

The Effect of Outsourcing on Remaining Workers, Rent Distribution, and Inequality

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Abstract

Firms can decide whether to produce some goods and services in-house or purchase them from the market. Increasingly, they are purchasing from the market—using subcontractors, temp agencies, and other outsourced labor. Low-wage workers’ wages decline when they are outsourced, but little is known about how outsourcing affects remaining workers. If firms are rent sharing, outsourcing might increase remaining workers’ earnings because there are more rents or fewer workers to share them with. This paper measures the impact of occupational layoff (OL) outsourcing, where firms outsource some occupations, on the earnings and separations of workers who remain employed by those firms. Using employer-employee data based on German social security records in a dynamic difference-in-differences design, outsourcing increases remaining workers’ long-run earnings by 6% in a sample of 260 OL outsourcing events. Remainders are also more likely to stay at the outsourcing firm—outsourcing decreases the probability of remainders switching firms by 7.5 percentage points. Higher earnings and fewer separations are consistent with remainders receiving additional rents. Earnings gains are larger for workers in the bottom-half of the within-firm earnings distribution. Outsourcing only increases remainders’ earnings in firms with collective bargaining agreements (CBAs). In firms with CBAs, outsourcing increases remainders’ long-term earnings by 6%. In firms without CBAs, outsourcing lowers short-term earnings by 3%. The results are consistent with a model of wage setting where outsourcing firms with CBAs need to compensate remainders. When there is no CBA, firms

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do not compensate remainers and can lower their wages. Analyzing the impact of outsourcing on within-firm and overall wage inequality, a typical outsourcing event in the sample lowers the within-firm Gini index by 5% as low-wage workers leave the firm and low-wage remainers are compensated. Using Recentered Influence Functions, increasing the share of workers part of an outsourcing event by 1 percentage point (from a baseline of 11.7%) increases earnings at the top of the distribution by approximately 10-15%, and the overall Gini index by 10%. Remainers are relatively high-wage, and outsourcing increases their earnings. By not accounting for this effect, prior studies likely underestimate the total impact of outsourcing on earnings inequality in Germany.

1 Introduction

Firms are increasingly relying on new contract relationships to perform important functions. Firms are using fewer occupations (Bloom, Guo, and Lucking, 2019; Handwerker, 2020), a sign of increased outsourcing and subcontracting. While this trend towards fewer occupations and increased outsourcing began in the 1980s and 1990s, it continues today. Outsourcing reduces outsourced workers' wages and increases inequality.¹ After being outsourced, low-wage workers end up in firms which pay less (Goldschmidt and Schmieder, 2017). But what happens to workers who remain in outsourcing firms? If firms are sharing profits with workers, outsourcing will increase profits and has decreased the number of workers. Outsourcing could therefore increase remainers' wages. How might the increase to remainers' wages affect inequality? If remaining workers are high-wage, outsourcing would further increase income inequality—the outsourced are poor and get poorer, and the remainers are rich and get richer. Thus, the effect of outsourcing on wage inequality depends on the effect on both outsourced workers and workers who remain in the firm.

As discussed by Coase (1937), outsourcing is a “make-or-buy” decision. If a firm wants to have their offices cleaned, they have two options. The first is to hire cleaners—producing in-house. The second is to buy from the market—hire a separate firm to provide cleaners. Firms which produce in-house are responsible for “information flow, incentives, monitoring, and performance evaluation” (Klein, 2005), meaning that in-house production is potentially costly. When buying from the market, the firm must negotiate contracts, pay transaction costs (Williamson, 1979) and the agreed-upon price for a given service. Firms will decide to purchase from the market when those transaction costs are low, or the incentive and monitoring costs are high. Changes in technology (Abramovsky and Griffith, 2005; Bergeaud et al., 2021), law (MacLeod and Nakavachara, 2006), or wages of contracted labor (Dustmann, Fitzenberger, et al., 2014) can make market transactions technically feasible or less expensive relative to in-house production. As a result of these changes,

¹There is some evidence of cross-country variation—see Dorn, Schmieder, and Spletzer (2018).

some firms outsource—remove an in-house service or product and purchase it from the market.

Previous work has focused on the effect of outsourcing on outsourced workers. (Dube and Kaplan, 2010; Drenik et al., 2021) This paper expands the investigation into the effect of outsourcing to examine the effects of outsourcing on another group—workers who are still employed by the firm. Under perfect competition, these remainers should not be affected by outsourcing, because their wage is their marginal product. However, if firms are sharing profits with workers (i.e. rent sharing), outsourcing could increase remainers’ wages because there are more rents to share and fewer workers to share them with. I outline a conceptual framework which explores the predicted effects of outsourcing on remainers under several rent sharing models. Models of intra-firm bargaining (Stole and Zwiebel, 1996; Cahuc, Marque, and Wasmer, 2008; Jäger and Heining, 2019), insider-outsider relations (Lindbeck and Snower, 1986; Lindbeck and Snower, 2001; Dolado and Bentolila, 1992), and union-mediated outsourcing (Frandsen, 2012) all predict increases in remainers’ earnings. Each model also has specific predictions about how different groups of remainers would be affected by outsourcing. By testing these predictions, I adjudicate between different wage setting models.

I apply the procedure developed by Goldschmidt and Schmieder (2017) Appendix B to a sample of nearly 5,000 firms linked to German administrative data. With these data, I observe the full set of workers and occupations in a firm.² Goldschmidt and Schmieder (2017) define “Occupational Layoff (OL) Outsourcing” events as instances where firms remove at least 75% of the jobs in a single occupation. Following this definition, I compare the earnings and retention patterns of remainers to similar workers in non-outsourcing firms. Methodologically, I use a matched dynamic difference-in-differences design on a sample of 260 OL outsourcing events. Outsourcing increases remainers’ earnings by 6% after 5 years relative to the control group. The earnings gains appear to be permanent—remainers’ earnings are approximately 6-7% higher at least 8 years after the outsourcing event. Outsourcing also decreases remainers’ probability of leaving the firm—remainers are 7.5 percentage points less likely to leave the outsourcing firm relative to the control group.³ This combination of results—higher earnings and fewer separations—is consistent with remainers’ obtaining more rents. There is little heterogeneity by worker tenure, education, or occupation. However, there is heterogeneity by worker’s wage ranking in the firm. For workers below the firm’s median wage, outsourcing increases earnings by 8.3%. For workers above the firm’s median wage, outsourcing increases earnings by 4.6%. This means that firms are reallocating rents to the lowest-wage remainers. This result is

²Observing outsourcing is generally difficult because researchers need to observe both the full set of workers in a firm and contracts between firms. I also cannot directly observe outsourcing.

³While hours worked are not observable in the data, there is no evidence of a change in part-time status, suggesting the earnings gain is a pure wage effect.

similar to Saez, Schoefer, and Seim (2019), who find similar rent sharing patterns in Swedish firms.

Comparing the results to the examined wage setting models, earnings gains at the bottom of the within-firm distribution are consistent with the model of union-mediated outsourcing. In the presence of a union, firms need workers' approval for outsourcing. In order to get that approval, firms compensate remainers by increasing wages for low-wage remainers more than high-wage remainers (though all remainers' wages increase). This compensation results in low-wage workers capturing more rents than high-wage workers. While firm-level unions (works-councils) cannot legally bargain over wages in Germany, Doellgast and Green (2007) demonstrate that German firms discuss outsourcing plans with works-councils, and that presence of a collective bargaining agreement (CBA) allows works-councils to extract concessions. This model also predicts that firms with weaker unions will not need to compensate remainers. I test this prediction by comparing whether the effect of outsourcing on remainers is stronger in firms with a CBA prior to the outsourcing event. In firms with a CBA, outsourcing increases remainers' earnings by 6% relative to the control group. In firms without a CBA, outsourcing decreases remainers' short-term earnings by 3% relative to the control group, though long-term earnings are unaffected. This decline is consistent with previous discussions on the role of outsourcing in reducing some remainers' wages (Doellgast and Green, 2007; Goldschmidt and Schmieder, 2017). The evidence shows that the presence of a CBA allows for workers to capture additional rents during outsourcing. When German firms outsource in the presence of a CBA, remainers are compensated. When there is no CBA, remainers' wages drop in the short-term. This result demonstrates the important role that collective bargaining plays in wage setting and rent allocation in the German labor market.

The interpretation that wage increases after outsourcing are caused by reallocating rents depends on whether alternative mechanisms can explain the results. I test several alternative explanations: (1) compensating differentials (Rosen, 1974; Smith, 1979; Rosen, 1986; MacLeod and Malcomson, 1989; Schettkat, 1993; Pedulla, 2011) (2) substitute workers "picking up the slack" (Currie, Farsi, and MacLeod, 2005) (3) more effective managers (Bloom, Brynjolfsson, et al., 2019; Bender, Bloom, et al., 2018) (4) increased productivity, (5) asymmetric information (Gibbons and Katz, 1991), and (6) fairness considerations (Rees, 1993; Card, Mas, et al., 2012; Dube, Giuliano, and Leonard, 2019). In each case, the empirical findings are inconsistent with these alternative explanations. For example, under compensating differentials outsourcing reduces job quality and earnings increase because the job has gotten "worse". Compensating differentials is inconsistent with the empirical finding that remainers are more likely to stay in the outsourcing firm. If earnings increases were due to compensating differentials, earnings would increase but separations would remain the same because workers are directly compensated. I examine each alternative mechanism in detail in Section

7.1.

Having demonstrated that outsourcing increases remainers' wages, what is the total effect of outsourcing on wage inequality? Recent work has found that wage inequality is increasing in both Germany (Card, Heining, and Kline, 2013) and the United States (Song et al., 2018). In both countries, increased wage inequality has been partially driven by sorting—high-wage workers are increasingly working in high-wage firms (Abowd, Kramarz, and Margolis, 1999). Both Card, Heining, and Kline (2013) and Song et al. (2018) suggest outsourcing is a potential mechanism for increased inequality. Goldschmidt and Schmieder (2017) show that outsourcing among low-wage occupations increased wage inequality in Germany. However, because remainers wages increase, that analysis may have under or over-estimated the effect of outsourcing on inequality. If remainers are low-wage and outsourcing increases their wages, Goldschmidt and Schmieder (2017) over-estimated the effect of outsourcing on inequality. If, instead, remainers are high-wage and their earnings increase, Goldschmidt and Schmieder (2017) under-estimated the effect of outsourcing on inequality. I examine the effect of outsourcing on within-firm earnings inequality and aggregate earnings inequality. After outsourcing, within-firm inequality declines—the within-firm 90-10 wage ratio declines by 10% and the Gini index declines by 5%. This decline in within-firm inequality occurs because the firms remove low-wage workers and outsourcing increases low-wage remainers' earnings more. This result is consistent with outsourcing as a partial explanation for recent sorting trends.

To estimate the total impact of outsourcing on earnings inequality, I incorporate the effect of outsourcing on remainers' earnings. This total effect is estimated using a matched difference-in-differences design combined with Recentered Influence Functions (RIF) following Firpo, Fortin, and Lemieux (2009). This methodology allows for estimation of the total effect of outsourcing on different parts of the wage distribution, incorporating the wage effect on remainers. Compared to the overall earnings distribution in the data, workers who leave the firm at the time of OL outsourcing are slightly poorer than the population, while remainers are substantially wealthier.⁴ Because the number of remainers substantially outweighs the number of leavers, there is no effect of the identified outsourcing events on the bottom of the unconditional earnings distribution. However, OL outsourcing increases the top of the unconditional earnings distribution. Increasing the share of all workers part of an outsourcing event by 1 percentage point (from a baseline of 11.7%) increases the top 3 deciles of the wage distribution by approximately 10-15%. When separating this effect out by leaving workers and remainers, increasing the share of all workers who are leavers by 1 percent-

⁴The fact that leavers are poorer than the population is again consistent with high-wage outsourcing firms removing their lowest-wage workers.

age point (from a baseline of 1.67%) reduces the bottom of the overall wage distribution by 25% (though these estimates are imprecise) and has no effect on the top of the wage distribution. Increasing the share of all workers who are remainers by 1% has no effect on the bottom of the unconditional earnings distribution, and increases the top three deciles of the unconditional earnings distribution by 10-15%.⁵

Examining measures of inequality, a 1 percentage point increase in the share of workers part of an outsourcing event increases the Gini index by approximately 10% and the variance of log wages by 5%. The results in this paper provide direct evidence on the effect of outsourcing on remaining workers in the firm. This is an important element of understanding the aggregate wage impacts of outsourcing. The literature has thus far focused on the impacts of outsourcing on the outsourced (Dube and Kaplan, 2010; Goldschmidt and Schmieder, 2017; Dorn, Schmieder, and Spletzer, 2018) or wage comparisons between outsourced and non-outsourced labor (Drenik et al., 2021). Compared to prior studies, this paper also utilizes a wider array of potential occupations to examine outsourcing.

This paper adds to the literature on wage setting and rent sharing. There have been a number of hypotheses to explain rent sharing between firms and workers including intra-firm bargaining (Stole and Zwiebel, 1996; Cahuc, Marque, and Wasmer, 2008), turnover costs and insider-outsider relations (Lindbeck and Snower, 1986; Lindbeck and Snower, 2001; Lindbeck and Snower, 2002), and union-mediated bargaining (Frandsen, 2012; Saez, Schoefer, and Seim, 2019). Each of these models has distinct predictions about the effects of outsourcing on remaining workers. The evidence from the data is consistent with a model of union-mediated outsourcing. Outsourcing primarily increases low-wage remainers' earnings, though all workers gain. Additionally, the fact that remainers' earnings only increase in the presence of a CBA demonstrate the role unions play in wage setting in the German labor market. These results demonstrate one mechanism behind the fact that union-presence collapses within-firm wage structure—when the union is capable of bargaining over rents, they do so in a way that compensates the bottom half of the distribution (Pencavel, 1991; Card, Lemieux, and Riddell, 2004; Biasi and Sarsons, 2020). There is also evidence of a gender gap—outsourcing increases men's earnings more than women's.⁶ The gender gap in rent sharing is similar to previous studies (Black and Strahan, 2001; Card, Cardoso, and Kline, 2016).

This paper also adds to the literature on the impacts of outsourcing on sorting and wage inequality. Recent work has shown large increases in wage inequality in several countries, including both Germany and

⁵The predicted increases are large because only 11.7% of workers in the data are part of an outsourcing event. A 1 percentage point increase in share of workers represents an 8.5% relative increase ($12.7/11.7$) in the share of workers part of an outsourcing event. Whether the results represent a true change in the German wage structure is dependent on how well the data replicate the true wage distribution in Germany.

⁶This difference is significant at the 10% level.

the United States (Card, Heining, and Kline, 2013; Song et al., 2018). The results show that outsourcing decreases intra-firm wage inequality, consistent with firms outsourcing their lowest-wage workers Goldschmidt and Schmieder (2017). found that outsourcing increases wage inequality via declines in low-wage workers' earnings. The results show an additional impact of outsourcing—high-wage workers earnings increase. This result suggests Goldschmidt and Schmieder (2017) underestimate the impact of outsourcing on German wage inequality

Finally, this paper contributes to the literatures examining indirect measures of outsourcing (Handwerker, 2020; Bloom, Guo, and Lucking, 2019) and monopsony power (Manning, 2003; Cho, 2018; Caldwell and Oehlsen, 2018; Kroft et al., 2020). The descriptive results suggest German firms are outsourcing more. Additionally, similar to Handwerker (2020) and Wilmers and Aeppli (2021), occupational concentration is associated with firms paying higher wages to workers in high-wage occupations, and lower wages to workers in low-wage occupations. After outsourcing, firms become more concentrated in a smaller number of occupations, consistent with occupational concentration measures accurately capturing outsourcing.⁷ This paper adds to the literature on monopsony by using the combination of changing wages and separations to measure firms' labor-market power, as in the model of Manning (2003). Using a methodology similar to Bassier, Dube, and Naidu (2020), I estimate a firm labor supply elasticity of approximately 3.2—similar to other studies and suggestive of moderate monopsony power. There is also a dynamic effect—wages take 5 years to increase to their permanently higher level, but separations decline immediately. When estimating a labor supply elasticity, this results in varied measures of the elasticity depending on timing. This result can help explain varied estimates of firm-labor supply elasticities.

The remainder of this paper is organized as follows. Section 2 is the conceptual framework, which outlines several models of wage setting which demonstrate why remaining workers should be affected by outsourcing. Section 3 describes the setting and administrative data used to identify the OL outsourcing events. Section 4 presents descriptive results which suggest outsourcing has increased over time. Section 5 outlines the empirical strategy, the matched sampling algorithm used to select the relevant comparison group, descriptive information on matched workers, estimating equations, and identification assumptions. Section 6 presents the results on the effect of outsourcing on remaining workers. Section 7 discusses how these results fit with the models of wage setting in Section 2 and alternative mechanisms. Section 8 outlines the results on the effect of outsourcing on inequality, both within-firm and in-aggregate. Finally, in Section

⁷It is not necessarily the case that outsourcing and occupational concentration are correlated. Firms that are outsourcing could reallocate workers to new tasks, decreasing overall concentration.

9 I conclude.

2 Conceptual Framework

This section outlines a number of models of wage setting which illustrate how remainers might be affected by outsourcing. The models are: (1) perfect competition, (2) the canonical model of intra-firm bargaining and wage determination between firms (Stole and Zwiebel, 1996) where workers cannot be replaced in the short-run, (3) models of turnover costs, where it is costly for firms to hire new workers (Lindbeck and Snower, 2001), and (4) a model of union-mediated outsourcing (Frandsen, 2012). Each of these models has distinct predictions on how remainers can be affected by outsourcing. For the full details on the construction of these models, see Appendix A.

2.1 Predictions of Wage Setting Models

Perfect Competition

First, how would outsourcing affect remaining workers under perfect competition? There are many buyers and sellers of remainers' labor in the market, and no asymmetric information. Each worker's wage is exactly their marginal product of labor. Because wages are driven solely by productivity and there is perfect information, there should be no effect of outsourcing on remainers' wages. By definition, they are not affected by outsourcing, therefore wages should not be affected.

Intra-Firm Bargaining

What about intra-firm bargaining models? In the model of wage determination within firms by Stole and Zwiebel (1996), workers are homogenous and cannot be replaced in the short-run. The fact that workers cannot be replaced results in workers capturing some rents. If outsourcing is equivalent to reducing the number of workers in the firm, remainers' wages should increase because the average marginal product of workers has increased (Jäger and Heining, 2019). The other possibility is that outsourcing simply replaces the lowest marginal-product worker with a subcontractor. This would increase remainers' wages because there are fewer workers to share rents with. Extending the model to allow for heterogeneous labor, as in Cahuc, Marque, and Wasmer (2008), would result in heterogeneity by occupation. Specifically, under the Cahuc, Marque, and Wasmer (2008) model outsourcing will have different effects on remainers depending on

whether they are substitutes versus complements to the outsourced occupation. This is because outsourcing would have different effects on substitute versus complement workers' marginal product.

Insider-Outsider Model

In Insider-Outsider models, wages are driven by turnover costs. In the framework outlined in Lindbeck and Snower (2002), firms pay costs of hiring new workers, and are unable to pass these costs on to insiders (i.e. incumbent employees). These costs create a labor market friction. The lower the hiring costs, the more substitutable insider and outsider wages. The higher the hiring costs, the more insiders can threaten to not cooperate with new hires, and the higher the wages they can demand. Because there are fewer insiders, and those insiders are more central to the firm's production process, they can more credibly threaten to sabotage the firm, increasing remainers' wages. Extending the model to include rising labor turnover costs results in an additional prediction—there will be heterogeneity in the effect of outsourcing by worker tenure.⁸ Workers with higher tenure have higher turnover costs, and can therefore capture more rents. Increased rents for workers with higher tenure is similar to the results in Kline et al. (2019), where higher tenured workers receive more rents after a valuable patent is approved.

Union-Mediated Outsourcing

The previous sets of models focused on models of individual bargaining between workers and firms. What if wages were bargained collectively? As discussed in the next section, unions play an important role in wage determination in the German labor market. Frandsen (2012) outlines a model of wage bargaining in the presence of a union. In this model, the final wage structure results in more rents shared with workers at the bottom, because these workers are needed to approve a wage agreement. What would be the effect of outsourcing under this model? In unionized firms, the union can fight outsourcing and shut down production. To avoid this, the firm offers a new wage schedule in order to receive union approval. As in Frandsen (2012), this wage schedule will result in more rents being shared with remainers' at the bottom of the within-firm wage distribution, though all remainers' wages should increase. In firms with no or weak unions, there would be no effect of outsourcing on remainers. In this model, firms compensate to receive union approval. If the union is weak there is no need to compensate.

⁸The same result can be achieved with equal changes in firing costs and pre-existing differences in bargaining power.

Table 1: Models and Predictions		
Model	Predicted Effect on Remainers	Specific Prediction
Perfect Competition	No Effect	No Effect
Intra-Firm Wage Bargaining	Remainers' Wages \uparrow	Heterogeneity by Complement vs. Substitute
Insider-Outsider	Remainers' separationsWages \uparrow	Heterogeneity by Tenure
Union-Mediated Outsourcing	Remainers' Wages \uparrow	Larger effect on <i>low-wage</i> remainers No effect for firms with weaker unions

Notes: This table outlines the predicted effect of outsourcing on remainers wages under perfect competition and several models of wage bargaining: (1) the intra-firm bargaining models of Stole and Zwiebel (1996) and Cahuc, Marque, and Wasmer (2008) (2) the insider-outsider model of Lindbeck and Snower (2002) and (3) the model of union-mediation of Frandsen (2012). Predicted effect on remainers outlines the predicted average effect of outsourcing on all workers remaining in the firm. Specific prediction outlines each model's prediction of sources of heterogeneity.

Takeaways

Each model generated different predictions about the effect of outsourcing on remainers. Table 1 outlines these predictions.

In Section 7, I examine how each prediction matches the data. The results are most consistent with the predictions of the framework of union-mediated outsourcing. In the next section, I discuss the setting and data.

3 Setting and Data

3.1 Setting: The German Labor Market

This section outlines features of the German labor market. This description provides additional context to the empirical analysis. One important part of the German labor market is the widespread use of apprenticeships, multi-year training schemes which young workers work for a firm during their schooling. These apprenticeships have been lauded as one of the reasons for Germany's relatively high-level of manufacturing employment relative to other OECD countries.⁹ Many workers do not end up working at their apprenticeship firm. Bender and Wachter (2006) find that workers who stay in their apprenticeship firm earn higher wages, and these gains are permanent if the firm is particularly high-paying or large. Because apprenticeships are widespread, workers who are younger than 25 or in an apprenticeship/trainee job are removed from the

⁹See <https://data.oecd.org/emp/employment-by-activity.htm>

analysis.

Germany also has a wide use of so-called *mini* and *midi* jobs, jobs which pay less than 450 euros/month and 850 euros/month respectively. *midi* jobs are also known as jobs in the “sliding zone” or transition area, where employers and employees pay a reduced contribution to pension and health insurance. The sliding zone was introduced to avoid high tax burdens when workers switched from mini jobs to better-paid work.¹⁰ In 2019, the transition area increased to 1,300 euros. These part-time and more informal jobs were legalized in 2003 as part of the Hartz labor market reforms. Workers in these jobs pay preferential income tax rates, and employers have fewer requirements for these jobs. Because of the widespread use of these jobs, workers who are in *mini* jobs at the time of the outsourcing event are removed from the analysis.¹¹

The aforementioned Hartz reforms in the early 2000s form a key part of my identification strategy. The first part of the Hartz reforms (Hartz I) included the introduction of Personal-Service-Agenturs (PSAs) and liberalization of the temporary work sector. PSAs were introduced as a form of aiding job search during unemployment. During the first Hartz reform in 2003, each local employment office was directed to set up a PSA. Each employment office either “contract[ed] out to a private temporary work agency or, if no provider [was] available, may run a PSA itself.” (Jacobi and Kluve, 2006) PSAs received a monthly lump-sum fee for employing workers, and then would hire workers out temporarily to other firms or find permanent placements. PSAs received bonuses for successful placements, and also provided training for workers. The Hartz reform also “abolished restrictions synchronisation, re-assignment, fixed-term contracts and the maximum duration of temporary employment.” (Jacobi and Kluve, 2006) While firms were required to pay temporary workers equally, there was a loophole in instances where temporary workers were covered by collective bargaining agreements. These collective bargaining agreements were negotiated in 2002, and allowed temporary agencies to deviate from collectively agreed minimums. (Doellgast and Green, 2007) These policy changes made it easier and cheaper for firms to outsource by using workers in temporary help firms. There is a spike in outsourcing events after 2002, consistent with these reforms making outsourcing more attractive for firms.¹² Additionally, these reforms could also make outsourcing more attractive. Contracting firms are more likely to use temporary labor (Doellgast and Green, 2007). Overall, Hartz I would have made the use of contractors (i.e. an outside firm) more attractive. These reforms are a central part of my identification strategy—the Hartz reforms induced some firms to outsource by making it relatively cheaper to do so.

The German labor market also has very high levels of collective bargaining. In the United States,

¹⁰If workers have multiple *mini* or *midi* jobs, the contribution rate depends on the sum of all jobs.

¹¹Restricting to workers who are not in the “sliding zone” has no effect on the estimates.

¹²See Figure 2.

labor unions are establishment-specific. In contrast, the German collective bargaining system exists at two levels. This “dual system” operates at both the sector level and the establishment level. When collectively bargaining, wages and working conditions are first negotiated between employers and industry level unions. The industry-level sectoral bargaining system negotiates over “wage *floors*, hours and working conditions with employer associations” (Jäger, Schoefer, and Heining, 2020), meaning that employers can move to offer higher wages, but may be restricted in their ability to reduce wages. There are also establishment-level elected works-councils, which can further collectively bargain, but are formally restricted from influencing wages if there is a sector-level collective bargaining agreement (CBA). Firms can offer lower wages than the CBA if they have an “opening clause”. Opening clauses allow firms to deviate from a bargaining agreement under certain conditions. (Ellguth, Gerner, and Stegmaier, 2012) Firms can follow the industry-level wage agreement without having a work council, and firms with work councils may have establishment-specific agreements without following the industry-level agreement. Some firms do not have collectively bargained wage agreements. In recent decades there has been a large decline in collective bargaining rates. Dustmann, Fitzenberger, et al. (2014) report that there have been substantial declines in industry-level bargaining agreements. Dustmann, Ludsteck, and Schonberg (2009) and Card, Heining, and Kline (2013) suggest that the reunification process between East and West Germany was part of the reason for this decline. The decline in collective bargaining rates may also provide a direct reason for outsourcing. (Doellgast and Green, 2007) suggest that as union membership declines it makes it easier for firms to outsource because the union is weaker. When examining whether collective bargaining is correlated with outsourcing in Appendix E, there is no apparent relationship between whether a firm has a CBA and the decision to outsource. However, Appendix Table E.1 suggests that larger firms are more likely to outsource. These firms are more likely to have a CBA. (Dustmann, Fitzenberger, et al., 2014) As a result, the vast majority of remainers are in firms with a CBA.

The high rates of firm-worker bargaining, and the restrictions labor agreements put on firms make Germany a particularly useful setting to investigate the effect of occupational layoff (OL) outsourcing on remaining workers. Firms may be restricted by bargaining agreements from offering lower wages to specific workers, especially if there are required wage floors. Existing agreements between firms and workers’ councils may require the firm to compress wages.¹³ Wage compression gives firms a stronger incentive to outsource, especially because contractors are less likely to be covered by collective bargaining and more likely to use

¹³I do find that layoff firms pay workers in the OL outsourced occupation 1.2 times the occupation average – consistent with the firm seeking to reduce labor costs.

temporary help. (Doellgast and Green, 2007) As shown in Table 4 the workers in the outsourced occupation are very highly paid relative to their peers.

As discussed in Goldschmidt and Schmieder (2017), bargaining agreements might not cover firms’ decision to outsource. Therefore, outsourcing would allow firms to cut wages for specific occupations. However, firm-level unions can still agitate in order to stop outsourcing. Section 6.3 examines whether the treatment effect is lower based on type of collective bargaining agreement. The results in Figure 7 show that OL outsourcing only increases workers earnings in firms with a CBA prior to the outsourcing event. When there is no CBA, remaining workers earnings decline. This result is consistent with the framework discussed in Section 2. Under this framework, firms profit from outsourcing. However, they only compensate remaining workers in the presence of a bargaining agreement, which signifies a stronger union. This means that there may be no effect of outsourcing on remaining workers in countries like the United States, with lower levels of unionization and establishment-specific collective bargaining.

Next, I discuss the data used in the empirical analysis.

3.2 Data: German Social Security Records

To analyze the impact of outsourcing on remaining workers, I use matched employer-employee data based on German Social Security records from 1993-2014. The primary data are the Linked Employer-Employee Data from the IAB – Longitudinal Model (LIAB), provided by the Research Data Centre (FDZ) at the Institute for Employment Research (IAB). The LIAB is constructed around the IAB Establishment panel, a multi-year representative survey of German establishments conducted between 1993 and 2014.

The IAB survey asks establishments to report information on business volume, type of bargaining agreement, whether they are part of a multi-establishment firm, and other questions. The LIAB is comprised of firms which were part of the IAB for several years, so-called “panel firms.” The “panel firms” are linked with employment biographies of all workers employed at those firms from 2002-2012. This means that for the years 2002-2012, the data include every worker at a panel firm. For those workers, the data include their full employment history from 1993-2014. The employment history includes information on all firms, including employment in non-panel firms, demographic information, and detailed information on daily earnings. The earnings data are generally very accurate because they are provided for the administration of Social Security. Parts of the analysis utilize the Sample of Integrated Employment Biographies (SIAB). These data comprise a 2% sample of all German workers from 1976-2014, and contain the same information as the LIAB.

The data have some limitations. The earnings information is top-coded, and the top-coded value varies

by year. Wages above the top coded value can be reported, but it is unclear whether these are data errors or indicative of extra bonuses. Only 1.5% of the sample in the main analysis is a top-coded value.¹⁴ It is impossible to observe multi-establishment firms. The Social Security system assigns establishment identifiers based on industry and location. For example, two factories operated by the same firm in Bonn would have the same identifier code. Factories under the same firm in Berlin and Munich would have different establishment numbers. For the purposes of the analysis the terms firm and establishment interchangeably.

The data also include detailed occupation codes, which form a central part of the methodology for identifying OL outsourcing. The codes from 1993-2010 are a consistent, field-based, firm-recorded occupation code *Bezeichnung der KldB – 1988 (beruf)*. Field-based means that for a given code, it incorporates all promotions for that code – a worker who is a “cook” (code 411) and promoted to line-chef would still have code 411. The coding scheme was updated and modernized in 2010, leading to missing codes in 2011 and 2012. While all pre-2011 data has been back coded using the new scheme, there is generally a 1:1 correspondence between the new and old coding schemes. The inclusion of occupation codes is key to my analysis. Many administrative datasets, such as those in the United States, do not generally have occupation codes at the individual level. With occupation codes, it is possible to identify OL outsourcing and see the impact on both remaining workers’ wages and their separation patterns.

4 Descriptive Results

As a first step, it is important to understand the extent of outsourcing—how much are German firms buying from the market, rather than producing in-house? Recent work has found that in the United States, the answer to that question is yes. (Handwerker, 2020). An increase in occupational concentration and a decline in the number of distinct occupations are generally taken as indicators that firms are deciding to outsource—purchase intermediate products or services from the market rather than produce those services in-house. (Coase, 1937; Handwerker, 2020)

Figure 1 shows the trends in firms’ occupational concentration and use of occupations between 1978 and 2010. Panel (A) graphs the change in average Firm Occupational Herfindahl-Hirschman Index (FO-HHI) for workers in large firms (over 100 workers) from 1978-2010. Generally, the HHI is used to measure how concentrated are firms within a market. The FO-HHI instead describes how concentrated *firms* are in the use of distinct types of labor—the higher the index, the fewer types of workers firms are using. The black

¹⁴In the main specifications, after the matching procedure, any value above the top-coding threshold is set equal to the threshold for that year.

line indicates the percentage point change in Average Herfindahl from 1978-2010, normalized to 0 in 1978. The FO-HHI has increased by over 20% from an average of 0.3438 in 1978.

It is possible this trend is not be driven by outsourcing. In Germany, like the United States, more women have entered the workforce, more workers have college degrees, and there has been a trend towards a more service-oriented economy.¹⁵(Dauth, Findeisen, and Suedekum, 2017) If women or higher-educated workers are more likely to work in occupationally concentrated firms, or service-sector firms are more occupationally concentrated, that could explain the trend in Figure 1 Panel (A). To account for these possibilities, I follow Molloy et al. (2016) and condition on worker demographics and industry information. The green line indicates the percentage change in the average Herfindahl conditioning on changing demographics. The red line conditions on changing demographics, industry, and occupation. Approximately half the change in average FO-HHI can be explained by changes in demographics and industry. Even when accounting for those factors, firms were 10% more occupationally concentrated in 2010 than 1978, suggesting they are outsourcing more.¹⁶

Figure 1 Panel (B) shows a similar measure—how much are firms using workers in a single occupation. The green line indicates the change over time in the share of workers in large firms that are a majority a single type of workers. Between 1978 and 2010, the share of workers in a majority single occupation firm increase by about 10 percentage points. The red line represents the share of workers in a firm that is extremely concentrated in a single occupation—at least 75% one occupation. Between 1978 and 2010, the share of workers in extremely concentrated firms doubled. Both panels provide descriptive evidence similar to Handwerker (2020). German firms are becoming more concentrated in fewer occupations. These trends are consistent with firms deciding to move towards market purchases of intermediate goods and services, rather than producing in-house. (Coase, 1937; Williamson, 1979) Additionally, in both Panel (A) and Panel (B), the increases begin in the mid-1980s, and continue through the 1990s, exactly the period of increased outsourcing discussed by Goldschmidt and Schmieder (2017).

What effect might changing firm concentration have on wages? If outsourcing makes firms more efficient, it could result in broad wage gains. Table 2 shows the descriptive relationship between worker earnings and firm occupational concentration—the effect of increasing FO-HHI on worker earnings based on whether

¹⁵U.S. Bureau of Labor Statistics, Labor Force Participation Rate for Women in Germany (DISCONTINUED) [DEULFPWNA], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/DEULFPWNA>, April 22, 2021.

¹⁶It is worth noting that the workforce transferring from manufacturing to service sector jobs could also be explained by OL outsourcing. If a manufacturing firm eliminates non-manufacturing workers, those workers would be more likely to end up in service-sector jobs.

the worker is in a high-wage occupation (column 1), in a managerial role (column 2), and their education level (column 3). Column (1) shows that a higher FO-HHI is associated with lower earnings for workers in low-wage occupations, and higher earnings for workers in high-wage occupations. Column (2) shows an increased FO-HHI is associated with lower earnings for non-managers and higher earnings for managers. Column (3) shows an increased FO-HHI is associated with lower earnings for workers without a college degree and higher earnings for workers with a college degree. Essentially, the more concentrated the firm, the lower the earnings for low-wage workers, the higher the earnings for high-wage workers. This relationship is the same one found by Handwerker (2020) in the U.S.

The results in table 2 suggest that outsourcing should impact remaining workers. If remaining workers after outsourcing are high-wage, the results in 2 suggest their earnings should increase. Outsourcing increases the firm’s occupational concentration, and this is associated with higher earnings for high-wage workers. The results in table 2 also suggest outsourcing increases inequality via two channels. First, as discussed by Goldschmidt and Schmieder (2017), low-wage workers earnings drop and they enter more concentrated firms. At the same time, there is an additional effect—high-wage workers’ earnings increase, further increasing inequality. In Section 8 I examine whether outsourcing increases also inequality via wage gains at the top. The evidence suggests outsourcing also increases the top of the wage distribution, demonstrating this additional impact of outsourcing on wage inequality.

The trends in Figure 1, and the results in Table 2 demonstrate that firms are becoming more focused in fewer occupations. These trends are consistent with firms purchasing more goods and services from the market rather than producing in-house. These changes are associated with earnings increases for high-wage workers and earnings declines for low-wage workers. The effect of outsourcing on low-wage workers and the resulting impact on inequality was well-documented by Goldschmidt and Schmieder (2017). However, the fact that higher occupational concentration is associated with higher wages, suggests that outsourcing impacts remaining workers, and that outsourcing could further increase inequality.

Are these descriptive results due to outsourcing? In the next section, I describe the methodology for identifying OL outsourcing events.

5 Empirical Strategy

This section outlines the empirical strategy for estimating the impact of outsourcing on remaining workers. I use a matched dynamic difference-in-differences design. This design compares workers whose firms occu-

pational layoff (OL) outsourced an occupation to a control group of similar workers whose firms did not OL outsource.

This section is organized as follows. Section 5.1 provides the definition used to identify outsourcing. Section 5.2 describes the matching algorithm for matching treated and control group workers. Balance tables and summary information on the events and OL outsourced workers are shown in Section 5.3.1. Section 5.4 contains the estimating equations for estimating the effect of OL outsourcing on remainders, and also the effect of OL outsourcing on inequality. Section 5.5 outlines the identification assumptions.

5.1 Identifying Occupational Layoff Outsourcing

It is generally very difficult to identify outsourcing. Few data exist on specific contracting relationships between firms. Even large worker flows between firms, such as those explored by Goldschmidt and Schmieder (2017), may understate the true impact of outsourcing if workers are distributed among several firms, or a new firm is brought in to perform a task. I also cannot directly observe outsourcing.

However, the LIAB contains information on all workers and their occupations. This means it is possible to observe when a firm has a large number of workers in an occupation and suddenly removes the vast majority of them. Following the definition in Appendix B in Goldschmidt and Schmieder (2017) the outsourcing event is defined by:

- *Occupational Layoff (OL) Outsourcing* – A firm j employs at least 10 workers in occupation p at time l . Between l and $l + 1$ the firm j reduces employment in occupation p by at least 75%.

This definition describes any instance where a firm employs a large number of workers in a specific occupation, and then removes the vast majority of workers in that occupation. Restricting to instances with at least 10 workers ensures the occupation was utilized by the firm, and we are not observing regular shifting between occupations or temporary labor.¹⁷

This definition likely captures more outsourcing events than both the definition based on worker flows in the main text of Goldschmidt and Schmieder (2017) First, it allows for non-FCSL occupations, meaning there are more possible types of outsourcing.¹⁸ Second, it captures instances where firms hire or subcontract

¹⁷Appendix C.1, provides a sensitivity analysis examining how the results change by restricting or expanding the minimum number of workers in occupation o . Figure C.1 outlines the effect of outsourcing on earnings 5 years after treatment ($\beta_5^{Treated}$) restricting to events with at least 5 workers in occupation o , at least 6 workers, etc. There is no effect of changing the minimum number of workers on estimated earnings.

¹⁸One minor difference between this definition and Goldschmidt and Schmieder (2017) is that FCSL occupations are not pooled into single “food workers” or “cleaners” occupations in order to identify layoff events (See Goldschmidt and Schmieder, 2017, table A-3 for the exact correspondence). This is to allow a single definition across FCSL layoffs and non-FCSL layoffs, as

to a new firm. Goldschmidt and Schmieder (2017) analyze instances where workers moved from the original establishment to a new establishment to identify outsourcing events. However, workers may quit rather than be outsourced, or the firm may hire a totally new firm rather than have their current workers be part of the supplying firm. In the late 1990s, the German telecommunications company T-Com subcontracted 80% of its directory assistance jobs to a different company. The workers were shuffled to different roles in the firm (Doellgast and Green, 2007). This type of event would be captured by this definition of outsourcing unless there were also substantial worker flows to the subcontractor.

As in Goldschmidt and Schmieder (2017), events in firms with fewer than 50 employees are removed. Events where the occupation code of the OL outsourced occupation was unclear are removed.¹⁹ Following Goldschmidt and Schmieder (2017), several additional restrictions are imposed:

- (1) the firm not hire back 10% of occupation p workers in $l + 2$ or $l + 3$
- (2) the firm not shrink to half of its l size between l and $l + 3$
- (3) the firm is not in a food, cleaning, security, logistics, or temporary help industry

Restriction (1) requires that the events be permanent, rather than temporary layoffs. Restriction (2) requires the firm survives, meaning these events are not mass layoffs or firm deaths. Restriction (3) requires the firm not be in a firm that would be providing outsourced labor, such as temporary help firms.²⁰

This definition identifies 279 OL outsourcing events between 2001 and 2009 in 225 firms. These events are fairly wide ranging, and include low-wage FCSL occupations such as cooks, cleaners, etc., manufacturing occupations such as upholsters, and other service occupations, such as health insurance professionals.²¹

This section has described the process for identifying outsourcing events. Because I aim to estimate the effect of outsourcing on remainers' earnings and labor supply, I utilize a matching procedure to find the most appropriate control group. The next section describes this procedure.

there is no similar aggregating process for non-FCSL workers. In practice, this allows for more events—this definition picks up instances of firms laying off their glass or building cleaners (*beruf* - 934) but not vehicle cleaners (*beruf* - 936). Pooling only FCSL occupations does not materially impact the results.

¹⁹Specifically, events where occupation o corresponded to *beruf* between 760 and 769 (workers in political or government occupations), *beruf* equal to 531 (unknown occupation) or above 970 (trainees, workers in early retirement, unknown occupation) are removed.

²⁰Appendix C.2 provides the main results both without restrictions (1)-(3), as well as additional restrictions. In both cases, there is no impact on the results.

²¹The change in occupation code in 2010 resulted in a substantial number of missing codes 2011 and 2012, making it impossible to analyze outsourcing via occupational layoffs after 2009. There may be unobserved increases in occupation-specific employment in 2011 or 2012 due to the change in occupation code. This would conflict with restriction (1). Appendix B displays the main results using events from 2006 and earlier. When examining only these events, there is no change in the results suggesting the change in occupation code does not impact the estimates.

5.2 Matching Procedure

In order to identify the wage effects of OL outsourcing on remaining workers, it is important to identify a similar comparison group for workers in firms whose firms do not OL outsource. For example, if remainers are generally high-wage, then estimating a simple treatment effect would be biased. To identify this control group, workers are matched based on observable characteristics. The procedure is motivated by Rosenbaum and Rubin (1985), who outline matching as a method of reducing bias due to imbalances in observed covariates.²² Because it is generally technically infeasible to match exactly on all observed characteristics, Rosenbaum and Rubin (1983) suggest reducing the dimensionality by using the propensity score—estimating the predicted probability of treatment on covariates, and matching treated and control group workers based on the propensity score. This also has the benefit of allowing for matches under the presence of continuous variables—few workers have exactly the same wage, age, firm-average wage, etc.

The analysis of the effect of outsourcing on remainers utilizes a difference-in-differences design, relying parallel trends assumption outlined in Section 5.5. This assumption states that the treated and control groups' trends in outcomes would have been similar but-for outsourcing. Without matching, this assumption may be violated. For example, firms which outsource may be more likely to be in West Germany or in specific industries. If wages are growing faster in East Germany, or faster in certain industries or occupations, it would violate the parallel trends assumption. In order to best match workers, I follow the methodologies of similar studies of outsourcing (Goldschmidt and Schmieder, 2017; Dorn, Schmieder, and Spletzer, 2018) mass layoffs (Couch and Paczek, 2010), and substitutability between workers. (Jäger and Heining, 2019) Workers are matched exactly on certain categorical characteristics (industry, occupation, location, year), and matched on the predicted propensity score for continuous variables.

The specific procedure is outlined below.

- **Time Notation**

Let t denote the calendar year, and l the year before OL outsourcing. $k = t - l$ is defined as the year relative to a given OL outsourcing event. $k = 0$ is the last year before OL outsourcing. In the LIAB it is only possible to observe the full set of workers in a firm from 2002-2012. Therefore, l ranges from 2001 to 2009.

- **Treatment Group**

²²Under the strong ignorability assumptions outlined in Rosenbaum and Rubin (1983) it is possible to estimate the average effects of a treatment by adjusting for differences in covariates between the treated and untreated. Strong ignorability states that if W is a binary treatment, $Y(0)$, $Y(1)$ are the unobservable potential outcomes, and X is a set of covariates, that (i) W is independent of $(Y(0), Y(1))$ conditional on $X = x$ and (ii) $c < Pr(W = 1|X = x) < 1 - c$ for some $c > 0$. (Abadie et al., 2004) The first assumption is similar to Assumption 1 in Section 5.5.

For each event, workers whose main job²³ was in the outsourcing firm in $t = l$ are identified.²⁴ To ensure that workers are not part of the outsourcing event, workers whose main job changed firms between $t = l$ and $t = l + 1$ are removed.²⁵ Additionally, to ensure that remainders are never themselves outsourced, workers whose occupation was ever outsourced or who were in an occupation which had at least 5 employees and had jobs cut by at least 75% are removed.²⁶ Workers who are missing their occupation code *beruf* or whose code corresponded to government administrators or association managers ($761 \leq \textit{beruf} \leq 763$) or unclear information ($\textit{beruf} = 531$) are removed. These restrictions ensure that the treated workers are not themselves outsourced, not treated in a different year, and are not in unclear jobs.

Additionally, workers who are new to the labor force or about to leave are removed. Because wage growth is very high when workers enter the labor market, the effects of outsourcing may be understated or overstated if a young worker is matched with an older worker. This would violate the parallel trends assumptions. Specifically, workers under the age of 25, over the age of 55, missing wage data from $t = l - 4$ to $t = l$ are removed. These restrictions ensure that workers are in prime working age. The last restriction also requires workers are in the labor force (though not necessarily employed) for 5 years. This means the results should be interpreted as the effect of outsourcing on remainders who are more attached to the labor force. Workers who are not regular employees—marginal part-time workers, trainees, in partial retirement, and workers who are in *mini*-jobs in $t = l$ —removed. This restriction limits to workers who are regular social security employees.

• Possible Control Group

The possible control group includes all workers whose firms were not observed OL outsourcing between calendar years t and $t + 1$. All control group workers who do not meet the restrictions applied to the treatment group—restrictions on age, occupation, type of employee, years of wage data, no changing firms, etc.—are removed.

Additionally, workers whose firms have fewer than 50 employees, operate in an FCSL industry, or whose employment levels shrank more than 50% between t and $t + 3$ are removed. These restrictions match the additional restrictions in the OL outsourcing definition, and ensure that particular restrictions on the

²³Main job is defined as the job which paid the highest earnings as of June 30th in a given year.

²⁴A worker’s “main job” in a given year is defined as the job for which their daily earnings was highest as of June 30th of that year.

²⁵Workers who leave between l and $l + 1$ may not be outsourced, but we cannot be certain. For example, if a firm removes all the jobs in an occupation with 9 employees, it would not meet the definition of OL outsourcing.

²⁶Effectively, these are occupations which met the definition of OL outsourcing but were either too small, or did not meet the additional restrictions outlined in Section 5.1.

definition of outsourcing do not impact the results. The control group includes workers who were not in panel firms at the time of treatment.²⁷

• Matching Procedure

Workers are matched via the following:

For each calendar year t , I run a logit regression where the dependent variable is whether a worker was in a firm which OL outsourced between l and $l + 1$. The logit model uses the following independent variables:

Worker Information: Three years of wages, tenure at the firm

Firm Information: Firm average wage, firm size bins²⁸, Blossfeld (1987) FO-HHI.

After running each regression, the predicted propensity score is retained for each worker. Each treated worker is matched 1:1 with replacement to a control-group worker in the same year, industry, occupation, pairs of years of firm tenure,²⁹ and whether they work in East Germany. For each treated worker, if there are several possible control group workers, they are matched to the worker with the closest propensity score. Matching with replacement means that that when a treated worker is matched, the corresponding control group worker can be resampled.³⁰ This matching procedure means workers are matched **exactly** on year, industry, occupation, bins of firm tenure, and whether they work in East Germany. Within those groups, workers are matched **inexactly** on wages, firm tenure, firm size, firm average wages, and firm concentration.

The goal of this matching procedure is to identify the control group which is most similar to the treatment group prior to outsourcing. The exact match on industry, occupation, tenure, year, and location ensures that workers are very similar. Because the matching on earnings was inexact and only included three years of earnings data prior to outsourcing, it is possible to examine pre-trends in outcomes. If there is a different pre-trend, it would suggest a violation of the parallel trends assumption. A match is found for approximately 85% the treated workers who meet the above restrictions. The matching procedure also removes some events.

After matching, there are 260 identified events in 218 firms between 2001 and 2009.

²⁷It is not possible to observe these workers' full firm information. Therefore it is possible that some of these firms in the control group OL outsourced at the same time. For these workers, the restriction that their main job be in the same firm in t and $t + 1$ ensures they were not OL outsourced. If there was unobserved OL outsourcing for these firms, it would attenuate any treatment effect towards zero. Requiring that workers only be in panel firms does not materially impact the results.

²⁸These bins correspond to 5 = 50-99 employees, 6 = 100-249 employees, 7 = 250-499 employees, 8 = 500+ employees.

²⁹Specifically, 1-2 years, 3-4 years, etc. 15, 16, and 17 years are in a single group. Matching exactly on tenure has similar results, but results in fewer treated workers in the final sample of analysis because no relevant control group worker can be found.

³⁰When matching without replacement, the number of successful matches drops substantially due to the curse of dimensionality. There is also a bias-variance trade off—matching with replacement reduces bias but increases variance because repeated control units reduces the overall variance in the data. See Caliendo and Kopeinig (2005) for details. Matching without replacement results in similar estimates in terms of direction and significance, but the estimated effect on remainders' earnings is slightly lower. Repeated workers in the control group are treated as separate workers in the final analysis. Additionally, control workers can be matched in separate years. See

The next section describes summary statistics on the matched firms and workers prior to OL outsourcing.

5.3 Summary Statistics

This section outlines summary statistics on the firms, workers, and events in the matched sample in $k = 0$, the year prior to OL outsourcing. The first goal of this section is to determine whether the matching algorithm was effective—are the treated and control group workers and firms similar. Workers were not matched on education level. If the treatment group is less-educated than the control group, and less-educated workers are on a different wage trend, it would result in a violation of the parallel trends assumption. The second goal is to provide context on the events and outsourced workers—what types of occupations are outsourced? What are the demographics of the workers in the outsourced occupations?

5.3.1 Comparison of Treated Workers and Firms

Table 3 shows the comparison between the treated and control group workers. As we can see, treated and control group workers are very similar. Their average age and gender are very similar. These variables were not part of the matching algorithm, which suggests that the algorithm was successful in identifying similar workers. The treatment group is composed of fewer workers with a university education than the control group (20.4% versus 24.9%). The difference in means is not statistically significant. Nevertheless, this difference prompts the inclusion of controls for education in the main specification.³¹

The treated workers and control group workers have very similar daily earnings (123.3 versus 124.8 euros per day). This corresponds to approximately a 1.2% difference in earnings. In annual terms, treated workers' earnings are approximately 45,500 euros. This earnings level is substantially above the average in the LIAB. Figure 8 graphically illustrates that remaining workers in OL outsourcing firms are much more likely to be at the top of the aggregate wage distribution when compared to the LIAB as a whole.

Table 3 also includes comparisons of the relevant treatment and control firms. The treatment and control firms are similar size (on average more than 250 workers) and age (over 20 years in business). These statistics suggest that the OL outsourcing events analyzed occur in larger, established firms. The treated and control firms also have similar occupational concentration, (0.257 versus 0.271). Lastly, there is no average change in firm size for the control group firms. This indicates that the control firms are (on average) not outsourcing or laying workers off. On the other hand, outsourcing firm employment declines by 4.5% on average. The

³¹When not controlling for education the results are similar. See Figure B.1.

small employment decline means these events are not mass layoffs, as examined by Couch and Paczek (2010) and Sullivan and Von Wachter (2009).

For nearly all variables, a t-test of the equality of means results in no statistically significant difference. The difference between firm size bins is significant at the 5% level, but the absolute difference (0.2) is still very small. Overall these results demonstrate that the remainers and matched control group workers are very similar.

5.3.2 Description of Events and Effects on Firms

This section provides summary statistics on the events (types of occupations removed) and the workers in the outsourced occupation. This information is in Table 4.³²

Table 4 Panel (A) shows the share of workers in events by the type of occupation removed. Using the classification system in Blossfeld (1987), the majority of events are in “unskilled services” and “manual” occupations. These occupations make up 86% of all treated workers. Including skilled services accounts for nearly all events. FCSL occupations represent approximately 35% of treated workers. This means that a large share of identified outsourcing is in FCSL events. However, many other occupations can feasibly be outsourcing. For example, gardening (*beruf* = 51) is a specific task that a firm might hire an outsider to perform. Gardening is classified as an “agricultural” occupation. This means focusing solely on FCSL occupations, or even service occupations, could miss outsourcing events. The evidence in Doellgast and Green (2007) show telecom firms outsourcing tasks such as call centers and telecom line installers and car manufacturers outsourcing parts manufacturing and both FCSL and non-FCSL support staff. To better understand which occupations are being outsourced, the 10 largest outsourced occupations by number of remainers are listed below.³³ They are:

- Housekeeping Manager/Vehicle Cleaner³⁴
- Cooks
- Health Insurance Professionals/Textile Workers³⁵
- Kindergarten Teachers/Nannies

³²All values are calculated as the average of matched treated workers. Conceptually, this is a weighted average of event-level data, weighted by number of workers in the matched sample.

³³Largest by number of treated workers in the matched sample.

³⁴Represents both occupations OL outsourced simultaneously.

³⁵Represents both occupations OL outsourced simultaneously.

- Others attending on guests
- Guards
- Cleaners
- Advertising Professionals
- Visual/Graphic/Textile Design
- Industrial Foreman/Supervisors

These occupations align with the conception of jobs that can be outsourced. Vehicle cleaners, others attending on guests, cooks, and guards are all FCSL occupations. Housekeeping managers is also a “cleaning” occupation. Health insurance professionals could be outsourced to an HR firm. Textile workers can be used as an intermediate production task, and could be outsourced to a different factory or subsidiary.³⁶ Kindergarten teachers could represent a firm outsourcing a within-firm daycare. etc. The list of occupations and the statistics in Table 4 Panel (A) suggest that the definition of OL outsourcing is reasonable.

Table 4 Panel (B) provides demographic information on the workers in the OL outsourced occupations. These workers are less educated than the matched sample, are middle aged (approximately 41 years old) and 36% women. The average tenure of workers in the OL outsourced occupations is 6.5 years. This means these workers are not temporary employees, and are relatively attached to the firms. Approximately 40% leave the firm at the time of OL outsourcing. Therefore, firms are not necessarily laying off workers in the outsourced occupations—some of them are shifted to other roles. Only 7% have a university degree, suggesting that these workers are (on average) less educated. This is consistent with descriptions of outsourcing in both Germany and the United States. (Doellgast and Green, 2007; Irwin, 2017)

Finally, the relative wages—the average wage of the OL outsourced workers when compared to the mean of their occupation—of the workers in the outsourced occupation are very high. The average relative wage is 1.26, meaning workers in the outsourced occupation are paid 26% above the average for their occupation. The high relative wages provides important context on why firms would outsource—workers are paid substantially above the average in the rest of the market.³⁷ The relative wages of leavers in the outsourced occupation is 1.17—meaning workers in the outsourced occupation who leave the firm are paid 17% above the average

³⁶e.g. vehicle upholstery for car manufacturing.

³⁷In Appendix F, I explore whether firms are saving from outsourcing. When only comparing the predicted earnings increase for remainers to the earnings of workers leaving the firm during outsourcing, over 85% of events are profitable.

for their occupation. However, the relative wages for the remainders is also high, 1.21. This means that the *firm* is relatively high wage, rather than a particular *occupation* being overpaid. The high relative wages is consistent with outsourcing occurring among high-wage firms (Abowd, Kramarz, and Margolis, 1999; Goldschmidt and Schmieder, 2017). High-wage firms outsourcing is also consistent with outsourcing as a mechanism for increased sorting in the labor market. (Card, Heining, and Kline, 2013; Song et al., 2018)

This section has shown that the matching algorithm was successful—treated and control workers are very similar. Additionally, workers in the outsourced occupations are highly paid relative to the average occupation. This provides useful context on why firms would outsource these occupations. The next section outlines the estimating equations.

5.4 Estimating Equations

5.4.1 Effect of Outsourcing on Remaining Workers and Outsourcing Firms

I estimate the effect of outsourcing on remaining workers and firm-level measures of inequality and sales. Methodologically, I use a dynamic difference-in-differences design. This design allows for direct graphic comparison in outcomes between remaining workers and the matched control group. Below are the estimating equations.

- **Estimating Equation - Effects of Outsourcing on Remainers**

$$y_{ijk} = \alpha_i + \gamma' X_{ik} + \sum_{k=-4}^5 \beta_k \times \mathbf{1}\{t-l=k\} + \sum_{k=-4}^5 \beta_k^{Treated} \times \mathbf{1}\{t-l=k\} \times Treated_i + \epsilon_{ijk} \quad (1)$$

y_{ijk} denotes the outcome y for a worker i , in year $k = t - l$. The worker is in firm j in l and $l + 1$. α_i are person fixed effects. X_{it} are several control variables.³⁸ $\mathbf{1}\{t-l=k\}$ are indicators for period k . β_k are the coefficients on the indicator for 5 years before treatment ($k = -4$ to $k = 0$) and the 5 years after treatment ($k = 1$ to $k = 5$). The coefficients of interest are $\beta_k^{Treated}$. These denote the average treatment effect of outsourcing on remaining workers in year $k = t - l$. $k = 0$ is the year before OL outsourcing, and $\beta_0^{Treated}$ is normalized to zero. To address the possibility of serial correlation, as discussed by Bertrand, Duflo, and Mullainathan (2004), standard errors are clustered at the level of treatment—the $k = 0$ firm. Because workers are matched exactly on year to the untreated control group there is no variation in treatment timing—all workers treatments occur between $k = 0$ and $k = 1$. As a result, there is no concern about negative weighting

³⁸In my preferred specification, controls include age and its square interacted with education and gender. In Appendix B provides the results without these controls, and they are similar in sign, significance, and magnitude.

due to variation in treatment timing. (Borusyak and Jaravel, 2018; Sun and Abraham, 2020; Chaisemartin and D’Haultfoeuille, 2020).

I also test heterogeneity in the treatment effects. To do so, I include interaction terms between treatment status, the relative time indicators, and a given covariate. For all estimates of heterogeneity I report $\beta_5^{Treated}$ —the treatment effect at $k = 5$ for each group.³⁹

The inclusion of person-level fixed effects accounts for differences in means across workers. As discussed in Section 5.5, Assumption 3 is that treated and control group workers are on similar trends in outcomes. But for the outsourcing events, the trend in outcomes would have been similar. The dynamic difference-in-differences design allows for examination of pre-trends to directly examine whether this assumption is true in the pre-period. In all instances there is no evidence of a difference in pre-trends.

I also examine the effect of outsourcing on firm-level data. In order to do this, I retain the panel firms from the matched sample. These firms are then linked to firm-specific measures of inequality, occupational specificity, sales, collective bargaining, and other outcomes. Firms with multiple treatments are considered as separate firms for the purpose of this analysis.⁴⁰ The effect of outsourcing on these firm-specific measures is estimated by the following equation.

• **Estimating Equation - Effects of Outsourcing on Firms**

$$y_{jk} = \psi_j + \lambda_t + \sum_{k=-4}^5 \eta_k \times \mathbf{1}\{t-l=k\} + \sum_{k=-4}^5 \eta_k^{Treated} \times \mathbf{1}\{t-l=k\} \times Treated_j + \epsilon_{jk} \quad (2)$$

Here, y_{jk} represents the outcome for firm j in year k . ψ_j are firm fixed effects. λ_t are year fixed effects. η_k are relative time fixed effects. This means $\eta_k^{Treated}$ represents the average treatment effect of outsourcing on a firm-level characteristic in year k .

The analysis is limited to the three years before outsourcing and the three years after due to data limitations. For each panel firm, the full set of workers in the firm is only available from 2002-2012, meaning there is only accurate data on some firm-level outcomes for 3 years after the last treatment year.⁴¹ The effect of OL outsourcing on firm occupational concentration and within-firm wage inequality are reported

³⁹I cannot observe certain control group bargaining agreements or workers’ rank within the firm. In those instances, I create a new treatment variable which denotes whether the worker is in the control, or in one of the separate treated groups. This effectively compares the outcomes of workers in the treated subgroups (i.e. bargaining agreement vs. no agreement) relative to the full set of control group workers.

⁴⁰For example, if a firm outsourced in 2002 and 2003, the analysis treats these as two separate firms that outsource in 2002 and 2003 separately. If a firm was in the control group in 2002 and 2003, those are also considered separate firms.

⁴¹For these data, there is also some missing pre-treatment data for treatments in 2001-2003. This should not affect the estimates because firms are matched exactly on year.

in Table 5. The effect of OL outsourcing on firm hiring, sales, employment, and bargaining agreements are reported in Appendix D.

In the next section, I discuss the estimation strategy for identifying the effects of outsourcing on different parts of the earnings distribution.

5.4.2 Non-Linear Effects of OL Outsourcing

One of the questions I seek to answer in this paper is whether prior analyses under or overestimate the effect of outsourcing on inequality. Remaining workers in outsourcing firms are largely in the top of the wage distribution.⁴² This suggests that effects on remaining workers will change the top of the overall wage distribution. To test this possibility directly, I use a non-linear difference-in-differences strategy.

When estimating a treatment effect on the conditional mean of earnings, it is easy to understand the impact on the unconditional mean. Via the law of iterated expectations, we know that the expected value of earnings is equal to any estimated coefficient times the expected value of the covariate. Estimating a treatment effect on an unconditional *quantile* of the earnings distribution is difficult because the law of iterated expectations cannot obtain unconditional estimated effects.

In order to estimate the effect of outsourcing on different parts of the wage distribution, I follow Firpo, Fortin, and Lemieux (2009), and use Recentered Influence Functions (RIF) in a matched dynamic difference-in-differences design. This estimation strategy is similar to the dynamic RIF regressions used by Dube (2019), as well as the RIF difference-in-differences (RIF-DiD) strategy used by Havnes and Mogstad (2015).

I now outline the methodology in detail. The goal is to estimate the predicted effect of outsourcing on the τ th quantile of the unconditional distribution of wages (Y). As stated above, it is difficult to identify the effect of a covariate on an unconditional quantile because the law of iterated expectations no longer applies. However, this is not true for the RIF. Firpo, Fortin, and Lemieux (2009) describe how, under the assumption that the conditional distribution function $F_{Y|X}()$ is unaffected by a small manipulation of the distribution of some variable X (i.e. outsourcing), we can calculate the RIF.⁴³

$$RIF(y_{it}; q_\tau) = q_\tau + \frac{\tau - \mathbf{1}\{y_{it} \leq q_\tau\}}{f_Y(q_\tau)} \quad (3)$$

Where y_{it} is the logarithm of earnings in a given year. q_τ is the quantile function $q_\tau = \inf\{q : F_Y(q) \geq \tau\}$.

⁴²See Figure 8.

⁴³Within the context of the analysis, the assumption is that a marginal change in the share of workers who are outsourced does not affect the overall conditional CDF of wages.

τ represents a given quantile $0 < \tau < 1$, $\mathbf{1}\{y_{it} \leq q_\tau\}$ is an indicator function for whether a given y_{it} is below the quantile q_τ , and $f_Y(q_\tau)$ represents the unconditional pdf of the distribution.

The RIF in equation 3 represents the influence that a *single* observation y_{it} has on the unconditional τ th quantile of the earnings distribution. Firpo, Fortin, and Lemieux (2009) further show that when regressing $RIF(y_{it}; q_\tau)$ on a linear model (i.e. OLS) any coefficient β represents the unconditional quantile partial effect (UQPE) of an independent variable X on the quantile of the distribution q_τ . In the context of this paper, by regressing outsourcing on $RIF(y_{it}; q_\tau)$ it is possible to estimate the effect of outsourcing on different parts of the earnings distribution.⁴⁴

I calculate $RIF(y_{it}; q_\tau)$ for regular employees in the whole LIAB. *Mini* job workers, non-regular social security employees, and workers aged 20 or below, or 61 and above are removed from the full LIAB. I calculate the within-year $RIF(y_{it}; q_\tau)$ for all remaining workers in the LIAB age 21-60. By calculating the RIF using the full sample of regular employees in the LIAB, it means that the RIF regressions will estimate the effect of outsourcing on the regular-worker earnings distribution in the LIAB.

Similar to the standard difference-in-difference estimation strategy, estimation of a treatment effect on various quantiles requires an assumption that the trends in earnings *distribution* of the treated group would be similar to the control group were it not for OL outsourcing. To account for this possibility, workers are again matched following the procedure described in 5.2. There is one change—workers who left the firm at the time of OL outsourcing, were in the outsourced occupation, or were removed for other reasons remain in the treated or control group. This change allows for estimation of the *total* effects of outsourcing on different parts of the wage distribution, including the effects on leaving workers and workers who change jobs within the firm due to outsourcing. Because treated workers are matched 1:1 to control group workers on earnings the assumption of similar trends in earnings distribution is reasonable.

The estimating equation is below:

$$\begin{aligned} RIF(y_{ik}; q_\tau) = & \alpha_i + \gamma' X_{it} + \sum_{k=-4}^5 \beta_k \times \mathbf{1}\{t - l = k\} \\ & + \sum_{k=-4}^5 \beta_k^{Treated} \times \mathbf{1}\{t - l = k\} \times Treated_i + \epsilon_{ijk} \end{aligned} \quad (4)$$

This is the same estimating equation as Eq. 1, where instead of the outcome variable y_{ijk} , the outcome

⁴⁴Again, Firpo, Fortin, and Lemieux (2009) assume that the conditional distribution function $F_{Y|X}()$ is unaffected by a small manipulation of the distribution of some variable X , in this the variable X is outsourcing.

variable is now $RIF(y_{ik}; q_\tau)$. Via the law of iterated expectations, $\beta_k^{Treated}$ represents the unconditional quantile partial effect of outsourcing on a given quantile τ for all τ in year k ($UQPE_k(\tau) = \beta_k^{Treated}$).⁴⁵ The coefficient of interest $\beta_k^{Treated}$ now represents the effect of outsourcing k years after outsourcing on the τ th quantile. As in the standard dynamic difference-in-differences methodology, this setup allows for examination of pre-trends. Additionally, I can examine the effect of outsourcing on leavers and stayers in the outsourcing firm separately.

In this section I have described the estimating equations. The next section describes the identification assumptions.

5.5 Identification

The identification strategy builds on a dynamic difference-in-differences design to estimate the effect of outsourcing on remaining workers earnings and separation patterns. This methodology has two advantages. First, it allows for direct observation of treatment effects over time. Second, I observe outcomes for treated and control group workers prior to the outsourcing event to directly evaluate pre-trends. The identification assumptions are below. Under these assumptions, it is possible to identify the causal effect of outsourcing on remaining workers.

5.5.1 Identification Assumptions

In a potential outcomes framework, denote $y(0)_{ij,l+k}$ as the (unobserved) counterfactual untreated outcome for worker i in year $t = l + k$. $L_j \in L_1, \dots, L_J$ denotes a group of workers in outsourcing firms $j = \{1, \dots, J\}$. Firms outsourcing in year l . $y_{ij,l+k}$ denotes the observed outcome for worker i in group L_j in year $t = l + k$. Let C denote the control group. I assume the following:

Assumption 1: $E[y(0)_{ij,l+k} - y(0)_{ij,l+k-1} | X_{it}, L_j] = E[y(0)_{ij,l+k} - y(0)_{ij,l+k-1}] \forall L_j$ (Exogeneity)⁴⁶

This assumption states that the shock affecting group L_j 's counterfactual outcome is mean independent of the decision to outsource. This implies that there is no relationship between the change in counterfactual outcomes and the treatment status, effectively assuming that outsourcing timing and assignment is not

⁴⁵The effects are analogously defined for measures of inequality, such as the variance of log wages or the Gini coefficient.

⁴⁶Note that Assumptions 1 and 2 are conditional on controls X_{it} .

correlated with outcomes. As in the model of Lemieux, MacLeod, and Parent (2009), I assume each firm faces fixed costs of outsourcing, and between l and $l + 1$, an exogenous decline in outsourcing costs made it profitable for some firms to outsource. This assumption is reasonable given that the timing of the events occurs during the implementation of Hartz I. As discussed in Section 3, Hartz I both established PSAs and further de-regulated the temporary help sector. Additionally, in 2002, employer associations came to collective agreements which allowed for temporary help firms to pay wages below those of workers in the firms that hire them. (Doellgast and Green, 2007) When examining the data by year, there is a spike in outsourcing events in 2003, consistent with Hartz instigating some outsourcing events.⁴⁷ Of course, there is outsourcing both before and after Hartz I. These outsourcing events are not inconsistent with Assumption 1. Different firms may have found it cheap enough to outsource prior to Hartz I. One example of this would be T-Com in the late 1990s outsourcing directory workers, or German car firms outsourcing to the East. Better communications technology and access to low-wage labor markets made outsourcing feasible for some firms or tasks. Similarly, firms may not have outsourced immediately Hartz because it was still too expensive or it was difficult to find a contractor. As the cost of outsourcing further declines, more firms could outsource. Assumption 1 only requires that outsourcing occurred between l and $l + 1$ because it became profitable for the firm to outsource. This assumption does not require that firms not explore outsourcing, only that that said exploration does not affect remainers' wages or firm tenure. Next, I assume no spillovers:

Assumption 2: $E[y(0)_{ij,l+k} - y(0)_{ij,l+k-1} | X_{it}, L_1, \dots, L_J, C] = E[y(0)_{ij,l+k} - y(0)_{ij,l+k-1} | X_{it}, L_j, C]$
 $\forall k, L_j$ (SUTVA)

This assumption states that for a given group of remainers in an outsourcing firm j , there is no effect on a different group's treatment. Essentially, this requires that there are no spillovers in the effect of outsourcing between firm j and other outsourcing firms or to the control group. This assumption is reasonable given the matching procedure. Specifically, workers are matched to similar workers in the same year, industry, occupation, and side of the country. Workers in the control group are by definition not affected because they are not in the same occupation as the outsourced workers, and do not leave their firms. Additionally, firms may outsource to exploit East/West German wage gaps. (Doellgast and Green, 2007) This could result in a violation of the SUTVA assumption if a treated West German worker is matched to a worker in East

⁴⁷See Figure 2.

Germany whose firm now has more business. Because workers are matched exactly matched on side of the country, this violation cannot occur.⁴⁸

I also require the standard difference-in-differences assumptions, following Callaway and Sant’Anna (2020). First, no anticipation:

Assumption 2: $E[y_{ij,l+k}|X_{it}, L_j] = E[y(0)_{ij,l+k}|X_{it}, L_j] \quad \forall L_j \text{ and } \forall k \leq 0, \forall L_j$: Workers do not anticipate the outsourcing event (No anticipation)

This assumption states that the expected value of pre-treatment outcomes for all workers i in a given firm j are unaffected by treatment prior to the outsourcing event, i.e. when $k \leq 0$. This assumption is reasonable for two reasons. First, workers are not directly affected by outsourcing because they are not in the outsourced occupation. Second, the definition of OL outsourcing represents a substantial, instantaneous cut in occupation-specific workforce, which would likely be unanticipated by remaining workers. Lastly, I assume parallel trends between remaining workers and the matched control-group workers.

Assumption 4: $E[y(0)_{ij,l+k} - y(0)_{ij,l+k-1}|X_{it}, L_j] = E[y(0)_{ij,l+k} - y(0)_{ij,l+k-1}|X_{it}, C]$: Trends in outcomes would have been similar for treated and control group workers but for the outsourcing event (Parallel Trends)

This assumption requires that the trends in outcomes for treated and control group workers be similar—it does not require similarities in levels, i.e. that workers have the same wages before the outsourcing event. Instead, it requires that the trend in wages and separations would have been similar for the treated and control group workers, but for the outsourcing event. This assumption is reasonable for two reasons. First, the matching procedure identifies workers with a similar earnings and employment trends prior to the outsourcing event. Workers are matched exactly on year, industry, occupation, firm tenure, and whether they are in East Germany. For workers in those groups, similar non-treated workers are selected based on wages and firm characteristics. Table 3 provides information on the differences between workers and firms. Overall, they are very similar. Second, it is possible to observe trends prior to outsourcing. There is no

⁴⁸These two assumptions are similar to Assumption 4 in Chaisemartin and D’Haultfoeuille (2020), including conditioning on controls.

evidence of a pre-trend in outcomes. Both of these facts suggest the parallel trends assumption is reasonable.

5.5.2 Threats to Identification

There are three main threats to identification. The first is that workers might be directly affected by OL outsourcing. Workers who leave the firm between l and $l + 1$ may also be outsourced, especially if they are in an occupation with fewer than 10 employees, which would not be identified as an outsourcing event in the definition. Workers who leave the firm between l and $l + 1$ are removed from the analysis. Workers whose own occupation was ever observed cut by 75% or more is also removed. This ensures that all workers in the analysis are not themselves outsourced.

The second threat to identification is that there is an unobserved factor which coincides with the outsourcing that is responsible for the effect on remainers. For example, if a firm that outsources is affected by local demand shocks which increase sales, workers' earnings may increase. If the firm invested in a labor-saving technology (such as a new machine) that *coincided* with outsourcing, it could increase some remainers' wages. This would be a story of skill-biased technical change (Card and DiNardo, 2002; Hershbein and Kahn, 2018). If the firm is drastically reducing in size, remainers' wages could decline. Firms could also be changing their collective bargaining agreements. To investigate this, I examine changes in firm-level statistics around the time of outsourcing. Appendix D shows these results. There is no effect on sales. There is no evidence of collective bargaining agreements being different to the one in the year before outsourcing. There is an immediate decline in hiring and employment, but firm size and hiring remain stable after the event. The fact that there is no subsequent decline in size or hiring suggests these are one-time events. These results are consistent with outsourcing—outsourcing reduces employment and shifts some workers to other areas. A labor-saving technology could potentially lower hiring and employment, but would have different earnings effects on remainers. Under skill-biased technical change, more educated workers' earnings would increase more. This is inconsistent with the results in Section 6.3. Firm FO-HHI increases after outsourcing, consistent with outsourcing. There is no effect on sorting—new hires have similar wages and worker fixed-effects (Abowd, Kramarz, and Margolis, 1999) before and after the event. Lastly, the set of largest outsourced occupations by number of remainers is very consistent with previous studies of outsourcing. All of these results suggest the mechanism for earnings increases is outsourcing, rather than a different contemporaneous effect.⁴⁹

⁴⁹Conceptually, outsourcing is similar to a new labor-saving machine. If we conceptualize the firm paying a fixed cost to outsource, that is functionally identical to a firm paying a fixed cost for a new machine which totally replaces the labor performing the task.

The last threat to identification is that the outsourcing firms may be unobservably different than the firms in the matched control group. Assumption 1 relies on outsourcing decisions occurring because of exogenous changes in outsourcing costs. The fact that outsourcing increases after the Hartz reforms do suggest that cost reduction plays a role. However, outsourcing remains at a high level several years after those reforms, and occurred prior to them. What causes this variation in timing and which firms outsource? Evidence suggests it is driven by availability and cost of contract workers, as well as technical feasibility.⁵⁰

When looking at outsourcing in the German auto industry, Doellgast and Green (2007) find that the large firms outsourced by creating new subsidiaries. Volkswagen established subsidiaries in East Germany where wages were lower, and used more temporary workers. In 2003, Ford established a new company Visteon, which subsequently outsourced all support services. (Doellgast and Green, 2007) In 2005, Daimler implemented a program called “CORE” which outsourced a number of in-house services, including cafeterias (Goldschmidt and Schmieder, 2017) This is consistent with Assumption 1. The ability of firms to shift production to East Germany and create subsidiaries. Doellgast and Green (2007) also examine outsourcing in the German telecommunications sector. In the late 1990s, the German telecommunications company T-Com subcontracted 80% of its directory assistance jobs to a different company. In that instance, T-Com was able to outsource because new communications technology made it feasible. Doellgast and Green (2007) also find that firms do consult with unions prior to outsourcing. Unions in the auto industry largely accepted outsourcing in exchange for concessions. In the telecom industry, Vodafone, Arcor, T-Mobile, and T-Com outsourced after consulting with workers because workers were covered by collective bargaining agreements.

These examples suggest outsourcing is driven by factors exogenous to the firm—changes in technology making outsourcing easier, and availability of lower-cost labor. T-Com outsourced when it was technologically feasible to do so. Volkswagen outsourced via subsidiaries in East Germany and the use of temporary workers. Timing appears to be driven by firms’ ability to find a contractor or create a subsidiary. There are other factors that could further affect the timing of outsourcing decisions. If outsourcing is a profitable management technology, it may take time for that technology to be adopted. (Bloom, Eifert, et al., 2013; Bender, Bloom, et al., 2018; Bloom, Brynjolfsson, et al., 2019) Firms may be unable to outsource until they can find and negotiate contracts or open new plants. All of these factors help explain why some firms outsource and

⁵⁰In Section E I examine the descriptive relationship between firm-level statistics and the outsourcing decision. The strongest predictors are year indicators for 2002, 2003, and 2004, consistent with the Hartz reform. Firms which are larger, have more wage variance and are less occupationally concentrated are more likely to outsource, but this is not surprising—small firms with homogenous workers have no need to outsource. There is no relationship between average worker AKM fixed effect, firm median wage, or whether there is a collective bargaining agreement on whether firms outsource. The coefficients on share of sales spent on payroll and firm age are both negative, but economically small. Overall this is consistent with outsourcing being driven mostly by factors outside the firm.

others do not. While contemporaneous labor market reforms made it cheaper to outsource, some firms may not have been pushed over the threshold to outsourcing being profitable. Finally, the existence of a union did not appear to play much of a role in when firms outsource. However, when firms do outsource, union with CBAs are consulted and earn concessions for remainers, consistent with the union-mediated outsourcing framework in Section 2.

Nevertheless, it is impossible to identify whether outsourcing firms are unobservably different than similar firms. While the empirical strategy successfully matches treated workers to similar control group workers, there may still be unobserved differences. This is a limitation of the analysis. Whether firms decide to outsource and what prompts that decision is a current open area of research.

6 Results

This section presents the results of the paper. First I report the dynamic difference-in-differences estimates of the effect of outsourcing on remainers' earnings and labor supply. Next I report the results of the heterogeneity analysis, and examine how those results align with the predictions of the models in Section 2.

6.1 Effect of Outsourcing on Remainers' Earnings

How does occupational layoff (OL) outsourcing affect remaining workers' earnings? Outsourcing increases remainers' earnings by 6% (s.e. 1.6%) after 5 years. Figure 3 Panel (A) displays the dynamic difference-in-differences estimates of the earnings effect of outsourcing on remainers. The X-Axis graphs year k relative to outsourcing. The Y-Axis graphs the point estimate and 95% confidence interval of the effect of outsourcing on the natural logarithm of remainers' earnings k years after the outsourcing event. Panel (A) shows that immediately after outsourcing, there is no difference in earnings between the treatment and control groups. However, the difference increases by approximately 1.2% per year. 5 years after outsourcing, remainers' earnings are 6% higher relative to the control group.

Some of this difference may be due to differences in tenure. Figure 3 Panel (B) provides the treatment effect of outsourcing after conditioning on firm tenure and its square. After conditioning on tenure, the treatment effect is smaller—a 4% increase in earnings relative to the control group. This suggests that 1/3rd of the increase in earnings for remainers comes from higher tenure at the firm. In both panels, the pre-treatment indicators are small, precisely estimated, not statistically significant, and display no evidence of a pre-trend. The lack of a pre-trend suggests the parallel trends assumption is reasonable.

It does appear that after 5 years, remainers' earnings are on an upward trend relative to the control group. Do earnings after outsourcing continue to increase? Figure B.6 shows the same estimates after restricting to events in 2006 or earlier, and extending the post-outsourcing treatment window to 5 years. The earnings effect peaks at 6% after 5 years, and remainers' earnings remain 6% higher than the control group at least 8 years after outsourcing. Based on this evidence, it appears outsourcing permanently increases earnings for remainers.

What does this effect mean in concrete terms? Treated workers' earnings in $k = 0$ earn an average of 123.3 euros per day. A 6% earnings increase corresponds to an additional 7.3 euros per day, or 2,700 euros per year. Appendix B provides estimates of the effect of outsourcing on remaining workers' earnings under different restrictions. In all instances, the results are largely similar. Appendix Figure B.2, shows demonstrate that the earnings effects are similar regardless of whether we restrict to FCSL occupations. There is no difference in the effect of outsourcing on remainers when restricting to firms which outsourced an FCSL occupation versus all other firms.

This section has demonstrated that after outsourcing, remainers' earnings increase by approximately 6% after 5 years. These effects appear to be permanent, remaining at a level 6% higher 8 years after outsourcing. As discussed in Section 2, the fact that remainers' earnings increase due to outsourcing is inconsistent with perfect competition. However, the rent sharing models of wage setting predict that remainers' earnings would increase. If the earnings increases are due to more rent sharing, there should also be an effect on workers' labor supply to the firm. In the next section, I examine the effect of outsourcing on workers' labor supply.

6.2 Effect of OL Outsourcing on Labor Supply

Figure 4 provides the results on the effect of outsourcing on remainers' likelihood of staying in the firm. Figure 4 Panel (A) shows the estimated treatment effect of outsourcing on the quit hazard rate—workers probability of changing firms in the next year.⁵¹ On the X-Axis is year relative to the outsourcing event and on the Y-Axis is the point estimate and 95% confidence interval of the effect of outsourcing on workers probability of changing firms between a given period k and $k + 1$. Because workers were matched on 2-year bins of tenure, there is little difference between treated and control workers attachment to the firm prior to outsourcing. Immediately after the outsourcing event, remainers are approximately 7.5 percentage points (s.e. 2.4 percentage points) less likely to change firms in a given year.

⁵¹Because the data ends in 2014, these figures. not contain any treatments from $l = 2009$, because next-period separations in $k = 5$ are undefined. Including treatments in $l = 2009$ it has no impact on the estimates.

Figure 4 Panel (B) provides the estimates of the effect of outsourcing on remainers' probability of staying in the $k = 0$ firm. As in Panel (A), prior to outsourcing, treated and control workers are similarly attached to their firm prior to outsourcing. Five years after outsourcing, the probability of remainers staying in the same firm is 18 percentage points higher when compared to the control group. It is also possible that outsourcing affected remainers' hours. While I cannot directly observe workers' hours, there is no evidence of a change in workers' likelihood of being part-time before and after outsourcing.⁵²

In models of rent sharing, when a firm shares more rents with workers the job becomes more valuable relative to the outside option. As a result, workers are more likely to stay in the firm and separations decline. The results in this section are consistent with these models—earnings increase and separations decline. Using these results, it is also possible to estimate firms' labor market (monopsony) power. A lower firm labor supply elasticity means that when workers' wages change, there is very little effect on whether workers change firms. By measuring the firm labor supply elasticity, it is therefore possible to estimate the degree of monopsony in the labor market. In the model of Manning (2003), in the steady state, firm labor supply elasticity can be measured via separation elasticities. Following the methodology of Bassier, Dube, and Naidu (2020), I estimate a firm labor supply elasticity of 3-4 in a DID-IV framework. This estimate is similar to Bassier, Dube, and Naidu (2020), and evidence of moderate monopsony power. The fact that estimated firm labor supply elasticity is similar to other studies is additional evidence of remainers' receiving additional rents. The declining separations and increasing earnings are also consistent with the rent sharing models discussed in Section 2.

One particularly interesting result is that separations decline immediately, while wages take 5 years to reach the new higher level. This means that when estimating a firm labor supply elasticity in $k = 1$, the estimated value is very high because there is a substantial decline in separations in response to no wage changes. When $k = 5$, the estimates are similar to other studies. This result suggests firm separations in response to outsourcing are dynamic—workers' separations patterns change in response to expected wage increases. This dynamic response could explain the different estimates of firm labor supply elasticity and monopsony power.⁵³ (Caldwell and Oehlsen, 2018; Cho, 2018; Kroft et al., 2020)

While these results are consistent with models of rent sharing—after outsourcing, remainers' earnings increase and separations decline—it is possible that not all workers' earnings increase equally. Black and Strahan (2001) and Card, Cardoso, and Kline (2016) find evidence that firms share fewer rents with women.

⁵²See Figure B.5.

⁵³For more detail on this result see Appendix G.

Additionally, while several models of wage setting in Section 2 predicted that remainers' earnings would increase, they had varied predictions about heterogeneity. In the next section, I test each of these predictions individually by examining whether there is heterogeneity in the effect of outsourcing on remaining workers.

6.3 Heterogeneity

This section provides the results of the heterogeneity analysis. In order to analyze heterogeneity, I run a similar specification to Eq. 1, interacting the time indicators β_k and $\beta_k^{Treated}$ with the dimension of interest (say, level of education). I report the estimated treatment effect and 95% confidence interval after 5 years ($\beta_5^{Treated}$) because this is the peak of the earnings effect. Heterogeneity across groups is tested through a Wald test.

Figure 5 reports the estimated heterogeneity by type of worker (college educated, manager, etc.). First, there are no workers whose earnings decline after outsourcing. There is no heterogeneity by or whether the worker was in an occupation that was a complement versus substitute to the removed occupation, worker tenure before outsourcing, or whether the worker was a manager versus non-manager,

However, there is some evidence of heterogeneity. While the differences are not statistically significant, the point estimates are larger for workers in the top third of highest paid occupations. This is consistent with firms outsourcing low-wage occupations. The earnings effect is larger for workers below age 40 (8%, s.e. 2%) versus workers above age 40 (2.7%, s.e. 1.5%). This difference is statistically significant at the 5% level. The effect on earnings is 7.1% (s.e. 2.2%) for workers without a university degree, compared to 2.1% (s.e. 1.4%) for workers with a university degree. The effect of outsourcing on earnings is 9.4% (s.e. 3.7%) for low-wage workers, and 2.8% (s.e. 1.6%) for high-wage workers⁵⁴. The effect is larger for men (7.2%, s.e. 1.7%) than women (2.6%, s.e. 2.3%). These differences are significant at the 10% level. These results indicate that rents are largely reallocated to low-wage remainers, who are more likely to be younger, less educated, lower worker fixed effect, etc. All groups earnings increase, but low-wage workers earnings appear to gain more. Additionally, the fact that men's earnings increase more than women's earnings is consistent with previous studies of gender bias in rent allocation. (Black and Strahan, 2001; Biasi and Sarsons, 2020; Card, Cardoso, and Kline, 2016)

Instead of examining heterogeneity by worker-specific factors, Figure 6 provides an analysis of heterogeneity by worker's rank within the firm. This analysis directly examines how rents are reallocated to workers

⁵⁴Low/Medium/High wage *workers* are defined following an Abowd, Kramarz, and Margolis (1999) fixed-effects model.

by both the worker’s own within-firm ranking as well as their occupation-specific ranking.⁵⁵ As shown in Figure 6, there is substantial heterogeneity by workers’ within-firm rank. For workers *below* the firm median wage, outsourcing increases their earnings by 8.3% (s.e. 1.8%). For workers *above* the firm median wage, outsourcing increases earnings by 4.6% (s.e. 1.7%).⁵⁶ The results are similar when examining differences by workers’ own wage relative to the average wage of the outsourced occupation and worker’s wage relative to the firm average. However, when we examine differences by the worker’s *occupation* relative to the average wage of the removed occupation, there is no difference in effect. What this means is that there is no heterogeneity by occupation or occupational wage rankings within the firm. Instead, heterogeneity appears to be based on workers’ own within-firm wage rankings. Nevertheless, it is important to note that there are no subgroups whose earnings decline due to outsourcing. Outsourcing increases all workers’ earnings, but workers in the bottom half of the firm’s wage distribution gain more.

This is consistent with the findings of Figure 5. There, the point estimates on the effect were larger for workers who are likely to be lower-earnings (younger, less-educated, etc.), but there was no heterogeneity by whether workers were complements versus substitutes to the outsourced occupation. Figure 6 directly shows that while all remainers’ earnings increase, rents are reallocated to the bottom of the wage distribution, and there is no heterogeneity by occupation, only heterogeneity by relative wage. Rent redistribution to the bottom of the within-firm wage distribution is similar to the findings of Saez, Schoefer, and Seim (2019) who find that Swedish firms allocate rents to the bottom of the wage distribution.

This section has outlined the results of the heterogeneity analysis in the effect of outsourcing on remaining workers. In the next Section, I discuss how these results fit with each of the models discussed in Section 2.

7 Discussion and Mechanisms

Section 2 outlined several models of wage setting, and the specific predictions each model had for the effect of occupational layoff (OL) outsourcing on remaining workers. In this section, I discuss each of these models in turn, their predictions, and how they relate to the results. I also outline other possible mechanisms. For the full set of models and predictions, see Table 1. For more detailed information on each model, see Appendix A.

⁵⁵Because not all control group workers are in panel firms, I instead identify whether there is heterogeneity the effect of outsourcing on wages for treated workers in a subgroup relative to the control group as a whole. Specifically, to estimate the effect of outsourcing on workers above versus below within-firm median wage, I create a new treatment variable that denotes whether a worker was in the control group, or (if in the treated group) above the median, or below the median.

⁵⁶This difference is statistically significant at the 1% level.

Perfect competition predicted that there would be no effect of outsourcing on remainders. The results are inconsistent with this prediction. As shown in Figure 3, outsourcing increases remainers' wages. Models of intra-firm bargaining predicted that outsourcing would increase remainers' wages. This prediction is consistent with the results in Figure 3. However, intra-firm bargaining models also predict heterogeneity by whether workers are complements versus substitutes to the outsourced occupation. Figure 5 shows that complement and substitute workers' earnings increase equally. Insider-outsider models predicted that there would be heterogeneity by worker tenure—workers with higher tenure would receive higher earnings increases. This prediction is inconsistent with the results in Figure 5.

The last model discussed is one of union-mediated outsourcing. This model predicted that remainers' earnings would increase, but the increases would be larger for workers at the bottom of the earnings distribution. The results are consistent with these predictions of this model. As shown in Figure 3, remainers wages do increase. Figure 6 demonstrates that outsourcing increases all workers' earnings, but the increases are larger for workers at the bottom-end of the within-firm earnings distribution. This model had a third prediction—there would be no effect of outsourcing on remainers' earnings if there was a weak or no union. I directly test this prediction by examining whether there is heterogeneity by whether the outsourcing firm had a CBA.

The results of this analysis are shown in Figure 7. When there was a CBA prior to outsourcing, outsourcing increases remainers' earnings. When there was no CBA, earnings decline. The differences between the estimates are statistically significant.⁵⁷ The decline in earnings among firms without a CBA is somewhat surprising. There is no apparent pre-trend, suggesting that the effect is due to outsourcing. In fact, this result is consistent with outsourcing potentially putting pressure on remaining workers' wages in the absence of a bargaining agreement. Doellgast and Green (2007) and Goldschmidt and Schmieder (2017) describe how the threat of outsourcing could result in lower wages for some workers.

These findings provide direct evidence of the role of unions in fairness and wage compression. (Pencavel, 1991; Biasi and Sarsons, 2020) The results are largely consistent with a model of unions compressing wages within the firm. However, this wage compression is due to the need for workers to vote on agreements. Following the model of Frandsen (2012), workers at the bottom end of the wage distribution receive more

⁵⁷As in Figure 6, not all control-group workers have data on firm bargaining agreement, and each control group worker is assigned the CBA status of the matched treated worker. This is effectively comparing the treatment effect for without-CBA treated workers to the treatment effect for with-CBA treated workers. The number of outsourcing firms without a CBA is relatively small, only 49. Additionally, these firms are somewhat smaller—only 2,736 remainers are in the without-CBA group. Nevertheless, the findings are suggestive of a difference in earnings effect, and there is no evidence of a pre-trend for either group.

rents. The findings demonstrate the important role that union-mediated collective bargaining plays in the German labor market. The presence of CBA allows for remainders receive higher rents. Without a union, firms can effectively pressure workers into lower wages. While it is possible for rent sharing to exist without unionization, as in the standard intra-firm bargaining models, these results demonstrate that unions allow workers to capture rents during outsourcing decisions. It is also possible that there are other mechanisms which explain these results. I discuss these alternative mechanisms in the next section.

7.1 Alternative Mechanisms

The results of this paper—outsourcing increases remaining workers’ wages—are consistent with firms real-locating rents to remaining workers in the presence of a collective bargaining agreement. However, whether this interpretation is valid depends on whether the results are consistent with other alternative mechanisms. I discuss several possible mechanisms here.

First, higher earnings from outsourcing may be due to compensating differentials. (Smith, 1979; Rosen, 1986; Schettkat, 1993) Under this explanation, wages increases are compensation for lower job quality. Pedulla (2011) finds that when firms use outsourced labor, relationships between workers and managers deteriorate—largely out of the perception that there will be more outsourcing in future. If outsourcing makes jobs worse, firms have to increase wages to retain workers.⁵⁸ However, the data are not consistent with compensating differentials. If the positive wage effect were due to compensating differentials, we would expect no change in workers’ likelihood of changing firms. Instead, after outsourcing, workers are *more* likely to work for the same firm. The increased labor supply response is consistent with remaining workers in the firm receiving higher wages after OL outsourcing.

Another alternative mechanism would be whether substitute workers are picking up the slack. This would be similar to the findings of Currie, Farsi, and MacLeod (2005), where after layoffs substitute workers receive higher earnings because they work longer hours. This is effectively an intensive-margin response to layoffs. First, as shown in Figure 5, there is no heterogeneity by whether a worker is a substitute to the outsourced occupation or a complement. If workers were “picking up the slack” we’d expect substitute workers earnings to increase. Additionally, the increased earnings in Currie, Farsi, and MacLeod (2005) are due to increased working hours. While I cannot directly observe working hours, there is no evidence of a change in whether remainders are full-time versus part-time. This suggests the results cannot be explained by substitute workers

⁵⁸Within the framework of implicit contracts MacLeod and Malcomson (1989), outsourcing could be seen as a breaking of the pre-existing relationship which would result in wage negotiation.

“picking up the slack.”

A third explanation for the results is that the firm becomes more productive through increased managerial effectiveness. This would be consistent with Bender, Bloom, et al. (2018) and Bloom, Brynjolfsson, et al. (2019). They find more effective managers can increase firm productivity. Under this framework, managers are responsible for a number of oversight tasks. When the firm outsources, those managers have fewer workers and types of tasks to oversee. Because the managers can more easily focus, firm productivity increases. The results are not consistent with this explanation. If firms are more productive because managers are more effective, managers marginal product has increased relative to other workers. Under perfect competition, managers’ earnings should increase more than non-managers. As shown in Figure 5, manager wages increase less than non-managers, suggesting increased managerial effectiveness does not explain the findings.

Another possible mechanism is increased firm productivity—the firm became more productive due to unobserved factors. In this framework, outsourcing is occurring alongside other reforms which make the firm more productive. I examine this possibility in Appendix D. There is no evidence of changing hiring or sales. Additionally, there is no evidence of increased sorting—the AKM fixed effect and earnings of new hires are similar before and after outsourcing. While the firm does become more “productive”—sales per worker increases— this is an instantaneous effect that occurs at the time of outsourcing due to the decline in employment levels. Sales do not change after outsourcing. This evidence is also consistent with the identification assumptions. Finally, there was a spike in outsourcing events around the time of the Hartz reforms, consistent with declining costs of outsourcing.

Asymmetric information could also be driving the results. Gibbons and Katz (1991). Under this explanation, firms lay off their low-type workers, and retain high-type workers. After the layoff, the market is now aware of which workers are low and high type, and remainers’ wages increase due to this market force. This explanation is inconsistent with the evidence. Firstly, if the earnings increases were due to market factors, this means remainers’ outside option has also become more attractive. If this were the case, separations should stay the same, because the both the inside and outside option have increased in value. The results in Figure 4 show that separations decline. Additionally, because outsourcing affects one occupation, the market might not update beliefs on the types of workers in complement occupations. This prediction is inconsistent with the result that there is no heterogeneity by whether the remainder is in a complement/substitute occupation.

The last mechanism I examine is fairness considerations. Firms and workers may prefer to offer a more equal wage profile, either to reduce quits or improve productivity. (Rees, 1993; Fehr and Schmidt, 1999;

Card, Mas, et al., 2012; Dube, Giuliano, and Leonard, 2019) Under this mechanism, outsourcing cuts off lower-productivity workers, and the firm can share more rents with remainers. However, if the results were driven purely by fairness considerations, there would be no effect of outsourcing on high-wage workers. The results in Figure 6 show that both low-wage and high-wage workers' earnings increase. Additionally, if the firm establishes a new more equal wage structure, new hires should also be part of that structure. This would raise new hires' earnings. Section D shows that there is no effect of outsourcing on the wages or AKM fixed effect of new hires.

However, it is still possible multiple mechanisms are occurring simultaneously. For example, if there are compensating differentials *and* rent sharing, it would result in lower quits and higher wages, but some of the wage effect would be due to compensation. In that instance, it is not possible to separate out the two effects.

The results suggest that outsourcing increases remaining workers' earnings. In the next section, I examine the impact of this finding on inequality. First, does outsourcing affect within-firm inequality. Second, do previous analyses under or overestimate the total impact of outsourcing on inequality?

8 Does OL Outsourcing Increase Inequality?

Previous analyses of the effect of outsourcing on inequality have focused on the fact that low-wage workers earnings decline. (Goldschmidt and Schmieder, 2017) The results in Section 6 demonstrate that there is an additional effect—remainers' earnings increase. What impact does this additional effect have on inequality? If remainers are low-wage, it would suggest that previous analyses overestimate the effect of outsourcing on inequality. While some low-wage workers' earnings decline, other low-wage workers' earnings increase. If, on the other hand, remainers are high-wage, the effect of outsourcing on inequality is stronger—low-wage workers earnings decline and high-wage workers earnings increase.

In order to examine which possibility is true, I utilize the full LIAB sample to better understand the wage distribution of remainers and leavers during outsourcing events relative to the LIAB sample as a whole. Figure 8 Panel (A) compares the share of workers in each wage decile in outsourcing firms, broken out by workers who leave the firm at the time of outsourcing and all remaining workers.⁵⁹ The black line represents the LIAB average—10% of workers are in the 1st decile of wages, 10% in the second, etc. The pink line represents the wage distribution of leavers—workers who leave the firm during outsourcing events. The green line represents remainers. As we can see, leavers are lower-wage than the population as a whole, with almost

⁵⁹Note: This includes workers in the outsourced occupation who are shifted to other roles.

20% of leavers in the bottom decile of the wage distribution. Remainders are particularly high wage, a large share of remainders are in the top of the wage distribution. Figure 8 Panel (B) provides a similar plot, taken instead as a sum. Here, the black line again represents the LIAB average—10% of workers at or below the 1st decile, 20% at or below the second decile, etc. The pink line again represents leavers during outsourcing, while the green represents remainders. Conceptually, in this graph the more shifted to the right a line is, the higher-wage the group as a whole. Figure 8 Panel (B) shows that leavers are slightly poorer than the LIAB as a whole, while remainders are very high-wage.

Figure 8 demonstrates that OL outsourcing should *decrease* within-firm inequality and *increase* aggregate inequality. Leavers are higher-wage than the population, but low-wage within their *firm*. This means that as they leave the firm, it should decrease within-firm inequality. This is also consistent with the predictions of the union-mediated bargaining model in Section 2. At the same time, remainders are high-wage and their earnings increase. This suggests that previous analyses underestimated the impact of outsourcing on inequality. Remainders are high-wage and their earnings increase. However, Figure 8 is descriptive. In the next section I directly examine the effect of outsourcing on within-firm and aggregate inequality.

8.1 Effect of OL Outsourcing on Within-Firm Inequality

I estimate the effect of outsourcing on within-firm inequality following the methodology in Section 5.4. I retain the establishment codes for “panel” firms in the matched treatment and control group. This removes some control-group firms. Because these are panel firms, it is possible to calculate time-varying measures of firm-level inequality. These firms are also linked to wages of new hires, business volume, bargaining agreements, and other data.^{60,61} The effect of outsourcing on firm-level inequality is estimated using the specification in Equation 2. By using the dynamic difference-in-differences framework it is possible to observe both the immediate effects of outsourcing on firm-level statistics, as well as the change over time.

Table 5 provides the difference-in-differences estimate of the effect of outsourcing on within-firm inequality and occupational concentration. Outsourcing reduces within-firm inequality, as evidenced by the decline in the 90-10 wage ratio and Gini coefficient. Additionally, firm occupational concentration increases.

This result is consistent with the findings of Handwerker (2020), as well as the descriptive relationship in Table 2. When firms outsource, the workers removed are low-wage. Firm-level Occupational Herfindahl

⁶⁰Because the panel structure is only in effect from 2002-2012, and other variables come from the LIAB, it is only possible to have outcomes data for 3 years when examining the effect on inequality and wages of new hires.

⁶¹Each treatment and control firm that is part of a separate event (i.e. an outsourcing firm that outsourced in 2002 and 2005, or a control firm that was matched in 2002 and 2005) are treated as separate firms when regressing and including firm fixed effects. However, estimates are still clustered at the firm level.

increases, and remaining workers' earnings increase. The fact that outsourcing also decreases within-firm inequality helps explain the findings in Card, Heining, and Kline (2013) and Song et al. (2018). Their conjecture that outsourcing is partially to explain for decreased intra-firm inequality is borne out by these results.

In this section, I have shown that OL outsourcing decreases within-firm inequality. But what happens to aggregate inequality? This question is answered in the next section.

8.2 Effect of OL Outsourcing on Aggregate Inequality

This section provides the estimates of the effect of outsourcing on aggregate wage inequality. Goldschmidt and Schmieder (2017) find that outsourced FCSL workers' wages decline by approximately 10%. Figure 9 aims to replicate those results. What is the effect of outsourcing on leaving workers' wages? Figure 9 shows that leavers' wages decline by approximately 10%, similar to Goldschmidt and Schmieder (2017).⁶² As shown in Figure 8, these workers are somewhat lower-wage than the population as a whole. Remainers' are very high and their earnings increase. What is the total effect on inequality?

Following the methodology outlined in Section 5.4.2 I estimate unconditional quantile partial effect (UQPE) of OL outsourcing on various quantiles τ in the aggregate wage distribution. Because this is a binary treatment, each estimate represents the effect of a 1% increase in the share of all workers who are part of an outsourcing event on a given quantile τ .

Figure 10, Panel (A) presents the results. There is no effect of outsourcing on the bottom-end of the earnings distribution. The estimated effect is zero and precisely estimated. However, as we move up the earnings distribution, the effect increases substantially. A 1% increase in the share of workers subject to an OL outsourcing event increases the 80th percentile of earnings by 15%. This result may seem contrary to the results in Figure 9, where leavers' earnings decline. This is because these estimates represent a weighted average of effects. The predicted earnings losses for leavers are offset by earnings gains for remainers. Additionally, there are approximately 10 times as many remainers as leavers. This means the estimated treatment effect is more weighted towards remainers. Figure 10, Panel (B) outlines the effect of outsourcing on different parts of the wage distribution broken out by whether the treated worker was a leaver or remainder. The pink line represents the estimated effect by leavers, while the green line represents the estimated effect for remainers. A 1% increase in the share of workers who are themselves outsourced decreases the first

⁶²The fact that these results accurately replicate Goldschmidt and Schmieder (2017) is further evidence that this analysis is correctly identifying outsourcing.

two deciles of the wage distribution by a point estimate of 25%, though these estimates are very imprecise. Meanwhile, a 1% increase in the share of workers who are remainers after an outsourcing event increases the top of the earnings distribution by 15%. These represent changes to the distribution of earnings in the LIAB. The extent to which this represents a true change in the wage structure in Germany depends on how accurately the LIAB reflects the German wage distribution.

In terms of aggregate measures of inequality, Figure 11 Panel (A) plots the dynamic effect of OL outsourcing on the aggregate variance of log wages. Panel (B) plots the dynamic effect of OL outsourcing on the overall Gini index. Both are standard measures of inequality. A 1% increase in the share of workers who are part of an outsourcing event increases the Gini coefficient by approximately 10%, and the variance of wages by approximately 20%. The effects outlined in this section may seem large, but it is worth noting that only 11.7% of workers are ever part of an OL outsourcing event. A 1% increase in the share of workers part of an event represents an 8.5% relative increase.⁶³ 1.67% of workers in the LIAB are leavers in an outsourcing firm, meaning that a 1% increase in the share of workers outsourced represents a near doubling of outsourcing, resulting in large negative point estimates.

These results demonstrate that OL outsourcing increases aggregate inequality not just by wage decreases for the outsourced, but also via wage increases to workers at the top of the distribution. While the earnings effect is larger for workers who are low-wage in their firm, those workers are still relatively high-wage relative to the *population*. Outsourcing increases their earnings, and the top of the earnings distribution increases as well. Previous measures of the effect of outsourcing on inequality underestimated its impacts. This result is also consistent with unions focusing on protecting remaining higher-wage and professional jobs, as discussed by Doellgast and Green (2007).

9 Conclusion

This paper analyzes the effects of outsourcing on remaining workers, rent allocation, and inequality. I demonstrate the recent labor market trends in Germany suggest outsourcing has increased—firms are using fewer distinct occupations and becoming more occupationally concentrated. What do these trends mean for workers who were in firms at the time of outsourcing?

In a matched dynamic difference-in-differences framework, outsourcing increases remaining workers' earnings by 6% after 5 years. Additionally, remainers are more likely to remain in the firm, consistent with

⁶³12.7/11.7.

remainers receiving more rents. When examining heterogeneity, there is no variation by whether remainers were complements or substitutes to the outsourced occupation. Instead, while all workers earnings increase, workers at the bottom of the within-firm earnings distribution see larger earnings.

Comparing these results to a number of models of wage bargaining, the results are best explained by a framework of union-mediated outsourcing. Under this framework, when there is a union firms compensate remainers to approve outsourcing. This results in broad earnings increases, but larger increases to the lower-wage workers. When examining heterogeneity by existence of a collective bargaining agreement, earnings only increase in firms with a CBA. Without a CBA, remainers' earnings decline. This is consistent with collective bargaining playing an important role in capturing rents. These results demonstrate the importance of collective bargaining in wage setting in the German labor market. When considering whether outsourcing might affect remainers in other countries—particularly the United States—there might be no effect. Unionization and CBA rates are much lower in the United States than Germany. Without collective bargaining, remainers may not be affected by outsourcing, or rents may be distributed more unequally. (Cho, 2018) I also provided evidence that suggests alternative mechanisms—compensating differentials, substitute workers “picking up the slack”, increased managerial effectiveness, unobserved contemporaneous effects, asymmetric information, and fairness considerations—cannot explain the results.

The results shed an important light on drivers of increased wage inequality. Previous work that examined outsourcing only took into account the wage effects on laid-off workers, and found that outsourcing increases wage inequality. The results show outsourcing increases earnings at the top of the wage distribution. This means previous analyses which only considered the wage impacts on outsourced workers likely underestimated the true effect of outsourcing on inequality.

There are many possible avenues of future research. This paper focuses on workers already in the labor market. Future work should investigate the long-term impacts of outsourcing on sorting into firms. For example, the remaining workers appear to find the outsourcing firm more attractive due to increased earnings, and separations declined. What about new workers entering the labor market? Under this environment, outsourcing has resulted in a firm that pays higher wages. While there is no evidence of sorting on average—new hires are similar before and after outsourcing—the effects might be different for younger workers or apprentices.

Workers may also find it difficult to move up the job ladder. If firms are more occupationally specific, workers may find it difficult to transfer to a better-paying job within the firm.⁶⁴ However it is also possible

⁶⁴See e.g. Irwin (2017)

that the lack of within-firm mobility could result in higher wage growth. If firms have a smaller (or no) internal labor market, they may find it harder to underpay workers with the promise of a promotion in the future. Macleod and Malcomson (1988), Prendergast (1993), and Gibbons and Waldman (2006) discuss the effect of within-firm hierarchies on wages. After outsourcing, workers may be more likely to switch to better paying firms rather than “sticking it out” in the hopes of a promotion. Given recent trends towards occupationally specific firms, it is important to understand the impacts on wage growth, not just rent reallocation. Future research should investigate the links between outsourcing and upward mobility.

Finally, it is also possible that the results may not be capturing the full effect of outsourcing. The empirical analysis focused only on large, single-year events where a firm removed almost all the workers in a given occupation. However, in many cases firms slowly wind-down occupations over several years. While these events are difficult to identify in terms of their broader wage impact, understanding the impact of these events is an important step to investigating the effect of firms becoming more occupationally concentrated.

Nevertheless, by documenting the earnings, labor supply, and inequality effects of OL outsourcing on remaining workers, this paper adds to our understanding of the impact of outsourcing and the role of collective bargaining in the German labor market.

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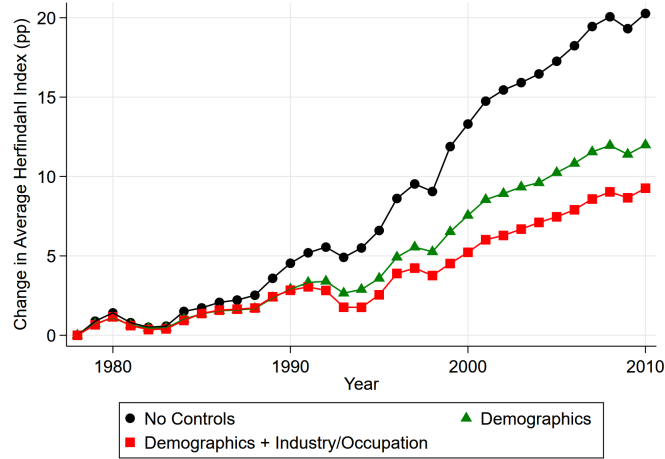
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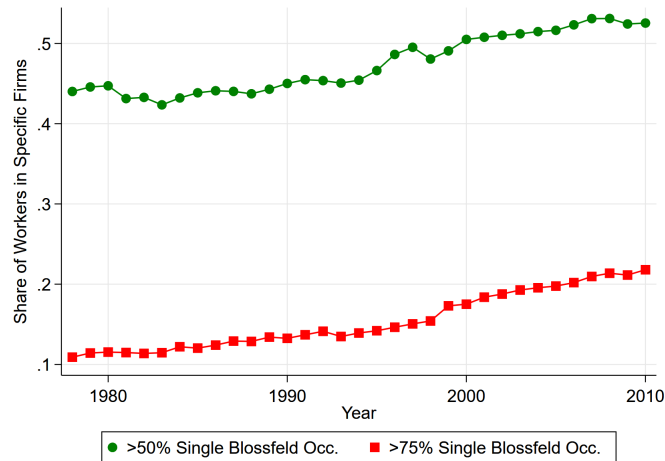
Figure 1: Trends in Firm Outsourcing

(A) Average Firm Occupation Herfindahl (Firms with 100+ Workers) 1978-2010



Notes: This graph represents the average Firm Occupational Herfindahl (FO-HHI), a proxy for outsourcing (Handwerker, 2020), from 1978-2010. Calculated as $\sum_{o=1}^{12} s_{oj}^2$, the sum of square shares of workers in one of 12 Blossfeld (1987) Occupation Groups. Black line represents worker-level average, green line represents worker-level average after conditioning on firm size bins, age, age squared, gender, and schooling level. Red line represents worker-level average after conditioning on firm size bins, age, age squared, gender, schooling level, industry fixed effects, and occupation fixed effects. All values relative to initial value of 3438 in 1978. Calculated from SIAB 2% sample of German workers. Only uses West German workers between the ages of 23 and 63.

(B) Share of Workers in Large Firms (100+ Workers) Whose Firms are >50% and >75% Single Occ. Group



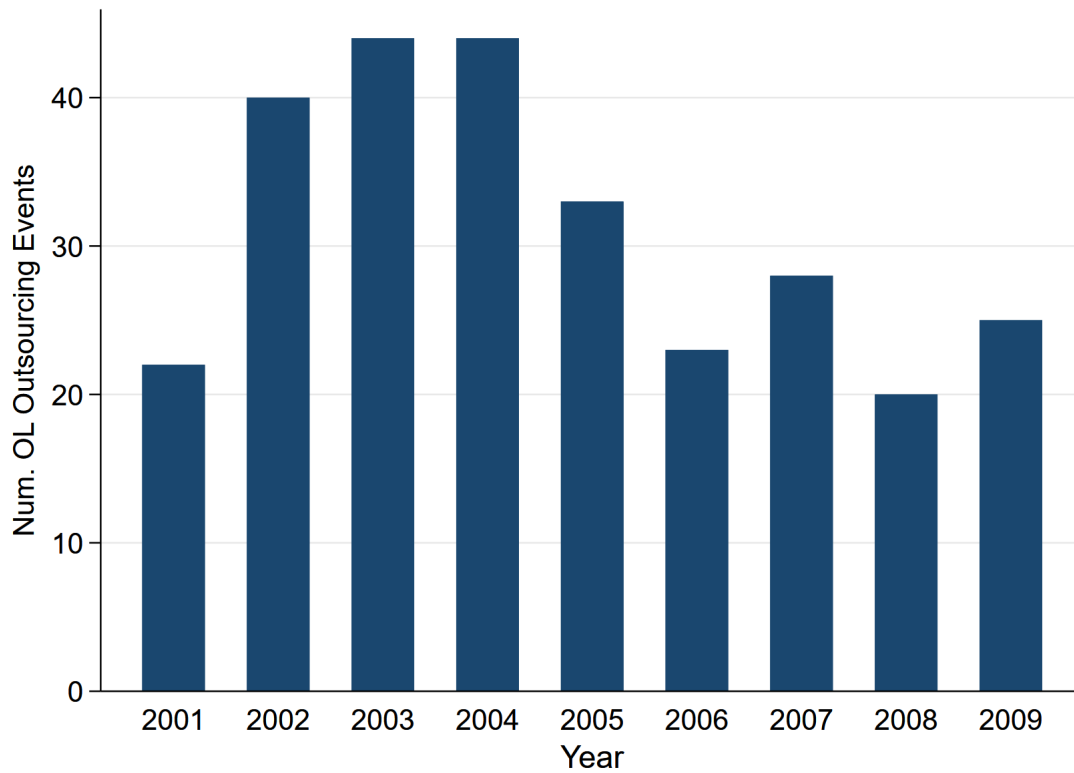
Notes: Green line represents worker-level average share of workers in large firms whose firms are >50% a single Blossfeld (1987) occupation. Red line represents worker-level average share of workers in large firms whose firms are >50% a single Blossfeld occupation. Calculated from SIAB 2% sample of German workers. Only uses West German workers between the ages of 23 and 63.

Table 2: Relationship between FO-HHI (Outsourcing Proxy) and Daily Earnings

	Outcome: ln(Daily Earnings)		
	(1)	(2)	(3)
FO-HHI _{jt} × Low-Wage Occ.	-0.344** (0.007)		
FO-HHI _{jt} × Med.-Wage Occ.	-0.067** (0.006)		
FO-HHI _{jt} × High-Wage Occ.	0.095** (0.007)		
FO-HHI _{jt} × non-Manager		-0.121** (0.006)	
FO-HHI _{jt} × Manager		0.052** (0.008)	
FO-HHI _{jt} × No Degree			-0.126** (0.006)
FO-HHI _{jt} × University Degree			0.067** (0.014)
N - Workers	178,994	178,994	178,994
Person FE	X	X	X
Year FE	X	X	X
Controls	X	X	X

Regression of the log of daily earnings on the Firm-Occupational Herfindahl – FO-HHI_{jt}. FO-HHI_{jt} = $\sum_{o=1}^{12} s_{jot}^2$ the sum of square shares of Blossfeld (1987) occupations for firm j in year t . Limited to West-German workers in large firms (100+ workers) who started career after 1976. Earnings are inflation-adjusted to 2010 euros. Controls include firm tenure, occupation tenure, overall experience, age, and their squares. Standard errors in parentheses, clustered at the worker level. Manager denoted by workers in “complex” tasks, $niveau \geq 3$. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

Figure 2: Occupational Layoff Outsourcing Events by Year



Notes: Represents the number of identified occupational layoff (OL) outsourcing events in each year. Following Goldschmidt and Schmieder (2017), OL outsourcing events defined as situations where a firm employs at least 10 workers in a single occupation in a given year, and in the next year the number of workers in that occupation is reduced by at least 75%. Restricted to instances where the firm does not (1) hire back 10% of the workers in the outsourced occupation over the next two years (2) does not shrink by more than 50% over the next two years, and is not in a food, cleaning, security, logistics, or temporary help industry.

Table 3: Balance Table

Worker Info				Firm Info			
	Treated	Control	Diff.		Treated	Control	Diff.
Daily Earnings	123.306 (36.298)	124.887 (37.721)	-1.581 (8.559)	FO-HHI _{jt}	0.257 (0.113)	0.276 (0.111)	-0.018 (0.024)
East Germany	0.185 (0.388)	0.185 (0.388)	0.000 (0.071)	Emp _{t+1} /Emp _t	0.951 (0.087)	0.996 (0.167)	-0.045* (0.021)
Age	41.948 (7.591)	40.986 (8.058)	0.962 (0.716)	Firm Age	21.339 (9.803)	22.624 (8.667)	-1.285 (2.639)
Female	0.256 (0.436)	0.258 (0.438)	-0.003 (0.583)	Firm Size (Bins)	7.823 (0.510)	7.644 (0.709)	0.179* (0.083)
University Degree	0.204 (0.403)	0.250 (0.433)	-0.046 (0.050)	N - Workers	75,861	75,861	
Part-Time	0.068 (0.252)	0.071 (0.258)	-0.003 (0.022)				
Firm Tenure	8.067 (3.636)	8.110 (3.552)	-0.042 (0.578)				
N - Workers	75,861	75,861					

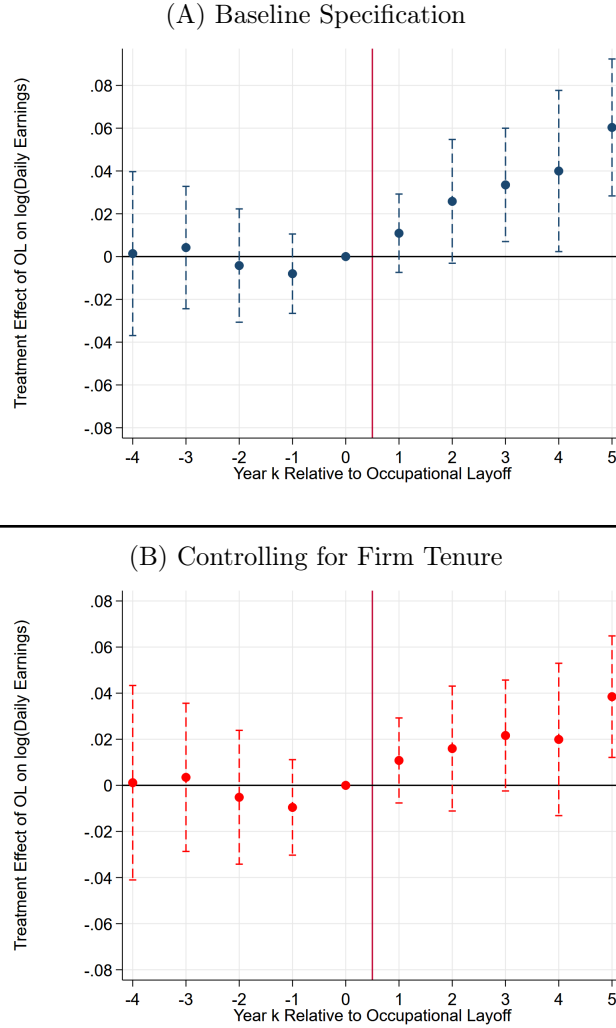
Notes: Means of relevant variables for matched treated and control group workers in the year before OL outsourcing. Treated workers defined as matched workers not in OL outsourced occupation. Firm size bins range from 1-8, where 8 denotes 500+ workers in the firm. Firm-Occupational Herfindahl - FO-HHI_{jt} = $\sum_{o=1}^{12} s_{jot}^2$ the sum of square shares of Blossfeld (1987) occupations for firm j in year t . Standard deviation in parenthesis. Difference represents difference in treated mean minus control mean, with standard errors clustered at the firm level. A T-Test of means (clustered at the firm level) is used to test differences between the group-level means. N - Clusters = 2,556. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

Table 4: Summary Stats on Events

Panel (A) - Summary Information on Events			
Occ. is “Unskilled” Manual	0.184 (0.387)	Occ. is “Skilled” Manual	0.293 (0.454)
Occ. is “Unskilled” Services	0.454 (0.498)	Occ. is “Skilled” Services	0.201 (0.401)
% FCSL Occupations	0.350 (0.477)	Number Workers in Occ.	67.363 (161.923)
Panel (B) - Demographics of Workers in OL Outsourced Occupation			
Age	41.550 (8.721)	Female	0.363 (0.332)
University Degree	0.071 (0.150)	Relative Wages	1.262 (0.538)
Leave Firm Next year	0.406 (0.387)	Firm Tenure	6.511 (3.848)

Notes: Panel (A) refers to number of workers in all removed occupations. Events can have multiple occupations represented. Classification of manual vs. services and skilled vs. non-skilled created following Blossfeld (1987). Relative wages denotes average wages of workers relative to occupation average for that year. Leave Firm denotes share of workers who leave the firm at the time of OL outsourcing. Standard deviation in parenthesis. Refers to mean of 75,861 treated workers in matched sample, 260 OL outsourcing events.

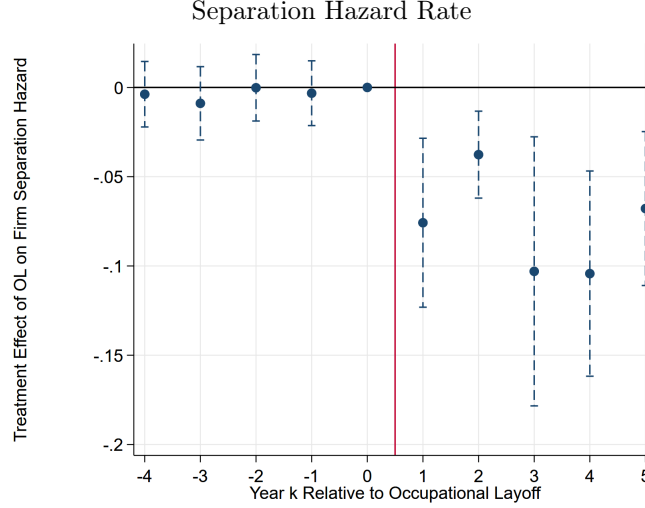
Figure 3: Effect of OL Outsourcing on Remaining Workers' Daily Earnings



Note: Figures shows regression coefficients and 95% confidence intervals for the treatment effect of OL Outsourcing on log(Daily Earnings) in a given year k relative to the treatment year i.e. $\beta_k^{Treated}$. Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Earnings are inflation-adjusted to 2010 euros. Regressions include person fixed effects, relative year fixed effects, and controls for age and age squared interacted with gender, and age and age squared interacted with education level. Panel (B) additionally includes controls for firm tenure and its square.

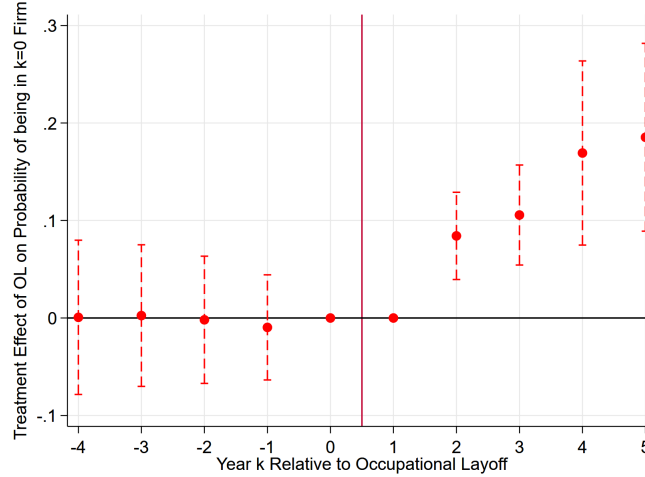
Figure 4: Effect of OL Outsourcing on Firm Separations n

(A)



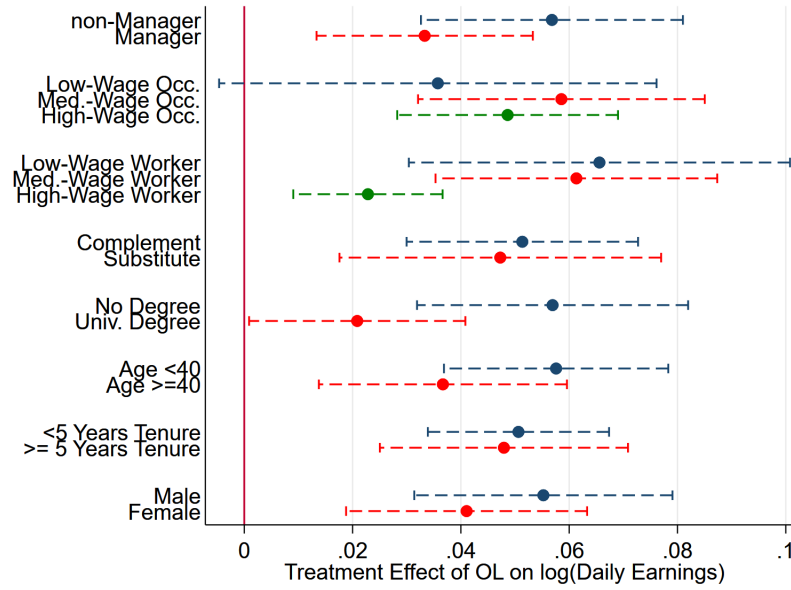
Note: The figure shows regression coefficients and 95% confidence intervals for the treatment effect of OL outsourcing on workers' probability of separating from current firm between relative year k and $k + 1$, conditional on being employed. Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Regressions include controls for age and age squared interacted with gender, and age and age squared interacted with education level. Only includes treatment and control group workers where the year before treatment l was 2008 or before.

(B) Staying in OL Outsourcing Firm



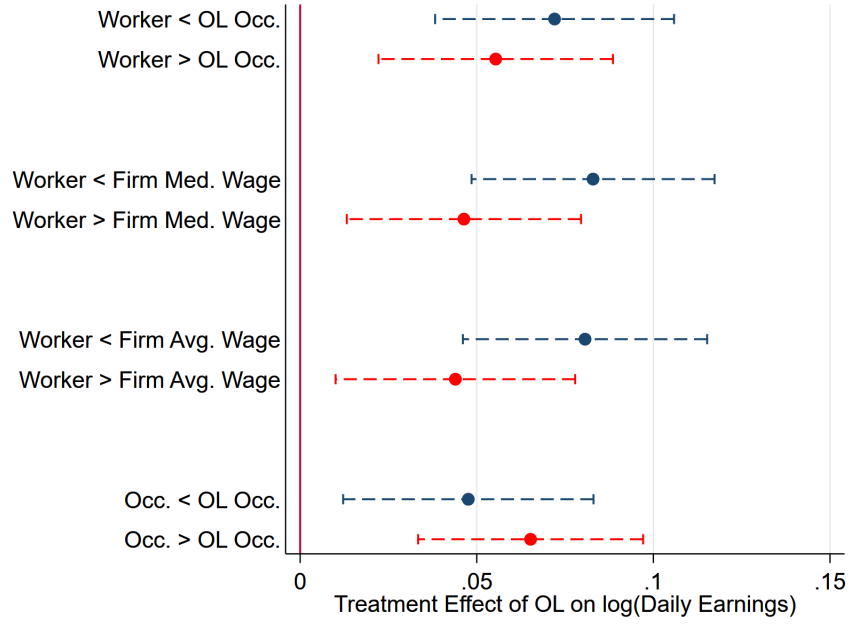
Note: The figure shows regression coefficients and 95% confidence intervals for the treatment effect of OL Outsourcing on workers' probability of remaining in $k = 0$ firm in a given year k relative to the treatment year i.e. $\beta_k^{Treated}$. Coefficient at $k = 1$ equal to zero due to restriction that all treated and matched control group workers remain in $k = 0$ firm between $k = 0$ and $k = 1$ (i.e. no workers have changed firms between $k = 0$ and $k = 1$ by construction). Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Regressions include person fixed effects, relative year fixed effects, and controls for age and age squared interacted with gender, and age and age squared interacted with education level.

Figure 5: Heterogeneity Analysis by Worker: Effect of OL Outsourcing on Remaining Workers' Earnings



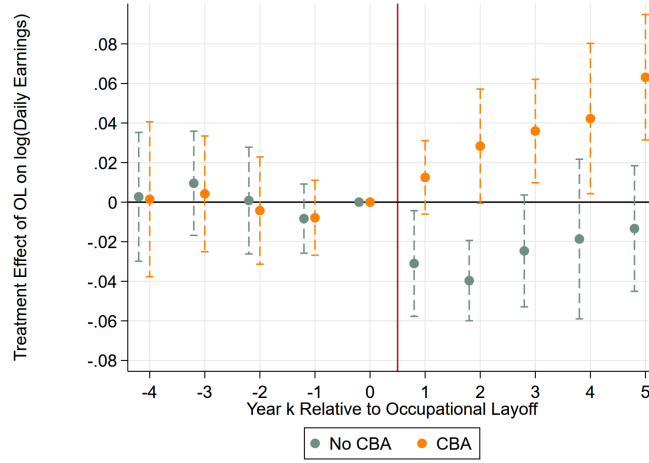
Note: The figure shows heterogeneity effects. Each row displays regression coefficients and 95% confidence intervals for the treatment effect of OL Outsourcing after 5 years (i.e. $\beta_5^{Treated}$) for various subgroups. Values calculated by interacting indicators for relevant group (i.e. managers, non-managers) with relative year indicators and treatment indicators. Managers defined as workers in job which requires complex tasks (*niveau* ≥ 3). Low/Med/High Wage occupation defined as whether occupation is in the bottom, middle, or top tercile of occupation average in LIAB sample. Low/Med/High Wage workers defined as whether a worker is in the bottom, middle, or top tercile of the matched sample's distribution of Person FE in a Two-Way Fixed Effect Model (Abowd, Kramarz, and Margolis, 1999). Substitute workers defined as workers in the same 1-digit occupation as the OL outsourced occupation, complements all other occupations. Age and tenure sub samples defined by worker age and tenure in the year before OL outsourcing. Clustered at the $k = 0$ firm level. Earnings are inflation-adjusted to 2010 euros. Regressions include person fixed effects, relative year fixed effects, and controls for age and age squared interacted with gender, age and age squared interacted with education level.

Figure 6: Heterogeneity Analysis by Rank: Effect of OL Outsourcing on Remaining Workers' Earnings



Note: The figure shows heterogeneity effects by workers and occupation rank. Each row displays regression coefficients and 95% confidence intervals for the treatment effect of OL Outsourcing after 5 years (i.e. $\beta_5^{Treated}$) for various groups. Values calculated by creating treatment indicator which denotes treated worker rank or control group. Therefore, each estimate represents treatment effect for treated subgroup relative to overall control group. Worker less than or greater than OL Occ. denotes the worker's own wage in $k = 0$ was below or above the average wage of the OL outsourced occupation in their firm. Worker less than or greater than Firm Med. or Firm Avg. denotes the worker's own wage in $k = 0$ was below or above the median or average wage in the firm. Occ. less than or greater than OL Occ. denotes the worker's occupation had lower or higher average wages than the OL outsourced occupation in $k = 0$. Clustered at the $k = 0$ firm level. Earnings are inflation-adjusted to 2010 euros. Regressions include person fixed effects, relative year fixed effects, and controls for age and age squared interacted with gender, age and age squared interacted with education level.

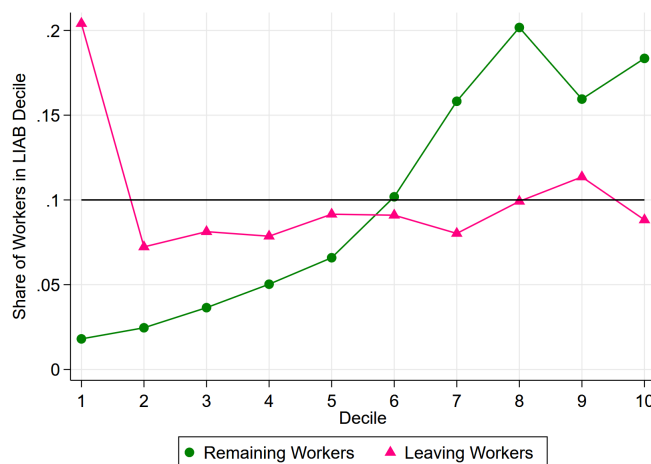
Figure 7: Effect of OL Outsourcing by Collective Bargaining Agreements



Note: The figure shows regression coefficients and 95% confidence intervals for the treatment effect of OL Outsourcing on log(Daily Earnings) in a given year k relative to the treatment year i.e. $\beta_k^{Treated}$. Values calculated by creating new treatment indicator which denotes No CBA, CBA, or control group. CBA and No CBA are determined based on firms' collective bargaining agreement in $k = 0$. "No-CBA" denotes firms which had no collective bargaining agreement in the year before OL outsourcing. "CBA" denotes the firms which had a CBA in the year prior to outsourcing. Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Earnings are inflation-adjusted to 2010 euros. Regressions include person fixed effects, relative year fixed effects, and controls for age and age squared interacted with gender, age and age squared interacted with education level.

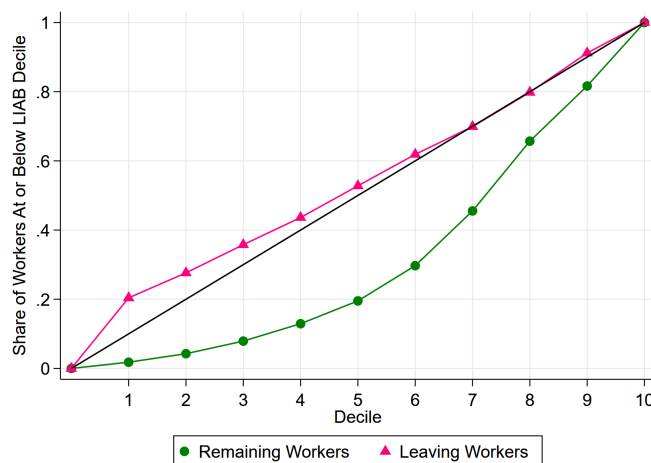
Figure 8: Earnings Distribution by Type of Treatment

(A) Share of Workers in Wage Deciles – By Remainer vs. Leaver



Note: The figure shows the earnings distribution of staying and leaving workers in OL outsourcing firms in the year before OL outsourcing relative to the overall LIAB. Each point represents the share of remaining or leaving workers in each wage decile bin. Black line represents overall LIAB (e.g. 10% of workers in the 2nd decile, 10% in the 3rd decile, etc.) Wage deciles calculated within-year for regular social security employees, age 21-60, with wages 15 euros per day and above. Earnings are inflation-adjusted to 2010 euros.

(B) Share of Workers At or Below Each Wage Decile – By Remainer vs. Leavers



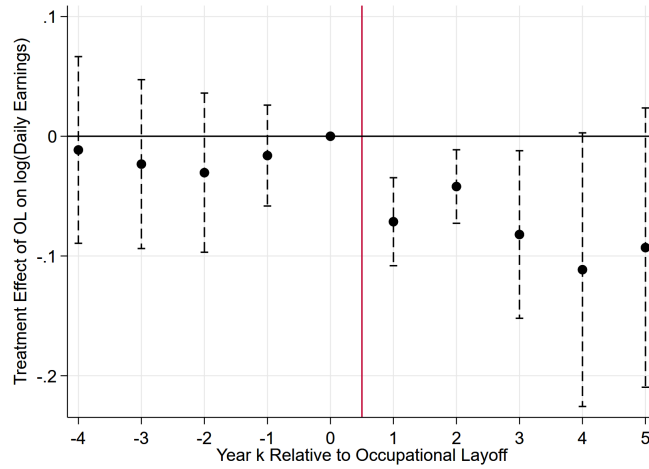
Note: The figure shows the earnings distribution of remaining and leaving workers in OL outsourcing firms in the year before OL outsourcing relative to the overall LIAB. Each point represents the share of staying or leaving workers at or below each wage decile bin. Wage deciles calculated within-year for regular social security employees, age 21-60, with wages 15 euros per day and above. Black line represents share for the full LIAB (e.g. 20% of workers at or below second decile). The more shifted to the right the line is, the wealthier the group relative to the population. Earnings are inflation-adjusted to 2010 euros.

Table 5: Effect of OL Outsourcing on Within-Firm Inequality and FO-HHI

Outcome: Firm-Level				
	90-10 Wage Ratio	$\text{Var}(\ln(w_{ijt}))$	Gini Coefficient	FO-HHI
	(1)	(2)	(3)	(4)
Treat \times Post	-0.346* (0.137)	-0.008 (0.009)	-0.005** (0.001)	0.013** (0.003)
Constant	3.596** (0.041)	0.275** (0.002)	0.193** (0.000)	0.157** (0.001)
N - Firms	1,258	1,258	1,258	1,258
N - Clusters	737	737	737	737
Firm FE	X	X	X	X
Year FE	X	X	X	X
Relative Year FE	X	X	X	X

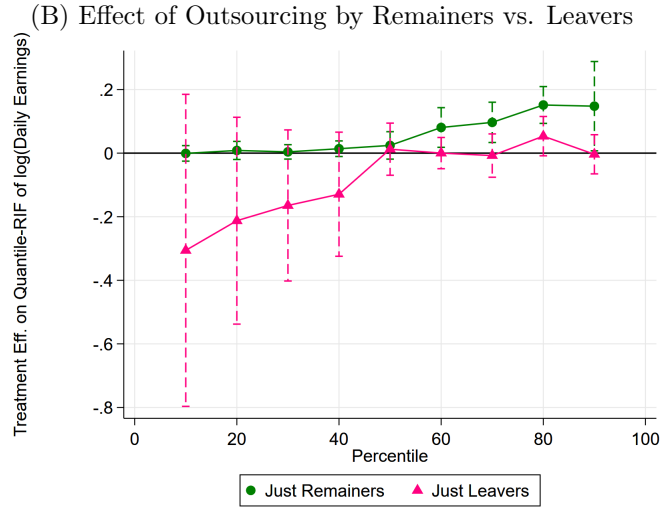
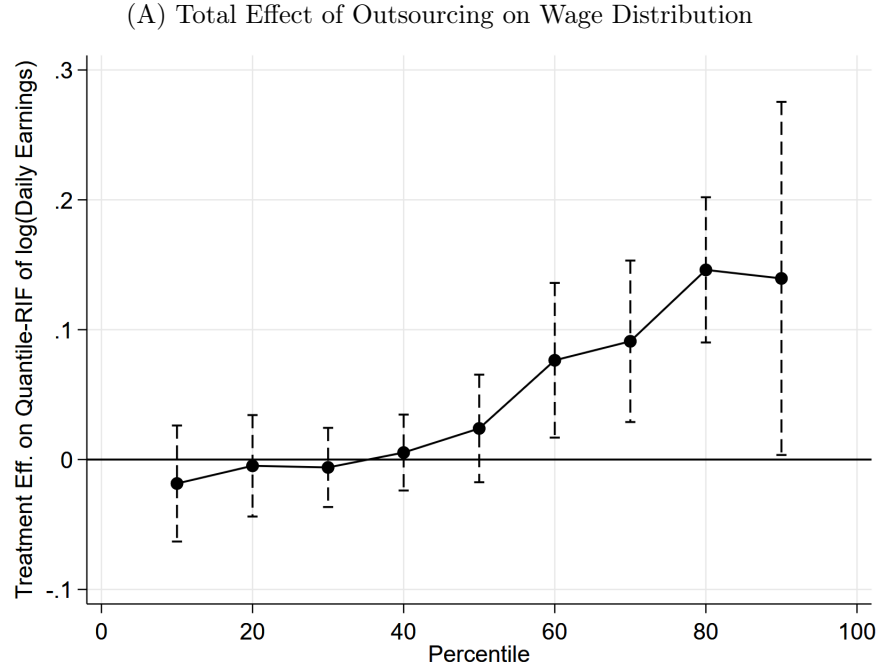
Difference-in-Differences estimation of the effect of OL outsourcing on firm-level inequality indicators. Limited to LIAB “panel firms” identified in the matched sample following the methodology in Section 5.2. Standard deviation in parenthesis. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$. $\text{Var}(\ln(w_{ijt}))$ represents the variance of the natural logarithm of daily earnings within the firm. FO-HHI denotes firm level sum of square shares of occupations $\sum_o s_o^2$ where s_o denotes the share of firm employment in a given occupation o . Clustered at the firm-level.

Figure 9: Effect of OL Outsourcing on Leaver's Wages



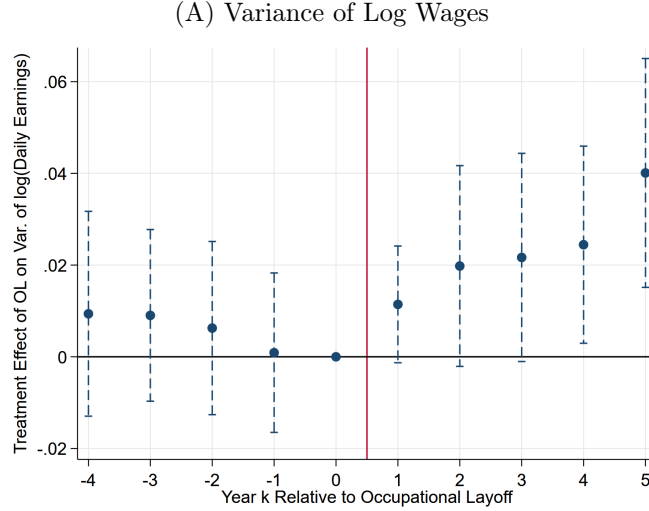
Note: The figure shows regression coefficients and 95% confidence intervals for the treatment effect of OL Outsourcing on log(Daily Earnings) in a given year k relative to the treatment year i.e. $\beta_k^{Treated}$. Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Earnings are inflation-adjusted to 2010 euros. Regressions include person fixed effects, relative year fixed effects, and controls for age and age squared interacted with gender, age and age squared interacted with education level. Restricted to workers who leave OL outsourcing firm between $k = 0$ and $k = 1$ and the relevant matched control group workers. Restricted to employed workers.

Figure 10: RIF Regression Effect of OL Outsourcing - by decile

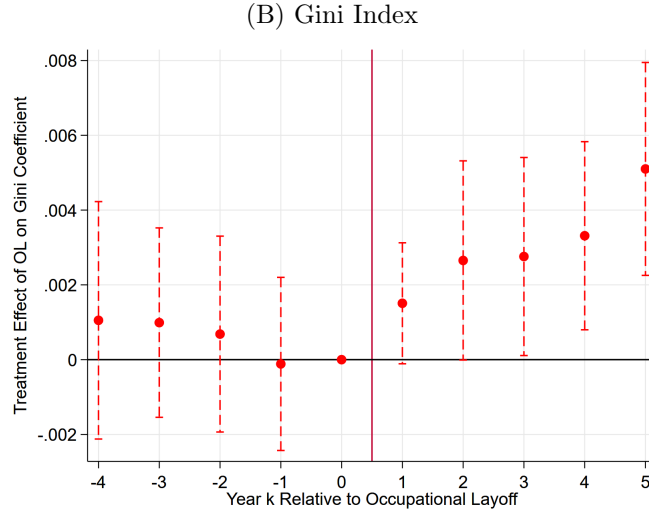


Note: Figures show RIF regression coefficients and 95% confidence intervals for the treatment effect of OL Outsourcing after 5 years (i.e. $\beta_5^{Treated}$) on the Recentered Influence Function (RIF) of each wage decile q_τ from the 10th percentile to the 90th percentile. RIF for each wage decile calculated within-year for all regular social security employees with wages above 15 euros per day, age 21-60 in the LIAB. Earnings are inflation-adjusted to 2010 euros. Regressions include controls for age and age squared interacted with gender, age and age squared interacted with education level, person fixed effects, and relative year fixed effects. Clustered at the treatment ($k = 0$ firm) level. Treatment effect represents effect of a 1pp increase in share of LIAB part of an outsourcing event on quantile q_τ , i.e. moving from 11.7% of workers part of an event to 12.7% of workers part of an event. Panel (B) provides same estimates regressed separately by remainers and matched control group (in green) and leavers and matched control group (in pink).

Figure 11: Effect of OL Outsourcing on Aggregate Inequality



Note: The figure shows regression coefficients and 95% confidence intervals for the treatment effect of OL Outsourcing on Recentered Influence Function (RIF) of variance of log wages in a given year k relative to the treatment year i.e. $\beta_k^{Treated}$. Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Regressions include person fixed effects, relative year fixed effects, and controls for age and age squared interacted with gender, and age and age squared interacted with education level. RIF calculated within each year for all regular Social Security employees, aged 21-60. Treatment effect represents increasing share of all workers who are part of an outsourcing event (leaver or remainder) by 1% on overall variance of log wages in the LIAB.



Note: The figure shows regression coefficients and 95% confidence intervals for the treatment effect of OL Outsourcing on RIF of Gini index in a given year k relative to the treatment year i.e. $\beta_k^{Treated}$. Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Regressions include person fixed effects, relative year fixed effects, and controls for age and age squared interacted with gender, and age and age squared interacted with education level. RIF calculated within each year for all regular Social Security employees, aged 21-60. Treatment effect represents increasing share of all workers who are part of an outsourcing event (leaver or remainder) by 1% on overall Gini index in the LIAB.

A Details of Models

Intra-Firm Bargaining

In the model of wage determination within firms by Stole and Zwiebel (1996), workers are homogenous and cannot be replaced in the short-run. Specifically, the firm is negotiating individually with N workers, output is produced according to a production function $F(N) : N \rightarrow \mathbb{R}_+$. Within this framework, the transition from $N - 1$ to N workers results in a change of output $F(N) - F(N - 1) = \Delta F(N)$. Profits are $\tilde{\pi}(N) = F(N) - \tilde{w}(N)N$ where $\tilde{w}(N)$ denotes the (equal) wage of each worker when there are N workers in the firm. Wages are equal because workers are homogenous.

The fact that workers cannot be replaced in the short-run results in workers capturing some rents. As shown by Stole and Zwiebel (1996), under pairwise negotiations, the worker and firm split a portion of profits, and results in a Nash equilibrium wage:

$$\tilde{w}(N) = \frac{1}{N(N+1)} \sum_{i=0}^N i \Delta F(i) + \frac{1}{2} \underline{w}$$

Where \underline{w} is the worker's outside option. As discussed in Jäger and Heining (2019), the wage for each worker is a weighted average of all workers' marginal products and the outside option. Because there are replacement frictions, workers capture some rents from the firm. Again, from Jäger and Heining (2019), because there is decreasing marginal product as workers are added, it is possible to calculate the change in wages from a worker exit.

$$\tilde{w}(N-1) - \tilde{w}(N) = \frac{1}{N+1} \left(\sum_{i=0}^{N-1} \frac{2i}{N(N-1)} \Delta F(i) - \Delta F(N) \right) > 0$$

Here, the left hand side represents the change in wages for a given worker in the firm after a different worker leaves. This change is positive, because the marginal product of the N th worker in the firm is lower than preceding $N - 1$ marginal products. If outsourcing is equivalent to reducing the number of workers in the firm, remainers' wages should increase because the average marginal product of workers has increased.

Another possibility is that, in the context of this model, outsourcing replaces the lowest marginal-product worker with the services provided by a subcontractor who charges the marginal cost of that worker. This releases rents that can be shared with the remaining workers. Therefore, remainers' wages increase because there are fewer workers to share rents with.

The Stole and Zwiebel (1996) model only considers workers with homogenous labor. What if workers were heterogeneous? Cahuc, Marque, and Wasmer (2008) introduces a model of intra-firm bargaining with heterogeneous labor. Under this model, there is a production function $F(N_1, \dots, N_n)$ with n distinct types of labor. Where $i = 1, \dots, n$. $N = (N_1, \dots, N_n)$ denotes the number of workers the firm uses in each type of labor. To hire a worker of type i the firm posts a vacancy V_i and pays a hiring cost γ_i .

As demonstrated by Cahuc, Marque, and Wasmer (2008), workers and firms bargain as in Stole and Zwiebel (1996), and worker bargaining power is denoted by β . As a result of Nash Bargaining, the wage earned by each type of worker i is:

$$w_i(N) = (1 - \beta)rU_i + \int_0^1 z^{\frac{1-\beta}{\beta}} F_i(Nz) dz$$

Intuitively, the wage expression here is similar to Stole and Zwiebel (1996). Wages are a function of the outside option rU_i , their bargaining power β , and the worker's own type marginal product integrated over employment in the firm. Finally, the effect of a change in type j labor on the wages of worker i is given by:

$$\frac{\partial w_i(N)}{\partial N_j} = \int_0^1 z^{\frac{1}{\beta}} F_{ij}(Nz) dz$$

What the above equation implies is that a reduction in the number of workers of type j will increase the wages of type i when i and j are substitutes. A reduction in the number of j workers will decrease the wages of type i workers when i and j are complements. Conceptually the idea is similar to the homogenous labor model. If workers of type i and j are substitutes, reducing type j labor increases the marginal product of type i because there are fewer type j workers. For workers who are complements, their marginal product is lower because of the complementarities, so their wages decline.

What would the Cahuc, Marque, and Wasmer (2008) model predict is the effect of outsourcing on remainders? Here, outsourcing changes the number of workers in a given type j . As discussed above, if outsourcing *replaces* the type j workers by some fixed cost, there may not an effect on substitute workers. Under the Cahuc, Marque, and Wasmer (2008) model, the increase in substitute workers' wages was due to increased marginal product because their labor is becomes valuable.⁶⁵ In this framework, the outsourced workers are replaced at the same marginal product and substitutes are not affected.⁶⁶ However, there may still be a decline in complement workers' wages. This is because after outsourcing, complement workers are

⁶⁵This idea is similar to Currie, Farsi, and MacLeod (2005) who find that after layoffs substitute workers' earnings increase.

⁶⁶The predictions are similar if the replacement workers are more productive. If that were the case, substitute worker's earnings are predicted to decline.

no longer in the same firm, which could reduce worker complementarities. If on the other hand outsourcing solely reduces the number of workers, the predicted effect is the same as the model—substitute workers’ earnings increase, while complement workers’ earnings decline. Under both scenarios, the Cahuc, Marque, and Wasmer (2008) model predicts heterogeneity by whether remainers are complements or substitutes.⁶⁷

Overall, intra-firm bargaining models have clear predictions of the effect of outsourcing on remaining workers. The standard model of Stole and Zwiebel (1996) predicts that remaining workers wages should increase. When extending to models of heterogeneous labor as in Cahuc, Marque, and Wasmer (2008), the model predicts heterogeneity by whether workers are substitutes or complements to the outsourced occupations.

Insider-Outsider Model

In Insider-Outsider models, wages are driven by turnover costs. In this framework, firms pay costs of hiring new workers, and are unable to pass these costs on to insiders (i.e. incumbent employees). As discussed by Lindbeck and Snower (2001), firms do not pay these costs until insiders are actually replaced, but this would require them to charge workers “exit fees”, which are usually illegal. These costs create a labor market friction. The lower the hiring costs, the more substitutable insider and outsider wages. The higher the hiring costs, the more insiders can threaten to not cooperate with new hires, and the higher the wages they can demand.

Lindbeck and Snower (2002) outline a one-period model of Nash Bargaining where labor turnover costs give insiders market power. Under this model, wages are bargained individually between the firm and workers. There are constant returns to labor. Each insider generates a^I and earns wage w^I . Under the bargaining agreement, firm profit is given by $\pi^I = a^I - w^I$, and the insider earns wage w^I . When there is a disagreement, the worker obstructs the firm, and the obstruction is costless. The firm faces a constant firing cost f and the profit from hiring a new worker is $a^E - w^E - h$, where a^E is the output of the entrant, w^E is the entrant’s wage, and h is the constant hiring cost. Therefore, the firm’s fall-back profit is:

$$\pi^o = (a^E - w^E - h) - f$$

If the insider’s reservation wage is $w^o = w^E$, the total turnover cost is $c = (a^I - a^E) + (h + f)$ which is the difference between insider and outsider productivity and the hiring and firing costs. Lindbeck and Snower

⁶⁷If the outsourcing firm manages to replicate the cross partial productivity effects exactly, then it would predict an equal effect of outsourcing on all workers, solely because there are fewer workers to share rents.

(2001) show that given the firm's fallback profit, the wage is the solution to the following Nash Bargaining problem:

$$\operatorname{argmax}_{w^I} (w^I - w^o)^\mu (a^I - w^I - \pi^o)^{1-\mu} = \mu(a^I - \pi^o) + (1 - \mu)w^o$$

Where $0 < \mu < 1$ denotes individual worker bargaining power relative to the firm. Letting $\pi^o = (a^E - w^E - h) - f$ this results in:

$$w^I = \mu c + w^E$$

The solution of this model clearly states that insiders are paid more than outsiders due to turnover costs. Intuitively, workers and firms bargain and insiders are paid more than outsiders because they can threaten to sabotage the firm.

Under this model, what would be the effect of outsourcing on remainders? If outsourcing reduces workers' ability to threaten or bargain, this could result in lower μ . If $\mu = 0$, insider and outsider wages are equal. Outsourcing lowering μ is consistent with Doellgast and Green (2007), who discuss how outsourcing reduces union power in German industries. Alternatively, outsourcing could *increase* wages. Because there are fewer insiders, and those insiders are more central to the firm's production process, they can more credibly threaten to sabotage the firm, increasing f , and therefore w^I . (Lindbeck and Snower, 2001) These effects would offset. However, Dolado and Bentolila (1992) examine whether one effect dominates using data from Spain. They find that when firms use more fixed-term labor, remaining workers' wages increase. Considering fixed-term labor as analogous to outsourcing, insider-outsider models and the evidence in Dolado and Bentolila (1992) predict outsourcing should increase remainders' wages.

Extending the model to include rising labor turnover costs it results in additional predictions. Assume that as workers spend more time in the firm, the cost of firing them increases. There are two types of workers—one with high tenure H and one with low tenure L . The workers have different firing costs $f_H > f_L$. As a result, we have:

$$w^{IH} = \mu c_H + w^E$$

$$w^{IL} = \mu c_L + w^E$$

Where the higher firing costs results in the high-tenure worker being paid more. When thinking about

the costs of outsourcing, if outsourcing changes firing costs differentially (i.e. higher-tenured workers firing costs increase more than lower-tenured workers or vice versa), this model predicts that there will be variation in the effect of outsourcing by worker tenure.⁶⁸

Union-Mediated Outsourcing

I now explore a different wage setting model which centralizes the role of unions in wage bargaining. This is a particularly relevant model given the institutional setting and data. As discussed in Section 3 both industry and firm-level unions play an important role in determining wage levels in the German economy. Doellgast and Green (2007) show that firms do consider the presence of a union when outsourcing.

In the model of Frandsen (2012), workers vote to accept a wage schedule at the firm in a four period game. The goal of the union is to maximize the expected vote share, subject to a minimum profit constraint for the firm and potential effects on worker separations. The final wage structure offers workers at the bottom of the human capital distribution more rents than workers at the top. This results in a compressed wage structure.

Under this model, what would be the effect if a unionized firm outsources? Because the firm is already unionized, it pays a wage schedule $w(H)$, where $w(H)$ represents the wage as a function of an individual worker's human capital. If the firm wants to outsource, they pay fixed cost ϕ . In exchange, the firm receives the production of workers below a given human capital threshold \underline{H} at their market wage v . However, the union can fight outsourcing and shut down production. To avoid a shutdown, the firm offers a new wage schedule, $\{w^N(H), \underline{H}\}$ where $w^N(H)$ represents the wage schedule as a function of an individual worker's human capital H . After the firm proposes the new wage schedule, workers vote to accept or reject it based on whether their new wage $w^N(H)$ is greater than the old wage $w(H)$. Assume workers whose wage is the same under both schedules vote no. If at least half of workers vote yes, the new schedule is approved and outsourcing occurs.

Workers for whom $H < \underline{H}$ automatically vote no, since they are clearly worse off. Because workers only vote yes if they are compensated, this means that the firm offers wage increases to workers $H \geq \underline{H}$. As Frandsen (2012) discusses, low- H workers receive higher rents than high- H workers because of the union's goal to maximize votes. In order to get workers on board with the original union agreement, low-wage workers are over-compensated with rents, while high-wage workers receive lower rents. When taking this logic to outsourcing, the result is the same.

⁶⁸The same result can be achieved with equal changes in firing costs and pre-existing differences in bargaining power.

When firms outsource, they save wages paid to workers below that \underline{H} , while paying (1) fixed cost ϕ ⁶⁹ and (2) compensating remainers. The union still exists in the firm, and the resulting wage structure would be similar. Low- H workers who are above \underline{H} will receive more wage increases than the highest-wage workers, because the firm needs their votes to approve outsourcing. High-wage workers are compensated as well, but more marginally. As in Frandsen (2012), this results in higher rents going to the bottom of the distribution of *remainers*, though all workers with $H \geq \underline{H}$ receive some compensation.

This model has concrete predictions on the effect of outsourcing on remainers. (1) all remainers' earnings should increase (2) low-wage remainers' wages should increase more than high-wage remainers (3) in firms with no or weak unions, there should be no effect on wages. The key here is that both compensating remainers and compensating low-wage remainers the most is a function of the existence of a union, and the necessity of any proposal getting past a union vote. Without a union, or with a weak union, the firm does not need to compensate because there is no threat of non-cooperation.

B Robustness Checks

In this section, I perform a number of robustness checks of my main results in Figure 3 in order to account for possible bias that may occur. In Figure B.1, I demonstrate my main results without controls and restricting to workers with a full 10 years of wage data. In my primary specification, I included controls for age and its square interacted with gender, age and its square interacted with education level. As we can see in Figure B.1 Panel (A), the results are very similar to the primary results in Figure 3, though are somewhat less precise. In Panel (B) I restrict to workers who are employed or in the data for the full 10 years of analysis—again the results are similar to Figure 3.

In Figure B.2, I provide the earnings results restricting to situations where the firm OL Outsourced occupations in food, cleaning, security, or logistics (FCSL) versus all other occupations. The blue shows FCSL occupations outsourced, while the red shows the effect of all other occupations outsourced. The treatment effects are largely similar, suggesting that the definition of OL outsourcing used in the main text is good at identifying OL Outsourcing when not limited to FCSL occupations.

In Figure B.3 I provide my main results both removing the largest event (by number of treated workers) in Panel (A). I perform this analysis to see whether specific events are driving my estimates. In Panel (B) I restrict to events where there was not a large increase in Occupation o employment between $l - 1$ and

⁶⁹It is possible to think of this fixed cost as the market wage of the outsourced workers v plus a markup.

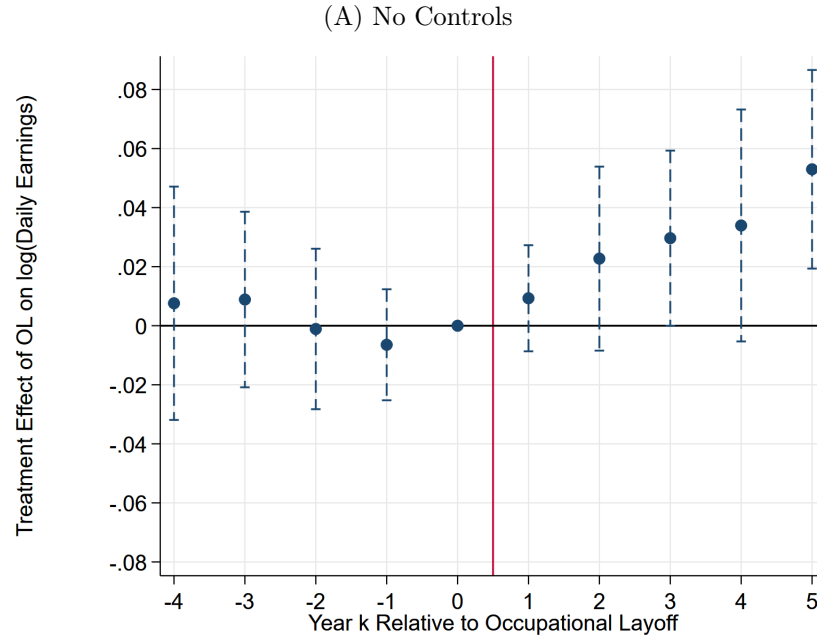
l —specifically, I restrict to instances where $l - 1$ employment was above $l + 1$ employment. In both panels, we can see that the results are similar to the results in Figure 3. This shows the results are not due to single large events, and are not due to temporary layoffs, or additions of temporary workers.

In Figure B.4, I provide my main results restricting to events that were not in non-profit industries (churches, government support, etc.). In the data, many of these firms have sales data, suggesting there is a profit component. Nevertheless, there may be other factors that drive OL outsourcing for these firms. I demonstrate these results in Panel (A). The results are similar to my main specification. In Figure B.4 Panel (B), I provide results removing treatment years $l = 2002$ and $l = 2007$ —the years of large recessions between l and $l + 1$. Eliminating recessions does not impact the results

Figure B.5 shows the estimated effect of OL outsourcing on whether workers are part-time. There is no apparent effect of outsourcing on the part-time dimension, suggestive evidence that hours are not changing. Figure B.6 shows the effects of OL outsourcing more than 5 years after the original treatment. After 5 years, the effect of outsourcing stabilizes at a level 5% higher than the pre-treatment level.

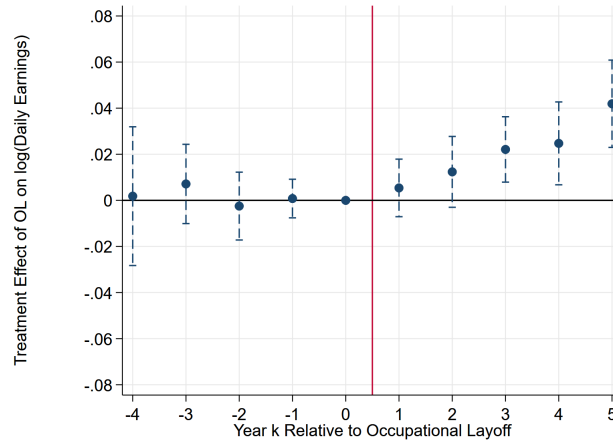
These robustness checks demonstrate that the results are not sensitive to inclusion of particular industries, the choice of occupations, particularly events, control variables, or workers leaving the data.

Figure B.1: Robustness Checks – No Controls and Full Panel



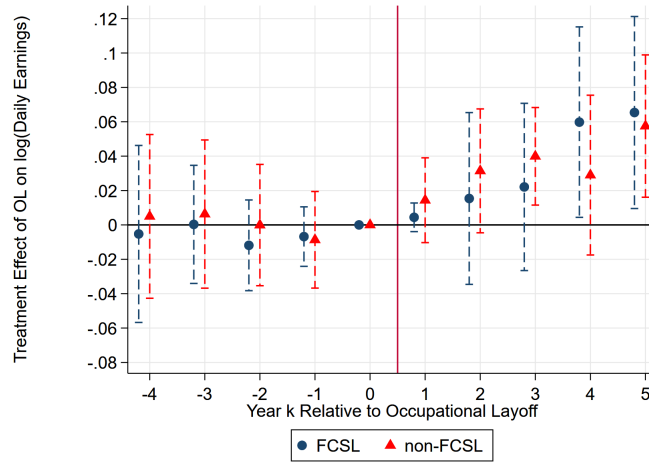
Note: The figure shows regression coefficients and 95% confidence intervals for the treatment effect of OL outsourcing on log(Daily Earnings) in a given year k relative to the treatment year i.e. $\beta_k^{Treated}$. Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Earnings are inflation-adjusted to 2010 euros. Regressions include person fixed effects and relative year fixed effects.

(B) Sample Restricted to Matched Worker Pairs with 10 years of Wage Data



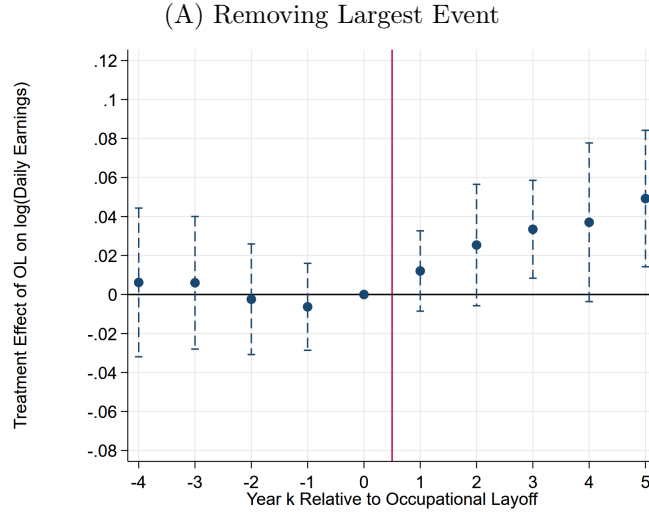
Note: The figure shows regression coefficients and 95% confidence intervals for the treatment effect of OL outsourcing on log(Daily Earnings) in a given year k relative to the treatment year i.e. $\beta_k^{Treated}$. Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Earnings are inflation-adjusted to 2010 euros. Only includes workers who are in $k = 0$ firm if $k > 0$. Regressions include controls for age and age squared interacted with gender, age and age squared interacted with education level. Restricted to matched worker pairs with a “full-panel” – 10 years of wage data.

Figure B.2: Robustness Checks – FCSL and non-FCSL OL Outsourcing

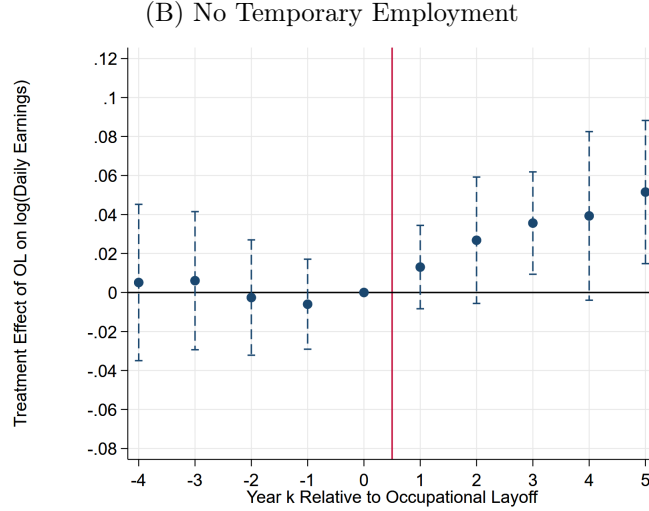


Note: The figure shows regression coefficients and 95% confidence intervals for the treatment effect of OL outsourcing on log(Daily Earnings) in a given year k relative to the treatment year i.e. $\beta_k^{Treated}$ by whether the outsourced occupation was in a Food, Cleaning, Security, or Logistics (FCSL) occupation versus non-FCSL. FCSL definition following Goldschmidt and Schmieder (2017). Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Earnings are inflation-adjusted to 2010 euros. Regressions include person fixed effects, relative year fixed effects, and controls for age and age squared interacted with gender, and age and age squared interacted with education level. Treatment and relative year fixed effects are interacted with whether the treated worker and matched control group worker were subject to an event where the firm OL outsourced an FCSL occupation.

Figure B.3: Robustness Checks – Largest Events, No Temporary Employment



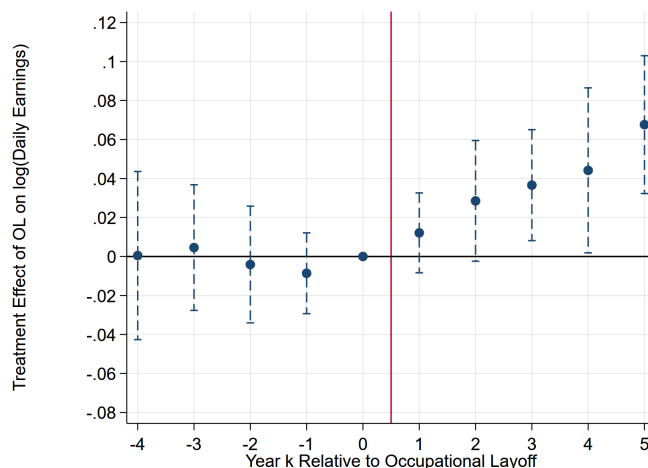
Note: The figure shows regression coefficients and 95% confidence intervals for the treatment effect of OL outsourcing on log(Daily Earnings) in a given year k relative to the treatment year i.e. $\beta_k^{Treated}$. Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Earnings are inflation-adjusted to 2010 euros. Regressions include person fixed effects, relative year fixed effects, and controls for age and age squared interacted with gender, and age and age squared interacted with education level. Eliminating event with largest number of treated workers in sample.



Note: The figure shows regression coefficients and 95% confidence intervals for the treatment effect of OL outsourcing on log(Daily Earnings) in a given year k relative to the treatment year i.e. $\beta_k^{Treated}$. Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Earnings are inflation-adjusted to 2010 euros. Regressions include controls for age and age squared interacted with gender, and age and age squared interacted with education level. Restricting to events where Occ. p employment in $l - 1$ was greater than or equal to Occ. p employment in $l + 1$.

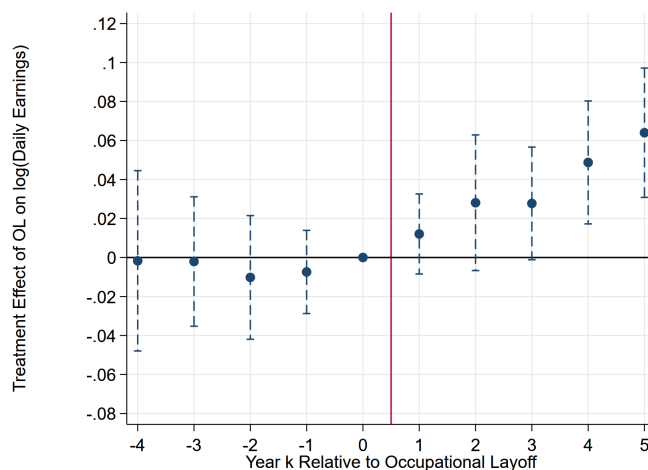
Figure B.4: Robustness Checks – No non-profits, No Recessions

(A) Removing Events in Non-Profit Industries



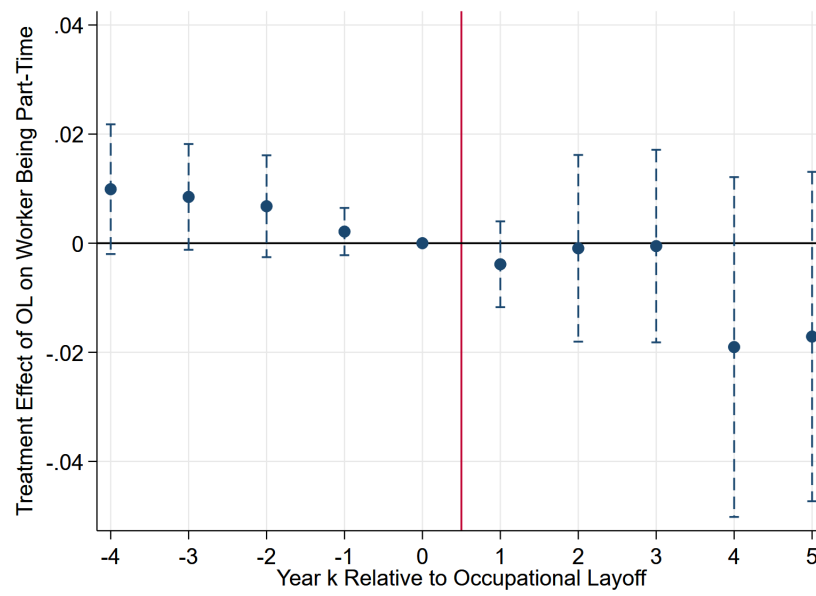
Note: The figure shows regression coefficients and 95% confidence intervals for the treatment effect of OL outsourcing on log(Daily Earnings) in a given year k relative to the treatment year i.e. $\beta_k^{Treated}$. Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Earnings are inflation-adjusted to 2010 euros. Regressions include person fixed effects, relative year fixed effects, and controls for age and age squared interacted with gender, and age and age squared interacted with education level. Eliminating events in non-profit industries (w73 3-digit industry code greater than 870)

(B) No Recessions



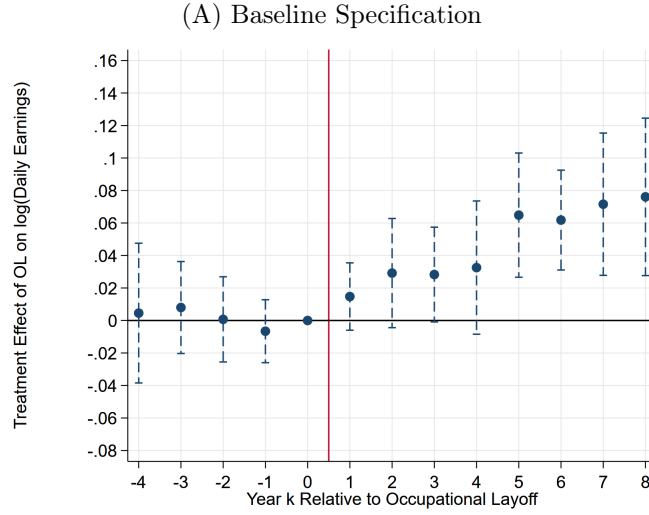
Note: The figure shows regression coefficients and 95% confidence intervals for the treatment effect of OL outsourcing on log(Daily Earnings) in a given year k relative to the treatment year i.e. $\beta_k^{Treated}$. Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Earnings are inflation-adjusted to 2010 euros. Regressions include person fixed effects, relative year fixed effects, and controls for age and age squared interacted with gender, and age and age squared interacted with education level. Eliminating events in $l = 2002$ and $l = 2007$.

Figure B.5: Effect of OL Outsourcing on Likelihood of Being Part-Time

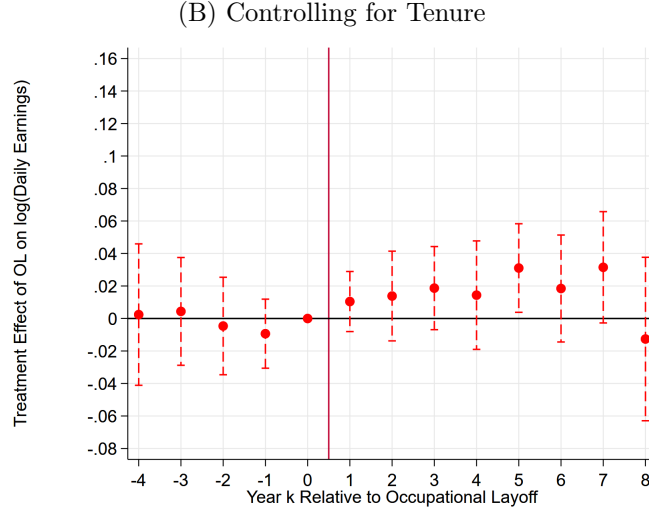


Note: The figure shows regression coefficients and 95% confidence intervals for the treatment effect of OL Outsourcing on workers' probability of being a part-time worker ($teilverg = 1$) firms in a given year k relative to the treatment year i.e. $\beta_k^{Treated}$. Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Regressions include person fixed effects, relative year fixed effects, and controls for age and age squared interacted with gender, age and age squared interacted with education level.

Figure B.6: Long-Term Effect of OL Outsourcing on Remaining Workers' Daily Earnings

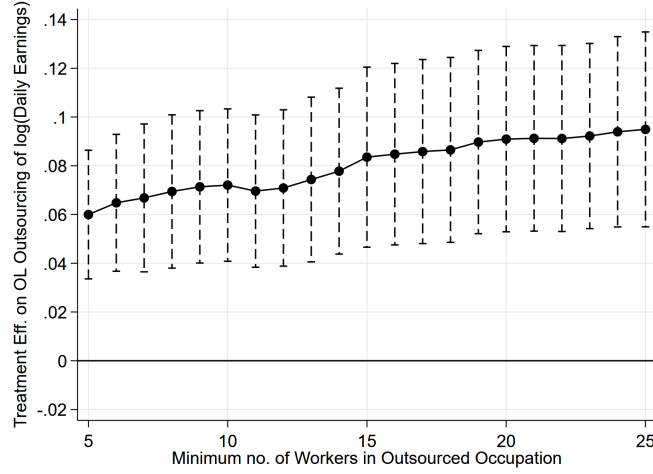


Note: The figure shows regression coefficients and 95% confidence intervals for the treatment effect of OL Outsourcing on log(Daily Earnings) in a given year k relative to the treatment year i.e. $\beta_k^{Treated}$. Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Earnings are inflation-adjusted to 2010 euros. Regressions include person fixed effects, relative year fixed effects, and controls for age and age squared interacted with gender, and age and age squared interacted with education level. Only includes treatment and control group workers where the year before treatment l was 2006 or before.



Note: The figure shows regression coefficients and 95% confidence intervals for the treatment effect of OL Outsourcing on log(Daily Earnings) in a given year k relative to the treatment year i.e. $\beta_k^{Treated}$. Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Earnings are inflation-adjusted to 2010 euros. Only includes workers who are in $k = 0$ firm if $k > 0$. Regressions include controls for age and age squared interacted with gender, and age and age squared interacted with education level. Also includes controls for firm tenure and its square. Only includes treatment and control group workers where the year before treatment l was 2006 or before.

Figure C.1: Sensitivity Analysis



Note: The figure shows regression coefficients and 95% confidence intervals for the treatment effect of OL outsourcing on log(Daily Earnings) 5 years after treatment year i.e. $\beta_5^{Treated}$. Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Earnings are inflation-adjusted to 2010 euros. Regressions include person fixed effects, relative year fixed effects, and controls for age and age squared interacted with gender, and age and age squared interacted with education level. Each regression estimates the effect of OL outsourcing when restricting to at least X workers in the outsourced occupation.

C Changing Restrictions and Definitions

C.1 Sensitivity Analysis

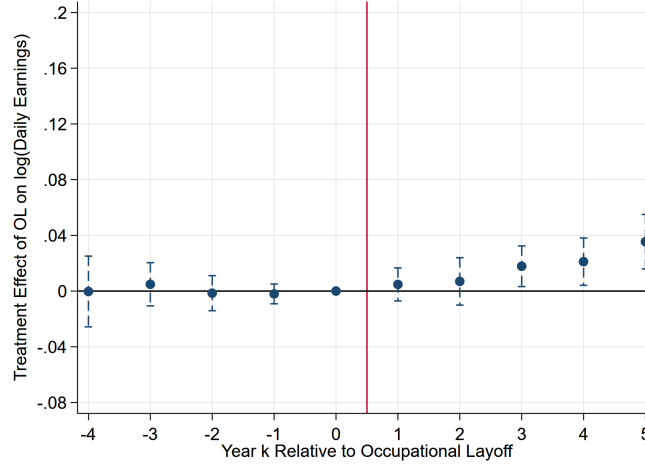
In this section I provide the results of my sensitivity analysis. Restricting to events with at least 5 workers in the outsourced occupation, at least 6, etc. has no impact on the results.

C.2 Changing Restrictions

In this section I provide the earnings results using the same definition of OL outsourcing, but removing the additional restrictions on events. I also perform the same analysis while further restricting (1) The firm did not decline by more than 30% between l and $l + 2$, and removing instances where employment in the outsourced occupation was lower in $l - 1$ than $l + 1$.

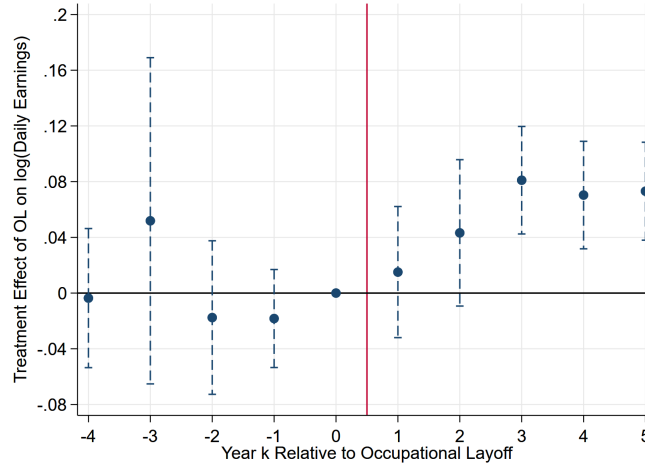
Figure C.2: Restrictions Changes

(A) No Restrictions



Note: The figure shows regression coefficients and 95% confidence intervals for the treatment effect of OL outsourcing on log(Daily Earnings) in a given year k relative to the treatment year i.e. $\beta_k^{Treated}$. Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Earnings are inflation-adjusted to 2010 euros. Regressions include person fixed effects, relative year fixed effects, and controls for age and age squared interacted with gender, and age and age squared interacted with education level. Removing all additional restrictions outlined in Goldschmidt and Schmieder (2017).

(B) Additional Restrictions



Note: The figure shows regression coefficients and 95% confidence intervals for the treatment effect of OL outsourcing on log(Daily Earnings) in a given year k relative to the treatment year i.e. $\beta_k^{Treated}$. Normalized to $k = 0$. Clustered at the $k = 0$ firm level. Earnings are inflation-adjusted to 2010 euros. Regressions include person fixed effects, relative year fixed effects, and controls for age and age squared interacted with gender, and age and age squared interacted with education level. Results created after additionally restricting to firms that did not decline in size by more than 30% between $k = 0$ and $k = 2$ and removing instances where outsourced occupation employment in $k = -1$ was greater than outsourced occupation employment in $k = 1$.

D Effect of OL Outsourcing on Firms

In this section, I provide the difference-in-differences estimates of the effect of OL outsourcing on firm hiring, employment, sales, bargaining agreements, and sorting. The goal of this section is two-fold. First, I aim to show that outside of the occupational layoff there is no other effect on the firm in order to provide supporting evidence of Assumption 2 in Section 5.4 that there are no unobserved contemporaneous events.

D.1 Results

I retain the firms identified via the matching procedure in Section 5.2, and limit to panel firms or firms which answered the IAB survey. I run the specification in Equation 2.

Table D.1 provides the difference-in-differences estimates of the effect of OL outsourcing on sales, sales per worker, whether the firm had a CBA, worker fixed effect, measures of sorting, employment, and hiring. As we can see, after OL outsourcing there is no change in sales, but sales per worker increases. There is no effect on whether the firm has a collective bargaining agreement or average worker fixed effect. There is no evidence of sorting—worker fixed effect and median wages are similar for new hires before and after the outsourcing event. Lastly, there are declines in employment and hiring, but this appears to only be due to outsourcing. When examining the occupations that were never outsourced, there is no change in hiring or employment. The decline in aggregate employment explains the increase in sales per worker. These results provide strong evidence that the firm is not contemporaneously changing outside of the outsourcing event.

Table D.1: Effect of OL Outsourcing on Firm

	$\ln(\text{Sales}_{jt})$ (1)	$\ln(\text{Sales}_{jt}/\text{Emp}_{jt})$ (2)	AKM FE $_{jt}$ (3)	AKM FE $_{jt}$ -Hires (4)	$\ln(\text{Med. Earn-Hires})$ (5)
Treat \times Post	-0.008 (0.045)	0.110* (0.043)	0.007 (0.005)	0.002 (0.009)	0.012 (0.014)
Constant	3.829** (0.003)	11.849** (0.004)	0.051** (0.001)	-0.029** (0.002)	4.526** (0.004)
N - Firms	1,229	1,113	1,258	1,255	1,255
N - Clusters	787	658	737	735	735
Firm FE	X	X	X	X	X
Year FE	X	X	X	X	X
Relative Year FE	X	X	X	X	X
Weighting - $k = 0$ Emp.			X	X	X

	$\ln(\text{Emp}_{jt})$ (6)	$\ln(\text{Oth. Emp}_{jt})$ (7)	$\ln(\text{Oth. Hir}_{jt})$ (8)	No CBA $_{jt}$ (9)
Treat \times Post	-0.147** (0.017)	-0.027 (0.020)	0.009 (0.042)	-0.008 (0.005)
Constant	5.628** (0.002)	5.602** (0.002)	3.273** (0.003)	0.060** (0.002)
N - Firms	1,296	1,296	1,288	1,060
N - Clusters	752	752	746	646
Firm FE	X	X	X	X
Year FE	X	X	X	X
Relative Year FE	X	X	X	X
Weighting - $k = 0$ Emp.			X	X

Difference-in-Differences estimation of the effect of OL outsourcing on firm-level statistics. Limited to firms identified in the matched sample following the methodology in Section 5.2 and that were either panel firms or in the IAB survey. j Limited to the 3 years before and 3 years after OL outsourcing ($k = -2$ to $k = 3$). j denotes firm. Sales_{jt} is millions of euros. No CBA indicates that the firm did not have a bargaining agreement year t . AKM FE denotes the average worker fixed effect for all employees in year t , AKM FE 0 - hires denotes average worker fixed effect for new hires to the firm in a Abowd, Kramarz, and Margolis (1999) model. Earnings in 2010 inflation adjusted euros. Oth. Employment denotes employment in occupations that were never OL outsourced in treated firms. Oth. Hiring denotes total hiring in occupations that were never OL outsourced. Weighted denotes weighted by $k = 0$ employment level. Standard deviation in parenthesis. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$. Clustered at the firm level.

E What Predicts Outsourcing?

In this section, I examine the descriptive relationship between firm-level characteristics and whether the firm outsources in a given year. I retain all panel firms with more than 50 employees which were not observed laying off an occupation with fewer than 10 workers, and do not shrink by more than 50% in the next three years. I then run a linear probability model where the dependent variable is whether the firm outsources in a given year. The results of this analysis are shown in Table E.1.

Table E.1: Relationship between Outsourcing and Firm-Level Statistics

	Outcome: Firm Outsources			
	(1)	(2)	(3)	(4)
Year = 2002	0.012*	0.011*	0.011*	0.011*
	(0.006)	(0.006)	(0.006)	(0.006)
Year = 2003	0.013**	0.013**	0.013**	0.013**
	(0.005)	(0.005)	(0.005)	(0.005)
Year = 2004	0.016**	0.015**	0.016**	0.016**
	(0.006)	(0.006)	(0.006)	(0.006)
Year = 2005	0.008 ⁺	0.008	0.007	0.007
	(0.005)	(0.005)	(0.005)	(0.005)
Year = 2006	0.002	0.001	0.008 ⁺	0.008 ⁺
	(0.005)	(0.005)	(0.005)	(0.005)
Year = 2007	0.005	0.004	0.011 ⁺	0.011 ⁺
	(0.005)	(0.005)	(0.006)	(0.006)
Year = 2008	0.001	0.000	0.005	0.006
	(0.004)	(0.004)	(0.005)	(0.005)
Year = 2009	0.005	0.004	0.011 ⁺	0.011 ⁺
	(0.004)	(0.004)	(0.006)	(0.006)
Firm Med. Wage	-0.000 ⁺	-0.000	-0.000	-0.000 ⁺
	(0.000)	(0.000)	(0.000)	(0.000)
$\ln(\text{Firm Emp.})$	0.018**	0.019**	0.020**	0.019**
	(0.004)	(0.004)	(0.004)	(0.004)
Avg. Worker FE	-0.004	-0.004	-0.000	-0.011
	(0.025)	(0.025)	(0.028)	(0.028)
Firm Age (Years)	-0.000**	-0.000*	-0.000*	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
Firm Var. of Wages	0.021**	0.021**	0.021**	0.017**
	(0.006)	(0.006)	(0.007)	(0.006)
Has CBA		-0.005	-0.003	-0.003
		(0.003)	(0.003)	(0.003)
Daily Payroll/Sales (MM Euros)			-2.69e-07*	-2.75e-07**
			(1.05e-07)	(1.04e-07)
Firm FO-HHI				-0.053**
				(0.011)
N	13,275	13,275	11,349	11,349
Industry FE	X	X	X	X

Note: Linear probability model estimating firm-level statistics on whether a firm outsources in a given year. Restricted to LIAB panel firms with more than 50 employees which do not shrink by more than 50% in the next three years. Standard deviation in parenthesis. Avg. Worker FE denotes the average of worker fixed effects in two-way fixed effect Abowd, Kramarz, and Margolis (1999) model. Firm Variance of wages denotes total variance of logarithm of firm wages. Firm FO-HHI denotes sum of square shares of occupations $\sum_o s_{jo}^2$ where s_{jo} denotes share of workers in occupation o in firm j . ⁺ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$. Clustered at the industry level.

F Analysis of Firm Profits

In this section, I examine how much firms may be profiting from OL outsourcing, and whether the observed findings in Section 6 comport with assumptions of OL outsourcing being profitable for the firm. Unfortunately, most of this analysis is speculative. As in other studies, it is not possible to directly observe (1) how much labor is being used (2) the demographics of the new workers, or (3) the amount of rents captured by any outsourced workers.

For example, a firm that OL outsources has (as per the definition) a minimum of 10 workers in a given occupation. If the new firm provides the same good or service with 5 workers, the firm has saved substantially on labor costs. This productivity gain is to be expected—if firms are hiring a cleaning service, we would expect those cleaners to be more productive, etc. In terms of demographics, the outside workers may be part of a group that receives lower wages, i.e. younger workers. Much older workers could also be cheaper and have fewer demands for occupational mobility. (Shin and Yuen, 2019) We do not know whether the new firm shares rents with their workers. Drenik et al. (2021) use data from Argentina to show that Temporary Help workers receive approximately half the rents of in-firm employees. However, rents are distinct from profits.

With that in mind, there are only two factors can be directly observed—how much did firms pay leaving workers, and how much did firms pay remainers. This also accounts for the fact that approximately half the workers in OL outsourced occupations stay in the firm, some workers have shifted roles.⁷⁰

With this in mind, in Table F.1, I examine average payroll of remainers in period $k = 0$ compared to the average payroll of leavers in period $k = 0$. I assume that payroll for remainers increases by 8.3% for workers below the firm’s median wage and 4.6% for workers above the firm’s median wage, as in the results in Figure 6. As we can see, the leaver payroll more than compensates the predicted increase in remainder payroll. On average, remainers receive 75% of the payroll of the leaving workers. While this does not account for the cost of hiring an outside firm, the result is consistent with firms profiting from outsourcing. Overall, just examining the change in payroll among leavers and stayers, 86.5% of the events are profitable.

This is likely an underestimate of the firm savings. As noted in Figure 3, the wage effects are dynamic, meaning that remainers are not compensated initially, while more remainers stay. This means that firms save over several years. Additionally, firms may now be using firms who are more productive in a given task and are on-average cheaper than the workers in the outsourced occupations. Lastly, the firm may be saving on hiring, training, or other costs by no longer using workers in the outsourced occupation. Unfortunately,

⁷⁰See 4.

without additional information on the cost of hiring an outside firm, we cannot directly compare the benefits and costs.

Table F.1: Potential Firm Savings

Leaver Payroll	Bottom-Half Payroll	Bottom-Half Compensation	Top-Half Payroll	Top-Half Compensation
(A)	(B)	(C)	(D)	(E)
		$(B) \times 0.083$		$(D) \times 0.046$
15,121.70	76,915.56	6383.99	107,699.70	4954.19
Total Compensation		Difference	Firm Share	
(F)		(G)	(C)	
$(C) + (E)$		$(A) - (F)$	$(G) / (A)$	
11,338.18		3,738.52	24.7%	

All values in inflation-adjusted 2010 euros per-day. For annual values multiply by 365. Leaver Payroll and Remainder top/bottom half payroll calculated as event-level averages from matched sample, $N = 260$. Compensation rate calculated as $\beta_5^{Treated}$ from 6, comparing effects by workers in top versus bottom half of within-firm wage distribution. Earnings gains from outsourcing for workers in bottom-half of within-firm distribution were 8.3%, compared to 4.6% increases for workers in top-half of within-firm wage distribution.

G Firm Labor Supply Elasticity

In this section, I outline the methodology for calculating firm labor supply elasticity. I primarily follow the methodology in Bassier, Dube, and Naidu (2020), using workers’ observed probability of moving conditional on wage changes. As discussed in Manning (2003), in the steady state, the firm labor supply elasticity can be calculated as a function of firm *separation* elasticities. Using the model in Bassier, Dube, and Naidu (2020), I wish to estimate the following separation elasticity.

$$s_{i,k+1} = \eta(w_{i,k} - w_{i,0}) + \alpha_i + \beta_k \times \mathbf{1}\{t - l = k\} + \epsilon_{ij} \quad (5)$$

Here, the left hand side is an indicator function for whether a worker i separates from their current firm between k and $k + 1$. α_i represents a worker fixed effect, and β_k represents a relative year fixed effect.

The variable of interest is the separation elasticity η , which is a function of the change in worker i ’s wages between period k and $k = 0$ (the year before OL outsourcing).⁷¹ It is worth noting some differences between this estimation and the estimation strategy in Bassier, Dube, and Naidu (2020). Here, there are a matched control group of workers. These workers constitute the “natural” separation rate in a given relative year k . Unlike Bassier, Dube, and Naidu (2020), I do not limit to workers remaining in the initial $k = 0$ firm when estimating separation elasticities. This is because when restricting to workers who remain at the firm, it underestimates the wage effect.⁷² This would result in a very high estimated firm labor supply elasticity. Additionally, 4 Panel (A) shows that there is no change in the separation rate after allowing workers to be part of their new firm.

This leaves two difficulties. First, estimating firm labor supply elasticity is difficult. Workers’ wages can vary for a number of reasons—skill, tenure, transitory shocks, etc.—meaning there is substantial omitted variable bias. The other difficulty is that there is a clear dynamic pattern to the wage effects I describe in Section 6. Figure B.6 illustrates that wages increase for several years, before stabilizing at a 6-7% higher level. At the same time, Figure 4 demonstrates that the separation rates drop immediately. This is not necessarily surprising. The model in Manning (2003) describes firm labor supply elasticity as a function of separation elasticities *in the steady state*. The dynamic structure to the results suggests that the new steady state is achieved at $k \geq 5$. Similarly, Bassier, Dube, and Naidu (2020) calculate separation elasticities

⁷¹Here, I am using the term earnings and wages interchangeably.

⁷²In particular, treated workers are much more likely to leave their firms after outsourcing. Imagine each treated and matched control group worker’s match quality of the job to be equal, and outsourcing increases the match quality among the treated. By restricting to workers who remain in the $k = 0$ firm in the control group, this will remove control group workers who have lower-quality matches. If workers with worse matches have less wage growth, it will bias the wage estimates downwards.

based on firm wage policies—the firms are implicitly in the steady state in the mover-based structure of their analysis.

In order to account for the issue of omitted variable bias, I utilize OL outsourcing as an instrument for the change in wages – specifically, I treat the OL outsourcing as an exogenous event, which we can use to predict the change in wage levels. Given I have a matched control group, I am estimating a Difference-in-Differences IV (DID-IV) strategy, where I use an instrument (in this case OL outsourcing). I run a first-stage equation:

$$w_{i,k} - w_{i,0} = \phi(Treat_i \times Post_k) + \alpha_i + \beta_k \times \mathbf{1}\{t - l = k\} + \epsilon_{ij} \quad (6)$$

In order to examine the dynamic response, I perform the above DID-IV estimation separately for each year k . Specifically, I estimate the probability that a worker k years after OL outsourcing separates from their current firm as a function of the change in wages between $k = 0$ and their current k . I include both $k = 0$ and k in any regression in order to allow for person fixed effects. Because I am using only two periods, and instrumenting with whether workers are in an OL Outsourcing firm, this is exactly a DID-IV estimation, where α_i subsumes the treatment indicator β_k is the relative time indicator, and η is the DID-IV estimator of the separation elasticity. One downside of this estimation strategy is it requires us to only utilize workers in firms, since separation rates and wages will be low for unemployed workers. Another downside is that in order to estimate the separation elasticity past $k = 4$, we have to remove treatment years, since the data ends in 2014. As a result, $k = 5$ only includes treatment years $l = 2001 - 2008$, $k = 6$ includes $l = 2001 - 2007$, etc. Using the DID-IV estimation strategy requires two additional assumptions, other than parallel trends.⁷³

Monotonicity

This assumption requires treatment to be monotone – specifically that there are no workers who, after an OL outsourcing event, receive lower wages. I believe this assumption is reasonable. The findings in Figure 5 suggest that all workers in the firm gain, and no subgroups lose wages.

Exclusion Restriction

This is a standard assumption in the IV literature. Here, I am assuming that there is no effect of OL outsourcing on workers' separation rates other than through the wage effect.

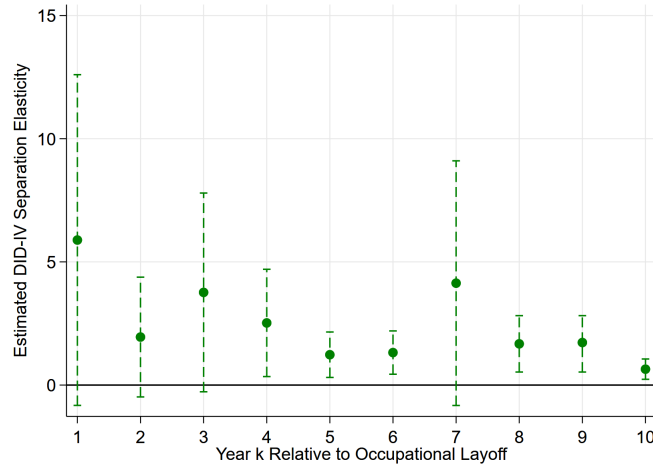
⁷³See Hudson, Hull, and Liebersohn (2017)

This strategy results in a dynamic path of firm separation elasticities. Figure G.1, graphically displays the one-by-one estimates and 95% confidence intervals. On the X-axis are the relevant estimates for each year k from $k = 1$ to $k = 10$. Even though the estimates are imprecise, from $k = 1$ to $k = 3$, the estimated separation elasticities are very large. After wages are in the apparent steady-state level after $k = 5$, separation elasticities for $k = 5$ to $k = 9$ are similar to estimates from other studies. Lastly, I run the specification in equation 5 using all data from $k = 0$ and $k = 5$ to $k = 10$. The estimated separation elasticity is 1.590 (s.e. 0.461). In the Manning (2003) model, firm labor supply elasticities are double the separation elasticities. With this in mind, this implies firm labor supply elasticities of approximately 3.179 (s.e. 0.922)—similar to those estimated in the main specification of Bassier, Dube, and Naidu (2020).⁷⁴ This firm labor supply elasticity is consistent with a moderate amount of monopsony power in Germany.

The dynamic response of the firm labor supply elasticity, specifically that workers' separations respond “early” to the expected wage increase, suggest that researchers should account for within-firm changes that might drive wages when estimating labor supply elasticity. If a firm is not in the steady state, it may result in overestimating firm labor supply elasticity if there is a dynamic wage effect and instantaneous separation effect.

⁷⁴Using all data from $k = -4$ to $k = 10$, the estimated firm labor supply elasticity is approximately 4.

Figure G.1: Estimated Firm Separation Elasticity



Note: The figure shows DID-IV coefficients and 95% confidence intervals for the DID-IV estimation strategy. Each year k is a separate IV regression where the outcome variable is whether a workers separates from their current firm between k and $k + 1$. The independent variable is the change in wages between period k and period 0 – the year before OL outsourcing. Instrumented by whether a workers was subject to an OL outsourcing event. Clustered at the $k = 0$ firm level. For first-stage F-statistics, number of clusters, number of workers see Table G.1

Table G.1: Estimated Firm Separation Elasticity

Period $k = t - l$	Outcome: Separation Between k and $k + 1$			
	$k = 1$	$k = 2$	$k = 3$	$k = 4$
Estimated Separation Elasticity	5.887 ⁺ (3.422)	1.949 (1.240)	3.761 ⁺ (2.057)	2.522* (1.111)
First-Stage F Stat.	2.237	2.271	6.079	4.066
N - Workers	149,466	145,548	142,295	141,030
N - Clusters	2,531	2,442	2,405	2,395
Person FE	X	X	X	X
Post Indicator	X	X	X	X

Period $k = t - l$	$k = 5$	$k = 6$	$k = 7$	$k = 8$	$k = 9$	$k = 10$
Estimated Separation Elasticity	1.232** (0.470)	1.319** (0.448)	4.136 (2.532)	1.674** (0.583)	1.727* (0.672)	0.646 ** (0.210)
First-Stage F Stat.	12.616	16.644	8.371	8.907	15.134	12.62
N - Workers	127,797	121,754	111,416	103,381	87,866	76,351
N - Clusters	2,134	1,955	1,763	1,608	1,371	1,097
Person FE	X	X	X	X	X	X
Post Indicator	X	X	X	X	X	X

Note: The figure shows DID-IV coefficients for the DID-IV estimation strategy. Each year k is a separate DID-IV regression where the outcome variable is whether a workers separates from their current firm between k and $k + 1$. The independent variable is the change in wages between period k and period 0 – the year before OL outsourcing. Instrumented by whether a workers was subject to an OL outsourcing event. Standard errors in parentheses, clustered at the $k = 0$ firm level. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.