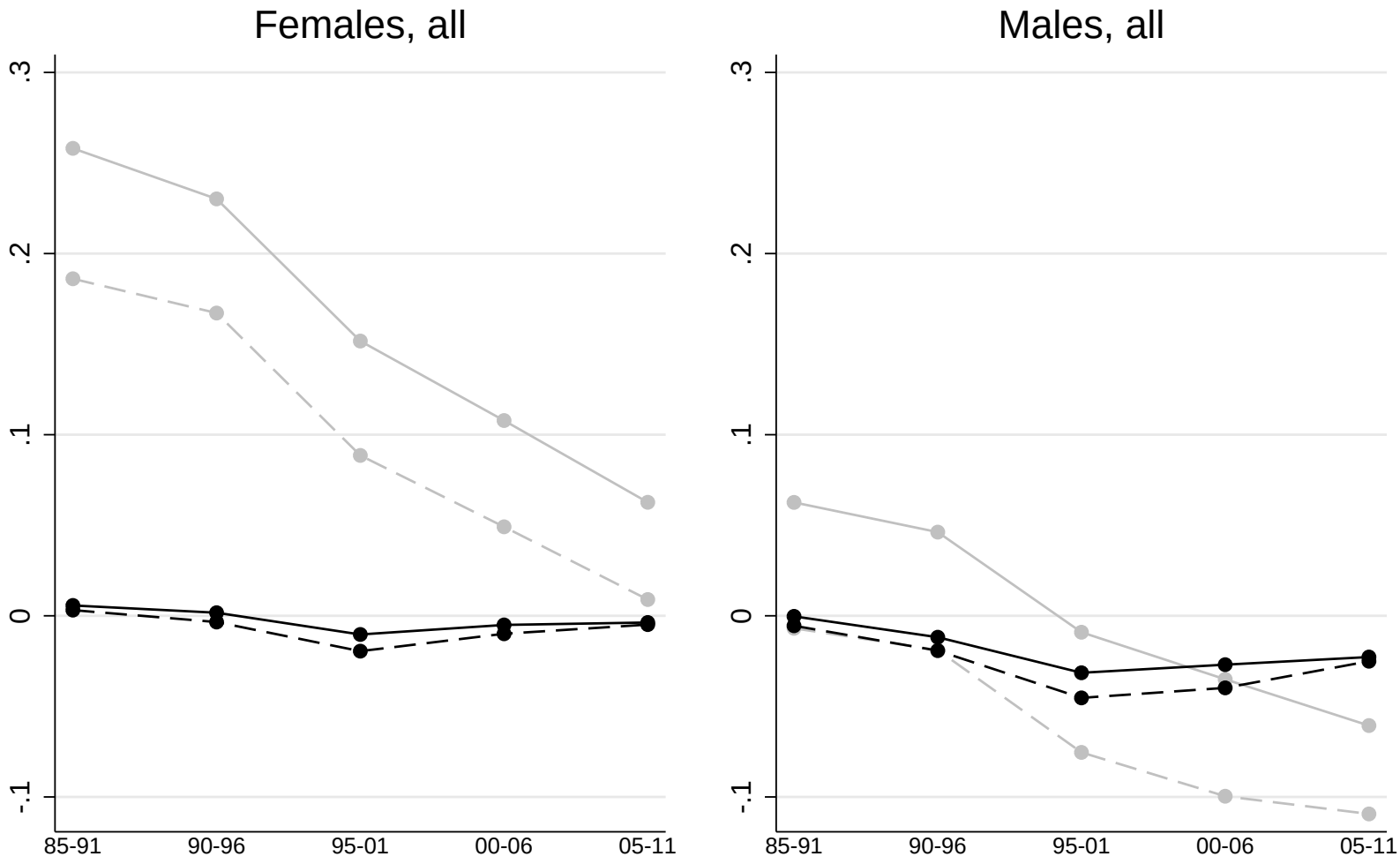
$$\log w_{it} = \beta^{\mathrm{p}}_{\mathrm{FE}} D^{\mathrm{p}}_{it} + \beta^{\mathrm{s}}_{\mathrm{FE}} D^{\mathrm{s}}_{it} + \alpha_i + X'_{it}\delta + u_{it}$$

Teacher wage gaps - OLS



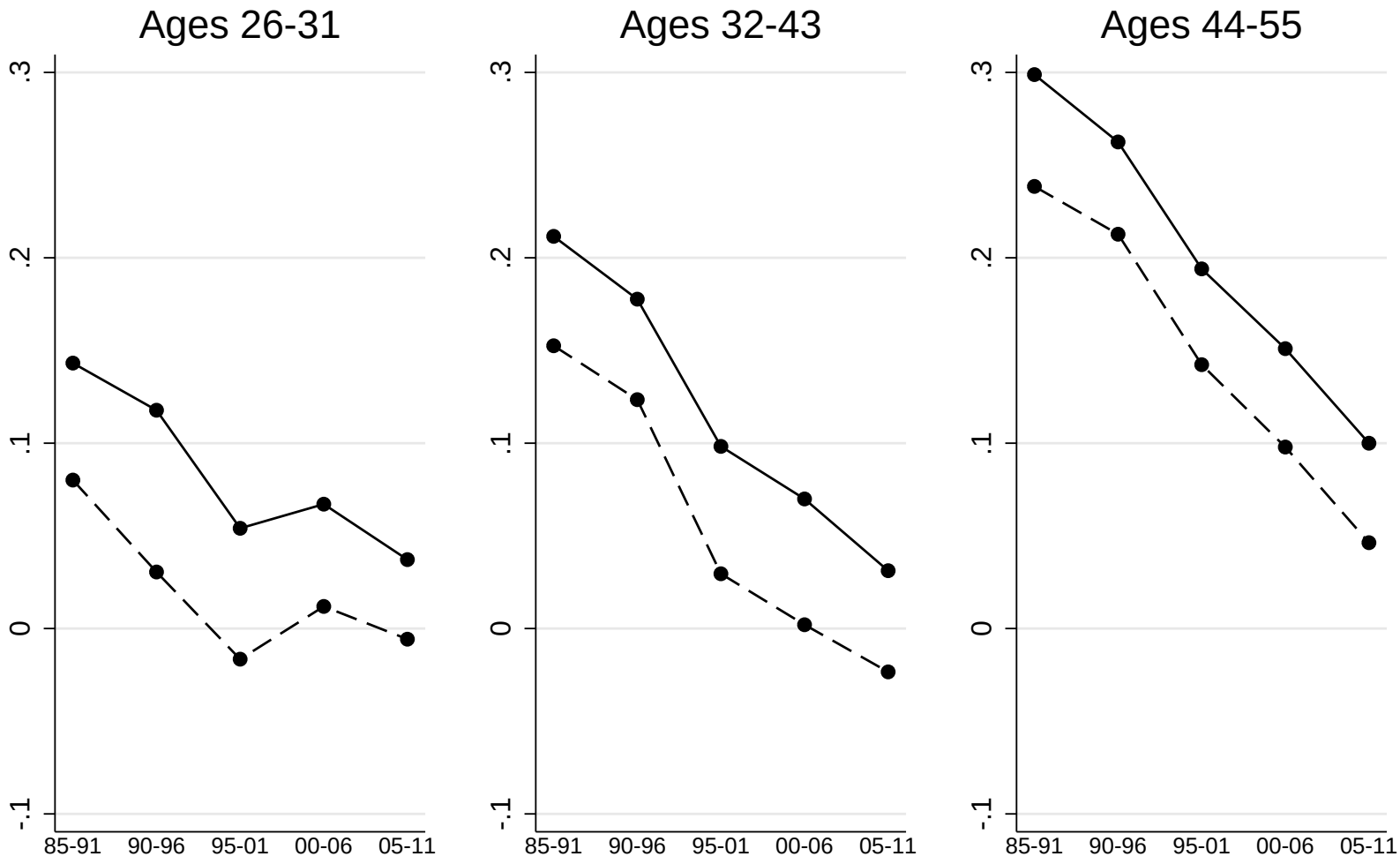
Dashed: primary, solid: secondary.

Teacher wage gaps - FE



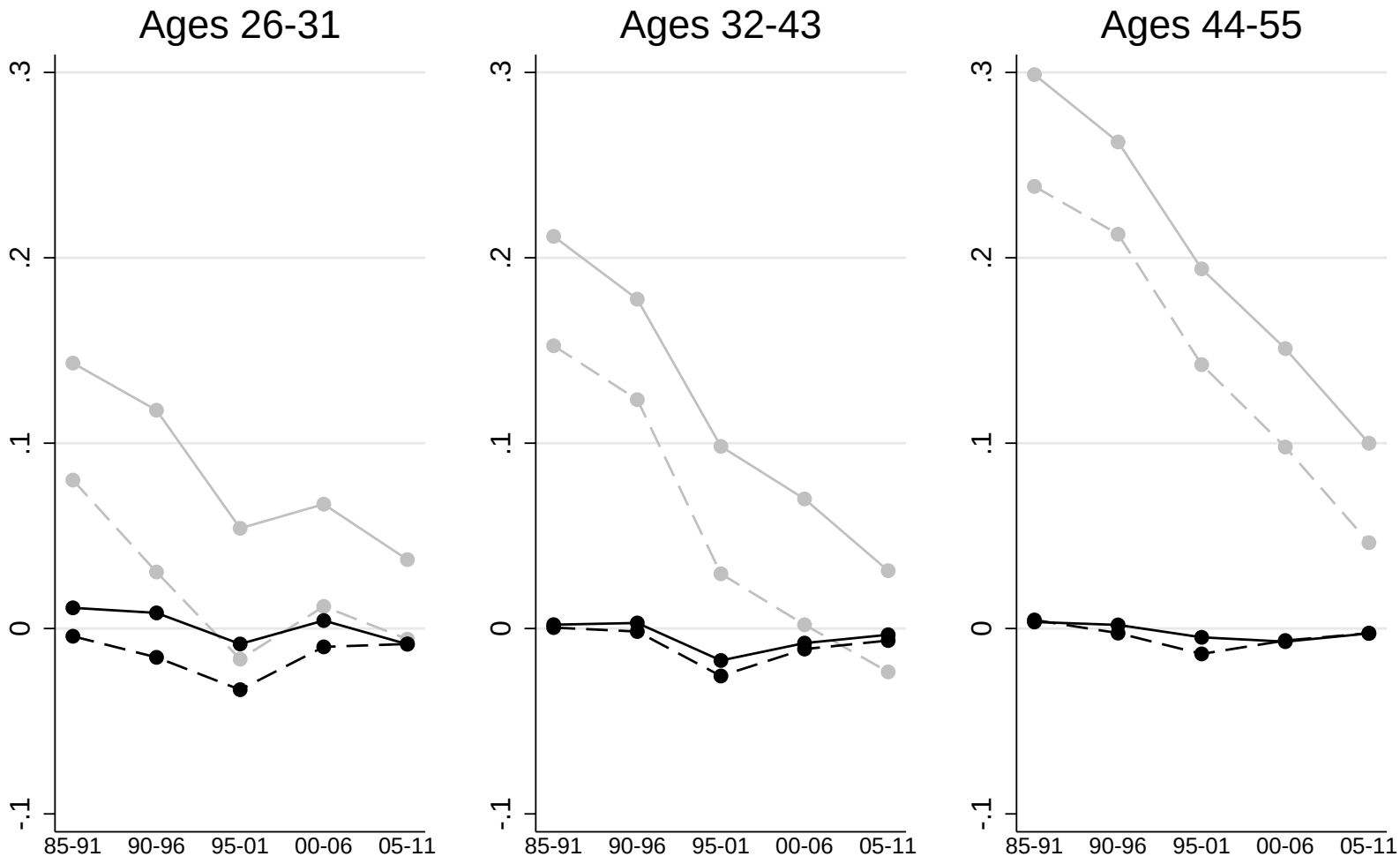
Dashed: primary, solid: secondary. Black: FE, grey: OLS.

Teacher wage gaps, females - OLS



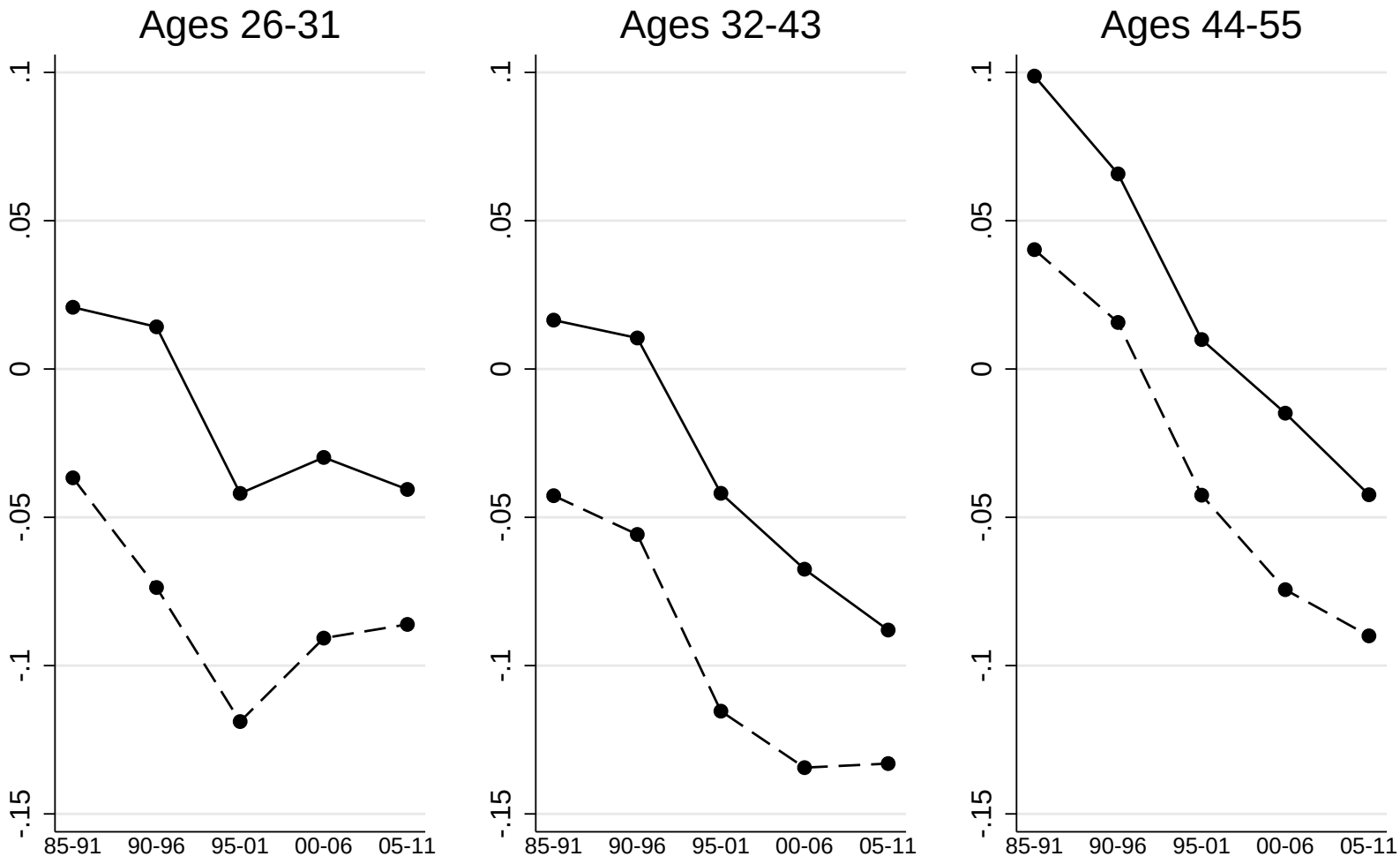
Dashed: primary, solid: secondary.

Teacher wage gaps, females - FE



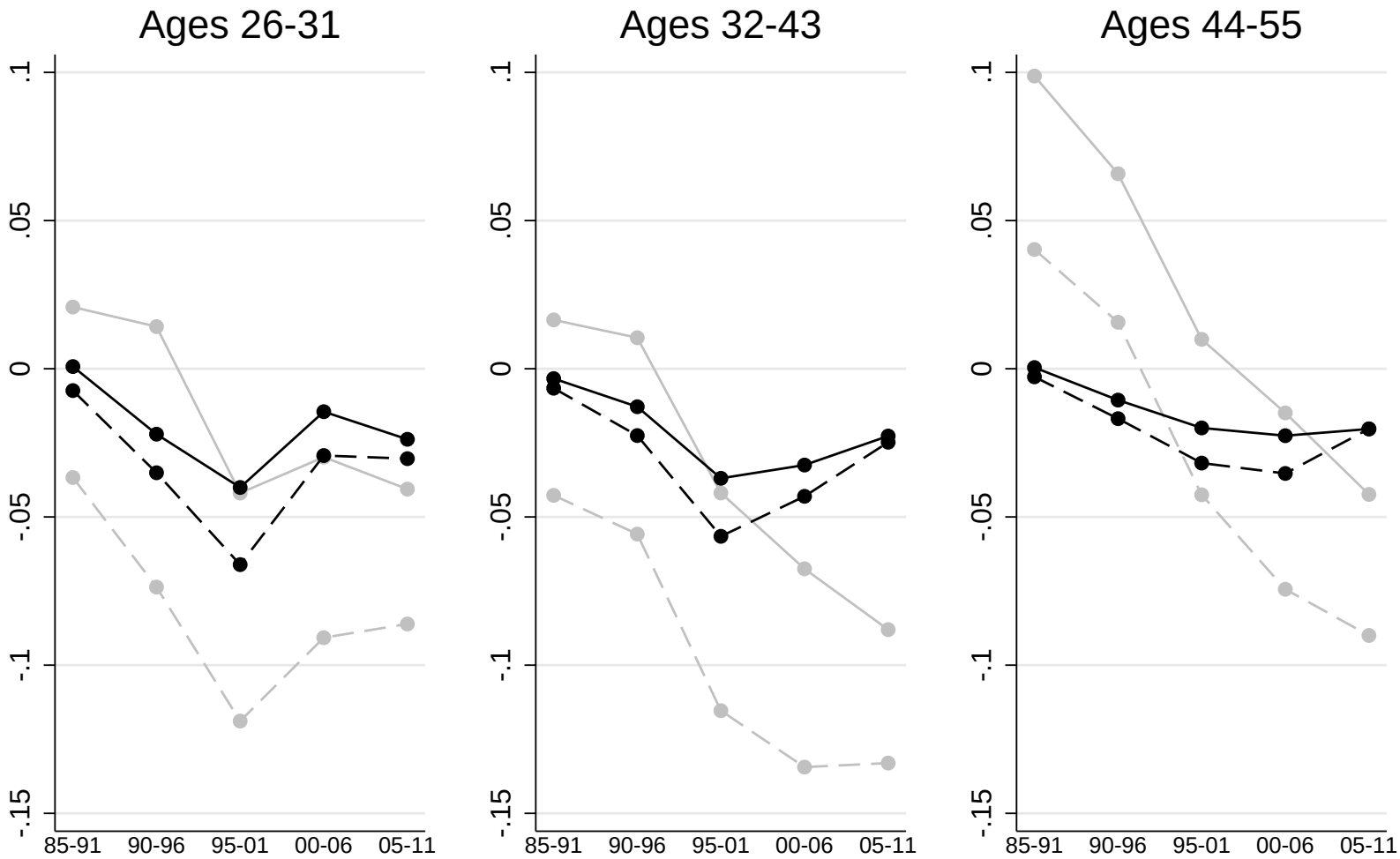
Dashed: primary, solid: secondary. Black: FE, grey: OLS.

Teacher wage gaps, males - OLS



Dashed: primary, solid: secondary.

Teacher wage gaps, males - FE



Dashed: primary, solid: secondary. Black: FE, grey: OLS.

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)

It must be that the type of worker who chooses teaching has changed dramatically: we investigate this by looking at **non-teaching wages 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	0.58	0.65	0.64	0.64	0.61
Often-teachers	0.04	0.03	0.04	0.04	0.04
Remainder	0.38	0.31	0.32	0.32	0.35

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)

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

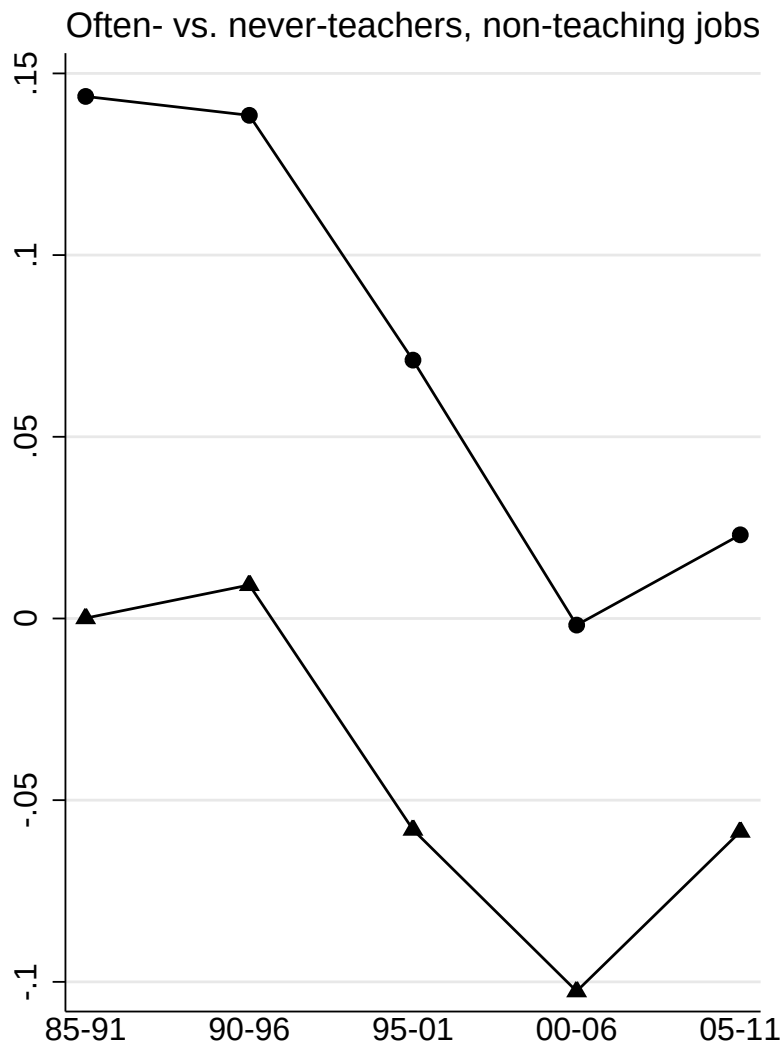
Run this regression twice

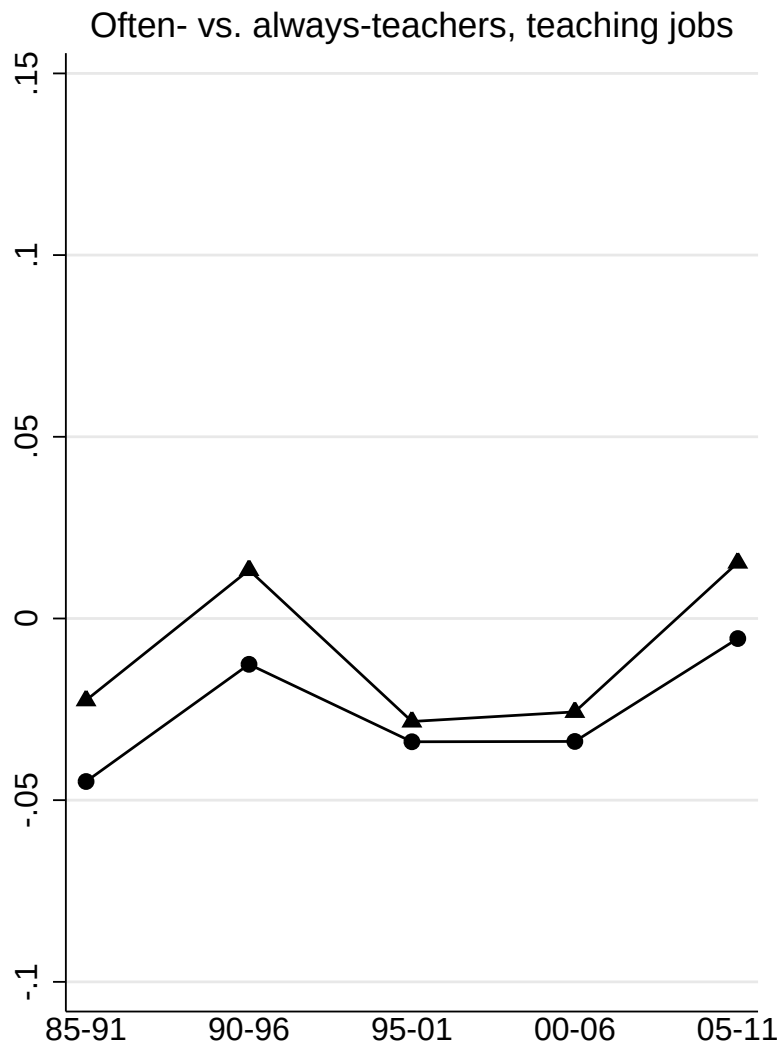
- non-teaching jobs (thus dropping always-teachers)
- teaching jobs (thus dropping never-teachers)

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

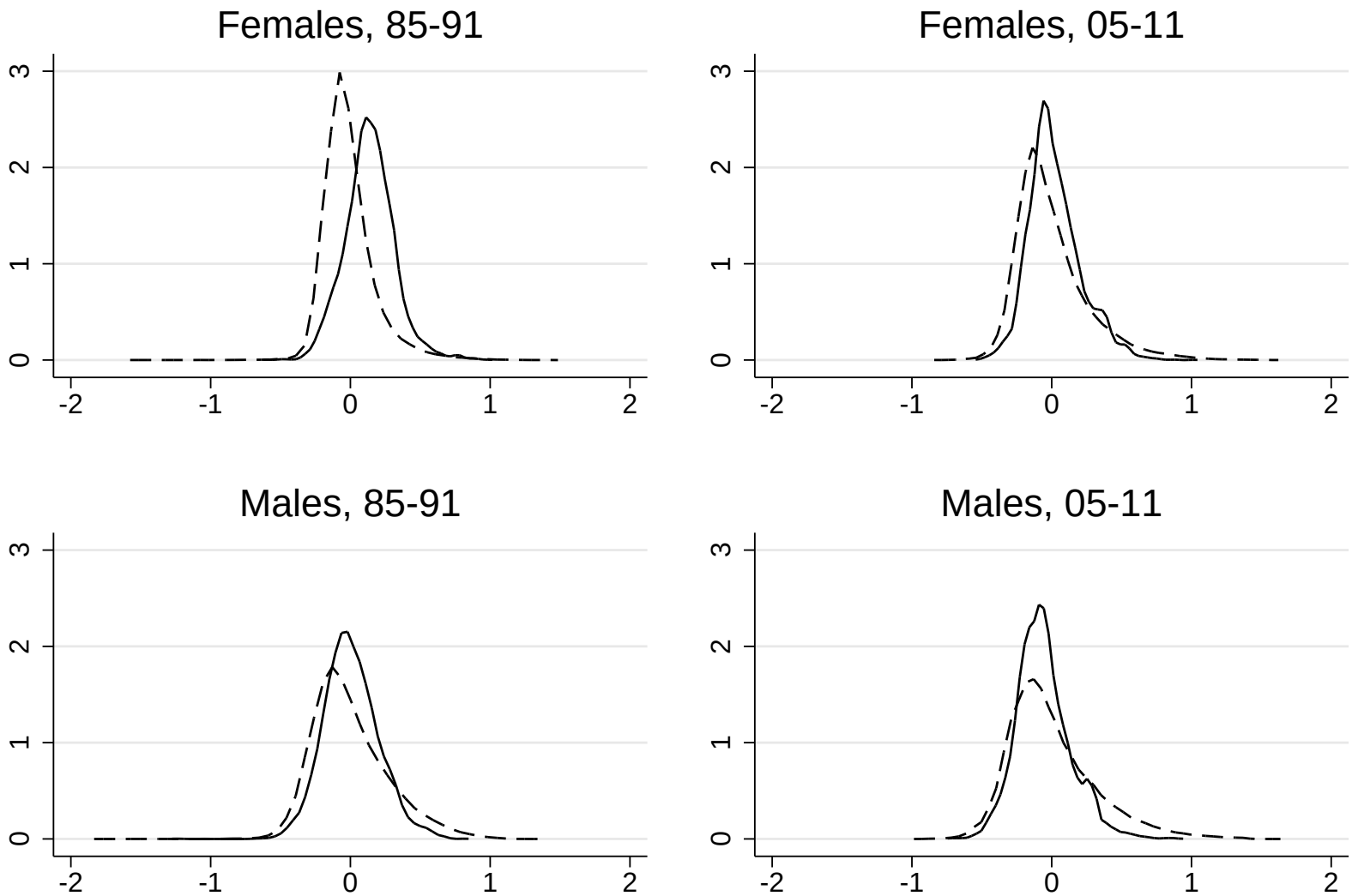
Wage gaps between often-, never-, always-teachers





Circles: females, triangles: males

Wage distributions of often- and never-teachers



Solid: often-teachers, dashed: never-teachers

Sectoral choices of often- and never-teachers

	Females		Males	
	Often	Never	Often	Never
1985-1991				
Education	17	2	18	2
Health, social work	44	36	15	6
Other public sector	8	10	14	12
Business services, finance	7	10	10	9
Other services	14	22	19	22
Primary, manufact., util.	9	21	24	49
2005-2011				
Education	40	8	20	2
Health, social work	15	31	10	5
Other public sector	14	8	12	5
Business services, finance	6	15	10	17
Other services	18	21	19	21
Primary, manufact., util.	7	17	30	49

Fact 3—summary

Stable within-individual wage gaps—declining quality of teacher pool in terms of non-teaching wages

- small and stable teacher wage gaps when controlling for FEs—mostly weakly negative, but almost always greater than -5 log points
- weak downward trend in some cases
- teachers who sometimes work in non-teaching jobs used to earn higher wages in these jobs

Outline

Are teachers' skills rewarded? Changes over time?

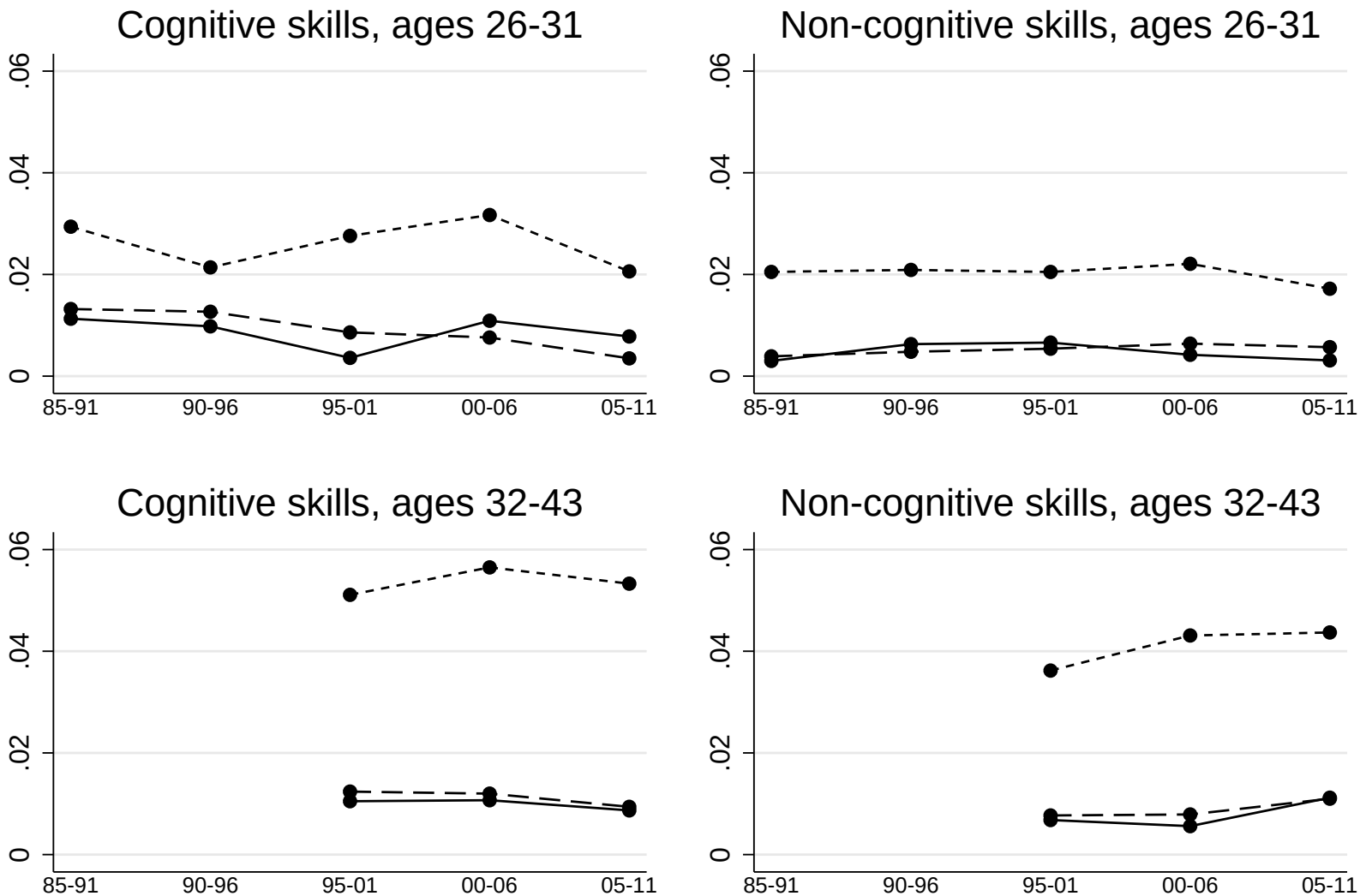
Obtain all quantities of interest from two-fold Oaxaca-Blinder decomposition of teacher wage gaps (separately for each 7-year period, type of teacher, age group—males only)

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

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

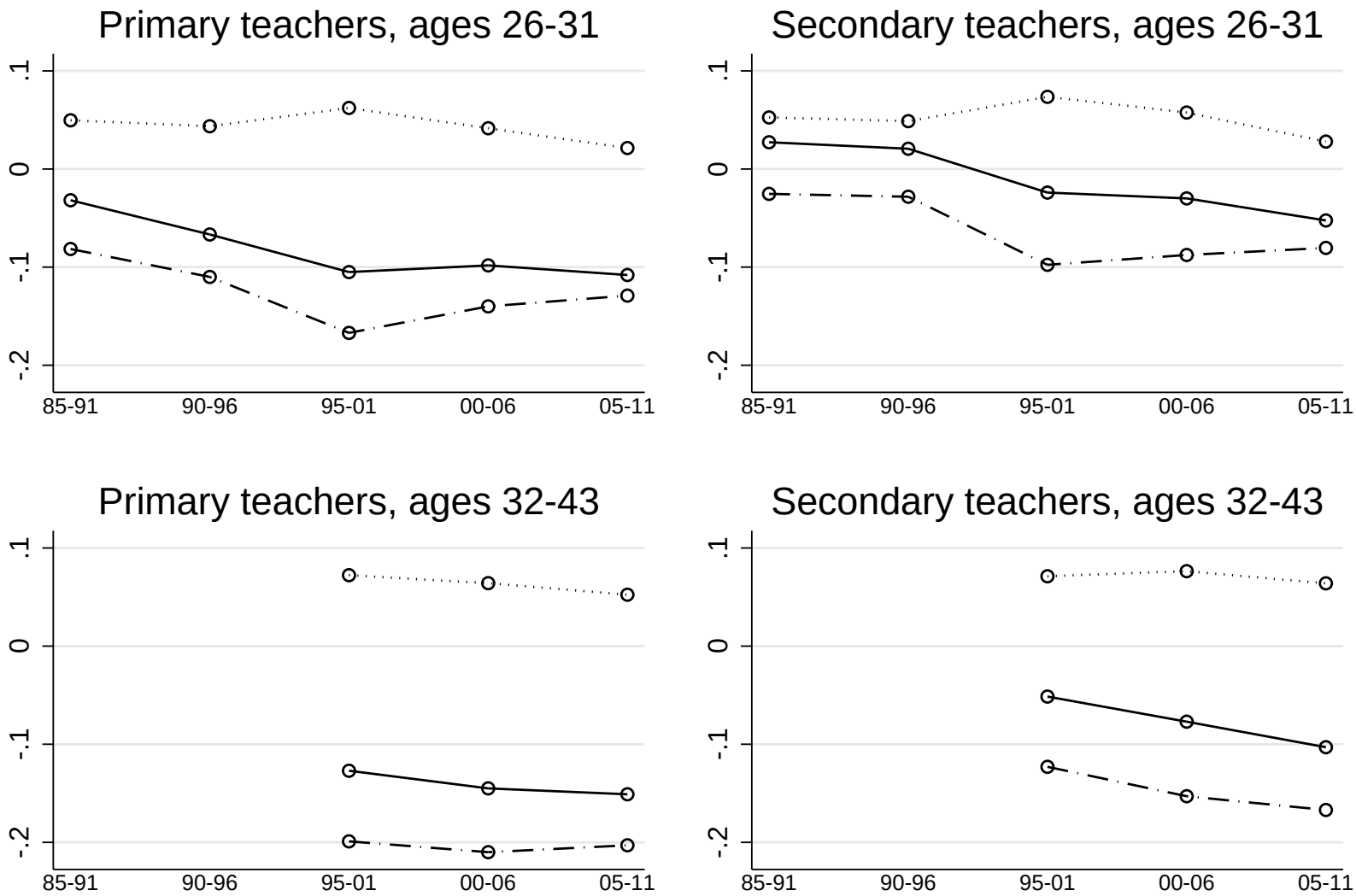
Covariates: cognitive skills, non-cognitive skills, age, time trend

Returns to skill



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

Oaxaca-Blinder decomposition



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

Fact 4—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

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 26-43, 1995-2013

	All years				5-yr intervals		10-yr intervals	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	cog.	non-cog.	cog.	non-cog.	cog.	non-cog.	cog.	non-cog.
Log wages, teachers	1.28	1.48	1.26	1.46	1.07	1.30	2.04	0.84
	(0.53)	(0.42)	(0.54)	(0.44)	(1.10)	(1.03)	(2.43)	(2.16)
Log wages, non-teachers	-0.22	-0.62	-0.22	-0.63	-0.92	-0.88	-1.20	-0.73
	(0.34)	(0.40)	(0.33)	(0.40)	(0.78)	(0.87)	(1.50)	(1.73)
Cognitive skills	-0.01	0.07	-0.01	0.07	-0.06	0.06	0.21	-0.02
	(0.05)	(0.05)	(0.05)	(0.05)	(0.14)	(0.12)	(0.34)	(0.28)
Non-cognitive skills	-0.01	0.03	-0.01	0.03	-0.04	0.10	-0.10	0.48
	(0.07)	(0.06)	(0.07)	(0.06)	(0.16)	(0.14)	(0.38)	(0.33)
Log public sector employment			-0.02	-0.05				
			(0.13)	(0.13)				
Log private sector employment			-0.06	-0.01				
			(0.12)	(0.11)				
N	1360	1360	1360	1360	357	357	214	214

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

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

	All years				5-yr intervals		10-yr intervals	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	cog.	non-cog.	cog.	non-cog.	cog.	non-cog.	cog.	non-cog.
Log wages, teachers	1.52	0.85	1.51	0.85	0.57	0.31	2.49	1.20
	(0.48)	(0.50)	(0.48)	(0.51)	(1.26)	(1.16)	(2.36)	(1.79)
Log wages, non-teachers	-0.12	-0.88	-0.11	-0.91	-0.60	-1.05	-2.07	1.17
	(0.55)	(0.50)	(0.54)	(0.51)	(1.68)	(1.10)	(2.87)	(2.25)
Cognitive skills	0.23	-0.01	0.21	-0.01	0.33	0.08	0.41	-0.20
	(0.07)	(0.07)	(0.07)	(0.07)	(0.15)	(0.17)	(0.32)	(0.27)
Non-cognitive skills	-0.08	0.13	-0.07	0.13	-0.18	0.19	-0.59	0.53
	(0.07)	(0.08)	(0.07)	(0.08)	(0.20)	(0.19)	(0.45)	(0.38)
Log public sector employment			-0.22	-0.08				
			(0.20)	(0.14)				
Log private sector employment			-0.02	0.06				
			(0.17)	(0.12)				
N	1889	1889	1889	1889	448	448	256	256

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: 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 Facts 2, 3, & 5 (changes in cross-sectional and within-individual teacher wage gaps, local labor market results)

What explains the fall in teacher skills?

Explanation 2: 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 trends for male teachers
- premise probably not quite correct

What explains the fall in teacher skills?

Explanation 3: changes in non-wage aspects of teaching

Teachers' reputation could have deteriorated, or working condition in schools worsened, or taste for teaching changed

- but compensating differences—contradicts Facts 3 & 4 (stable within-individual wage gaps, no increase in unexplained component of wage gap)

Policy implications

They obviously depend on what the right explanation is—suppose it is wages. Should teacher wages be raised, and if so, by how much?

Two questions

- Trade-off b/w teacher quality and alternative uses of public funds—perhaps voters have been choosing in a socially efficient way? How to judge?
- If there has been a policy failure, what is the friction responsible?

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?
- incur costs now, benefits later—what's the right discount rate?
- how to treat incumbent teachers?

Outline

Conclusion

Large decline in teachers' skills, most likely because teacher wages have fallen relative to outside options—but policy implications unclear without some cost-benefit calculations and understanding of political economy

To-do list

- female cognitive and non-cognitive skills—impute using brothers
- analyse trends in sub-scores (logical, verbal etc.)
- 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
- ...