Industrial Espionage and Productivity

Albrecht Glitz and Erik Meyersson

Universitat Pompeu Fabra and SITE

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Motivation

- Industrial espionage remains pervasive across industrialized countries.
- China and Russia often seen as main culprit although high-profile leaks (e.g. WikiLeaks) suggest allies also spy on each other's industrial secrets.
- The annual economic damage from industrial espionage is estimated to amount to
  - 19.0 billion dollars for the US economy (FBI, 2013).
  - 11.8 billion euros for the German economy (Corporate Trust, 2014).
  - Both estimates are at the lower end of a wide spectrum of estimates.
- Research on economic *benefits* of industrial espionage largely non-existent beyond individual case studies.

Contribution of the Paper

1. Comprehensive documentation of the extent of East German industrial espionage in the West during the Cold War.

2. First systematic quantitative assessment of the economic returns to industrial espionage.

3. Industry-level analysis linking industrial espionage to sector-specific productivity growth.

Main Findings

- Economic returns to industrial espionage are substantial.
  - A one standard deviation increase in information acquired from industrial espionage reduces...
  - ... the West-to-East German log TFP gap (log output per worker gap) by 6.9 (5.5) percentage points.
- Industrial espionage seems particularly effective in narrowing the gap in cases where:
  - East Germany was technologically not too far behind West Germany.
- Positive effect on East German productivity growth is driven by select pieces of high quality information.

Literature

Related to several strands of the **economics** literature:

1. The literature on the link between **innovation and economic growth** (e.g. Griliches, 1980; Griliches and Lichtenberg, 1984; Romer, 1990; Grossman and Helpman, 1991; Aghion and Howitt, 1992; Hall, Mairesse and Mohnen, 2010).
2. **Knowledge diffusion** (Bloom et al., 2013) through **trade** (e.g. Eaton and Kortum, 1999; Keller, 2004; Cameron et al., 2005), **FDI** (Fons-Rosen et al., 2013) and **migration** (Moser et al., 2014), as well as factors bearing directly on the choice of technology **adoption versus innovation** (Griffith et al., 2004; Acemoglu et al., 2006).
3. Consequences of **secrecy** (e.g. Harrison, 2008; Harrison, 2013; Harrison and Zaksauskiene, 2016) and **surveillance** (Lichter et al., 2015).
4. **Innovation and historical economic development** (e.g. Schmookler, 1966; Sokoloff, 1988; Moser and Voena, 2012; Moser, 2013).

Historical Context

- Industrial espionage carried out by East Germany on, primarily, West Germany during the Cold War.
- East German industrial espionage partly a response to Western containment policies; high trade barriers, bans against an extensive set of sensitive "dual-use" goods.
- Several factors allowed East Germany to build up a spy network in West Germany over time.
- Stasi
  - It served as both a domestic secret police as well as a foreign intelligence agency.
  - Responsible for espionage activities abroad was the Main Directorate for Reconnaissance (*Hauptverwaltung Aufklärung* or HVA).
  - In 1989, before its dissolution, the HVA had more than 4,000 full-time employees, handling around 1,550 informants (so-called IM's) in West Germany (Müller-Enbergs, 2008).

The HVA Headquarters (Berlin-Lichtenberg)

The Stasi

"The Ministry for State Security has the goal of acquiring, in steadily increasing volume, scientific-technical information and documents from West Germany and other capitalist countries."

– Erich Mielke, Minister of State Security (1957-1989), BStU, Policy Documents. DA, 3/55/DSt 100938

Data Sources

- Throughout the paper, we work with three primary data sources:

    1. The SIRA Data.

    2. Industry-level Data.

    3. Patent and Trade Data.

The SIRA Data

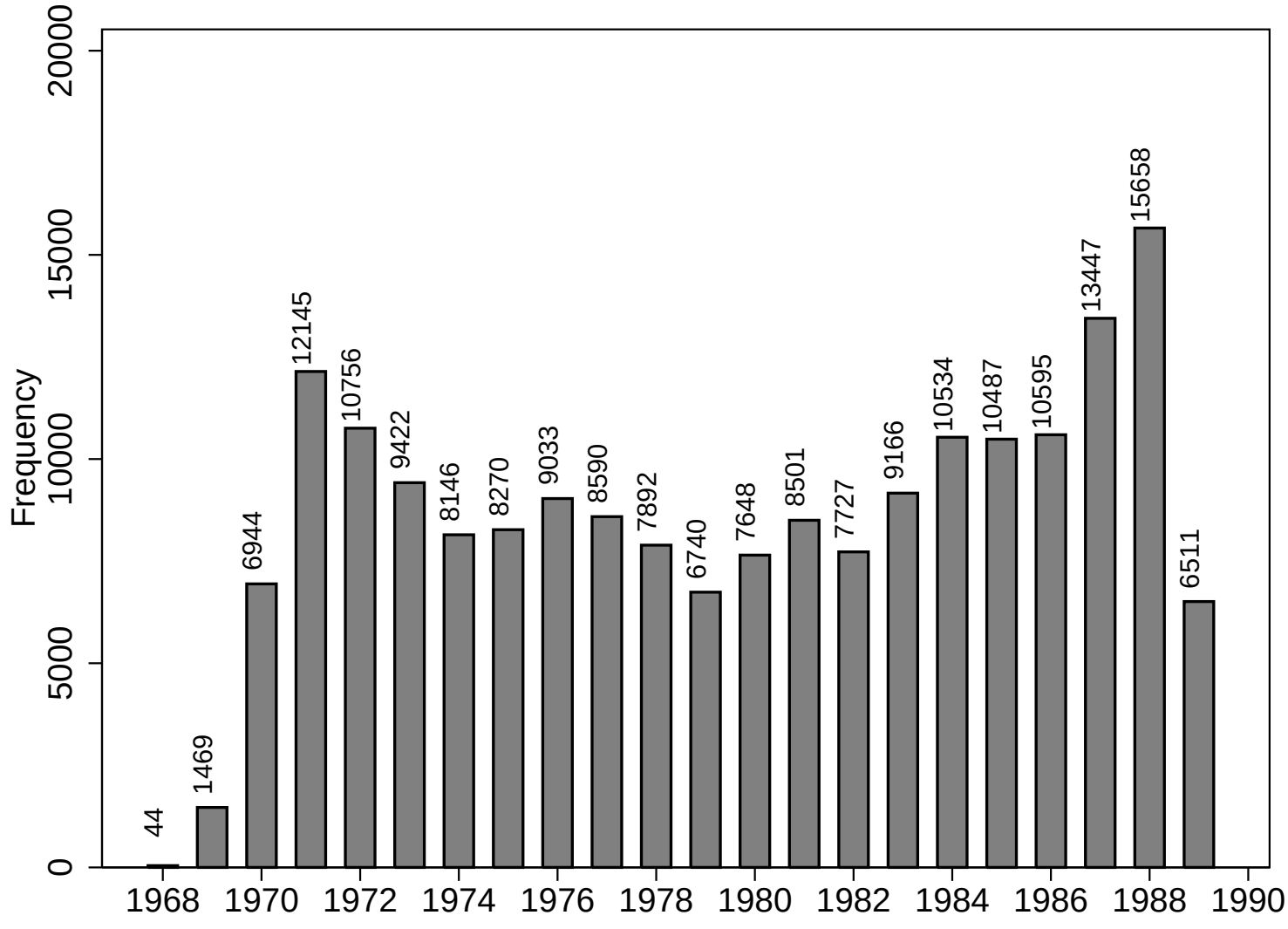
- In 1974: HVA creates SIRA, a mainframe database meant to facilitate efficient storage/retrieval of intelligence received from informants abroad.
- After the fall of the Berlin Wall the original database was destroyed.
- But in the late 1980s the HVA had carried out a comprehensive data conversion of the SIRA system, in the process of which copies of the original data were made.
- These data form the basis of our empirical analysis.

The SIRA Data

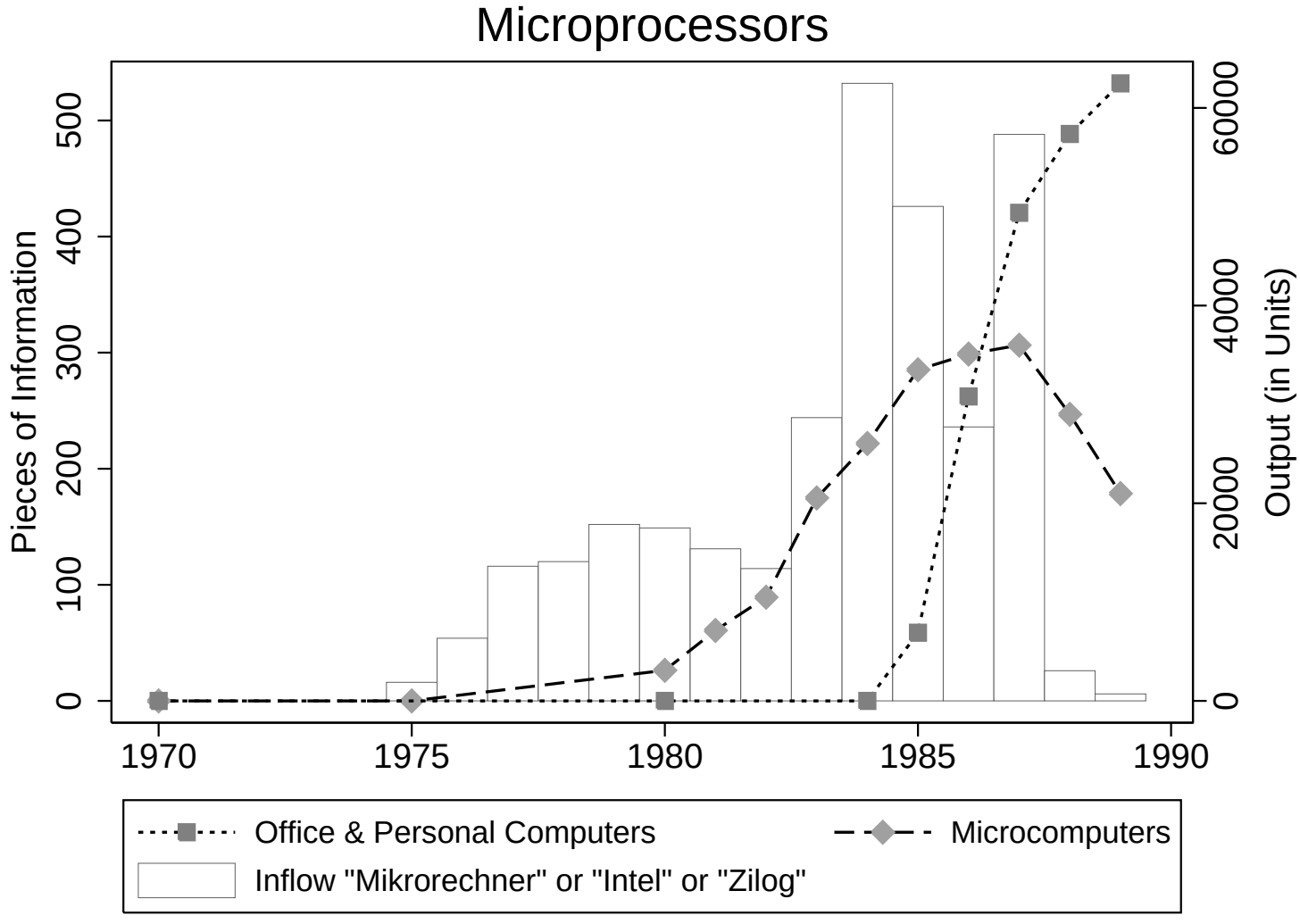
The SIRA Data

- Full records of all information sent by the Stasi's informants abroad between 1969 and 1988.
- Overall, 189,725 pieces of information related to industrial espionage.
- Each piece of information described by a number of different keywords.
- Overall, 143,005 distinct keywords, two thirds of which are only used once.
- On average, each piece of information described by 5.6 keywords.

The SIRA Data



Case Study - Microprocessors



The SIRA Data - Linking Information to Industry Sectors

- Problem of linking espionage information to industry sectors.
- Strategy:
  1. Select 2,000 most frequently occurring keywords.
     - Top 2,000 keywords account for 63.8% of all entries in the database.
  2. Allocate these keywords to their corresponding sector(s).
     - Able to allocate 55.0% of keywords to at least one of the 16 sectors for which input/output information is available.
     - Remaining 45.0% are either not classifiable (80.9%) or refer to alternative sectors (19.1%).
  3. Assign pieces of information to sectors based on allocated keywords.

The SIRA Data - Allocating Keywords to Sectors

			Sector															
Rank	Original Keyword	Freq.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	Other	Unclassified
1.	Objekt	19,786																		✓
2.	Militaertechnik	12,471																	✓	
3.	Elektronik	11,807													✓					
4.	Elektrotechnik	11,307													✓					
5.	S	10,968																		✓
6.	Austausch_Ausgeschlossen	10,419																		✓
7.	Mikroelektronik	9,666													✓					
8.	Software	9,645													✓					
9.	Rechentechnik	9,046													✓					
10.	Nachrichtentechnik	7,868					✓								✓					
11.	Chemie	7,519								✓										
12.	R	5,734																		✓
13.	Anwendung	5,331																		✓
14.	NA	5,312																		✓
15.	Hardware	4,326													✓					
16.	Technologie	3,734																		✓
17.	MT	3,582																		✓
18.	EDV	3,416													✓					
19.	Kleinrechner	3,343													✓					
20.	Programm	3,335													✓					
21.	Beschreibung	3,166																		✓
22.	Umweltschutz	3,085																		✓
23.	Datentechnik	3,060													✓					
24.	Muster	3,034		✓				✓							✓					
25.	EDVA	3,018													✓					
	⋮	⋮																		
1991.	Schwermetall	57											✓							
1992.	Schwingquarz	57													✓					
1993.	Soman	57								✓									✓	
1994.	Temperaturverteilung	57																✓		
1995.	Turbinenschaufel	57												✓						
1996.	Umkehrosmose	57	✓															✓	✓	
1997.	Verformung	57																		✓
1998.	Verkehr	57																	✓	
1999.	Waermedaemmung	57																	✓	
2000.	Wolfram	57								✓										

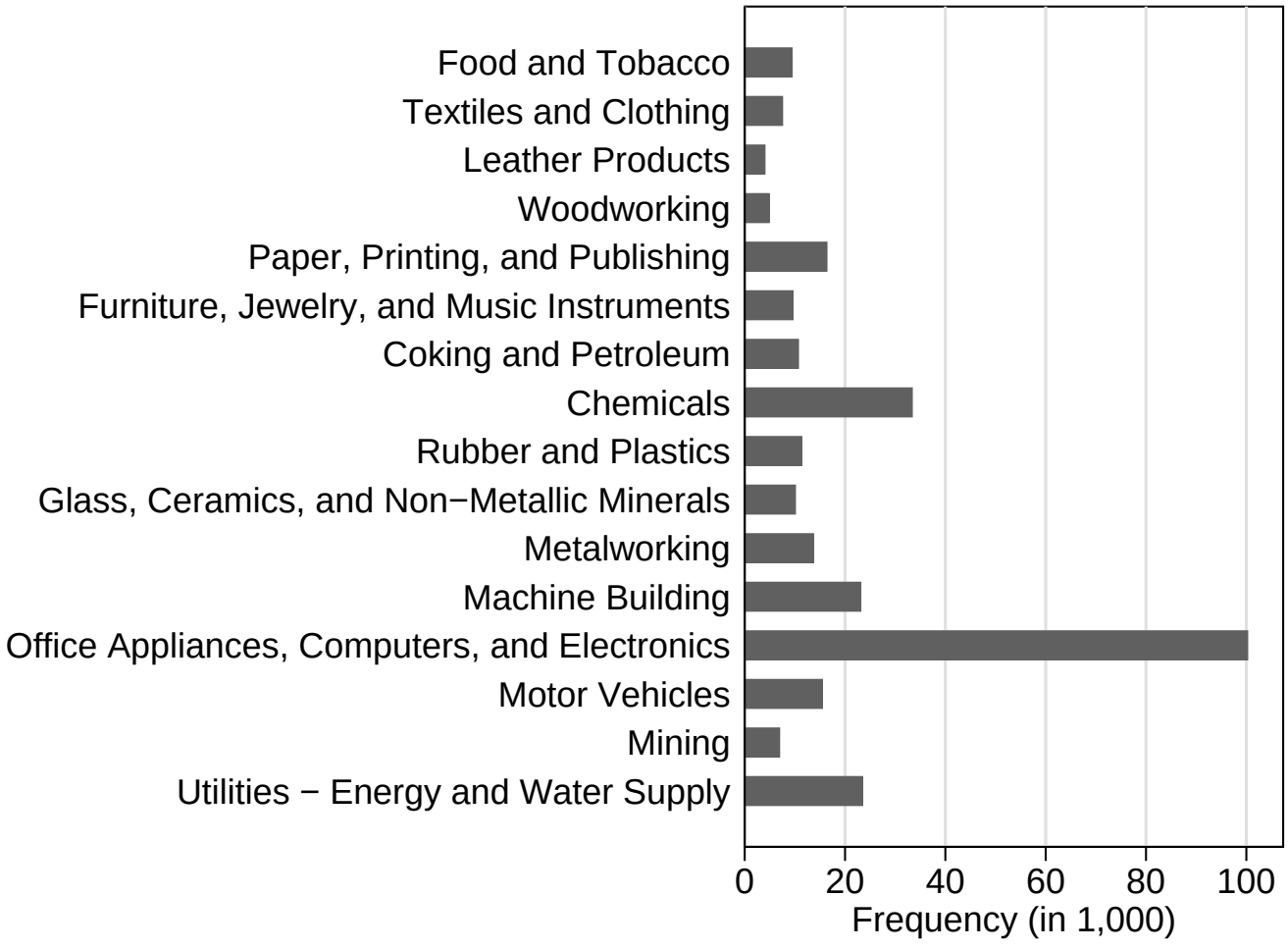
List of sectors: 1. Food and Tobacco, 2. Textiles and Clothing, 3. Leather Products, 4. Woodworking, 5. Paper, Printing, and Publishing, 6. Furniture, Jewelry, and Music Instruments, 7. Coking and Petroleum, 8. Chemicals, 9. Rubber and Plastics, 10. Glass, Ceramics, and other non-Metalic Minerals, 11. Metalworking, 12. Machine Building, 13. Office Appliances, Computers, and Electronics, 14. Automobiles, 15. Mining, 16. Utilities–Energy and Water Supply.

The SIRA Data - Allocating Information to Sectors

Two Examples

ID	Keywords (Original)	Keywords (English)	Assigned Sector(s)
2388127	ELEKTROCHEMIE	Electrochemistry	Chemicals, Electronics
2388127	OPTOELEKTRONIK	Optoelectronics	Electronics
2388127	MIKROELEKTRONIK	Microelectronics	Electronics
2388127	PLASMAPHYSIK	Plasma Physics	Electronics
2388127	OBJEKT	Object	
2388127	CHEMIE	Chemistry	Chemicals
2388127	KRISTALLZUECHTUNG	Crystal Growing	Chemicals
$\longrightarrow$ **Baseline (unweighted):**			**Chemicals 1, Electronics 1**
$\longrightarrow$ Adjusted (weighted):			Chemicals 3/7, Electronics 4/7
2388709	OBJEKT	Object	
2388709	CHEMIE	Chemistry	Chemicals
2388709	AUSTAUSCH_AUSGESCHLOSSEN	Non-returnable	
2388709	VERNETZUNG	Networking	
2388709	EPOXIDHARZ	Epoxy Resin	Chemicals, Rubber and Plastics, Electronics
$\longrightarrow$ **Baseline (unweighted):**			**Chemicals 1, Rubber and Plastics 1, Electronics 1**
$\longrightarrow$ Adjusted (weighted):			Chemicals 1/2, Rubber and Plastics 1/4, Electronics 1/4

The SIRA Data: Sectoral Distribution of Information



The SIRA Data

Top 20 Informants, 1968 - 1989

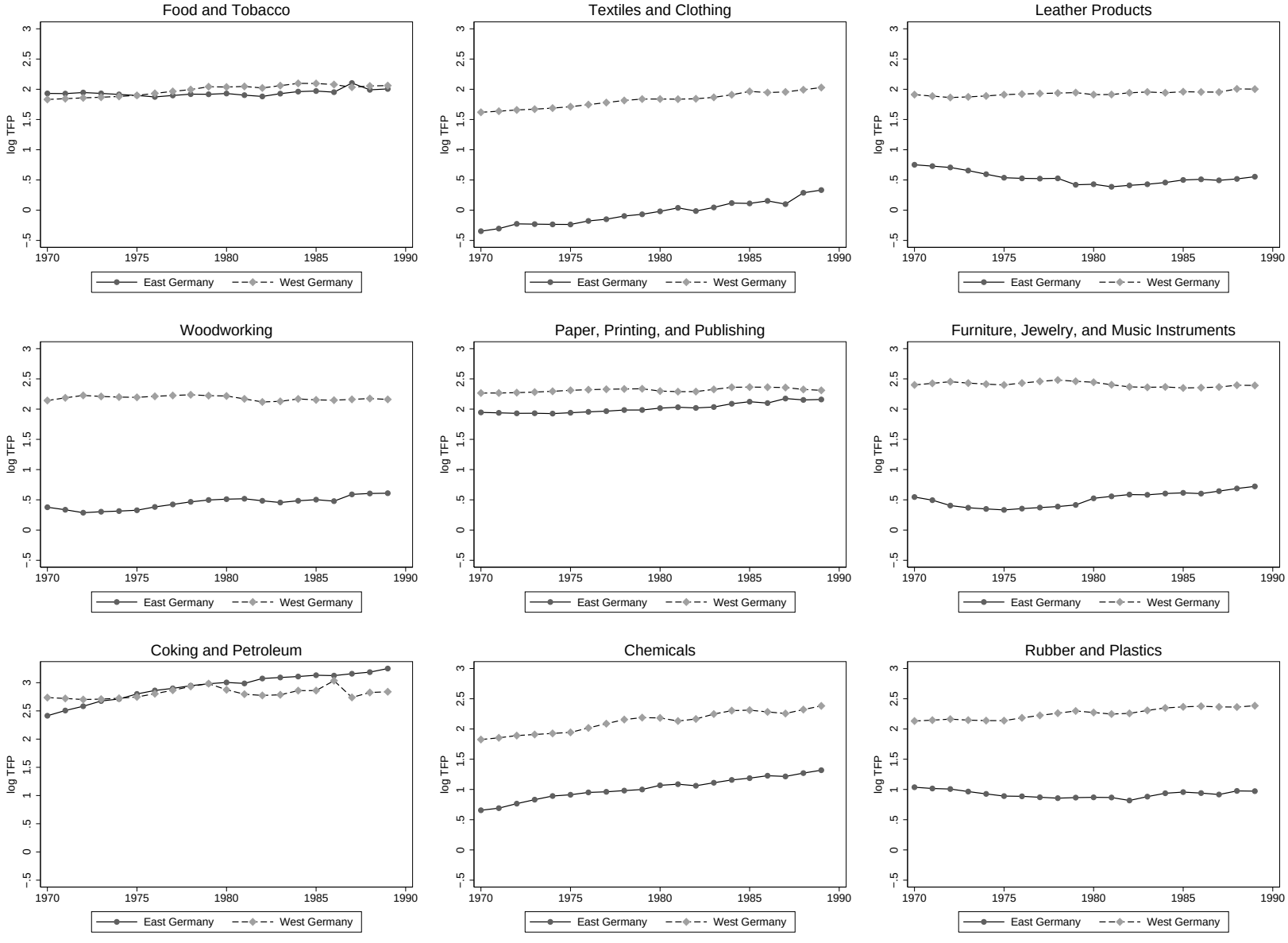
Registration	Code Name	Pieces of Information	Reliability	First Active Year	Last Active Year
(1)	(2)	(3)	(4)	(5)	(6)
XV/6603/80	FROEBEL	5,344	A	1982	1989
XV/2768/76	SEEMANN	4,902	A	1970	1988
XV/1967/64	KOREN	4,257	A	1973	1987
XV/78/71	ZENTRUM	3,373	A	1969	1989
XV/436/70	IRMGARD KRUEGER	3,288	A	1970	1989
	DR. GROSZ	2,630	A	1969	1974
XV/1754/68	RING	2,485	A	1968	1978
XV/2550/74	HERZOG	2,239	A	1974	1989
XV/2234/74	JUERGEN	1,631	A	1969	1987
XV/2110/67	OPTIK	1,472	A	1969	1989
XV/4070/70	LORENZ	1,374	B	1971	1979
XV/3074/78	SCHNEIDER	1,347	B	1969	1989
XV/6412/82	PICHLER	1,157	A	1982	1989
XV/238/68	RITTER	1,123	B	1969	1986
XV/47/68	ERICH	1,068	A	1971	1988
XV/450/86	ZELTER	1,065	B	1984	1989
XV/3/75	HARTMANN	1,043	A	1969	1981
XV/2001/73	JACK	944	A	1973	1987
XIV/14/69	ALFRED	890	A	1970	1989
XV/1508/75	WEBER	867	A	1969	1980

Note: Reliability is measured by the mode of the recorded assessments. An "A" denotes "reliable" (*zuverlässig*), a "B" denotes "trustworthy" (*vertrauenswürdig*), a "C" denotes "not checked" (*nicht überprüft*), a "D" denotes "questionable" (*fragwürdig*), and an "E" denotes "double agent" (*Doppelagent*). Only values A, B and C appear in the data.

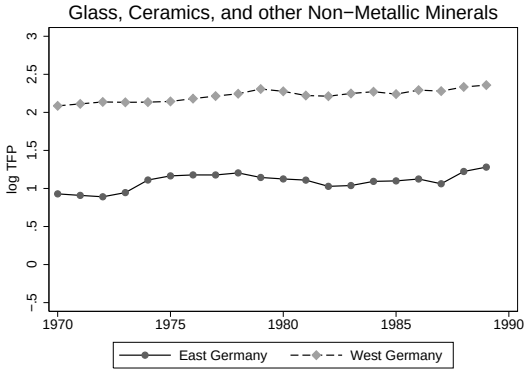
Industry Data

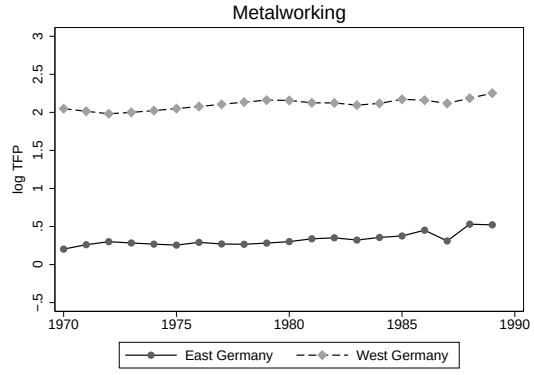
- Industry level information taken from Heske (2013), for 1950-1989 on industry-specific output, employment and investments in constant prices for both EG and WG.
- No direct measures of sector-specific TFP available over time period considered.
- Use growth accounting (Caselli, 2005; Caselli and Coleman, 2006; Mankiw et al., 1992.)
  - Back out measures of TFP from a standard Cobb-Douglas production function,
  - estimate capital stock as in Caselli (2005) using the perpetual inventory method and..
  - ... calculate initial capital stock K_0 as $I_0/(g+\delta)$, where I_0 is the value of the investment series in the first year available (1950), and g is the average geometric growth rate for the investment series between the 1950 and 1970, and $\delta = 0.06$.

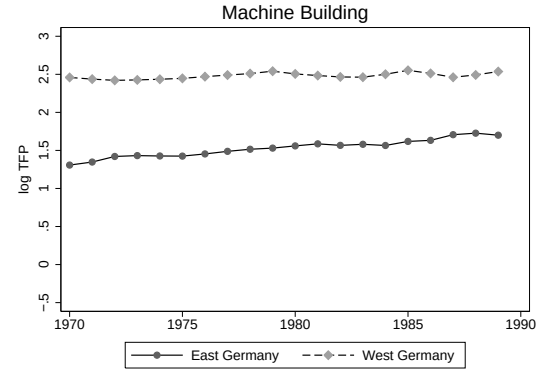
Estimated Log TFP - by Sector

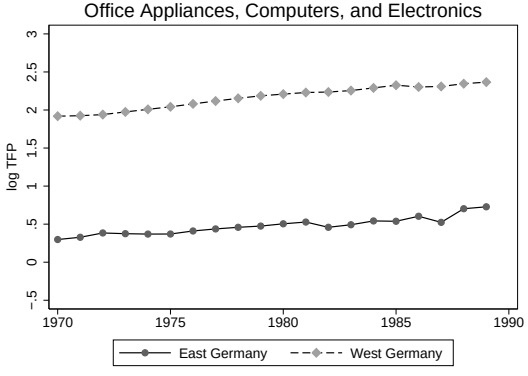


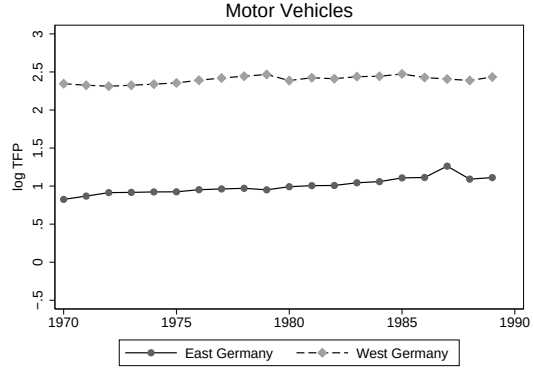
Estimated Log TFP - by Sector

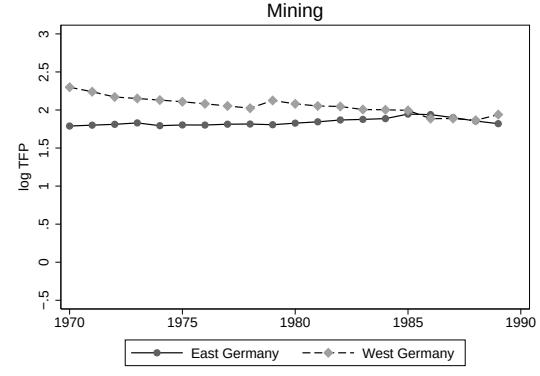


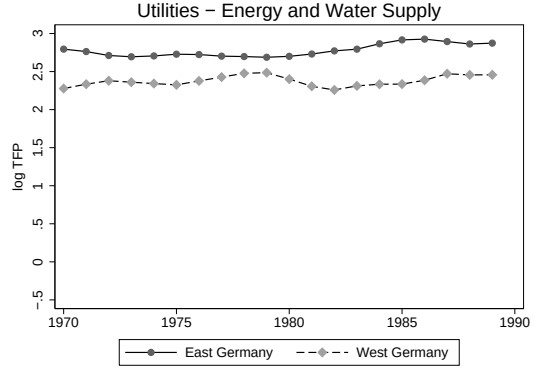












Empirical Framework

- Following the empirical literature on R&D and productivity growth (e.g. Griffith, Redding and Van Reenen 2004), we assume TFP growth in country i, industry j, is given by:

$$\Delta \ln A^i_{j,t+1} = \alpha + \rho^i \left(\frac{S^i_{jt}}{Y^i_{jt}} \right) + \eta^i \left(\frac{R^i_{jt}}{Y^i_{jt}} \right) + \theta^i \ln \left(\frac{A^F_{jt}}{A^i_{jt}} \right) + \mathbf{X'}^i_{jt} \mathbf{\Phi}^{\mathrm{i}} + \lambda^i_j + \pi^i_t + \mu_{jt} + \varepsilon^i_{jt}$$

where

- $\ln(A^F_{jt}/A^i_{jt})$: distance to the world technological frontier.
- S^i_{jt}: inflow of sector-specific espionage information.
- R^i_{jt}: measure of sector-specific R&D investments.
- ρ^i: marginal product of industrial espionage.
- η^i: marginal product of R&D investments.
- X^i_{jt}: vector of country-specific control variables.
- λ^i_j, π^i_t, μ_{jt}: country-sector, country-year, and global sector-year fixed effects.

Empirical Framework

- Our main outcome of interest is the change in the log TFP gap between WG and EG,

$$\Delta \ln A^W_{j,t+s} - \Delta \ln A^E_{j,t+s}$$

- Our main estimation equation is thus given by:

$$\Delta \ln \left(\frac{A^W_{jt+s}}{A^E_{jt+s}} \right) = \rho \left(\frac{S^E_{jt}}{Y^E_{jt}} \right) + \eta r_{jt} - \theta \ln \left(\frac{A^W_{jt}}{A^E_{jt}} \right) + \mathbf{X}'_{jt}\mathbf{\Phi} + \lambda_j + \pi_t + \varepsilon_{jt}$$

where,

  - $\lambda_j \equiv \lambda^W_j - \lambda^E_j$, $\pi_t \equiv \pi^W_t - \pi^E_t$ and $\mathbf{X}_{jt} \equiv \mathbf{X}^W_{jt} - \mathbf{X}^E_{jt}$
  - $r_{jt} \equiv (R^W_{jt}/Y^W_{jt}) - (R^E_{jt}/Y^E_{jt})$: R&D investment gap.
  - $\rho = -\rho^E$

and where we (for now) assume
$\eta^W = \eta^E = \eta, \theta^W = \theta^E = \theta, \Phi^{\mathrm{W}} = \Phi^{\mathrm{E}} = \Phi.$

Summary Statistics

	West Germany		East Germany		Difference	
	Mean	SD	Mean	SD	Mean	SD
	(1)	(2)	(3)	(4)	(5)	(6)
Inflow/Y			1.524	(1.403)		
Δ log TFP	0.025	(0.072)	0.046	(0.070)	-0.020	(0.096)
Δ log Output per Worker	0.050	(0.079)	0.090	(0.070)	-0.040	(0.098)
Patents/Y	0.392	(0.372)	0.313	(0.433)	0.079	(0.225)
Log TFP	2.227	(0.250)	1.194	(0.866)	1.033	(0.752)
Log Output per Worker	3.679	(0.414)	2.385	(1.091)	1.294	(0.782)
Imports/Y	2.412	(4.564)	0.296	(0.340)	2.116	(4.584)

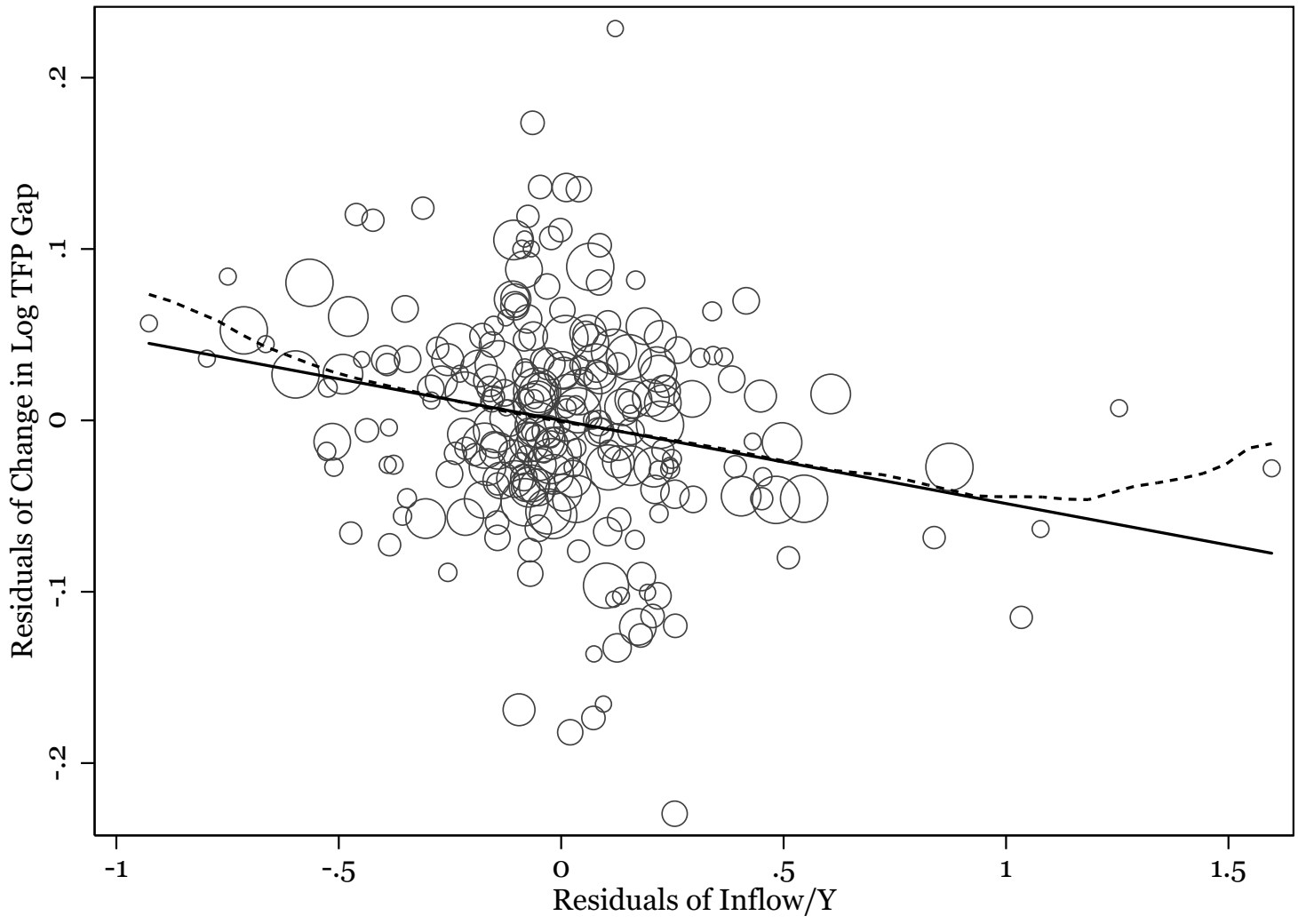
Note: Summary stats computed for 3-year overlapping observations for the period 1970 to 1989. Number of observations 240 (234 for Import/Y ratio).

Main Results

Overlapping observations

	Log TFP			Log Output per Worker		
	Baseline spec	Patents gap	Lagged gap	Baseline spec	Patents gap	Lagged gap
	(1)	(2)	(3)	(4)	(5)	(6)
Inflow/Y	-0.039*	-0.046**	-0.049***	-0.030*	-0.040**	-0.039**
	(0.020)	(0.020)	(0.013)	(0.016)	(0.018)	(0.017)
Patents/Y Gap		0.071**	-0.024		0.103***	0.012
		(0.028)	(0.022)		(0.026)	(0.028)
Log TFP Gap			-0.589***			
			(0.097)			
Log Output/Worker Gap						-0.514***
						(0.100)
P-value WB	0.068	0.042	0.010	0.080	0.082	0.116
R-squared	0.31	0.33	0.55	0.31	0.35	0.51
Observations	240	240	240	240	240	240

Main Results - Log TFP Gap



Alternative Specifications and Robustness Tests

	Main spec	Weighted by output	No weights	No IT	Sector trends	Trade gap	Flexible labor share	Keyword weighted	Machine learning
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Espionage	-0.049***	-0.076**	-0.047***	-0.043**	-0.043***	-0.047***	-0.044***	-0.086***	-0.046**
	(0.013)	(0.032)	(0.014)	(0.017)	(0.012)	(0.013)	(0.013)	(0.024)	(0.018)
Patents Gap	-0.024	-0.022	0.002	0.022	0.013	-0.019	-0.020	-0.017	-0.023
	(0.022)	(0.044)	(0.032)	(0.045)	(0.076)	(0.023)	(0.025)	(0.020)	(0.017)
Log TFP Gap	-0.589***	-0.783***	-0.565***	-0.595***	-1.201***	-0.592***	-0.574***	-0.606***	-0.602***
	(0.097)	(0.172)	(0.091)	(0.095)	(0.095)	(0.102)	(0.107)	(0.087)	(0.087)
Trade Gap						-0.001			
						(0.003)			
P-value WB	0.006	0.056	0.030	0.048	0.012	0.008	0.018	0.002	0.048
R-squared	0.55	0.58	0.54	0.54	0.70	0.55	0.54	0.55	0.53
Observations	240	240	240	225	240	234	240	240	240

IV Results

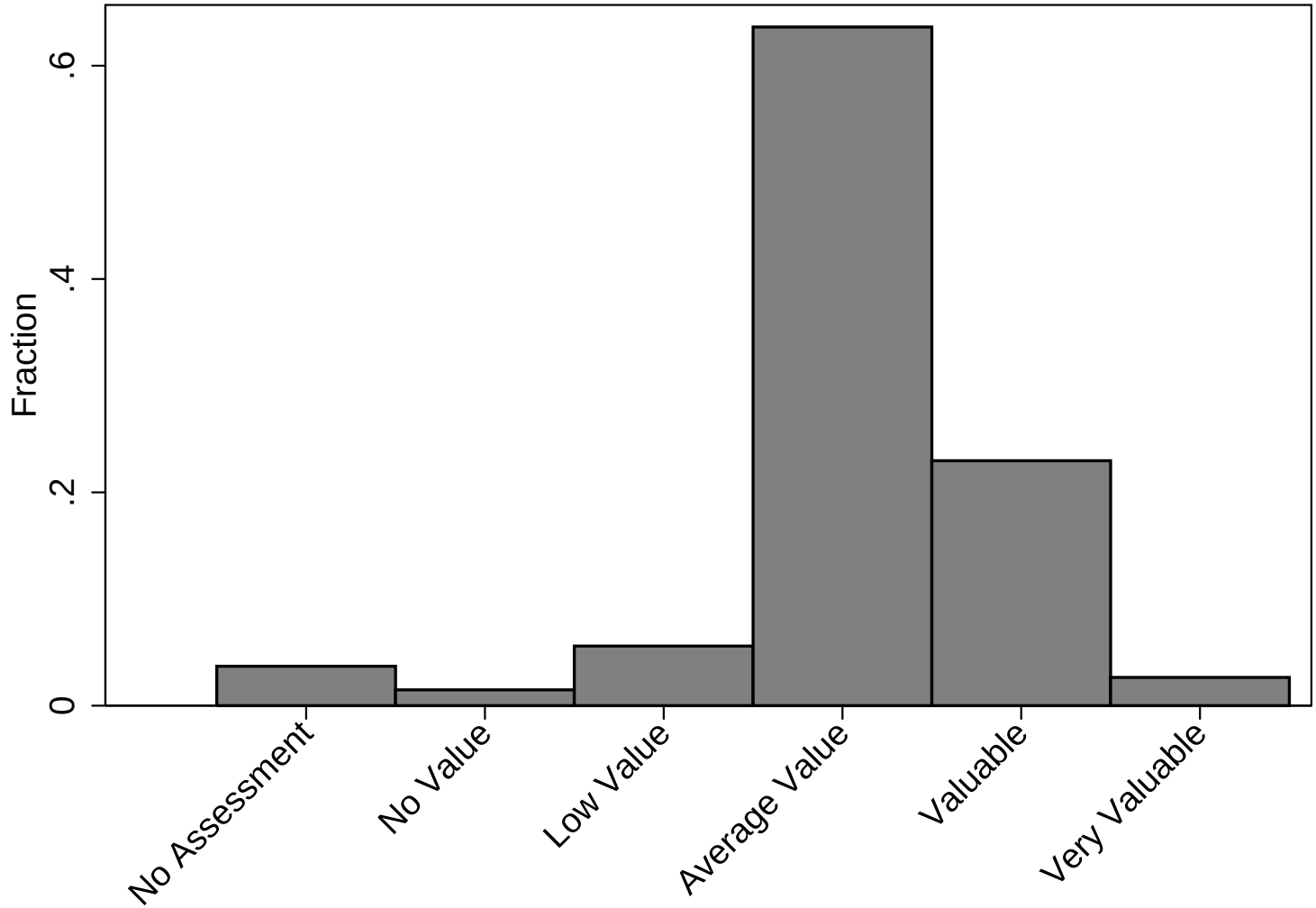
	Log TFP				Log Output per Worker			
	Old Informants		Exit of Informants		Old Informants		Exit of Informants	
	First stage	IV results	First stage	IV results	First stage	IV results	First stage	IV results
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Espionage		-0.066***		-0.121***		-0.059**		-0.119***
		(0.025)		(0.035)		(0.028)		(0.040)
Patents Gap	-0.548	-0.020	-0.013	-0.043	-0.531	0.018	0.017	0.001
	(0.391)	(0.022)	(0.222)	(0.048)	(0.388)	(0.025)	(0.196)	(0.049)
Log TFP Gap	0.197	-0.591***	0.654	-0.701***				
	(0.427)	(0.095)	(0.568)	(0.147)				
Log Output/Worker Gap					0.298	-0.514***	0.844**	-0.613***
					(0.305)	(0.096)	(0.383)	(0.133)
Instrument Old Informants	0.637***				0.640***			
	(0.082)				(0.083)			
Instrument Exits			-4.409***				-4.568***	
			(0.607)				(0.536)	
F-stat		60.7		52.7		59.9		72.6
Observations	240	240	192	192	240	240	192	192

Additional Results - Information Quality

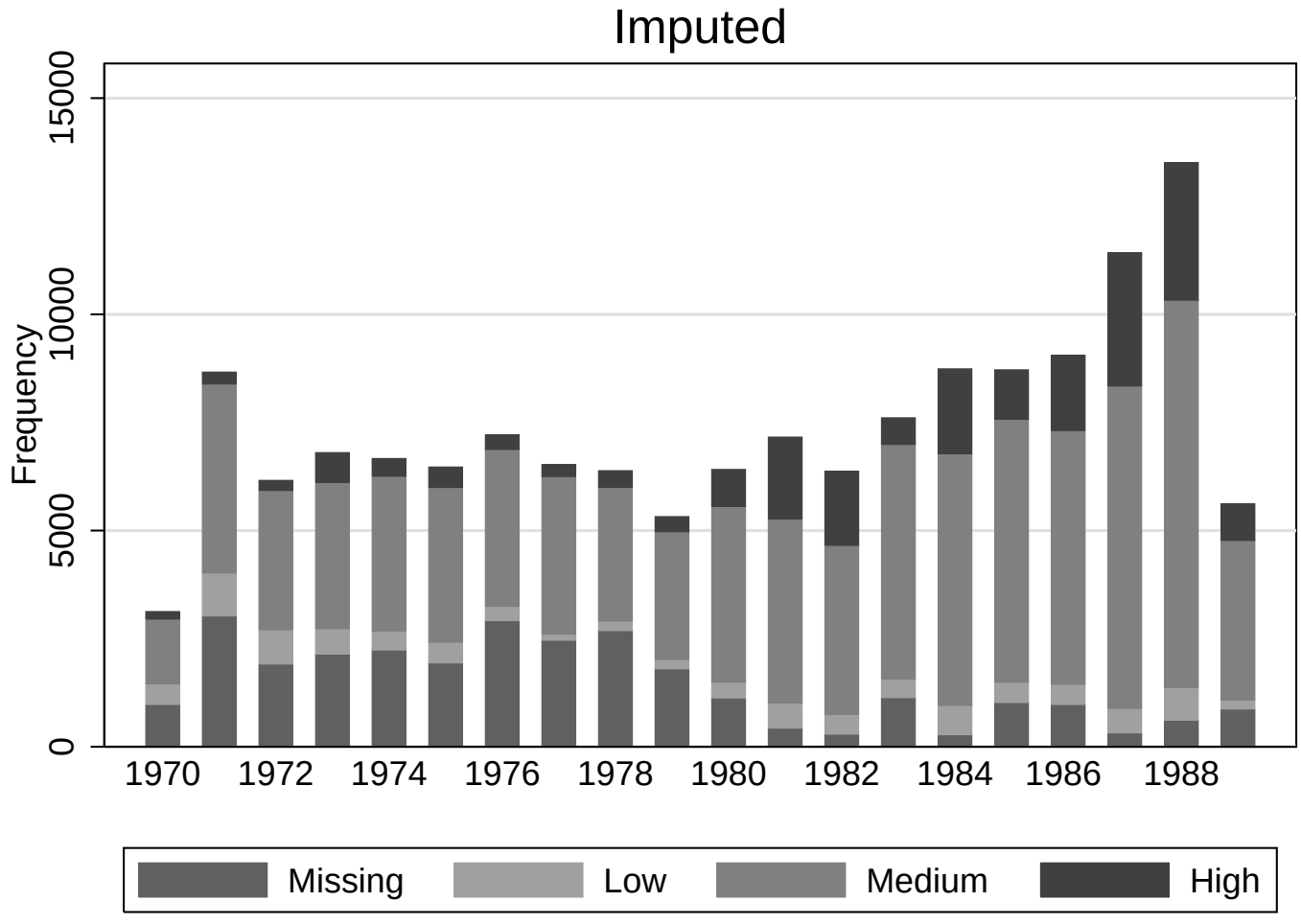
- Effects of industrial espionage are
  - ... primarily driven by high quality pieces of information.

Additional Results - Information Quality

Figure: Distribution of Quality Assessments



Additional Results - Information Quality

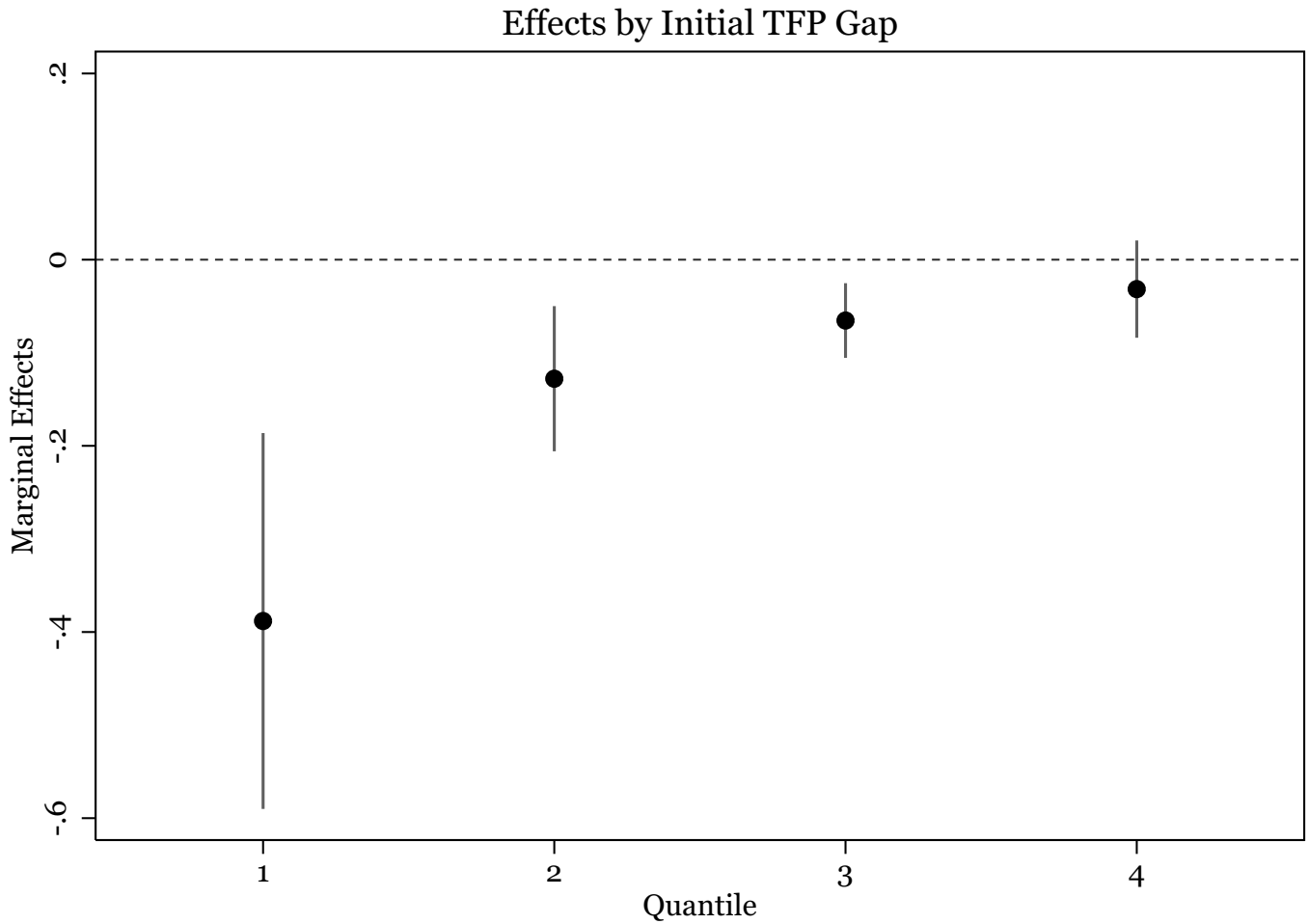


	Δ Log TFP Gap			Δ Log Output per Worker Gap		
	Main spec	Observed quality	Imputed quality	Main spec	Observed quality	Imputed quality
	(1)	(2)	(3)	(4)	(5)	(6)
Inflow/Y	-0.049***			-0.039**		
	(0.013)			(0.017)		
Quality - No Value		-2.258	-0.017		-1.156	0.100
		(1.670)	(0.241)		(1.895)	(0.198)
Quality - Low Value		0.009	-0.214***		-0.219	-0.259***
		(0.622)	(0.061)		(0.660)	(0.079)
Quality - Average Value		-0.039	-0.026		-0.030	-0.010
		(0.117)	(0.037)		(0.131)	(0.044)
Quality - Valuable		0.225	0.183		0.248	0.213
		(0.312)	(0.116)		(0.390)	(0.138)
Quality - Very Valuable		-1.538**	-1.661**		-1.603	-1.809**
		(0.701)	(0.633)		(0.975)	(0.619)
Quality - Missing		-0.067***	-0.049		-0.051*	-0.029
		(0.021)	(0.047)		(0.025)	(0.047)
Patents/Y Gap	-0.024	0.051	0.047	0.012	0.085	0.085
	(0.022)	(0.040)	(0.053)	(0.028)	(0.051)	(0.069)
Log TFP Gap	-0.589***	-0.586***	-0.609***			
	(0.097)	(0.098)	(0.085)			
Log Output/Worker Gap				-0.514***	-0.513***	-0.555***
				(0.100)	(0.104)	(0.097)
R-squared	0.55	0.56	0.56	0.51	0.52	0.54
Observations	240	240	240	240	240	240

Additional Results - Heterogeneous Effects

- Effects of industrial espionage are
  - ... more pronounced in industries closer to the technology frontier.

Figure: Heterogenous Effects of Industrial Espionage



Additional Results - West vs. East

- Effects of industrial espionage are entirely driven by those on East Germany's TFP growth; near-zero effects in West Germany.

- Industrial espionage crowded out East Germany's patents; no effect on West German patenting.

Table: Additional Results - West vs. East

	Log TFP				Patenting	
	FRG/GDR		FRG	GDR	FRG	GDR
	(1)	(2)	(3)	(4)	(5)	(6)
Inflow/Y	-0.049***	-0.033***	-0.006	0.027**	-0.001	-0.115**
	(0.013)	(0.009)	(0.009)	(0.010)	(0.007)	(0.050)
Patents/Y Gap	-0.024					
	(0.022)					
Log TFP Gap	-0.589***					
	(0.097)					
GDR Patents/Y		-0.094	-0.036	0.058	0.033	0.105*
		(0.056)	(0.062)	(0.044)	(0.027)	(0.057)
FRG Patents/Y		-0.140**	-0.084	0.057	0.846***	-0.206***
		(0.063)	(0.073)	(0.077)	(0.036)	(0.070)
GDR Log TFP		0.593***	0.095	-0.498***	-0.074	0.008
		(0.098)	(0.098)	(0.089)	(0.046)	(0.143)
FRG Log TFP		-0.653***	-0.407***	0.246	0.056	0.085
		(0.101)	(0.136)	(0.153)	(0.062)	(0.220)
P-value WB	0.006	0.016	0.568	0.058	0.942	0.074
R-squared	0.55	0.56	0.67	0.46	0.99	0.97
Observations	240	240	240	240	240	240

Counterfactual Simulation

- Simulate how East Germany would have performed in the absence of industrial espionage.
- Set $S_{jt}^{E} = 0$ for all industries and time periods.
- Forward predict counterfactual productivity profiles for East Germany.
  - Scenario 1: No espionage, no patent substitution.
  - Scenario 2: No espionage, full patent substitution.

Figure: Counterfactual Simulations - Aggregate

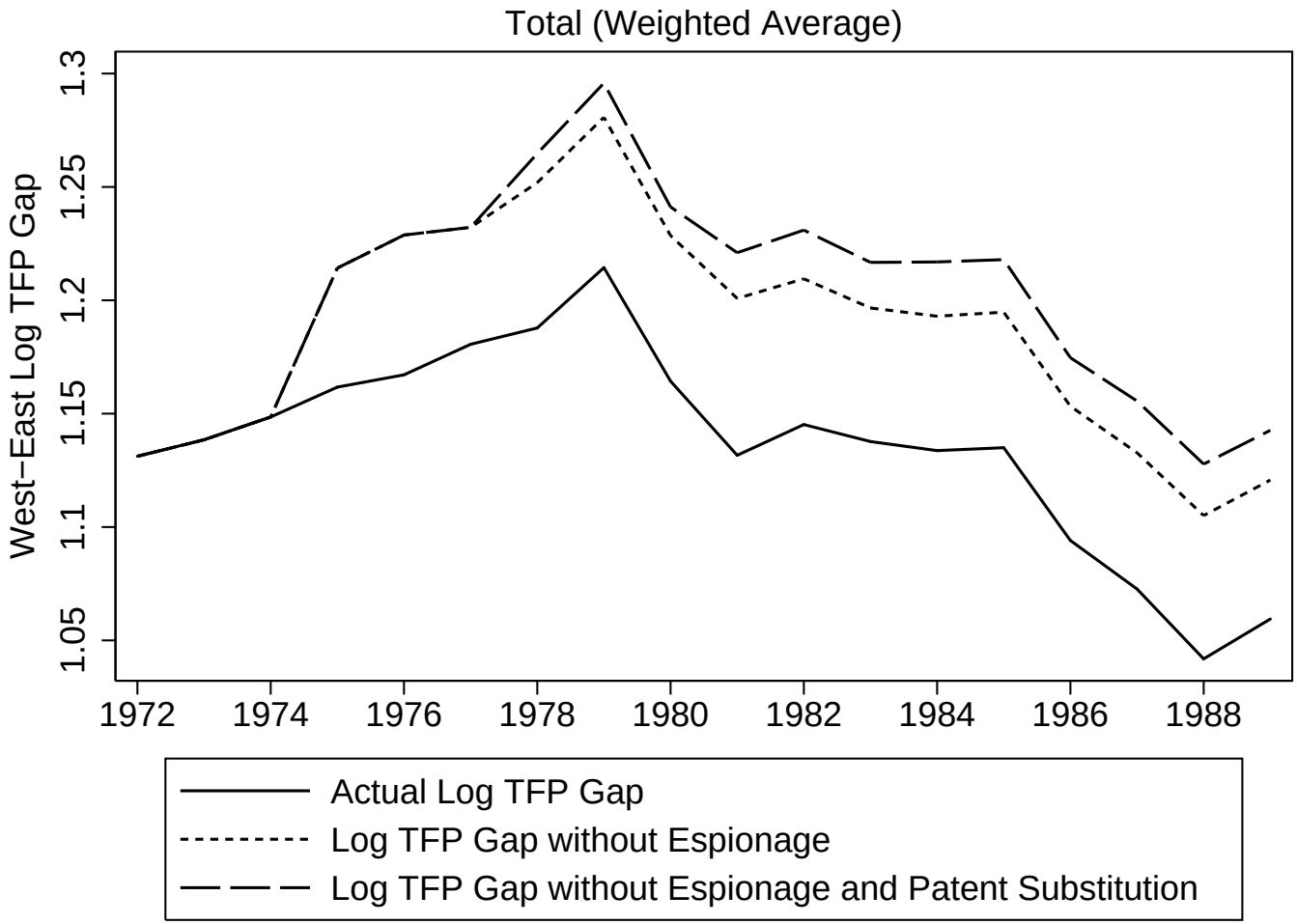
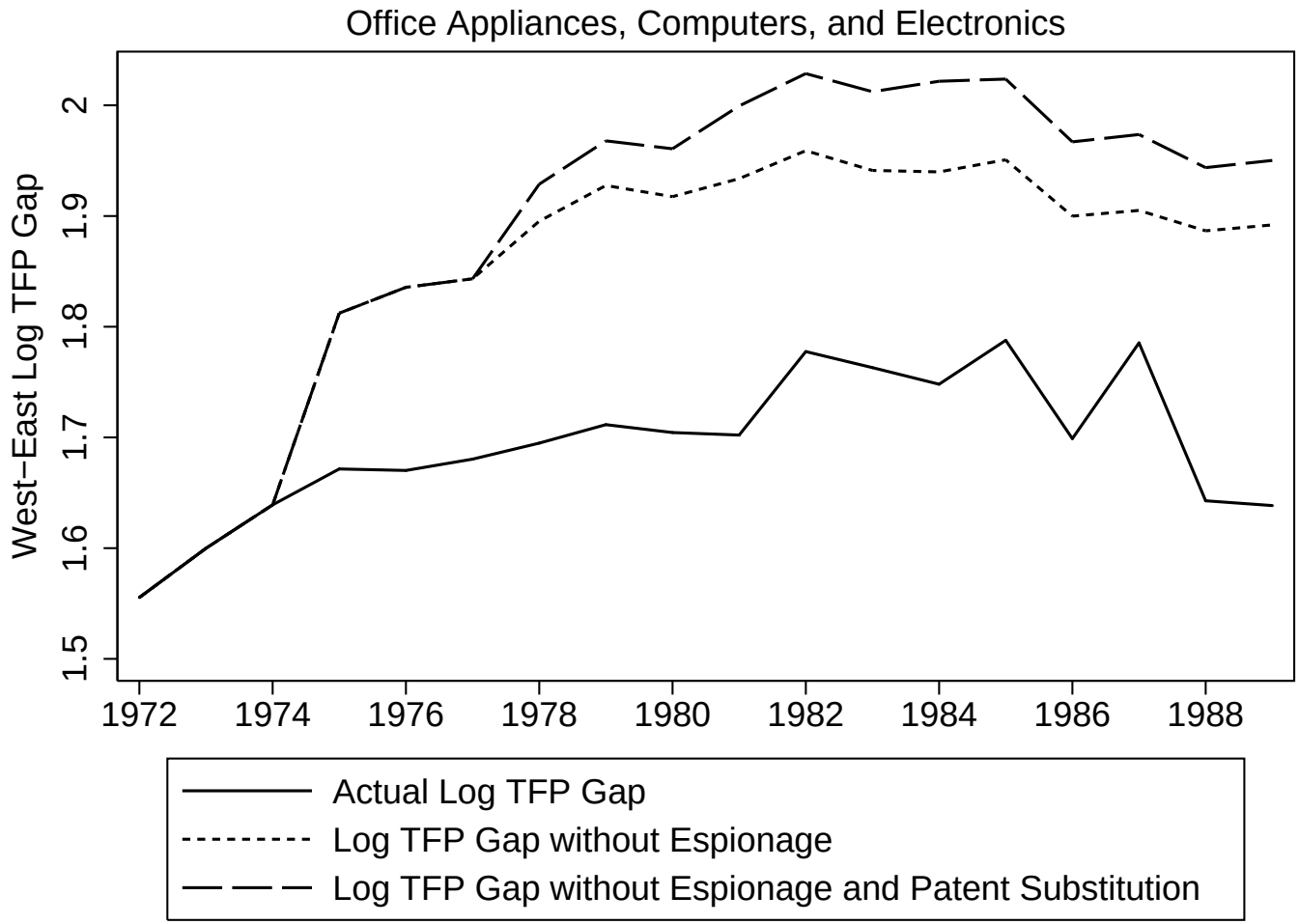


Figure: Counterfactual Simulations - Electronics Sector



Cost-Benefit Analysis

- Previous findings show that industrial espionage benefited the East German economy by accelerating productivity growth.
- But at which cost?
  - According to the last head of the HVA, its annual budget for operational purposes at the end of the 1980s amounted to around 17.5 million East German Mark and 13.5 million Deutsche Mark.
  - According to the HVA, the benefits amounted to more than 1.5 billion East German Mark at the end of the 1980s.
  - Our own estimates point to even larger benefits of around 7.3 billion Deutsche Mark in 1988.

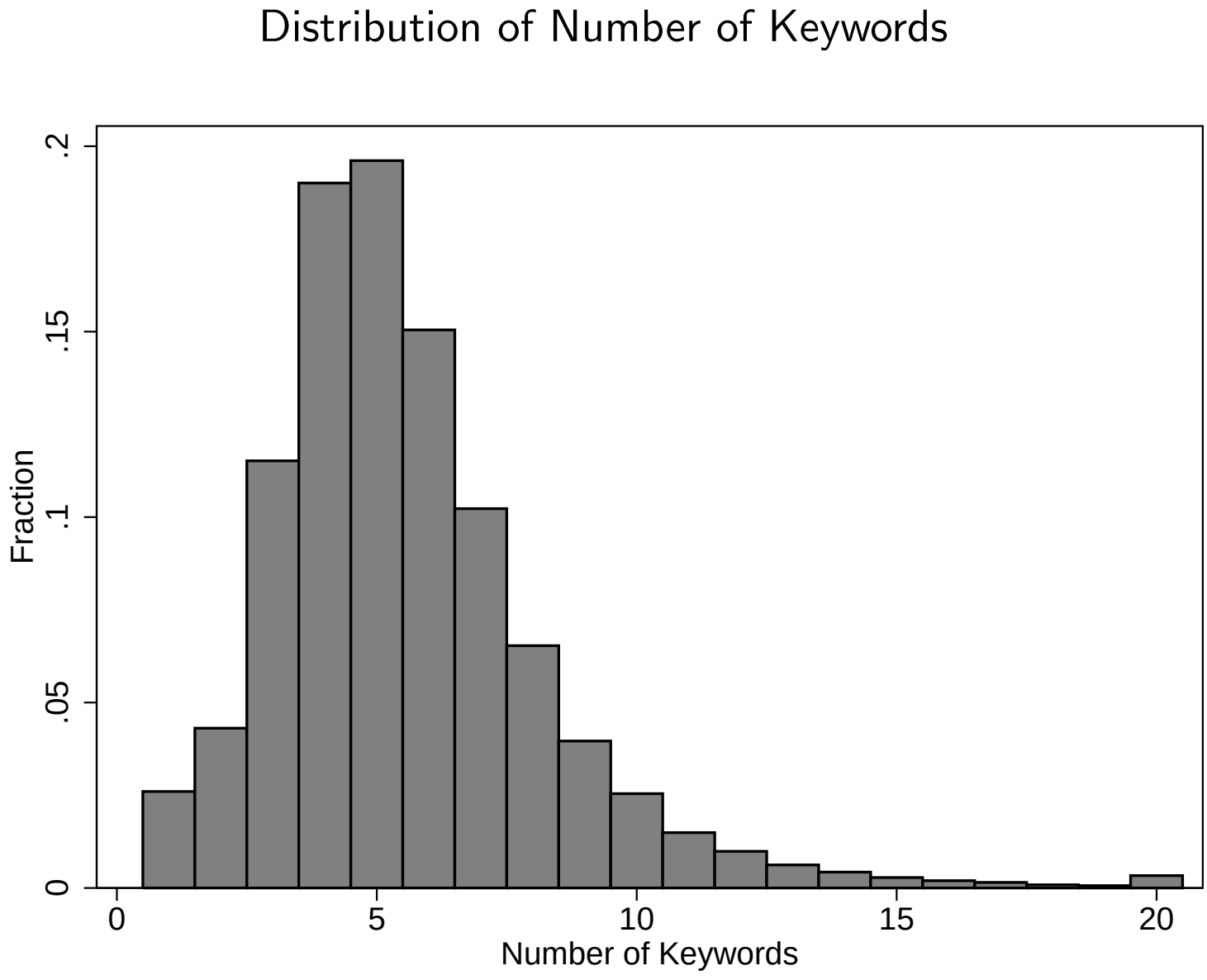
$\rightarrow$ High return on investment in industrial espionage.

Conclusion

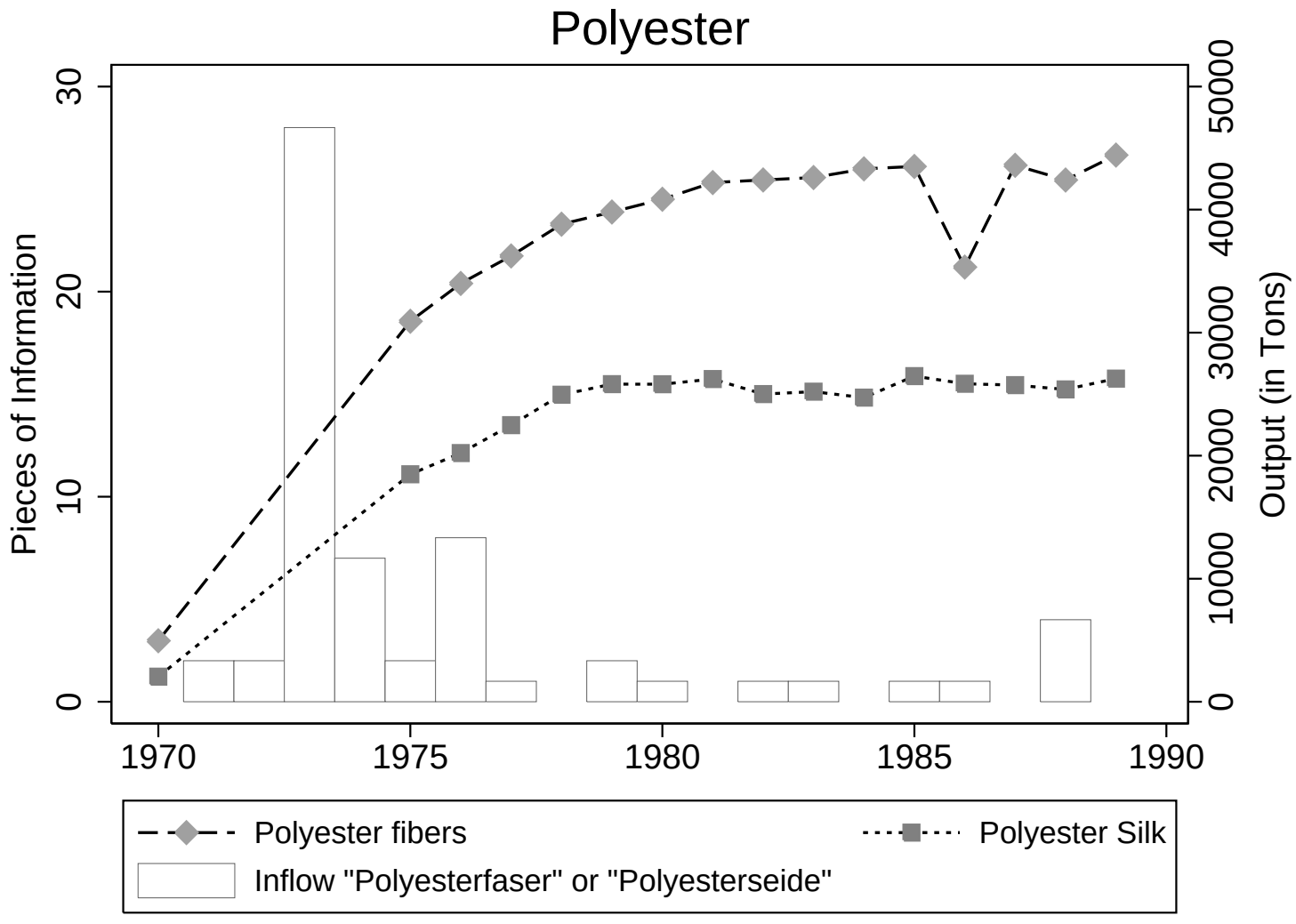
- Economic benefits from industrial espionage are substantial, especially in sectors where East Germany was technologically not too far behind West Germany.
- Positive effect on East German productivity growth is driven by select pieces of high quality information.
- Overall, East German industrial espionage had a significant but quantitatively modest effect on the productivity gap with West Germany.
- However, in some sectors, East German industrial espionage was vital in keeping up with the West.

Thank you.

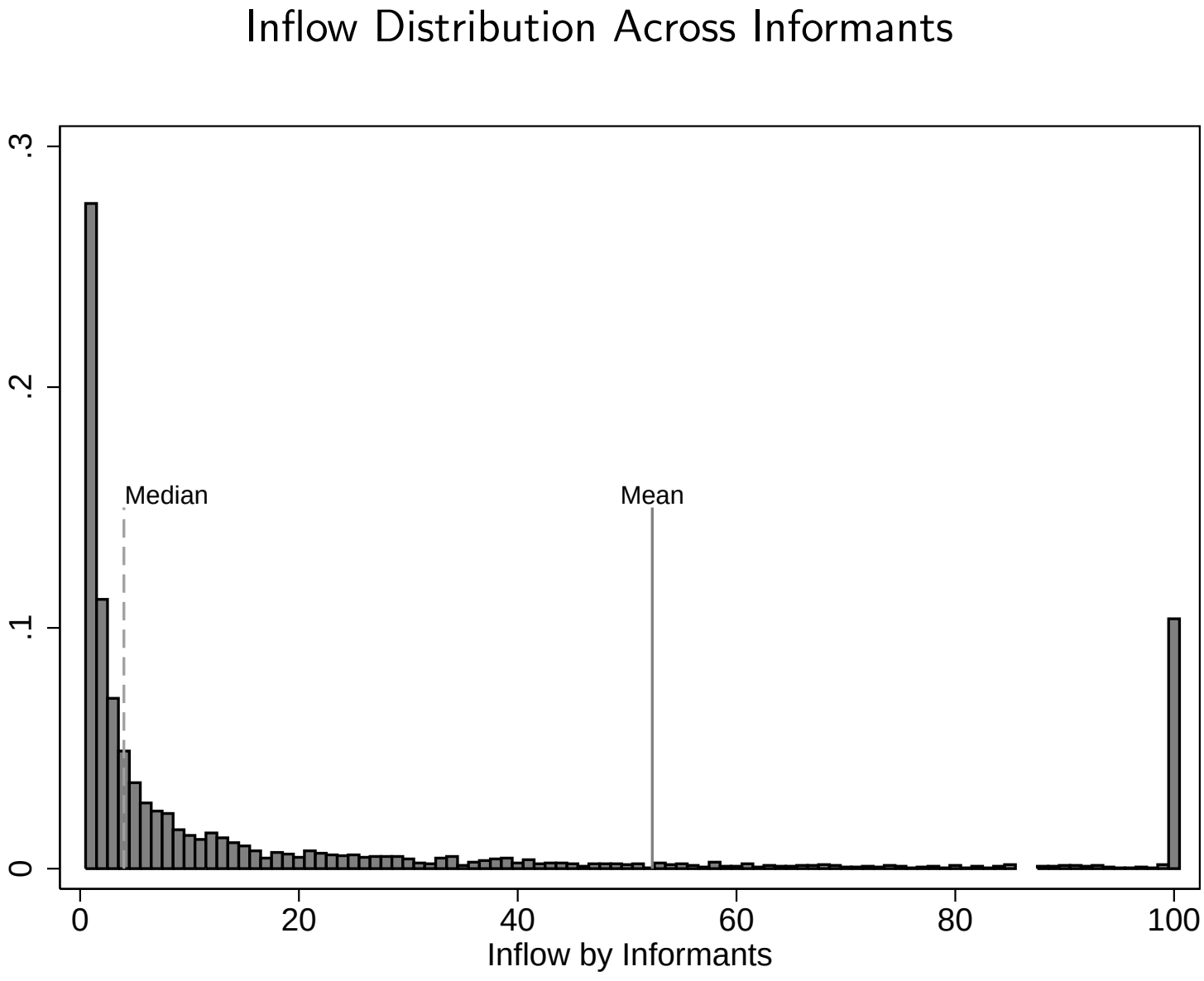
The SIRA Data



Case Study II - Polyester



The SIRA Data



Patents Data

- No consistent time series data available for sector-specific R&D investments for West and East Germany over the period 1969 to 1989.
- Use sector-specific patent applications, scaled by industry output, as a proxy for R&D investments.
- WG patent data taken from German and European patent offices; EG data from the East German Statistical Office.

Imports Data

- Trade data taken from the "World Trade Flows 1962-2000" by Feenstra et al. (2005).
- SITC-level data collapsed to ISIC/industry-level using concordance from Muendler (2009).
- Use import data, scaled by industry output, to construct measures of the import intensity gap (similar to Cameron et al. 2005) between West and East Germany.

Instrumental Variables - Old Informants

- Assume that informants active at the beginning of the sample period in 1970, as well as their differential access to information across different sectors at the time, are exogenous to any subsequent changes in the Stasi's strategic objectives.
- Define

$$z_{jt}^{old} \equiv \sum_{i \in 1970} \theta_{i,70} \lambda_{ij,70} \sum_{s=t-2}^{t} I_s$$

where

  - $\theta_{i,70}$: the share of the total information received in 1970 that was sent by informant i.
  - $\lambda_{ij,70}$: the fraction of that information pertaining to sector j.
  - I_s: the total inflow in period s received from sources who were already active in 1970.

Instrumental Variables - Exit of Informants

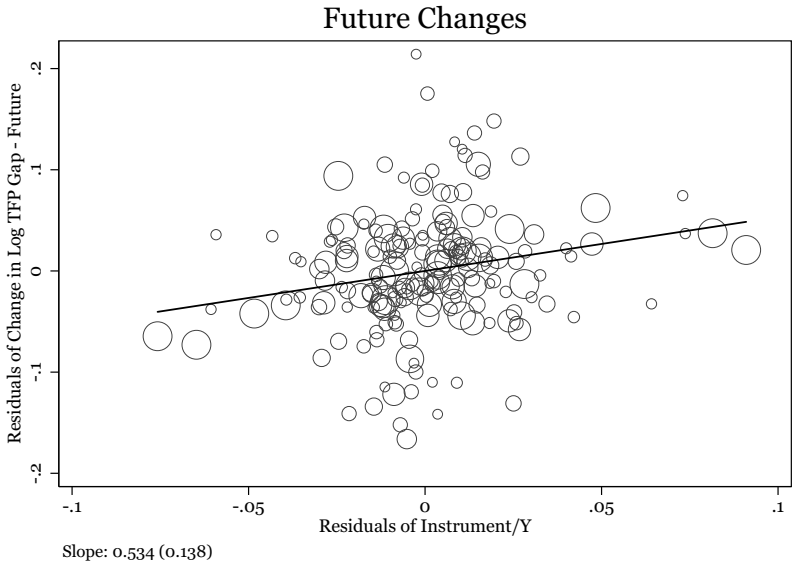
- Assume that the exit of highly productive informants is exogenous to any changes in the Stasi's strategic objectives.
- Define

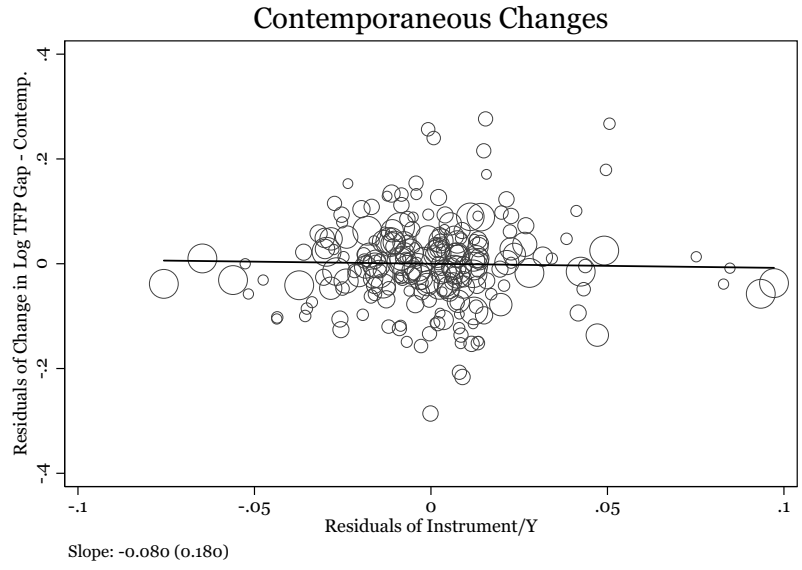
$$z_{jt}^{exit} \equiv \sum_{s=t-5}^{t-3} \sum_{i^*(s)|\bar{I}_{i^*j} \geq 20} \bar{I}_{i^*j}$$

where

- $\bar{I}_{i^*j}$: the average annual inflow of information generated by informant i^* pertaining to sector j over the entire sample period.
- $i^*(s)$: the set of informants who are last observed in period s.

IV Results - Exits of Informants





Placebo Estimation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	GDR	All	AUS	AUT	BEL	DNK	ESP	FIN	FRA	GRC
Inflow/Y	-0.038**	-0.015	-0.026	0.010	0.096	-0.028	-0.021	0.020	-0.005	0.002
	(0.018)	(0.022)	(0.024)	(0.028)	(0.062)	(0.032)	(0.023)	(0.042)	(0.049)	(0.046)
Log Output/Worker Gap	-0.526***	-0.358***	-0.668***	-0.461***	-0.569***	-0.417**	-0.568***	-0.511***	-0.040	-0.314**
	(0.085)	(0.056)	(0.129)	(0.116)	(0.151)	(0.169)	(0.076)	(0.119)	(0.048)	(0.113)
R-squared	0.52	0.53	0.33	0.34	0.42	0.46	0.52	0.58	0.55	0.29
Observations	240	3945	225	225	225	225	225	225	225	225
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
	IRL	ITA	JPN	KOR	LUX	NLD	PRT	SWE	UK	USA
Inflow/Y	0.116	0.021	-0.041	0.062	0.043*	-0.004	-0.042	-0.017	0.019	-0.059
	(0.092)	(0.038)	(0.061)	(0.058)	(0.022)	(0.021)	(0.030)	(0.030)	(0.020)	(0.075)
Log Output/Worker Gap	-0.044	-0.378***	-0.336***	-0.520***	-0.388	-0.737***	-0.435*	-0.449**	-0.261*	-0.560**
	(0.077)	(0.097)	(0.085)	(0.116)	(0.259)	(0.174)	(0.228)	(0.152)	(0.132)	(0.222)
R-squared	0.55	0.51	0.53	0.53	0.88	0.46	0.61	0.59	0.62	0.51
Observations	225	225	210	225	210	225	225	225	225	150