Review of Economic Studies (2026) **0**, 1–0 doi:10.1093/restud/rdaa002

Monopsony Makes Firms not only Small but also Unproductive: Why East Germany has not Converged

RÜDIGER BACHMANN
University of Michigan, CEPR, CESifo, ifo, and IZA,
E-mail: rudib@umich.edu
CHRISTIAN BAYER
Rheinische Friedrich-Wilhelms-Universität Bonn, CEPR, CESifo, and IZA,
E-mail: christian.bayer@uni-bonn.de
HEIKO STÜBER
Hochschule der Bundesagentur für Arbeit, IAB, and IZA,
E-mail: Heiko.Stueber@arbeitsagentur.de
FELIX WELLSCHMIED:
Universidad Carlos III de Madrid and IZA, E-mail: fwellsch@eco.uc3m.es

When employers face a trade-off between being large and paying low wages—and in this sense have monopsony power—some productive employers decide against building large business networks, forgo sales, and remain small. These decisions have adverse consequences for aggregate labor productivity. Using high-quality administrative data from Germany, we document that East German plants (compared to West German ones) face steeper size-wage curves, invest less in their business networks, remain smaller, and are less productive. A model with labor market monopsony, product market power, and business network investments matching these features of the data predicts a ten percent lower aggregate labor productivity in East Germany.

Key words: aggregate productivity, plant heterogeneity, collective bargaining, monopsony power, size-wage curve, business networks, customer capital, size distortions
JEL: E20, E23, E24, J20, J42, J50

1. INTRODUCTION

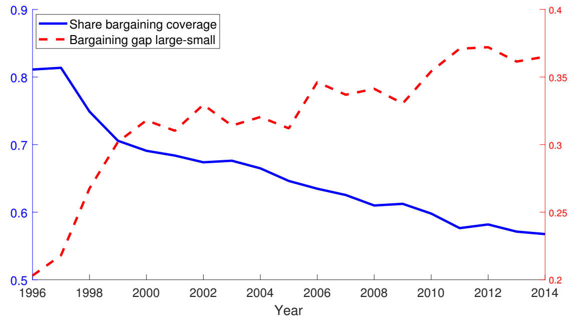
Union membership around the world has declined. This decline did not happen uniformly but was most pervasive at small plants. Figure 1 shows this for Germany, where the collective bargaining gap between small and large plants roughly doubled between 1996

The editor in charge of this paper was Kurt Mitman.

and 2014, the year before Germany introduced a national minimum wage. Workers in large plants used to be 20 percentage points more likely to be covered by a collective bargaining agreement, and that difference has risen to 37 percentage points. Importantly, as union-/collectively-bargained wages are higher, non-uniform union retrenchment effectively leads to firms facing a steeper size-wage trade-off and, in this sense, to more monopsony power.

FIGURE 1

Non-uniform union retrenchment



Notes: The figure displays the share of workers covered by collective bargaining (share bargaining coverage, left axis) and the difference in the probability of a worker to be covered by collective bargaining at plants with at least 250 employees relative to workers at plants with fewer employees (Bargaining gap, right axis). Data is for all of Germany, private non-primary sector. Data source: *IAB Establishment Panel*, IAB (2019).

In the communist German Democratic Republic, trade unions represented party, not worker interests. As a consequence, after reunification, union membership fell dramatically (see Schnabel, 2005); most pronounced at small plants. As a result, East Germany has a particularly strong concentration of collective bargaining in large plants compared to West Germany and, consequently, the size-wage curve is steeper in East than in West Germany. At the same time, East and West Germany share the same legal and, by and large, cultural institutions. Therefore, the East and West German comparison provides a good laboratory to study how firms' employment and business strategy decisions respond to monopsony power in the labor market and how this influences aggregate productivity.

We use this variation in size-wage curves to show that stronger monopsony power creates incentives for firms in East Germany to choose small-scale business models when they start up. Consequently, even the most productive firms hire relatively few workers and create smaller business networks, i.e., they acquire fewer customers. Monopsony power, thus, distorts firms' investment decisions in their business models at entry. This distortion creates a compressed size distribution of firms in East Germany and sizable aggregate productivity effects. Thirty years after the German reunification, labor productivity and wages remain about 25 percent lower in East Germany, and the disincentives from a steeper size-wage curve explain at least ten percentage points of this gap.

We arrive at this conclusion by employing high-quality administrative wage data and a new calibrated heterogeneous-firm model. We document that, in the data, aggregate and industry differences in labor productivity and wages are systematically related to the absence of large plants in East Germany.[1] The share of employment at large plants with more than 249 employees is almost twice as large in the West. This difference is manifest already at plant entry and persists. In industry-level data, there is a positive correlation between missing large plants and the East-West productivity/wage gap. For example, vehicle manufacturing has both a particularly large East-West gap in labor productivity (36%) and in the concentration of employment at large plants (21 percentage points), while construction has a smaller labor productivity gap (14%) and virtually the same employment concentration at large plants in East and West Germany. Moreover, we show that East German firms invest less in business networks.

For these findings, wage data provide an explanation: The plant size elasticity of wages is one fifth larger in East Germany relative to West Germany and this, in turn, is explained by larger differences in collective bargaining between large and small plants in East Germany. Exploiting again differences across industries, we show that industries with steeper size-wage curves in the East are also industries with particularly low average wages and particularly many missing large plants, which is again already manifest at entry. What is more, industries that face particularly steep size-wage curves in East Germany have particularly small customer networks and investments in them.

To quantify the effects of a steeper size-wage trade-off on the plant/firm size distribution and aggregate labor productivity, we employ a Melitz (2003)-type heterogeneous-firm model with variety-loving final-good bundlers. To this model, we add customer acquisition (in the spirit of Sedláček and Sterk, 2017; Arkolakis, 2010) and labor market power (as in Berger, Herkenhoff, and Mongey, 2022). Given that the effects of the size-wage curves are manifest already at entry, we model long-run optimal firm decisions in a static framework, which also allows us to characterize the solution in closed form. In our model, firms first decide about market entry; second, conditional on entry, they learn their productivity and decide on investments in their business network. Third, firms hire labor and produce, facing both a size-wage and an output-price trade-off. We show that monopsony power affects all of these decisions. As it increases profits, it boosts firm entry, but it also incentivizes firms to choose a smaller-scale business model.

We also show that the effects of labor market monoposony power on business model choice dominate those on entry, leading to less efficient production networks, as variety-loving final-good bundlers bundle from fewer firms. In addition, monopsony power works through a labor allocation channel: Reallocating labor from more to less productive firms, it compresses the employment distribution.

We calibrate the model, implicitly assuming single-plant firms, to the average plant size and the share of large plants in West Germany. Imposing the steeper size-wage curve from East Germany as a menu for the firms in our model to choose from reduces aggregate labor productivity by ten percentage points. Smaller business networks explain half of this number, labor reallocation to less productive firms explains the other half. Moreover, we show that collective bargaining differences explain almost all the model-implied productivity loss. In addition, untargeted, the model, parsimoniously, replicates the plant size distribution in East Germany closely. For manufacturing, where East-West differences in plant size, the size-wage trade-off, and aggregate productivity are particularly pronounced, the calibrated model explains 18 percentage points lower productivity in East Germany. Finally, we also show that size wage-curve differences have narrowed between East and West Germany over time, that in line with this the

1. Most firms are essentially single-plant, and our data is of high quality at the plant level.

differences in entry size shrunk, and that convergence in labor productivity and wages has accelerated.

The paper proceeds as follows: First, we review the literature. Then, Section 2 discusses our data sets. Section 3 provides the empirical analysis. Section 4 introduces our model, and Section 5 discusses its quantitative implications. Section 6 concludes. We relegate additional material to a number of appendices, in particular a discussion of alternative explanations for East-West differences in aggregate labor productivity (Appendix A) and plant size (Appendix B).

Literature. First, our paper is related to the literature that explains aggregate productivity losses as a result of too little employment at the most productive plants. For example, Hsieh and Klenow (2014) and Braguinsky, Branstetter, and Regateiro (2011) take the relatively slow growth of plants/firms as evidence of high (implicit) taxes on growing large and quantify the resulting productivity loss. More recently, the literature, like our paper with collective bargaining, starts from existing institutions like firing protections and links them to aggregate productivity losses caused by their effects on the plant/firm size distribution. Examples include Garicano, Lelarge, and Van Reenen (2016) and Cingano, Leonardi, Messina, and Pica (2016). Our paper highlights a new force behind productivity losses from a compressed plant/firm size distribution: steeper size-wage trade-offs.

As we have argued, steeper size-wage trade-offs result in a form of monopsony power that firms have when choosing the size of their business network. Recently, Berger et al. (2022) have also highlighted monopsony power as a force that reallocates labor from more to less productive firms. Their focus is on the employment decisions given a firm's business model, while ours is on a distortion affecting the long-term choice of the business model itself.[2] Consequently, they use fluctuations in corporate taxes as shifters of labor demand to identify monopsony power. In our case, higher wages at larger firms do not arise directly as a means to attract more workers but indirectly from an increased incidence of collective bargaining. We view both perspectives on monopsony power as complementary.

Second, our paper relates to the large literature on productivity (non-)convergence between countries in general (see Johnson and Papageorgiou, 2020, for a recent survey), as well as former socialist countries in particular (see Svejnar, 2002, for a survey). We study non-convergence within a country and, thus, non-convergence within the same legal framework.[3] Our focus, therefore, differs from those earlier studies that examine the challenges faced by other former socialist countries which had to build their own strong legal institutions. Studying non-convergence within a country has the additional advantage that we can use high-quality micro data with common measures of factor inputs across the regions.

Non-convergence within Germany has drawn attention in the literature, particularly because convergence had been expected after reunification (see Boltho, Carlin, and Scaramozzino, 1997), given the same (high-quality) institutions in East and West Germany. On the other hand, Becker, Mergele, and Woessmann (2020) and Sleifer

2. In addition to this more conceptual difference relative to Berger et al. (2022), we focus on monopsonistic, as opposed to oligopsonistic, competition. What is more, we restrict the analysis to allocative effects, abstracting from normative efficiency questions.

3. Non-convergence can also be found in other countries (Italy's "Mezzogiorno", the US' "Rust-belt", etc.). What makes the German case of regional non-convergence particularly interesting is that there is a well-defined starting date from which onward we should expect convergence (October 3, 1990), a point made by Uhlig (2006).

(2006) show that East Germany has been nine percent poorer before World War II, and, therefore, full convergence should perhaps not be expected. Today, however, the discrepancy is, with 25 percent, much larger. We explain 40% of today's productivity difference between the two regions or two-thirds of its post World War II increase. Snower and Merkl (2006) study unemployment differences between East and West Germany and relate them to government transfers. Regarding convergence in labor productivity, Burda (2006) emphasizes the role of capital accumulation frictions for the slow convergence between the two regions. While capital accumulation has played an important role for convergence right after the reunification, it cannot explain the persistent differences between East and West Germany (see Appendix A). Uhlig (2006) shows that initial conditions, i.e., at reunification, may be self-perpetuating when agglomeration effects in production networks are important. In our model, differences in business networks also play a role. They arise, however, endogenously from differently steep size-wage curves that reduce the average productivity of a job. In fact, using cross-border worker mobility, Fuchs-Schündeln and Izem (2012) find that job, in contrast to worker, characteristics explain lower wages in East Germany. Using matched employer-employee data, Heise and Porzio (2021) document a low mobility of German workers across the two parts of the country. What is more, they also find that worker productivity differences between East and West Germany explain little of the overall productivity difference. While their paper takes these plant productivity differences as given and explains why *worker mobility* does not remove East-West German wage differences, our paper explains why plant/firm labor productivity is lower in East Germany, and *firm entry* does not remove these wage differences, either. We, thus, view both papers as complementary.

In terms of model ingredients, our paper marries two literatures. There is a large literature concerned with the labor market effects of monopsony power (Jäger, Roth, Roussille, and Schoefer, 2024; Lamadon, Mogstad, and Setzler, 2022; Berger, Herkenhoff, and Mongey, 2022; Card, Cardoso, Heining, and Kline, 2018; Manning, 2011, 2003; Burdett and Mortensen, 1998). We, by contrast, highlight that monopsony power also distorts long-run investment decisions, e.g., in establishing business networks, through which firms acquire customers. Customer acquisition, in addition to differences in technical productivities, is another force the literature has highlighted to explain the size distribution of plants/firms (see Einav, Klenow, Levin, and Murciano-Goroff, 2021; Sedláček and Sterk, 2017; Gourio and Rudanko, 2014; Drozd and Nosal, 2012; Arkolakis, 2010). We show that, combined with a love-of-variety-in-production argument (see, e.g., Bilbiie, Ghironi, and Melitz, 2012), less customer acquisition leads to lower aggregate labor productivity in a framework with monopsony power in the labor market.

Lastly, our paper also relates to the literature on minimum wages and monopsony power (see Dube and Lindner, 2024, for a recent survey). This literature usually points out that minimum wages reduce employers' monopsony power and can increase aggregate employment (see Azar, Huet-Vaughn, Marinescu, Taska, and Von Wachter, 2024, for a recent example). We abstract from aggregate employment effects and, instead, highlight that reducing monopsony power increases aggregate productivity by reallocating employment to more productive firms and by increasing business networks which increase productivity for all firms. These predictions are consistent with Dustmann, Lindner, Schönberg, Umkehrer, and vom Berge (2022) who show that the introduction of a national minimum wage in Germany in 2015, indeed, led to reallocation of workers to more productive plants. They are also consistent with Ku (2022) and Coviello, Deserranno, and Persico (2022) who both find that minimum wages do increase firm-level productivity.

2. DATA

For our analysis, we use administrative aggregate, industry-level, and micro data at the regional level. We focus on the private, non-primary sector (industries 10 to 82 in the German WZ2008 industry classification system). Specifically, we use German national income and product accounts data, *Volkswirtschaftliche Gesamtrechnung (VGR)*, to compute labor productivity at the regional level.[4] The micro data sets are, respectively, the German Structure of Earnings Survey (*SES*), *Verdienststrukturerhebung*, the Administrative Wage and Labor Market Flow Panel (*AWFP*), and the ZEW Mannheim Innovation Panel (*MIP*).

Ideally, all our micro data would be at the firm level because the model is a firm model and this makes sense in the German institutional setting, where collective bargaining happens at the level of the employer in the legal sense, which is the firm, not the plant. However, available plant-level data are of vastly superior scope and quality, and most firms are essentially single-plant firms.

2.1. *Structure of Earnings Survey (SES)*

The *SES* is a cross-sectional matched employer-employee data set provided by the Federal Statistical Office of Germany (*Statistisches Bundesamt*). The employer in the data is coded as the plant the employee works at. The *SES* is carried out every four years beginning in 2006. The statistical office randomly samples plants and, by law, these plants are required to provide detailed information on their employees and their employees' monthly working hours, earnings, and contract types. Hence, selection due to nonresponse does not arise. It contains the number of employees at a plant, its industry classification, and its location, dividing Germany into five regions.[5] The sample is representative for the universe of all German plants with at least ten employees.[6] Self-employed workers are not covered.

For our baseline analysis, we employ the 2006, 2010, and 2014 samples, which are prior to the introduction of a national minimum wage in Germany. In a supplementary analysis, we exploit this introduction, using the 2018 sample. We drop all civil servants from our sample as well as all plants where at least 50% of employees are civil servants. Moreover, we restrict the sample to full-time employees for our baseline analysis and provide a robustness check including part-time workers. The final sample contains 2,364,862 worker-plant observations. The 2006 sample uses a different industry classification than the later two samples. As a result, we have to merge some industries to have a consistent industry classification. Table C1 in the Appendix C provides a crosswalk for this merger and shows how it relates to the industries from the national accounts.

The *SES* provides the best available data source for our analysis. First, data on regular earnings, overtime pay, bonuses, and hours paid, both regular and overtime, are extracted from the payroll accounting and personnel master data of plants and transmitted via software interface to the statistical office. Transmission error is, hence, negligible. That

4. The published regional national account data is only available at the supra-industry level. We thank Dr. Thalheimer from the statistical office of Baden-Württemberg for making data at the industry level available to us.

5. North: Schleswig Holstein, Hamburg, Bremen, Berlin, and Lower Saxony; West: Northrhine-Westphalia; South-West: Hesse, Rhineland Palatinate, and Saarland; South: Baden-Württemberg and Bavaria; East: Thuringia, Saxony, Saxony-Anhalt, Mecklenburg Western Pomerania, and Brandenburg. West Germany is North, West, South-West, and South. We provide robustness checks regarding the assignment of Berlin in Appendix B.

6. This restriction is meant to reduce the administrative burden on small enterprises.

is, unlike German social security data, the *SES* reports the actual (e.g., not top-coded) pay and actual hours worked of employees. Second, it also provides detailed information on workers' sex, age, education, occupation, tenure, and job levels. Third, the survey has information on about 3.2 million employees from roughly 28,700 plants in 2006, 1.9 million employees from 32,200 plants in 2010, and 0.9 million employees from 35,800 plants in 2014.[7]

Over all samples, 87% of all full-time employees work at West German plants. In West (East) Germany, 39% (21%) of full-time employees work at large plants (¿249 employees), indicating the missing large plants problem; 45% (31%) of all full-time employees are paid according to a collective bargaining agreement. At large (small) plants 64% (31%) of all full-time employees are paid according to a collective bargaining agreement.[8]

Turning to real wages (all in 2016 Euro, all for full-time employees), over all samples, average hourly real wages are 20 Euro overall, and split by West/East: 21 vs. 14 Euro. They are 22 Euro for collectively bargained wage contracts, and 18 Euro for the non-collectively bargained ones. Workers at small plants receive on average an 17 Euro hourly real wage, and workers at large plants 24 Euro.

In 2006 only, the *SES* data contains also the number of workers at the firm that owns the plant. Comparing for this survey year the plant and firm employment information, we find that 83% of all workers work at the "major plant" of a firm (82% West, 84% East), where we consider a plant "major" if more than 85% of the firm's workforce works at that plant.[9] In other words, most employees work in essentially single-plant firms. Assigning the plant location to the corresponding firm highlights that not only large plants are missing in East relative to West Germany but also large firms: In West Germany, 46% of all full-time employees work at plants belonging to large firms, in East Germany this number is 27%.

2.2. *Administrative Wage and Labor Market Flow Panel (AWFP) and IAB Establishment Panel (IAB EP)*

For some analyses, mainly for longer time series and because of additional information about plants, we supplement the *SES* with the *AWFP* which is a quarterly plant-level data set based on German social security data and which contains daily earnings, not wages, up to the social security cap, i.e., there is top-coding in the earnings part of the data. The *AWFP*'s earnings data are thus inferior to the *SES*'s wage data. The *AWFP* data we use covers the universe of German plants for both West and East Germany from 1996 until 2018 (see Bachmann, Bayer, Merkl, Seth, Stüber, and Wellschmied, 2021; Stüber and Seth, 2018). The *AWFP*'s data source is the Employment History (*Beschäftigten-Historik*, *BeH*) of the German Institute for Employment Research (IAB). The *BeH* is an individual-level data set covering all workers in Germany subject to social security.[10] The information in the *BeH* originates from the notification procedure

7. The number of sampled employees decreased over time because the sampling probability of plants became smaller to reduce bureaucratic costs. In our analysis, we equalize observation weights across surveys so that all surveys receive equal weight.

8. In Germany, for a plant to be covered by collective bargaining, the employer needs to join an employer association. Workers can pressure employers to do so by striking (see Jäger, Noy, and Schoefer, 2022). It is natural that unions concentrate such costly efforts on large employers.

9. We define this cut-off point to account for situations in which a firm has only one physical location, but for organizational/legal purposes has an additional unit organized as a separate plant: for example, a canteen or a traveling sales force.

10. Marginal part-time workers (*geringfügig Beschäftigte*) have been covered since 1999. The main types of employees not covered by the *BeH* are civil servants (*Beamte*), military personnel, and the self-employed. East German employees were integrated with the West German social security administration only after 1992.

for social security. Essentially, this procedure requires employers to keep the social security agencies informed about their employees by reporting any start and end date of employment and by annually confirming continuing employment relationships. The *AWFP* aggregates this individual worker data to the plant level.[11]

The *IAB EP* provides additional information for a subset of up to 15,500 plants in the *AWFP*, surveyed annually by the IAB (see Ellguth, Kohaut, and Möller, 2014). For our purposes, we use the information on collective bargaining agreements at the plant level contained in the *IAB EP*.

2.3. *ZEW Mannheim Innovation Panel (MIP)*

The ZEW Mannheim Innovation Panel, *MIP*, is a firm-level panel data set that surveys German firms about their innovation, marketing, and sales activities. It asks every two years a detailed set of questions regarding marketing expenses, business strategies, competitive environments, product characteristics, and, in particular, their customer and supplier networks. We use the 2007–2015 survey waves that report data for the years 2006–2014 in line with our main *SES* sample. The industry coverage is slightly different from the *SES*, but broadly comparable, see Appendix C. We use the confidential data that can be accessed only on site.[12]

3. EMPIRICAL ANALYSIS

In this section, we document that, at the aggregate level, East Germany has lower labor productivity and labor compensation. Plants are smaller—already at entry—and firms invest less in business networks. The *SES* data allows us to establish that all these facts are related to a steeper size-wage relationship in East Germany, which, in turn, is related to East-West differences in collective bargaining coverage by plant size. We exploit East-West differences at the industry level to reach this conclusion.

3.1. *Aggregate Productivity*

In 1990, when centrally planned East Germany reunited with West Germany and became a market economy, a broad range of factors played an important role in depressing labor productivity: Capital was in short supply, machines were outdated, political pressure had plants overemploy labor in the East, and business customer networks evaporated. Consequently, labor productivity did not even reach 50% of the West German level in 1991 (see the first panel in Figure 2). During the first couple of years after reunification, labor productivity and wages grew rapidly in East Germany. However, this process of fast growth ended around 1995. Since then, convergence in labor productivity and wages has almost come to a halt and the difference remains currently at 18%.[13] What is more, as the bottom panel of Figure 2 shows, the East-West productivity difference remains with

11. For consistency over time, most variables in the *AWFP*—and all variables used in this paper—are calculated on a 'regular worker' basis. In the *AWFP*, a person is defined as a 'regular worker' when she is employed full-time and belongs to one of the following person groups: 'employees subject to social security without special features', 'seamen' or 'maritime pilots.' Employees in part-time and partial retirement, interns, etc., are not counted as regular workers.

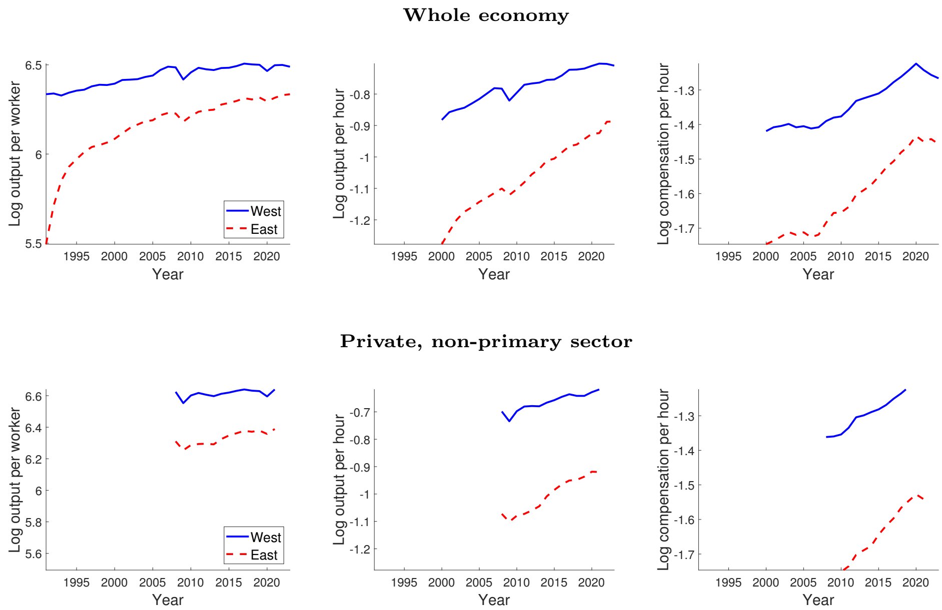
12. We are extremely grateful to the team at the ZEW, in particular Christian Rammer and Sandra Gottschalk, who provided and helped us with the data access.

13. We use output per worker as our baseline measure of labor productivity. As the figure shows, differences in output per hour are even somewhat larger than those in output per worker.

FIGURE 2

Output and wages

Output per worker Output per hour Compensation per hour



Notes: The figure displays yearly log real output per worker, yearly log real output per hour, and yearly log real labor compensation per hour in East and West Germany. Output is measured as gross value added, which is the GDP concept available at the regional level, because product-specific subsidies and taxes (the difference between the two) are only available at the national level. The top panel displays it for the whole economy, the bottom panel for the private, non-primary sector. Calculations are based on national accounts (VGR, DESTATIS (2023)) from 1992 to 2017. The data is available by region and sector only since 2008, which is why the lower panel starts only in that year. Similarly, data on hours worked by region starts in 2000. Weinand and von Auer (2020) provide county-level consumer price indices for Germany in 2016 that we aggregate to the regional level using population weights. With 2016 as the base year, we then calculate a time series of regional prices using the regional GDP-deflator-based inflation rates from national accounts.

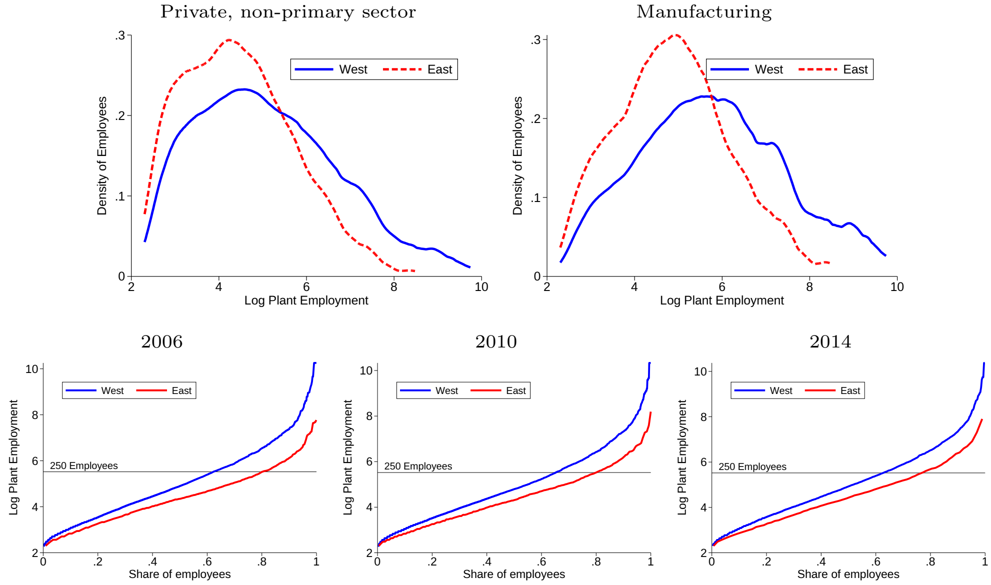
25% even larger in the private (non-primary) sector. Finally, the rightmost panels show a similar magnitude for East-West differences in real wages. That wage differences mirror productivity differences makes the following explanation for productivity differences based on mere accounting unlikely: Headquarters of most large firms are located in West Germany, and, hence, the income from unlocalized intangible capital is accounted for there. Given that we measure productivity as value added productivity, this type of accounting would increase measured West German productivity. Yet, it would leave wages unaffected across the two regions. Therefore, in such a world without other underlying localized productivity differences, wages across the two regions would be the same.

3.2. *Missing Large Plants in East Germany*

East Germany has fewer large plants than West Germany in the private, non-primary sector, as can be seen from Figure 3. The top panels show this in terms of the (employment-weighted) density of plants over log employment for the pooled samples. The bottom panels show this in terms of the CDF of employment over (log) plant sizes for each survey year. In all sample years, employment is more concentrated at large

FIGURE 3

Plant-size distributions in East and West Germany

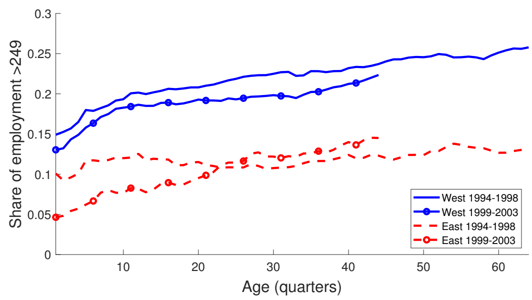


Notes: The figure displays employment-weighted plant size distributions for East and West Germany. The top panels display, respectively, an estimated density function (by a Gaussian kernel smoother) in the private, non-primary sector and in the manufacturing sector. We pool the 2006, 2010, and 2014 samples. The bottom panels display, for different survey years, what fraction of employees is employed at plants up to a certain size as measured by plant log-employment. Data source: *SES* 2006/10/14, DESTATIS (2006, 2010, 2014), own calculations.

plants in the West. In Appendix B, we show that this difference in plant size extends back into the 1990s and is not driven by differences in urbanization between East and West Germany, nor by the assignment of Berlin to West Germany in the *SES*.

FIGURE 4

Employment share 250+ by cohort



Notes: The figure displays, for the private non-primary sector, for different plant-entry cohorts the share of employment at plants with more than 249 employees over their life-cycles. Data source: *AWFP*, IAB (2018), own calculations

A potentially confounding factor for the East-West difference in the plant size distribution could be plant age. The restructuring of the East German economy led to the exit of many old and large plants. Figure 4 shows, however, that, even conditional on plant age, East German plants are smaller because they enter smaller and they remain smaller. Put differently, already at entry, plants in East Germany appear to choose business models that imply a relatively small plant size. What is more, the East-West difference in the employment share of large plants is essentially constant both in plant age and across entry cohorts.

In line with this idea of business model choice, we show that in the *MIP* data, controlling for industry and time fixed effects, firms in East Germany (i) have lower marketing expenditures, (ii) are less likely to invest in new distribution channels, (iii) have a higher share of sales with their top three customers (in terms of sales), and (iv) purchase a higher share of all their inputs from their top three suppliers (in terms of purchases), see Table 1. Taken together, (iii) and (iv) imply that East German firms have a sparser network of firms with which they interact.

Table 1
Customer networks: difference between East and West Germany

	Marketing expenditures to sales (in %)				Investment in new distribution channels (in %)			
East Germany	-0.9	-0.7	-0.2	-0.1	-8.5	-6.2	-8.1	-11.0
	(0.2)	(0.2)	(0.2)	(0.3)	(3.1)	(3.0)	(2.6)	(3.2)
N	20455	20438	6393	1186	24071	24070	7794	1448
	Customer diversity (in %)				**Supplier diversity (in %)**			
East Germany	-10.4	-9.7	-10.2	-11.3	-5.3	-4.7	-10.7	-10.4
	(2.4)	(2.4)	(2.5)	(4.1)	(2.1)	(2.1)	(2.7)	(4.1)
N	4450	4450	1116	217	4074	4074	1050	196
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y	Y
Size Controls	N	Y	Y	Y	N	Y	Y	Y
Additional controls	N	N	Y	Y	N	N	Y	Y
Only intermediate goods industries	N	N	N	Y	N	N	N	Y

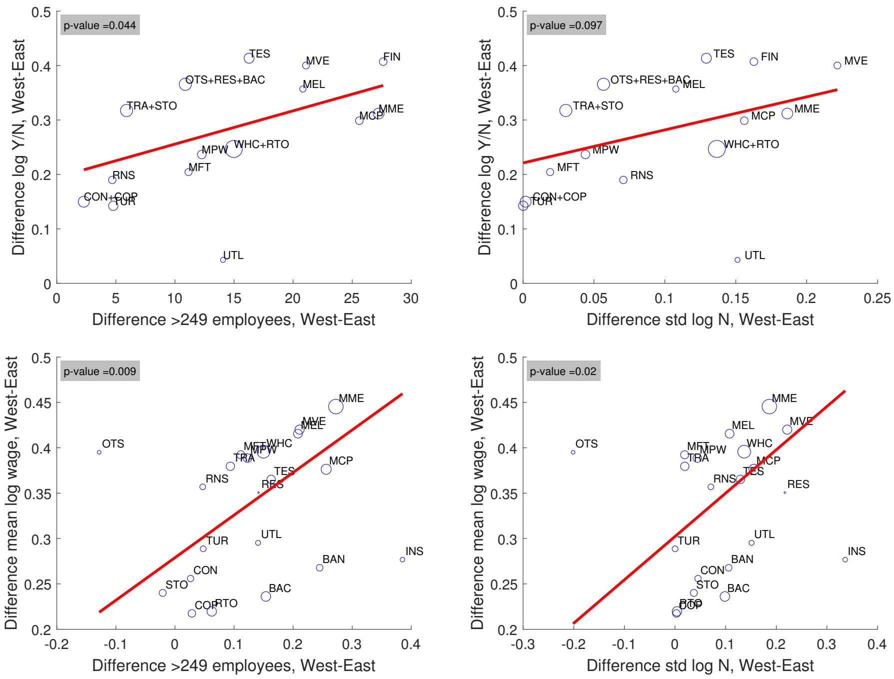
Notes: The table displays the dummy coefficient for East Germany in firm-level, sales-weighted linear regressions for: (top-left) expenditures on marketing, relative to sales; (top-right) whether a firm reports to have invested in new distribution channels; (bottom-left) the share of sales that do not go to the three most important customers (in terms of sales); and (bottom-right) the share of purchases that do not come from the three most important suppliers (in terms of purchases). Data comes from the Mannheim Innovation Panel, ZEW (2016b). The top panel uses the biannual data from 2006-2014, the bottom panel only from 2010. Samples based on availability of the corresponding questions. All regressions are estimated with time and industry fixed effects. Columns 2-4 control in addition for firm size. Columns 3-4 control additionally for exporting intensity, innovation expenditures, new products on the market, investment in physical capital, a dummy for government subsidies, the substitutability of one's products by products of competitors, and the wage bill relative to sales. Column 4 uses only observations from industries, which have less than 5% sales going to final-use customers (using the German input-output table). Columns 5-8 repeat this pattern. Own calculations.

These results are broadly robust to the inclusion of firm size and additional controls, see columns two and three in each panel. The results are also robust when we focus on industries with less than 5% of sales to final consumers in the German input-output tables, i.e., industries that produce almost exclusively intermediate goods, see column

FIGURE 5

Productivity and wage differences and large plants by industry

Share of plants > 249 Std. log employment



Notes: The top panels relate 2014 log differences in output per worker between West and East Germany within industries to the share of employment at plants with more than 249 employees (left panels) and the standard deviation of log plant employment (right panels). Output is measured as gross value added, which is the GDP concept available at the regional level, because product-specific subsidies and taxes (the difference between the two) are only available at the national level. The lines show (VGR) employment-weighted least squares regressions. The bottom panels relate differences in mean log wages between West and East Germany within industries to the same plant size measures. The lines show (*SES*) employment-weighted least squares regressions. MFT: Food and textile manufacturing, MPW: Paper and wood manufacturing, MCP: Chemical and plastic manufacturing, MME: Metal manufacturing, MEL: Electronics manufacturing, MVE: Vehicle manufacturing, UTL: Utilities, CON: Construction, COP: Construction preparations, WHC: Wholesale and car retail, RTO: Other retail, TRA: Transportation, STO: Storage, TUR: Tourism, BAN: Banking, INS: Insurance, RNS: Research services, TES: Technical services, RES: Rental services, BAC: Building and area care, OTS: Other services, FIN: Finance. The industry definitions in the upper panel *(VGR)* are coarser than in the lower panel *(SES)*, and the cross-walk is detailed in Appendix C. Data sources: *SES* 2006/10/14 (plant sizes, wages), own calculations, and *VGR* (labor productivity).

four in each panel. This addresses the potential concern that within-industry differences in customer type drive the differences between East and West Germany.

These business model choices and in particular the density of the business networks will likely have plant size and productivity implications. Motivated by this idea and the fact that the plant size distribution differences are not uniform across sectors, as we saw in the two top panels of Figure 3,[14] we next analyze industry-level East-West differences in size, productivity, and wages.

The left panels of Figure 5 use the share of employment at plants with more than 249 employees to compare plant size distributions. The right panels use the standard deviation of log-employment instead. The employment-weighted correlation between productivity differences and plant size distribution differences (top row) is 0.53 for the 249-share and 0.44 for the standard deviation. Both top-row scatter plots show that those industries where productivity is particularly low in the East are also the industries where particularly fewer workers are employed at large plants in East Germany relative to West Germany. Relating the size distribution to output per worker has the drawback that it confounds labor share and marginal labor productivity differences between East and West Germany. To alleviate this concern, the bottom row looks at differences in average log wages. Similar to output per worker, we find that those industries where wages are particularly low in the East are also the industries where particularly fewer workers are employed at large plants in East Germany relative to West Germany. The correlations are 0.55 (249-share) and 0.49 (standard deviation), respectively.[15]

3.3. *The Role of the Size-Wage Nexus*

Besides East-West differences in the plant-size distribution, productivity and business model choices, another difference between East and West Germany stands out: East German plants face a steeper size-wage curve, which, in turn, is related to East-West differences in collective bargaining coverage by plant size. What is more, industries where the size-wage curve is particularly steep in East Germany have more missing large plants (even at entry), pay lower wages, and choose smaller business networks.

3.3.1. Measuring the Size-Wage Nexus. We use the *SES* data to estimate the following reduced-form relationship between individuals' log wages, $\ln w_{it}$, and the log employment at their plant, $\ln E_{it}$:

$$\ln w_{it} = \beta_0 + \beta_E East_i + \hat{\omega}_W \ln E_{it} + (\hat{\omega}_E - \hat{\omega}_W) East_i \ln E_{it} + \beta x_{it} + e_{it}, \tag{3.1}$$

where $East_i$ is a dummy equal to one when the employee's plant is in East Germany, and x_{it} are other observable plant or worker characteristics. The coefficient of interest is the difference in the size-wage slope $\hat{\omega}_E - \hat{\omega}_W$, the interaction term. In our baseline specification, we non-parametrically control for a workers' age and sex by a full set of interaction dummies and for time and industry fixed effects.

The top panel of Table 2 displays the results. It first shows that large plants pay higher average wages in both regions, as $\hat{\omega}_W, \hat{\omega}_E > 0$. Importantly, the size premium is larger in East Germany. In the West, a 1% higher employment is associated with a 0.078% higher wage. The corresponding number for the East is 0.094%, one fifth higher. For example, in West Germany, a firm with a business model requiring 100 employees expects to pay 5.6% higher wages than a firm with a business model requiring 50 employees (log

14. They are much stronger in the manufacturing sector, where in the West, 55% of all employees work at plants with more than 249 employees, while in the East it is only 31%.

15. An additional advantage of using wages is that both the size distribution and wage measures come from the same data source (*SES*) with the same sampling procedures.

Table 2
Size-wage elasticities

	Non-primary private sector		
	Baseline	Occupation × Education	Job level × Education
Size-Wage elasticity, West, $\hat{\omega}_W$	7.8 (0.1)	6.1 (0.1)	5.5 (0.1)
Difference in elasticities, $\hat{\omega}_E - \hat{\omega}_W$	1.6 (0.3)	2.0 (0.2)	2.5 (0.2)
Implied elasticity, East, $\hat{\omega}_E$	9.4	8.1	8.0
N (in thousands)	2365	2365	2228
	Manufacturing sector		
	Baseline	Occupation × Education	Job level × Education
Size-Wage elasticity, West, $\hat{\omega}_W$	8.8 (0.2)	6.9 (0.1)	6.5 (0.1)
Difference in elasticities, $\hat{\omega}_E - \hat{\omega}_W$	4.3 (0.4)	4.9 (0.3)	5.4 (0.3)
Implied elasticity, East, $\hat{\omega}_E$	13.1	11.8	11.9
N (in thousands)	1025	1025	970

Notes: The table displays the estimated size-wage elasticities for the non-primary private (manufacturing) sector in West and East Germany. Standard errors are in parentheses. The top panel is for all workers. All coefficients are multiplied by 100 for better readability. *Baseline*: Controls for a workers' age and sex by a full set of dummy interactions, plus time, and industry fixed effects. *Occupation × Education*: Controls for a workers' age, sex, education, and occupation by a full set of dummy interactions, plus time and industry fixed effects. *Job level × Education*: Controls for a workers' age, sex, education, and job level (five levels, coding the level of autonomy, complexity, and responsibility a worker's job has, see Bayer and Kuhn, 2018) by a full set of dummy interactions, plus time and industry fixed effects. Data source: *SES* 2006/10/14, own calculations.

difference 0.69). In East Germany, the same difference in business models comes with 6.7% higher wages. Appendix D.1 shows that the result is robust to including non-linear size terms, which might otherwise drive differences in the average size-wage gradient given the differences in the plant size distributions.[16]

Another concern may be that the steeper size-wage relationship in East Germany reflects large plants there attracting a larger share of high-ability workers. For this reason, we consider a second (and a third) specification where we fully interact age, sex, education, and occupation (job-level) dummies (in addition to time and industry fixed effects) to allow for plant-size-related differences in occupational (job-level) patterns within industries between East and West. The last two columns of Table 2 show that the difference between the two regions becomes yet slightly larger when we control additionally for age-, sex-, and education-specific occupational or job-level patterns.[17]

16. Appendix D.1 also extends the analysis to include part-time workers and shows that this, if anything, increases East-West differences in the size-wage nexus. We also estimate a more flexible regression that allows for East/West-specific industry fixed effects and East/West-specific effects of worker characteristics (age and sex). This controls for potential East/West-differences in sorting and East/West-specific industry-level demand shocks. Again, we find that the differences in the size-wage elasticities become even a bit larger than in our baseline specification. Appendix D.3 shows that the finding of an East-West difference in the slope of the size-wage curve is also robust to using the firm size information in the *SES* 2006 sample instead of plant size.

17. In Appendix D.2, we investigate the issue of selection further by using the *AWFP* data, based on social security records, which allow us, with the caveat that these are top-coded earnings as opposed to hourly wage data, to use estimates of plant-level fixed effects controlling for worker fixed effects. We find the same pattern of a steeper East German size-wage curve. The *AWFP* data also has a finer spatial

Table 3
Size-CBI / wage nexus

	Size-CBI nexus		
	Linear	Probit	Logit
Size-CBI coefficient, West, $\hat{\omega}_W^{\text{CBI}}$	10.2 (0.3)	29.5 (1.1)	49.6 (1.9)
Difference in coefficients, $\hat{\omega}_E^{\text{CBI}} - \hat{\omega}_W^{\text{CBI}}$	1.0 (0.6)	6.1 (2.0)	10.7 (3.4)
N (in thousands)	2365	2365	2365
	Size-wage elasticities		
	Type of bargaining		Wage imputed
	Non-collective	Collective	using bargaining
Size-Wage elasticity, West, $\hat{\omega}_W$	7.7 (0.2)	5.8 (0.2)	0.8 (0.0)
Difference in elasticities, $\hat{\omega}_E - \hat{\omega}_W$	-0.3 (0.4)	-0.3 (0.4)	1.2 (0.2)
N (in thousands)	1378	986	2351

Notes: CBI: collective bargaining incidence. The top panel estimates the baseline regression from Table 2 replacing wages as the left-hand side by a dummy that equals one if the worker is paid according a collective bargaining contract. The first two columns of the bottom panel repeat the baseline regression from Table 2 splitting the sample by whether the worker is covered by a collective bargaining agreement or not. The last column of the bottom panel estimates the baseline regression on imputed wages, where wages are estimated regressing wages on the bargaining type, industry, year, region dummies and a full set of dummy interactions for age and sex. All coefficients are multiplied by 100 for better readability. Standard errors are in parentheses. Data source: *SES* 2006/10/14, own calculations.

3.3.2. Size-Wage Nexus and Collective Bargaining. What lies behind these differences in the steepness of the size-wage curves? We highlight the role of collective bargaining and the differences in the role of unions rooted in the different historical developments in the two Germanies before 1990. In the former socialist East Germany, union membership was high because non-membership was associated with economic and social disadvantages (see Hans-Böckler-Stiftung, 2022). As a result, unions were not viewed as part of civil society, as they are in West Germany, and union membership fell quickly after reunification. This union retrenchment was particularly pronounced at small plants, leaving collective bargaining concentrated at large plants.

We can see this in the SES data. The top panel of Table 3 presents estimates of linear probability, probit, and logit models for the probability that an individual worker's contract is collectively bargained, the collective bargaining incidence (CBI). We use the same set of regressors as in our baseline size-wage regression. We find that overall the probability of collectively bargained wages increases in plant size and it does more so in East Germany.[18] In other words, union effort for collective bargaining is, in East Germany, more selectively focused on large plants.

Moreover, the East-West differences in size-CBI and size-wage curves are related. To show this, we begin by estimating the size-wage curve separately for workers with collectively and non-collectively bargained wages, see the bottom-left panels of Table 3. We find that, once we condition on whether individual employment contracts are subject to collective bargaining, the size-wage curve in East and West Germany is basically identical.[19] First and foremost, this means that it must be differences in collective bargaining that drive the East-West difference in the size-wage curve.

resolution allowing us to distinguish between metropolitan and non-metropolitan areas and to show that our results are not driven by differences in metropolitan and non-metropolitan size-wage curves.

18. This is consistent with Table 2 in Schnabel (2005).

19. Collectively-bargained wages in Germany still depend on size for at least two reasons: First, unions can negotiate firm-specific wage agreements that then hold for the entire workforce of that firm.

Next, we estimate how much of the East-West difference in the size-wage elasticities is driven by the fact that collectively bargained wages are higher (and, as we have seen, the size-CBI curve is steeper in East Germany). For this purpose, we estimate a regression of real wages (in levels) on a full set of interaction dummies for sex and age, time fixed effects, industry fixed effects, and a dummy for East Germany. This is the same set of regressors as the baseline size-wage regression except for all regressors that include size. We instead include a dummy for collectively bargained wages. Importantly, there is no *direct* effect of plant size on the *predicted* individual wages from this regression. We then estimate the baseline size-wage regression using these predicted individual wages on the left hand side (after a log transformation). As this regression includes all the regressors from the prediction regression but collective bargaining, any size effect on wages must come from collective bargaining. We report this exercise in the bottom right cell of Table 3. We find that this yields an estimated size-wage elasticity difference of 1.2% compared to the 1.6% baseline estimate (see Table 2).

Beyond being higher, collectively bargained wages are also less elastic in size compared to non-collectively bargained ones (5.8% vs. 7.7% in West Germany, Table 3). This contributes, however, only approximately another 0.3% to the average East-West size-wage elasticity difference, given that East Germany has a 14% higher fraction of non-collectively bargained wages and these have a 1.9% higher elasticity ($14\% \times 1.9\% \approx 0.3\%$). In sum, the effects of collective bargaining basically explain the entire East-West difference in the size-wage elasticity.

3.3.3. Size-Wage Nexus, Missing Large Plants, and Lower Wages. Going back to Table 2 and to size-wage curves, we can see that the difference between East and West Germany is even more pronounced in the manufacturing sector (lower panel). The fact that the East-West difference in the size-wage nexus is not uniform across industries generalizes. Importantly, it is also systematically related to industry variation the prevalence of large plants and average wages. To show this, we estimate Equation (3.1) for 21 individual industries. In the top-row panels of Figure 6, we plot the difference $\hat{\omega}_E - \hat{\omega}_W$ against (a) the difference in the share of employment at large plants, (b) the difference in the standard deviation of log employment, and (c) the difference in the average log wage for each industry. We find that the steeper the size-wage curve is in the East relative to the West, the smaller is the relative share of employment at large plants (employment-weighted correlation of 0.30). The employment-weighted correlation for the standard deviation of log plant employment is 0.33. The correlation between average wages and the size-wage nexus is with 0.52 even stronger. The steeper the size-wage curve is in an East German industry relative to its West German “twin”, the more are East wages lagging behind. Appendix E.1 repeats the exercise of Figure 6 (as well as of Figure 5) splitting up West German industries by four regions. The resulting correlations are similar but come with a higher degree of statistical confidence.

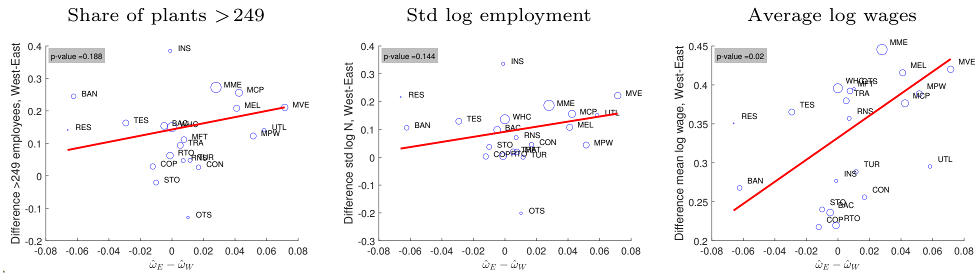
Moreover, the bottom panels of Figure 6 show that our findings regarding missing large plants and lower wages by industry are also related to plant-size-specific differences in the collective bargaining incidence. On the x-axes, we show, for each industry, a double difference in the (log) incidence of collectively bargained wage contracts between large and small plants and between East and West. This double difference is then plotted against our two measures of East-West differences in the plant size distribution: the

Second, the typical collective bargaining agreement establishes a wage floor for all firms bound by the agreement but allows to pay an individual worker better, e.g., through bonuses.

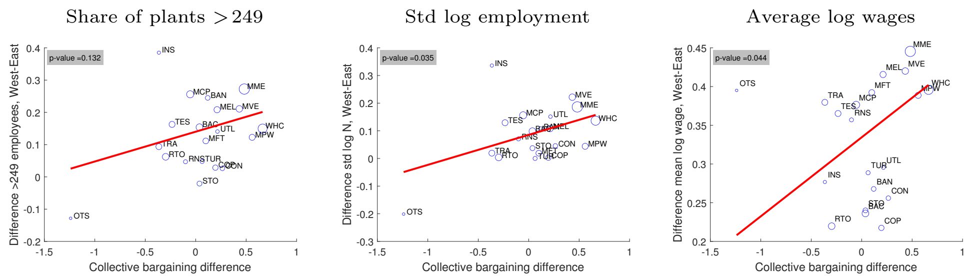
FIGURE 6

The share of large plants, wages, the size-wage nexus, and collective bargaining

Nexus between $\hat{\omega}_E - \hat{\omega}_W$ and ...



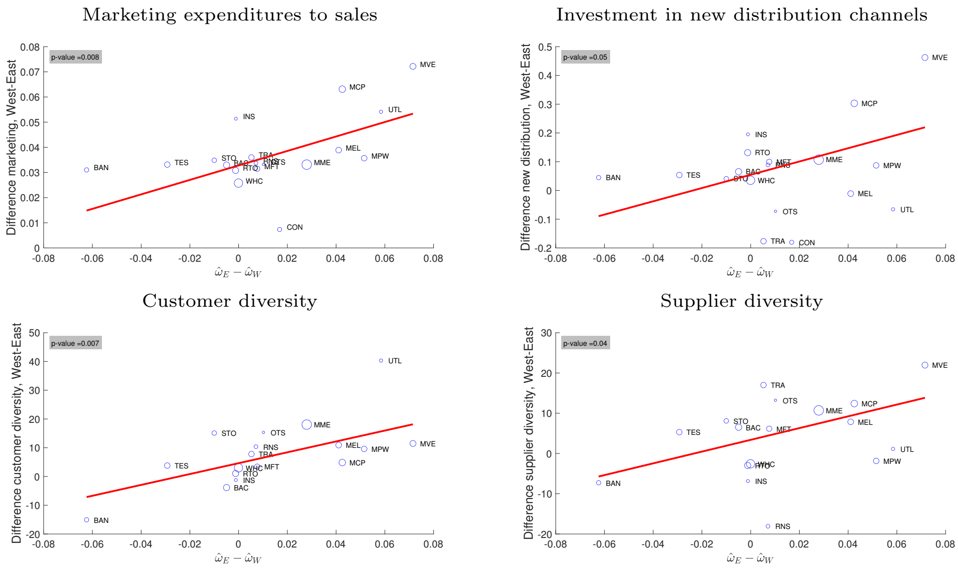
Nexus between differences in the incidence of collective bargaining and ...



Notes: The top-row panels relate differences between West and East Germany in the share of employment at large plants, the standard deviation of log plant employment, and average log wages to differences in size-wage relationships. The bottom-row panels relate differences between West and East Germany in the share of employment at large plants, the standard deviation of log plant employment, and average log wages to the following double difference: $[\log P(C|L,E) - \log P(C|S,E)] - [\log P(C|L,W) - \log P(C|S,W)]$, where $P(C|\cdot)$ is the conditional probability of a worker being subject to collective bargaining in our sample in (L)arge (>249 employees) or (S)mall ($\leq$249 employees) plants in the (E)ast and (W)est. The lines show employment-weighted least square regressions. *MFT*: Food and textile manufacturing, *MPW*: Paper and wood manufacturing, *MCP*: Chemical and plastic manufacturing, *MME*: Metal manufacturing, *MEL*: Electronics manufacturing, *MVE*: Vehicle manufacturing, *UTL*: Utilities, *CON*: Construction, *COP*: Construction preparations, *WHC*: Wholesale and car retail, *RTO*: Other retail, *TRA*: Transportation, *STO*: Storage, *TUR*: Tourism, *BAN*: Banking, *INS*: Insurance, *RNS*: Research services, *TES*: Technical services, *RES*: Rental services, *BAC*: Building and area care, *OTS*: Other services. Data source: *SES* 2006/10/14, own calculations.

share of employment at large plants (left panel) and the standard deviation of log plant-level employment (center panel). Differences in the relative CBI of large and small plants are positively related to our measures of missing large plants—the employment-weighted correlations are 0.35 and 0.47, respectively. Industries in which the incidence of collectively bargained wages increases relatively more in plant size in the East are also those industries where, compared to West Germany, large plants are particularly missing in the East. Finally, the right panel relates the double difference to wage differences across industries. Industries in which the incidence of collectively bargained wages increases relatively more in plant size in East Germany are also those industries where, compared to West Germany, wages are particularly low (correlation: 0.46).

FIGURE 7
Customer networks and the size-wage nexus



Notes: Top-left: Expenditures on marketing, relative to sales. Top-right: Share of firms that report to have invested in new distribution channels. Bottom-left: Share of sales that do not go to the three most important customers (in terms of sales). Bottom-right: Share of purchases that do not come from the three most important suppliers (in terms of purchases). Top row: Data from the Mannheim Innovation Panel, 2006–2014 (biannual). Bottom row: Data from the Mannheim Innovation Panel, 2010. Samples based on availability of the corresponding questions. All data are sales-weighted when aggregating to the industry level. Size-wage elasticity estimates from *SES* data. Own calculations.

Taken together, the data suggest that plants in East Germany face a stronger trade-off between being large and paying low wages. This stronger trade-off appears to originate from (a) collectively bargained wages being higher, and (b) a relatively larger concentration of collective bargaining at large plants in East Germany. Most importantly, across industries, the stronger size-wage trade-off in East Germany correlates with missing large plants and plants paying on average low wages.

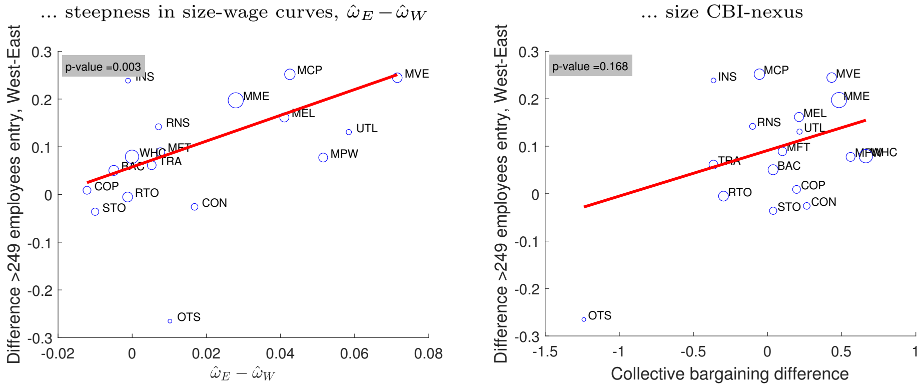
3.3.4. Size-Wage Nexus and Smaller Business Networks. The implications of monopsony power, however, do not stop with the labor market, specifically its effects on employment concentration and wages. Monopsony, by changing incentives to be large in terms of employment, also can be expected to change the incentives for choosing the scale of firms' business models, which Table 1 shows to be smaller in East Germany.

Using again industry-level differences, we find these East-West differences in business model choices are related to differences in size-wage curves, see Figure 7. West German firms in industries with steeper size-wage curves in East Germany relative to West Germany have a higher marketing expenditures to sales ratio, invest more in new distribution channels, and have more diverse business networks in terms of both customer and supplier diversity. This means that firms facing a steeper size-wage trade-off have smaller-scale business models. In Appendix E.2, we show that these findings are robust to the inclusion of controls.

FIGURE 8

Difference in employment share at entry in terms of ...

... steepness in size-wage curves, $\hat{\omega}_E - \hat{\omega}_W$ ... size CBI-nexus



Notes: The figure displays the differences in the share of employment at large plants (more than 249 employees) within the group of plants that are at most three years old (y-axis) against (left panel) the estimated size-wage elasticity difference (x-axis) and (right panel) the difference in the incidence of collective wage bargaining between small and large plants. Data source: for employment shares: *AWFP* 2006–2014, for wage-size elasticity estimates and collective bargaining: *SES* 2006/10/14, own calculations.

The literature (see Sedláček and Sterk, 2017) thinks of business model choices happening oftentimes when firms enter a market. This is consistent with Figure 4 which shows that East-West size differences manifest already at entry. To further corroborate this view, Figure 8 shows that the industry-level relationship of the share of employment in large plants and the steepness of the size-wage / the size-CBI nexus can already be found at plant entry. Compared to Figure 6, here, we use the employment shares of large young plants among all young plants (less than 3 years of age) as the left-hand side variable. Since the SES data does not provide the age of a plant, we rely on the AWFP data instead.

In summary, the data suggests that a steeper size-wage nexus leads firms to choose smaller scale business models and that this choice happens around entry.

4. A MODEL OF MISSING LARGE PLANTS/FIRMS

To understand why a stronger size-wage trade-off leads to missing large plants/firms and lower aggregate productivity in East Germany, we develop a model with heterogeneous firms (to be able to capture size differences), which have labor market power (to capture the size-wage elasticities), and decide both about entry and about investment in business networks (which suggests a model of differentiated products). Since the effects of the differences in size-wage elasticities are manifest already at entry, see Figures 4 and 8 in the previous section, it is sufficient to keep the analysis in a static framework, which also provides tractability.

We will capture labor market power in the form of monopsonistic competition: A firm individually faces an upward-sloping labor supply curve despite our assumption of a fixed aggregate labor supply. As suggested by the evidence on collective bargaining from the previous section, we provide a rationalization of why size-related collective bargaining differences increase the slope of the firm's size-wage trade-off: Large firms are more likely to pay wages according to a collective bargaining agreement and these wages are higher. Thus, expected wages increase in firm size, leading to labor market power when the firm chooses its business network. Furthermore, we set up the model as a model of firms because business network decisions are usually top level. Incidentally, this is also consistent with the German institutional setting where the employer has to be a legal subject able to enter collective bargaining agreements—hence, typically a firm.

In our model, firms first decide on market entry; second, conditional on entry, they learn their technical productivity and decide on investments in their business network, think, the decision to be a small-scale or a large-scale producer. Third, firms hire labor and produce intermediate goods, which they sell to bundlers, facing both a size-wage and an output-price trade-off. We show that monopsony power affects all of these decisions. Monopsony power, as it increases profits, boosts entry of firms, but it also incentivizes each individual firm to choose smaller-scale business models. This goes beyond and amplifies the reallocation of labor from more productive to less productive firms, which is already present in models without a choice of business networks and entry (see, e.g., Berger et al., 2022). This goes also beyond the standard output loss associated with monopsony power due to underemployment, from which we abstract by assuming a fixed aggregate labor supply.

With our setup, we introduce labor market power to a Melitz (2003)-type model. There, firms have an entry decision and a decision about their exporter status. In our model, we draw on a recent and growing heterogeneous-firm literature that puts some form of customer acquisition at the center stage in addition to technical productivity differences (see Einav, Klenow, Levin, and Murciano-Goroff, 2021; Sedláček and Sterk, 2017; Gourio and Rudanko, 2014; Drozd and Nosal, 2012; Arkolakis, 2010). Therefore, our firms decide about entry and whether to enter a business relationship with a downstream bundler. Differently from the original Melitz setup, labor market power induces them not to serve all bundlers (countries in Melitz), but to decide about the size of their business network. Accordingly, firms in East Germany choose a smaller-scale business model because, in expectation, they, thus, avoid paying high collectively bargained wages.

4.1. *Bundlers*

There is a unit mass of bundlers indexed by j. All bundlers produce a final consumption good, Y_j, using a Dixit-Stiglitz aggregator:

$$Y_j = \left(\int_{\Omega_j} y_{ij}^{\frac{\eta-1}{\eta}} \, di \right)^{\frac{\eta}{\eta-1}} = \left(\int \gamma_i \theta_{ij} y_{ij}^{\frac{\eta-1}{\eta}} \, di \right)^{\frac{\eta}{\eta-1}}, \tag{4.2}$$

where, as in Melitz (2003), Ω_j is the set of varieties available to the bundler. Bundler j bundles differentiated goods, y_{ij}, from a continuum of potential intermediate good producers i (again of mass one).[20] Whether a specific bundler uses the goods from a specific producer depends on two of the business decisions outlined above: the producer

20. We emphasize the interaction of business network choice and labor market power in shaping firm size and productivity, and, therefore, we abstract, for tractability reasons, from how interregional trade additionally influences this nexus. We, thus, model East and West Germany as closed economies each, which is tantamount to assuming that the bundlers in both regions produce perfect substitutes. In addition, since firms in both regions, because of free entry, make zero expected profits in equilibrium, there is no incentive for firms to start up in another region.

must have entered and be active, $\gamma_i = 1$, and must have formed a customer relationship with the particular bundler $\theta_{ij} = 1$.

Following Melitz (2003), Appendix F.1 shows that the resulting cost-minimizing price of bundler j, the ideal price index, is given by

$$\bar{P}_j = (\Gamma\bar{\Theta})^{\frac{1}{1-\eta}} \left(\int p_{ij}^{1-\eta} di \right)^{\frac{1}{1-\eta}}, \tag{4.3}$$

where Γ is the mass of all active producers, $\bar{\Theta}$ is the average fraction of bundlers that an active producer sells to (and, therefore, has no j index), and thus $\Gamma\bar{\Theta}$ is the number of varieties available to bundlers. We focus on the symmetric equilibrium in which intermediate goods producers charge the same price to all bundlers, $p_{ij} = p_i$, and all bundlers are equally large, $Y_j = Y$. From this follows $\bar{P}_j = \bar{P}$.

4.2. *Intermediate Good Producers*

An intermediate good producer i employs $l_i\Theta_i$ workers, where Θ_i is the mass of bundlers that constitute producer i's business network, and l_i are the units of labor required to produce the representative quantity that an active producer supplies to each bundler, $y_i = z_i l_i$. That is, intermediate good producers operate a constant returns to scale production function, where z_i denotes producer i's idiosyncratic technical productivity.

4.2.1. Price-Setting to a Single Bundler and Profits. Intermediate good producers, knowing that they face monopolistic competition, post a price to any bundler they have established a network connection with ($\theta_{ij} = 1$). Hence, they set prices as a mark-up over marginal costs, given by wages w_i relative to productivity z_i:[21]

$$p_i = \frac{\eta}{\eta - 1} \frac{w_i}{z_i}. \tag{4.4}$$

Using this optimal price allows us to express gross profits as a function of the mass of connected bundlers and marginal costs:

$$\pi(\Theta_i, w_i) = \Theta_i (p_i y_i - w_i l_i) = \Theta_i \left(\frac{w_i}{z_i} \right)^{1-\eta} \left(\bar{P} \frac{\eta - 1}{\eta} \right)^{\eta} \frac{Y}{\eta - 1}. \tag{4.5}$$

Importantly, gross profits for a given wage are linear in the mass of bundlers in the firm's business network. However, an intermediate good producer's wage is increasing in its total number of employees, i.e., it faces monopsonistic competition in the labor market.

4.2.2. Modeling Monopsony Power in the Labor Market. As in our empirical specification in Equation (3.1), we assume the wage-size relation to have a

21. The intermediate good producers' price-setting can ignore the fact that they are in monopsonistic competition in the labor market, as each bundler is infinitesimally small and, hence, a marginal increase in the quantity sold to a single bundler has only a second-order impact on the producer's total labor demand and is, thus, irrelevant for the producer's first-order condition.

constant elasticity:

$$w_i = \left(\frac{l_i\Theta_i}{\bar{l}\bar{\Theta}}\right)^{\hat{\omega}} W, \tag{4.6}$$

where we express size relative to the average producer size in the economy, $\bar{l}\bar{\Theta}$, and W is a wage index, which we set to 1, making labor the numeraire.

The following is a simple rationalization of this formulation as a first-order approximation which permits tractability: Along the lines of our empirical exercises regarding collective bargaining, assume a firm has to pay an individual worker according to a collective bargaining agreement with probability $p_{coll} = p_0 + p_1 \ln\left(\frac{l_i\Theta_i}{\bar{l}\bar{\Theta}}\right)$.[22] Further, firms expect to pay a multiplicative wage premium of τ over the non-collective wage $\tilde{W}$. This means that a firm *expects* to pay

$$\ln \mathbb{E} w_i = \ln\left[\left((1+\tau)p_{coll} + (1-p_{coll})\right)\tilde{W}\right] = \ln\left[(1+\tau p_{coll})\tilde{W}\right] \approx \tau p_{coll} + \ln \tilde{W}$$

as its average wage. Lastly, we allow for the non-collectively bargained wage to be directly size-dependent for reasons such as preferences for specific workplaces (see, e.g., Berger et al., 2022) or imperfect information about outside options (see, e.g., Jäger, Roth, Roussille, and Schoefer, 2024) and, thus, specify $\tilde{W} = \hat{W}\left(\frac{l_i\Theta_i}{\bar{l}\bar{\Theta}}\right)^{\xi}$.

Plugging in for p_{coll} and $\tilde{W}$ and rearranging, we then obtain for the wage that a firm expects to pay when deciding about their business model

$$\mathbb{E} w_i = \hat{W} \exp(\tau p_0) \left(\frac{l_i\Theta_i}{\bar{l}\bar{\Theta}}\right)^{\tau p_1 + \xi}.$$

This is the functional form of Equation (4.6). It gives an interpretation to $\hat{\omega}$ as the product of the collective bargaining wage premium, τ, and the semi-elasticity of p_{coll} on firm size, p_1, plus a term unrelated to collective bargaining, ξ. In line with our empirical results, see bottom left of Table 3, we assume the latter is constant across regions, i.e., regional differences in $\hat{\omega}$ reflect regional differences in collective bargaining. Given this rationalization, we now proceed with Equation (4.6).

4.2.3. Choosing the Business Network. The intermediate good producer maximizes gross profits net of investments in the business network but takes into account that wages are a function of the total number of employees. To connect with one additional bundler, the intermediate good producer has to invest $\mu\bar{P}$ (μ measures costs in terms of the output good). One example for such costs would be the costs of marketing. The resulting operating profits are:

$$\Pi_i(\Theta_i) = \pi(\Theta_i, w_i(\Theta_i)) - \mu\bar{P}\Theta_i. \tag{4.7}$$

where we use the fact that we can express wages as a function of the mass of bundlers in firm i's network. Using the price setting equation and the production function, we

22. It is well known that the linear probability model is a good approximation to the logit/probit model for probabilities in the range of 0.1 and 0.9. We have tested whether employment size should enter in logs or in levels and found that the log-formulation achieves a substantially higher likelihood in both the probit and logit estimate.

obtain, summarizing aggregate terms in $\bar{w}$ (see Appendix F.2) the following functional form:

$$w_i(\Theta_i)=z_i^{\frac{(\eta-1)\hat{\omega}}{1+\eta\hat{\omega}}}\,\bar{w}\left(\frac{\Theta_i}{\bar{\Theta}}\right)^{\frac{\hat{\omega}}{1+\eta\hat{\omega}}}. \tag{4.8}$$

Equation (4.7) together with (4.5) shows that profits depended linearly on the size of the business network Θ_i if it was not for monopsony power in the labor market. Therefore, it is monopsony power in the labor market that implies an interior solution to the optimal business model choice. Appendix F.2 shows that we can write the resulting first-order condition as

$$\frac{\Theta_i}{\bar{\Theta}}=z_i^{\frac{1+\hat{\omega}}{\hat{\omega}}}\left[\frac{1+\hat{\omega}}{1+\eta\hat{\omega}}\frac{Y}{\mu}\frac{1}{\eta}\left(\frac{\bar{P}}{\bar{w}}\frac{\eta-1}{\eta}\right)^{\eta-1}\right]^{\frac{1+\eta\hat{\omega}}{\hat{\omega}(\eta-1)}}. \tag{4.9}$$

This equation relates the optimal amount of connected bundlers to a producer's idiosyncratic productivity, z_i. More productive producers find it optimal to create a larger business network, but the steepness of the size-wage curve, $\hat{\omega}$, moderates this relationship. A yet different way to think about the producers' optimal business network decision is to use (4.8) and express (4.9) in terms of the real wage paid by a producer:

$$\frac{w_i}{\bar{P}}=\left[\frac{1+\hat{\omega}}{1+\eta\hat{\omega}}\frac{Y}{\mu}\frac{1}{\eta}\right]^{\frac{1}{\eta-1}}\frac{\eta-1}{\eta}z_i. \tag{4.10}$$

The real wage is proportional to idiosyncratic technical productivity, z_i, which also implies that marginal costs, $\frac{w_i}{z_i}$, and hence prices, are constant across producers. Owing to producers' product market power, workers do not receive the full marginal product of labor. Instead, they get a wage equal to the technical productivity multiplied by the inverse mark-up in the product market, $\frac{\eta-1}{\eta}$, and by the term in squared brackets, which reflects the efficiency of the producer's network. The producer chooses a larger and, hence, more efficient network, if profits in one market (in goods), i.e., Y multiplied by the profit margin $\frac{1}{\eta}$, relative to the costs (in goods) of serving one more market, μ, are higher. In addition, in this choice, producers take into account the effect of their workforce size on their wages and, hence, their operating profits. This effect becomes stronger when the size-wage trade-off becomes steeper as captured by the elasticity $\frac{1+\hat{\omega}}{1+\eta\hat{\omega}}<1$, decreasing the network size.

Appendix F.2 also shows how aggregating the individual business network choice in Equation (4.9) leads to an expression for the average network size:

$$\bar{\Theta}=\frac{Y/\Gamma}{\mu}\frac{1}{\eta}\frac{1+\hat{\omega}}{1+\eta\hat{\omega}}. \tag{4.11}$$

Importantly, the average network size depends negatively on the size-wage elasticity, $\hat{\omega}$, as higher monopsony power discourages investments in business networks, in line with the data (see Figure 7).[23] It depends positively on the market size per producer acquired by one unit of business network investment spending, $\frac{Y/\Gamma}{\mu}$.

To derive a closed-form solution for the distribution of optimal business network choices, we need to make a distributional assumption about idiosyncratic productivity, z_i.

23. Note that Figure 7 displays positive relationships because the y-axis uses West-East and the x-axis East-West differences.

We assume that z_i is log-normally distributed, $z_i \sim LN(\ln \bar{z}, \Sigma^2)$ and define $\phi = \exp\left(\frac{1}{2}\Sigma^2\right)$, such that average productivity is $\bar{z}\phi$.[24]

This distributional assumption allows us to to express individual business network choices, (4.9), as a function of z_i, labor market power, and distributional parameters (see Appendix F.3 for details):

$$\frac{\Theta_i}{\bar{\Theta}} = \left(\frac{z_i}{\bar{z}\phi}\phi^{-\frac{1}{\hat{\omega}}}\right)^{\frac{1+\hat{\omega}}{\hat{\omega}}}. \tag{4.12}$$

This equation highlights that the more a producer's productivity exceeds average productivity ($z_i > \bar{z}\phi$), the larger is its business network relative to the average. What is more, the increase is more than proportional because $\frac{1+\hat{\omega}}{\hat{\omega}} > 1$. This inequality is also the reason that $\log \Theta_i$, which is also normally distributed, has a larger variance than $\log z_i$. This means that the distribution of business networks, the distribution of Θ_i, is more right-skewed than the productivity distribution: The most productive producers build particularly large networks. The endogenous business network choice amplifies, therefore, productivity heterogeneity. This amplification becomes smaller as $\hat{\omega}$ increases: A stronger size-wage trade-off renders the acquisition of additional customers less attractive because wages rise faster.

Before we turn to the final intermediate producer decision, namely entry, we point out two properties of the optimal producer size. First, expressing l_i also as a function of z_i and combining it with (4.12), yields overall producer size as a function of individual productivity and aggregates (see Appendix F.3):

$$l_i \Theta_i = z_i^{1/\hat{\omega}} Y (\Gamma \bar{\Theta})^{\frac{\eta}{1-\eta}} \bar{\Theta} \left(\frac{1}{\bar{z}\phi}\phi^{-\frac{1}{\hat{\omega}}}\right)^{\frac{1+\hat{\omega}}{\hat{\omega}}}. \tag{4.13}$$

From this equation follows immediately that producer size is increasing in idiosyncratic productivity.

Second, from (4.13), we obtain an explicit solution for the standard deviation of log producer employment:

$$std(\log(l_i \Theta_i)) = std\left(\frac{1}{\hat{\omega}}\log z_i\right) = \frac{1}{\hat{\omega}}\Sigma. \tag{4.14}$$

That is, the distribution of log producer employment is, similarly to the distribution of business networks, normally distributed. Its dispersion depends positively on the standard deviation of idiosyncratic productivity, Σ. Importantly, and consistent with the data in Figure 6, it depends negatively on the size-wage elasticity.[25]

4.2.4. Producer Entry. We assume free producer entry which implies that competition drives average producer profits to zero. Denoting with $\lambda \bar{P}$ (λ is measured

24. Later we show that the plant size distributions in East and West Germany are well approximated by our model assuming a log-normal productivity distribution. Strictly speaking, we approximate the solution, ignoring the upper bound on Θ_i. The support of the log-normal distribution of z_i has no upper bound and, hence, there are always some firms for which (4.9) produces a $\Theta_i > 1$. However, in our calibration, that fraction is negligible.

25. Specifically, we refer to the middle-upper panel in Figure 6. Note that Figure 6 displays positive relationships because the y-axis uses West-East and the x-axis East-West differences.

again in terms of the output good) the costs to establish a producer, the zero profit condition reads

$$\int \Theta_i y_i \left(p_i - \frac{w_i}{z_i}\right) di - \int \mu \bar{P} \Theta_i di = \lambda \bar{P}, \tag{4.15}$$

for given business model choices and price setting, where we use that producers learn their idiosyncratic productivity level, z_i, only after entry.

The gross profits per unit of goods sold (in terms of goods) are constant in every market and equal to $1/\eta$. Therefore, the expected gross profits are this profit margin times the average goods sold per producer which is Y/Γ. This implies that the zero-profit condition simplifies to

$$\frac{Y}{\Gamma}\frac{1}{\eta} = \lambda + \mu \bar{\Theta}, \tag{4.16}$$

which equalizes expected gross profits with the entry costs, λ, plus average business network investment costs, $\mu \bar{\Theta}$.

4.3. *Equilibrium*

In equilibrium, the total amount of employment needs to equal aggregate labor supply, which we fix at one unit.[26] Hence, labor demand of all active producers, (4.13), integrated over all producers needs to be one:

$$\Gamma \int l_i \Theta_i di = \Gamma \int z_i^{\frac{1}{\hat{\omega}}} Y (\Gamma \bar{\Theta})^{\eta/(1-\eta)} \bar{\Theta} \left(\frac{1}{\bar{z}\phi} \phi^{-\frac{1}{\hat{\omega}}}\right)^{\frac{1+\hat{\omega}}{\hat{\omega}}} di = 1 \tag{4.17}$$

which, solving for Y, yields:

$$Y = \bar{z}\phi (\Gamma \bar{\Theta})^{\frac{1}{\eta - 1}} \phi^{\frac{2}{\hat{\omega}}}. \tag{4.18}$$

This equation highlights two key properties of the model: First, aggregate output increases not only with expected technical productivity, $\bar{z}\phi$, but also in the mass of intermediate good producers connected with the representative bundler, $\Gamma \bar{\Theta}$. This network size effect is important because of love-of-variety at the level of the bundlers. It reflects the fact that a larger variety of intermediate inputs used by the final good bundlers increases their efficiency. Second, the last term, $\phi^{\frac{2}{\hat{\omega}}}$, is a labor allocation effect similar to the Oi-Hartman-Abel effect (see Oi, 1961; Hartman, 1972; Abel, 1983). It arises through the complementarity of labor and technical productivity, z_i. This complementarity can be exploited better when a low $\hat{\omega}$ allows for a higher concentration of labor at the most productive producers.

Ultimately, Equation (4.18) together with the average network size, (4.11), and producer entry, (4.16), determine the aggregate equilibrium in the economy. Normalizing

26. Assuming that the cost of business network creation, μ, the cost of increasing the share of connected customer-bundlers by one unit, scales with population size makes this an innocuous normalization even though the economy features an aggregate demand externality, as we show below.

average producer productivity $\bar{z}\phi$ to one and solving these equations for aggregate output, the average mass of connected bundlers, and the share of active producers yields:

$$Y = \left(\frac{1}{\mu\eta}\frac{1+\hat{\omega}}{1+\eta\hat{\omega}}\right)^{\frac{1}{\eta-2}} \left(\phi^{\frac{2}{\hat{\omega}}}\right)^{\frac{1}{\eta-2}} \phi^{\frac{2}{\hat{\omega}}}, \tag{4.19}$$

$$\bar{\Theta} = \frac{\lambda}{\mu}\left[\frac{1}{\eta-1}\left(\frac{1+\hat{\omega}}{\hat{\omega}}\right)\right], \tag{4.20}$$

$$\Gamma = \frac{1}{\lambda}\frac{\eta-1}{\eta}\frac{\hat{\omega}}{1+\eta\hat{\omega}}Y. \tag{4.21}$$

Equation (4.19) shows that output is the product of three terms, which are all negatively affected by the size-wage trade-off. The last term, $\phi^{\frac{2}{\hat{\omega}}}$, is the aforementioned labor allocation effect on output that would also be present in a pure monopsony model with heterogeneous producers but without endogenous customer acquisition (and without product market power), as we show in Appendix G.[27] In other words, there is an output loss because labor market power leads to insufficient employment at large, productive firms.

Dividing (4.18) by (4.19) (and taking into account the normalization of productivity $\bar{z}\phi = 1$) yields a convenient interpretation of the first two terms of the right hand side of (4.19): They reflect the efficiency of the transformation of intermediate goods into final goods, a love-of-variety effect. This efficiency depends on $\Gamma\bar{\Theta} = \left(\frac{1}{\mu\eta}\frac{1+\hat{\omega}}{1+\eta\hat{\omega}}\right)^{\frac{\eta-1}{\eta-2}} \left(\phi^{\frac{2}{\hat{\omega}}}\right)^{\frac{\eta-1}{\eta-2}}$, the number of varieties available to bundlers, which is negatively affected by monoposony power. The first term, $\left(\frac{1}{\mu\eta}\frac{1+\hat{\omega}}{1+\eta\hat{\omega}}\right)$, reflects the fact that all producers reduce their business network size because of their monopsony power. This term would also be present in a model without producer heterogeneity, $\phi = 1$. The second term, $\phi^{\frac{2}{\hat{\omega}}}$, reflects the fact that it is particularly harmful that the most productive producers reduce their network size. The fact that both terms enter the average network size with an exponent, $\frac{\eta-1}{\eta-2}$, larger than one, reflects that there is a demand externality in the model, which can also be seen in (4.21): When aggregate demand is high, more producers enter, the number of varieties increases and the economy becomes more productive. In turn, output increases further and, hence, also demand.[28] Turning now to Equations (4.20) and (4.21), we see that monopsony power in the labor market decreases the size of business networks, $\bar{\Theta}$, and increases entry, Γ, given Y. The latter effect should not come as a surprise because monopsony power leads to higher profits, which incentivize entry. Importantly, however, the product of the two, the total number of available varieties and, therefore, the efficiency of the economy is negatively affected by $\hat{\omega}$. The effect on business network investments

27. Whether one interprets the impact of $\hat{\omega}$ on the allocation of labor across differently productive producers—through $\phi^{\frac{2}{\hat{\omega}}}$—as an inefficiency depends on the ultimate source of $\hat{\omega}$. We have discussed some potential sources in Section 4.2.2. Given the positive focus of this paper, we ultimately do not need to take a stance on this question.

28. This demand externality is one important difference to Kroft, Luo, Mogstad, and Setzler (2020), who discuss the effects of simultaneous labor market and product market power in a model in which each producer serves only a single product market. They find that product and labor market power dampen each other. The demand externality implies that an increase in product market power, which comes with an increase in love of variety, makes the distortions of the production network size that come from labor market power more detrimental in our model.

dominates. As a result, in an economy with large monopsony power in the labor market, there are fewer varieties available, and the varieties available originate more from entry as opposed to business investments. This means that, in such an economy, the typical entrant is small.

Perhaps surprisingly, the equations also show that the total number of varieties, $\Gamma\bar{\Theta}$, does not depend on the entry costs λ. Higher entry costs reduce producer entry. However, they increase the average output per producer, Y/Γ, see Equation (4.21), and thus incentivize business network investments, see Equation (4.11). By contrast, business network costs, μ, do affect negatively the total number of varieties as just highlighted. We discuss this further in Section 5.2.1.

From Equations (4.19) to (4.21), it also follows that aggregate labor compensation measured in final goods, which equals aggregate output minus entry and marketing costs, is proportional to aggregate output, where the proportionality factor is the inverse markup:

$$LC = Y - \Gamma(\lambda + \mu\bar{\Theta}) = Y\left[1 - \left(\frac{\eta-1}{\eta}\frac{\hat{\omega}}{1+\eta\hat{\omega}} + \frac{1}{\eta}\frac{1+\hat{\omega}}{1+\eta\hat{\omega}}\right)\right] = Y\frac{\eta-1}{\eta}. \tag{4.22}$$

This means that it is irrelevant whether we compare Y or LC differences across regions in what follows (assuming η is the same).

5. MODEL IMPLICATIONS

Using this model, we now quantify the implications of the differences in monopsony power between East and West Germany that we documented in Section 3, in particular those for aggregate productivity. Moreover, we provide additional cross-sectional and time-series evidence supporting the model's main mechanism.

5.1. *East-West Productivity and Size Differences*

The model contains five parameters, only three of which matter for the comparison of East and West German aggregate labor productivity: The degree of labor market power, $\hat{\omega}$, the degree of product market power, η, and the standard deviation of idiosyncratic technical productivity, Σ.

To isolate and quantify the effect of a steeper size-wage trade-off in East Germany, our calibration strategy is to set all parameters in East and West Germany to the same value except for labor market power. For $\hat{\omega}$, we use our baseline estimates ($\hat{\omega}_W = 0.078$, $\hat{\omega}_E = 0.094$) from Section 3.3.1. Bundesbank (2017) finds an average price-cost margin of 1.4 in Germany, and, therefore, we set $\eta = 3.5$. Finally, we calibrate the standard deviation of idiosyncratic log technical productivity, Σ (0.16), to match the share of employment in West German large plants.

The business network investment costs, μ, and entry costs, λ, are irrelevant for the *relative* productivity question. Therefore, we simply pick μ (25) such that the average business network is small ($\bar{\Theta} = 0.01$) and virtually no firm is connected to all bundlers. Given this choice, we calibrate λ (0.05) to match the average West German plant size (61 employees) in the data, i.e., we interpret the plant data as coming from single-plant firms. This notion of plant size allows us to impose a truncation at ten employees in the model simulation in line with the truncation in the data. We use this truncated numerical simulation whenever we evaluate the model's plant size distribution against

Table 4
Size distortions and output losses: model vs. data

Variable	Model West	Model East	Data West	Data East
		Private non-primary sector		
		$\hat{\omega}_W = 0.078$ and $\hat{\omega}_E = 0.094$		
$1/\Gamma$	**61.4**	44.8	**61.4**	46.4
Share E > 249	**0.39**	0.22	**0.39**	0.21
Y_{east}/Y_{west}	0.90		0.74	
		Manufacturing sector		
		$\hat{\omega}_W = 0.088$ and $\hat{\omega}_E = 0.131$		
$1/\Gamma$	**98.5**	57.2	**98.5**	64.2
Share E > 249	**0.55**	0.24	**0.55**	0.31
Y_{east}/Y_{west}	0.84		0.71	

Notes: The table compares model simulated moments to data moments from the *SES* (pooled 2006/10/14) and German national accounts for the private, non-primary sector (top panel) and manufacturing (bottom panel). $1/\Gamma$: Average plant size, *Share E* > 249: Share of employment at plants with more than 249 employees. Bold numbers are calibrated/calibration targets. Y_{east}/Y_{west}: Output per worker in East relative to West Germany.

the empirical one. However, we compute aggregate productivity in the model following the closed-form solution (4.19), i.e., using the non-truncated producer distribution, when we compare it to national accounts data that is based on the universe of producers.

The top panel of Table 4 displays the results of this exercise. First and importantly, by varying only $\hat{\omega}$, the model matches the moments of the plant size distribution (that were targeted for West Germany) extremely well also in East Germany where they were not targeted. That is, the average firm/plant size decreases from 61 to 45 employees compared to 46 in the data, and the share of workers employed at large firms/plants decreases from 39 to 22 percent compared to 21 percent in the data. As Figure 9 shows, this tight match of model and data in both East and West Germany extends to the entire employment-weighted plant size distribution, despite the fact that only two moments of the West German distribution are targeted.

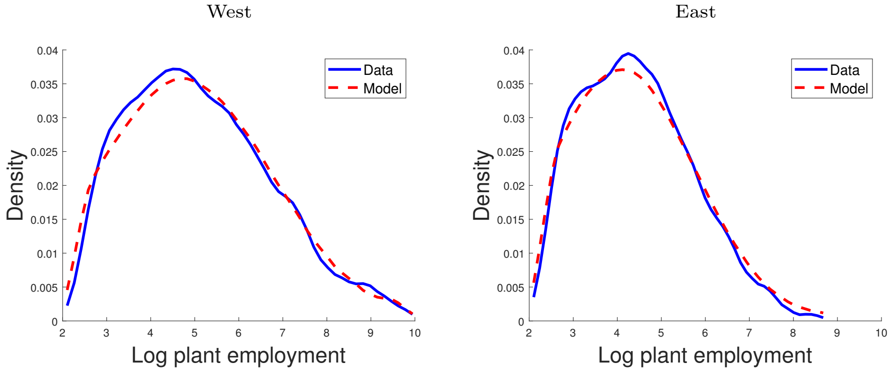
Second, the model, through these effects of $\hat{\omega}$ on the firm size distribution, implies a substantial productivity drop by ten percentage points. In other words, the model explains roughly 40 percent of the observed output differences per worker between East and West Germany. From Equation (4.22), it follows that the model also rationalizes a ten percentage points lower labor compensation.

Section 3.3.1 shows that East-West size and productivity differences are particularly large in manufacturing. To investigate whether the model is able to match this stylized fact, we next, keeping the general calibration strategy the same, recalibrate our economy to the manufacturing sector in West Germany. The bottom panel of Table 4 shows that the average plant size in manufacturing is larger than in the total private, non-primary sector and that a larger share of workers is employed at large plants. Accordingly, we adjust the dispersion of idiosyncratic productivity, Σ (0.17), and entry costs, λ (0.82). Bundesbank (2017) finds that average price-cost margins in manufacturing are lower than in the private sector as a whole, implying $\eta = 6$.

The bottom panel of Table 4 shows that also for the manufacturing sector the difference in the size-wage trade-off alone is able to explain the smaller average plant size and the lower share of employment at large plants in East Germany. Importantly,

FIGURE 9

Plant size distribution: model vs. data



Notes: The figures display the empirical employment-weighted plant size distributions (blue solid lines) for East and West Germany as well as simulations of the plant size distribution from our structural model (dashed red lines). Actual and simulated distributions are estimated using a Gaussian kernel smoother. Data source *SES* 2006/10/14, private non-primary sector, own calculations.

and consistent with the data, the model produces output differences in manufacturing that are larger than in the private sector as a whole. The model predicts that output in East Germany is 84 percent of output in West Germany, in the data it is 71 percent.

We can also use the model to decompose the predicted output losses into channels and sources. The top panel of Table 5 provides the decomposition into the two channels we have highlighted in Equation (4.19). In the private, non-primary sector, the total output effect is split roughly half into the business network size and the labor allocation effect. In manufacturing, the share of the effects is roughly one third and two thirds, respectively. Of the two terms that constitute the business network size effect, in the private non-primary sector, the term arising from heterogeneity is quantitatively larger than the effect that would also be present in a homogeneous producer model. In other words, the model implies that monopsony power is particularly costly when it discourages the most productive producers to choose a business model with many customers, rendering the business networks in the economy less efficient. In the manufacturing sector, the split is more even.

The bottom panel addresses how much of the output losses can be attributed to an effect stemming from the incidence of collective bargaining itself and the plant-size dependence of collective bargaining. East German workers on average are less likely to be paid according to a collective bargaining agreement, and wages paid according to a collective bargaining agreement depend in either region less on plant size. However, this has only a small effect on the overall size-wage elasticity. For the entire private non-primary business sector, it is 0.3% (out of 1.6%) as detailed in Section 3.3.2. For the manufacturing sector, the implied elasticity difference is 0.6%. The model predicts an output loss of 2.3% and 3.1%, respectively, from this source alone. The bulk of the size-wage elasticity difference, by contrast, stems from the plant-size dependence of collective bargaining. This leads to implied elasticity differences of 1.2% and 2.5% and output losses of 8.1% and 10.6%, respectively.

Table 5
Channels and sources of output losses

	Private non-primary	Manufacturing
Total productivity difference	10.3%	15.5%
Business network size effect, $(\Gamma\bar{\Theta})^{\frac{1}{\eta-1}}$	5.3%	5.6%
without heterogeneity, $\left(\frac{1}{\mu\eta}\frac{1+\hat{\omega}}{1+\eta\hat{\omega}}\right)^{\frac{1}{\eta-2}}$	1.9%	2.9%
with heterogeneity, $\phi^{\frac{2}{\hat{\omega}}\frac{1}{\eta-2}}$	3.5%	2.8%
Labor allocation effect, $\phi^{\frac{2}{\hat{\omega}}}$	5.2%	10.6%
Effect of		
average collective bargaining (CB)	2.3%	3.1%
plant-size dependence of CB	8.1%	10.6%

Notes: The table displays the output losses per worker in East relative to West Germany, $1-Y_{east}/Y_{west}$ from Table 4. The top panel decomposes, to the first order, the loss into the three channels highlighted in the discussion of Equation (4.19). The bottom panel shows the productivity losses when setting the size-wage elasticity differences to those implied by (1) the difference coming from differences in average collective bargaining coverage and the difference in the West German size-wage elasticities of collectively and non-collectively bargained wages (0.3% for the private non-primary sector and 0.6% for manufacturing); and (2) the estimated differences using the imputed wages as in Table 3 (1.2% for the private non-primary sector and 2.5% for manufacturing).

5.2. *Discussion of Additional Model Implications*

5.2.1. Wages, Business Network Investment Costs, and Consumption. In this subsection, we explore whether introducing wedges in the firm's decision problem can change output net of resources spent on entry and investment in business networks. Within the limitations of our model, we can think of this as aggregate consumption, C:

$$C := Y - \Gamma(\lambda + \mu\bar{\Theta}). \tag{5.23}$$

We establish two properties of the model: We begin by arguing that introducing a wedge on wages, intended to change a firm's incentive to hire has no effect on consumption. For the sake of concreteness, think of a wage subsidy. Intuitively, such a subsidy raises the labor demand of all producers but neither change the relative distortions of labor demand nor create incentives to invest in larger business networks. Wages go up one for one with the subsidy, this leaves profits unaltered, so that also entry does not change. With fixed aggregate labor supply, constant aggregate consumption follows. Appendix H contains the formal argument.

Next, introducing a wedge on business network investments, intended to increase a firm's incentive to create larger business networks, can increase consumption. The intuition for this result is that, first, product market power implies that the social resource cost of investing in business networks is smaller than the private resource cost, which includes the markup. Second, privately, the firm takes into account that larger networks require a larger workforce, which raises wages, when deciding about its business network investments. Yet, these private costs of higher wages are not social resource costs. As a result, a negative wedge, "a subsidy," on business investment can increase aggregate consumption because larger networks that render all producers more productive (in terms of the final good) create a positive externality by making more varieties available to bundlers. Appendix I formalizes this argument. It shows that there is a consumption-maximizing positive "subsidy", which also increases the number of active firms. This means that even in a setup where households have preferences not only over consumption but also over the number of employers they can work for (like in the monopsony model of Berger et al., 2022), these households should prefer such a subsidy.[29] Yet, as Appendix I also shows that such a subsidy can only ameliorate the business network size effect *without* heterogeneity (as defined in Table 5).

5.2.2. Sales per Worker. Thus far, we have studied the predictions of the model with respect to aggregate productivity differences. However, our model also has a strong prediction in terms of firm-level revenue productivity of labor: Its elasticity with respect to the total workforce equals $\hat{\omega}$. To see this, we note that the total sales of a firm are $p_i y_i \Theta_i$ and the total workforce is $l_i \Theta_i$. Using equation (4.3) and recalling that all firms charge the same price, we obtain that real sales per worker

$$\frac{\frac{p_i}{\bar{P}} y_i \Theta_i}{l_i \Theta_i} = \frac{p_i}{\bar{P}} z_i = (\Gamma \bar{\Theta})^{\frac{1}{\eta - 1}} z_i \tag{5.24}$$

is proportional to technical productivity. At the same time, we obtain from (4.13) that the number of employees,

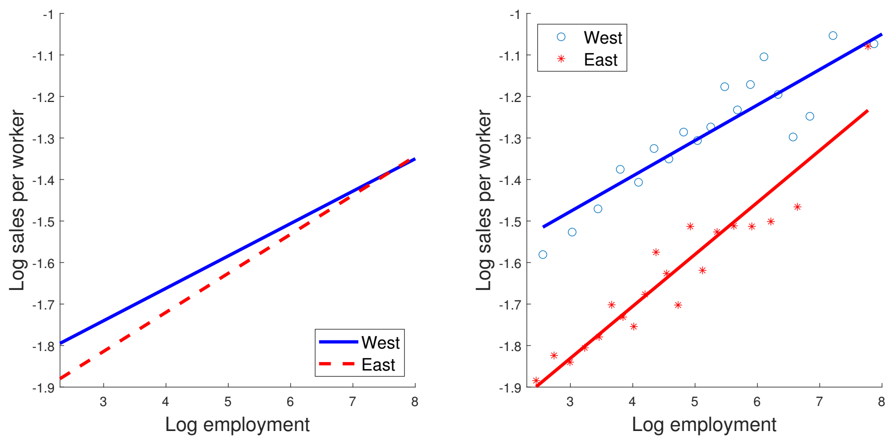
$$\bar{\kappa} (l_i \Theta_i)^{\hat{\omega}} = z_i \tag{5.25}$$

is log-linear in productivity, where $\bar{\kappa}$ is an aggregate shifter (that captures aggregate productivity). Combining both gives the stated result.

29. In our calibration, the output-net-of-cost maximizing "subsidy" would be 37% in West Germany and would increase output net of costs by 9%. Owing to the steeper size-wage curve, the optimal subsidy is slightly larger in East Germany (38%) and the output gain (again net of costs) would be 10%.

FIGURE 10
Firm size and sales per worker

Model Data



Notes: The figure shows the log sales per worker plotted against log employment. The left panel shows the relationship in our model (baseline calibration), the right panel shows a binscatter plot from the ZEW Mannheim Innovation Panel (2006-2014), ZEW (2016a), together with linear regressions (own calculations). Data are weighted by the square root of employment to capture precision. We adjust the aggregate price level (unit of account) in the model to match the empirical log-sales per worker of the East German firms with a workforce of 10 workers.

The MIP data contains both total employment and sales of firms and, thus, allows us to test this prediction, operationalizing the revenue product of labor as sales per worker. Figure 10 plots the relationship for the model (left panel) alongside a binscatter plot and linear regressions for the data (right panel). We find: (i) the log-relationship is a good fit, and (ii) the slope is steeper for East Germany, also as predicted, and (iii) the slopes in the data and in the model are of comparable magnitudes. In the data, the East and West German curves are further apart than in the model. This ultimately corresponds to the residual aggregate productivity difference between East and West Germany that our model cannot explain.

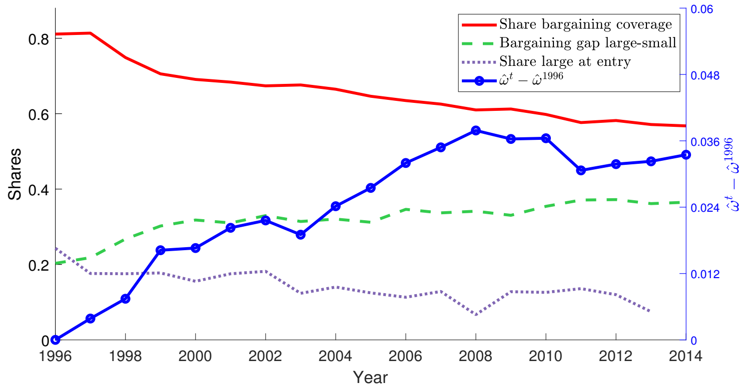
5.2.3. Time-Series Evidence. We, next, provide further suggestive evidence from the *AWFP* for the basic model mechanism, now from time series, see Figure 11.

We use similar statistics as in our earlier micro and cross-sectional evidence in Section 3. First, the figure shows that, in Germany as a whole, the fraction of workers covered by collective bargaining agreements has substantially declined over time, 24 percentage points between 1996 and 2014. What is more, collective bargaining declined foremost at small plants (for evidence on size-dependent retrenchment in collective bargaining see also Jäger et al., 2022).[30] In 1996, workers at plants with more than 249 employees

30. In an influential study, Brown and Medoff (1978) show that, at the industry level in the U.S., high unionization rates are positively associated with labor productivity. Subsequent studies fail to confirm this earlier finding using within-industry, firm-level data (see Hirsch, 2004, for a survey). Our analysis suggests that these results may not be contradictory. At an aggregate (industry) level, an

Figure 11

Large plants, steepness of the size-wage curve, and collective bargaining over time



Notes: On the left axis, the figure displays for all of Germany, private non-primary sector, over time and employment-weighted the share of workers covered by a collective bargaining agreement (share bargaining coverage), the difference in the probability to be covered by collective bargaining for workers at plants with at least 250 employees relative to workers at plants with fewer employees (Bargaining gap), and the share of employment at plants of at least 250 employees in an entering cohort of plants, four quarters after entry (share large at entry). On the right axis, it displays the steepness of the size-wage curve minus its steepness in 1996 ($\hat{\omega}^t - \hat{\omega}^{1996}$). Data sources: *AWFP* for $\hat{\omega}^t - \hat{\omega}^{1996}$ and "share large entry" and *IAB Establishment Panel*, for "Share bargaining coverage" and "Bargaining gap", own calculations.

had a 20 percentage points higher probability to be covered by collective bargaining compared to workers at plants with fewer employees. This gap rose to 37 percentage points by 2014. Second, and in line with our cross-sectional evidence, this selective decline in collective bargaining goes along with a Germany-wide steepening of the size-wage curve, here estimated from the AWFP data available annually, (see also Kovalenko, Sauerbier, and Schröpf, 2024, reconfirming our evidence). Finally, and again in line with the cross-sectional data (industry differences across East-West) and our theory, there is a concomitant trend towards smaller plant sizes (at entry). Figure 11 shows that 24% of all employees of an entry cohort used to be at large plants in 1996. This share has declined to 12% by 2013.

Turning back to East-West differences in size-wage elasticities, we use again the *SES* data starting in 2006, but extending the time period to 2018, to study their time-series behavior. Over time, the differences have shrunk; the model-implied long-run output losses, therefore, have also shrunk, see Table 6. Given the static nature of the model, these output losses need to be interpreted as steady state differences. Thus, their changes should be understood as changes of long-run convergence targets a richer, dynamic model would speak to.

increase in unionization of small plants flattens ex-ante size-wage curves, making it more attractive to choose productivity-enhancing large-scale business models. This raises aggregate labor productivity. However, given that the threat of unionization affects business model choices at entry, productivity differences need not manifest themselves when individual unionized and non-unionized firms are compared within industry.

Table 6

Size-wage elasticities over time in the SES and implied long-run output losses

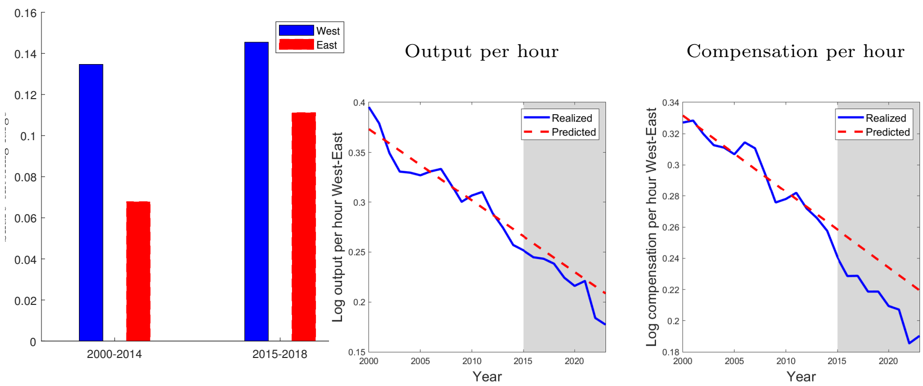
	2006	2010	2014	2018
Size-Wage elasticity, West, $\hat{\omega}_W$	7.1 (0.2)	7.6 (0.2)	8.7 (0.2)	8.9 (0.2)
Difference in elasticities, $\hat{\omega}_E - \hat{\omega}_W$	2.0 (0.5)	1.6 (0.5)	0.8 (0.5)	-0.5 (0.4)
Implied elasticity, East, $\hat{\omega}_E$	9.1	9.2	9.5	8.4
N (in thousands)	1097	917	351	357
Implied long-run output loss	15.1%	11.3%	4.9%	—

Notes: The table displays the estimated size-wage elasticities for the non-primary private sector in West and East Germany in 2006/2010/2014/2018 using the baseline specification. Standard errors are in parentheses. All coefficients are multiplied by 100 for better readability. Data source: *SES* 2006/2010/2014/2018, own calculations. The last row displays, by survey year, the model-implied long-run output loss for East Germany stemming from its higher estimated size-wage elasticity.

The convergence in size-wage curves was particularly strong after 2014.[31] Therefore, we would expect the following: (i) the size of firms at entry should go up in East Germany relative to West Germany, and (ii) productivity convergence between East and West should be accelerated. Both predictions are borne out in the data. First, we use the *AWFP* data (extended to 2018) to compare entry cohorts in terms of the share of employment at large plants before and after 2014. This comparison can be found in the left panel of Figure 12. The East-West difference has shrunk substantially after 2014.

FIGURE 12

Changes in convergence, West and East Germany, after minimum wage introduction



Notes: The left panel displays the share of employment of large plants (¿249 employees) one year after entry for 2000-2014 and 2015-2018 for East and West Germany. Data source: *AWFP*.
The center and right panels show the log difference in output per hour (center) and compensation per hour (right) between West and East Germany. The blue solid lines are the actual data, the red dashed lines are linear trends estimated on the 2000-2014 data. Data source: *VGR*, own calculations.

Second, with all the caveats that come with a simple trend extrapolation exercise, we compare the relative developments of output per hour and compensation per hour in

31. This likely reflects, to some extent, a major policy change in Germany in 2015 that we can expect to affect size-wage curves. Germany, for the first time, introduced a national minimum wage. This was more binding in East Germany (see e.g. Dustmann et al., 2022). While a wage floor does not map one-for-one into $\hat{\omega}$ or otherwise easily into our model, as it would break the log-linear structure, it is clear that it lowers the relative advantage of choosing a small-scale business model with few customers and few low-paid employees.

East and West Germany after 2014 to its trend until 2014, see the center and right panel of Figure 12. Both in terms of output per hour and compensation per hour, convergence between East and West Germany has substantially accelerated relative to what the wage trend until 2014 suggests: After 2014, the realized time series are below the predicted trend in every single year.

6. CONCLUSION

Large aggregate labor productivity differences persist across regions where government policies (and legal institutions enforcing these) are almost identical. We consider the case of Germany where, more than two decades after reunification, the East German private, non-primary sector remains about 25% less productive than its West German counterpart. We show that this difference in productivity is closely linked to differences in the size distribution of plants, which are, in turn, related to differences in collective bargaining by plant size. In East Germany, collective bargaining is much more concentrated at large plants than it is in West Germany. This selective difference in collective bargaining creates incentives to chose business models in East Germany where the plant and its associated firm stays small. By staying small, the firm avoids paying high collectively-bargained wages, i.e., more size-dependent collective bargaining creates additional labor market monopsony power in East relative to West Germany. Finally, these East-West differences in monopsony power correlate with differences in average wages, productivity, and various measures of business network investments.

We develop a model that merges labor market power and customer acquisition, in the form of business network investments, and show that labor market power distorts the size distribution of firms and lowers, thereby, aggregate labor productivity. When firms face steeper size-wage curves and, thus, have more labor market power, they decide to invest less in business networks because otherwise they would require a larger workforce, which raises wages. This leads to long-run business models relying on smaller production networks for all firms and to a smaller concentration of workers at the most productive firms. Both channels affect aggregate labor productivity adversely. The model, calibrated to the estimated difference in monopsony power and the West German plant size distribution, matches the East German plant size distribution extremely closely and explains about 40 percent of the observed lower labor productivity in East Germany. Put differently, monopsony power in the labor market has strong negative aggregate productivity effects.

Acknowledgments. We thank seminar participants at various conferences and universities for their comments. Christian Bayer gratefully acknowledges funding from the European Research Council under the European Union’s Seventh Framework Program (FTP/2007-2013) / ERC Grant agreement no. 282740 and support by the DFG through CRC TR-224 as well as through Germany’s Excellence Strategy (EXC 2126/1 – 390838866). Christian Bayer was a visiting professor at the German ministry of finance while part of this research was conducted. The usual disclaimer applies. Felix Wellschmied gratefully acknowledges financial support through grants RYC2023-043181-I, PID2024-158085NB-I00, and CEX2021-001181-M funded by MICIU/AEI/ 10.13039/501100011033 and by ERDF/UE and thanks the Department of Economics at ITAM for its hospitality. Heiko Stüber gratefully acknowledges support from the German Research Foundation (DFG) under priority program “The German Labor Market in a Globalized World” (SPP 1764).

Supplementary Data

Suplementary data are available at Review of Economic Studies online.

Data Availability

SES data (DESTATIS, 2006, 2010, 2014, 2018), IAB data (IAB, 2019, 2018), and ZEW data (ZEW, 2016b) are proprietory and confidential. The authors were granted access under license of the respective proprietors. The data are publicly available for scientific use upon presentation of a research proposal and, in case of the SES, against a fee. The replication package describes in detail how researchers can obtain access to the data and is available on Zenodo: https://doi.org/10.5281/zenodo.18367172

References

Abel, A. B. (1983). Optimal investment under uncertainty. *American Economic Review 73*(1), 228–233.

Arkolakis, C. (2010). Market penetration costs and the new consumers margin in international trade. *Journal of Political Economy 118*(6), 1151–1199.

Azar, J., E. Huet-Vaughn, I. Marinescu, B. Taska, and T. Von Wachter (2024). Minimum wage employment effects and labour market concentration. *Review of Economic Studies 91*(4), 1843–1883.

Bachmann, R., C. Bayer, C. Merkl, S. Seth, H. Stüber, and F. Wellschmied (2021). Worker churn in the cross section and over time: New evidence from germany. *Journal of Monetary Economics 117*, 781–797.

Bayer, C. and M. Kuhn (2018). Which ladder to climb? wages of workers by job, plant, and education. *CEPR Discussion Paper No. DP13158*.

Becker, S. O., L. Mergele, and L. Woessmann (2020). The separation and reunification of germany: Rethinking a natural experiment interpretation of the enduring effects of communism. *Journal of Economic Perspectives 34*(2), 143–71.

Berger, D. W., K. F. Herkenhoff, and S. Mongey (2022). Labor market power. *American Economic Review 112*(4), 1147–93.

Bilbiie, F. O., F. Ghironi, and M. J. Melitz (2012). Endogenous entry, product variety, and business cycles. *Journal of Political Economy 120*(2), 304–345.

Boltho, A., W. Carlin, and P. Scaramozzino (1997). Will east germany become a new mezzogiorno? *Journal of Comparative Economics 24*(3), 241–264.

Braguinsky, S., L. G. Branstetter, and A. Regateiro (2011). The incredible shrinking portuguese firm. *NBER Working Paper No. 17265*.

Brown, C. and J. Medoff (1978). Trade unions in the production process. *Journal of Political Economy 86*(3), 355–378.

Bundesbank (2017). Mark-ups of firms in selected european countries. *Monthly Report, December* (December 2017), 53–67.

Burda, M. (2006). Factor reallocation in eastern germany after reunification. *American Economic Review (Papers and Proceedings) 96*(2), 368–374.

Burdett, K. and D. T. Mortensen (1998). Wage differentials, employer size, and unemployment. *International Economic Review 39*(2), 257–273.

Card, D., A. R. Cardoso, J. Heining, and P. Kline (2018). Firms and labor market inequality: Evidence and some theory. *Journal of Labor Economics 36*(S1), S13–S70.

Cingano, F., M. Leonardi, J. Messina, and G. Pica (2016). Employment protection legislation, capital investment and access to credit: Evidence from italy. *The Economic Journal 126*(595), 1798–1822.

Coviello, D., E. Deserranno, and N. Persico (2022). Minimum wage and individual worker productivity: Evidence from a large us retailer. *Journal of Political Economy 130*(9), 2315–2360.

DESTATIS (2006). Survey of earnings structures, doi: 10.21242/62111.2006.00.00.3.1.0. Technical report, RDC of the Federal Statistical Office and Statistical Offices of the Federal States.

DESTATIS (2010). Survey of earnings structures, doi: 10.21242/62111.2010.00.00.3.1.0. Technical report, RDC of the Federal Statistical Office and Statistical Offices of the Federal States.

DESTATIS (2014). Survey of earnings structures, doi: 10.21242/62111.2014.00.00.3.1.0. Technical report, RDC of the Federal Statistical Office and Statistical Offices of the Federal States.

DESTATIS (2018). Survey of earnings structures, doi: 10.21242/62111.2018.00.00.3.1.0. Technical report, RDC of the Federal Statistical Office and Statistical Offices of the Federal States.

DESTATIS (2023). Vgr der länder. Technical report, Statistisches Landesamt Baden-Württemberg.

Drozd, L. A. and J. B. Nosal (2012). Understanding international prices: Customers as capital. *American Economic Review 102*(1), 364–95.

Dube, A. and A. Lindner (2024). Minimum wages in the 21st century. In C. Dustmann and T. Lemieux (Eds.), *Handbook of Labor Economics*, Volume 5, pp. 261–383. Elsevier.

Dustmann, C., A. Lindner, U. Schönberg, M. Umkehrer, and P. vom Berge (2022, 08). Reallocation Effects of the Minimum Wage. *The Quarterly Journal of Economics 137*(1), 267–328.

Einav, L., P. J. Klenow, J. D. Levin, and R. Murciano-Goroff (2021). Customers and retail growth. *NBER Working Paper No. 29561*.

Ellguth, P., S. Kohaut, and I. Möller (2014). The iab establishment panel—methodological essentials and data quality. *Journal for Labour Market Research 47*(1), 27–41.

Fuchs-Schündeln, N. and R. Izem (2012). Explaining the low labor productivity in east germany - a spatial analysis. *Journal of Comparative Economics 40*(1), 1–21.

Garicano, L., C. Lelarge, and J. Van Reenen (2016). Firm size distortions and the productivity distribution: Evidence from france. *American Economic Review 106*(11), 3439–79.

Gourio, F. and L. Rudanko (2014). Customer capital. *Review of Economic Studies 81*(3), 1102–1136.

Hans-Böckler-Stiftung (2022). Zentrale einheitsgewerkschaft – die strukturen des fdgb. *https://www.gewerkschaftsgeschichte.de/ost-strukturen-des-fdgb.html accessed 15. July 2022.*

Hartman, R. (1972). The effects of price and cost uncertainty on investment. *Journal of Economic Theory 5*(2), 258–266.

Heise, S. and T. Porzio (2021). The aggregate and distributional effects of spatial frictions. *NBER Working Paper No. 28792*.

Hirsch, B. (2004). What do unions do for economic performance? *Journal of Labor Research 25*(3), 415–456.

Hsieh, C.-T. and P. J. Klenow (2014). The life cycle of plants in india and mexico. *The Quarterly Journal of Economics 129*(3), 1035–1084.

IAB (2018). Administrative worker and labor flow panel. Technical report, Institut für Arbeitsmarkt- und Berufsforschung.

IAB (2019). Establishment panel. Technical report, Institut für Arbeitsmarkt- und Berufsforschung.

Jäger, S., S. Noy, and B. Schoefer (2022). The german model of industrial relations: Balancing flexibility and collective action. *Journal of Economic Perspectives 36*(4), 53–80.

Jäger, S., C. Roth, N. Roussille, and B. Schoefer (2024). Worker beliefs about outside options. *The Quarterly Journal of Economics 139*, 1505–1556.

Johnson, P. and C. Papageorgiou (2020). What remains of cross-country convergence? *Journal of Economic Literature 58*(1), 129–75.

Kovalenko, T., T. Sauerbier, and B. Schröpf (2024). The fall and rebound of average establishment size in west germany. *Deutsche Bundesbank Discussion Paper No. 11/24*.

Kroft, K., Y. Luo, M. Mogstad, and B. Setzler (2020). Imperfect competition and rents in labor and product markets: The case of the construction industry. *NBER Working Paper No. 27325*.

Ku, H. (2022). Does minimum wage increase labor productivity? evidence from piece rate workers. *Journal of Labor Economics 40*(2), 325–359.

Lamadon, T., M. Mogstad, and B. Setzler (2022). Imperfect competition and rent sharing in the us labor market. *American Economic Review 112*, 169–212.

Manning, A. (2003). *Monopsony in Motion*. Princeton University Press.

Manning, A. (2011). Imperfect competition in the labor market. In *Handbook of Labor Economics*, Volume 4, Part B, pp. 973–1041. Elsevier.

Melitz, M. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica 71*, 1695–1725.

Oi, W. Y. (1961). The desirability of price instability under perfect competition. *Econometrica 29*, 58–64.

Schnabel, C. (2005). Gewerkschaften und arbeitgeberverbände: Organisationsgrade, tarifbindung und einflüsse auf löhne und beschäftigung. *Zeitschrift für Arbeitsmarkt Forschung-Journal for Labour Market Research 38*(2/3), 181–196.

Sedláček, P. and V. Sterk (2017). The growth potential of startups over the business cycle. *American Economic Review 107*(10), 3182–3210.

Sleifer, J. (2006). *Planning Ahead and Falling Behind: The East German Economy in Comparison with West Germany 1936-2002*. Volume 8: Jahrbuch für Wirtschaftsgeschichte: Beiheft. Akademie Verlag.

Snower, D. J. and C. Merkl (2006). The caring hand that cripples: The east german labor market after reunification. *American Economic Review 96*(2), 375–382.

Stüber, H. and S. Seth (2018). The administrative wages and labor market flow panel. *FAU Discussion Papers in Economics No. 01/2017 (updated Dec. 2018)*.

Svejnar, J. (2002). Transition economies: Performance and challenges. *Journal of Economic Perspectives 16*(1), 3–28.

Uhlig, H. (2006). Regional labor markets, network externalities and migration: The case of german reunification. *American Economic Review (Papers and Proceedings) 96*(2), 368–374.

Weinand, S. and L. von Auer (2020). Anatomy of regional price differentials: Evidence from micro-price data. *Spatial Economic Analysis 15*(4), 413–440.

ZEW (2016a). Mannheim innovation panel, mip (on-site access). Technical report, Zentrum für Europäische Wirtschaftsforschung, Mannheim, Germany.

ZEW (2016b). Mannheim innovation panel, mip (scientific-use files). Technical report, Zentrum für Europäische Wirtschaftsforschung, Mannheim, Germany.