Economic Espionage, Knowledge Flows, and Firm Performance*

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Economic espionage is a pervasive global phenomenon. We study how knowledge acquired through this clandestine activity affects firms' economic performance. Exploiting historical data from East Germany that trace the flow of scientific-technical information from its sources in the West to its recipients in the East, we show that economic espionage increased firms' productivity and reshaped their production structure and input choices. We further find that the resulting technical change was labor-augmenting and that the associated productivity gains propagated through the production network via input-output linkages. In the long run, firms receiving larger inflows of espionage information were significantly more likely to survive the transition to a market economy following German reunification.

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JEL Codes: *L2, N4, O3, P2*

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I. Introduction

The diffusion of knowledge across firms and countries is a central driver of productivity growth. A large literature examines how such knowledge flows arise through international trade, foreign direct investment, migration, and R&D spillovers (e.g. Buera and Oberfield, 2020; Guadalupe, Kuzmina and Thomas, 2012; Moser, Voena and Waldinger, 2014; Bloom, Schankerman and Van Reenen, 2013). Despite these advances, much less is known about how technological knowledge is transmitted when these conventional channels are restricted and firms face barriers to accessing foreign technologies. Understanding these alternative mechanisms is important for assessing how technological advantages diffuse across countries and how firms adapt to externally acquired knowledge.

Economic espionage constitutes one such alternative channel through which technological knowledge may be transferred across firms and countries.[1] Governments around the world are widely believed to engage in large-scale efforts to acquire technologies through covert means, with recent reports by the European Commission (2018), the Federal Bureau of Investigation (2019), and the German Verfassungsschutz (2024) documenting both the scope of these activities and their perceived economic impact.[2] Concerns about economic espionage have become increasingly salient amid rising geopolitical tensions, particularly between the United States and China, and have prompted a range of policy responses aimed at restricting the international flow of knowledge, including export controls, investment screening, and stronger intellectual property protection. Yet despite its growing policy relevance, there is little direct quantitative evidence on how such knowledge flows affect firm behavior and economic performance in the perpetrating country.

In this paper, we study economic espionage as a mechanism of international technology transfer and examine how externally acquired knowledge reshapes firms' production decisions and generates spillovers throughout the production network. Our analysis relies on unique archival data from the Cold War period during which the East German Ministry for State Security (the so-called *Stasi*) engaged in extensive economic espionage in the West. The centerpiece of the analysis is SIRA (Konopatzky, 2019), an electronic database that contains records on the universe of intelligence reports that East Germany (the German Democratic Republic, GDR) received from its informants between 1970 and 1989. During this period, the Stasi collected more than 180,000 pieces of scientific-technical information, reflecting the enormous scale of its activities in the West. For the majority of these items, SIRA records the precise date of receipt, the registration number of the informant who delivered the information, an assessment of the information's value on a

[1] The term "economic espionage" refers to activities in the economic domain conducted on behalf of foreign governments for purposes that are not exclusively commercial. By contrast, "industrial espionage" refers to activities conducted by individual firms against competitors for commercial gain (Nasheri, 2005).

[2] While inherently difficult to quantify, the damages associated with economic and industrial espionage are widely believed to be substantial, with estimates of 225–600 billion U.S. dollars annually for the United States (IP Commission, 2017) and around 290 billion euros annually for Germany (Bitkom, 2025).

scale from one to five, and the list of firms within the GDR to which the information was forwarded. The data thus allow us to trace the flow of scientific-technical information from its sources in the West to the final recipients in the East, providing a rare opportunity to observe knowledge flows directly, both in terms of quantity and assessed quality.

We combine this information with newly digitized firm-level data to study how externally acquired knowledge affected firms' productivity and economic performance. To complement our main analysis, we reconstruct the production network of the East German economy using historical input-output linkages and examine how the effects of economic espionage propagated through this network. As a summary measure of firms' proximity to the technological frontier, we finally analyze how access to espionage information affected their likelihood of successful privatization following German reunification in 1990.

Our findings reveal that economic espionage had a sizable positive impact on East German firms' output and productivity. In our preferred specification, a one percentage-point increase in the annual inflow rate of espionage-based information increases both value-added and labor productivity growth by 0.9 log points. We further find evidence for a positive impact on firms' capital-labor ratio and intermediate input use, but no impact on workforce composition, consistent with economic espionage inducing labor-augmenting but skill-neutral technical change. As an indicator of improvements in firms' competitiveness, we document a significant positive effect of espionage inflows on East German firms' export performance, which is largely driven by an increase in exports to other socialist countries, especially the Soviet Union. Complementary evidence from detailed product-level data suggests that these gains were not driven by diversification into new product lines but rather by increased specialization in firms' core products and improvements in product quality. While economic espionage thus strengthened East Germany's position within the Eastern Bloc, it did not enable it to compete more successfully with Western countries in international markets. Finally, while we find no evidence of complementarity between espionage-based knowledge flows and firms' own R&D activities, there is suggestive evidence that economic espionage crowded out subsequent patenting by East German firms, consistent with historical accounts in Macrakis (2008).

Beyond these direct effects on recipient firms, economic espionage also generated sizable indirect effects throughout the East German production network. Using the historical data on input-output linkages, we show that espionage-induced productivity gains propagated both upstream and downstream across sectors. Firms benefited not only from their own access to espionage information but also from productivity improvements among their suppliers and customers. These indirect effects complement our earlier findings on firms' increased use of intermediate inputs and growing specialization in core products, suggesting that espionage-induced expansions in production translated into stronger demand for upstream inputs and more efficient input provision to downstream customers.

Consistent with these direct and indirect effects, back-of-the-envelope calculations suggest that economic espionage generated substantial gains for the East German economy. Considering only the direct effects of the information received, we estimate that the intelligence collected between 1976 and 1985 increased total value added in the industrial sector covered by our firm data by about 3.2 percent in 1988. Accounting for the propagation of productivity improvements through the production network, the estimated increase rises to about 22.3 percent, implying a network multiplier of 7, in line with previous estimates in the literature (Acemoglu, Akcigit and Kerr, 2016). This increase in total value added translates into an annual monetary return per piece of intelligence of around 330,000 euros in 2020 prices. While such calculations should be interpreted with caution, they suggest that externally acquired knowledge generated sizable productivity gains that extended far beyond the firms directly receiving espionage information from the West.

Finally, linking the East German firm and espionage data with administrative information on privatization outcomes after reunification, we show that firms receiving larger inflows of information were significantly more likely to survive the transition to a market economy through successful privatization. This finding suggests that economic espionage not only improved firms' short-run productivity and competitiveness within the socialist economy, but also had persistent effects on their long-run viability.

This paper contributes to several strands of the economics literature. Most importantly, since economic espionage inherently involves the flow of technological knowledge from the targeted to the perpetrating country, our findings contribute to the extensive work on international technology diffusion (Comin and Mestieri, 2014; Keller, 2021). This literature has either focused directly on international R&D spillovers (e.g., Jaffe, Trajtenberg and Henderson, 1993; Griffith, Harrison and van Reenen, 2006; Coe, Helpman and Hoffmaister, 2009; Moretti, Steinwender and Van Reenen, 2025) or studied the role of trade (e.g. Cameron, Proudman and Redding, 2005; Buera and Oberfield, 2020; Cai, Li and Santacreu, 2022), foreign direct investment (e.g. Javorcik, 2004; Keller and Yeaple, 2009; Guadalupe, Kuzmina and Thomas, 2012; Chen et al., 2022) or migration (e.g. Hunt and Gauthier-Loiselle, 2010; Hornung, 2014; Moser, Voena and Waldinger, 2014; Giorcelli, 2019) as possible channels of international knowledge spillovers. In contrast to most of this work, we observe firm-specific knowledge flows directly, both in terms of quantity and quality. This unique feature of our analysis allows us to accurately assess their impact on firms' production structure and productivity.

Viewing economic espionage as an alternative mechanism for technological upgrading, our work is also related to the literature on the roles of innovation and imitation in driving productivity growth (e.g., Aghion and Howitt, 1992; Aghion et al., 2001; Juhász, Squicciarini and Voigtländer, 2024). By examining how the effects of espionage vary across East German firms with different levels of R&D intensity, we further connect to the literature on absorptive capacity (e.g. Cohen and Levinthal, 1990; Griffith, Redding and van Reenen, 2004; Aghion and Jaravel, 2015), as well as to work on technology adoption and technological catch-up (e.g. Acemoglu, Aghion and Zilibotti, 2006; Comin and Hobijn, 2010; Bloom, Schankerman and Van Reenen, 2013; Giorcelli and Li, 2021). Our analysis contributes to these literatures by providing direct firm-level evidence on how externally acquired frontier knowledge reshapes firms' production decisions and generates productivity gains that propagate through the production network.

Despite its long history as a channel of technology transfer (see e.g., Laiou, 2002; Ben-Atar, 2004), economic espionage remains an understudied phenomenon. While a small theoretical literature in economics examines the rationale for economic espionage and its welfare implications (e.g., Whitney and Gaisford, 1999; Solan and Yariv, 2004; Chen, 2016; Grabiszewski and Minor, 2019; Barrachina and Forner-Carreras, 2022), reliable empirical evidence on the costs borne by targeted countries and the benefits accruing to perpetrating countries is very scarce. On the cost side, recent work by Curti et al. (2023); Kao and Tadepalli (2025), and Michaelides et al. (2025) documents large negative effects of espionage incidents on U.S. firms' revenues, innovation activity, and stock-market returns. On the benefit side, a notable exception is earlier work by Glitz and Meyersson (2020), who use the same SIRA data to show that economic espionage increased *sectoral* productivity growth across 16 industries in the East German economy.

Our analysis complements Glitz and Meyersson (2020) but addresses a distinct set of questions. Whereas Glitz and Meyersson (2020) focused on the direct effects of espionage on sectoral TFP in East Germany, we use newly digitized firm- and product-level data to study how externally acquired scientific-technical information affected firms' production structure, input use, specialization patterns, and market access, as well as the direction of technical change (Acemoglu, 2003; Doraszelski and Jaumandreu, 2018). Combining detailed information on the recipients of espionage intelligence with historical input-output linkages, we further examine how the resulting productivity gains propagated through the production network and generated spillovers beyond the directly targeted firms.

Finally, our study also contributes to a broader historical literature on espionage, which has largely focused on specific case studies or the careers of individual spies (e.g. Andrew and Mitrokhin, 1999; Münkel, 2013; Andrew, 2018). A notable exception is the work of Macrakis (2008), who adopts a more comprehensive perspective and argues that East Germany's economic espionage activities ultimately failed because the increasing emphasis on stealing rather than generating technologies gradually undermined firms' own innovative capacity. While our quantitative findings likewise point to a crowding out of firms' internal R&D activities, they also show that East German economic espionage was highly effective in raising firms' productivity and competitiveness within the Eastern Bloc.[3]

[3]Regarding East German espionage specifically, several books provide valuable historical background for our analysis (e.g. Childs and Popplewell, 1996; Knabe, 1999; Herbstritt, 2007), complementing the extensive work on the Stasi and its informants in the West by Müller-Enbergs (1998, 2008, 2011).

II. Historical Background

East Germany established its economic espionage program largely in response to the strict economic containment policies that the capitalist West imposed on the communist East at the outset of the Cold War in the 1950s (Jackson, 2001). Over the following decades, the country steadily expanded its espionage activities in the West, targeting both the political and economic spheres. These operations were primarily overseen by the HVA (*Hauptverwaltung Aufklärung*), the Stasi's foreign intelligence branch headquartered in East Berlin. Within the HVA, a dedicated unit was responsible for the acquisition of scientific-technical information: the Sector for Science and Technology (*Sektor Wissenschaft und Technik*, SWT). The SWT comprised three specialized departments covering the fields of Energy, Biology and Chemistry (*Abteilung XIII*), Electronics and Electrical Engineering (*Abteilung XIV*), and Machine Building and Embargo Goods (*Abteilung XV*), alongside a department responsible for evaluating the intelligence received (*Abteilung V*). Müller-Enbergs (1998) provides details on the structure of the HVA.

For its espionage activities in the West, the Stasi relied on an extensive network of unofficial informants, the vast majority of whom were located in West Germany. Most informants engaged in economic espionage were middle-aged men, predominantly engineers or employees with scientific training, although some also worked in business or personnel departments (Herbstritt, 2007; Macrakis, 2008). In its effort to keep pace with the West, the Stasi gathered scientific-technical information across most sectors of the targeted economies, with electronics, chemicals, utilities, and machine building accounting for the largest share of the intelligence obtained (Glitz and Meyersson, 2020). However, information was also acquired in more specialized sectors such as textiles and clothing, metalworking, and mining. We provide a detailed description of the intelligence-gathering process when discussing the SIRA data in Section IV.A. For detailed accounts of the structure and operations of the HVA, as well as the profiles of its informants, see, for example, Müller-Enbergs (1996, 1998, 2008, 2011), Knabe (1999), and Herbstritt (2007).

III. Empirical Framework

To study how the receipt of scientific-technical information from the West affected the production structure and economic performance of East German firms, we estimate a series of reduced-form models that relate the annualized change in the outcome variable of interest to the lagged annualized inflow of espionage information received by the respective firm. We lag our inflow variable as it is unlikely that East German firms were able to economically exploit any new information immediately. Our main estimation equation is

$$\Delta y_{it} = \alpha + \beta \left(\frac{\Delta E_{it-1}}{Y_{it-2}} \right) + \gamma \left(\frac{\Delta G_{it-1}}{Y_{it-2}} \right) + \mu_{jt} + \varepsilon_{it}, \quad (1)$$

where Δy_{it} denotes the annualized change in outcome y for firm i between periods $t-1$ and t.[4] Our main regressor of interest is $\Delta E_{it-1}/Y_{it-2}$, which represents the normalized change in the espionage-based knowledge stock of firm i. It is constructed as the annualized number of pieces of information received between the end of periods $t-2$ and $t-1$, divided by the firm's output Y in period $t-2$. By normalizing the inflow measure with lagged output, we follow the related literature on the impact of R&D on productivity growth (e.g., Griffith, Redding and van Reenen, 2004; Hall, Mairesse and Mohnen, 2010).

To proxy for changes in a firm's conventional R&D-based knowledge stock, we additionally include the regressor $\Delta G_{it-1}/Y_{it-2}$, defined as the number of patent applications filed by the firm between the end of periods $t-2$ and $t-1$, divided by output in period $t-2$. Finally, we include a full set of sector-by-year fixed effects μ_{jt}. Identification therefore comes from within-sector variation in espionage inflows across firms and over time.

When constructing the espionage inflow measure, we restrict attention to information assessed by the HVA as either "valuable" or "very valuable." As we show in Section V.B, these are the types of information that drive changes in firms' outcomes. In the same section, we also provide evidence supporting the lag structure used in Equation (1).

In the main analysis, we estimate the regression model in Equation (1) for a range of outcome variables capturing firms' output, productivity, and input use. Identifying causal effects requires the inflow of espionage information to be exogenous conditional on the controls included in the specification. This assumption may be violated if the East German authorities systematically directed espionage activities toward particular firms or industries. Estimating the model in first differences partly addresses this concern by removing time-invariant factors such as persistent productivity differences or other fixed firm characteristics. In addition, the inclusion of sector-by-year fixed effects accounts for common trends and demand shocks within the different sectors of the economy. Nevertheless, firms within the same sector may still have received differential treatment. For example, the East German authorities may have prioritized specific technologies or production lines, thereby simultaneously intensifying both the covert acquisition of information and firms' own overt R&D activities. To account for this possibility, we include firms' patenting activity as a key control variable in the specification. Taken together, the included controls address several important channels through which our regressor of interest could be spuriously correlated with firm outcomes. At the same time, the inherently uncertain nature of economic espionage implies that random factors affecting access to valuable information are likely to constitute an important source of identifying variation.

To address remaining endogeneity concerns, we also implement an instrumental-variable approach similar in spirit to Glitz and Meyersson (2020). Specifically, we instrument the observed espionage inflows received by an East German firm with the inflows that the firm

[4] We use annualized changes because our data cover the years 1975, 1980, 1985, and 1988, implying that the intervals over which changes are measured differ in length.

would have been predicted to receive in the absence of any contemporaneous changes in the Stasi's strategic priorities. Consider the total inflow of information received by firm i in period t. This inflow can be decomposed into information provided by newly recruited spies—defined as spies recruited between the base period 1970 and period t ($s \in N$)—and information provided by original spies, that is, spies who were already active in the base period ($s \in O$):

$$\text{Inflow}_{it} = \sum_{s} \text{Inflow}_{ist} = \sum_{s \in N} \text{Inflow}_{ist} + \sum_{s \in O} \text{Inflow}_{ist} \tag{2}$$

Let $\theta_{ist} = \text{Inflow}_{ist}/\text{Inflow}_{st}$ denote the share of information provided by spy s in period t that is passed on to firm i, and let $\theta_{st} = \text{Inflow}_{st}/\sum_{s \in O} \text{Inflow}_{st} = \text{Inflow}_{st}/\text{Inflow}^{o}_{t}$ denote spy s's share in the total information collected by original spies in period t. The previous equation can then be written as:

$$\text{Inflow}_{it} = \sum_{s \in N} \text{Inflow}_{ist} + \sum_{s \in O} (\theta_{ist} - \theta_{is70})\text{Inflow}_{st} + \sum_{s \in O} \theta_{is70}\theta_{st}\text{Inflow}^{o}_{t}$$

$$= \underbrace{\sum_{s \in N} \text{Inflow}_{ist}}_{\substack{\text{new spies} \\ \text{recruited}}} + \underbrace{\sum_{s \in O} (\theta_{ist} - \theta_{is70})\theta_{st}\text{Inflow}^{o}_{t}}_{\substack{\text{original spies redirected to} \\ \text{deliver for different firms}}} + \underbrace{\sum_{s \in O} \theta_{is70}(\theta_{st} - \theta_{s70})\text{Inflow}^{o}_{t}}_{\substack{\text{original spies induced to} \\ \text{collect more information}}} + \underbrace{\theta_{i70}\text{Inflow}^{o}_{t}}_{\substack{\text{inflow due to initial} \\ \text{distribution of spies}}} \tag{3}$$

where θ_{i70} denotes the share of all information received in the base period that was passed on to firm i ($\sum_{s \in O} \text{Inflow}_{is70}/\text{Inflow}^{o}_{70}$). The first three terms in Equation (3) capture the different channels through which the Stasi may have responded to changes in the demand for information related to firm i: by recruiting new spies to collect relevant information for the firm, by redirecting the activities of original spies toward information relevant to the firm, or by inducing original spies to collect more information.

Our instrument is based on the final term in Equation (3), which reflects the inflow of information that firm i would have been expected to receive if the structure of espionage activities had remained unchanged from the 1970 base period. Specifically, we construct the predicted espionage inflow rate as follows:

$$Z_{i\Delta t} = \frac{\theta_{i,69-71} \cdot \text{Inflow}_{s \in [1969,1971],\Delta t-1}}{Y_{t-2}}, \tag{4}$$

where $\theta_{i,69\text{–}71}$ denotes the share of all information received from spies between 1969 and 1971 that was passed on to firm i. We use the 1969–1971 window to obtain more precise estimates of these initial shares. $\text{Inflow}_{s \in [1969,1971],\Delta t-1}$ denotes the total inflow of information between the end of periods $t-2$ and $t-1$ that was delivered by original spies s who were already active between 1969 and 1971.

The identifying assumption is that the initial distribution of spies across East German firms—or, more precisely, firms' reliance on the original group of spies—around 1970 is conditionally exogenous (Goldsmith-Pinkham, Sorkin and Swift, 2020). In other words, absent contemporaneous espionage inflows, firms with better access to espionage information in 1970 would not have followed systematically different trends than firms with worse access, conditional on operating within the same broad industry. Importantly, by construction, the instrument excludes all variation in espionage inflows driven by the recruitment of new spies into targeted sectors or by the reassignment of existing spies across sectors, which are arguably the main channels through which the Stasi could have strategically redirected its espionage activities.

Since our instrument is not a traditional shift-share instrument, it is not possible to systematically test the underlying identification assumption following the approach proposed by Goldsmith-Pinkham, Sorkin and Swift (2020).[5] Nevertheless, several empirical regularities, discussed in more detail in Section V, support the validity of our identification strategy. First, conditional on our control variables—sector-by-time fixed effects and patenting rates—the arrival of *non-valuable* espionage information is uncorrelated with changes in firms' output and productivity. Second, while inflows of valuable information significantly increase output and productivity, they have no discernible effect on firm size as measured by employment. Third, future inflows of valuable information are unrelated to current changes in firms' output and productivity. Fourth, including direct controls for firms' demand for information does not alter the main conclusions of the analysis. Taken together, these findings suggest that the causal relationship runs from the receipt of information to changes in firm outcomes rather than in the opposite direction.

IV. Data

Our main analysis combines three distinct archival data sources containing information on the Stasi's espionage activities, East German firms' production structure, and East German firms' patenting activities. We restrict the sample to firms for which both espionage and patenting information are available, resulting in a sample of 144 firms with observed outcome changes for at least one of the periods 1980–1985 and 1985–1988. While the original data also contain information for 1989, we exclude this year because firm outcomes were likely already affected by the fall of the Berlin Wall in November 1989.

A. SIRA Data

To measure the amount of espionage information received by East German firms, we use information recorded in Sub-database 11 (*Teildatenbank 11*) of the HVA's electronic

[5] Unlike the standard Bartik instrument, popularized by Blanchard and Katz (1992), which predicts local employment growth by interacting local industry employment shares with national industry growth rates, our instrument contains only a single "share" for each East German firm. Combined with the absence of a clear pre- and post-treatment period in our setting—as espionage activities occurred throughout the sample period—and the lack of data on firm-level characteristics prior to 1975, this prevents us from implementing the plausibility tests proposed by Goldsmith-Pinkham, Sorkin and Swift (2020). Our setting is most closely related to the early work of Altonji and Card (1991), who use the lagged *overall* immigrant share in a U.S. region as an instrument for future immigrant inflows into that region.

database SIRA (*System der Informationsrecherche der Hauptverwaltung Aufklärung*). Decoded by the Agency of the Federal Commissioner for the Stasi Records (BStU) during the 1990s, this database contains detailed records of all scientific-technical information received by the Stasi from its informants in the West during the 1970s and 1980s (Konopatzky, 2019). The database survived the turmoil following the fall of the Berlin Wall largely by chance: safety copies of the original SIRA data, created during a comprehensive data conversion in 1988/1989, were overlooked when the Stasi hastily disbanded in early 1990 and destroyed most other evidence of its activities. Between 1968 and 1989, 189,725 distinct pieces of information were recorded in SIRA's Sub-database 11, the vast majority of which originated in West Germany (Müller-Enbergs, 2011).

When a new piece of intelligence reached the HVA's headquarters, specialist internal evaluators created an electronic entry in the SIRA database recording, among other things, the date of arrival, the source of the information, a qualitative assessment, and a short list of keywords describing its content. Following this initial registration and evaluation, the material was then forwarded to potentially interested parties for further assessment and economic exploitation. The recipients were typically either large state-owned firms, known as combines (*Kombinate*), or East German research institutions. Crucially, the SIRA system recorded the recipients of each piece of information, enabling us to link the flow of espionage-based knowledge to the archival data on the receiving East German firms.

While all tangible materials—such as documents, photographs, and blueprints—that accompanied the incoming intelligence reports were destroyed during the dissolution of the Stasi, we observe a qualitative assessment for the majority of the reports, recorded on a five-point scale. Of the items assessed during the sample period from 1976 to 1988, only 25.9 percent were classified as either "valuable" (23.2 percent) or "very valuable" (2.7 percent).[6] In the empirical analysis, we focus on the impact of these valuable pieces of information, as our evidence suggests that the large volume of less valuable information had no meaningful effect on the East German economy.

East German firms, as well as administrative units within the Stasi, could place explicit procurement requests with the HVA for specific intelligence from the West. In total, Sub-database 11 records 8,272 such requests (so-called *Beauftragungsinformationen*) during the 1976–1988 sample period, 4,524 of which originated from one of the 144 firms included in our analysis. These requests provide a direct measure of firms' demand for information, which we exploit in a robustness check to address remaining endogeneity concerns.

Table 1 presents summary statistics on the espionage information received by the East German firms included in our analysis during the sample period. On average, each firm

[6] In the raw data for that period, 0.9 percent of all pieces of information received a quality assessment of "no value", 3.2 percent of "low value", 34.2 percent of "average value", 12.0 percent of "valuable", and 1.4 percent of "very valuable". The remaining 48.4 percent have missing quality information. In Appendix B1, we describe the imputation procedure we use to assign quality categories to observations with missing assessments.

Table 1—Summary Statistics for Espionage and Firm Activity

	Mean	SD	P10	P50	P90	N
Espionage Activity (Lagged)						
Espionage Inflows	20.3	57.3	0	1	36	263
Espioange Inflow Rate	0.010	0.028	0.000	0.000	0.021	263
Patenting (Lagged)						
Patents	60.6	63.9	4	42	156	263
Patenting Rate	0.031	0.044	0.002	0.017	0.079	263
Firm Indicators						
Annualized Change in Log ...						
Output Value	0.042	0.034	0.013	0.035	0.071	263
Gross Value Added	0.075	0.050	0.031	0.070	0.133	263
Labor Productivity	0.074	0.048	0.031	0.067	0.131	263
Hourly Productivity	0.073	0.048	0.031	0.067	0.131	263
Exports Total	0.047	0.098	-0.041	0.044	0.126	247
Exports West	0.043	0.140	-0.107	0.037	0.166	235
Exports East	0.045	0.103	-0.033	0.039	0.132	233
Exports Soviet Union	0.046	0.161	-0.083	0.041	0.154	200
Exports East without Soviet Union	0.047	0.126	-0.059	0.034	0.178	228
Total Capital	0.089	0.049	0.041	0.080	0.153	263
Equipment Capital	0.136	0.081	0.045	0.114	0.264	263
Other Capital	0.046	0.036	0.019	0.037	0.087	263
Total Employment	0.001	0.012	-0.010	0.000	0.016	263
Blue-Collar Employment	0.002	0.014	-0.013	0.001	0.019	262
White-Collar Employment	-0.021	0.014	-0.036	-0.020	-0.006	263
Capital-Labor Ratio	0.088	0.049	0.036	0.081	0.155	263
White/Blue-Collar Employment Ratio	-0.022	0.015	-0.038	-0.023	-0.003	262
Intermediate Inputs	0.033	0.033	0.003	0.029	0.068	262
Average Monthly Wage	0.030	0.011	0.017	0.028	0.046	263
Average Monthly Wage Blue-Collar	0.030	0.013	0.016	0.027	0.049	262
Financial Cost Administration	-0.004	0.020	-0.023	-0.006	0.019	263

Notes. This table reports summary statistics for all firms included in the main estimation sample. Espionage inflows and patents are defined as the annualized number of pieces of espionage information received and patents filed over the periods 1976-1980 and 1981-1985. The espionage inflow rate and patenting rate are defined as the corresponding annualized inflows relative to a firm's output in the base year (measured in thousand East German marks). Only pieces of espionage information classified as either "valuable" or "very valuable" are included. The production indicators are reported as annualized log changes over the periods 1980-1985 and 1985-1988. The annualized log change in the capital stock is approximated by the investment rate, while the annualized change in the log capital-labor ratio is defined as the investment rate minus the annualized log change in total employment. All observations are weighted by the average number of workers in the firm.

received 20.3 pieces of valuable information per year, corresponding to an espionage inflow rate of 1.0 percent. This inflow rate—our main regressor of interest—is defined as the annualized number of valuable pieces of information received over a given interval divided by the firm's output in the initial year (measured in thousand East German marks at constant 1985 prices). The summary statistics reveal substantial variation in firms' access to espionage information. The standard deviation of the inflow rate is 2.8 percentage points, with firms at the 10^{th} percentile receiving no valuable information and firms at the 90^{th} percentile exhibiting an inflow rate of 2.1 percent.

B. *East German Firm Data*

Our firm-level data (the so-called *Langfristige Reihen*) were compiled by the East German Statistical Office as part of an effort to construct consistent time series for key economic indicators of the largest centrally managed East German combines. These combines, which operated under the direct control of central state authorities, were typically both horizontally and vertically integrated, comprising 29 establishments on average. Originally intended for internal use only, the tabulations contain up to 43 economic indicators for 145 combines covering the years 1975, 1980, and 1985 to 1989.[7] In 1985, these combines accounted for 42.3 percent of East Germany's national income, underscoring their importance for the GDR economy.[8] Because of missing patent information, we have to exclude one combine from the sample.

As an illustration of the original format of the data, Figure C1 in the appendix shows a scan of a data sheet for the *Kombinat Carl Zeiss Jena*, a world-renowned East German producer of optical instruments during the Cold War. The data contain information on output, employment, investments, capital, exports, and costs, among other indicators. To ensure comparability over time, the East German Statistical Office went to considerable lengths to maintain a stable composition of each combine in terms of its constituent establishments (at the reference date of 1 January 1990). The data compilation followed a bottom-up approach in which individual establishments were responsible for constructing consistent time series for the respective indicators, which were then aggregated to the combine level.[9] We digitized these firm-level data and, to the best of our knowledge, are the first to use them for scientific research.

Table 1 reports summary statistics for our main outcome variables. Consistent with

[7]For six indicators, the initial two observations refer to 1976 and 1981. Similar longitudinal data also exist for 94 locally managed combines (so-called *bezirksgeleitete Kombinate*), which typically consisted of smaller firms producing consumer goods. Since our patent data do not cover these locally managed combines, we do not include them in the analysis.

[8]To obtain this figure, we sum the 145 combines' so-called *Nettoprodukt* in 1985, which broadly corresponds to value added, and divide the resulting amount (102,385 million East German marks) by the *Nationaleinkommen*, or national income, reported for the same year in Heske (2009) (241,863 million marks). East Germany's national accounting system was based on the Material Product System (MPS), in which value added was largely confined to material production. Relative to East German GDP in 1985, estimated by Heske (2009) at 311,800 million marks using the standard System of National Accounts (SNA), the contribution of the 145 combines amounted to 32.8 percent.

[9]A detailed description of the compilation procedure is provided in the *Richtlinie fuer die Bildung, Speicherung, Pflege und Auswertung rechnergestuetzt ermittelter langfristiger Reihen im Bereich der Industriekombinate*, published by the East German Statistical Office (*Staatliche Zentralverwaltung fuer Statistik*) on 1 January 1988 and available in the German Federal Archives.

Equation (1), we provide information on the annualized log changes of the different indicators together with their distribution across combines and over time. On average, total output—measured as total industrial goods production (*Industrielle Warenproduktion*)—grew by 4.2 log points per year. Labor productivity, measured as gross value added per worker, increased by 7.4 log points annually. Exports also expanded over time, with an average annual growth rate of 4.7 log points, although there was substantial heterogeneity across firms. Turning to factor inputs, total employment remained largely stable, growing by only 0.1 log points per year on average. By contrast, the combines' capital-labor ratio increased considerably, by 8.8 log points per year on average.

C. Patent Data

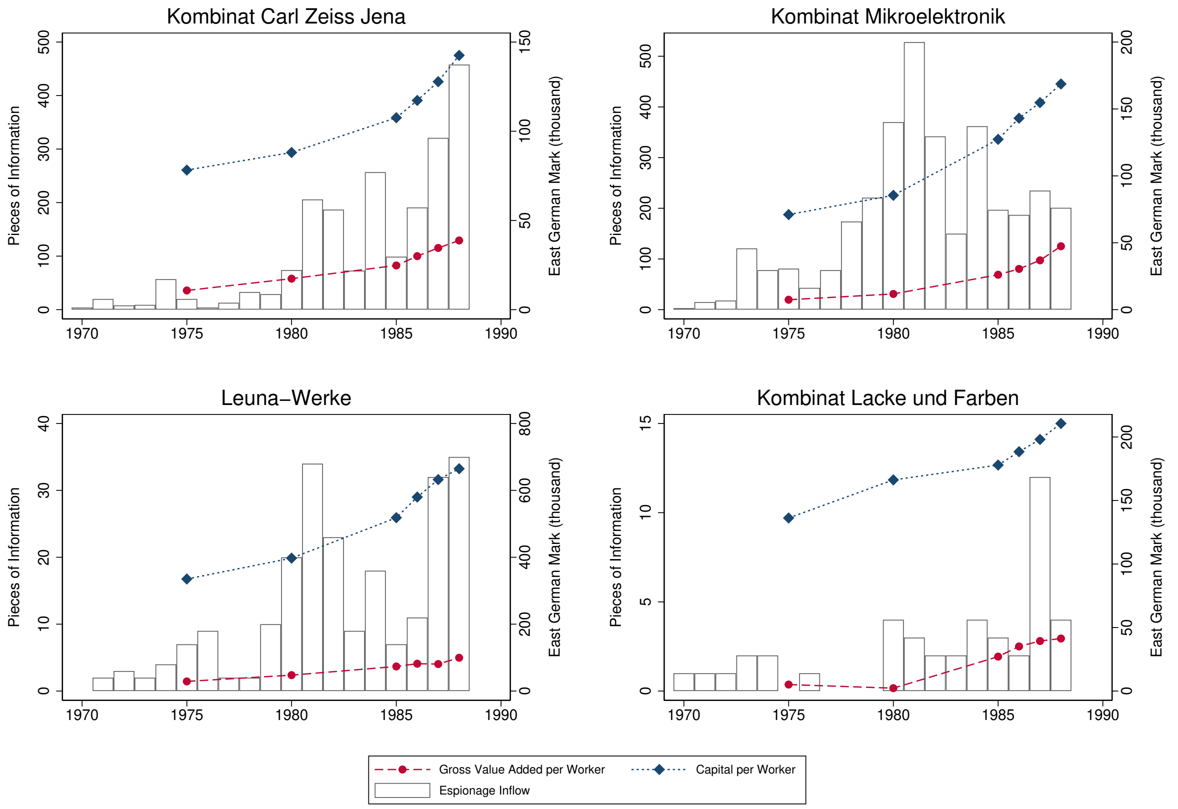
To proxy for firms' own innovation activities, we use data on the number of patent applications filed by each firm. We extract these data from formerly confidential publications of the East German Statistical Office (*Ergebnisse der Erfindertätigkeit und Schutzrechtsarbeit*) covering the period from 1970 to 1989. For each year and centrally managed combine, these publications report several innovation-related outcomes, including the number of patent applications filed in East Germany.[10] As shown in Table 1, on average each firm applied for 60.6 patents per year, corresponding to a patenting rate of 3.1 percent.

Although East German patenting differed in important respects from patenting in market economies, East Germany broadly adhered to international intellectual property practices. As a founding member of the World Intellectual Property Organization, it protected its intellectual property through patenting both domestically and abroad and offered a traditional "exclusive patent" (*Ausschließungspatent*) to foreign applicants to facilitate international knowledge transfer. One important difference from Western patent systems was that the exploitation rights associated with the standard "economic patent" (*Wirtschaftspatent*)—essentially the only type of patent available to domestic inventors—were held by the state rather than the inventor. Nevertheless, East German patent law granted inventors a one-time financial compensation linked to the patent's economic value as an incentive for innovation. While this arrangement created some alignment between inventors' incentives and the objectives of central planners, it did little to encourage state-owned firms to modernize.[11] Despite these institutional peculiarities, we regard patent applications by East German firms as a useful proxy for their R&D activities.

[10]The other innovation-related outcomes reported are the number of patent applications originating from R&D activities (1970–1982), the number of innovators applying for patents (1980–1982), the number of patent engineers working in the patent office (*Büro für Schutzrechte*) (1980–1989), and the number of university-trained employees working in R&D (1986–1989). Although we cannot use these alternative measures because of their limited time coverage, they are highly correlated with the number of patent applications: 0.984 for patent applications from R&D activities, 0.923 for the number of innovators applying for patents, 0.878 for the number of patent engineers, and 0.899 for the number of university-trained employees working in R&D.

[11]For overviews of the East German patent system and its post-war evolution, see Wiessner (2013) and Hipp et al. (2024).

Figure 1. Examples



Notes. Gross value added per worker is measured in constant 1985 East German marks, capital per worker is measured in constant 1986 East German marks. The espionage inflow refers to pieces of information assessed to be either "valuable" or "very valuable".

D. *Data Linkage*

To link the espionage data to the archival firm data, we use information on the recipients to whom a given piece of intelligence was forwarded following its initial registration in the SIRA system. In many cases, these recipients were either the firms' central headquarters or specific, often research-oriented, establishments within the firms. In either case, the information received was likely eventually transmitted to all relevant establishments within the firm, making the firm the appropriate unit of analysis. Using the East German Establishment Register—an annual register of all economically active establishments in the GDR—we match each establishment to its parent firm, and then aggregate the number of intelligence items received by each firm within a given calendar year. If multiple establishments of the same firm appear in the recipient list for a particular item, we count this as a single inflow of information at the firm level.

Figure 1 illustrates the structure of the linked data using four case studies. The top-left panel depicts, for the flagship combine *Carl Zeiss Jena*, the annual number of high-quality intelligence reports received (bars, left axis) together with its gross value added and capital stock per worker (lines, right axis). *Carl Zeiss Jena* has been described as having achieved "remarkable competence" in innovation despite operating in a socialist economy (Kogut and Zander, 2000). As our data reveal, a substantial part of its innovation input originated from economic espionage in the West. Over time, the combine received an exceptionally large volume of information, with the annual inflow rising from four pieces of information in 1970 to 458 in 1988. This increase was accompanied by rapid productivity growth: labor productivity almost quadrupled, rising from 10,760 marks per worker in 1975 to 38,800 marks per worker in 1988 (red line). At the same time, the combine experienced substantial capital deepening, with the capital-labor ratio increasing from 78,248 to 142,533 marks per worker (blue line).

The top right panel presents corresponding information for another important firm, the combine *Mikroelektronik*. This firm was one of the main producers of electronic components in East Germany, famously cloning various Intel and Zilog microprocessors for use in East German computers. Once again, we observe large inflows of espionage information—particularly in the early 1980s—followed by rapid increases in both labor productivity and the capital-labor ratio.

Not all firms, however, benefited equally from the Stasi's economic espionage in the West. The bottom two panels present analogous information for the *Leuna-Werke* and the combine *Lacke und Farben*, the main East German producers of petrochemical products and of paints and varnishes, respectively. In both cases, the inflows of information were substantially smaller in absolute terms. The comparatively small and highly specialized combine *Lacke und Farben*, for example, typically received fewer than five pieces of information per year.

V. The Direct Effects of Economic Espionage

We begin our analysis by examining the direct effects on firms receiving espionage information. Using detailed firm-level data, we trace the impact across multiple margins of adjustment and provide a comprehensive account of firms' production responses.

A. Main Outcomes

Production. Table 2 summarizes the estimation results for firm production, measured either as total output (*Industrielle Warenproduktion*) or gross value added, both expressed in constant 1985 prices.[12] Column 1 shows that, without controlling for firms' own R&D activities, a one percentage-point increase in the espionage inflow rate (roughly one third of a standard deviation; see Table 1) is associated with a 0.704 log-point increase in annual output growth. Once patent applications are included as a control variable in column 2, the estimated relationship weakens somewhat, declining to 0.607. This pattern suggests that part of the espionage effort was directed toward firms with expanding research activities. Patenting itself is also positively associated with output growth: a one

[12] In the original data, value added is reported in current prices. We construct a proxy for value added in constant prices by multiplying value added in current prices by the ratio of total output in constant prices to total output in current prices, both of which are separately reported in the original data.

Table 2—Output and Value Added

	Δ Log Output			Δ Log Value Added		
	OLS	OLS	IV	OLS	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Espionage	0.704***	0.607***	0.700***	0.733***	0.759***	0.875***
	(0.092)	(0.114)	(0.270)	(0.121)	(0.144)	(0.303)
Patenting		0.153***	0.122		-0.040	-0.079
		(0.054)	(0.100)		(0.073)	(0.115)
1st Stage: Old Informants			2.308***			2.308***
			(0.560)			(0.560)
Anderson-Rubin F-stat (p-value)			0.000			0.000
Effective F-stat			16.99			16.99
Sector-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	263	263	263	263	263	263

Notes. The dependent variables are the annualized changes in log output in columns 1–3 and in log gross value added in columns 4–6, both measured at constant prices. Espionage activity is defined as the annualized inflow of espionage information in a period over lagged output. Patenting is defined as the annualized number of patents in a period over lagged output. Observations are weighted by the average number of workers in a firm. The effective F-statistic is for the weak instrument test of Montiel Olea and Pflueger (2013). Standard errors in parentheses are clustered at the firm level: * p<0.10, ** p<0.05, *** p<0.01.

percentage-point increase in the patenting rate corresponds to a 0.153 log-point increase in annual output growth. Based on these estimates, the inflow of one valuable piece of intelligence therefore appears to be about as effective as four patents.

In column 3, we present the results from our instrumental-variable specification, using the predicted inflow of espionage information from spies already active between 1969 and 1971 as an instrument for the observed inflow (see Section III). The estimated relationship between espionage and output growth remains positive and statistically significant. The coefficient implies that a one percentage-point increase in the espionage inflow rate raises annual output growth by 0.700 log points. The fact that the IV estimate exceeds its OLS counterpart may suggest that the Stasi tended to intensify espionage activities for firms experiencing weaker output growth. The two estimates, however, are not statistically different from one another, and the change in magnitude could also reflect heterogeneous treatment effects and the specific source of variation isolated by the instrumental variable.

The first-stage estimation results indicate that the instrument has reasonably strong predictive power for actual espionage inflows, with an effective F-statistic (Montiel Olea and Pflueger, 2013) of about 17. Following recent recommendations for just-identified settings, we also report the p-value of the Anderson–Rubin Wald F-statistic, which is fully robust to weak instruments (Andrews, Stock and Sun, 2019; Keane and Neal, 2023). The results confirm that our key parameter of interest is statistically different from zero.

Turning to the results for gross value added, we again find that accounting for the potential endogeneity of espionage inflows moderately increases the estimated effect of

Table 3—Productivity

	Δ Log Labor Productivity		Δ Log Hourly Productivity		Δ Profit Share	
	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Espionage	0.646***	0.901***	0.632***	0.880***	0.269***	0.294***
	(0.163)	(0.334)	(0.164)	(0.317)	(0.053)	(0.085)
Patenting	-0.022	-0.107	-0.051	-0.134	0.042	0.034
	(0.069)	(0.133)	(0.074)	(0.130)	(0.030)	(0.035)
Observations	263	263	263	263	262	262

Notes. The dependent variables are the annualized changes in log labor productivity in columns 1–2, log hourly productivity in columns 3–4, and the profit share in columns 5–6. The productivity measures relate gross value added at constant prices to total employment (labor productivity) and to total hours worked by all employees (hourly productivity). The profit share is defined as total output minus total production cost divided by total output. Espionage activity is defined as the annualized inflow of espionage information over lagged output. Additional control variables are patenting activity defined as the annualized number of patents in a period over lagged output and sector-year fixed effects. Observations are weighted by the average number of workers in a firm. Standard errors in parentheses are clustered at the firm level: * p<0.10, ** p<0.05, *** p<0.01.

interest. Our preferred IV estimate implies that a one percentage-point increase in the espionage inflow rate raises the annual growth rate of gross value added by 0.875 log points. In contrast to the results for total output, firms' own patenting activity does not appear to be positively associated with value-added growth, although this coefficient should not be given a causal interpretation. Taken together, the results in Table 2 indicate that the arrival of espionage information led to an expansion of firm production.

Productivity. Table 3 reports the effects of espionage inflows from the West on firm productivity. Columns 1 and 2 focus on labor productivity, measured as gross value added per worker. The IV estimates indicate a significant positive effect: a one percentage-point increase in the espionage inflow rate raises labor productivity growth by 0.901 log points. This increase does not appear to be driven by longer working hours, as column 4 shows that the effect on hourly productivity—measured as gross value added per hour worked—is of similar magnitude, with an estimated coefficient of 0.880.

Columns 5 and 6 report the effects on an alternative measure of production efficiency, the so-called profit share (*Gewinnquote*), defined as the difference between the value of finished products sold (*Realisierte finanzgeplante Warenproduktion*) and the total cost of production, expressed as a share of the former.[13] According to the IV estimate, a one percentage-point increase in the espionage inflow rate raises the profit share by 0.294 log points, pointing to substantial efficiency gains from East Germany's espionage activities.[14]

[13] For the 20 combines in the construction sector, the relevant output measure is the value of construction work (*Produktion des Bauwesens*), which corresponds to the value of finished products sold reported for all other combines. Note that the "profits" of East German firms (*Reingewinn des Betriebes*) were not measures of firm-level profitability in the capitalist sense, but rather indicators of firm performance and production efficiency.

[14] One potential concern regarding the results in Tables 2 and 3 is that the presence of some measure

Table 4—Inputs

	Δ Log Capital			Δ Log Employment			Δ Log		
	Total (1)	Equip-ment (2)	Else (3)	Total (4)	White-Collar (5)	Blue-Collar (6)	Capital /Labor (7)	White /Blue-C (8)	Intermed. Inputs (9)
Panel A. OLS									
Espionage	0.594***	0.631***	0.548***	0.113*	0.117*	0.110	0.481***	0.007	0.512***
	(0.156)	(0.151)	(0.124)	(0.061)	(0.065)	(0.066)	(0.112)	(0.031)	(0.128)
Observations	263	263	263	263	263	262	263	262	262
Panel B. IV									
Espionage	0.378*	0.557**	0.606***	-0.025	0.018	-0.015	0.403**	0.033	0.717**
	(0.194)	(0.248)	(0.225)	(0.054)	(0.058)	(0.057)	(0.169)	(0.068)	(0.294)
Observations	263	263	263	263	263	262	263	262	262

Notes. The dependent variables are the annualized change in the log total capital stock in column 1, log equipment capital stock in column 2, log non-equipment capital stock in column 3, log total employment in column 4, log blue-collar workers in column 5, log white-collar workers in column 6, log capital-labor ratio in column 7, log white-collar to blue-collar workers ratio in column 8, and log intermediate inputs in column 9. The changes of the log capital stocks are approximated by the respective investment rates, defined as gross capital investments divided by the initial gross capital stock in the base period. The annualized change in the log capital-labor ratio is defined as the overall investment rate minus the annualized change in log total employment. Intermediate inputs are determined as the total value of finished products sold minus gross value added. Espionage activity is defined as the annualized inflow of espionage information in a period over lagged output. Additional control variables are patenting activity defined as the annualized number of patents in a period over lagged output and sector-year fixed effects. Observations are weighted by the average number of workers in a firm. Standard errors in parentheses are clustered at the firm level: * p<0.10, ** p<0.05, *** p<0.01.

Inputs. In Table 4, we examine how firms' factor inputs respond to the inflow of espionage information. A complication in the firm-level data is that capital stocks are recorded at original acquisition or construction cost (*Grundmittel Bruttowert*), without accounting for accumulated depreciation. As a more suitable proxy for changes in the effective net capital stock employed by a firm, we use the investment rate, defined as gross capital investment divided by the initial gross capital stock in the base period.[15]

The OLS estimates reveal a positive association between the espionage inflow rate and growth in both firms' capital stock and employment. Once we account for the endogeneity of espionage inflows, however, there is no evidence of a systematic effect on employment,

of output in both the dependent variable and the denominator of the main regressor could mechanically induce a positive correlation between the two variables. To address this concern, we estimate a set of placebo regressions in which we randomly reshuffle the 263 espionage inflows across observations in the sample, construct hypothetical espionage inflow rates by dividing these randomly assigned inflows by firms' actual lagged output, and then re-estimate the model by OLS using the same set of control variables. Figure C2 in the appendix displays the distribution of the resulting 1,000 placebo coefficients together with vertical lines indicating the actual point estimates reported in Tables 2 and 3. Both placebo distributions are tightly centered around zero, suggesting that our main results are not driven by a mechanical correlation between the dependent variables and the regressor of interest.

[15]Because the gross capital stock exceeds the net capital stock, the investment rates understate the relative changes in firms' effective capital stocks. Assuming that the net capital stock represents a constant share of the gross capital stock across firms, our estimated impact of espionage inflows on the investment rate can therefore be interpreted as a lower bound for the effect on firms' net capital stocks.

with all IV coefficients becoming quantitatively small and statistically insignificant. Taken together, these findings imply a significant positive impact on the capital-labor ratio (column 7), but no effect on the skill composition of the workforce (column 8), consistent with espionage inflows inducing labor-augmenting but skill-neutral technical change in the receiving firms (see Appendix A for a formal derivation). The weak employment response may also reflect rigidities in the East German economy, where central planning and widespread resource shortages likely constrained the efficient reallocation of labor toward more productive firms (Hansch, Nimczik and Spitz-Oener, 2025).

Finally, column 9 of Table 4 documents a significant increase in the use of intermediate inputs, which rise by 0.717 log points in response to a one percentage-point increase in the espionage inflow rate.[16] This finding suggests that espionage inflows also generate indirect effects on upstream suppliers of intermediate inputs, a mechanism for which we provide additional evidence in Section VII. Overall, Table 4 indicates that firms adjusted their production structure by increasing the use of capital and intermediate inputs while leaving employment broadly unchanged.

Table C1 in the appendix presents results for additional employment-related outcomes. We find some evidence of a negative impact on workers' wages, particularly among blue-collar workers. However, the estimated magnitudes are small: a one percentage-point increase in the espionage inflow rate reduces average monthly wages by only about 0.044 log points. We do not find evidence of adjustments in average working hours, but we do find a small negative effect on workers' average downtime (for example, due to illness).

Exports. We next examine firms' export performance. The OLS results in Table 5 reveal a positive relationship between economic espionage and the total value of exports (column 1).[17] A one percentage-point increase in the espionage inflow rate is associated with export growth of 0.544 log points. Distinguishing between export destinations reveals markedly different patterns for trade with Western and socialist countries. While exports to non-socialist countries are unaffected (column 2), exports to socialist countries increase significantly (column 3). The IV estimates confirm the positive effect on exports to the socialist economic area. Distinguishing further between exports to the Soviet Union and exports to other socialist countries shows that the effect is driven primarily by increased exports to the Soviet Union. The IV estimate for the impact on exports to the West is sizable but very imprecisely estimated, making it hard to draw strong conclusions.

Our results in Table 5 suggest that East Germany's economic espionage had only a limited impact on the ability of its firms to compete in Western product markets. This

[16]We proxy the value of intermediate inputs by the difference between the total value of finished products sold and gross value added. The original firm data directly report the ratio of material costs to gross production value for the period 1985–1988. For those years, the correlation between our proxy and the reported measure of intermediate input use is 0.994.

[17]The number of observations is somewhat smaller than in the previous specifications because not all combines exported in every period.

Table 5—Exports

	Δ Log Exports				
	Total	West	East	SU	East w/o SU
	(1)	(2)	(3)	(4)	(5)
Panel A. OLS					
Espionage	0.544***	0.098	0.738***	0.581	0.668*
	(0.180)	(0.353)	(0.199)	(0.517)	(0.398)
Observations	247	235	233	200	228
Panel B. IV					
Espionage	0.693**	0.683	0.627**	1.540***	-0.237
	(0.314)	(0.593)	(0.258)	(0.579)	(0.402)
Observations	247	235	233	200	228

Notes. The dependent variables are the annualized changes in log total exports in column 1 and log exports to non-socialist countries in column 2, socialist countries (including the Soviet Union) in column 3, the Soviet Union in column 4, and socialist countries excluding the Soviet Union in column 5, with exports measured at constant prices. Espionage activity is defined as the annualized inflow of espionage information in a period over lagged output. Additional control variables are patenting activity defined as the annualized number of patents in a period over lagged output and sector-year fixed effects. Observations are weighted by the average number of workers in a firm. Standard errors in parentheses are clustered at the firm level: * p<0.10, ** p<0.05, *** p<0.01.

finding is not surprising in the historical context, given that the technological frontier was constantly advancing and East German firms needed time to translate newly acquired knowledge into tangible improvements in production.

Although unable to make substantial inroads into Western markets, our findings suggest that East German firms successfully expanded exports to countries that were similarly constrained by Western Cold War containment policies, most notably the Soviet Union. This pattern is consistent with the view that, for much of the Cold War, East Germany was regarded as "the communist world's high-technology leader" (New York Times, 1989). Our results indicate that part of this relative technological success within the Eastern Bloc can be traced back to East Germany's superior access to frontier knowledge through economic espionage in the West.

Patenting. One might expect the extent to which East Germany benefited from espionage-based knowledge flows to depend on its absorptive capacity—that is, the tacit knowledge required to understand and assimilate the discoveries of others. To test this hypothesis, we extend our main specification by including an interaction between the espionage inflow rate and a firm's own lagged patenting rate (see, e.g., Griffith, Redding and van Reenen, 2004). Table 6 reports the corresponding results for our main outcomes, output and labor productivity. We find no evidence that combines with higher patenting rates benefited more from the arrival of new information than less innovation-intensive firms (columns 2 and 4). One possible explanation is that, in a centrally planned economy such

Table 6—Patenting

	Δ Log Output		Δ Log Labor Productivity		Patenting Rate	
	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Espionage (demeaned)	0.576	0.708*	0.778	1.016**	-0.033	-0.205
	(0.408)	(0.419)	(0.506)	(0.485)	(0.098)	(0.169)
Espionage x Patenting	0.321	-0.165	-1.360	-2.173		
	(3.158)	(3.052)	(3.850)	(3.789)		
Patenting (demeaned)	0.155**	0.124	-0.030	-0.088	0.699***	0.756***
	(0.067)	(0.078)	(0.079)	(0.090)	(0.114)	(0.130)
AR F-stat (p-value)		0.000		0.000		0.172
Kleibergen-Paap F-stat		35.04		35.04		16.99
Observations	263	263	263	263	263	263

Notes. The dependent variables are the annualized changes in log output at constant prices in columns 1–2, log labor productivity in columns 3–4, and the patenting rate in columns 5–6. The patenting rate is the annualized number of patents in a period over lagged output (same definition as the patenting control, apart from using current rather than lagged patent applications). Espionage activity is defined as the annualized inflow of espionage information over lagged output. Additional control variables are patenting activity and sector-year fixed effects. Observations are weighted by the average number of workers in a firm. Standard errors in parentheses are clustered at the firm level: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

as the GDR's, the authorities could provide relevant scientific and technical expertise through specialized research institutes or by assigning knowledgeable experts to firms in need. This may have reduced the importance of firms' own personnel and technological capabilities for the effective exploitation of espionage-based information.

An interesting question regarding the interplay between overt R&D through patenting and covert R&D through economic espionage is whether the latter crowds out the former, as argued, for example, by Macrakis (2008). In columns 5 and 6 of Table 6, we report results from OLS and IV regressions relating a firm's patenting rate to the espionage inflows received in the previous period. The IV estimate points to a moderate, though statistically insignificant, crowding-out effect: each additional piece of information received from the West is associated with 0.2 fewer patent applications in the subsequent period. This finding is consistent with the Stasi's own assessment that its espionage program saved the East German economy roughly 75 million marks in R&D expenditures (Macrakis, 2008).

B. *Specification and Robustness Checks*

In this section, we present a series of specification and robustness checks focusing on our main results regarding the impact of economic espionage on firm output and productivity.

As discussed in Section III, our analysis concentrates on *valuable* pieces of information, since there is no evidence that the large volume of non-valuable information collected in the West had any meaningful impact on the East German economy. Table C2 in the appendix reports OLS estimates of Equation (1) for the outcomes considered in Tables 2 and 3, including both valuable and non-valuable information inflow rates simultaneously. The coefficients on the non-valuable inflow rate are very close to zero and statistically insignificant throughout. Moreover, including the non-valuable inflow rate leaves the coefficients on the valuable inflow rate virtually unchanged. This suggests that the two types of inflows are largely uncorrelated and that high-quality inflows were not merely the by-product of a broader intensification of espionage activities in the West.

In Equation (1), we use the lagged rather than the contemporaneous espionage inflow rate as our main regressor of interest. Intuitively, it is unlikely that East German firms could benefit immediately from newly acquired knowledge, since this information first had to be absorbed and integrated into production processes. Table C3 in the appendix reports results from an OLS specification that includes both the lagged and contemporaneous inflow rates simultaneously. While the lagged inflow rate is strongly associated with changes in the different outcome variables, the coefficient on the contemporaneous inflow rate is small in magnitude and statistically insignificant throughout.

The specification in Table C3 also includes the future espionage inflow rate as an additional regressor. Relative to the effects of the lagged inflow rate, the coefficients are small and, in most cases, statistically insignificant. For value added and labor productivity, the coefficients on future inflows are marginally significant and negative, which is consistent with the possibility that the Stasi intensified its espionage activities for firms experiencing weak growth in these two outcomes. This could explain why the OLS estimates in Tables 2 and 3 are smaller than their IV counterparts. More generally, the fact that the coefficient on the lagged inflow rate remains remarkably stable after controlling for contemporaneous and future inflow rates suggests that the correlation across these inflow measures is limited. This is what one would expect if the arrival of high-quality information were largely quasi-random and independent of firm-specific demand for information.

To further assess the robustness of our main results, we exploit the fact that, from 1977 onward, the SIRA database also records the procurement requests submitted to the HVA by each East German firm. As shown in Table C4 in the appendix, controlling for this measure of firms' demand for intelligence does not change the main findings.[18] The IV estimates are somewhat larger than those in Tables 2 and 3 but are estimated less precisely due to a weaker first stage, with an effective F-statistic of 7. Nevertheless, all estimates remain statistically significant, also according to the Anderson–Rubin F-statistic. Overall, the robustness of our results to the inclusion of a direct measure of firms' demand for intelligence further alleviates concerns about the endogeneity of espionage inflows.

Finally, Table C5 in the appendix re-estimates our main specification including a full set of firm fixed effects. In this specification, the parameter of interest is identified exclusively from within-firm variation in espionage inflow rates over time. As there are only two observation periods per firm, the identifying variation is substantially reduced, resulting

[18]We construct the demand-related regressor by annualizing the number of procurement requests, dividing this measure by a firm's output in the initial year, and then lagging the resulting demand rate by one period, analogous to the construction of the main espionage inflow rate regressor.

in a considerably weaker first stage with an effective F-statistic of about 3.7. However, even under this demanding specification, we still find a positive and statistically significant effect of espionage inflows on both output and labor productivity growth.

C. Additional Outcomes

Apart from the outcomes discussed in the previous subsections, the firm-level data also contain information on several additional indicators, many of which are closely related to the outcomes examined above. For completeness, Table C6 in the appendix reports the results for these remaining indicators. The estimated effects of espionage on output and productivity are robust to alternative measures of production and to using values measured in current rather than constant prices.

While economic espionage increased firms' total output and value added, it did not significantly affect their sales of final goods to the East German population (top panel, column 4). This suggests that the newly acquired scientific and technical knowledge from the West was initially used primarily to expand the production of capital goods, intermediate inputs, and export goods. Over time, these direct effects may then have propagated through the production network, an issue we revisit in the next section.

As an additional outcome, we also observe a measure of total production costs, including wages, capital costs, and expenditures on intermediate inputs (bottom panel, column 1). These costs increase in response to espionage inflows, but by less than total output. Economic espionage therefore increased output and value added while also raising productivity, at least in part through a more efficient use of inputs.

VI. Effects on the Product Mix

In this section, we provide a complementary analysis of how the inflow of espionage information from the West affected the product portfolios of East German firms. To this end, we digitized archival data from the East German Statistical Office on industrial production in East Germany (*Industrieberichterstattung*). These annual data contain detailed information on the monetary values and physical quantities of the specific products manufactured by an average of 4,664 establishments per year. Between 1980 and 1988, the typical establishment produced 6.1 distinct four-digit products. At the same time, there was substantial heterogeneity across establishments, ranging from a single product at the 5^{th} percentile to 16 products at the 95^{th} percentile, with a maximum of 70 products. On average, 469 distinct products are recorded in a given year, providing an unparalleled view of East Germany's industrial output during the final phase of the Cold War.[19]

[19] To assess the quality of the product-level data, we aggregate the monetary values of all goods produced by a combine's establishments (measured in constant 1985 prices) and re-estimate our baseline regression using this alternative measure of total production. The resulting estimate, 0.766 (0.312), is very similar to the coefficient reported in column 3 of Table 2, 0.700 (0.270). This consistency is reassuring, as the firm-level data should ultimately have been compiled from the underlying product-level information.

Table 7—Quantity and Price of Products

	Δ Log Output					
	Value		Quantity		Price	
	(1)	(2)	(3)	(4)	(5)	(6)
Espionage	0.886***	0.896***	0.415***	0.353**	0.471***	0.543***
	(0.219)	(0.296)	(0.127)	(0.178)	(0.173)	(0.192)
1st Stage: Old Informants	1.985***	1.977***	1.985***	1.977***	1.985***	1.977***
	(0.361)	(0.346)	(0.361)	(0.346)	(0.361)	(0.346)
AR F-stat (p-value)	0.000	0.000	0.001	0.016	0.000	0.000
Effective F-stat	30.22	32.73	30.22	32.73	30.22	32.73
Product FE	No	Yes	No	Yes	No	Yes
Observations	5,723	5,723	5,723	5,723	5,723	5,723

Notes. The dependent variables are the annualized changes in log output at constant prices in columns 1–2, log output quantity in columns 3–4, and log price in columns 5–6. Espionage activity is defined as the annualized inflow of espionage information over lagged output. Patenting is defined as the annualized number of patents over lagged output. Additional control variables are patenting activity defined as the annualized number of patents in a period over lagged output and sector-year fixed effects. The level of aggregation of the outcome variables is the firm-by-product-by-measurement unit, with products defined at the 4-digit level. Observations are trimmed below the 1st percentile and above the 99th percentile of the difference in the log change in value and the log change in quantity to account for outliers due to measurement error. Observations are weighted by the average number of workers in a firm. The effective F-statistic is for the weak instrument test of Montiel Olea and Pflueger (2013). Standard errors in parentheses are clustered at the firm level: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Column 1 of Table 7 reports the results from a specification in which we regress the change in the log value of a given product, measured in constant prices, on the espionage inflow rate, clustering standard errors at the firm level. As before, the variation in the main regressor is at the firm level, whereas the variation in the outcome variable is now at the firm-by-product level. Column 2 adds a full set of product fixed effects to the specification. In both cases, our main finding of a positive effect of espionage information on production is confirmed: a one percentage-point increase in the espionage inflow rate raises the output value of a given product by approximately 0.896 log points.[20]

The production values reported in columns 1 and 2 are expressed in constant prices. In the context of East Germany's centrally planned economy, this means that state-imposed regulatory price adjustments for a given product—for example, in response to changes in relative scarcity or input costs—were removed from the calculation of these values. By contrast, price increases reflecting improvements in product quality, as assessed by the relevant East German authorities, were treated as increases in productive performance and retained in the calculations.[21] As a result, increases in a product's production value—

[20]Reassuringly, this estimate is similar in magnitude to the coefficient reported in column 3 of Table 2 (0.700), where the dependent variable is combines' total output measured in constant prices.

[21]For descriptions of how price indices were constructed within the statistical system of the GDR, see the *Richtlinie fuer die Bildung, Speicherung, Pflege und Auswertung rechnergestuetzt ermittelter langfristiger Reihen im Bereich der Industriekombinate* (1988) and the *Analyse der Zeitreihenorganisation in ausgewählten Betrieben und Kombinaten* (1978), both available in the German Federal Archives. For a detailed historical account of the East German price system during the Cold War, see Melzer (1985).

Table 8—Product Mix

	Products				Δ Log Output Products	
	Δ Log Count (1)	Rate New (2)	Rate Exit (3)	Herfindahl Index (4)	Most Important (5)	Excl. Important (6)
Espionage	0.081	0.029	-0.053	0.303***	1.344***	0.062
	(0.073)	(0.076)	(0.068)	(0.097)	(0.386)	(0.162)
1st Stage: Old Informants	2.308***	2.308***	2.308***	2.308***	2.302***	2.302***
	(0.560)	(0.560)	(0.560)	(0.560)	(0.558)	(0.558)
AR F-stat (p-value)	0.344	0.706	0.510	0.000	0.000	0.712
Effective F-stat	16.99	16.99	16.99	16.99	17.01	17.01
Observations	263	263	263	263	256	256

Notes. The dependent variables are the annualized change in the log number of products in column 1, the annualized number of new products relative to the total number of products in the base year in column 2, the annualized number of discontinued products relative to the total number of products in the base year in column 3, and the annualized change in the Herfindahl index for the concentration of production across products in column 4.The dependent variables in columns 5 and 6 are, respectively, the annualized changes in the log output of the product with the highest production share and of all other products in the firm's base-year product portfolio. In case of a tie, all products with the highest production share are selected. Espionage activity is defined as the annualized inflow of espionage information over lagged output. Additional control variables are patenting activity defined as the annualized number of patents in a period over lagged output and sector-year fixed effects. Products are defined at the 4-digit level. The level of aggregation is the firm. Observations are weighted by the average number of workers in a firm. The effective F-statistic is for the weak instrument test of Montiel Olea and Pflueger (2013). Standard errors in parentheses are clustered at the firm level: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

even when measured in constant prices—may reflect either an expansion in the physical quantity produced (meters, kilograms, liters, kilowatts, units etc.) or an increase in the quality-adjusted price charged for the product. In columns 3 to 6 of Table 7, we decompose the estimates reported in columns 1 and 2 into these two components.

We find a positive and statistically significant effect of espionage inflows on the physical output of individual products, both in specifications with and without product fixed effects (columns 3 and 4). We also find a positive effect on product prices of broadly similar magnitude (columns 5 and 6). Given the uncertainty surrounding the extent to which state-administered price adjustments accurately reflected genuine improvements in product quality, it is reassuring that espionage inflows also increase physical production quantities, pointing to a real expansion in output. At the same time, insofar as price adjustments reflected improvements in product quality, the positive effect on product prices suggests that economic espionage contributed to quality upgrading in existing products.

Table 8 provides additional insights into the impact of economic espionage on firms' product portfolios. We find no evidence that East German firms significantly increased the number of distinct products they manufactured (column 1). The estimated effects on both the entry rate of new products (column 2) and the exit rate of existing products (column 3) are statistically insignificant, suggesting that economic espionage primarily led to increased production and quality improvements in existing products rather than the development of new ones. What did change, however, was the focus of production, as reflected in the positive effect on the Herfindahl index of a firm's product portfolio (column 4). Espionage inflows increased production of a firm's main output good (column 5), while having little effect on the output of other products (column 6). This pattern suggests that part of the productivity gains resulted from greater production specialization.

VII. The Indirect Effects of Economic Espionage

Besides the direct effects of economic espionage on firms' production structure and economic performance, East German firms may also have benefited indirectly from espionage-induced productivity improvements among their upstream suppliers and downstream customers. To study these indirect effects, we digitized the 1977 input-output matrix of the East German economy (*Verflechtungsbilanz der Volkswirtschaftlichen Gesamterzeugung*), which contains information on final-good production, value added, and input-output linkages for 118 distinct product groups.[22] For each product group, the matrix reports the value of output delivered to destination product groups in its rows and the value of inputs sourced from other product groups in its columns. Using these data, we follow the production-network literature (e.g. Acemoglu, Akcigit and Kerr, 2016) and compute the Leontief inverse of the input-output matrix to measure the importance of product groups as suppliers of intermediate inputs and as customers for the output of other groups.

Figure C3 in the appendix visualizes the input-output linkages among the 118 product groups in the East German economy. Each edge represents an input-supply relationship between two product groups. The larger nodes at the center of the network correspond to product groups that supply intermediate inputs to many other sectors. In terms of total value, the most important intermediate inputs are (1) livestock products, (2) crude oil and petroleum products, and (3) electrical energy. Other major intermediate inputs include retail services, rolled steel products, and textile raw materials.

To link the network information to the firm-level production indicators, we require a mapping between the 118 product groups in the input-output table and the 144 combines in our firm-level data. To construct this mapping, we use the product-level data described in Section VI, which provide information on the types of goods produced by each establishment and their corresponding output values. Assigning each product to one of the broader product groups and aggregating to the firm level, we compute for each firm i the share of output accounted for by product group j, denoted by s_{ij}. Appendix B2 provides details on this mapping procedure, including how we account for products that fall outside industrial goods production.

The direct inflow of espionage information associated with product group j in period t

[22] East German input-output matrices are available for the years 1972, 1977, 1982, and 1987 at varying levels of detail. We use the 1977 matrix because it predates our sample period while still providing a sufficiently detailed product-group classification.

is defined as:

$$Inflow_{jt} = \sum_i s_{ij} \Delta E_{it}, \tag{5}$$

where ΔE_{it} is the espionage inflow to firm i in period t. The indirect inflow of espionage information relevant for product group j across its upstream suppliers is then given by:

$$Indirect_{jt}^{upstream} = \sum_{j'} (l_{jj'}^{in} - \mathbb{1}_{j=j'}) \frac{Inflow_{j't}}{Y_{j'77}}, \tag{6}$$

where $l_{jj'}^{in}$ denotes the (j, j') element of the Leontief inverse of the input-output matrix with rows being normalized by the total sales of product j, and $Y_{j'77}$ denotes the total output of product j' taken from the 1977 input-output table.[23] Similarly, the indirect inflow of espionage information relevant for product group j across its downstream customers is given by:

$$Indirect_{jt}^{downstream} = \sum_{j'} (l_{jj'}^{out} - \mathbb{1}_{j=j'}) \frac{Inflow_{j't}}{Y_{j'77}}, \tag{7}$$

where $l_{jj'}^{out}$ denotes the (j, j') element of the Leontief inverse of the transposed input-output matrix, with rows being normalized by the total sales of product j. Finally, to link these indirect espionage inflow rates back to specific combines, we calculate

$$Indirect_{it}^{upstream} = \sum_j s_{ij} Indirect_{jt}^{upstream} \tag{8}$$

and

$$Indirect_{it}^{downstream} = \sum_j s_{ij} Indirect_{jt}^{downstream}, \tag{9}$$

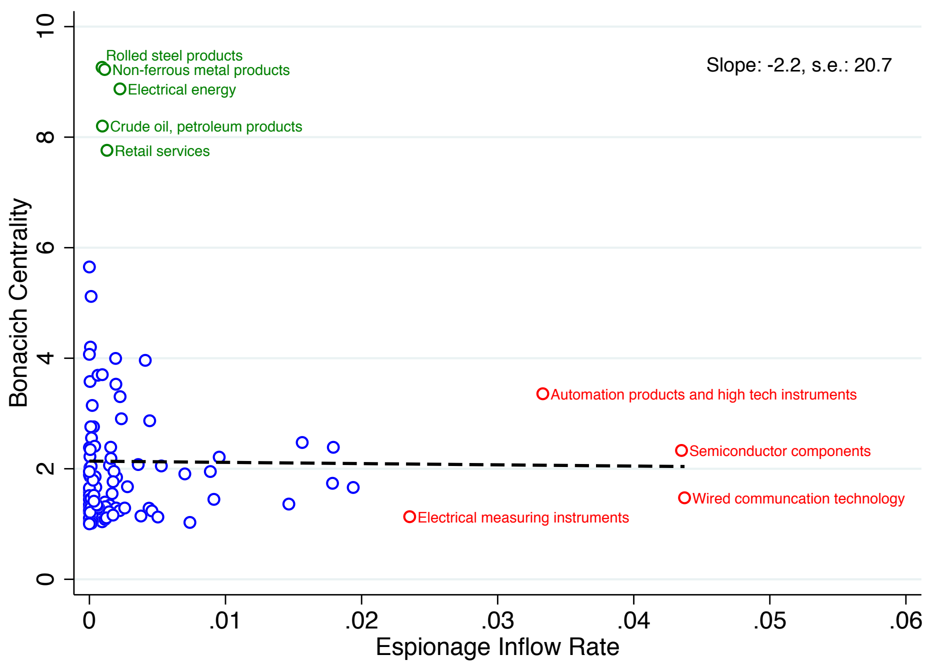
which we include as additional regressors in our estimation equation after lagging them by one period. Intuitively, these indirect inflow rates capture weighted averages of the espionage inflows received by a firm's upstream suppliers and downstream customers, where the weights account for both direct and indirect linkages in the production network. In the IV estimation, we instrument these indirect inflow rates using their IV counterparts. Specifically, rather than using the observed inflows ΔE_{it}, we use the predicted inflows from spies already active between 1969 and 1971, $\theta_{i,69-70} \cdot \text{Inflow}_{s \in [1969,1971], \Delta t-1}$, to construct $Inflow_{jt}$ in Equation (5). We then follow the same subsequent steps to generate instruments for the two indirect inflow rates defined in Equations (8) and (9).

Figure 2 shows the relationship between each product group's Bonacich centrality in the production network and the espionage inflows it received.[24] There is no relationship be-

[23] We determine $\mathbf{L^{in}} = (\mathbf{I} - \mathbf{A})^{-1}$, where the (j, j') element of $\mathbf{A}$ is defined as $a_{jj'} = \frac{p_{j'} x_{jj'}}{p_j Y_j}$, the value of product j' as an input for the production of product j, normalized by the total sales of product j. We determine $\mathbf{L^{out}} = (\mathbf{I} - \widehat{\mathbf{A}})^{-1}$, where the (j, j') element of $\widehat{\mathbf{A}}$ is defined as $\widehat{a}_{jj'} = \frac{p_j x_{j'j}}{p_j Y_j}$, the value of product j as an input to product j', normalized by the total sales of product j.

[24] Bonacich centrality measures the importance of a product group within the production network. A product group connected to many other product groups that are themselves highly central has high Bonacich centrality (Bonacich, 1987).

Figure 2. Product Group Centrality and Espionage Inflows



Notes. The espionage inflows shown on the x-axis are constructed as annualized inflow of espionage information related to a product group over total output of a product group in the 1977 input-output network (valuable espionage information only, averaged for periods 1976–80 and 1981–1985). The y-axis shows each product group's Bonacich centrality in the 1977 input-output network. The dashed black line represents the best linear fit from an OLS regression for the relationship between product group centrality and the espionage inflow rate.

tween the two measures, suggesting either that the Stasi did not strategically concentrate its espionage efforts on the sectors most central to the network, or that the quasi-random nature of access to high-quality information obscured such strategic targeting.

Table 9 reports the results from our augmented specification, which simultaneously includes espionage inflows to both a firm's suppliers, $IndirectRate_{it-1}^{upstream}$, and customers, $IndirectRate_{it-1}^{downstream}$. Both the OLS and IV estimates point to positive indirect effects of espionage inflows to a firm's customers on its own output and value added (columns 1 and 2), consistent with downstream industries increasing their demand for intermediate inputs. The estimated indirect effects of espionage inflows to a firm's suppliers are similar in magnitude, although statistically insignificant, likely reflecting the relatively weak first stage in these specifications. Such upstream effects are consistent with espionage-induced productivity shocks propagating downstream through the production network (Acemoglu, Akcigit and Kerr, 2016). Comparing the magnitudes of the direct and indirect effects, we find that a one standard deviation increase in the direct espionage inflow rate (0.028) raises value added by 1.70 log points. By comparison, a one standard deviation increase in the indirect inflow rates for upstream and downstream industries (approximately 0.004 in both cases) increases value added by 1.38 and 1.27 log points, respectively.

We also examine the indirect effects of economic espionage on firms' labor productivity.

Table 9—Indirect Effects on Output and Productivity

	Δ Log Output	Δ Log Value Added	Δ Log Labor Productivity	Δ Log Hourly Productivity	Δ Profit Share
	(1)	(2)	(3)	(4)	(5)
Panel A. OLS					
Espionage	0.522***	0.591***	0.482***	0.453***	0.196***
	(0.107)	(0.137)	(0.139)	(0.143)	(0.057)
Indirect From					
Upstream Industry	1.120	2.287	3.214	2.979	0.867
	(1.970)	(2.706)	(2.591)	(2.508)	(0.931)
Downstream Industry	1.565*	3.033**	2.429**	2.910**	1.380***
	(0.903)	(1.213)	(1.151)	(1.174)	(0.386)
Observations	263	263	263	263	262
Panel B. IV					
Espionage	0.504**	0.606**	0.614**	0.604**	0.175**
	(0.234)	(0.280)	(0.303)	(0.296)	(0.085)
Indirect From					
Upstream Industry	2.474	3.452	4.394**	4.001*	1.514*
	(1.640)	(2.209)	(2.140)	(2.164)	(0.809)
Downstream Industry	2.374*	3.165*	1.890	2.292	1.441***
	(1.262)	(1.667)	(1.741)	(1.714)	(0.525)
AR F-stat (p-value)	0.000	0.000	0.000	0.000	0.000
Kleibergen-Paap F-stat	5.87	5.87	5.87	5.87	5.87
Observations	263	263	263	263	262

Notes. The dependent variables are the annualized changes in log output at constant prices in column 1, log gross value added in column 2, log labor productivity in column 3, log hourly productivity in column 4, and the profit share in column 5. Espionage activity is defined as the annualized inflow of espionage information in a period over lagged output. The indirect espionage measures are weighted espionage inflow rates to both a firm's suppliers (upstream) and a firm's customers (downstream) according to Equations (8) and (9), respectively. Additional control variables are patenting activity defined as the annualized number of patents in a period over lagged output and sector-year fixed effects. Observations are weighted by the average number of workers in a firm. Standard errors in parentheses are clustered at the firm level: * p<0.10, ** p<0.05, *** p<0.01.

In this case, inflows to firms' suppliers have larger effects than inflows to their customers (columns 3–4, Panel B). Using the profit share as an alternative measure of production efficiency, we again find fairly symmetric upstream and downstream effects, with coefficients of roughly 1.5 (column 5, Panel B). Importantly, across all specifications, the direct effects of espionage remain relatively stable and statistically significant after including the indirect espionage inflow rates as additional regressors. Overall, the results in Table 9 imply that the direct effects of economic espionage on individual firms propagated throughout the economy via input-output linkages, generating increases in output and productivity even in firms that did not directly benefit from espionage-based knowledge transfers.

VIII. The Aggregate Gains from Economic Espionage

In this section, we present back-of-the-envelope calculations of the aggregate gains from economic espionage for the industrial sector covered by our firm-level data. For each firm, we estimate the counterfactual decline in 1988 value added in the absence of espionage-based knowledge flows between 1976 and 1985, taking into account both direct and indirect effects. Specifically, we first estimate the specification underlying column 2 of Table 9 and then predict counterfactual growth rates of value added after setting the direct and indirect espionage inflow rates equal to zero for all firms and periods. Starting from the observed levels of value added in 1980, we use these counterfactual growth rates to construct firm-specific counterfactual values of value added in 1988. In the final step, we aggregate these counterfactual values across all firms and compare the result with the actual level of total value added observed in the sample.

Our estimates suggest that, between 1980 and 1988, East Germany's espionage program increased value-added growth by 33.3 percentage points (83.0 versus 49.7 percent). Labor productivity growth was likewise substantially higher, by 27.9 percentage points (82.4 versus 54.5 percent). As a result, total value added in 1988 was 22.3 percent—or 20,216 million East German marks—higher than it would have been in the absence of espionage-based knowledge flows. These simulations imply an annual monetary return per piece of valuable information acquired in the West of approximately 1.64 million East German marks, corresponding to roughly 330,000 euros in 2020 prices.[25]

We can further assess how the East German industrial sector would have evolved if we disregarded the propagation effects through the production network. To do so, we set only the indirect espionage inflow rates to zero while leaving the direct inflow rates unchanged. Relative to the counterfactual without espionage inflows, the growth rate of value added between 1980 and 1988 would then have been 4.8 percentage points higher, and total value added in 1988 would have been 3.2 percent higher. The indirect network effects therefore account for a substantial share of the overall gains from economic espionage, implying a network multiplier of $22.3/3.2 = 7.0$. For comparison, Acemoglu, Akcigit and Kerr (2016) estimate multipliers for value-added growth of 6.4 for shocks to either imports or federal spending, and 15.6 for shocks to total factor productivity.

While these calculations abstract from several complexities—such as potential crowding-out effects on firms' own patenting activities, for which we find only limited evidence, and other general-equilibrium adjustments—they nevertheless point to a large economic impact of the Stasi's espionage activities. Especially when viewed against the backdrop of an annual operational budget of only around 76.9 million East German marks in the late 1980s, the GDR's economic espionage program can, by any reasonable standard, be regarded as a remarkable success.[26]

[25] To derive this figure, we first convert the 20,216 million East German marks into Deutsche Marks using the unofficial exchange rate prevailing at the end of the 1980s of approximately 4.4:1. We then convert Deutsche Marks into euros using the official conversion rate of 1.95583:1 and adjust for the increase in the German consumer price index between 1989 and 2020 of 72.5 percent (IMF, 2025). Finally, we divide the resulting amount by the 12,291 pieces of valuable information received by the firms in our sample between 1976 and 1985.

[26] According to Werner Großmann, the last head of the HVA, who testified before a parliamentary

IX. Economic Espionage and Privatization Success

Having established that espionage inflows strengthened the competitiveness of East German firms within the socialist economic bloc, we conclude by examining whether they also left a lasting imprint on firms' trajectories during the transition to a market economy. In particular, we investigate whether access to espionage-based knowledge affected firms' likelihood of successful privatization in the aftermath of German reunification.

A. Institutional Background

German reunification in 1990 and the ensuing transition from state-owned enterprises to private ownership in the East German economy were largely unexpected. Most Germans did not anticipate reunification within their lifetime (Herdegen, 1992). Yet the uprising of the East German population, combined with a unique geopolitical situation, brought about a historic turning point not only for Germany, but for Europe and the world.

East Germany effectively adopted West German institutions overnight through the creation of an economic, monetary and social union. To manage the transition, the government established the *Treuhandanstalt* ("trust agency", or simply *Treuhand*), which assumed ownership of all East German firms outside the core public sector. The agency's legal mandate was to privatize viable firms and liquidate non-viable ones (Treuhandgesetz, 1990). The sheer number of *Treuhand* firms, their low productivity levels relative to Western firms (Akerlof et al., 1991), and the collapse of former trade relationships with other Eastern Bloc countries made this a Herculean task (Dornbusch and Wolf, 1994).

In carrying out its mandate, the *Treuhand*'s first step was to dissolve the East German combines by separating their constituent establishments. In some cases, these establishments were further subdivided to improve their marketability. Enjoying a high degree of protection from political interference, the *Treuhand* then systematically evaluated firms according to their market potential (Dyck, 1997; Hau, 1998). Firms considered viable were privatized primarily through direct sales, with each firm marketed individually to investors, while firms deemed to have no realistic prospect of survival were liquidated. The privatization program therefore effectively acted as a screening device for former East German firms (Mergele, Hennicke and Lubczyk, 2025).

The privatization program ended in December 1994, only four years after reunification. Over this period, the *Treuhand* privatized roughly 60 percent of all East German firms and liquidated almost 30 percent, with the remainder either restituted or transferred to municipalities (Mergele, Hennicke and Lubczyk, 2025).[27]

committee in the 1990s, the agency's annual operational budget in the late 1980s amounted to roughly 17.5 million East German marks and 13.5 million Deutsche Marks (Glitz and Meyersson, 2020). We convert the latter into East German marks using the unofficial exchange rate of 4.4:1.

[27] Some firms were restituted to previously expropriated owners through legal procedures outside the *Treuhand*'s control. In a few sectors, such as public transport, firms could also be transferred to local municipalities.

B. Data

For this part of the analysis, we combine information on firms' espionage inflows with a measure of their success in the *Treuhand*'s privatization program. We view privatization as a proxy for the proximity of East German firms to the Western technological frontier. Our starting point is the administrative firm register of the *Treuhand*'s successor organization, the *Bundesanstalt für vereinigungsbedingte Sonderaufgaben* (BvS), described in detail by Mergele, Hennicke and Lubczyk (2025). This register covers 13,378 Treuhand firms, among them those created through the breakup of former GDR combines. The register records whether the firms were privatized, liquidated, restituted, or transferred to a municipality, along with the original names under which they were registered in the GDR.

In the next step, we match the original GDR names of the *Treuhand* firms to the corresponding entries in the East German Establishment Register of the year 1989, which contain, for all establishments, information on their respective parent entities—typically a combine, but in some cases also a ministry or another administrative unit.[28]

Overall, we are able to trace 9,275 *Treuhand* firms back to their original parent entities, of which 3,355 belonged to one of the 144 centrally managed combines included in our analysis. Within this group of firms, 54.4 percent were successfully privatized, 31.8 percent were liquidated, and the remainder were either restituted or transferred to municipalities.

In the final step, we combine these data with the espionage information recorded in the SIRA database and the firm characteristics from the *Langfristige Reihen*. Consistent with the main analysis, we use the East German combine as the unit of analysis.[29]

Because combines were dissolved and their establishments privatized separately, the concept of "privatization success" is not directly defined at the combine level. As a proxy, we use the difference between the logarithm of total employment across a combine's establishments at the time of privatization and the logarithm of employment in the same combine in 1988.[30] As an alternative but closely related measure, we also use the share

[28]The matching procedure is based primarily on comparisons of establishment names. We use probabilistic string matching based on bigram similarity scores to identify potential matches and verify each match manually. In this process, we also combine information on establishments' geographic location and industry affiliation from the BvS data, the *Treuhand* Firm Surveys, and the THA documentation.

[29]Conducting the analysis at the establishment level is problematic because the SIRA data do not allow us to observe the precise number of information items available to a specific East German establishment. While individual establishments (VEBs) are sometimes explicitly listed as recipients, it is likely that information forwarded to their parent combines was subsequently transmitted to the relevant establishments even when they were not directly mentioned. Combines therefore constitute the more appropriate unit of analysis for measuring espionage inflows accurately.

[30]More precisely, for each *Treuhand* firm successfully privatized during the 1990s, we obtain employment at the time of privatization, aggregate these employment levels across all firms belonging to the same combine, take the logarithm of the resulting sum, and subtract the logarithm of the combine's employment level in 1988. When aggregating employment, we exclude restitution and municipalization cases because these outcomes were driven primarily by legal rather than economic considerations. For 3.5 percent of privatized *Treuhand* firms associated with one of the 144 centrally managed combines, the privatization date is missing in the *Treuhand* Firm Surveys. In these cases, we impute the missing value using the modal privatization year among non-missing observations (1992). For 16.8 percent of privatized firms, employment at the time of their privatization is unavailable. In these cases, we use the reported employment level from the closest preceding year. If no exact employment level is available for any year

Table 10—Espionage and Post-Reunification Outcomes

	Δ Log Employment (Privatized)			Share Employment Privatized		
	OLS	IV	IV	OLS	IV	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Full Sample						
Espionage (1976–88)	1.502	-0.413	3.350**	0.266	-0.070	0.642
	(1.893)	(2.420)	(1.665)	(0.489)	(0.595)	(0.467)
Patenting (1976–88)	-1.811*	-1.112	-2.575***	-0.336	-0.213	-0.409**
	(0.959)	(1.089)	(0.767)	(0.243)	(0.253)	(0.193)
Anderson-Rubin F-stat (p-value)		0.868	0.085		0.909	0.256
Effective F-stat		13.68	18.98		13.73	19.18
Cubic Control for Firm Size	No	No	Yes	No	No	Yes
Observations	115	115	115	119	119	119
Panel B. Excluding Robotron						
Espionage (1976–88)	2.920*	3.708*	3.779**	0.555	0.814	1.072*
	(1.604)	(1.896)	(1.896)	(0.498)	(0.637)	(0.556)
Patenting (1976–88)	-2.419**	-2.715**	-2.733***	-0.459*	-0.557*	-0.569**
	(1.000)	(1.080)	(0.952)	(0.265)	(0.297)	(0.248)
Anderson-Rubin F-stat (p-value)		0.052	0.060		0.203	0.057
Effective F-stat		97.75	96.34		98.50	97.52
Cubic Control for Firm Size	No	No	Yes	No	No	Yes
Observations	114	114	114	118	118	118

Notes. The dependent variables are the difference between the log of the total employment of privatized establishments of a given combine at the time of privatization and the log employment of that same combine in 1988 in columns 1–3 and the share of employment before reunification in 1988 that got privatized in columns 4–6. Espionage activity is defined as the annualized inflow of espionage information in the period 1976–1988 over output in 1975. Patenting is defined as the annualized number of patents in the period 1976–1988 over output in 1975. Sector fixed effects are included in all specifications. Observations are weighted by the average number of workers in a firm. The effective F-statistic is for the weak instrument test of Montiel Olea and Pflueger (2013). Robust standard errors are reported in parentheses: * p<0.10, ** p<0.05, *** p<0.01.

of a combine's 1988 employment that was ultimately privatized during the 1990s. On average, 29.3 percent of a combine's workforce was retained through the privatization process, although there was substantial heterogeneity across combines, ranging from 5.9 percent at the 10th percentile to 63.1 percent at the 90th percentile.

C. *Results*

Table 10 presents the results for specifications comparable to those in the main firm-level analysis. The estimates in column 1 of Panel A suggest that firms receiving larger inflows of high-quality espionage information between 1976 and 1988 were more successful in the privatization process, in the sense that a larger share of their 1988 workforce transitioned into privatized firms after reunification. However, once we instrument the espionage inflow rate in column 2, the coefficient becomes negative, small in magnitude, and insignificant.

Closer inspection reveals that the estimates in columns 1 and 2 are heavily influenced

(12.9 percent), we impute employment using the average firm size among non-missing observations within the corresponding employment-size category, which is recorded for all but 10 establishments.

by a single outlier, the combine *Robotron*. As East Germany's main computer manufacturer, *Robotron* received exceptionally large amounts of espionage information during the 1970s and 1980s. Yet only a small fraction of its establishments survived the privatization process, as illustrated in Figure C4 in the appendix. Rather than reflecting a purely post-socialist phenomenon, *Robotron*'s rapid demise after reunification should be understood against the broader background of the global consolidation of the microcomputer industry in the late 1980s and early 1990s. This process undermined the viability of national computer industries throughout Western Europe, including those in West Germany, France, and the United Kingdom (Bresnahan and Malerba, 1999).

Panel B shows a consistent positive relationship between espionage inflows and privatization success once this single combine is excluded from the sample. A one percentage-point increase in the espionage inflow rate raises the share of the workforce transitioning into privatized firms by 3.7 log points (column 2) or 0.8 percentage points (column 5). Controlling for a firm's employment level in 1975—capturing the fact that larger combines generally experienced bigger workforce declines during privatization—yields similar estimates (columns 3 and 6), even when *Robotron* is retained in the sample.

Overall, the results suggest that economic espionage brought East German firms closer to the technological frontier and shaped their trajectories well beyond the socialist era.

X. Conclusion

This paper provides the first comprehensive firm-level evidence on the economic effects of large-scale economic espionage. Using unique archival data tracing the flow of scientific-technical information from Western sources to specific recipient firms in East Germany, we show that espionage generated substantial productivity gains. Firms receiving larger inflows of intelligence experienced faster output growth, higher labor productivity, and greater production efficiency. These gains were accompanied by capital deepening and increased use of intermediate inputs. We further show that the effects propagated through the production network and that firms with greater access to espionage-based knowledge were more likely to be successfully privatized after reunification.

At the same time, our results highlight important limits to these gains. While economic espionage strengthened firms' performance and competitiveness within the socialist bloc—most visibly through increased exports to the Soviet Union—it did not translate into stronger performance in Western markets. We also find some suggestive evidence that reliance on espionage-based knowledge may have weakened firms' incentives to innovate by shifting effort away from internal knowledge creation toward external sourcing.

These findings offer a new perspective on current debates about economic espionage and international technology competition. They show that access to foreign technology—even when obtained through illicit channels—can generate sizable productivity gains, helping to explain why economic espionage remains a persistent and strategically relevant activity for many countries. However, our results also indicate that such gains are not sufficient to ensure competitiveness at the global technological frontier, underscoring the limits of externally acquired knowledge in closing deeper technological gaps.

Our analysis therefore highlights both the potential and the limitations of economic espionage as a channel of technology transfer. More broadly, it suggests that policies aimed at restricting international knowledge flows—through export controls, investment screening, or stronger intellectual property enforcement—may succeed in limiting unauthorized technology transfer, but could also slow the diffusion of ideas underpinning productivity growth. Such policies could therefore have important implications for both the pace and the global distribution of technological progress.

While our analysis is rooted in the specific institutional setting of the East German economy during the Cold War, the mechanisms we document are likely to extend beyond this historical context. Economic espionage represents one channel through which firms and states can acquire foreign knowledge and improve economic performance, and is not unique to centrally planned economies. Moreover, some features of the East German system, such as the central state's active role in steering industrial development and technology acquisition, are also present in contemporary economies such as China. Nevertheless, the precise magnitudes of the economic effects of espionage may differ in modern market economies, where firms face stronger competitive pressures and have access to a broader range of legal channels for knowledge diffusion. Our findings should therefore be interpreted as evidence on the potential effectiveness of espionage-based knowledge flows, while recognizing that their impact depends on institutional conditions and firms' ability to absorb externally acquired information.

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Online Appendix

Appendix A: Derivation from Production Function

Assume that each East German combine produces its output with a CES production function that permits factor-augmenting technical change (Antràs, 2004):

$$Y_{it} = \left[\delta(A_{it}^K K_{it})^{\frac{\sigma-1}{\sigma}} + (1-\delta)(A_{it}^L L_{it})^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}, \tag{A1}$$

where i and t index combines and time periods; Y_{it}, K_{it}, and L_{it} are value added, capital services and labor services; and δ and σ are constant parameters, the latter representing the elasticity of substitution between capital and labor. We assume that technical change is factor-augmenting and evolving in the following way

$$A_{it}^K = A_{i0}^K E_{it}^{\beta_K} G_{it}^{\gamma_K} \exp(\tilde{u}_{it}^K) \quad \text{and} \quad A_{it}^L = A_{i0}^L E_{it}^{\beta_L} G_{it}^{\gamma_L} \exp(\tilde{u}_{it}^L) \tag{A2}$$

where E_{it} denotes the knowledge stock accruing from economic espionage, G_{it} the traditional R&D knowledge stock, and $\exp(\tilde{u}_{it})$ an unobserved disturbance term. The parameters β_K and β_L capture the extent to which economic espionage increases the efficiency of capital and labor. If $\beta_K = \beta_L$, then economic espionage induces Hicks-neutral technical change. Each combine maximizes profits, taking the price of capital (R_{it}) and wages (W_{it}) in the economy as given. This leads to the following relationship:

$$\ln(K_{it}/L_{it}) = \alpha + \sigma \ln(W_{it}/R_{it}) + (1-\sigma)(\beta_L - \beta_K)\ln E_{it} + (1-\sigma)(\gamma_L - \gamma_K)\ln G_{it} + u_{it} \tag{A3}$$

where $u_{it} = (1-\sigma)(\tilde{u}_{it}^L - \tilde{u}_{it}^K)$. Taking first differences over time yields:

$$\Delta\ln(K_{it}/L_{it}) = \sigma\Delta\ln(W_{it}/R_{it}) + (1-\sigma)(\beta_L - \beta_K)\Delta\ln E_{it} + (1-\sigma)(\gamma_L - \gamma_K)\Delta\ln G_{it} + \Delta u_{it} \tag{A4}$$

In our empirical analysis, we proxy for $\Delta\ln E_{it}$ and $\Delta\ln G_{it}$ by (the one-period lags of) $\Delta E_{it}/Y_{it-1}$ and $\Delta G_{it}/Y_{it-1}$, following the literature on the impact of R&D on productivity growth (e.g., Griffith, Redding and van Reenen, 2004; Hall, Mairesse and Mohnen, 2010). From Equation A4, one can see that a positive coefficient on the espionage inflow regressor in a regression in which the dependent variable is the change in the log capital/labor ratio would indicate that $(1-\sigma)(\beta_L - \beta_K) > 0$. Since capital and labor are likely to be gross complements ($\sigma < 1$) in production (see, e.g., Oberfield and Raval, 2021), this would imply that $\beta_L - \beta_K > 0$ and, therefore, that espionage inflows are relatively labor-augmenting. On the other hand, a zero coefficient would indicate that $\beta_L = \beta_K$ and, therefore, that espionage inflows are factor-neutral. A similar argument based on an extended production function with white- and blue-collar workers would provide an explicit link between the changes in a firm's skill mix and the relative skill bias of espionage information.

Appendix B: Additional Data Construction Information

B1. Imputation of Quality Assessments

To impute missing quality assessments, we follow Glitz and Meyersson (2020) and implement a procedure that replaces missing values with a spy-based predicted measure of quality. Specifically, we regress the observed quality assessments on spy fixed effects and a cubic polynomial in the spy's experience, measured as the number of years since the informant's first recorded intelligence item in the SIRA database. A small number of intelligence items have multiple quality assessments (1.3 percent), with 0.7 percent containing conflicting evaluations. In these cases, we retain the most recent assessment and, in the event of remaining ties, the highest one.

We then use the estimated model to predict a spy-specific and experience-adjusted quality score for each intelligence item with missing information, rounding the predicted values to the nearest integer. This procedure allows for the possibility that informants improved over time in their ability to obtain valuable information, either through learning or through better access to relevant material. Figure B1 compares the distribution of quality assessments in the original data with the distribution after the imputation.

To construct measures of spy experience, we rely on both the registration numbers and code names of the spies. Since not all code names were unique, we use registration numbers whenever available to distinguish spies. However, since the SIRA data do not always report registration numbers, we also use code names to maximize coverage.

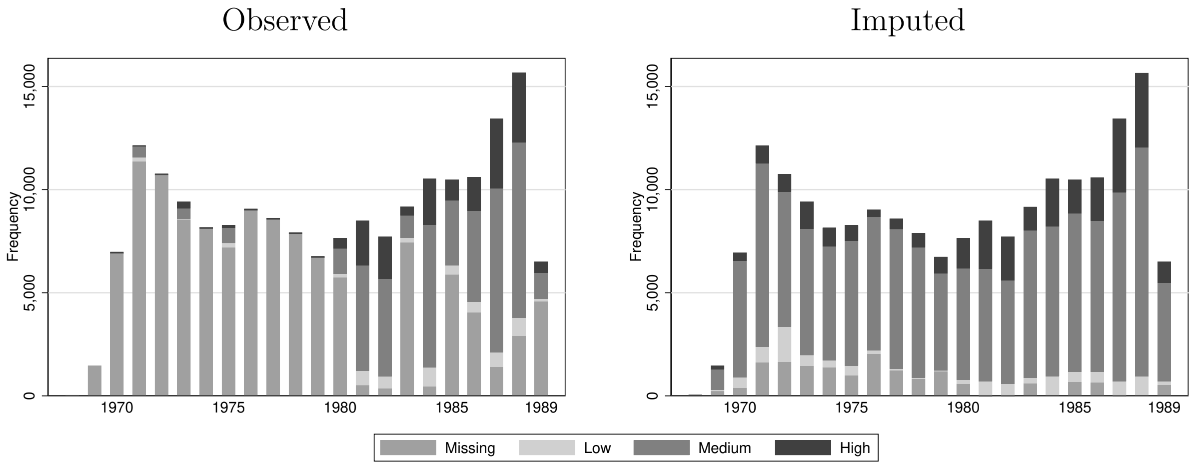
In a first step, whenever a code name is associated with a unique registration number, we assign that registration number to all observations carrying the same code name. This procedure allows us to recover registration numbers for 82 percent of all observations. In subsequent steps, we exploit additional information on the specific agency unit and Stasi employee responsible for maintaining contact with the informant, assuming that a given agency unit or employee uses a particular code name only once. For example, within each code name–agency unit–employee cell, we assign the most common registration number to observations with missing information. We repeat this procedure for code name–agency unit cells and code name–employee cells. Finally, if a code name still cannot be linked to any registration number after these steps, we assign it a unique identifier of our own.

B2. Determining the Production of Firms By Product Groups of the Input-Output Table

To compute the share of a firm i's output accounted for by different product groups j (s_{ij}), we rely on the East German Establishment Register and the product-level industrial production data (*Industrieberichterstattung*).

The product data provide detailed annual information at the establishment level on the monetary values of specific products produced. Through the mapping provided with the 1977 input-output table, we can aggregate the monetary values of the specific products at the level of the input-output table's product groups. However, because the product

Figure B1. Distribution of spy pieces quality assessments by year – original data and imputation



Notes. The figure shows the total number of pieces of information recorded in a given year by quality assessment. The left panel shows the distribution as observed in the raw data and, the right panel shows the distribution after the imputation of missing quality assessments. The classification aggregates pieces of information with a quality assessment of "very valuable" and "valuable" to "high", "average value" to "medium", and "low value" and "no value" to "low".

data focus on industrial goods production, we observe production for only 94 of the 118 product groups. Excluded groups are, for example, project development services or buildings. Thus, in this step we can calculate for each firm only the share of each industrial product group in total industrial production. We do so for the year 1980—the first year for which reliable product-level information is available

To account for firms' non-industrial production, we use five-digit industry information from the East German Establishment Register and manually map these industries based on their labels to the corresponding product groups. This mapping identifies for each establishment—according to the industry classification—whether production is primarily for one of the industrial product groups or for one of 15 non-industrial product groups.[31]

We then aggregate this information at the firm level. We start by determining the number of establishments linked to an industrial production industry and take it as the basis for the share of industrial production in total production. For example, if a firm consists of 10 establishments and 6 of them have an industry code associated with industrial production, we assume that the share of industrial production is 60 percent. Using the share of each industrial product group in total industrial production from the product-level data, we can further subdivide the share of industrial production to get to the relative importance of an industrial product group in total production. In our example firm, if the industrial production value is split 1:3 between cars and trains, then the share of cars (trains) in total production would be 15 percent (45 percent). To obtain the shares for

[31]This procedure leaves 9 product groups that do not appear in the product-level data and cannot be linked through the industry mapping. Included are plant and equipment categories for specific industries and scrap material.

non-industrial product groups, we again rely on establishment counts. For example, if 2 of the remaining establishments are primarily involved in industries linked to project development services, such as the industry "Engineering office–rationalization", and if the other 2 establishments are primarily involved in the construction of residential buildings, the shares for each of these product groups in total production would be 20 percent.

While, in principle, we would like to have harmonized information on production values for all 118 product groups, we are not aware of any data source that provides such information. With our approach, on average 81.6 percent of a firm's establishments focus on industrial production.

Appendix C: Additional Tables and Figures

Figure C1. Example Page – Archive Data

A/ BLATT: -0049 STRUKTUR 1.1.90/6.1-52

STATISTISCHES AMT DER DDR

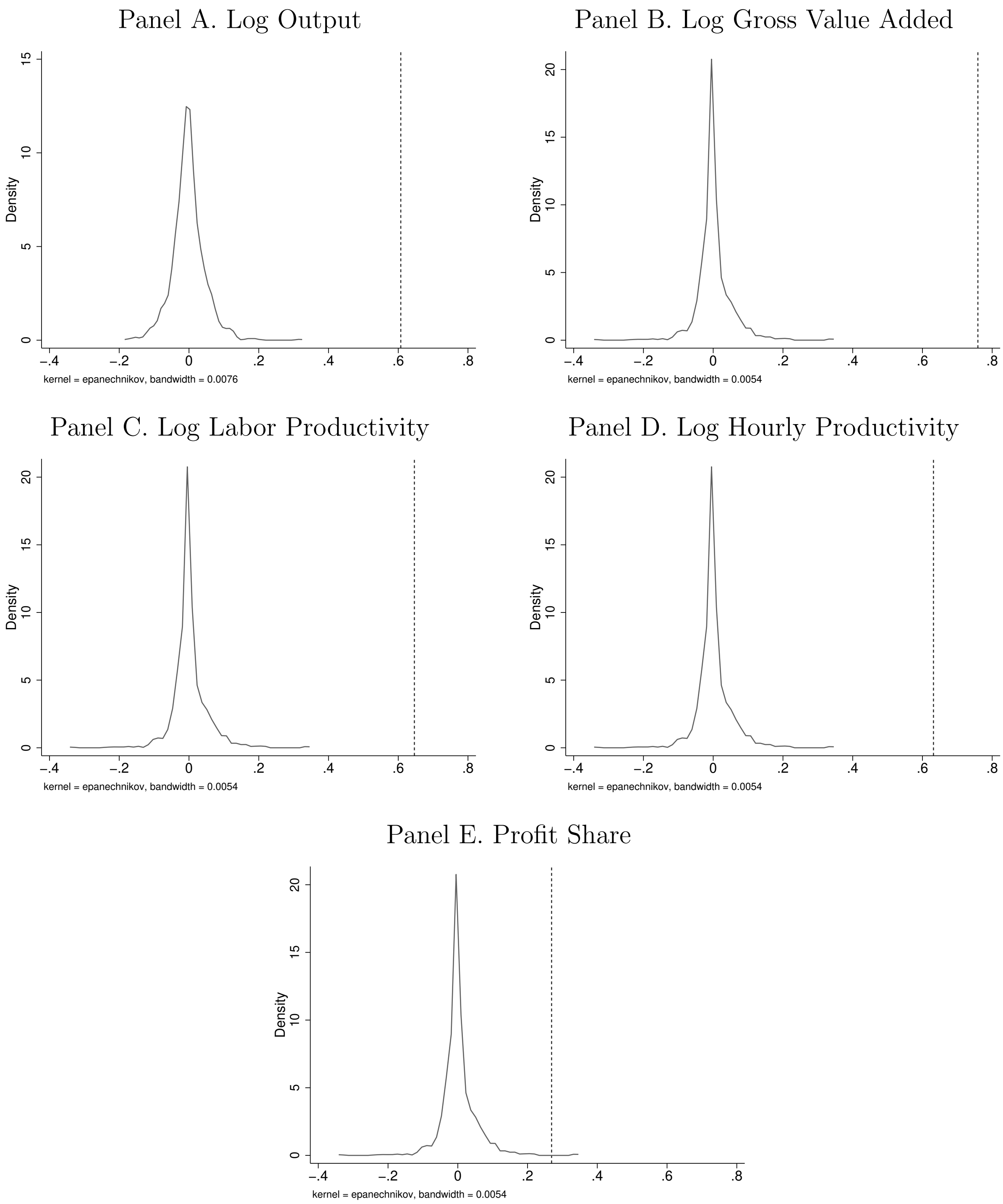
L A N G F R I S T I G E R E I H E N

HERSTELLUNGSDATUM: 12.05.90

KOMBINAT: CARL ZEISS MINISTERIUM: BER.E/E

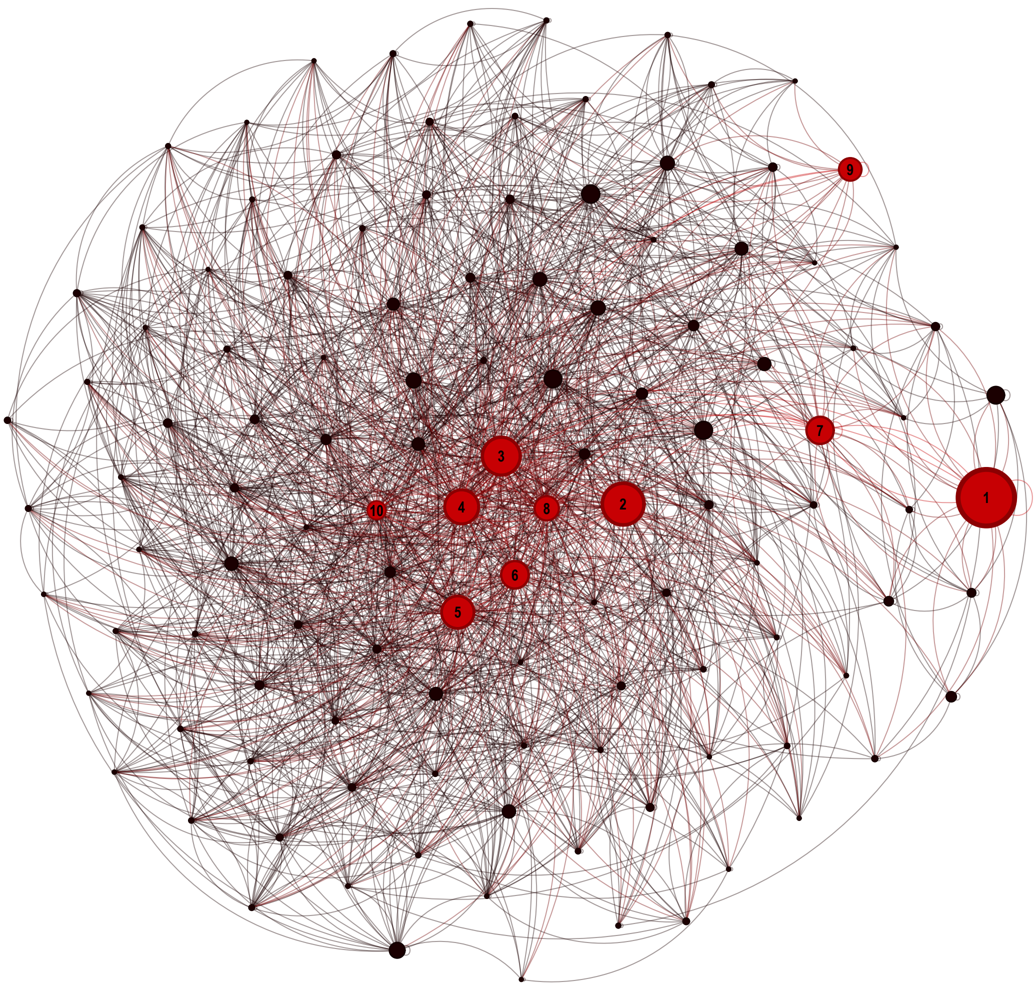
KENNZIFFER	ABSOLUT						ENTWICKLUNG VORJAHR=100				%DURCHSCHNITT. JAEHRLICH	
	1975/76	1980/81	1986	1987	1988	1989	1986	1987	1988	1989	1985: 75(76)	ENDJ: 1985
IND. WP ZU KP85	1674897	2648757	4130721	4641904	5140184	4944005	112,2	112,4	110,7	96,2	108,2	107,6
IWP ZU IAP (AK.PR)	1738564	2734073	3926476	4470437	4871139	4726803	106,6	113,9	109,0	97,0	107,8	106,4
FER.F.D.BEV.(AK.PR)	296620	394201	298396	355305	359355	398139	99,4	119,1	101,1	110,8	100,1	107,3
ANTEIL FE AN IWP	6,5	4,7	3,6	3,9	4,0	8,4	94,7	108,3	102,6	210,0	94,2	121,9
STD.-PROD.AA KP85	18	30	40	45	50	49	111,1	112,5	111,1	98,0	107,2	108,0
EXP.SW VER.BP(AK.PR)	603960	940481	1344269	1418750	1484883	1278549	106,0	105,5	104,7	86,1	107,7	100,2
EX.NSW VER.BP(AK.PR)	239182	485910	588948	561784	540996	442086	115,3	95,4	96,3	81,7	107,9	96,5
EXP.SU VER.BP(AK.PR)	310967	543354	761999	767362	785242	638777	104,6	100,7	102,3	81,3	108,9	96,3
EXPORTQU. SW BP		33,5	25,9	21,6	22,8	17,8	96,6	83,4	105,6	78,1		90,3
EXPORTQU. NSW BP		12,1	11,1	8,4	8,3	6,2	132,1	75,7	98,8	74,7		92,7
MAT.INVESTIT. INSG.	142190	323076	703227	923108	952533	895777	139,2	131,3	103,2	94,0	113,5	115,4
MAT.INVESTIT. BAU	12504	64959	180609	157136	118157	105696	151,3	87,0	75,2	89,5	125,3	97,0
MAT.INVESTIT. AUSR.	88072	219074	488386	735266	805259	763885	137,5	150,6	109,5	94,9	115,0	121,1
GRUNDMITTEL INSG.	4476781	5066711	7247431	7868188	8767045	9758439	109,3	108,6	111,4	111,3	104,0	110,1
GRUNDMITTEL AUSR.	1991670	2381551	4015392	4508462	5241122	6126316	111,5	112,3	116,3	116,9	106,1	114,2
ANT.BAU-INV.AN INSG	8,8	20,1	25,7	17,0	12,4	11,8	108,9	66,1	72,9	95,2	110,4	84,1
ANT.AUSR-INV.AN INS	61,9	67,8	69,4	79,7	84,5	85,3	98,7	114,8	106,0	100,9	101,3	105,0
ANT.NUTZ-INV.AN INS	92,7	77,0	91,0	92,3	102,4	91,9	67,8	101,4	110,9	89,7	104,2	91,0
ANT.RAT-INV.AN INSG		35,8	47,1	46,7	72,2	72,7	90,4	99,2	154,6	100,7		108,7
GRUNDFONDSQU.85/86	374,1	522,3	570,0	590,0	586,3	506,6	102,7	103,5	99,4	86,4	104,0	97,7
GRUNDF-QU.NP AK/86	142,7	203,6	243,2	260,7	258,0	228,5	105,5	107,2	99,0	88,6	104,9	99,3
GFA PR86 /AA	78248	88097	117272	127801	142533	160678	109,0	109,0	111,5	112,7	103,2	110,6
NETTOPR. (AK.PR)	639033	1031421	1762300	2051153	2261626	2229548	115,3	116,4	110,3	98,6	109,1	109,9
ARB.-PROD. KP85	29275	46055	66840	75397	83568	81406	111,9	112,8	110,8	97,4	107,4	108,1
ARB.-PROD.NP AK.	11169	17934	28516	33316	36769	36711	115,0	116,8	110,4	99,8	108,3	110,3
STD.-PROD.AA NP AK	7	11	17	20	22	22	113,3	117,6	110,0	100,0	107,9	110,0
ARBEIT.U.ANG.IN VBE	57213	57513	61800	61566	61509	60733	100,2	99,6	99,9	98,7	100,8	99,6
BRUTTOLOHNSUMME A/A	498611	607930	750123	778945	797489	814427	103,4	103,8	102,4	102,1	103,8	102,9
PROD.PERSONAL IN VBE	31267	30172	31837	31255	31177	30517	98,4	98,2	99,8	97,9	100,3	98,6
LEITG.U.VERW. IN VBE	10896	10818	9924	9586	9011	8600	100,3	96,6	94,0	95,4	99,0	96,6
ANTEIL PP AN AA	54,7	52,5	51,5	50,8	50,7	50,2	98,3	98,6	99,8	99,0	99,6	98,9
ANTEIL LVP AN AA	19,0	18,8	16,1	15,6	14,6	14,2	100,6	96,9	93,6	97,3	98,3	97,1
MONATSLOHN AA	726	881	1011	1054	1080	1117	103,2	104,3	102,5	103,4	103,0	103,3
MONATSLOHN PP	678	813	932	968	994	1020	102,5	103,9	102,7	102,6	103,0	102,9
NOMINELLE AZ JE AA	2062,23	2043,60	2185,03	2192,39	2200,19	2191,82	100,3	100,3	100,4	99,6	100,5	100,2
TATS.ARBEITSZ.JE AA	1657,57	1602,84	1731,03	1738,23	1750,38	1738,98	100,1	100,4	100,7	99,3	100,4	100,1
AUSFALLZEITEN JE AA	251,50	268,36	273,76	269,48	266,70	262,77	103,4	98,4	99,0	98,5	100,5	99,8
MAT.KO.SENK.O.ABP			414,51	396,45	380,13	381,19	93,9	95,6	95,9	100,3		96,4
KOSTEN LUV (AK.PR)		293833	309062	308221	281944	272604	107,4	99,7	91,5	96,7		98,7
RFWP (OIAB,AK.PR)	1786200	2702329	4296636	4667732	5101965	4939278	111,7	108,6	109,3	96,8	108,9	106,5
GSK RFWP(OIAB,AK.PR)	1906673	2730157	3999291	4136528	4293443	4228365	107,6	103,4	103,8	98,5	107,7	103,3
KOSTENSATZ AK/OIAB	106,74	101,03	93,08	88,62	84,15	85,61	96,3	95,2	95,0	101,7	98,9	97,0

Figure C2. Placebo Analysis for Effects of Spy Inflows



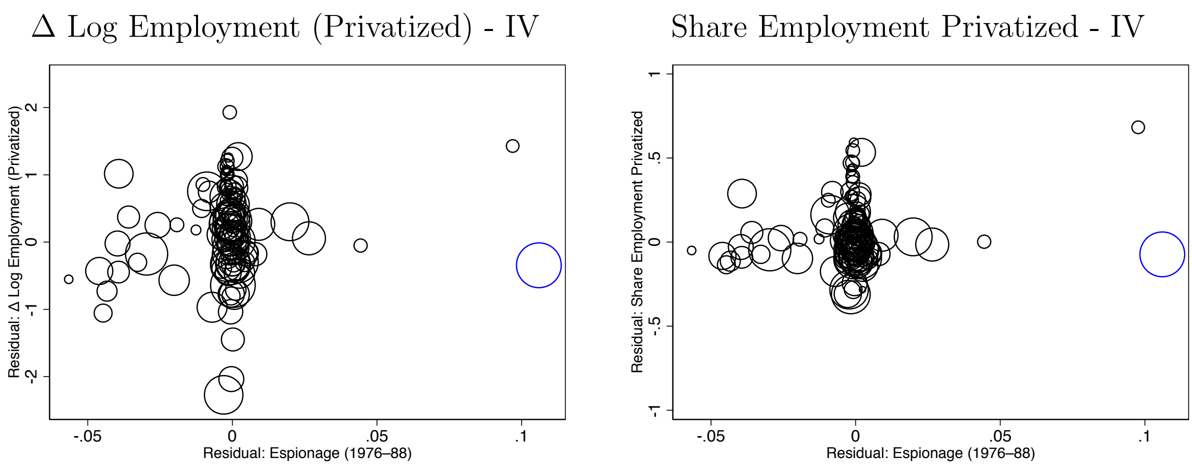
Notes. The figure displays the distribution of 1,000 estimated placebo coefficients for hypothetical espionage inflow rates on the annualized changes of the log output at constant prices (Panel A), log gross value added (Panel B), log labor productivity (Panel C), log hourly productivity (Panel D), and profit share (Panel E). Each estimate is obtained by, first, randomly reshuffling the 263 actual high quality espionage inflows across observations, second, computing hypothetical espionage inflow rates by dividing the randomly assigned inflows by actual lagged output, and, third, re-estimating the model by OLS with the same set of control variables as in the main specifications. The dashed line shows the coefficient estimate for the actual espionage inflow rate.

Figure C3. The Production Network of East Germany



Notes. The data source is the East German input-output table (*Verflechtungsbilanz*) for 1977. The figure is drawn with the software Gephi using the Fruchterman-Reingold layout. Each node corresponds to one of the 118 product groups in the 1977 input-output table. Each edge corresponds to an input-supply relation between two product groups. For better visibility, we trim the data by keeping only edges for which the associated input transaction is above 1 percent of a group's total input purchases. This leaves 13.2 percent of the original observations (1,839 edges) which together comprise 89.3 percent of the total input volume. Larger nodes closer to the center of the production network represent product groups supplying inputs to many other product groups. The 10 top input suppliers in terms of value are: (1) livestock products (*Erzeugnisse der Viehwirtschaft*), (2) crude oil, petroleum products (*Erdöl, Erdölprodukte*), (3) electrical energy (*Elektroenergie*), (4) retail services (*Handelsleistungen*), (5) rolled steel products (*Walzstahlerzeugnisse*), (6) non-ferrous metal products (*nichteisenmetallische Erzeugnisse*), (7) crop products (*Erzeugnisse des Pflanzenbaus*), (8) freight transport (*Gütertransportleistungen*), (9) textile raw materials (*Textile Rohstoffe*), (10) services for vehicle production and engineering products (*Materielle Leistungen an Transport- und Fördermitteln, Landmaschinen und an Komplettierungsteilen des Maschinenbaus*).

Figure C4. Residual plots – Privatization Outcomes



Notes. The figure plots the residualized difference between the log employment of a combine in 1988 and the log of the total employment in privatized establishments of the same combine (left panel) and the residualized share of a combine's employment that was privatized (right panel) against the residualized predicted espionage inflow rates. The residualization is based on the specifications in columns 2 and 5 of Panel A in Table 10. The combine Robotron is highlighted in blue color.

Table C1—Labor Outcomes

	Δ Log Wage		Δ Log Cost	Δ Log	
	All	Blue-Collar	White-Collar	Working Time	Down Time
	(1)	(2)	(3)	(4)	(5)
Panel A. OLS					
Espionage	-0.013	-0.010	0.004	-0.009	-0.027
	(0.017)	(0.022)	(0.040)	(0.016)	(0.019)
Observations	263	262	263	263	263
Panel B. IV					
Espionage	-0.044**	-0.046*	-0.092	-0.006	-0.030*
	(0.020)	(0.025)	(0.121)	(0.017)	(0.017)
Observations	263	262	263	263	263

Notes. The dependent variables are the annualized changes in the log wage in column 1, log wage of blue-collar workers in column 2, log of total cost for administration in column 3, log of average actual working time in column 4, and log of average down-time in column 5. Espionage activity is defined as the annualized inflow of espionage information in a period over lagged output. Additional control variables are patenting activity defined as the annualized number of patents in a period over lagged output and sector-year fixed effects. Observations are weighted by the average number of workers in a firm. Standard errors in parentheses are clustered at the firm level: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Table C2—Output Effects By Quality of Espionage Information (OLS)

	Δ Log Output	Δ Log Value Added	Δ Log Labor Productivity	Δ Log Hourly Productivity	Δ Profit Share
	(1)	(2)	(3)	(4)	(5)
Valuable Espionage	0.598***	0.716***	0.529***	0.538***	0.254***
	(0.120)	(0.148)	(0.125)	(0.127)	(0.065)
Non-Valuable Espionage	0.004	0.016	0.044	0.035	0.006
	(0.021)	(0.033)	(0.037)	(0.042)	(0.013)
Observations	263	263	263	263	262

Notes. The dependent variables are the annualized changes in log output at constant prices in column 1, log gross value added in column 2, log labor productivity in column 3, log hourly productivity in column 4, and the profit share column 5. Espionage activity is split according to its assessed value into the annualized inflow of valuable espionage information in a period over lagged output and annualized inflow of non-valuable and undetermined espionage information in a period over lagged output. Additional control variables are patenting activity defined as the annualized number of patents in a period over lagged output and sector-year fixed effects. Observations are weighted by the average number of workers in a firm. Standard errors in parentheses are clustered at the firm level: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Table C3—Output Effects with Past and Future Espionage Information (OLS)

	Δ Log Output	Δ Log Value Added	Δ Log Labor Productivity	Δ Log Hourly Productivity	Δ Profit Share
	(1)	(2)	(3)	(4)	(5)
Espionage t-1	0.680***	0.929***	0.750***	0.798***	0.339***
	(0.172)	(0.213)	(0.225)	(0.215)	(0.075)
Espionage t	-0.047	-0.154	-0.083	-0.172	-0.079
	(0.275)	(0.270)	(0.245)	(0.209)	(0.111)
Espionage t+1	-0.190	-0.240*	-0.194*	-0.137	-0.028
	(0.186)	(0.125)	(0.105)	(0.104)	(0.075)
Observations	263	263	263	263	262

Notes. The dependent variables are the annualized changes in log output at constant prices in column 1, log gross value added in column 2, log labor productivity in column 3, log hourly productivity in column 4, and the profit share column 5. Espionage activity is defined as the annualized inflow of espionage information in a period over lagged output and included for the lagged, current, and leading period. Additional control variables are patenting activity defined as the annualized number of patents in a period over lagged output and sector-year fixed effects. Observations are weighted by the average number of workers in a firm. Standard errors in parentheses are clustered at the firm level: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

TABLE C4—OUTPUT AND PRODUCTIVITY - CONTROLLING FOR DEMAND

	Δ Log Output	Δ Log Value Added	Δ Log Labor Productivity	Δ Log Hourly Productivity	Δ Profit Share
	(1)	(2)	(3)	(4)	(5)
Panel A. OLS					
Espionage	0.677***	0.865***	0.757***	0.763***	0.346***
	(0.169)	(0.166)	(0.183)	(0.176)	(0.066)
Demand	-0.472	-0.715	-0.743	-0.881	-0.520*
	(0.575)	(0.530)	(0.533)	(0.550)	(0.294)
Patenting	0.164***	-0.024	-0.005	-0.031	0.054*
	(0.048)	(0.070)	(0.066)	(0.072)	(0.030)
Observations	263	263	263	263	262
Panel B. IV					
Espionage	0.898*	1.148**	1.343**	1.341**	0.422***
	(0.543)	(0.557)	(0.624)	(0.577)	(0.130)
Demand	-1.191	-1.639	-2.657	-2.769	-0.768**
	(1.805)	(1.792)	(2.225)	(2.076)	(0.384)
Patenting	0.143**	-0.051	-0.061	-0.086	0.047
	(0.071)	(0.090)	(0.102)	(0.103)	(0.030)
AR F-stat (p-value)	0.029	0.006	0.000	0.000	0.010
Effective F-stat	7.00	7.00	7.00	7.00	7.00
Observations	263	263	263	263	262

Notes. The dependent variables are the annualized changes in log output at constant prices in column 1, log gross value added in column 2, log labor productivity in column 3, log hourly productivity in column 4, and the profit share column 5. Espionage activity is defined as the annualized inflow of espionage information in a period over lagged output, demand is defined as the annualized number of information requests over lagged output, and patenting is defined as the annualized number of patents in a period over lagged output (all variables lagged by one period). Additional control variables are sector-year fixed effects. Observations are weighted by the average number of workers in a firm. The effective F-statistic is for the weak instrument test of Montiel Olea and Pflueger (2013). Standard errors in parentheses are clustered at the firm level: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Table C5—Output and Productivity - Including Combine Fixed Effects

	Δ Log Output	Δ Log Value Added	Δ Log Labor Productivity	Δ Log Hourly Productivity	Δ Profit Share
	(1)	(2)	(3)	(4)	(5)
Panel A. OLS					
Espionage	0.637	1.129	1.047	1.080	0.214
	(0.755)	(0.838)	(0.774)	(0.813)	(0.377)
Firm FE	Yes	Yes	Yes	Yes	Yes
Observations	263	263	263	263	262
Panel B. IV					
Espionage	2.517**	2.475***	2.279***	2.322***	0.254
	(1.114)	(0.909)	(0.807)	(0.661)	(0.289)
AR F-stat (p-value)	0.059	0.034	0.024	0.006	0.601
Effective F-stat	3.71	3.71	3.71	3.71	3.73
Firm FE	Yes	Yes	Yes	Yes	Yes
Observations	263	263	263	263	262

Notes. The dependent variables are the annualized changes in log output at constant prices in column 1, log gross value added in column 2, log labor productivity in column 3, log hourly productivity in column 4, and the profit share column 5. Espionage activity is defined as the annualized inflow of espionage information in a period over lagged output. Additional control variables are patenting activity defined as the annualized number of patents in a period over lagged output and sector-year fixed effects. Observations are weighted by the average number of workers in a firm. The effective F-statistic is for the weak instrument test of Montiel Olea and Pflueger (2013). Standard errors in parentheses are clustered at the firm level: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Table C6—Other outcomes (IV)

	(1)	(2)	(3)	(4)	(5)
	Δ Log Output (curr. prices)	Δ Log Gross Value Added (curr. prices)	Δ Log Finished Products (curr. prices)	Δ Log Final Goods for Consumers	Δ Log Exports East (curr. prices)
Espionage	0.599**	0.775***	0.788***	-0.168	0.526**
	(0.260)	(0.292)	(0.291)	(0.302)	(0.254)
Observations	263	263	262	260	233
	Δ Log Exports West (curr. prices)	Δ Log Exports SU (curr. prices)	Δ Share Final Goods	Δ Share Exports East	Δ Share Exports West
Espionage	0.582	1.441**	-0.000	-0.019	0.047
	(0.588)	(0.568)	(0.015)	(0.041)	(0.038)
Observations	235	200	228	217	225
	Δ Log Labor Productivity (output)	Δ Log Labor Productivity (value added, curr. prices)	Δ Log Hourly Productivity (output)	Δ Log Hourly Productivity (value added, curr. prices)	Δ Log Gross Capital Productivity (output)
Espionage	0.725**	0.801**	0.707**	0.780**	0.787***
	(0.302)	(0.324)	(0.292)	(0.307)	(0.300)
Observations	263	263	263	263	263
	Δ Log Gross Capital Productivity (output, curr. prices)	Δ Log Investment Total	Δ Log Investment Structure	Δ Log Investment Equipment	Δ Log Gross Total Capital Stock
Espionage	0.863***	1.403***	3.375***	0.884***	-0.088
	(0.332)	(0.453)	(1.098)	(0.307)	(0.105)
Observations	263	263	262	263	263
	Δ Log Gross Equipment Capital Stock	Δ Share Investment Structure	Δ Share Investment Equipment	Δ Share Investment Completed	Δ Share Investment Rationalization
Espionage	0.129	0.408**	-0.393***	-0.356	-0.688**
	(0.132)	(0.160)	(0.143)	(0.336)	(0.284)
Observations	263	262	263	263	263
	Δ Log Total Wage Bill	Δ Log Contracted Working Time	Δ Share Blue-Collar Employment	Δ Share White-Collar Employment	Δ Log Gross Capital Stock per Worker
Espionage	-0.071	-0.009	0.005	0.005	-0.062
	(0.067)	(0.015)	(0.011)	(0.014)	(0.084)
Observations	263	263	262	263	263
	Δ Log Total Cost	Δ Share Intermediate Inputs			
Espionage	0.487**	0.011			
	(0.207)	(0.040)			
Observations	262	125			

Notes. The definition of each dependent variable is specified above each estimate. "Output" refers to the total industrial goods production (*Industrielle Warenproduktion*), "Finished Products" refers to the value of finished products sold (*Realisierte finanzgeplante Warenproduktion*). The distinction between "output" and "value added" in parentheses specifies the variable with respect to which productivity is computed. Espionage activity is defined as the annualized inflow of espionage information in a period over lagged output. Additional control variables are patenting activity defined as the annualized number of patents in a period over lagged output and sector-year fixed effects. Observations are weighted by the average number of workers in a firm. Standard errors in parentheses are clustered at the firm level: * p<0.10, ** p<0.05, *** p<0.01.