

Lone Stars or Constellations? The Impact of Performance Related Pay on Matching Assortativeness in Academia

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AEA/ASSA Annual Meeting, 7-9 January 2022

Motivation

- Performance pay is widespread and increasingly more prevalent (Lemieux '09)
- Effects of performance pay on effort and sorting studied extensively (e.g. Dohmen and Falk '11, Bandiera et al. '05, Lazear '00)
 - BUT effects on workforce composition and matching assortativeness much less understood
- Performance pay is expected to affect matching assortativeness if there are complementarities in worker skill:
 - Complementarities in worker skill cause matching to be positive assortative -> large effects on output and growth (Kremer '93)
 - Positive assortativeness by worker productivity increases total output if production function is supermodular (Legros and Newman '02)
- Complementarities may be particularly pronounced in knowledge creation/academia (Borjas and Doran '15, Agrawal et al. '14, Oettl '12, Waldinger '10, Azoulay et al. '10)
 - Performance pay may thus have particularly strong effect on matching assortativeness in academia, and academic output

Overview of Paper

- Study of the effect of performance pay on matching assortativeness in academia (clustering of similarly productive academics)
- Use introduction of performance pay in German academia as natural experiment + data of universe of academics in Germany
- Hypothesis:
 - Performance pay should increase positive assortative matching if there are complementarities in worker skill
 - Increase in positive assortativeness should be larger if complementarities are stronger
- Two-step analysis:
 - Estimate strength of complementarities using plausibly exogenous variation in hiring budget to instrument for productivity of new hires
 - Test hypothesis in diff-in-diff framework, using strength of complementarities as continuous treatment variable
 - Focus on 2 channels that affect departmental composition: hiring and “firing” (leavers)

Takeaways

Main findings:

- There are sizeable positive complementarities in research productivity among co-located faculty
 - but only in fields with ample collaboration
- Performance pay increases positive assortative matching
 - higher quality departments in high complementarity fields hire more productive academics
 - biggest change in matching assortativeness of newly tenured academics (“junior” hires)
- Evidence of **sub**modularity of production function
 - suggesting increased assortativeness decreases total research output

Institutional Detail - Pay Reform

- Before reform: age-related pay (“C-Pay”)
- Reform introduced performance-related pay scheme (“W-Pay”)
- Performance pay scheme pays basic wage plus bonuses
 - Bonuses awarded for performance in research, education, training & promotion of young scientists
 - Research performance: number **and** quality of papers, funding awards, prizes etc.
 - Bonuses potentially more than double monthly pay
 - Only **tenured** professors can earn bonuses
- Reform announced in 2002, implemented in 2005
- As of 2005, any **new** contract falls under performance pay scheme

Estimation of Spillover Effects

Instrument for productivity of new hire with hiring budget $B_{j,t-1}$:
number of professors that retire (turn 66) between $t-1$ and t from
university to which department j belongs

- Plausibly exogenous variation in slack in hiring budget, because:
 - departmental age composition historically determined
 - mandatory retirement age
 - constant personnel budget and number of chairs

$$\bar{y}_{j,f,t}^{affil} = \beta_1 \bar{y}_j^{old} + \beta_2 \bar{y}_{j,t-1}^{nh,IV} + \gamma_t + c_f + u_{jt}, \text{ 2SLS}$$

$$\bar{y}_{j,f,t}^{new} = c + \beta_1 B_{j,t-1} + \beta_3 \bar{y}_j^{old} + \gamma_t + c_f + u_{jt}, \text{ first stage}$$

- $\bar{y}_{j,f,t}^{new}$: average productivity of new hires in faculty j in field f in year t
- $\bar{y}_{j,f}^{old}$: average productivity of existing affiliates of faculty j in field f in pre-sample years 1999/2000 (departmental quality)
- $\bar{y}_{j,f,t}^{affil}$: n -year future average productivity of affiliates in faculty j in field f in year t
- $\bar{y}_{j,f,t}^{nh,IV}$: instrumented average productivity of new hires of faculty j in field f , hired in year t

Spillover Effects

(Dep.Var.: 2-year Avg Productivity)	First Stage	2SLS		Low Complementarity		High Complementarity	
		1a	1b	First Stage	2SLS	First Stage	2SLS
Avg Prod of New Hires		0.319** (0.137)	0.325** (0.140)		-0.443 (0.976)		0.341*** (0.131)
Avg Prod of New Hires * Dept Quality			-0.017*** (0.005)				
Department Quality	0.830*** (0.139)	0.751*** (0.221)	1.223*** (0.230)	0.070* (0.037)	0.539*** (0.187)	0.859*** (0.149)	0.744*** (0.236)
Hiring Budget (lagged)	0.095*** (0.021)			0.007** (0.003)		0.192*** (0.049)	
N	1896	3359	3359	1031	1771	865	1588
N_g	705	851	851	389	449	316	402

- High/Low Complementarity: academic fields with above/below median average number of authors on a paper
 - Rationale: larger coauthor teams > more collaboration > greater opportunity for spillovers
- Negative interaction $\bar{y}_j^{old} \cdot \bar{y}_{j,t-1}^{nh,IV}$ in column 1b suggests production function is **submodular**
 - Would imply that an increase in positive matching assortativeness decreases total research output

Increase in Positive Assortativeness?

Study change in departmental composition:

- Hiring: “junior” hires (first time tenured professors) and “senior hires” (professors moving)
- “Firing”: tenured professors leaving department
- If matching assortativeness increases in response to performance pay, higher quality departments:
 - can attract more productive new hires
 - less productive academics leave
 - Response should be stronger if complementarities are larger

$$\bar{y}_{j,f,t}^{\{k\}} = \beta_1 \bar{y}_{j,f}^{old} + \beta_2 Compl_f + \beta_3 Compl_f \cdot \bar{y}_{j,f}^{old}$$

$$+ \beta_4 post \cdot \bar{y}_{j,f}^{old} + \beta_5 post \cdot Compl_f + \beta_6 post \cdot Compl_f \cdot \bar{y}_{j,f}^{old} + c_f + \gamma_t + u_{jt} \quad (1)$$

- $Compl_f$: average number of authors on a paper in a field - a proxy for complementarity strength
- $post$ is zero before the reform ($t < 2005$) and one thereafter
- sample restricted to 2001-2006 to avoid simultaneity bias and abstract from other events

Positive Assortative Matching - Triple Interactions

