Science after Communism:

Why does Westernization Correlate with Productivity?

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Institutions and Innovation

Production Function and Competition

- How do competitive pressures affect the productivity of scientists?
 - i.e., Is competition an integral part of the *academic* production function?
- Positive correlation of competition and productivity is found in many sectors ...
- ... because of reallocation and not because competition is an input in the production function (Backus, Ecmtrica 2020, Collard-Wexler and Loecker, AER 2015).

Institutions and Innovation

Production Function and Competition

- HOWEVER: today's institutions were reshaped over decades by competitive pressures in:
 - the academic labor market (Azoulay et al., RAND 2011)
 - financing of research activities (Tabakovic, JPubE 2019)
 - commercialization (Bikard and Marx, Manag.Sci. 2020)

- How to test for *causality* then??
- Why do we care?
 - Research \rightarrow Innovation \rightarrow long term growth
 - Institutional structure may affect innovation.

East German STEMM and Westernization



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East German HEIs & STEMM

- Unlike West Germany's decentralized Humboldtian system, East Germany's HE system was centrally organized as in the Soviet system with a clear separation of HE and research.
- East German policy makers offered preferential treatment to STEMM for needs of the centrally planned economy.
 - Search for *Wunderwaffe*
 - ► ⇒ protective environment for STEMM in the East vs. highly competitive academic environment of the West.

 East German system: competition and mobility were discouraged; publications in Western journals were restricted (or absent for social sciences)

Fall of the Berlin Wall in November 1989 and Re-unification in October 1990



After Re-unification

Western-style rules

- Westernization of East German academia means that
 - West German HEI structure was applied to East German university and research institutes.
 - East German scientists were introduced to a new set of norms such as increased competition.
 - Publications play a key role as had been the case in the West for several decades.
- Adjustment in relatively politically neutral subjects such as the natural sciences and engineering was less challenging.

After Re-unification

Western-style rules and STEMM

- All university staff and non-university research staff were subject to political and academic review:
 - \blacktriangleright Downsizing of academia \rightarrow positive evaluation did not guarantee job
 - 1990-1995 most intense re-structuring; initial firing/re-hiring was completed in 1995.

 Many West German scientists could obtain positions in East German universities and research institutes 1990-1995.

Academic Structure after Re-Unification

	Hir	ed Professors	Percentage of	
	Total	from West Ger	West Ger hires	
Natural Sciences & Engineering	351	175	49.9%	
Biological Sciences	32	23	71.9%	
Physics	74	46	62.2%	
Computer Sciences	39	23	59%	
Mechanical Eng.	44	22	50%	
Civil Engineering	19	9	47.4%	
Chemistry	53	21	39.6%	
Biochemistry	8	3	37.5%	
Mathematics	69	25	36.2%	
Electronics	13	3	23.1%	
Social Sciences	236	203	86%	
Political Sci.	22	22	100%	
Philosophy	17	17	100%	
Economics	51	47	92.2%	
Sociology	30	25	83.3%	
History	52	43	82.7%	
Management	39	30	76.9%	
Psychology	25	19	76%	

Data

- Identify all STEMM researchers on Web of Science (WoS) who
 - have a predominantly West German or East German affiliation in 1979-1989
 - published at least once during 1979-1989 and 1996-2006
 - are active in physics, chemistry, biology, biomedical research, clinical medicine, engineering and technology, mathematics (STEMM fields on WoS).
- ▶ 8,771 West German scientists w/692,411 publications
- ▶ 1,136 East German scientists w/60,859 publications
- ▶ Pre-1990 coverage? → Science Citation Index was created in 1960s aiming also to index Eastern bloc's research.

Identification

West and East German Research Profiles 1979-1989

Field (within main discipline)	Share of field in all publications
West German scientists	
Biochemistry & Molecular Biology (Biomedical Research)	7.8%
General & Internal Medicine (Clinical Medicine)	5.13%
General Chemistry (Chemistry)	5.1%
General Physics (Physics)	4.9%
Cardiovascular System (Clinical Medicine)	4.7%
Nuclear & Particle Physics (Physics)	4.6%
Immunology (Clinical Medicine)	3.11%
Neurology & Neurosurgery (Clinical Medicine)	3.05%
Gastroenterology (Clinical Medicine)	2.7%
East German scientists General Chemistry (Chemistry)	12.2%
Physical Chemistry (Chemistry)	8.5%
Biochemistry & Molecular Biology (Biomedical Research)	8.3%
Veterinary Medicine (Clinical Medicine)	3.7%
Applied Physics (Physics)	3.6%
Applied Physics (Physics) General & Internal Medicine (Clinical Medicine)	3.6% 3.5%
Applied Physics (Physics) General & Internal Medicine (Clinical Medicine) Solid State Physics (Physics)	3.6% 3.5% 3.22%
Applied Physics (Physics) General & Internal Medicine (Clinical Medicine) Solid State Physics (Physics) Endocrinology (Clinical Medicine)	3.6% 3.5% 3.22% 3.19%
Applied Physics (Physics) General & Internal Medicine (Clinical Medicine) Solid State Physics (Physics) Endocrinology (Clinical Medicine) Pharmacy (Clinical Medicine)	3.6% 3.5% 3.22% 3.19% 3.16%
Applied Physics (Physics) General & Internal Medicine (Clinical Medicine) Solid State Physics (Physics) Endocrinology (Clinical Medicine) Pharmacy (Clinical Medicine) General Physics (Physics)	3.6% 3.5% 3.22% 3.19% 3.16% 3.1%
Applied Physics (Physics) General & Internal Medicine (Clinical Medicine) Solid State Physics (Physics) Endocrinology (Clinical Medicine) Pharmacy (Clinical Medicine) General Physics (Physics) Inorganic & Nuclear Chemistry (Chemistry)	3.6% 3.5% 3.22% 3.19% 3.16% 3.1% 2.9%

Identification

West and East German Research Profiles 1979-1989



Differences among East Germans

 $y_{st} = X_{st}\beta + \gamma(Post1990 \times Overlap_s) + \phi_s + \phi_t + \epsilon_{st}$

 y_{st} is s's productivity in year t (pubs, cites, impact factor)

 X_{st} is s's time-variant individual quality controls and age polynomial

 $Overlap_s$ is the comparability of *s*'s research profile with West German research of 1979- 1989

Differences among East Germans

	East Germans only			East and West Germans		
	Papers	Cites	IF	Papers	Cites	IF
Panel A:Overlap based on						
Post1990*Overlap	-0.296 ^b	-0.0290	0.427 ^b	-0.439 ^a	-0.192 ^a	-0.335 ^a
	[0.134]	[0.109]	[0.177]	[0.0504]	[0.0444]	[0.0473]
Post1990*East				0.121 ^a	0.171 ^a	0.259 ^a
				[0.0333]	[0.0290]	[0.0442]
Post1990*Overlap*East				0.127	0.183	0.702 ^a
				[0.140]	[0.124]	[0.177]
Panel B:Overlap based on	intensity					
Post1990*Overlap	-0.0903	-0.0154	0.344 ^a	-0.211 ^a	-0.0902 ^a	-0.163 ^a
	[0.0854]	[0.0663]	[0.120]	[0.0321]	[0.0301]	[0.0315]
Post1990*East				0.119 ^a	0.186 ^a	0.259 ^a
				[0.0335]	[0.0287]	[0.0450]
Post1990*Overlap*East				0.106	0.0806	0.479 ^a
				[0.0897]	[0.0761]	[0.122]
Panel C:Overlap based on	similarity					
Post1990*Overlap	-2.535 ^a	-0.260	1.259	-3.273 ^a	-0.636 ^a	-1.272 ^a
	[0.794]	[0.671]	[0.915]	[0.274]	[0.228]	[0.237]
Post1990*East				-0.259	-0.125	-0.735
				[0.429]	[0.390]	[0.474]
Post1990*Overlap*East				0.728	0.621	2.122 ^b
				[0.807]	[0.734]	[0.879]
Observations	14793	10780	10761	136500	107871	107714

Collaborations of East Germans

$E(\textit{Collab}_{st}^{j}|\textit{Publication}_{st} > 0) = \beta^{c}X_{st} + \alpha^{c}(\textit{Post1990} \times \textit{Overlap}_{s}) + \phi_{s}^{c} + \phi_{t}^{c} + \epsilon_{st}^{c}$

	Collaboration					Productivity		
[Panel A]	West Ger	Inmig.	Outmig.	West/US	USSR	Pubs.	Cites	IF
Post1990*Overlap	0.166 ^a	0.127 ^a	-0.153 ^a	-0.0487	-0.133 ^c	-0.296 ^b	-0.0290	0.427 ^b
	[0.0566]	[0.0479]	[0.0496]	[0.0832]	[0.0704]	[0.134]	[0.109]	[0.177]
P90*Soviet	-0.0305	0.133	0.0261	0.339 ^c	-0.792 ^a	0.557 ^c	0.660 ^a	0.519
	[0.142]	[0.131]	[0.0743]	[0.191]	[0.195]	[0.321]	[0.244]	[0.356]
P90*Soviet*Overlap	0.293	-0.609	0.0207	-0.192	-0.0155	-0.167	-1.456 ^c	-1.835
	[0.528]	[0.404]	[0.262]	[0.635]	[0.763]	[1.156]	[0.846]	[1.240]
Observations	10780	10780	10780	10780	10780	14793	10780	10761

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Research Proximity of East-West German Collaborations



Cognitive Mobility



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Cognitive Mobility

	[Correlation coeff.]
Post1990*Overlap	-0.123 ^a
	[0.0414]
Post1990*Soviet	-0.0502
	[0.0759]
Post1990*Overlap*Soviet	0.141
	[0.278]
Observations	35809

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Attrition



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Attrition

	East Geri	mans only	East and West Germans
	to 2001	to 2005	
Post1990*Overlap	-0.0443 ^c	-0.00174	0.0171 ^a
	[0.0249]	[0.0244]	[0.00646]
Post1990*East			0.0149 ^b
			[0.00620]
Post1990*East*Overlap			-0.0191
			[0.0240]
Observations	9830	12365	134072

Conclusion

Full paper is on ssrn.com/abstract=3961712

- East German scientists' productivity increased after 1990; catching up with their West German peers in research quantity and quality.
- This increase in productivity is mainly driven by:
 - Re-wiring of collaborations despite diminished research proximity,
 - field-switching behavior
 - attrition
- Intense competition in R&I leads to reallocation and attrition rather input-driven productivity.