Economics Letters 241 (2024) 111826

Contents lists available at ScienceDirect

Economics Letters

journal homepage: www.elsevier.com/locate/ecolet

Short and medium-term effects of foreign acquisitions on manufacturing firms: Evidence from Germany☆

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ARTICLE INFO

JEL classification:
F23
F61

Keywords:
Foreign direct investment
Foreign acquisitions
Firm behavior
Ex-post evaluation

ABSTRACT

This paper, for the first time, investigates the impact of foreign acquisitions on German manufacturing firms using, newly available unique administrative micro data spanning 25 years. Based on an event study design combined with propensity score matching techniques, we find that foreign acquisitions significantly increase labor productivity and average wages in acquired firms. A reduction in employment drives both effects.

1. Introduction

Germany's economy, particularly its manufacturing sector, is deeply integrated into the global economy. This shows itself through high export and import activity but also through foreign direct investments (FDI). For instance, the FDI stock in Germany reached approximately 1000 billion USD in 2021 (cf. United Nations Conference on Trade and Development (2023)). Despite the significance of foreign investments, little is known about their specific impacts on acquired companies. How does their competitive position evolve? What happens to employment levels, and how do wages develop? Against the backdrop of a potential disintegration of the global economy, e.g., due to political instabilities or security considerations, these already critical questions gain even greater significance. This paper contributes to answering these questions.

We investigate the response of firm-level measures of economic performance – productivity, output, employment and average wages – to an inflow of foreign investment through an acquisition of a domestic firm by a foreign owner. The analysis is based on comprehensive, new and unique firm-level panel data for Germany, covering 25 years from 1995 until 2019. We implement an event study design, which we combine with propensity score matching techniques, in order to identify the effects of foreign acquisitions at the firm level.

Our paper makes three contributions: First, we estimate the effect of foreign investment on German manufacturing firms. There are related papers looking at the effects of cross-border M&As or FDI more broadly on firm performance in the context of other countries, also using similar methods (e.g. Arnold and Javorcik (2009), Criscuolo and Martin (2009), Guadalupe et al. (2012), Girma et al. (2015), Arnold et al. (2023)).[1] However, comparable evidence for Germany is scarce.[2]

☆ The project generating the dataset used in this paper has been contracted by and received funding from the German Federal Ministry for Economic Affairs and Climate Action. We thank the Research Data Center (RDC) the Federal Statistical Office and the Research Data and Service Centre (RDSC) of the Bundesbank for granting us access to the micro-data. The specific project title in the data usage agreement with the Bundesbank is "Evaluating the impact of foreign acquisitions in Germany (Project ID 2023/0047)". All results in this paper were generated via Controlled Remote Execution. Jakob Lehr acknowledges additional funding through the German Research Foundation (DFG) through CRC TR 224 (Project B07).

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[1] Literature also looks at the impact of inward FDI on aggregate productivity and performance more generally (cf. Görg and Greenaway (2004), Greenaway and Kneller (2007), Keller (2024)).

[2] The most notable exceptions are Wagner and Weche-Gelübcke (2015) and Weche-Gelübcke (2015) who look at the impact of foreign acquisitions on access to finance, and employment and productivity of target firms respectively. They use data for 2007 to 2010. Their definition of foreign ownership is based on Foreign Affiliate Statistics (FATS) for Germany, which only includes majority foreign owned firms. Our definition is based on foreign investments equivalent to at least a 10 percent ownership share (see Kruse et al. (2023) for a discussion). More importantly, our data cover a much longer time period allowing us to consider also medium to long run effects. Moreover the data we use are available for approved researchers at the Research Data and Service Centre at the Bundesbank and the Research Data Centre of the Federal Statistical Office.

https://doi.org/10.1016/j.econlet.2024.111826
Received 15 April 2024; Received in revised form 18 June 2024; Accepted 18 June 2024
Available online 21 June 2024
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Filling this gap is particularly important given the degree of openness of the German economy, its size, level of technology, and its role as Europe's industrial powerhouse.

Second, we conduct our analysis linking, for the first time, two large administrative micro datasets: the German census of the manufacturing industry provided by the German Federal Statistical Office and the Microdatabase Direct Investment collected by the German Bundesbank. The link between the two datasets has been established only recently, and we are the first to exploit this new and unique database. With this data, spanning 25 years, we are able to estimate short and medium-term effects of foreign acquisitions. Generally, studies as the ones cited above only look at short run effects.

Third, we employ an empirical specification that recognizes recent advancements in the difference-in-differences literature, which might be particularly relevant in our setting given the staggered treatment adoption. We implement the event study estimator proposed by Sun and Abraham (2021), combining it with propensity score matching techniques to estimate the causal effects of acquisitions on firms.

Our results show that foreign acquisitions lead to a strong and lasting increase in labor productivity and average wages. For instance, over an eight-year period following the takeover, average labor productivity and wages increase by 5% and 2%, respectively, in acquired firms compared to the control group. Both effects are driven by firms reducing employment while maintaining a constant output level and only moderately decreasing total labor costs. Effects are robust to a variety of alternative specifications.

2. Data

We can, uniquely, combine the German census of the manufacturing industry with the Microdatabase Direct Investment – MiDi – to investigate the effect of foreign acquisitions on German firms.[3] The census data spans the period 1995–2019 and covers the population of manufacturing firms with at least 20 employees. It contains basic information on firms' characteristics, like the economic sector, and measures of economic performance, such as gross output, the number of employees and the total wage bill. The MiDi database contains comprehensive information on foreign investments in Germany at the investment-firm-year level, starting in 1999.[4] The data cover the universe of FDI, subject to two reporting thresholds: firstly, the balance sheet total of the German firm receiving the investment has to exceed 3 million Euros; secondly, the investor must own at least 10% of the voting rights in the German company.

We combine the two datasets using common firm identifiers and define a foreign-ownership dummy equal to one if the firm appears in the MiDi data. To ensure that a switch of the foreign-owned dummy from 0 to 1 captures a real change in the firm's ownership status, rather than an already foreign-owned firm trespassing the 3 million Euro threshold, we exclude all firms with a balance sheet total of less than four million euro in the first year they appear in MiDi.[5] We also exclude all firms in foreign ownership in 1999, the first year of MiDi.

3. Empirical approach

We employ an event study specification to identify the effect of foreign acquisitions on German firms. The central identifying assumption requires treated firms' counterfactual trends in outcomes to be parallel to trends in the control group. While parallel trends prior to treatment yield strong support for this assumption, we aim to further increase confidence in the parallel trends assumption by choosing a control group similar to the treatment group concerning the distribution of covariates. To achieve this, we use propensity score matching techniques.[6]

Specifically, each firm acquired by a foreign investor in $t+1$ gets paired with a domestic firm based on the firm's propensity score (1:1 matching), which we predict from a logistic regression of a dummy indicating a foreign acquisition on 3-digit-sector dummies, year dummies, the logs of the number of employees, the average wage, labor productivity (measured as output per worker) as well as output and wage growth. All variables relate to two years prior to acquisition.

We then estimate the following event study equation on the matched sample:

$$y_{itc} = \beta_0 + \sum_{j=-4}^{8} \beta^j D_{i,t}^j + \tau_{tc} + \phi_i + \xi_{itc} \quad (1)$$

The dependent variable, y_{itc}, can be any outcome of firm i at time t. The subscript c indicates the cohort, i.e., the year the firm was acquired or matched as a control. We are interested in the vector of coefficients β on the event indicators $D_{i,t}^j$. The coefficient for the last year before the acquisition ($j = -1$) is normalized to zero, and therefore, all estimates are to be interpreted relative to that year. The coefficients for years prior to takeover ($j < 0$) test pre-trends while the coefficients ($j \geq 0$) capture the post-acquisition dynamics. The effects are estimated conditional on the time-cohort fixed effect τ_{tc} and the firm fixed effect ϕ_i. While the latter absorbs all time-invariant firm characteristics, τ_{tc} controls for time effects by cohort of treated and control firms. Finally, ξ_{itc} is a random disturbance term.

We follow Abadie and Spiess (2022) and cluster standard errors at the level of the matched pairs. We also recognize recent advancements in the difference-in-differences and event study literature (de Chaisemartin and D'Haultfœuille, 2020; Goodman-Bacon, 2021; Sun and Abraham, 2021; Callaway and Sant'Anna, 2021) and employ the event study estimator suggested by Sun and Abraham (2021).[7]

4. Descriptive statistics

Panel A of Table 1 provides summary statistics of main variables for the full sample. This contains over 900,000 firm-year observations from 1995 to 2019. Panel B shows summary statistics for firms acquired by a foreign investor, and Panel C for the matched controls (figures for both groups come from the year firms were taken over/matched). Comparing Panel A and Panel B, it is notable that foreign investors pick larger and more productive firms. Panel C shows that the matching successfully homogenizes the estimation sample: acquired firms and their matched controls are of similar size – in particular medians are closely aligned – and also productivity proxies are of comparable magnitude.

Fig. A.1 in the appendix provides background information on the origin of investors and the number of takeovers in each year from the post-matching sample.

[3] For further information on the Microdatabase Direct Investment, see Friederich et al. (2021) and Blank et al. (2020) (DOI: 10.12757/Bbk.MiDi.9920.09.09). The specific dataset for the manufacturing industry has been compiled for this project and is not a standard data product offered by the Research Data Centers of the Federal Statistical Office. This project-based dataset combined NACE Rev. 2 sections B-F: including mining and quarrying, manufacturing, energy and water supply, as well as construction. It is derived from the RDC products AFiD-Panel Industrieunternehmen (DOI: 10.21242/42221.2021.00.01.1.1.0), AFiD-Panel Unternehmenstrukturstatistiken (DOI: 10.21242/42231.2020.00.05.1.1.0) and AFiD-Panel Energieunternehmen (DOI: 10.21242/43221.2021.00.01.1.1.0). For the combined data set cf. also Boddin et al. (2024).

[4] A firm can thus appear multiple times annually if it has received more than one foreign investment. In this case, we aggregate to the firm level to have one firm observation per year.

[5] A change in the foreign-owned dummy can indicate an FDI shock along the extensive or the intensive margin, given that it might reflect a crossing of the voting-right threshold. It is standard practice in this literature, though, to define a firm as foreign if the share of foreign ownership exceeds 10% (cf. Bajgar and Javorcik (2020)). In practice, most ownership shares are much higher, suggesting that changes happen mainly along the extensive margin.

[6] PSM techniques have been used extensively in this literature, see Girma and Görg (2007), Arnold and Javorcik (2009), Guadalupe et al. (2012), Brucal et al. (2019).

[7] We use the Stata command eventstudyinteract which implements the estimator suggested by Sun and Abraham (2021).

Table 1
Summary statistics.

	Mean	Sd	p50	p10	p90	N
A. Full Sample						
Gross Output (in 1000€)	48 237.74	722 988.78	7789.09	1994.44	63 602.36	924 391
# Employees	170	1438	57	26	283	924 391
Average Wage (in 1000€)	35.58	15.43	33.25	17.00	56.42	924 391
Investment (in 1000€)	1671.10	25 359.55	180.46	8.62	2195.14	924 391
Gross Output/# Employees	181.16	399.89	130.84	53.58	322.52	924 391
B. Firms Taken Over						
Gross Output (in 1000€)	57 502.29	154 182.98	25 476.11	8562.27	122 605.23	1354
# Employees	218	306	134	50	434	1354
Average Wage (in 1000€)	39.31	11.57	37.83	26.11	53.91	1354
Investment (in 1000€)	1975912.6	5253759.9	654 821.31	85 696	4 069 002	1354
Gross Output/# Employees	261.66	289.80	186.89	96.93	466.30	1354
C. Control Firms						
Gross Output (in 1000€)	63 628.8	137 233.58	23 364.35	6081.98	135 089.03	1354
# Employees	249	479	128	43	506	1354
Average Wage (in 1000€)	38.86	11.33	37.97	25.82	53.29	1354
Investment (in 1000€)	2135069.3	6180518.3	521 790.33	47 520.67	4575142.5	1354
Gross Output/# Employees	244.48	282.13	175.37	92.56	445.12	1354

Notes: Part A of the Table shows summary statistics for the main variables from all observations pooled across years. Parts B and C of the Table show summary statistics from the matched sample, separately for treated firms (Part B) and the matched control firms (Part C) from the year firms were matched. Source: Research Data Centre of the Federal Statistical Office and Research Data and Service Centre (RDSC) of the Deutsche Bundesbank: Project-specific Data based on the Census of Manufacturing Industry (1995–2019) and Microdatabase Direct Investment (1999–2019), own calculations.

(a) Log of GO **(b)** Log of # Worker **(c)** Log of Wagebill

(d) Log Average Wage **(e)** Log of GO/Worker

Fig. 1. Main results: Event Study Estimates.

Notes: Figures a–e show event study estimates from the matched sample following the approach by Sun and Abraham (2021). . (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)
Source: Research Data Centre of the Federal Statistical Office and Research Data and Service Centre (RDSC) of the Deutsche Bundesbank:Project-specific Data based on the Census of Manufacturing Industry (1995–2019) and Microdatabase Direct Investment (2000–2019), own calculations.

5. Results

Subfigures a–e in Fig. 1 plot the main results from the baseline event study specification shown in Eq. (1). The number of observations in the estimation sample is 54,055. All estimates show the differential evolution in outcomes in the treatment group relative to the control group and the year prior to the acquisition. In the plots, the vertical gray line indicates the acquisition time and the shaded blue areas demarcate the 95th confidence intervals.

Fig. 1(a) plots the results with the log of gross output on the left-hand side. Reassuringly, all pre-treatment coefficients are close to zero and statistically insignificant, both individually and jointly. The point estimates for the post-period indicate an increase in output during the first two to three years after the ownership change. These positive effects fade away quickly, as indicated by the statistically insignificant coefficients in later years. In fact, we cannot reject the null hypothesis that all post-coefficients are jointly statistically insignificant.

Subfigure b proceeds with the effect on employment: again, pre-trends are flat and indistinguishable from zero. By contrast, all post-treatment coefficients are negative, increasing over time and jointly significant. For example, two years after a firm was acquired, employment is 2% lower among treated firms relative to the matched control

Table 2
Effect of acquisitions by region of investment origin.

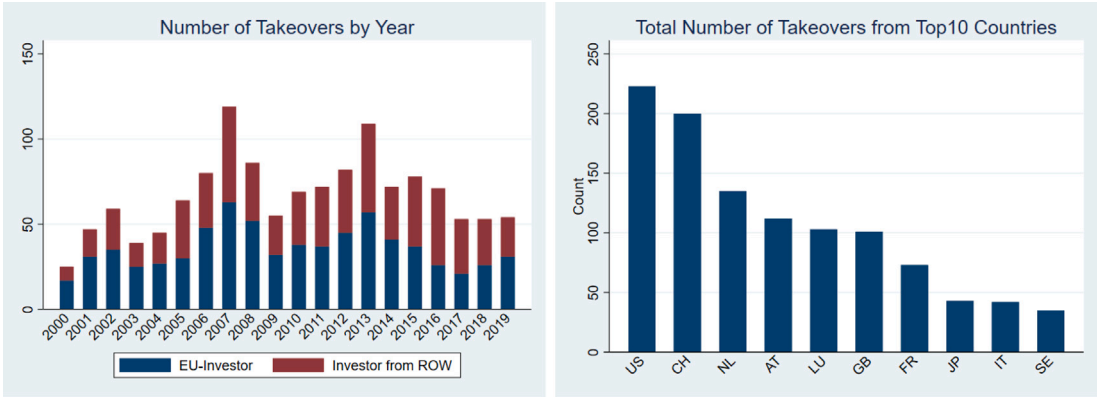
Post treatment					
	Log of Go	Log of #Worker	Log of Wagebill	Log of Wage	Log of GO/Worker
EU	−0.0056	−0.0706***	−0.0552***	0.0154**	0.0650***
	(0.0221)	(0.0173)	(0.0184)	(0.0079)	(0.0162)
ROW	−0.0061	−0.0152	−0.0000	0.0152*	0.0091
	(0.0248)	(0.0177)	(0.0200)	(0.0084)	(0.0183)
Pre treatment					
EU	0.0092	0.0094	0.0083	−0.0012	−0.0002
	(0.0158)	(0.0120)	(0.0124)	(0.0065)	(0.0123)
ROW	0.0048	0.0007	0.0004	−0.0003	0.0041
	(0.0180)	(0.0129)	(0.0133)	(0.0067)	(0.0131)

Notes: The Table reports the joint pre- and post-takeover coefficients from the event study estimates on a matched sample. The number of observations in the EU-takeover sample is 24,968 and 21,074 in the ROW sample. Source: Research Data Centre of the Federal Statistical Office and Research Data and Service Centre (RDSC) of the Deutsche Bundesbank: Project-specific Data based on the Census of Manufacturing Industry (1995–2019) and Microdatabase Direct Investment (2000–2019), own calculations.

* Significance levels is indicated as $p < 0.1$.

** Significance levels is indicated as $p < 0.05$.

*** Significance levels is indicated as $p < 0.01$.



(a) Takeover Count by Year (b) Top 10 Countries

Fig. A.1. Takeovers in the post-matching sample.
Notes: Subfigure (a) reports the number of takeovers per year in the matched sample, separately for takeovers from an investor based in an EU country (blue) and the rest of the world (red). Subfigure (b) shows the number of takeovers in the estimation sample for the ten countries of investment origin. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)
Source: Research Data Centre of the Federal Statistical Office and Research Data and Service Centre (RDSC) of the Deutsche Bundesbank: Project-specific Data based on the Census of Manufacturing Industry (1995–2019) and Microdatabase Direct Investment (2000–2019), own calculations.

firms; and eight years after the takeover, employment has been reduced relative to control firms by 8%. The post-treatment effects are jointly highly significant and indicate an overall reduction in employment as a consequence of the takeover by 4%.

A negative effect on the wage bill, i.e., the sum of all wages, as shown in Subfigure c, reflects the decline in employment. In the years immediately after treatment, the wage bill remained stable and only dipped four years after the takeover. The joint effect of the post-coefficients implies a 2% reduction in labor costs, albeit statistically insignificant.

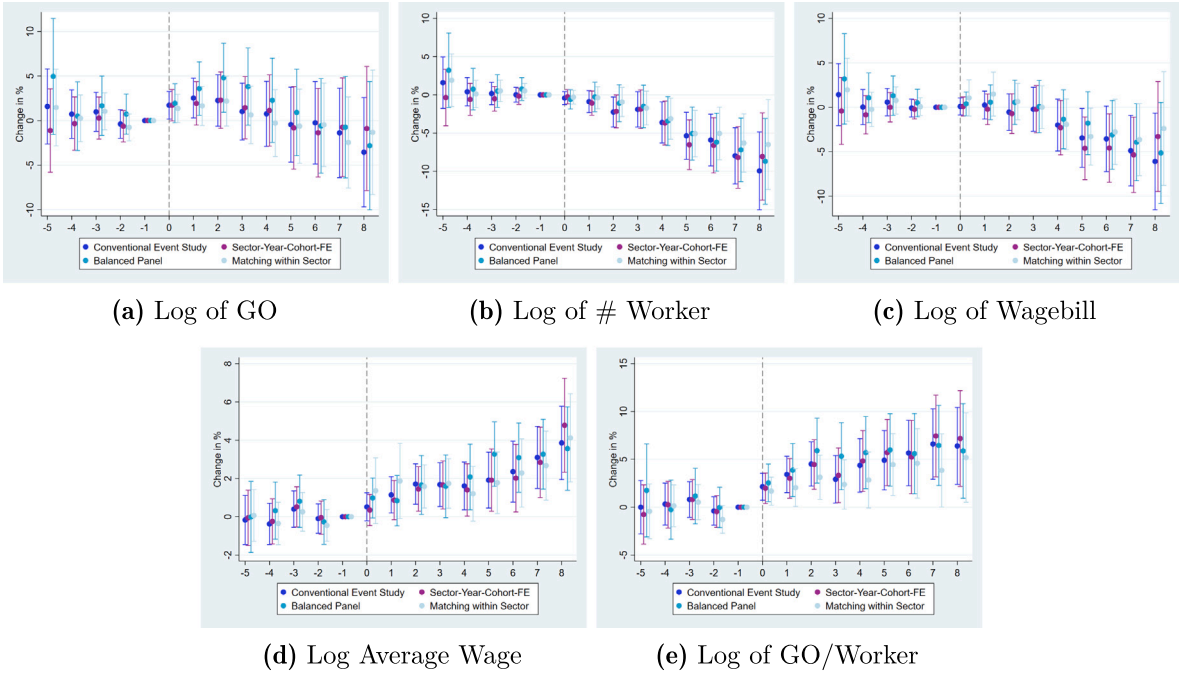
We find an immediate increase in gross output per worker and the average wage (Subfigures d and e). In the first year after the takeover, gross output per worker increased by almost 3.5% and wages are about 1% higher relative to the control group. These effects grow larger over time, with all post-coefficients being individually significant. Jointly, the post-coefficients indicate a 2% increase in the average wage and a 5% increase in gross output per worker.

We check the robustness of our results towards alternative specifications. Fig. A.2 in the appendix plots the estimates for all outcomes from four alternative specifications: a conventional event study ignoring recent refinements to the difference-in-differences framework, our baseline specification with year-cohort-sector fixed effects instead of year-cohort fixed effects only, the baseline specification estimated on a balanced panel and finally an exact matching within economic sectors.[8] Results are robust towards the choice of the empirical specification.

We split the sample of treated firms into those whose investor is from an EU country and those with an investor from the rest of the world. Table 2 reports the subsample results; the joint coefficients from the post-treatment years are in the upper part of the Table, and the lower part of the Table reports the joint pre-treatment coefficients. Reassuringly, all pre-treatment coefficients are small and statistically insignificant and thus support the parallel trends assumption.

It is evident from the Table that EU countries drive the main results, as shown in Eq. (1). The average reduction in employment after an investment from an EU country over the 8-year post-treatment event window is 7%. This estimate is 3% larger than in the main results. Moreover, we also find a substantial and highly significant reduction in the wage bill. Nonetheless, average wages increase by about 1.5% after an acquisition, and we also find a positive effect on labor productivity.

[8] We use the same propensity score as in the baseline specification and then match within two-digit industries, enforcing common support within each industry.



(a) Log of GO (b) Log of # Worker (c) Log of Wagebill

(d) Log Average Wage (e) Log of GO/Worker

Fig. A.2. Robustness: Alternative specifications.

Notes: Each subfigure reports results for one outcome from four different empirical specifications: a conventional event study as opposed to the approach by Sun and Abraham (2021), a specification with year-cohort-sector fixed effect, a balanced panel specification and an alternative matching, i.e., matching within economic sectors. The number of observations varies by specification and is, in the above order, 54055, 51978, 27098, 53365. The dots in the figures mark the point estimates, and the vertical lines show the 95th confidence intervals, with standard errors clustered at the level of the matched pairs. Source: Research Data Centre of the Federal Statistical Office and Research Data and Service Centre (RDSC) of the Deutsche Bundesbank: Project-specific Data based on the Census of Manufacturing Industry (1995–2019) and Microdatabase Direct Investment (2000–2019), own calculations.

The effects of acquisitions from the rest of the world are all sign-consistent with the main effects but smaller and insignificant except for the effect on average wages.

6. Conclusion

This paper presents first evidence on the effect of foreign acquisitions on German manufacturing firms based on newly available unique administrative micro data covering two and a half decades. We find that acquired firms experience a positive and lasting boost to productivity: Output per worker increases by about 5%, and average wages by roughly 2% compared to the control group. The effects are mainly due to investments from other EU countries. The increase in productivity results from a reduction in employment and overall labor costs while maintaining the same output level. This mechanism might be most relevant in countries close to the technological frontier, such as Germany, whereas upgrading technology after a takeover presumably plays a larger role in developing countries for any positive effects on productivity. From a policy point of view, our results suggest that foreign acquisitions can benefit the economy by increasing aggregate productivity and improving competitiveness. This, however, may come at the expense of somewhat lower employment.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

Appendix

See Figs. A.1 and A.2

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