Collusion Among Employers in India

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Abstract

This paper evidences collusion among employers in the textile and clothing manufacturing industry in India. First, I develop a simple comparative static test to distinguish standard forms of imperfect competition from collusion. I show that, for very general labor supply and production structures, the spillover effects of firm-specific demand shocks predict opposite employment effects at unshocked competitors who operate independently (↓ employment), versus those who were previously colluding but whose collusion dismantles due to the shock (↑ employment). Next, I argue that large employers in the garment industry organize into industry associations to pay workers exactly the state- and industry-specific minimum wage, using it as a focal point for coordination. Members of industry associations are substantially more likely to bunch from above at the local minimum wage than non-members, and to track its policy-induced rise without reducing employment. I show that small export demand shocks evoke the standard imperfectly competitive response among non-members (higher wages and employment), but elicit no response from members (they forego export opportunities to stick to the minimum wage). By contrast, when a large demand shock leads affected members to deviate from the minimum wage, unaffected non-members respond as in oligopsony (↑ wage, ↓ employment), but unaffected members respond as if their collusion dismantles (↑ wage, ↑ employment). Imposing specific models of labor supply and production, the "full-IO" approach statistically rejects the oligopsony model in favor of the breakdown of collusion. I conclude that collusion spurs substantial losses even compared to a world wherein each firm exercises its own, but not their collective, market power, reducing the average worker's wage by 9.6% and employment by 17%.

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1 Introduction

"We rarely hear, it has been said, of the combination of masters. But whoever imagines upon this account that masters rarely combine is as ignorant of the world as of the subject." In fact, "masters are always and everywhere in a sort of tacit combination not to raise the wages of labor above its value" (Smith, 1776). Although economists have long suspected that employers conspire to pay workers below their worth, empirical evidence of collusion remains scarce. This lack of evidence represents a significant blind spot for antitrust policy in developed and developing countries alike, which has, until now, focused almost exclusively on regulating the product market. Evidence of collusion among employers would, however, provide a compelling rationale for anti-trust intervention also in the labor market.

This paper empirically investigates collusion among employers in the Indian textile and clothing manufacturing industry. This industry is among the largest employers in developing countries, employing over 90 million workers overall, and 6 million in India alone (ILO 2018).

The key challenge with detecting collusion is that collusive and non-collusive models of the labor market often yield identical predictions. For instance, neighboring firms that compete perfectly, collude, or that independently exercise their market power should all adjust wages in tandem, regardless of the underlying model of competition. To overcome this diagnostic challenge, I develop a simple test that leverages demand shocks to distinguish collusion from standard forms of imperfect competition. Its main insight is that, for very general structures of labor supply and production, the spillover effects of firm-specific demand shocks predict opposite employment effects at unshocked competitors who operate independently ($\downarrow$ employment), versus those who previously colluded, but whose collusion dismantles due to the shock ($\uparrow$ employment). Importantly, the test enables me to diagnose collusion without having to make strong structural assumptions, or estimate many structural objects, which is the tradition in the literature. To quantify the relative fit of various models, I complement the simple, comparative static test with a "full IO" approach, imposing specific structures of labor supply and production to identify the model of conduct best satisfying exclusion restrictions.

The paper proceeds in four steps. First, I derive the simple test. Second, I provide motivating evidence that large employers in the Indian garment manufacturing industry organize into industry associations, which coordinate to pay workers exactly the state- and industry-specific minimum wage. Or, in other words, that associations use the minimum wage as a focal point for coordination. Coordination essentially renders the minimum wage a *maximum* wage in the garment sector. Industry associations ostensibly advocate for members' interests in the product market. For instance, the most prominent association in India's largest garment manufacturing hub, Tirupur, the Tirupur Exporters' Association (TEA), recently successfully lobbied the government to enact free trade agreements with Australia and the UK. Members of industry associations employ a large fraction (over half) of all workers in the garment industry. Third, I implement the comparative static test and the "full-IO" approach to furnish evidence of collusion among members of industry associations. Finally, I quantify the wage and employment losses that accrue due to collusion, and investigate the role of the minimum wage as a new tool for anti-trust policy.

My analysis relies on a linkage of four new datasets: (i) employer-employee linked social security records covering the universe of formal workers in India, (ii) establishment-level membership in local industry associations, scraped from their websites, (iii) minimum wages across time for all states and industries in India, and (iv) exports at the establishment-level from customs records.

Test I begin by deriving the test. Its main insight is that, for very general labor supply and production structures — where demand (weakly) slopes downward, and an increase in one's competitor's wage reduces labor supply to oneself — the spillover effects of firm-specific demand shocks predict opposite employment effects under non-cooperative models of competition vs. the breakdown of collusion.[1] When firms operate independently, such as in a monopsony, Cournot oligopsony, or Bertrand oligopsony, a positive demand shock to some firms leads their unshocked competitors to raise wages and *reduce* employment. Shocked firms increase wages to attract new workers, drawing them away from unshocked competitors. Unshocked competitors best respond by raising their own wage. However, to ensure optimality again, they must shed workers to raise their marginal product. Thus, spillovers unambiguously reduce employment. By contrast, a firm-specific demand shock that dismantles collusion leads unshocked employers to raise not just their wage, but also employment. This is because colluding firms internalize the fact that raising their wage diminishes labor supply to fellow members of their cartel. Therefore, they suppress both wages and employment below the independently optimal levels. Dismantling collusion increases both. The test covers two standard forms of collusion: at a single wage, or by partly or fully internalizing others' profits.[2]

The fact that unshocked competitors unambiguously reduce employment under oligopsony is not obvious. Specifically, spillovers exert competing forces on employment, which are best understood via the first order condition, $w_j = \mu_j mrpl_j$. Higher wages at shocked firms raise an unshocked competitor's optimal markdown, μ_j, since she must raise pay to retain workers. On the one hand, she wishes to reduce employment in order to raise marginal product. On the other hand, she wants to grow large enough again to pay workers a smaller markdown. I show that the first force unambiguously dominates the second, and employment unambiguously declines.[3]

[1] I assume (i) invertible labor supply, i.e., employers are not perfect substitutes, (ii) connected substitutes, i.e. that, all else equal, a higher wage at one employer weakly lowers labor supply to all other employers, with enough strict substitution to warrant treating employers in a single supply system, and (iii) weakly diminishing marginal revenue product of labor. Assumptions (i) and (ii) nest all standard (and many non-standard) labor supply systems, including nested CES (e.g. as in Berger, Herkenhoff and Mongey 2022), discrete-choice logit (e.g. as in Card et al. 2018), nested logit, mixed logit with connected substitutes, linear, Kimball, translog, among others. The test applies to two standard forms of collusion: at a single wage, or by partly or fully internalizing other firms' profits.

[2] Former colluders raise employment as long as the demand shock is "small enough" to spur an oligopsony equilibrium close to the counterfactual that would prevail if colluders did not originally collude. Very large demand shocks, that spur transitions to equilibria far from this original counterfactual would, however, also predict lower employment among unshocked colluders (e.g. if the shocked firm wants to employ its entire labor market). The test nonetheless demonstrates that non-cooperative models of competition can *never* predict higher employment at unshocked competitors for assumptions (i) - (iii), whereas a breakdown of collusion can. The appendix formally derives the maximum shock size for which unshocked colluders raise employment, and section 4 verifies that the studied shock is smaller.

[3] Figure 1 illustrates this intuition: higher wages at shocked competitors rotate an unshocked competitor's labor supply curve to the left. She moves up her demand curve, increasing her wage and reducing employment.

Motivating Evidence Step two documents four empirical facts to motivate the notion that industry associations in the garment industry coordinate to pay workers exactly the minimum wage, using it as a focal point for collusion. Each state in India establishes a separate minimum wage for garment workers. Large employers in the industry also organize into local industry associations, which advocate for their interests in the product market, and collectively employ over half of all garment workers.

First, I find that members of industry associations exhibit substantial bunching from above at the local minimum wage, while a fringe of smaller/less productive firms pay below the minimum wage. In social security records, nearly 30% of garment workers earn exactly the local minimum wage, 55% earn below the minimum wage, and 15% earn above. Members of industry associations almost entirely account for the bunching from above at the minimum wage — 43% of their workers earn precisely the minimum wage. In contrast, only 15% of workers outside the association earn the minimum wage, with over 71% earning below the minimum.

Second, industry associations expunge members who deviate to paying wages above the minimum wage. The most prominent association in India's largest garment manufacturing hub, the Tirupur Exporters' Association, features a two-year long probationary term before new members can be elected to permanent membership.[4] I find that probationary members who deviate to paying wages above the minimum are substantially less likely to be promoted to permanency compared to probationers who never deviate (a 38pp decrease relative to a baseline rate of 75%).

Third, I show that members of industry associations track increases in the minimum wage without reducing employment, indicating the presence of imperfect competition in the labor market. Using a dynamic difference-in-differences design around nine large minimum wage hikes occurring between 2014 and 2018, I find that members of industry associations are substantially more likely than non-members to raise their modal wage to exactly match the new minimum wage. However, this increase does not come at the expense of employment among either members or non-members. I rule out very small declines in employment with a high degree of confidence.

Although tracking increases in the minimum wage without reducing employment evidences imperfect competition in the labor market, it does not evidence coordination. Therefore, in a final motivating investigation, I examine how members and non-members respond to routine (small) shocks to demand. Small positive demand shocks should elicit the standard imperfectly competitive response among employers who face upward-sloping labor supply curves (higher wage and employment), but may elicit no response if employers abide by the minimum wage. I define routine demand shocks by exploiting both the transitory nature of export demand, and the repeat nature of export relationships. I define an establishment as receiving a routine demand shock if the average price of imports to its chief importer from the previous export season increases by 5 to 15pp in the current season. The chief importer is an establishment's largest importer, in value, from the previous export season (e.g. Zara USA, or Gap USA). To isolate shocks to labor demand as opposed to labor supply, the price shock measure leaves out exports from an establishment's own state. I use a DiD event

[4] Tirupur employs 30% of garment workers in India and accounts for a majority of exports.

study to compare establishments in shocked seasons to their unshocked selves in other seasons.

Routine demand shocks elicit the standard imperfectly competitive response from non-members, who raise wages to expand employment. In contrast, I find that members forego the small export opportunities presented by routine demand shocks to stick to the minimum wage. They do not deviate to paying wages above the minimum, do not increase employment, and do not expand exports. Together these facts suggest that industry associations coordinate at the minimum wage.

Test of collusion: empirics In the main empirical test for collusion, I study the spillover effects of a large, firm-specific demand shock that led affected members of the industry association to deviate to paying wages above the minimum. The shock originated as a result of labor audits that uncovered severe labor law violations at large Vietnamese factories, and compelled twenty six prominent brands to temporarily relocate their production operations to India. In a single season, prices at affected Indian exporters grew 24.5pp more than unaffected exporters. The relocation shock thus constitutes a positive demand shock to the subset of establishments previously exporting to affected brands. I study its effect in Tirupur, which hosts 30% of India's garment workers and the majority of exports. The shock impacted 15% of establishments in Tirupur and 13% of members of the Tirupur Exporters' Association. Affected and unaffected members (and non-members) closely resembled each other in baseline characteristics.

Unlike routine demand shocks, the relocation shock led affected TEA members to raise wages and employment above the minimum wage. I employ a DiD event study design to compare establishments in shocked seasons to their counterfactual selves in unshocked seasons. The shock increased wages at affected members by 9pp, and employment by 8pp.

I find that spillovers onto unaffected employers outside the industry association manifested as under oligopsony, by leading unshocked non-members to raise their wages and reduce employment. By contrast, spillovers onto unaffected members of the industry association occurred as if the shock dismantled collusion, by leading them to raise both wages *and* employment. Four months following the relocation shock, the average wage at unaffected non-members grew 5pp relative to trend, and employment declined 6pp. By contrast, wages at unaffected members rose 6.5pp and employment *increased* 8.5pp.

Could the above findings be driven by factors other than a breakdown of collusion? I rule out four sets of concerns. I rule out subcontracting within the association by showing that unaffected members' new exports fully account for their higher workforce, leaving little scope to fill sub-contracts. Second, to rule out correlated demand shocks, or that affected members sub-contract out "worse" export orders to their unaffected counterparts, I show that the price of unaffected members' exports is unchanged. Only demand shocks that increase prices can compel oligopsonistic or monopsonistic firms to raise employment.[5] In addition, while affected members' profits increased (by 16%), consistent with them having received a positive demand shock, profits of unaffected members declined (by 5%), consistent with no longer being able to access to higher collusive profits. Together these

[5]Only demand shocks that raise prices or TFP can compel monopsonistic or oligopsonistic firms to increase employment, since only these shocks raise the *mrpl*.

results reveal that the wage/employment increase among unaffected members reflected not a positive shock to demand, but, rather, a greater *supply* of exports when some members' deviations from the minimum wage rendered the old collusive scheme untenable. Third, common TFP or cost shocks that affect members of the association concurrently with the demand shock could increase their labor demand, and, hence, employment. Disparate impacts on prices and profits suggest disparate, and not a common, source of shocks.[6] Finally, a host of other tests rule out violations of weakly downward sloping demand (e.g. due to external economies of scale) or a reduction in labor supply when competitors raise wages (e.g. due to non-homothetic preferences) as driving the increase in employment at unaffected members.[7]

Although the simple test is appealing due to its minimal structure, a full structural approach enables me to quantify the relative fit of different models of conduct. Under assumed models of labor supply (a three-nested CES where workers choose across locations, industries, and employers within the industry) and production (Cobb-Douglas in capital and labor), I augment the approach of Backus, Conlon, & Sinkinson (2021) to test for *changes* in conduct. I reject the oligopsony model in favor of a breakdown of collusion from the minimum wage.[8]

Quantification: losses and minimum wage policy I conclude by quantifying the wage and employment losses that accrue due to collusion, and assess the role of minimum wage policy in mitigating them. To quantify losses, I calculate the counterfactual wages and employment that would prevail if employers instead competed in a Cournot oligopsony. Counterfactuals require solving the model and, thus, imposing structure. I assume a Cobb Douglas production function in labor and capital with a Hicks-neutral productivity shock, whose distribution I estimate. I estimate a nested logit labor supply system where workers choose over three nests (locations, industries, and employers within the industry). Finally, I infer a simple punishment strategy from the data, where the cartel punishes deviations from the minimum wage by switching to oligopsony for six months. The cartel endogenously evolves to only comprise firms that profit from colluding at the minimum wage.

Collusion at the minimum wage induces substantial wage and employment losses, even compared to a world wherein each firm exercises its own, but not their collective, market power. Switching from collusion to Cournot oligopsony increases the average garment worker's wage by 9.6pp. Wages rise for two reasons. First, former members of the cartel raise wages above the minimum. Higher wages in the cartel also exert upward wage pressure on fringe employers. Higher wages in the garment industry attract new workers away from other industries and from unemployment. Overall, employment in the garment sector rises 17pp, of which a fifth comprise transitions from unemployment.

Since paying the minimum wage is entirely legal, antitrust authorities have limited legal recourse available for tackling the type of collusion evidenced in this paper. However, policies to raise the minimum wage could effectively mitigate the ill effects of collusion by catalyzing coordination at

[6]The timing of changes is also most consistent with a breakdown of collusion. Affected members' wages rise immediately following the relocation shock whereas unaffected members' wages rise two months later.

[7]In other words, unaffected members did not raise employment by virtue of competing in an oligopsony that violates these assumptions. See section 4.3.

[8]I additionally reject collusion at a new wage, or moving to joint profit maximization.

a higher minimum wage. An important institutional feature of the garment industry renders such coordination highly likely, namely, that foreign buyers enforce compliance with the minimum wage.

I therefore conclude by studying the impact of three different minimum wage hikes on wages and employment. The first two counterfactuals increase the current monthly minimum wage of Rs.8170 in Tirupur's garment industry, by 10% and 50% of its present value. A third policy aligns with global advocacy for a "living wage" in the garment industry, and raises the minimum wage to a monthly living wage of Rs.33,920 proposed by the NGO Asia Wage Floor Foundation. The cartel endogenously evolves to only comprise firms that profit from collusion at the proposed minimum wage. Both the 10% and 50% minimum wage hikes raise wages and employment. Surprisingly, the 50% minimum wage hike outperforms oligopsony in its positive impact on both wages and employment. This occurs because highly productive firms now also profit from colluding at the higher wage. Facing less intense competition from their productive counterparts, less productive firms raise wages and employment above a more-competitive oligopsony. The second force outweighs the first, and the average garment worker's wage increases 32pp; employment rises 23pp. Since colluders were previously the most productive firms in the economy, their expansion raises productive efficiency (Baqaee and Farhi 2020). Finally, I find that the proposed living wage cannot sustain collusion.

Related literature This paper contributes to a large and growing literature on labor market power (reviewed in Manning 2011, and more recently in Sokolova and Sorensen 2021, Manning 2021, and Card 2022). Although economists have long suspected that employers coordinate to set wages (Smith 1776), this paper is, to the best of my knowledge, the first to document employer collusion in a contemporary labor market setting. The closest paper is Delabastita & Rubens (2022), who employ a structural approach to uncover collusion in the Belgian coal cartel of the 1870s. The authors employ production function estimation to estimate wage markdowns, estimate input supply curves, and uncover the degree to which employers internalizing others' profits would justify the estimated markdowns. Roussille & Scuderi (2022) adopt and augment the structural approach developed in Backus, Conlon, and Sinkinson (BCS, 2021) to test for conduct on an online recruitment platform for high wage engineers in the US. In other words, under estimated labor supply and production functions, the "correct" model of conduct will imply productivity shocks uncorrelated with instruments that only shift markdowns. The authors find that employers behave as independent monopsonists, rather than oligopsonists who strategically interact.

To the best of my knowledge, this paper is the first to evidence employer collusion in a contemporary labor market setting. It makes three additional contributions. First, I develop and implement a simple comparative static test of collusion valid for very general structures of labor supply and production. In so doing, I diagnose collusion without needing to estimate several structural objects. Section 5 complements this simple test to quantify the relative fit of various models, adapting and augmenting the BCS 2021 approach to test for changes in conduct. Second, I diagnose collusion at a focal point wage. Many forces in the real world push towards such a focal point over models where employers collude perfectly, or by internalizing others' profits.[9] A focal point wage is easy to observe and monitor. The garment industry also faces transitory shocks that are difficult to publicly observe.[10] Finally, foreign buyers enforce compliance with the minimum wage, rendering it a reasonable target for collusion. The paper's third contribution is to detect collusion in an important industrial setting in a developing country context. The garment industry is among the largest employers in developing countries, employing over 90 million workers overall.

The paper adds to a large literature on minimum wages. While the minimum wage typically binds from below (e.g in the US as in Cengiz et al. 2018, and Brazil in Derenoncourt et al. 2021), I document that the minimum wage can serve as a focal point for collusion even when it is non-binding.[11] My findings demonstrate that higher minimum wages can successfully limit the ill effects of collusion by catalyzing coordination at a higher wage.

Outline The rest of the paper proceeds as follows. Section 2 presents the simple test to arbitrate between own profit maximization and the breakdown of collusion. Section 3 describes the data and setting, and presents motivating evidence that industry associations coordinate to pay the minimum wage. Section 4 implements the comparative static test of collusion. Section 5 employs the full-IO test of conduct to quantify the relative fit of the oligopsony model versus the breakdown of collusion. Section 6 calculates the losses due to collusion, and evaluates the impact of minimum wage policy in mitigating them. Section 7 concludes.

2 Test

This section demonstrates that, under quite general labor supply and production structures — where demand (weakly) slopes downward and an increase in one's competitor's wage reduces one's labor supply — spillovers from firm-specific demand shocks predict opposite employment effects at unshocked firms that operate independently (↓ employment) versus firms that were previously colluding, but whose collusion dismantles due to the shock (↑ employment). The test covers perfect competition, monopsony, Bertrand oligopsony, and Cournot oligopsony.[12] It additionally holds for two standard forms of collusion: at a single wage, or by partly or fully internalizing others' profits.[13] Section 4 tests the reduced form implications of this theory, by studying the spillover effects of firm-specific demand shocks onto members and non-members of industry associations. Section 5 adds more structure to statistically arbitrate between various models of conduct.

[9] The test also applies for collusion by internalizing others' profits.

[10] For example, Athey, Bagwell and Sanchirico (1998) highlight how, in settings with transitory shocks, a rigid-pricing scheme where a firm's collusive price is independent of its current cost position sacrifices efficiency benefits but also diminishes the informational cost of collusion. Collusion at the minimum wage sacrifices efficiency over joint profit maximization because wages/worker allocations do not reflect productivity.

[11] A seminal study by Knittel & Stango (2003) documents that state-specific interest rate ceilings serve as focal points for tacit collusion in the US credit card market, albeit using a different empirical strategy.

[12] Spillovers only occur under perfect competition if the shock is market-level, i.e., affects enough firms

[13] The test broadly applies to collusive schemes where at least some firms currently earn higher collusive profits than their counterfactual oligopsony profits absent collusion. The number of unshocked cartel members who will increase employment depends on the underlying distribution of productivity across firms and the precise collusive scheme.

2.1 Setup

The economy features a continuum of firms. A finite subset $\mathbf{J}$ of these firms compete in a labor market, $j \in \{1, ..., J\}$. Time is discrete and indexed by t.

Labor supply Labor supply is invertible, i.e., employers are not perfect substitutes in the eyes of workers. Labor supply to each firm depends on its own wage w_{jt}, a vector of wages at competitors $\mathbf{w_{-jt}} = \{w_{1t}, ..., w_{j-1,t}, w_{j+1,t}...w_{Jt}\}$, and a vector of non-wage amenities offered by employers $\mathbf{a_t}$. $n_{jt} = f(w_{jt}, \mathbf{w_{-jt}}, \mathbf{a_t})$ for $j \in 1, ..., J$. The fact that employers are imperfect substitutes generates imperfect competition in the labor market. The fact that labor supply n_j is potentially a function of competitor $-\mathbf{j}$'s wages generates the prospect for strategic interactions, or, spillovers. Namely, spillovers only occur when a firm-specific demand shock to some firm $j_2 \in -\mathbf{j}$, that alters j_2's wage, in turn rotates labor supply to employer j, thereby causing j to best respond by altering its own wage and/or employment.

The assumption of invertibility is a small, technical requirement that ensures a unique distribution of workers across employers who all pay a common wage.[14] Invertibility does not rule out most popular (and many unpopular) labor supply systems in use today, for example, it nests nested CES (e.g. as in Berger, Herkenhoff and Mongey 2022), discrete-choice logit (e.g. as in Card et al. 2018), nested logit, mixed logit, linear, Kimball, translog, and many others.

I make one additional assumption: that employers are connected substitutes (Berry, Gandhi & Haile 2013).[15] In other words, that employers are weak substitutes, in that a higher wage at one employer weakly reduces labor supply to all other employers, with sufficient strict substitution to warrant treating employers as part of a single labor supply system. Assumption 1 formally defines the connected substitutes condition.

Although not fully general (as described below), connected substitutes is natural to assume a labor market setting. Its main role is to ensure the occurrence of spillovers, i.e., that a higher wage at j reduces labor supply to j', which in turn raises j''s optimal wage. While nesting most standard labor supply systems, connected substitutes enables substantially more flexible patterns of substitution across employers than is commonly assumed. For example, although both nested CES and nested logit labor supply satisfy the connected substitutes condition, unlike these systems I do not impose symmetric preferences.[16] Connected substitutes also nests models wherein workers climb a common job ladder, and where, all else equal, higher wages or amenities elevate employers up this ladder (e.g. as in Sorkin 2018). In sum, the connected substitutes condition ensures that the comparative static test derived in this section is applicable across a large range of labor supply structures without making functional form restrictions, smoothness assumptions, or strong domain

[14] This unique distribution is a key feature of imperfectly competitive labor markets where market power arises from workers' heterogeneous preferences/constraints across employers (e.g. Berger et al. 2022, Card et al. 2018, Sharma 2023). Nonetheless, my analysis allows for arbitrarily large but finite elasticities of substitution between employers, which approximates well the case of perfect substitutes (Kucheryavyy 2012).

[15] Berry et al. 2013 show that the connected substitutes condition is sufficient for invertibility, meaning that the connected substitutes assumption nests invertibility.

[16] Namely, that the significance of any firm for all other firms is summarized by the firm's market share.

restrictions. Nonetheless, I assess and establish the robustness of my empirical findings to potential violations of the connected substitutes condition in Section 4.3. To summarize the main assumption about labor supply:

Assumption 1. (Connected substitutes) Employers are weak substitutes in that, all else equal, an increase in w_j weakly lowers labor supply to all other employers $\frac{\partial ln n_{j'}}{\partial ln w_j} \leq 0 \forall\, j' \in \mathbf{J} \setminus j$. In addition, define the directed graph of a matrix to represent substitution among employers $\chi(w)$ whose elements are $\chi_{j+1,k+1=} \begin{cases} 1\{good\ j\ substitutes\ to\ employer\ k\ at\ x\} \\ 0 \end{cases}$. For all possible w, the directed graph of $\chi(w)$ has, from every node $k = 0$, a directed path to node 0.

While assuming connected substitutes is natural for a labor market setting, it may be violated if workers possess non-homothetic preferences over employers. For instance, if richer workers disproportionately value employer amenities, then an increase in some employer j's wage that raises its employees' wealth could lead these workers to increase — as opposed to decrease — labor supply to a different high amenity employer j'. Section 4.3 empirically rules out non-homotheticity and other violations of the connected substitutes condition as driving my results.[17]

Firms Firms post wages. Depending on the model of conduct, they maximize profits by choosing the number of workers to hire or wage to set, taking as given their competitors' employment decisions (under Cournot oligopsony), wages (under Bertrand oligopsony), or by considering themselves atomistic (monopsonistic competition). In the collusive equilibrium, a cartel coordinates to pay the focal point wage, whereas fringe employers choose the number of workers to hire taking as given their competitors' employment decisions and the cartel's behavior.[18]

Each firm operates a production function of the form $z_{jt} f_j(n_{jt}, k_{jt})$, that uses inputs of capital k_{jt} and labor n_{jt}, and is twice differentiable and concave in both. Here z_{jt} is a product of TFP and price. Firms are price-takers in the product market.[19] Capital is supplied in a competitive market at rate R_t. Therefore, I can substitute in optimal capital demand into the production function to express it in terms of labor alone, $y_{jt} = \tilde{z_{jt}} \tilde{f}_j(n_{jt})$. Here $\tilde{z_{jt}}$ is a function of z_{jt}, R_t, and primitives. The second assumption underlying conclusions is:

[17] My main empirical finding is that a large, firm-specific demand shock that affected some employers spilled over to unshocked employers unaffiliated with the industry association as under oligopsony (by $\uparrow$ their wage and $\downarrow$ employment), but onto unshocked members of the association as after a breakdown of collusion (by $\uparrow$ their wage and $\uparrow$ employment). Section 4.3 shows that the opposite employment responses also occur when comparing members and non-members who offered the same amenities at baseline. By contrast, non-homothetic preferences would predict similar changes to the labor supply, and hence employment, of the two sets of firms. Similarly, I show that most other violations of the connected substitutes condition predict that in order for employment to be strategic complements, wages must be strategic substitutes (Appendix). Since I find an increase in unshocked members' wages, their higher employment cannot be rationalized by an oligopsony model that violates the connected substitutes condition.

[18] Qualitative conclusions are unchanged if fringe employers instead choose wages, taking as given their competitors' wages.

[19] Assuming price-taking in the product market is reasonable for the highly-traded textile and clothing manufacturing industry. However, all qualitative predictions are unchanged if firms instead possess product market power, as long as the revenue function exhibits weakly diminishing marginal product of labor (Assumption 2). Indeed, product market power is a source of downward sloping demand curves.

Assumption 2 (Weakly diminishing marginal revenue product) The revenue function for each firm $f_j(z_{jt}, n_{jt}, k_{jt})$ exhibits (weakly) diminishing marginal product of labor $\frac{\partial^2 f_j}{\partial n_{jt}^2} \leq 0$.

Note that Assumption 2 covers cases where firms possess excess capacity or are credit constrained, which renders the demand curve horizontal instead of downward sloping.

Shock A firm j experiences a positive demand shock, $dlnz_{jt} > 0$. My goal is to predict the wage and employment responses at firms $j' \in \{\mathbf{J} \setminus j\}$ under various forms of conduct.

2.2 Perfect competition

A firm-specific demand shock under perfect competition has no effect on either j's wage, nor on the wage at any other firm. Since firms in a perfectly competitive labor market are atomistic and face flat labor supply curves, a shock $dlnz_{jt} > 0$ simply causes j to increase employment until its marginal product equals the market wage again, absent any change to the market wage. Under perfect competition, thus, $\frac{dlnw_{j't}}{dlnz_{jt}} = 0 \; \forall \; j' \in \mathbf{J} \setminus j$, $\frac{dlnn_{j't}}{dlnz_{jt}} = 0 \; \forall \; j' \in \mathbf{J} \setminus j$. Market-level positive demand shocks increase the market wage, and reduce employment at unshocked employers.

2.3 Oligopsony or Monopsony

Proposition 1: For oligopsonistic or monopsonistic conduct, any invertible labor supply system, and Assumption 2, a positive demand shock to one firm j ($dlnz_{jt} > 0$), causes unshocked competitors j' in its labor market to weakly increase their wage and reduce employment, with strict inequality under Assumption 1. In other words, $\frac{dlnw_{j't}}{dlnz_{jt}} \geq 0 \; \forall \; j' \in \mathbf{J} \setminus j$ and $\frac{dlnn_{j't}}{dlnz_{jt}} \leq 0 \; \forall \; j' \in \mathbf{J} \setminus j$, with strict inequality whenever employers are connected substitutes.

Proof See Appendix.

Proposition 1 demonstrates that, under Assumptions 1 and 2, spillovers under monopsony or oligopsony always lead unshocked competitors to increase their wage and reduce employment. For employers that maximize their own profits, thus, spillovers cannot predict higher employment.

Figure 1 illustrates the intuition underlying this result. Consider a Bertrand oligopsony. An individual employer j' faces upward-sloping labor supply (imperfect competition) and downward-sloping demand (Assumption 2). A positive demand shock to firm j increases j's labor demand, leading j to raise its wage in order to attract more workers (given its upward sloping labor supply curve). This higher wage attracts workers away from unshocked competitor j' whenever workers can substitute from j' to j, including via connections. Exit creates upward wage pressure at j', leading j' to also raise its wage. In Figure 1, j''s labor supply curve rotates to the left, she moves up her demand curve, raising her wage and reducing employment.

While the rationale behind positive wage spillovers is obvious, that behind an unambiguous decline in employment is not. In particular, spillovers exert competing forces on employment. This is best illustrated via the first order condition $w_{j'} = \mu_{j'} mrpl_{j'}$, where $\mu_{j'}$ is the markdown and $mrpl_{j'}$ is the marginal revenue product of labor. The shock increases unshocked competitor j''s optimal markdown $\mu_{j'}$.[20] On the one hand, j' wishes to decrease employment to raise marginal product. On the other hand, she wishes to grow large enough again to pay workers a smaller markdown. I show that, for any production function with declining marginal product, and any labor supply system where employers are connected substitutes, the first force dominates the second, and employment unambiguously declines.

Finally, spillovers also reduce employment when employers are monopsonistic instead of oligopsonistic. This is because spillovers manifest by changing the curvature of labor supply. Even when an employer faces no strategic motive for wage setting (as in monopsony), the curvature of labor supply can depend on competitors' wages.[21] If yes, spillovers unambiguously reduce employment under monopsonistic competition.

Binding minimum wage Spillovers from firm-specific demand shocks continue to predict negative employment effects at unshocked competitors in monopsony or oligopsony models with a binding minimum wage. This is best visualized via a monopsony 101 picture featuring downward-sloping labor demand and upward-sloping labor supply (Figure 1). When the minimum wage binds from below, firms inhabit their labor supply curve instead of the first order condition, i.e., the optimal monopsony wage that equates marginal product to marginal cost lies below the minimum wage. A left rotation of labor supply nonetheless induces unshocked competitors to reduce employment. They may either continue paying the minimum wage but employ fewer workers, since fewer workers now supply labor to them at the minimum wage. Alternatively, if the rotation pushes them onto their first order condition, they may instead raise wages, but, nevertheless, reduce employment. The minimum wage may alternatively bind from above. More workers supply labor than demanded, and firms inhabit their labor demand curve. Spillovers that induce a left rotation of labor supply nonetheless lead unshocked competitors to weakly reduce employment. If the minimum wage continues to bind from above, unshocked competitors change neither wages nor employment. For a large enough rotation of labor supply, however, they raise wages and reduce employment.

Violations of assumption 1 or 2 In sum, together Assumptions 1 (connected substitutes) and 2 (weakly diminishing marginal revenue product of labor) imply that wages under oligopsonistic or monopsonistic competition are strategic complements and employment is strategic substitutes. As previously noted, these assumptions cover all standard forms of labor supply including nested CES, nested logit, mixed logit with connected substitutes, common job ladder, and extend to cases where demand is horizontal (binding minimum wage, credit constraints, excess capacity). Nonetheless, the

[20] See step 1 of Proof or Proposition 1 establishing that such an optimal markdown exists for any competition structures and invertible labor supply systems.

[21] Formally, the curvature or perceived elasticity of labor supply is defined as $\sigma_{jt} = \frac{dlnn_{jt}}{dlnw_{jt}} = \frac{\partial lnn_{jt}(w_{jt}, w_{-jt}, a_t)}{\partial lnw_{jt}} + \sum_{j' != j} \frac{\partial lnn_{jt}(w_{jt}, w_{-jt}, a_t)}{\partial lnw_{j't}} \frac{dlnw_{j't}}{dlnw_{jt}}$. Here $\frac{dlnw_{j't}}{dlnw_{jt}}$ is the conjectured response of competitors. Under monopsonistic competition, $\frac{dlnw_{j't}}{dlnw_{jt}} = 0$. However, the first term can still depend on competitor wages.

assumptions may be violated in certain reasonable scenarios. For instance, the connected substitutes condition could be violated in a "cream-skimming" world, where a higher wage at employer j attracts away competitor j''s least tethered workers (for example, workers with the weakest idiosyncratic preference for j'), leaving behind more inelastic workers. This would reduce, rather than increase, j''s optimal markdown, $\mu_{j't}$. The appendix characterizes and rules out three mutually exclusive and exhaustive violations of the connected substitutes condition as explaining the results. I either show analytically that violations continue to predict strategic substitutability in employment, or, establish conditions under which they could yield strategic complementarity, and empirically eliminate these possibilities (Appendix, and Section 4.3). Assumption 2 may be violated if the shock prompts external economies of scale, such as if it leads shocked and unshocked competitors to collaboratively negotiate cheaper input contracts. Section 4.3 empirically rules out such violations as driving the results, namely, where demand is neither horizontal nor downward sloping.

2.4 Breakdown of collusion

Assumption 3. (Current collusive profits exceed oligopsony profits for some members) At least some members of a cartel earn collusive profits exceeding the counterfactual oligopsony profits they would earn absent collusion. Without needing to take a stance on the specific game in which firms interact, this condition ensures that the shock does not occur when each cartel member sacrifices higher oligopsony profits today for the promise of higher collusive profits in the future.[22] Although I consider two specific cases, Proposition 2 is true under assumptions 1 through 3.

Proposition 2 (a): For any labor supply system where employers are connected substitutes, if a positive demand shock to some firm j ($dlnz_{jt} > 0$) causes collusion at a single wage to break down, and firms go to oligopsony, then $\exists\ j' \in \{\textbf{cartel}\backslash j\}$ for which $\frac{dlnn_{j't}}{dlnz_{jt}} > 0$.

Proposition 2 (b): For any labor supply system where employers are connected substitutes, if a positive demand shock to some firm j ($dlnz_{jt} > 0$) causes collusion by partially or fully internalizing others' profits to break down, and firms go to oligopsony, then $\exists$ $j' \in \{\textbf{cartel}\backslash j\}$ for which $\frac{dlnn_{j't}}{dlnz_{jt}} > 0$.

Proof See Appendix.

A simple intuition underlies the proof—in order for collusion to be profitable, at least some firms (and, under some conditions, many firms) must depress both wages and employment to collude at the minimum wage, compared to oligopsony. Although I study firms' coordination at a focal point wage, the intuition for why wage suppression is beneficial is most apparent when considering the case

[22] Assumption 3 matters for the proof because no cartel member needs to depress wages and employment if no one benefits from collusion. However, I show that, in order for collusion to yield higher profits, at least some firms must depress both wages and employment relative to oligopsony.

of joint profit maximization (i.e., firms fully internalizing others' profits). Jointly profit-maximizing firms internalize the negative effect of each firm's higher wage on its competitors' labor supply, and, thus, suppress both wages and employment below their individually optimal levels. Similar motives lead firms to collude at a focal point wage.[23] A breakdown of collusion that causes unshocked firms to revert to oligopsony then predicts higher wages and employment at firms that were previously coordinating.

Former colluders raise employment as long as the demand shock is "small enough" to spur an oligopsony equilibrium close to the counterfactual that would prevail if firms did not collude. Very large demand shocks, that spur transitions to equilibria far from this original counterfactual, would, however, also predict lower employment among unshocked members of a cartel. For example, consider an extremely large shock that inspires a firm to desire employing its entire labor market. The test nonetheless demonstrates that, under Assumptions 1 and 2, non-cooperative models of competition *never* predict higher employment at unshocked competitors, whereas a breakdown of collusion can.

2.5 Discussion

The results from this section clarify that if spillovers from firm-specific demand shocks cause unshocked competitors to increase employment, then this is inconsistent with all models with independently operating firms (Proposition 1), but consistent with the breakdown of coordination (Proposition 2).

My goal is not to argue that a single firm's deviation from its collusive wage must necessarily dismantle collusion. Indeed, such an argument would be false—the Folk Theorem postulates that several alternative collusive schemes are sustainable for sufficiently patient firms. For instance, a cartel could temporarily allow its members that receive positive demand shocks to raise production, while asking unshocked members to cut back. It could then reverse these roles when the shocks reverse. Such a scheme would not unambiguously predict higher employment at unshocked members of the cartel. Rather, the aim of the theory is to demonstrate that, under very general structures of labor supply and production, a breakdown of collusion *can* predict higher employment at unshocked competitors, for any punishment strategy that leads to breakdown. In contrast, independent profit maximization can *never* predict higher employment at unshocked competitors. Section 4 tests the reduced form implications of this theory. Section 5 assesses the fit of various models of conduct, including collusion without breakdown, and demonstrates that the breakdown of collusion from a focal point wage model best fits the data.

[23] Coordination in the Indian garment industry resembles coordination at the minimum wage, as opposed to internalizing others' profits. In fact, joint profit maximization would predict wage dispersion among employers with different productivity z_j, and not bunching at a single wage. Many forces in the real world push towards a focal point wage. First, it is easy to observe and monitor. Second, the garment industry faces transitory shocks that are hard to observe. Finally, foreign buyers enforce compliance with the minimum wage, rendering it a reasonable target for collusion.

3 Data and Setting

3.1 Data Sources

My analysis links four new sources of data: (i) wages and worker outcomes from linked employer-employee social security records covering the universe of formal workers in India, (ii) establishment-level membership in local industry associations, scraped from their websites, (iii) minimum wage levels and changes over time for all states and industries in India, and (iv) exports at the establishment-level from customs records. Each dataset spans the period between 2014 and 2018.

For information on workers, I use social security records obtained from India's Employers' Provident Fund Organization (EPFO) for the five year period from 2014 to 2018. The EPFO collects pension contributions for all formal workers in India with monthly earnings below Rs.15,000. The data track workers across employers. For each employment spell, they report a worker's monthly wage, tenure, and status as a part or full-time worker. The data also report demographic worker characteristics, such as age and gender, and employer characteristics, such as location (city or district), and six-digit industry.

For information on membership in local industry associations, I first identify the largest industry association in each of five main centers of garment manufacturing in India, each in a different city—Tirupur (Tamil Nadu), Bangalore (Karnataka), Gurgaon (Haryana), Faridabad (Haryana), and Noida (Uttar Pradesh). Together these cities employ 63% of all workers in the garment industry. I scrape member lists for these associations from their websites. Industry associations have an average membership of 555 employers.

I obtain information on minimum wage levels from official state government announcements. For each of twenty eight states, and each of one hundred and five scheduled industries, I compile a panel dataset tracking the state-and-industry-specific minimum wage for the period between 2014 and 2018. Examples of industries include "biscuit manufacturing", "tobacco processing", and "garments, costumes, and tailoring establishments". The data report the minimum wage for three skill levels in each industry, denoted as "unskilled", "semi-skilled", and "skilled" workers.

Finally, I generate measures of firm-specific demand shocks using establishment-level export data contained in customs records, and digitized by the organization Panjiva. The data range from 2014 to 2020. They report annual exports of each product exported by an establishment, including its value and destination. The data record product information at the 6-digit level, which encodes both the type of product and its material, for e.g. "women's or girls' track suits of cotton", and "men's or boys' shirts of man-made fibers". I use exporter names and zip codes to match exports and membership in industry associations with the social security records. Name-matching employs a combination of the Jaro-Winkler and Levenshtein minimum distance algorithms.

3.2 Institutional Setting

This paper argues that two key institutional features underlie coordination among employers in the Indian garment industry. First, large employers organize into local industry associations, which ostensibly coordinate members' actions in the product market. Second, each state government in India notifies a separate minimum wage for each industry. I argue that members of industry associations coordinate to pay workers exactly the local, state- and industry-specific minimum wage, although they would pay higher average wages if they were instead independently maximizing profits (e.g. as under oligopsony).

Industry associations Nearly half of all workers in India's textile and garment manufacturing industries are employed at factories with membership in local industry associations. Associations advance members' interests in policy and provide other perks, such as organizing trade fairs and trainings. For instance, industry associations regularly lobby the government for concessions—the most prominent association in India's largest garment manufacturing hub, Tirupur, the Tirupur Exporters' Association, recently extensively lobbied the central government to enact free-trade agreements to boost India's exports to Australia and the UK, and lobbied against an agreement that would raise imports from Bangladesh. Industry associations also regularly organize networking events where members learn about each others' production processes, and trade fairs to showcase members' goods to foreign buyers. Core members of associations often know each other socially.

I identify the most prominent industry association in each of five main centers of garment manufacturing in India—Tirupur (Tamil Nadu), Bangalore (Karnataka), Gurgaon (Haryana), Faridabad (Haryana), and Noida (Uttar Pradesh). The bunching results reported below apply to all associations.[24] However, the empirical analysis in Section 4 focuses on the Tirupur Exporters' Association (TEA). Tirupur employs 31% of garment workers in India and accounts for a majority of exports.

Membership in the TEA is restricted to large and prosperous factories. In order to be eligible for membership, factories must have a minimum turnover of Rs. 50 lakh over the past three years (1.3 million USD in PPP terms). They must additionally receive the endorsement of two existing members. Prospective members of the TEA undergo a two-year long probationary term as associate members before they can be elected to permanent membership. In total, the association has 1076 permanent members and 155 associates. By way of comparison, these numbers in 2018 were 931 permanent and 155 associate members.

Table 1 describes summary statistics comparing members of industry associations to employers outside the association. Members of industry associations are some of the largest and most productive firms in the economy. They employ on average 152 workers, compared to 101 workers employed at establishments outside the association. Members of associations are also more likely to be exporters (71% compared to 52% outside the association), and, conditional on exporting, export on average more products (2.2 compared to 2.1 outside the association), and a greater annual value (3 million USD compared to 2.6 outside the association). On average, associations pay their workers a monthly wage of \$1765 (USD adjusted for PPP) compared to \$1511 outside the association.

[24] I do not name all associations since the bunching evidence is purely suggestive.

Minimum wage Each state in India establishes a daily minimum wage for each of 105 scheduled employments (roughly, two-digit industries).[25] This wage is intended to cover basic living expenses for a family of four members. While states vary somewhat in their precise definition of "basic living expenses", these definitions consistently rely on cost of living calculations. For instance, the national government proposed the following, very specific basket of goods that a reasonable minimum wage would enable households to afford[26]: "food items amounting to the level of 2,400 calories, along with proteins $\geq$ 50 gm and fats $\geq$ 30 gm per day per person", "essential non-food items, such as clothing, fuel and light, house rent, education, medical expenses, footwear and transport equal to the median class' expenditure as per the NSSO-CES 2011/12 survey data", and "expenditure on any other non-food items equivalent to the sixth fractile (25-30 per cent) of the household expenditure distribution." States typically comply with these requirements by gathering price information from several different locations before adjusting the minimum wage. For example, Karnataka collects prices from 16 urban and rural locations before revising its minimum wage.

In principle, the law requires state governments to revise each industry's minimum wage once every five years, and to adjust it for inflation once every six months. In practice, however, revisions are uncommon. The average state only revised its minimum wage for the garment industry four times during the five year period spanning from 2014 to 2018.

Examples of scheduled employments that feature separate minimum wages include "garments, costumes, and tailoring establishments", "biscuit manufacturing", and "tobacco processing". Within each schedule, the government notifies separate minimum wages for three different categories of workers: "unskilled", "semi-skilled", and "skilled". The wage for semi-skilled workers is typically 5.9% higher than the unskilled wage, and for skilled workers is typically 14.3% higher. Examples of skilled workers in the garment industry include designers, cutting machine operators, and master or grade I tailors. Semi-skilled workers encompass slightly less skilled workers, including grade II tailors, button hole machine operators, and stitchers. Unskilled workers include helpers and packers.

Table 2 describes key statistics on the minimum wage in the garment industry during July 2016. The monthly minimum wage for unskilled workers ranged between Rs. 4390 and Rs. 9568 across states, with an average value of Rs. 6962. For semi-skilled workers, this monthly minimum wage ranged from Rs. 4700 to Rs. 10582, with an average value of 7439. Finally, the minimum wage for skilled workers ranged from Rs. 5171 to Rs. 11622, with an average of 8034. These average wages correspond with monthly earnings of \$361, \$387, \$418 respectively when converted to USD adjusted for purchasing power parity. Of the total value of the minimum wage, 9.4% typically comprises a basic wage that covers basic living expenses at the time when the wage is set. The remaining 90.6% comprises a "variable dearness allowance" (VDA) that constitutes periodic adjustments to the minimum wage for inflation.

Both the central and state governments are tasked with enforcing compliance with the minimum wage, but, as I will show below, its enforcement is highly imperfect. Enforcement typically takes

[25] The precise number of scheduels is determined by worker populations—any industry employer over 1000 workers features a separate minimum wage. Schedules vary between 45 and 1699, with a median of 105.

[26] Source: https://pib.gov.in/newsite/PrintRelease.aspx?relid=188610

the form of labor inspections. Inspectors located in different geographic zones within a state inspect establishments that lie within their jurisdictions, either randomly or, in rare cases, based on complaints (Shyam Sundar 2010). Inspections assess an employer's compliance with all local labor regulations, including payment of the minimum wage. Any employer found as paying workers below the minimum wage faces a fine of up to Rs.10,000 and imprisonment of up to five years. However, as I will show below, over half of all workers employed at formal establishments in India, and who show up in social security records, earn below the minimum wage. This reflects both the government's highly imperfect enforcement of the minimum wage, and virtually no sharing of information between the social security administration and Ministry of Labor.

3.3 Motivating Evidence: Industry associations bunch from above at the minimum wage

My analysis begins by documenting four facts which demonstrate that members of industry associations disproportionately cluster from above at the local minimum wage, whereas non-members typically pay workers below the minimum wage. The resulting model I propose is one where large and productive firms organize into a cartel to pay workers precisely the minimum wage (the industry association), while less productive fringe firms pay below the minimum.

Fact 1: Employers bunch from above at the local industry and state-specific minimum wage Figure 2 (Panel a) plots the distribution of wages for all formal employees in the Indian garment manufacturing industry, denominated in days around their local minimum wage. For each worker, I calculate and plot her average monthly earnings between January 2015 and July 2015. I find that 29.2% of workers are paid within two days of the statutory minimum wage. Over 54.7% of workers are paid below the minimum wage, and only 16.1% of workers are paid above the minimum wage. Figure 3 replicates this finding separately for the four largest centers of garment manufacturing in India—Tamil Nadu, Karnataka, Uttar Pradesh, and Haryana. Together these states employ nearly 63% of all workers in the garment manufacturing industry. Clustering wages right at the local minimum wage implies that it effectively serves as a maximum wage in the garment industry.

One potential concern with the documented pattern is reporting bias. Social security contributions are calculated based on reported earnings, which could lead employers to falsely declare paying workers the legally mandated minimum wage to minimize their social security contributions, while paying the remainder of a worker's wage under the table. To address this concern, Appendix Figure 1 plots the distribution of self-reported wages in the garment industry from the Primary Labor Force Survey (PLFS), a nationally representative survey. Self-reported wages are less susceptible to reporting bias since they are not used for calculating social security contributions. Mitigating concerns of reporting bias, I find that self-reported earnings display the same level of bunching at the minimum wage as exhibited by social security records. Even beyond survey data, qualitative accounts support the prevalence of garment workers in India earning exactly the minimum wage.[27] For example, Adhvaryu et al. (2019) evaluated a worker voice intervention at India's largest garment exporter, that empowered workers to voice their dissatisfaction with a disappointing minimum wage increase. The intervention was predicated on the premise that these garment workers expected to earn precisely the new, disappointing, minimum wage.

A second concern is that earnings below the minimum wage may reflect part-time work. I evaluate this concern by plotting the distribution of modal earnings at an establishment. According to the PLFS survey, the vast majority of garment workers are full-time employees, implying that the modal earnings likely represent the wage of a full-time employee. Modal wages also display a substantial mass below the minimum wage. Nearly 50% of establishments pay their modal worker below the minimum wage, with 30% clustering right at the minimum.

Fact 2: Members of industry associations disproportionately bunch from above at the minimum wage Figure 2 (Panel b) reveals that members of industry associations disproportionately bunch from above at the minimum wage. It plots the distribution of wages separately for employers within and outside industry associations. Among members of their local industry association, 42.8% of workers earn within two days of the minimum wage, 38.7% earn below the minimum wage, and 18% earn above the minimum wage. By contrast, employers who are unaffiliated with the association exhibit substantially less bunching at the minimum, paying a large share of workers below the minimum wage (71.4%), and only 15.1% of workers within two days of the minimum wage.

The pattern of clustering right at the minimum wage is true of industry associations across locations. This is shown in Figure 3, which plots the distribution of wages separately by industry association membership for four of the largest centers of garment manufacturing in India: Tamil Nadu, Karnataka, Haryana, and Uttar Pradesh. Together these states employ over 63% of Indian's garment workers.

Fact 3: Members who deviate to paying wages above the minimum wage are disproportionately expelled from the association The Tirupur Exporters' Association features a two-year long probationary term before new members can be promoted to permanent membership. In a third motivating investigation, I examine whether probationary members who pay wages above the minimum wage are less likely to be promoted to permanency. Consistent with a model where deviations above the minimum wage result in exclusion from the association, I find that probationary members who deviate are significantly less likely to be elected to permanent membership (Table 3), with the promoted share from 75% among never-deviations to 37% among deviators (38pp decline).

Fact 4: Members of industry associations track increases in their local minimum wage, without reducing employment To study the effect of minimum wage hikes, I first identify nine

[27] In background interviews that I conducted across various locations in India, including discussions with garment workers, owners of large garment factories, heads of industry associations, and nonprofit organizations advocating for workers' rights, it consistently emerged that a large share of garment workers receive exactly the minimum wage.

large increases in the minimum wage between 2015 and 2018, wherein a state government increased its minimum wage for the garment industry by at least 7.5% worth its previous value (or two days). I employ a stacked event study design to evaluate the effect of these hikes on wages and employment, separately for members and non-members of industry associations. To this end, I generate a panel dataset that tracks establishments affected by the increase, i.e. located in the state that raised its minimum wage, and comparison establishments in other states, that did not increase their minimum wage, for twelve months around the time of each event. The empirical specification is:

$$y_{jst} = \sum_{t=-3}^{t=8} \beta_{t,assoc} Treat_{st} \times A_j \times 1_t + \sum_{t=-3}^{t=8} \beta_{t,not\ assoc} Treat_{st} \times (1-A_j) \times 1_t + \alpha_j + \lambda_t + \eta_{month} + \epsilon_{jst} \quad (1)$$

where y_{jst} is the outcome for establishment j, in state s, in month t relative to the time of the event. I study two outcomes: an indicator equal to one if the modal wage at an establishment is within two days of the new minimum wage, and total employment. $Treat_{st}$ is an indicator equal to one in states that increase their minimum wage in $t = 0$ while is equal to zero for states that never or are yet to increase their minimum wage. A_j is an indicator equal to one for employers who belong to the local industry association. α_j capture establishment fixed effects, λ_t capture monthly fixed effects around the time of the reform, and η_{month} capture calendar month fixed effects. β_t represent the coefficients of interest, with $\beta_{t=-1}$ normalized to 0. For the average employer, β_t track the trajectory of wages and employment relative to its $t = -1$ value. I cluster standard errors by establishment. The estimates remain similar when using the de Chaisemartin and d'Haultfoeuille (2020) procedure to account for heterogeneous treatment effects across cohorts and time.

I find that members of industry associations are disproportionately more likely to track the higher minimum wage compared to non-members, without reducing employment. Figure 4, Panels a and b plot the coefficients β_t for the two outcomes. I find that two months after a minimum wage hike, members of industry associations in treated states are nearly 21pp more likely to increase their modal wage to the new, higher minimum wage compared to employers outside the state (Panel a). By contrast, employers outside the industry association are only around 10pp more likely to pay the new minimum wage. Members are persistently more likely to pay the new minimum wage compared to non-members: eight months following an increase in the minimum wage, members are nearly 35pp more likely to pay workers the new minimum wage, compared to only 10pp of non-members. Panel b plots the average treatment effect on employment at the two sets of employers. Eight months following a minimum wage hike, there is no statistically significant treatment effect on employment at either members or non-members. If anything, members of industry associations, who are more likely to pay the higher minimum wage, experience a small positive treatment effect on employment three to six months after the hike in the minimum wage (4pp).

Together the facts presented in this section motivate the notion that industry associations in the garment industry use the minimum wage as a focal point for coordination. In a final motivating investigation, I study how members and non-members of the association respond to routine (small) demand shocks. Small positive shocks to demand should elicit the standard imperfectly competitive response at employers who face upward-sloping labor supply curves (higher wage and employment), but may elicit no response if employers abide by the minimum wage.

4 Empirical Results

This section presents the main empirical results studying the response of both members and non-members to firm-specific demand shocks. First, I provide motivating evidence that members of the industry association forego lucrative export opportunities that arise as a result of routine shocks to export demand to stick to paying workers the minimum wage. In contrast, employers outside the association cater to routine demand shocks as predicted by standard models of imperfect competition with independently optimizing firms, by raising wages to attract more workers. Second, the chief empirical exercise of the paper takes the comparative static test from Section 2 to the data. Specifically, I study the spillover effects of a large, firm-specific demand shock that led affected members of the industry association to deviate to paying wages above the minimum wage. All results in this section pertain to the city of Tirupur, which employs 31% of garment workers in India and accounts for a majority of garment exports. Tirupur's main industry association is the Tirupur Exporters' Association (TEA).

4.1 Routine (small) shocks

Fact 5: Members of industry associations forego export opportunities from small positive (price) shocks to demand, whereas non-members respond by raising wages, employment, and exports I first examine employer responses to small demand shocks (small price increases). Imperfectly competitive firms that operate independently and face upward-sloping labor supply curves would cater to higher demand by raising wages to attract more workers. By contrast, colluding firms that face upward-sloping labor supply curves may forego the export opportunity in order to stick to the minimum wage, unless the gains from deviating exceed the benefits of continued coordination. Formally, consider a case where members of a cartel who deviate to wages above the minimum wage earn a punishment profit Π_{punish} for T periods. Members would adhere to the minimum as long as $\sum_{T+1} \delta^t \Pi_{coll} > \Pi_{dev} + \sum_{T} \delta^t \Pi_{punish}$. Small price shocks may not raise Π_{dev} enough to inspire a deviation.

I leverage two features of the garment industry to generate a measure of routine (small) demand shocks. First, demand is highly transitory, which reflects the idiosyncratic fashion trends prevalent in garment industry, such as the introduction of a new fashion line, or special seasons sales. Second, export relationships are recurrent—i.e., establishments routinely export to the same importer across seasons. Exports in the garment industry peak twice a year, prior to the holiday season in November, and prior to the commencement of summer sales in July. For each establishment, I define its chief importer as the entity to which it exported the most in dollar value during its previous peak export season. Chief importers typically constitute a brand-and-location combination, such as Zara USA or Nike Brazil. For each establishment in state s, I then define it as experiencing a small, routine demand shock if the average price of imports to its chief importer, leaving out imports from its own state s, grows between 5 and 15pp between any two peak export seasons. The labor demand shock occurs three months prior to the export shock, since export contracts typically award three months of lead time. Formally, an establishment j with chief importer c in state s experiences a small demand shock in export season k if:

$$RShock_{jcsk} = 1[0.05 \leq \frac{\bar{P}_{c,-s,\ k} - \bar{P}_{c,-s,\ k-1}}{\bar{P}_{c,-s,\ k-1}} \leq 0.15]$$

where $\bar{P}_{c,-s,\ k}$ is the average price of a single unit of garment products imported by chief importer $c$from all states $-\mathbf{s} \in \{\mathbf{states} \setminus s\}$ excluding s.

I employ a DiD event study design to study the shock's effect on wages and employment, comparing an establishment in seasons during which it experiences a small demand shock to itself in unshocked seasons. To do so, I construct a panel dataset that tracks outcomes for all establishments experiencing at least one routine demand shock between 2014 and 2018, for all months between $t = -4$ and $t = 6$ relative to the start of any peak export season. The sample includes both shocked and unshocked seasons for all establishments that ever receive a routine demand shock. The following regression then evaluates the shock's effect on members and non-members of the industry association[28]:

$$Y_{jtk} = \alpha_{jt} + \sum_{t=-4}^{t=6} \beta_{t,1} RShock_{jk} A_j 1_{month=t} + \sum_{t=-4}^{t=6} \beta_{t,2} RShock_{jk} (1 - A_j) 1_{month=t} + \epsilon_{jt} \tag{2}$$

where Y_{jtk} is the outcome of interest (modal wage or total employment) for employer j in month t relative to the start of export season k. A_j is an indicator for membership in the local industry association. α_{jt} is an establishment-period fixed effect. β_t are the coefficients of interest, with $\beta_{t,1=-1}$ and $\beta_{t,2=-1}$ omitted. For the average employer, β_t track the trajectory of outcomes relative to their $t = -1$ value, in seasons during which an establishment experiences a demand shock, relative to seasons in which it does not. I cluster standard errors by chief importer.

The identifying assumption is that, absent the shock, outcomes at a shocked establishment would have evolved in parallel to its outcomes during unshocked seasons. In order to identify the effect of a demand — as opposed to a supply — shock, members must additionally not experience shocks to their TFP or input costs concurrently with the routine demand shock. Section 4.3 rules out differential shocks to members' TFP or costs relative to non-members as driving the results.

[28] An alternative specification controls for a common average trend around the start of export season (as opposed to establishment-specific trend), studying how outcomes evolve in a shocked versus unshocked season: $\alpha_j + \sum_{t=-4}^{t=6} \lambda_{1,t} A_j 1_t + \sum_{t=-4}^{t=6} \lambda_{2,t} (1 - A_j) 1_t + \sum_{t=-4}^{t=6} \beta_{1,t} Shock_{jk} A_j 1_t + \sum_{t=-4}^{t=6} \beta_{2,t} Shock_{jk} (1 - A_j) 1_t + \epsilon_{jt}$. Here λ_t captures the average outcome relative to $t = -1$ during unshocked seasons, β_t captures the differentially higher effect during shocked seasons. The two strategies yield very similar estimates.

Results Appendix Figure 2 plots the first stage effect of a routine (small) demand shock on the export price obtained by employers who belong to industry associations and non-members. A 10% increase in the leave-state-out price of imports to one's chief importer increases an establishment's own export price by 7pp. The outcome includes all prices, not just the price received from one's chief importer. Indeed, I do not condition any result on continuing to export to one's chief importer from the previous period. In any export season, routine demand shocks affect fewer than 5% of establishments in any given city.

I next turn to studying member and non-members' responses to routine demand shocks. Figure 5 shows the effect of a routine demand shock on the modal wage and employment at non-members, i.e., employers unaffiliated with the association. If these employers are maximizing profits and face upward-sloping labor supply curves, then a positive demand shock should cause them to raise wages and employment. As predicted, non-members who experience a positive demand shock increase their wage by 10.3pp more during seasons in which they experience the shock compared to seasons without a shock (Panel a, month 4). Employment grows 9.8pp (Panel b).

Figure 6 shows the effect of a routine demand shock on members of the industry association. If these employers coordinate to pay the minimum wage, then we should not expect routine demand shocks to affect their wages, employment, or exports. As predicted, I find that members of industry associations forego the export opportunity presented by routine demand shocks. Panel a shows no average effect on their modal wage during shocked seasons compared to seasons with no shock (point estimate 0.004 95% CI (-.008, .017). Similarly, Panel b shows no average effect on the number of workers employed in seasons with versus without a shock.

Note that members would only forego export opportunities, as I find, if their labor supply slopes upward at the minimum wage. In other words, if employers must, but are unable to, raise wages above the minimum in order to attract new workers (for example because such a deviation would violate their collusive agreement). Section 6 microfounds upward-sloping labor supply curves using heterogenous preferences across employers. Estimates of labor supply elasticities reveal that labor supply indeed slopes upward at the minimum wage.

One may expect member and non-members to differ in their response to routine demand shocks even absent collusion if the shocks to members are on average "smaller". However, as previously discussed, routine demand shocks have a remarkably similar first stage effect on the export price received by members and non-members. This suggests that the different wage/employment responses to routine demand shocks reflect not differences in shocks, but, rather, different responses to similar shocks. Overall, my results indicate that members of the industry association forego export opportunities to abide by the minimum wage.

4.2 Large shock

Next, to put the theory in Section 2 to test, I study the spillover effect of an exceptionally large, positive demand shock, that affected over 13% of exporters in Tirupur, and increased export prices by 24.5pp between 2016 and 2017. The shock originated as a result of labor audits in Vietnam that revealed severe labor law violations at several large factories. Conducted by the NGO Worker Rights Consortium, these audits accused the factories of practicing wage theft, unjust overtime practices, pregnancy discrimination, and health and safety infractions, among other violations (Figure 7, Panel a).[29] The audits prompted twenty six prominent fashion brands, including Zara USA, Macy's, Nike, and Gap, to temporarily relocate their production operations away from Vietnam (Figure 7, Panel b). Many of these factories' existing suppliers, to which they relocated production, were located in Tirupur, India.

The Vietnam relocation shock thus serves as a positive demand shock to employers in Tirupur that were already exporting to the affected brands (affected employers), but not to employers exporting to other brands (unaffected employers). Figure 8 shows a strong first stage effect of the relocation shock on the export price received by affected versus unaffected employers. For six months following the shock, between July and December 2017, the export price for affected employers grew 20 to 30pp above the price at unaffected employers. The relocation shock impacted 14% of employers outside the association and 13% within the association.

In order to deliver the effects of a demand instead of a supply shock, the ideal exogenous variation in a firm's demand would be uncorrelated with changes to the firm's labor supply, TFP, or input costs. Figure 9 shows that affected and unaffected employers within the association, and those outside the association, closely resembled each other in baseline characteristics. In other words, affected and unaffected employers within the association were similar and affected and unaffected employers outside the association were similar. Specifically, the two sets of employers exported similar products (HS 6 digit codes) and had similar baseline distributions of firm size. The similarity in baseline characteristics among affected and unaffected employers within (and outside) the association suggests that the shock constitutes an exogenous shock to demand, uncorrelated with changes to the firm's labor supply, TFP, and input costs. Section 4.3 explicitly rules out common TFP shocks as driving the results.

To study the relocation shock's direct effect on affected employers, I use an empirical specification identical to equation (2). The shock variable is now an indicator equal to one if an establishment's chief importer in the previous season was a brand forced to relocate its production operations from Vietnam to India. As before, the labor demand shock occurs three months prior to exports. To study the spillover effects of the shock, I use an empirical specification similar to equation (2), but run only for the sample of unaffected employers:

$$Y_{jtk} = \alpha_{jt} + \sum_{t=-4}^{t=6} \beta_{t,1} A_j 1_{month=t} + \sum_{t=-4}^{t=6} \beta_{t,2} (1 - A_j) 1_{month=t} + \epsilon_{jt} \tag{3}$$

where all variables are defined as in equation (2).

[29] The audits were conducted at the behest of universities with merchandise sourced from these factories, including the University of Washington and Cornell University.

Results Figure 10 reports the impact of the relocation shock on the modal wage and employment of affected non-members (employers outside the industry association). Similar to routine demand shocks, non-members responded to the large demand shock by increasing their wage and employment. Four months after the shock, the wage at affected non-members increased 8pp relative to trend (Panel A), and employment grew 8pp (Panel B). Both the wage and employment increase persists for six months.

Figure 11 reports the impact of the relocation shock on members of the TEA. Unlike with routine demand shocks, affected members also responded to the Vietnam shock by increasing their wage and employment. In particular, affected members deviated to paying wages above the minimum. Four months after the shock, affected members' wages rose 9pp relative to trend (Panel A) and employment grew 8pp (Panel B).

The fact that affected members of the industry association shifted to paying wages above the minimum following the large relocation shock, but not after routine demand shocks, is consistent with a model where a member of the cartel sticks to paying the minimum wage until her benefit from deviating outweighs the benefit of continuing to coordinate at the minimum. Because the relocation shock spurred a substantially higher price increase compared to routine demand shocks—24pp relative to 5 to 15pp during a routine shock—it conceivably raised the benefit from deviating more than the typical shock.

Given that the relocation shock inspired affected members to deviate away from the minimum wage, I can perform the comparative static test of spillovers outlined in Section 3. Specifically, I ask whether the shock's spillover effects are consistent with standard, non-cooperative forms of imperfect competition, where unshocked competitors $\uparrow$ their wage and $\downarrow$ employment, or with the breakdown of collusion from a focal point wage, where unshocked competitors $\uparrow$ their wage and $\uparrow$ employment.

Figure 12 reports the spillover effect of the relocation shock on non-members. As predicted by non-cooperative models of imperfect competition, spillovers lead unaffected employers to increase their wage and reduce employment. Four months after the relocation shock, the wage at unaffected non-members is 5pp higher than trend (Panel a). Employment is 6pp lower.

By contrast, unshocked members of the association respond as if the shock dismantles their collusion from a focal point wage (Figure 13). In particular, these unaffected members of the association on average increase both their wage and employment. Four months after the shock, the wage at unaffected members is 6.3pp higher than trend (Panel a). Employment is 8.6pp higher (Panel b). As illustrated in Section 3, this positive spillover effect onto employment is inconsistent with models in which firms maximize their own profits (Proposition 1). Instead, it is consistent with a model in which members of the industry association were previously coordinating to depress both wages and employment, to pay the minimum wage, but where the positive demand shock dismantles their collusion (Proposition 2), or spurs a different collusive scheme.

In sum, I find that spillovers from the relocation shock onto unaffected employers outside the industry association are consistent with models of own profit maximization, such as oligopsony or monopsony. Unaffected non-members increase their wage, and *reduce* employment. In contrast, spillovers onto unaffected members of the industry association are consistent with a breakdown of collusion from a focal point wage. Unaffected non-members increase their wage, and *increase* employment.

Boundaries of the cartel Some nuance is in order when defining the boundaries of the cartel. Although I define the cartel as the industry association, the true cartel is potentially smaller than the full association. Two descriptive analyses reveal that permanent members of the association (82% of the total membership) constitute a more likely boundary of the cartel. First, I find that permanent members are more likely to bunch from above at the minimum wage compared to probationary members who are in their first two years of probation. Second, I show that the association appears to enforce compliance with the minimum wage among probationary members by expunging those who deviate to paying wages above the minimum (Fact 3 in Section 3). The results of this section nonetheless show that the industry association can be considered a loose boundary of the cartel, as indicated by the average increase in employment among unshocked members following the large shock.[30]

4.3 Robustness

At least four alternative explanations could lead unaffected members of the industry association to increase employment even absent a breakdown of collusion. I evaluate each in turn and find that they cannot explain the results.

Correlated demand shocks First, unaffected members may not be truly unaffected. For instance, affected members of the association might pass surplus orders from the brands implicated in Vietnamese audits to their unaffected counterparts within the TEA. Alternatively, they might subcontract production to unaffected members or shed off "worse" export orders, thereby causing a positive demand shock at unaffected employers. Higher employment among unaffected members could then reflect greater demand rather than collusion. Four findings point against this explanation. First, I find that unaffected members hired more workers by expanding exports to their most important importer from the previous period, rather than to affected brands (Table 4).[31] A simple back-of-the-envelope calculation reveals that these higher exports would entirely account for the larger workforce at these establishments, leaving little room to fill sub-contracts.[32] Second, I find an increase in employment at large unaffected members of the association (defined as establishments employing over 100 workers), who do not accept subcontracts.

[30] Ongoing work uses a longer time horizon and multiple shocks to identify the boundary of the cartel using the test developed in this paper as a diagnostic tool. Specifically, if enough shocks dismantle collusion, then one can generate statistical guarantees around the likelihood that an unshocked employer increases employment following the shock.

[31] A survey of 116 large exporters in the Indian garment manufacturing industry finds that forty percent regularly turn away export orders or accept smaller orders due to capacity constraints, explaining how unaffected members rapidly expanded their exports when they no longer had to adhere to the minimum wage (ILO 2016).

[32] Specifically, for the average firm, $\Delta export = mp \times \Delta n$, where $\Delta n = \bar{n}\Delta lnn$, $\bar{n}$ denotes the average firm size and $\Delta lnn = 0.065$, and marginal product is assumed proportional to average product in a Cobb-Douglas production function.

Third, I find no detectable impact on the price of the exports of unaffected members (Appendix Figure A1). Only demand shocks that increase prices can inspire oligopsonistic or monopsonistic employers to produce more by moving up their labor supply curves, since only these shocks raise workers' marginal revenue product of labor. Thus, the finding that prices do not change suggests that higher exports by unaffected members reflected a greater *supply* of exports when these employers no longer had to abide by the minimum wage, rather than greater demand.

Finally, I examine the effect of the relocation shock on the profits of both affected and unaffected members of the industry association. Positive demand shocks should increase profits, whereas a shock that prevents employers from accessing their (higher) collusive profits should lower profits. Data on profits is sourced from the Prowess database and covers 24% of establishments in my sample.[33] Table 5 reports results. Consistent with the relocation of production from Vietnam precipitating a positive demand shock among affected members of the industry association, I find that their profits increase by 16.2% (SE 0.081). In contrast, the profits of unaffected members decrease by 5.3% (SE 0.012). Declining profits furnish evidence against a positive demand shock experienced by unaffected members of the industry association.

Together the results from this section suggest that the increase in employment among unaffected members of the industry association did not reflect correlated demand shocks. Rather, the absence of price changes and declining profits imply that members of the industry association were previously suppressing both wages and employment to earn higher collusive profits. When the shock rendered their collusion infeasible, they responded by increasing both.

TFP/cost shocks to association members Second, common total factor productivity (TFP) or cost shocks that simultaneously affect members of the industry association, but not non-members, could increase labor demand among members, and, hence, employment, even absent collusion. For example, if association members share common input suppliers, any reduction in the input prices they pay to suppliers could boost both input demand and employment.[34]

Three facts mitigate the concern that common TFP or cost shocks explain the empirical findings. First, I find that affected and unaffected members of the association systematically vary in the price of new exports (Appendix Figure A1). Whereas affected members intensify exports to affected brands at higher prices, unaffected members of the association increase exports to the original brands to which they previously exported (unaffected), with no detectable impact on prices. Common TFP or cost shocks might instead predict similar price patterns at the two sets of exporters. Instead, the current pattern is consistent with affected members expanding exports as a result of a demand shock (price increase), whereas unaffected members doing so as a result of no longer have to abide by the minimum wage. Second, common TFP or cost shocks that affect all members of the industry

[33]Prowess compiles financial performance data of Indian companies from annual reports, stock exchanges, and regulatory filings. It covers 40,000 companies in India, including all publicly listed firms, as well as a sample of unlisted public and private companies of varying sizes and ownership structures

[34]The value added production function I model is net of materials; which is equivalent to assuming that gross output is Leontief in materials (Ackerberg et al. 2015). A decline in the price of materials would thus increase the demand for labor.

association at the same time would predict simultaneous changes in their wages and employment. However, I find systematic differences in the timing of when wage and employment effect manifest for the two sets of employers. Whereas affected members of the association increased their wages and employment immediately following the arrival of the relocation export orders, in $t = 0$, unaffected members only adjusted their wages and employment two months later, in $t = 2$. The varying timing of these changes does not align with the idea of simultaneous shocks affecting either TFP or costs. Instead, it suggests that collusion ceased when other employers noticed deviations from the minimum wage. Finally, the test of conduct in Section 5, which quantifies the relative fit of the oligopsony model vs a breakdown of coordination from a focal point wage does not impose restrictions on TFP shocks. Its conclusions are thus robust to any common TFP/cost shocks that affect all members.

Non-homothetic preferences As discussed in Section 2, non-homothetic preferences for amenities could also lead unaffected members to increase their employment through a labor supply channel, if the amenities they provide surpass those provided by unaffected non-members. While I do not directly observe amenities at each establishment, I leverage the observation that foreign buyers are prone to enforcing certain common amenities across all their exporters (e.g. as in Boudreau 2021, Alfaro-Ureña et al. 2022). For example, brands frequently employ audit agencies like SEDEX to ensure compliance with local labor regulation (interviews in Tirupur, summer 2023). Thus, comparing members and non-members who export to the same importer controls for common amenities enforced by the importer, thereby accounting for non-homotheticity. I control for importer-time fixed effects in the following modified version of the regression from equation (2):

$$Y_{jtk} = \alpha_{ct} + \sum_{t=-4}^{t=6} \beta_{t,1} Shock_{jk} A_j 1_{month=t} + \sum_{t=-4}^{t=6} \beta_{t,2} Shock_{jk} (1 - A_j) 1_{month=t} + \epsilon_{jt} \tag{4}$$

Appendix Figure A2 shows that, even after controlling for a common change to labor supply to exporters of brand c, the shock leads to opposite employment effects between members and non-members. Additional analyses controlling for job values net of wage premiums, as well as observed amenities such as location and the share of women in the workforce produce similar results.

Other violations of Assumption 1 (connected substitutes) and Assumption 2 (weakly diminishing marginal revenue product) A final concern is that Assumption 1 or 2 may be violated. Recall that the connected substitutes condition implies that a higher wage at one's competitor reduces labor supply to oneself. Together the two assumptions yield strategic substitutability in employment under oligopsonistic or or monopsonistic competition. Conversely, a violation of either could lead employment to exhibit strategic complementarity even in an oligopsony. For example, connected substitutes could be violated if labor supply is non-homothetic, or, in a cream skimming world where a higher wage at employer j attracts away its competitor j''s least tethered workers (for example, workers with the weakest idiosyncratic preference for j'), leaving behind more inelastic workers. The loss of elastic workers would reduce, rather than raising, j''s optimal markdown, $\mu_{j't}$.

The appendix characterizes and eliminates three mutually exclusive and exhaustive violations of the connected substitutes condition as driving the results. First, I show that when employers are not connected substitutes, but an employer's optimal markdown increases in its wage, then employment can only exhibit strategic complementarity under oligopsony if wages are strategic substitutes (i.e., employment can only rise if wages fall). In contrast, I find a decline in unshocked members' wages. Second, when employer are not connected substitutes but the optimal markdown declines in an employer's wage, then wages and employment must both either exhibit strategic substitutability or strategic complementarity. The standard cream-skimming story inhabits case one, i.e., both are strategic substitutes. An unshocked competitor who loses elastic workers can pay her inelastic workers who remain a lower wage, but must nonetheless reduce employment because she would have to increase wages to attract workers back. Employment remains analytically strategic substitutes. Alternatively, case 3 could occur if the shock alters the pool of workers accessible to unshocked members. This is largely ruled out by the observed decline in profits — since unshocked members increase employment by expanding exports to existing importers, they could, in principle, have retained their old export opportunities by maintaining lower wages and employment to earn higher profits. Instead, the decline in profits suggests a loss of access to previously higher collusive profits. Profits could decline if unshocked members no longer access their old, lower (wage, employment) combination. I rule this out by showing that unshocked members' new workers closely resemble old workers in observed characteristics. Moreover, the opposite employment effects found at unshocked members and non-members could only both be rationalized in an oligopsony model if members differentially lose access to the available pool of workers, which seems implausible given common support in member/non-member characteristics.

The downward-sloping demand assumption could be violated by external economies of scale arising from the shock. For instance, the shock could prompt shocked and unshocked members of the TEA to collaborate to negotiate cheaper input contracts. However, such renegotiations and external economies of scale are inconsistent with the observed decrease in profits among unshocked members, who could have retained their old export opportunities by maintaining lower wages and employment to earn higher profits. Instead, the decline in profits suggests a loss of access to previously higher collusive profits. Additionally, several qualitative accounts indicate that the association does not engage in collective contract negotiations (interviews).

5 Test of conduct

Although the simple comparative static test of collusion is appealing due to its minimal structure, a full structural approach enables statistically adjudicating between different models of conduct. I employ and augment the approach developed in Backus, Conlon, & Sinkinson (BCS, 2021) to test for *changes* in conduct. I make two comparisons. First, I test between continued oligopsony versus the breakdown of collusion from a single wage. Second, I test between the breakdown of collusion from a single wage versus switching to the optimal collusive scheme. Although used in this section, labor supply and production are estimated in Section 6 (counterfactuals).

5.1 Summary

The BCS approach uses exclusion restrictions to statistically arbitrate between different models of conduct, employing the idea that the true model best satisfies exclusion restrictions. It imposes structure on labor supply and production. For a given observed wage, it then backs out the implied productivity shock given any specified model of conduct. Ultimately, it identifies the model of conduct that best satisfies the following exclusion restriction—the recovered productivity shock is uncorrelated with instruments that only alter markdowns but not marginal product. BCS employ the Rivers & Vuong (2002) test to test the null hypothesis that any two models fit equally well; the model that rejects this null hypothesis is said to fit better.

I modify the BCS approach to instead uncover how conduct changes following the large demand shock studied in Section 4. Under the correctly specified change, the implied change in productivity should be uncorrelated with an instrument that only alters markdowns. In my case, the instrument for employer j is a weighted average of the demand shock at employers excluding j. The instrument only affects j's markdown by rotating its labor supply, without directing impacting j's productivity (z_{jt}). I assume the production function described in section 6: $\tilde{z_{jt}} n_{jt}^{\alpha_2}$, where z_{jt} is a product of TFP and price for employer j at time t, $\tilde{z}_{jt}$ is the modified version after plugging in optimal capital demand (capital is supplied competitively in a rental market), and n_{jt} is labor. To uncover the implied change in markdowns under various changes to conduct, I assume a three-nested CES labor supply system where workers choose in turn across locations, industries, and then employers within an industry. Section 6 describes estimation. A firm j's best response wage is given by[35]:

$$w_{jt} = \mu_{jt} mrpl_{jt}$$

Here μ_{jt} is the optimal markdown and $mrpl_{jt}$ is the marginal revenue product of labor. Totally differentiating the best response function following any change to firms in the market:

$$dlnw_{jt} = dln\mu_{jt} + dlnz_{jt} + (\alpha_2 - 1)dlnn_{jt}$$

The moment condition embodies the idea that, under the true model, $dlnz_{jt}$ is uncorrelated with an instrument that only alters markdowns:

$$M := E[dlnz_{jt} \times \sum_{j'!=j} \frac{s_{j't}}{1 - s_{jt}} 1_{shocked,j'}] = 0$$

$$M := E[[dlnw_{jt} - (\alpha_2 - 1)dlnn_{jt} - (ln\mu_{jt+1} - ln\mu_{jt,})] \times \sum_{j'!=j} \frac{s_{j't}}{1 - s_{jt}} 1_{shocked,j'}] = 0$$

[35]Step 1 of the proof of Proposition 1 shows that such a best response function characterizes a firm's optimal wage for any structure of competition and invertible labor supply system.

Here $1_{shocked,j'}$ is an indicator equal to one for establishments affected by the relocation shock and s_j is employer j 's baseline wage bill market share. The instrument is a share-weighted sum of indicators for exporting to brands affected by the Vietnam relocation shock, summed over employers excluding j.[36]

I generate an empirical analog of the moment condition. Different shifts in conduct predict different $dln\mu_{jt}$ among unshocked employers. Given that I observe $dlnn_{jt}$ and $dlnw_{jt}$, I can then recover the implied change in productivity, $dlnz_{jt}$, for each employer. I formulate a pairwise test statistic for testing between two models 1 and 2 (as in Rivers and Vuong 2002, and BCS 2021):

$$t_{1,2} := \frac{(M_1 - M_2)}{\frac{\hat{\sigma}_{1,2}}{\sqrt{n}}}$$

Here $\hat{\sigma}_{1,2}/\sqrt{n}$ is an estimate of the standard error of the difference $M_1 - M_2$; I use the observed variance $\hat{\sigma}_{1,2}$, and n equal to the number of employers. Rivers and Vuong (2002) show that $t_{1,2}$ has a standard normal distribution under the null hypothesis of model equivalence.

Tests I conduct two pairwise comparisons to test for changes in conduct among unshocked members of the industry association. First, I test between oligopsony throughout vs. switching from coordination at the minimum wage to oligopsony due to the shock. Second, the shock could conceivably shift employers closer to joint profit maximization. For example, the cartel may decide that the shock justifies bearing the fixed cost of transporting workers from a neighboring state. I thus test between switching from coordination at the minimum wage to oligopsony vs. switching to joint profit maximization. I do not test for collusion at a new wage since post-period wages among industry association members exhibit substantial dispersion.

Change in markdown Conduct determines the change in markdown ($dln\mu_{jt}$). For the continued oligopsony case, these changes fall into three categories. For employers who do not pay the minimum wage at baseline, the change in the optimal markdown is $dln\mu_{jt} = \sum_{j'} \frac{\partial ln\mu_{jt}}{\partial lnw_{j't}} dlnw_{j't}$. The appendix derives the corresponding analytical expressions when labor supply is nested CES, and employers compete in a Cournot oligopsony. For employers who previously paid a binding minimum wage, but whose wage changes following the shock, the change in the optimal markdown is $dln\mu_{jt} = ln\mu_{j,t+1}^{oligopsony}(\mathbf{s_{t+1}}) - ln\mu_{j,t}^{olig,mw} = ln\mu_{j,t+1}^{oligopsony}(\mathbf{s_{t+1}}) - 0$, where $\mu_{j,t+1}^{oligopsony}$ is the optimal Cournot oligopsony markdown implied by the post-period distribution of shares. The pre-period markdown with a binding minimum wage is simply one, i.e., workers are paid exactly their marginal product.[37] For employers who continue to pay a binding minimum wage, the difference in the optimal markdown is zero.

For the collusion to oligopsony case, the post-period markdown is simply the oligopsony mark-

[36]Even the one-time relocation shock furnishes variation in the instrument since the value of the instrument differs with employer size. Intuitively, large employers' markdowns are more responsive to others' shocks (Amiti et al. 2019, Sharma 2023).

[37]A binding minimum wage shifts employers onto their labor demand curve.

down. The pre-period markdown is $ln\mu_{jt}^{coll,mw} = lnmw_{jt} - lnz_{jt} - (\alpha_2 - 1)lnn_{jt}$. Thus, $dln\mu_{jt} = ln\mu_{j,t+1}^{oligopsony}(\mathbf{s_{t+1}}) - ln\mu_{jt}^{coll,mw}$. I use a slightly modified version of the moment condition, where I additionally assume that the shock is uncorrelated with pre-period productivity, $E[(dlnz_{jt} - lnz_{jt})I_j] = 0$, with I_j as the instrument. The change in conduct now predicts $(dlnz_{jt} - lnz_{jt})$. Under the true model, the predicted value is uncorrelated with the instrument. The assumption that the relocation shock is uncorrelated with baseline productivity is substantiated by the fact that shocked and unshocked members of the industry association closely resemble each other in baseline characteristics (Figure 8).

5.2 Results

Table 6 reports results from the pairwise comparisons. A positive value indicates the column model fits better than the row. I find that switching from collusion at the minimum wage to oligopsony fits better than either the continued oligopsony model or switching from collusion to the optimal collusive scheme.

Although Table 6 reveals the switching from collusion to oligopsony is the best-fitting model, it does not reveal how well the breakdown model fits the data. Appendix Figure A3 thus evaluates the objective fit of the breakdown model by plotting the correlation between $dlnz_{jt}$ and the instrument. This correlation should be flat under the true model, not just zero in expectation. Reassuringly, I find no correlation between $dlnz_{jt}$ and the instrument. Thus, switching from collusion at a focal point wage to oligopsony fits the data well.

6 Counterfactuals

This section develops a simple model to generate ballpark estimates on two topics. First, I quantify the wage and employment losses that accrue as a result of employers coordinating to pay the minimum wage, relative to a Cournot oligopsony where each employer independently maximizes profits, and a perfectly competitive world in which no employer exercises market power. Second, I study the effectiveness of the minimum wage as a prospective tool for anti-trust policy, asking how different increases in the minimum wage affect wages and employment.

6.1 Model

Environment The economy features a continuum of geographies $r \in [0, 1]$ (districts). Each geography has a discrete number of industries, indexed by $k \in 1, ..., M_r$, and firms within the industry $j \in 1, ..., J_m$. A measure one of workers possess heterogeneous preferences over employers. Firms demand labor under one of two possible competition structures. The first is a collusive equilibrium, where a subset of firms (the "cartel") coordinates to pay the minimum wage, while firms outside the cartel (the "fringe") choose labor to maximize profits taking as given other firms' employment choices and the cartel's behavior. By contrast, in a Cournot oligopsony, each firm chooses labor to maximize its own profits taking others' employment decisions as given. Time is discrete and indexed by t.

Labor Supply Workers possess heterogeneous preferences over employers. Each worker i chooses to work at her highest utility employer, and exhibits three-nested preferences. She first chooses a location, then an industry within the location, and finally an employer with the industry. Each worker must earn income $y_i \sim F(y)$ which is a product of hours and wages $y_i = w_j h_{ij}$. A worker's utility from working at employer j comprises a common component, rising in the wage and amenity at employer j, and an idiosyncratic preference shock specific to each employment relationship:

$$u_{ijkrt} = lnw_{jt} + lna_{jt} + lna_k + \epsilon_{ijk} \tag{5}$$

w_{jt} denotes the wage at employer j in period t, a_k denotes industry-specific amenities, and a_{jt} denotes the employer's deviation from the industry norm. ϵ_{ijk} has a nested Type I extreme value distribution. Its variance is governed by three dispersion parameters that determine the correlation of idiosyncratic draws across employers within an industry, η, across industries, θ, and across locations, λ.

$$F(\epsilon_{i1}, ..., \epsilon_{NJ}) = \exp\left[-\sum_r (\sum_{k=1}^{M} (\sum_{j=1}^{J_m} e^{-(1+\eta)\epsilon_{igjk}})^{\frac{1+\theta}{1+\eta}})^{\frac{1+\lambda}{1+\theta}}\right]$$

I obtain labor supply by aggregating the preferences of individual workers. The probability of choosing employer j is, as in nested logit (McFadden 1978):

$$p_{jt} = \underbrace{\frac{(a_{jt}w_{jt})^{1+\eta}}{\sum_{j'\in k}(a_{j't}w_{j't})^{1+\eta}}}_{prob\ of\ choosing\ firm\ j\ in\ industry\ k} \times \underbrace{\frac{a_k^{1+\theta}\left(\sum_{j\in k}(a_{jt}w_{jt})^{1+\eta}\right)^{\frac{1+\theta}{1+\eta}}}{\sum_{k'\in R} a_{k'}^{1+\theta}\left(\sum_{j\in k'}(a_{jt}w_{jt})^{1+\eta}\right)^{\frac{1+\theta}{1+\eta}}}}_{prob\ of\ choosing\ industry\ k} \times \underbrace{\frac{\bar{W}_{rt}^{1+\lambda}}{\sum_{R'}\bar{W}_{rt'}^{1+\lambda}}}_{prob\ of\ choosing\ region\ r}$$

Aggregating these probabilities over workers yields the labor supply curve to employer j:

$$n_{jkrt} = \left(\frac{w_{jkrt}^{\alpha}}{\bar{W_{krt}}}\right)^{\eta}\left(\frac{\bar{W_{krt}}}{\bar{W_{rt}}}\right)^{\theta}\left(\frac{\bar{W_{rt}}}{\bar{W_t}}\right)^{\lambda} a_{jkrt}^{1+\eta}a_k^{1+\theta}N_t$$

Here $\bar{W_{krt}} = (\sum_{j\in k} a_{jkrt}w_{jkrt}{}^{1+\eta_g})^{\frac{1}{1+\eta_g}}$ is the amenity-adjusted group-specific wage index for industry k in region r, $\bar{W_{rt}}$ is the wage index of region r, and $\bar{W}_t$ is the aggregate wage index. The bars indicate that these expressions also include amenities. N_t is aggregate labor supply.

Relatively high wages and amenity employers attract more workers—labor supply to an employer is increasing in its wage and amenity relative to the industry, and in the industry's wage index relative to the geography. Since the counterfactual considers a Cournot solution concept, where firms choose employment taking their inverse labor supply curves as given, I define it here,

$$w_{jkrt} = \left(\frac{n_{jkrt}}{N_{krt}}\right)^{\frac{1}{\eta}} \left(\frac{N_{krt}}{N_{rt}}\right)^{\frac{1}{\theta}} \left(\frac{N_{rt}}{N_{t}}\right)^{\frac{1}{\lambda}} \bar{W}_t \tag{6}$$

Production Firms operate a value-added production function that uses inputs of capital k_{jt} and labor n_{jt}:

$$y_{jt} = z_{jt}(k_{jt}^{1-\gamma} n_{jt}^{\gamma})^{\psi} \quad , \gamma \in (0,1) \ , \ \psi < 1$$

z_{jt} is a product of TFP and price. For now, I abstract from product market power and assume that firms are price takers in the product market. Capital is rented in a perfectly competitive market at rental rate R_t. For any choice of labor, I derive optimal capital demand as a function of n, z, and parameters alone. I plug this optimal capital choice into all future expressions, to define production in terms of labor alone $\tilde{y}_{jt} = \tilde{z}_{jt}\tilde{n}_{jt}^{\tilde{\psi}}$.

Labor Demand: Cournot Oligopsony If firms compete in a Cournot oligopsony, they maximize profits by choosing the number of workers to hire taking their competitors' employment decisions as given. The first order condition is:

$$\frac{\partial y_{jt}}{\partial n_{jt}} = w_{jt} \underbrace{\left(1 + \frac{1}{e_{jt}}\right)}_{\mu_{gjt}^{-1}} \tag{7}$$

e_{jt} is the elasticity of the firm's residual labor supply curve. Under nested logit preferences, the elasticity of labor supply has a closed form solution that depends only on a firm's payroll share s_{jkrt}, and the industry's share s_{krt} in each market r:

$$e_{jt} = \left[\frac{1}{\eta} + \left(\frac{1}{\theta} - \frac{1}{\eta}\right) s_{jkrt} + \left(\frac{1}{\lambda} - \frac{1}{\theta}\right) s_{jkrt} s_{krt}\right]^{-1} \tag{8}$$

Labor Demand: Collusion Under collusion, a cartel emerges to pay the minimum wage. The cartel endogenously evolves to only comprise firms that benefit from collusion at the minimum wage, while fringe firms can pay wages different from the minimum. The cartel engages in a two-period Bertrand game, where each period spans six months. The cartel rewards members for paying the minimum wage in the first period by continuing to stick to the minimum wage in the second period. In contrast, it punishes deviations above the minimum wage by switching to oligopsony in the second period. The cartel is defined as firms for which collusive profits exceed both oligopsony profits ($\Pi_{mw} > \Pi_{olig}$), and the gain from deviation ($2\Pi_{mw} > \Pi_{dev} + \Pi_{olig}$), where profits are determined in equilibrium. Each cartel firm's strategy is to pay the minimum wage as long as other cartel members pay the minimum, and, otherwise, to pay oligopsony wages. Fringe firms maximize their own profits, by choosing the wage to pay taking other firms' behavior as given.

Labor supply and firm profits are then determined in equilibrium. Fringe firms have first order conditions that resemble equation (7). By contrast, cartel members only hire as many workers as are willing to work there at the minimum wage:

$$n_{jt|cartel} = \left(\frac{mw}{\bar{W_{kt}}}\right)^{\eta} \left(\frac{\bar{W_{kt}}}{\bar{W_{rt}}}\right)^{\theta} \left(\frac{\bar{W_{rt}}}{\bar{W_t}}\right)^{\lambda} N_t$$

The cartel thus depresses both wages and employment to increase profits.

Three caveats are worth highlighting. First, per the Folk Theorem, several alternative collusive schemes are feasible. Section 6.3 discusses the implications of different punishment strategies for conclusions. Second, I assume that the minimum wage only serves as a coordination device and is otherwise imperfectly enforced. That half of all workers in the garment industry earn below the minimum wage substantiates its imperfect enforcement (Figure 2). Still, Section 6.3 details the impact of enforcement on conclusions. Finally, I assume that the cartel only coordinates at the minimum wage and at no other wage. This assumption reflects a key institutional feature of the garment industry, namely, that foreign buyers enforce compliance with the minimum wage.[38] Foreign-buyer-induced enforcement of the minimum wage generates interesting implications for minimum wage policy, which are discussed in Section 6.3 below.

6.2 Estimation and Mechanics

I now turn to studying the wage and employment consequences of coordination, and the effect of counterfactual policies that raise the minimum wage. Determining the counterfactual distribution of wages and employment requires four key ingredients. First, I estimate the labor supply system, parameterized using the nested logit framework outlined in Section 6.1. Second, I estimate the underlying distribution of productivity across firms (z_{jt}). Third, labor demand is determined either by the collusive equilibrium concept or a Cournot oligopsony. Finally, I estimate or calibrate other necessary parameters in the production function (α,γ), and upper-level labor supply (φ,$\bar{\varphi}$). Table 7 summarizes all requisite parameters.

Labor Supply I estimate the nested logit labor supply system using standard techniques in the literature (Berry, Levinsohn, Pakes 1995, Nevo 2001). To recap, a worker i's utility from working at employer j is given by:

$$u_{ijkrt} = lnw_{jt} + lna_j + lna_k + lna_{jt} + \epsilon_{ijk}$$

where w_{jt} is the wage at employer j, a_k is a time-invariant industry-specific amenity, a_j is the employer's deviation from this industry norm, and a_{jt} is an unobservable time-specific amenity shock. The share of workers choosing employer j and industry k are, respectively:

[38] Interestingly, my estimates indicate that single collusive wage that would maximize the joint sum of profits is below the minimum. However, foreign buyers' enforcement of the minimum justify its use as a focal point.

$$s_{jkrt} = \frac{(a_j a_{jt} w_{jt})^{1+\eta}}{\bar{W_{kt}}^{1+\eta}} \times \frac{a_k^{1+\theta} \bar{W_{kt}}^{1+\theta}}{\bar{W_{rt}}^{1+\theta}} \times \frac{\bar{W}_{rt}^{1+\lambda}}{\bar{W}_t^{1+\lambda}}, \quad s_{krt} = \frac{a_k^{1+\theta} \bar{W_{kt}}^{1+\theta}}{\bar{W_{rt}}^{1+\theta}} \times \frac{\bar{W}_{rt}^{1+\lambda}}{\bar{W}_t^{1+\lambda}}$$

I leverage variation in s_{jkrt} and s_{krt} over time to estimate demand parameters (η, θ, a_j, a_k). Employer-specific amenities a_j are captured by employer fixed-effects, and industry-specific amenities a_k by industry-fixed effects.

$$\begin{aligned} lns_{jkrt} = & \underbrace{(1+\eta)lna_j}_{employer\ fixed\ effect} + (1+\eta)w_{jt} + \underbrace{(1+\theta)lna_k}_{industry-FE} + (1+\theta)lnW_{kt} + \underbrace{(1+\lambda) - (1+\theta))lnW_{rt} - (1+\lambda)W_t}_{state-time-FE} \\ & + (1+\eta)lna_{jt} \end{aligned}$$

I use the importer-induced demand shocks described in Section 4 and local industry-specific minimum wage changes as instruments for the wage. The premise identifying the required parameters is that these shocks are uncorrelated with a_{jt}. The moment condition is, therefore, $E[a_{jt}\mathbf{z_{jt}}] = 0$, where $\mathbf{z_{jt}}$ denotes the vector of instruments. Estimation is achieved by inverting the observed shares and imposing the exclusion restriction. In other words, for a candidate set of parameters (η, θ, a_j, a_k), a_{jt} is set to minimize the difference between observed shares $lns_{jt,observed}$ and model-implied shares $lns_{jt,implied}$. The estimated parameters $(\hat{\eta}, \hat{a_j}, \hat{\theta}, a_k)$ minimize the empirical analog of the following moment conditions:

$$\hat{\mathbf{G}} = \frac{1}{N_{jt}} \sum_{j,t} \hat{a_{jt}} \mathbf{z_{jt}^D}$$

Table 3 reports estimates. I estimate $\hat{\eta}$ equal to 3.5, and $\hat{\theta}$ equal to 1.1. I calibrate the cross-location elasticity from Sharma (2023), $\hat{\lambda} = 0.03$.[39] Using a more standard instrumental variables strategy to estimate labor supply parameters yields very similar estimates to the BLP approach (see strategy in Sharma 2023).

Productivity distribution I employ indirect inference to obtain the underlying distribution of productivity across employers. In particular, I assume that productivity z_{jt} follows a log-normal distribution with mean 1 and standard deviation σ. I assume that the large shock fully dismantles collusion, and precipitates a Cournot oligopsony equilibrium. σ can then be calibrated as the productivity dispersion that rationalizes the post-large-shock concentration found in the textile industry, measured via the wage bill Herfindahl Hirschmann Index HHI_{kr}. Specifically, I run the oligopsony model for various candidate values of σ, and choose the one that best matches the observed post-shock HHI. One caveat to this indirect inference approach is that the post-period market shares of employers reflect not just their pre-period distribution of productivity, which I need for the coun-

[39] The low estimate of λ is consistent with a series of studies which find that workers exhibit limited geographic mobility even in the face of large shocks that adversely affect their local labor markets (e.g. Autor et al. 2013, Dix-Carneiro & Kovak 2013, Sharma 2023).

terfactual exercises, but, rather, this productivity plus the shock itself. To mitigate this concern, I replicate the empirical shock in the model by randomly assigning 13% of firms with a 25pp price shock. I then estimate σ to reflect the post-period distribution of productivity minus this shock. I calibrate the productivity shifter Z to match the average wage in the textile industry (described in the Appendix).

The indirect inference approach assumes that the large shock precipitated a full breakdown of collusion, which may be a strong assumption. Although the test of conduct reveals that the full breakdown model best fits the data (Section 5), I employ a second approach to back out the productivity distribution of productivity that does not assume a full breakdown. Specifically, I employ an approach analogous to Carrillo et al. (2024), using the demand shock to back out the distribution of marginal products across employers, and, hence, productivity. The approach only relies on taking a first order Taylor expansion around the production function without imposing conduct in the pre or post-period, or labor supply.

Other parameters I calibrate other necessary parameters. I calibrate decreasing returns to scale α to Berger et al. (2022). I calibrate the exponent on labor γ to match the labor share. The Frisch elasticity, φ, is calibrated to Berger et al. (2022). Finally, I calibrate the disutility of labor $\bar{\varphi}$ to match the average firm size in the market (described in the Appendix).

Untargeted moments As a first diagnostic statistic, the calibrated model closely replicates the share of workers who are paid the minimum wage, 41% in model, compared to 46% in the data.

Mechanics I make a few simplifying assumptions. I assume away establishment-specific amenities a_j that deviate from industry norms. I restrict counterfactuals to the five major industries that employ the largest number of workers: the manufacturing of textiles and clothing, food and beverage products, metal products, machinery, and automobiles. Together these industries employ over 15% of the formal labor force.

For each counterfactual, I quantify its effect on the average wage and total employment in the garment sector. Unlike estimation, counterfactuals require solving the model. I solve for two fixed points: an upper-level industry share and lower-level within-industry share. For the counterfactual that quantifies the wage and employment losses due to collusion, I induce cartel members to independently maximize profits in a Cournot oligopsony, instead of coordinating at the minimum wage. The average wage rises for two reasons. As collusion dismantles, many cartel members raise wages above the minimum. A few, those who were least productive to begin with, slightly reduce wages. On balance, however, the first effect far outweighs the second, and the average garment wage rises. Higher wages in the cartel also induce upward wage pressure on fringe employers. As workers substitute from non-members to wage-enhancing members, the formers' shares decline. Non-members face more elastic labor supply (equation 8), which causes them to raise wages and workers to reallocate across garment employers (lower-level fixed point). This yields a new wage index for each industry and upper-level industry share; I solve until a fixed point in upper-level industry shares.

Switching to oligopsony also increases employment in the garment industry—higher wages draw workers in from other industries (governed by θ), other geographies (governed by λ), and from unemployment (governed by φ).

My second set of policy counterfactuals study the effect of increasing the minimum wage, of Rs.8170 per month, by 10%, 50%, and 100% of its existing value. A final counterfactual increases the minimum wage to a "living wage" of Rs.33,920 per month, as advocated by the Asia Floor Wage Alliance. As the minimum wage rises, the cartel changes composition. New, productive establishments enter, who now find it profitable to collude at the minimum wage. Some existing members, who were least productive to begin with, no longer find collusion profitable and, thus, exit. Changes to cartel composition alter wages in the garment industry, thereby altering employer and industry shares. As before, I solve for upper and lower level fixed points in shares.

6.3 Results

Collusion versus Cournot oligopsony To study the wage and employment losses accruing due to collusion, I calculate their counterfactual values if employers instead operated in a Cournot oligopsony. I find that switching from collusion to Cournot oligopsony increases the average garment worker's wage by 9.6% (Figure 14). The average wage rises for two reasons—First, as collusion unravels, the majority of cartel members increase their wage above the minimum. However, a few firms, that were initially the least productive, slightly reduce wages. Intuitively, these firms previously benefited from wage suppression at highly productive firms. Facing less intense competition in the collusive world, they could earn higher profits by paying more and hiring more workers than in a more-competitive oligopsony. On balance, however, the first effect far outweighs the second, and the average worker at former cartel members earns 15.2% more. Higher wages in the cartel also induce upward wage pressure on other, fringe employers. Overall, the average garment worker's wage rises 9.6% under oligopsony compared to collusion.

Employment in the garment sector also increases by 17%. Higher wages at garment factories attract new workers from other industries (governed by θ), other geographies (governed by λ), and unemployment (governed by Frisch elasticity φ). Of the total effect, roughly one-fifth represent transitions from unemployment.

Finally, oligopsony is more efficient than collusion. Because the largest and most productive firms were previously cartel members, their expansion increases productive efficiency in the garment sector. I define aggregate productivity as the ratio of realized to potential output ($\Omega = Y_{realized}/Y_{potential}$). Potential output is achieved when no employer exercises her market power, and workers are allocated according to productivity alone. Switching from collusion to oligopsony increases Ω by 4.3%.

A caveat to these conclusions is that I assume that the cartel punishes deviations in the first period with oligopsony for six months. Although the simple two-period model does not feature shocks, the punishment period is based on observing that a large fraction of firms return to paying the minimum wage six months after the relocation shock. A more (less) severe punishment strategy would, instead, imply larger (smaller) losses from collusion. For example, a better enforced cartel could reduce the deviation profit to $\Pi_{dev} + \Pi_{olig} - punishment$. More productive firms, with higher $\Pi_{dev} + \Pi_{olig}$, would now also enter the cartel, thereby reducing wages and employment more than in a world without *punishment*. The analysis does not yet consider firms' anticipation of future shocks, which may cause collusion to dismantle even absent deviations in the first period, thereby rendering collusion harder to sustain. This is ongoing.

In sum, I find that coordination at the minimum wage induces substantial wage, employment, and productivity losses in the garment industry, even compared to a world wherein each firm exercises it own—but not their collective—market power. Dismantling collusion would increase the average wage in the garment industry by 9.6%, increase employment by 17%, and increase productive efficiency by 4.3%.

Minimum wage as a tool for anti-trust policy Given that paying the minimum wage is entirely legal, it is hard to imagine how traditional anti-trust policies could dismantle the type of collusion evidenced in this paper. For example, neither breaking up large firms nor targeting concentration would work. If anything, collusion implies lower concentration than oligopsony since collusive firms coordinate to pay the minimum wage, thereby compressing firm size more than if they were paying wages more commensurate with their productivity (e.g. as under oligopsony).

However, my findings suggest that minimum wage hikes could potentially help combat market power. If employers coordinate to pay the minimum wage, then the government could raise wages, employment, and efficiency by raising the minimum wage. I study four policies. The first three raise the current monthly minimum wage, of Rs.8170, by 10%, 50%, and 100% respectively. The final policy increases the minimum wage to a monthly living wage of Rs.33,920, proposed by the NGO Asia Wage Floor Foundation.

Figure 14 reports results. I find that a 10% increase in the minimum wage increases the average garment worker's wage by 13.6% and raises employment by 15.6%. As previously noted, these numbers reflect gains among both members and fringe employers. Interestingly, I find that a 50% minimum wage hike outperforms oligopsony in its positive impact on wages and employment. It raises the average wage by 32% and employment by 23%. This occurs because highly productive firms now also profit from colluding at the higher wage. Facing less intense competition from their productive counterparts, less productive firms raise wages and employment above a more-competitive oligopsony. The gains from raising the minimum wage, do, however, diminish after a point, and the 100% increase performs worse than oligopsony. It increases the average wage by 40%, but only raises employment 12%.

Finally, I find that the proposed monthly living wage of Rs.33,920 cannot sustain collusion. The Asia Floor Wage Alliance proposed this living wage as a means to cover basic living expenses for a family of four members, covering daily food expenses worth 3000 calories, and an equivalent amount of non-food expenses. Under my assumptions, namely, that employers can only coordinate at the minimum and no other wage, and that the minimum wage is not legally enforced, the living wage cannot sustain collusion. It precipitates a switch to oligopsony.

Enforcement My conclusions rest on two assumptions. First, I assume that the minimum wage only serves as a coordination device and is otherwise imperfectly enforced. That half of all workers in the garment industry earn below the minimum substantiates its imperfect enforcement (Figure 1). Second, I assume that employers can only coordinate at the minimum and at no other wage.[40] This second assumption reflects an important institutional feature of the garment industry, namely, that foreign buyers enforce compliance with the minimum wage. Prominent brands such as Zara and Nike regularly audit their suppliers to enforce compliance with local labor regulation, including the minimum wage (e.g. via audit agencies like SEDEX). Indeed, non-compliance with labor regulations in Vietnam is exactly what precipitated the large demand shock studied in this paper (Section 4).

Foreign buyers' enforcement of the minimum wage yields two competing implications for minimum wage policy. On the one hand, if establishments can only access lucrative export orders when they pay the minimum wage, then policy can potentially sustain a higher minimum wage than my estimates suggest (since fewer establishments leave the cartel when the minimum wage rises). However, importers may instead exhibit elastic demand, such that increasing the minimum wage reallocates production from high-cost minimum wage factories, to low-cost non-compliers. Future work will investigate the relative strength of these competing forces, and their implications for minimum wage policy.

7 Conclusion

This paper evidences collusion among employers in the Indian textile and clothing manufacturing industry. I show that local industry associations in the sector operate as cartels, coordinating to pay workers exactly the minimum wage. Its use as a focal point essentially renders the minimum wage a maximum wage in the garment industry. I find that while members forego small export opportunities to stick to the minimum wage, non-members cater to higher demand by raising their wages to hire more workers, consistent with non-cooperative models of market power. Developing a simple comparative static test to diagnose collusion, I show that a large demand shock that leads affected industry association members to raise wages spills over onto unshocked non-members as in oligopsony (by $\uparrow$ their wages and $\downarrow$ employment), but onto unshocked members as if it dismantles collusion (by $\uparrow$ their wage and $\uparrow$ employment).

Collusion at the minimum wage induces significant wage and employment losses, even relative to an imperfectly competitive world wherein each firm exercises its own, but not their collective, market power. Switching to a Cournot oligopsony would increase the average garment worker's wage by 9.6%, and increase employment in the garment industry by 17%.

A surprising conclusion of my findings is that minimum wage hikes can outperform oligopsony in their positive impact on wages and employment. Despite its limited legal enforcement, the minimum wage's use as a focal point implies that higher minimum wages can catalyze coordination at higher wages. Productive firms now also find it profitable to collude at a higher minimum wage, suppressing

[40] For example, I find that the "optimal" single collusive wage that maximizes the joint sum of profits is lower than the minimum wage.

their wages and employment to do so. Facing less intense competition, less productive firms raise wages and employment above oligopsony.

Why do employers collude to pay the minimum wage and not a different wage? One important driver is that foreign buyers enforce compliance with the minimum wage via regular audits. For example, brands such as Zara, Nike, and Gap regularly audit their supplier factories (e.g. through audit agencies like SEDEX) to ensure compliance with local labor regulation, including paying the minimum wage. Enforcement by foreign buyers yields competing policy implications. On the one hand, policy could sustain a higher minimum wage if firms can only access lucrative export opportunities when paying the minimum wage (since fewer firms would drop out of the cartel when the minimum wage rises). On the other hand, policy could sustain a lower minimum wage if export demand is elastic, such that higher minimums cause importers to reallocate production from high-cost, minimum-wage factories to low-cost, non-compliant factories, or even abroad. Ongoing work studies the implications of these forces for minimum wage policy.

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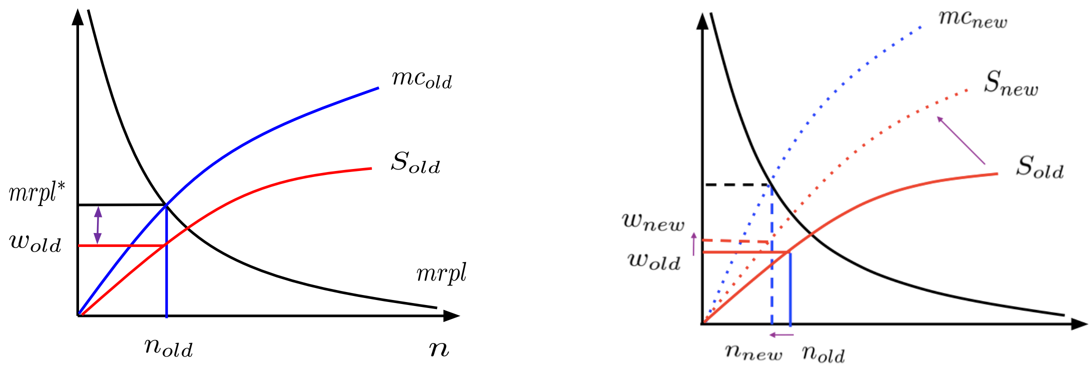
Figures

Figure 1: Spillover Test

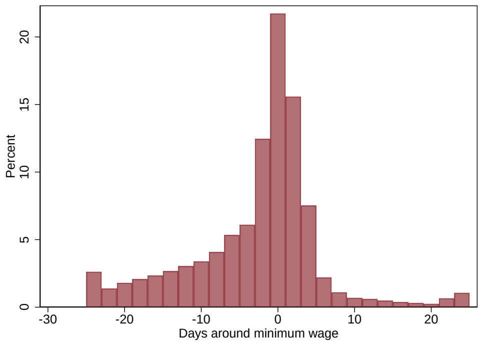
(a) Firm optimization in oligopsony/monopsony (b) Spillover, left rotation of labor supply



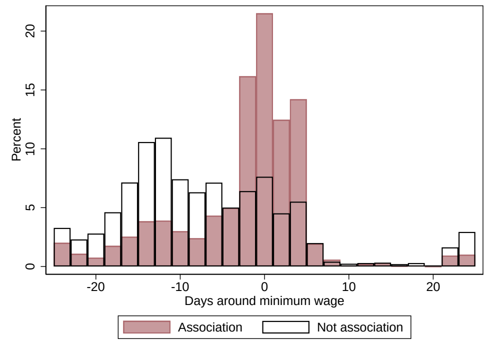
Notes: The left panel plots the optimization problem of an oligopsonistic or monopsonistic firm, and the right panel plots the spillover effect of a positive demand shock to its competitor. The shock reduces labor supply to the unshocked competitor, thereby rotating her labor supply curve left. She moves up her demand curve, increasing wage and reducing employment. Diminishing marginal revenue product of labor (Assumption 2) yields downward sloping demand. Invertible labor supply, i.e., employers are not perfect substitutes, yields upward-sloping labor supply to individual employers. Connected substitutes (Assumption 1) implies that, when one's shocked competitor increases their wage, labor supply to an unshocked competitor declines.

Figure 2: Bunching at the minimum wage

(a) Wage distribution in the garment industry



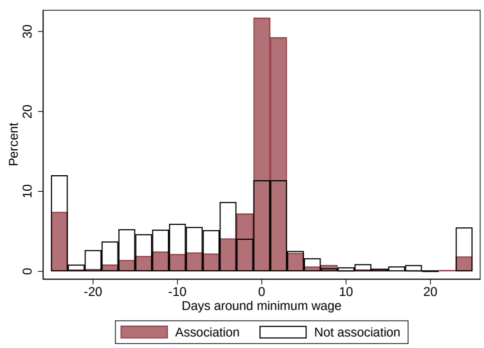
(b) Wage distribution, by association membership



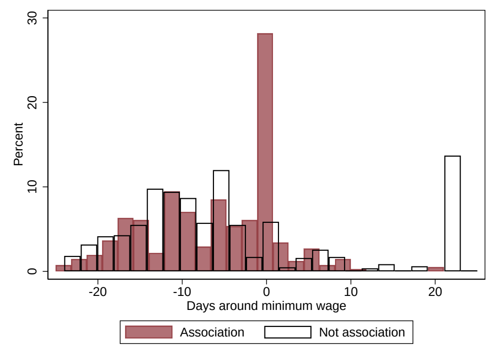
Notes: This figure plots the distribution of wages across all formal workers in the garment industry in India, calculated in denominations of days around the local semi-skilled minimum wage. For example, a value of one on the x-axis signifies that the worker is paid one day above the minimum wage for semi-skilled workers in their state. Panel A plots the distribution of all wages, and Panel B instead plots wages separately for workers employed at employers who are members and non-members of industry associations. For all workers employed between January 2015 and July 2015, I calculate and plot their average monthly wage during this period.

Figure 3: Bunching at the minimum wage across locations

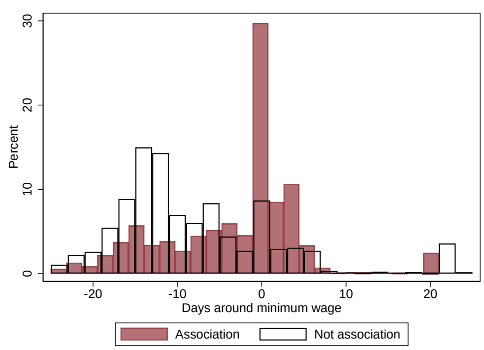
(a) Karnataka



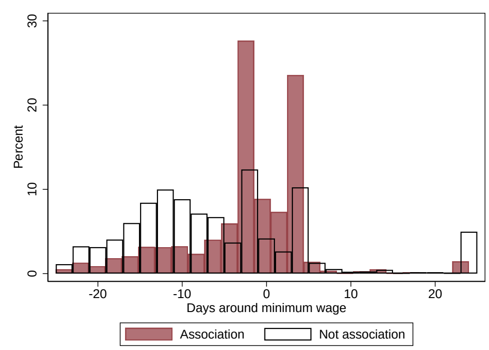
(b) Tamil Nadu



(c) Haryana



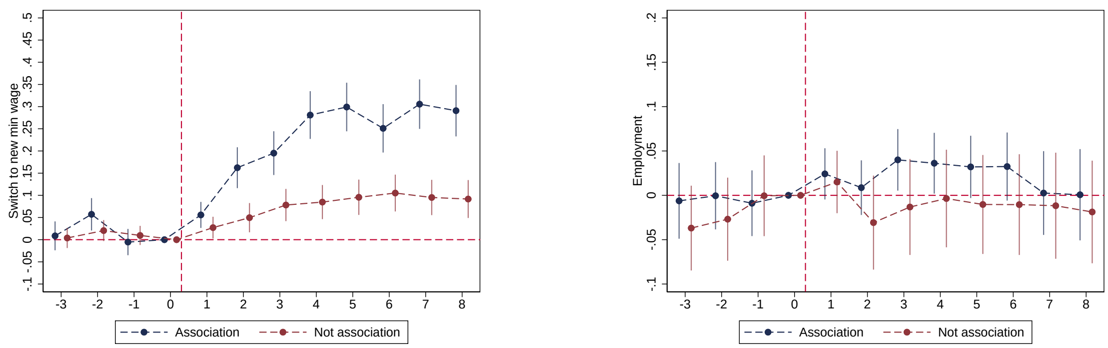
(d) Uttar Pradesh



Notes: This figure plots the distribution of wages for formal workers in the garment industry across four large centers of garment manufacturing in India: Karnataka, Tamil Nadu, Haryana, and Uttar Pradesh. Together these states account for x% of employment in the Indian garment industry. This figure is identical to Panel B of Figure 2, only splitting the distribution across the four states.

Figure 4: Effect of minimum wage increases on wages and employment

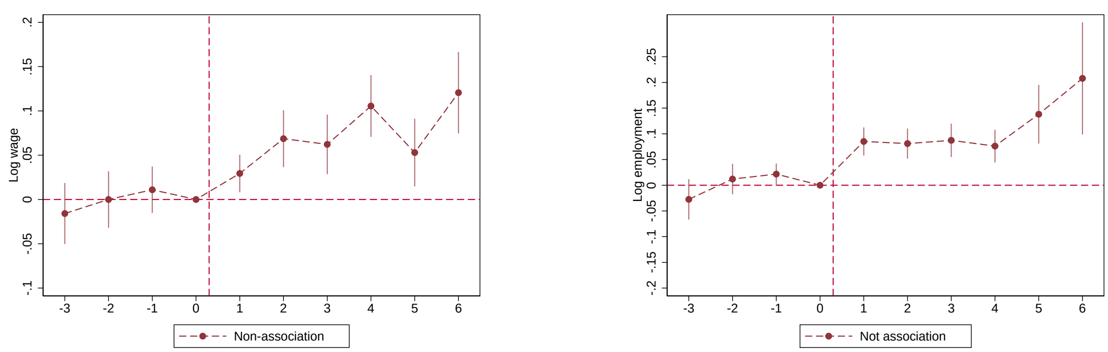
(a) Pay new minimum wage (b) Log employment



Notes: This figure plots results from the stacked event study specification described in equation (2). It plots estimates of the β_k coefficients for $k \in [-3, 8]$ (with $k = -1$ omitted. Each event corresponds with a large increase in the minimum wage, of at least 7.5% (or 2 days) over its previous value. For each event, the treated group comprises employers in the state where the minimum wage hike occurs, and the comparison group comprises employers in all other states that do not increase their minimum wage. The outcome in Panel A is a dummy variable equal to one if the modal wage at an establishment is within two days of the new semi-skilled minimum wage, and in Panel B is total employment. Confidence intervals at a 95% level are reported. Standard errors are clustered at the establishment level.

Figure 5: Effect of routine (small) demand shocks on non-members

(a) Log wage (b) Log employment

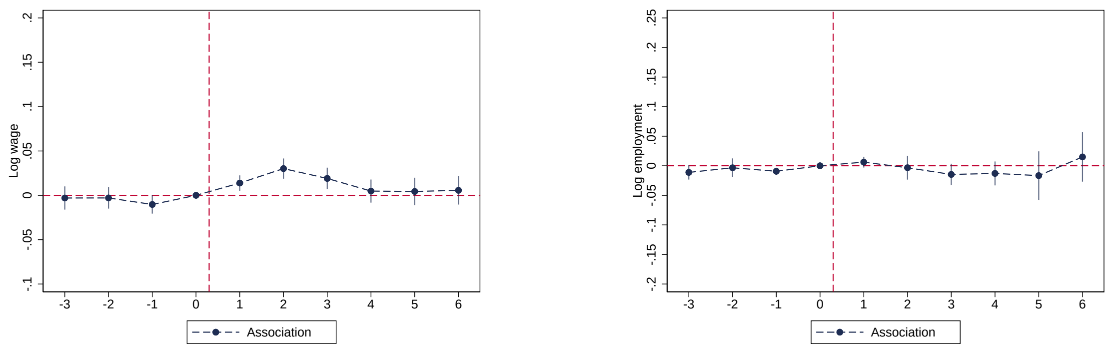


Notes: This figure plots the effect of routine firm-specific demand shocks on the log wage and employment of establishments that are not members of industry associations. It plots estimates of the β_k coefficients for $k \in [-4, 6]$ months around the shock (with $k = -1$ omitted). A firm-specific demand shock is defined using a leave-state-out measure of price increases for imports to an employer's chief importer. A shock occurs whenever the price of imports to an establishment's chief importer from all exporters outside its state increases by at least 10% between two peak export seasons. I define $k = 0$ as occurring three months prior to exports. The outcome in Panel A is the log of the modal wage at an establishment and in Panel B is the log of employment. Confidence intervals at a 95% level are reported. Standard errors are clustered at the establishment level.

Figure 6: Effect of routine (small) demand shocks on industry association members

(a) Log wage

(b) Log employment



Notes: This figure plots the effect of routine firm-specific demand shocks on the log wage and employment of establishments that are members of industry associations. It plots estimates of the β_k coefficients for $k \in [-4, 6]$ months around the shock (with $k = -1$ omitted). A firm-specific demand shock is defined using a leave-state-out measure of price increases for imports to an employer's chief importer. A shock occurs whenever the price of imports to an establishment's chief importer from all exporters outside its state increases by at least 10% between two peak export seasons. I define $k = 0$ as occurring three months prior to exports. The outcome in Panel A is the log of the modal wage at an establishment and in Panel B is the log of employment. Confidence intervals at a 95% level are reported. Standard errors are clustered at the establishment level.

Figure 7: Impetus for relocation shock

Audits uncover rights violations

- **Wage theft**
- **Pregnancy discrimination**
- **Forced overtime**
- **Illegal restrictions on access to toilets**
- **Illegal recruitment fees**
- **Health and safety violations**

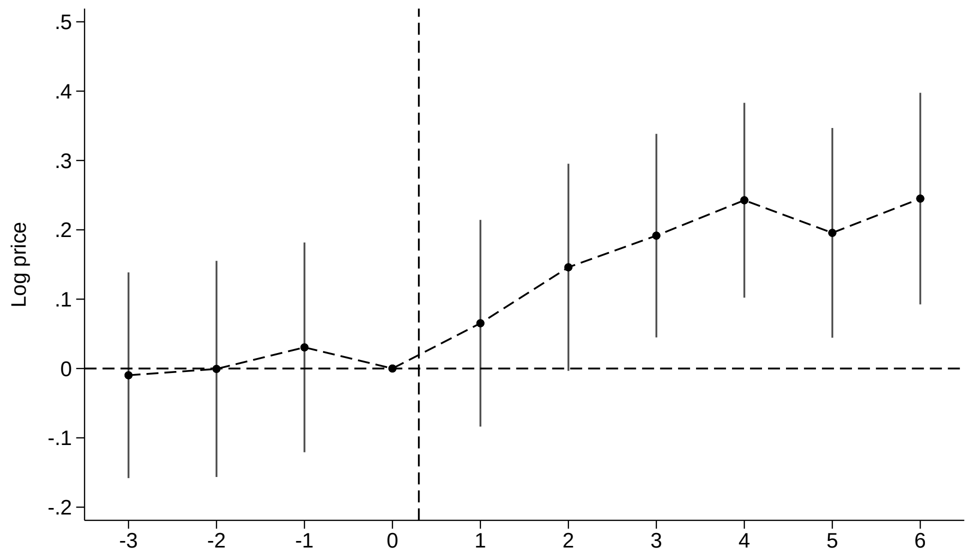
Affected brands

Audit Number	Buyer (Brand or Retailer)
1.	Pink/VSS/VSD
2.	Costco buyer
3.	Canadian buyer
4.	Hanes
5.	The Children's Place
6.	MGF
7.	Amazon
8.	Express
9.	Macy's
10.	Polo
11.	Hanes
12.	Nike
13.	Polo
14.	Kohl's
15.	Zara/Inditex
16.	Aero
17.	JC Penny
18.	Nike
19.	Gap, Nike, Target, Walmart
20.	Gap
21.	Canadian buyer
22.	Kasper
23.	Gill
24.	Express
25.	J-Crew
26.	Gill/Ascena/Dressbarn

Notes: This figure shows the rights violations discovered by the Worker Rights Consortium at Hansae Vietnam. The right panel reports the set of affected brands.

Figure 8: Effect of large relocation shock on prices

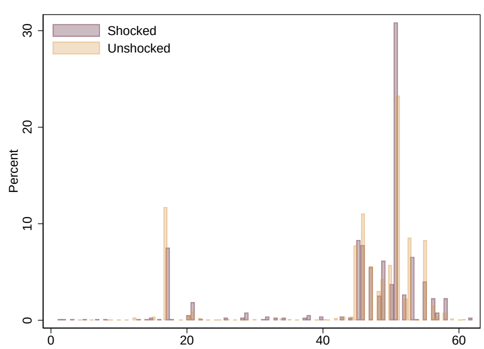
(a) Log price



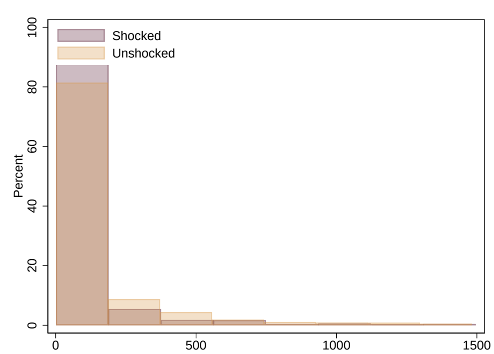
Notes: This figure plots the effect of the relocation shock from Vietnam – which led several prominent brands to temporarily relocate production to India – on the prices of affected and unaffected exporters. Affected exporters are those whose largest volume of exports was to one of the affected brands. Unaffected exporters are those whose largest volume of exports was to one of the unaffected brands. The figure plots an establishment-level DiD event study, comparing the log price of exports at affected versus unaffected exporters. Confidence intervals at a 95% level are reported.

Figure 9: Baseline characteristics of affected and unaffected industry association members

(a) HS-6 code of main export



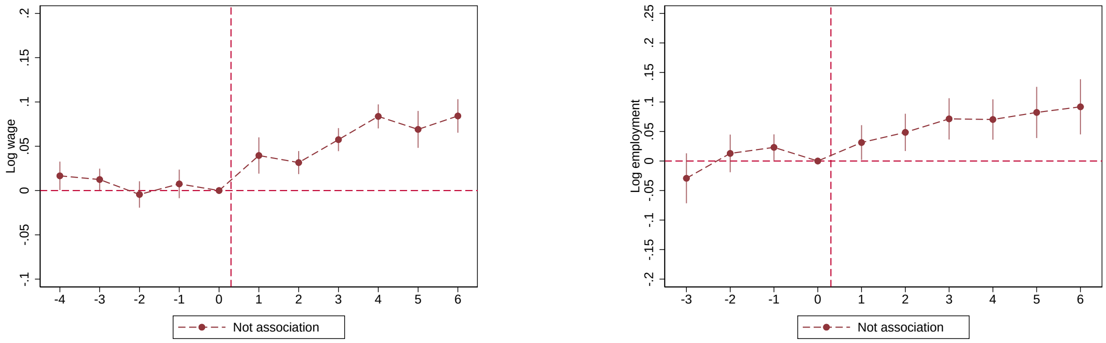
(b) Size



Notes: Panel A plots the distribution of the main 6-digit HS code product exported by affected and unaffected members of the industry association at baseline. The main export is defined as the highest value exported product. Panel B plots the distribution of establishment sizes for the two sets of employers.

Figure 10: Effect of large shock on affected non-members

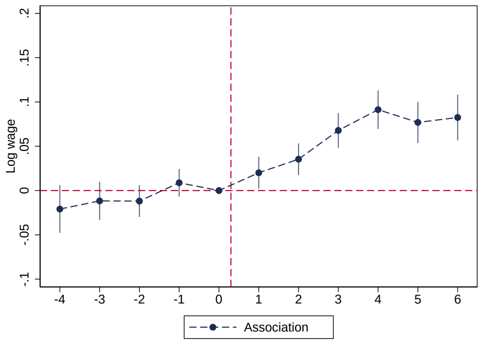
(a) Log wage (b) Log employment



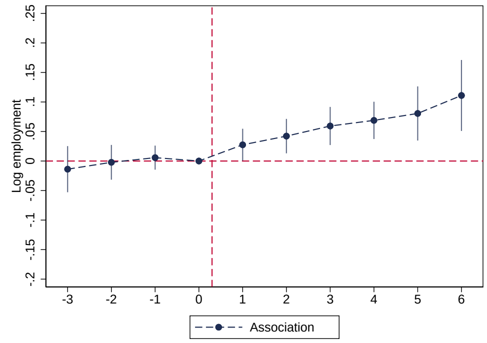
Notes: This figure plots the effect of a relocation demand shock on the log wages and employment of affected employers outside the industry association. The shock led several leading brands to temporarily relocate production to Indian manufacturers. The shock affected 14% of employers in total, and 13% of members of the industry association. The figure plots estimates of the β_k coefficients in equation 2 for $k \in [-4, 6]$ months around the time of the shock (with $k = -1$ omitted). $k = 0$ occurs three months prior to exports. The outcome in Panel A is the log of the modal wage at an establishment, and in Panel B is the log of employment. Each specification includes establishment fixed effects, comparing establishments to their $t = -1$ value. I report 95% confidence intervals. Standard errors are clustered at the establishment level.

Figure 11: Effect of large shock on affected industry association members

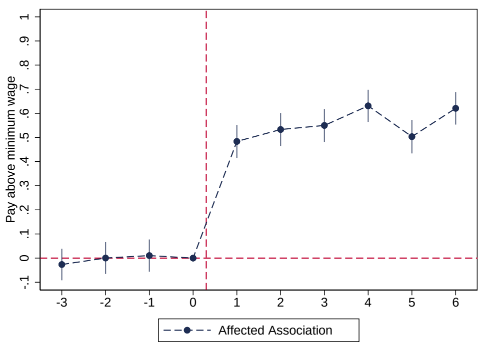
(a) Log wage



(b) Log employment



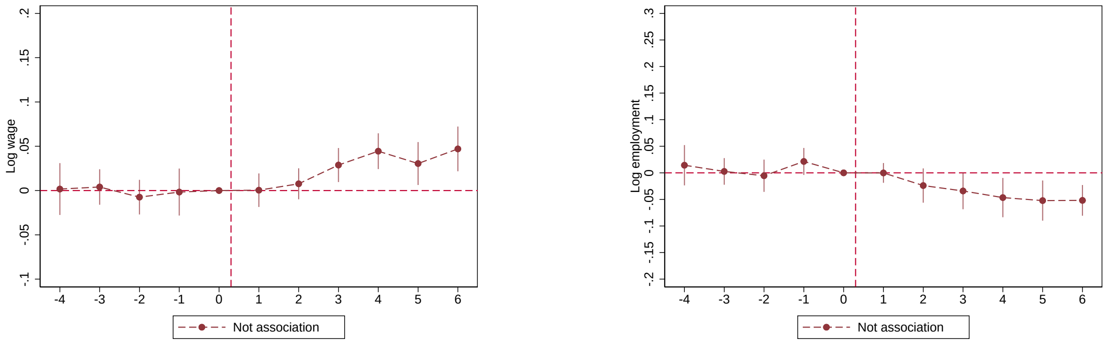
(c) Pay above the minimum wage (indicator)



Notes: This figure plots the effect of a relocation demand shock on the log wages and employment of affected members of the industry association. The shock led several leading brands to temporarily relocate production to Indian manufacturers. The shock affected 14% of employers in total, and 13% of members of the industry association. The figure plots estimates of the β_k coefficients in equation 2 for $k \in [-4, 6]$ months around the time of the shock (with $k = -1$ omitted). $k = 0$ occurs three months prior to exports. The outcome in Panel A is the log of the modal wage at an establishment, in Panel B is the log of employment, and in Panel C is an indicator equal to one for paying above the minimum wage. Each specification includes establishment fixed effects, comparing establishments to their $t = -1$ value. I report 95% confidence intervals. Standard errors are clustered at the establishment level.

Figure 12: Spillover effects on unaffected non-members

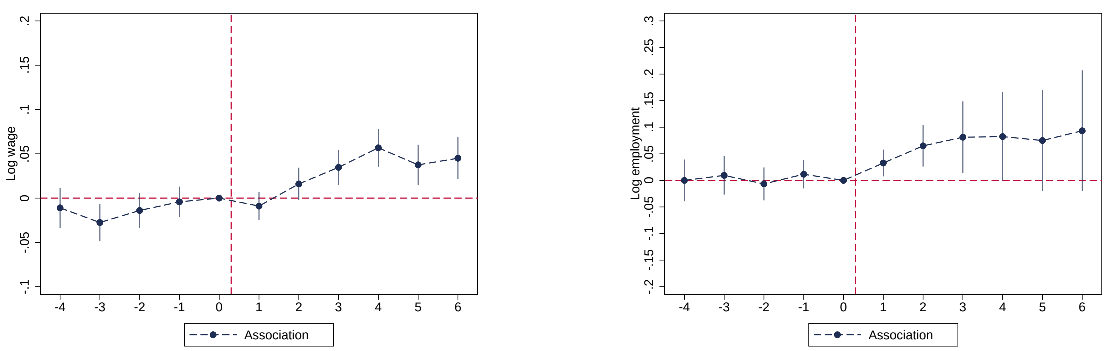
(a) Log wage (b) Log employment



Notes: This figure shows spillover effects on unaffected employers outside the industry association. These employers respond in ways consistent with oligopsony–by increasing their wage and reducing employment. The figure plots estimates of the β_k coefficients in equation 2 for $k \in [-4, 6]$ months around the time of the shock (with $k = -1$ omitted). $k = 0$ occurs three months prior to exports. Panel A shows effects on the log of the modal wage at an establishment, and Panel B shows effects on the log of employment. Confidence intervals at a 95% level are reported. Standard errors are clustered at the establishment level.

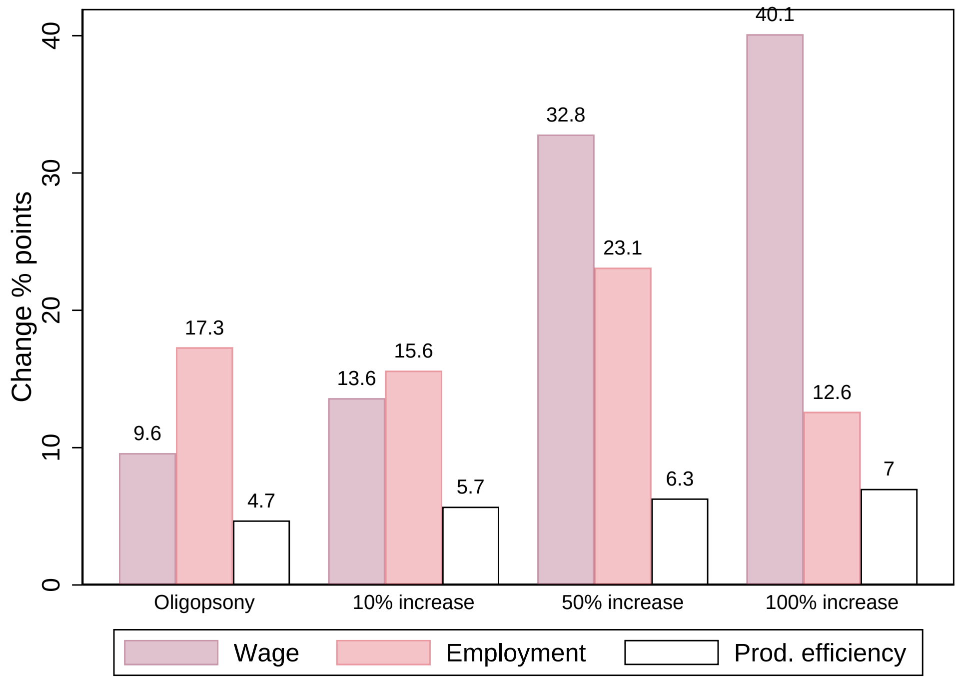
Figure 13: Spillover effects on unaffected members of the industry association

(a) Log wage (b) Log employment



Notes: This figure shows spillover effects on unaffected members of the industry association. These employers respond, on average, in ways consistent with the breakdown of collusion–by increasing their wage and increasing employment. The figure plots estimates of the β_k coefficients in equation 2 for $k \in [-4, 6]$ months around the time of the shock (with $k = -1$ omitted). $k = 0$ occurs three months prior to exports. Panel A shows effects on the log of the modal wage at an establishment, and Panel B shows effects on the log of employment. Confidence intervals at a 95% level are reported. Standard errors are clustered at the establishment level.

Figure 14: Counterfactual results



Notes: This figure plots the results from four counterfactual exercises.

Tables

Table 1: Characteristics of industry associations

	Association	Not association
Size	152	101
Exporter	71%	52%
Value of exports (USD, million)	3.034	2.605
Products exported	2.2	2.1
Avg. wage (USD, PPP)	1765	1511
Share of labor market	46%	54%

Notes: This table describes characteristics of members and non-members of the industry association.

Table 2: Minimum wages in the garment manufacturing industry

Wage	Minimum (Rs.)	Maximum (Rs.)	Average (Rs./USD PPP)
Unskilled	4390	9568	6262 (361 USD PPP)
Semi-skilled	4700	10582	7439 (387 USD PPP)
Skilled	5171	11622	8034 (418 USD PPP)

Notes: This table summarizes the state-specific minimum wage in the garment industry in July 2016.

Table 3: Promotion from probationary to permanent member

	Full member
Probation×deviate	-0.384***
	(0.038)
Baseline rate	0.74
Observations	489

Notes: This table describes the rate of promoting probationary members to permanent members of the association.

Table 4: Export expansion at unaffected members

	Exports	Share		
		Chief importer	Affected	Other
Post	0.11**	82%	11%	7%
	(0.042)			
Observations	1433			

Notes: This table describes the nature of export expansion at unaffected members of the industry association after the relocation shock. Column 1 reports the effect on total exports. Subsequent columns report the share of export expansion to one's previous chief importer (Column 2), to affected brands (Column 3), and to other importers (Column 4).

Table 5: Profits

	Unaffected member	Affected member
Post	-0.053***	0.162*
	(0.012)	(0.081)
Observations	688	121

Notes: This table reports the effect on profits for unaffected and affected members of the industry association.

Table 6: Test of conduct

	Cournot Oligopsony	Collusion at min wage $\rightarrow$ joint profit max
Breakdown of collusion from min wage	28.42	15.10

Notes: This table performs the quantitative test of conduct described in section 5. A positive value indicates that the row model fits better than the column. In other words, that the breakdown of collusion from the minimum wage to oligopsony model fits better than the column models (either continuous Cournot oligopsony or going from collusion at the minimum wage to the optimal collusive scheme). The null hypothesis is that the two models fit equally well.

Table 7: Model parameters for counterfactuals

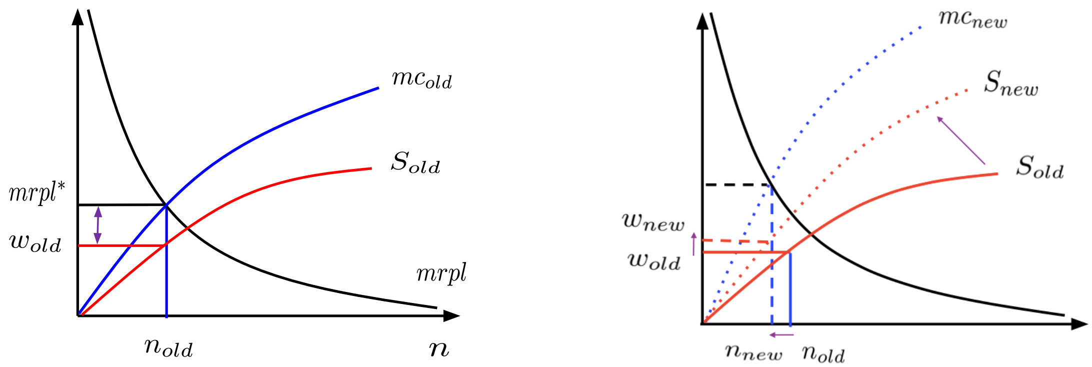
Parameter	Name	Value	Source	Component
Estimated				
η_g	Cross-employer elasticity of substitution	3.51	Elasticity estimate	LS
θ_g	Cross-industry	1.19	Elasticity estimate	LS
λ_g	Cross-location	0.04	Elasticity estimate	LS
φ	Frisch elasticity	0.5	Calibrated from Berger et al. 2022	LS
s_{gk}	Share of industries	Varies	Data	Eqbm
W_{gk}	Industry-specific wages	Varies	Data	Eqbm
a_{gk}	Industry-specific amenities	Varies	Match s_{gk} in data	Eqbm
σ	Productivity dispersion	0.7	Firm size distribution	Prod
Z	Productivity shifter	387	Match average wage in data	Prod
Calibrated				
α	Decreasing returns to scale	0.94	Berger et al. 2023	Prod
M	Number of firms in textiles	2530	Match data	Market

Notes: This table notes parameters needed to simulate the model, their source, and which feature of the environment they correspond with (LS = labor supply, Prod = production function, Eqbm = equilibrium object).

Appendix Figures

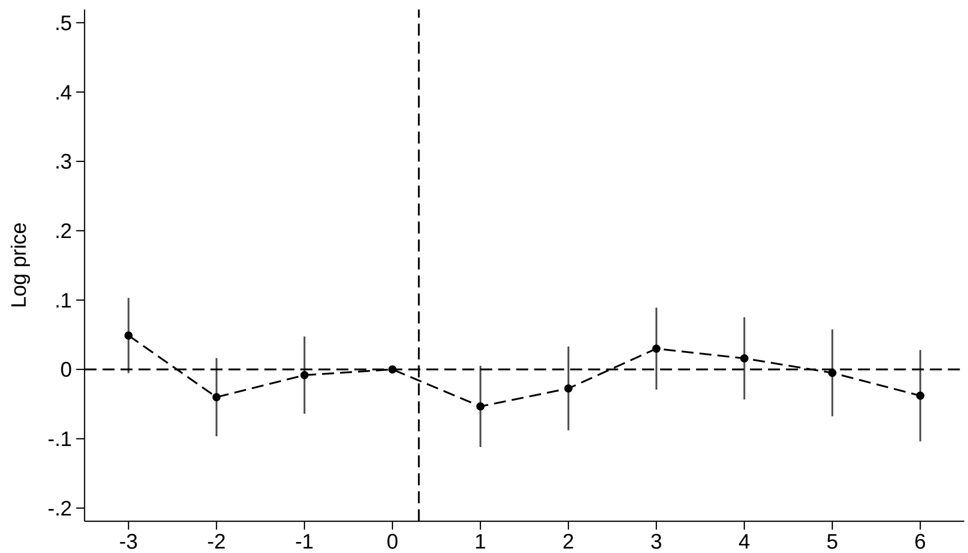
Figure A1: Spillover Test

(a) Firm optimization in oligopsony/monopsony (b) Spillover, left rotation of labor supply



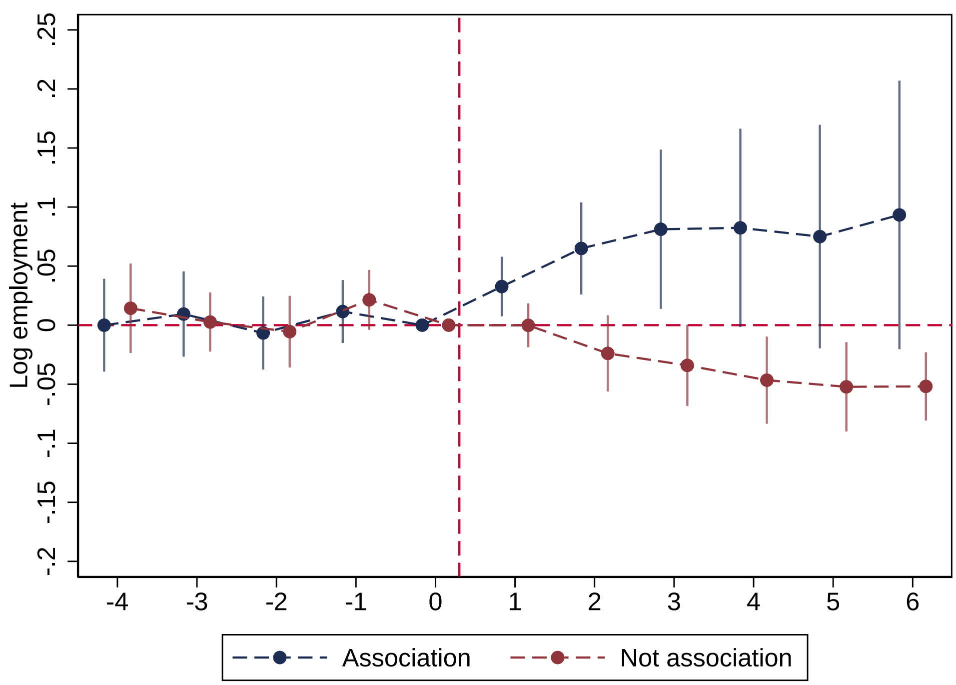
Notes: The left panel plots the optimization problem of an oligopsonistic or monopsonistic firm, and the right panel plots the spillover effect of a positive demand shock to its competitor. The shock reduces labor supply to the unshocked competitor, and rotates her labor supply curve left. She moves up her demand curve, increasing her wage and reducing employment. Diminishing marginal revenue product of labor (Assumption 2) yields downward sloping demand. Invertible labor supply, i.e., employers are not perfect substitutes, yields upward-sloping labor supply to individual employers. Connected substitutes (Assumption 1) implies that, when one's shocked competitor increases her wage, labor supply to an unshocked competitor declines.

Figure A2: Prices of unaffected exporters



Notes: This figure plots the event study estimates of the effect of the relocation shock on prices at unaffected exporters.

Figure A3: Effect on employment at unaffected members and non-members, controlling for importer



Notes: This figure plots the effect on unaffected employers' employment, controlling for importer-time trends.

8 Appendix: Proofs

I make the following assumptions.

Assumption 1 (Connected substitutes) There is weak substitution between all employers and sufficient strict substitution to necessitate treating employers in a single supply system. Formally, employers are weak substitutes in that, all else equal, an increase in w_j weakly lowers labor supply to all other employers: $\frac{\partial lnn_{j'}}{\partial lnw_j} \leq 0 \ \forall \ j'! = j$. In addition, define the directed graph of a matrix to represent substitution among employers $\chi(w)$ whose elements are $\chi_{j+1,k+1} = \begin{cases} 1\{good\ j\ substitutes\ to\ employer\ k\ at\ x \\ 0 \end{cases}$. For all possible w, the directed graph of $\chi(w)$ has, from every node $k = 0$, a directed path to node 0.

Assumption 2 (Diminishing marginal revenue product) The revenue function for each firm $f_j(z_{jt}, n_{jt}, k_{jt})$ exhibits diminishing marginal product of labor $\frac{\partial^2 f_j}{\partial n_{jt}^2} < 0$.

Assumption 3 (Derivative of optimal markdown) The derivative of the log of each firm's optimal markdown function wrt its wage is weakly negative, holding fixed competitor wages, $\mathbf{w_{-j}}$. $\frac{\partial ln\mu_{jt}}{\partial lnw_{jt}}|_{\{w_j,\mathbf{w_{-j}}\}} \leq 0$. Below I show that, for any conduct and invertible labor supply system, $\exists$ such a log markdown function, $\Lambda_j(w_{jt}, \mathbf{w_{-jt}}, \mathbf{a_t}) := ln\mu_{jt}$, such that a firm's profit maximizing wage $\tilde{w_{jt}}$ is the solution to a fixed point problem for any wage vector at competitors $\mathbf{w_{-jt}}$, $ln\tilde{w_{jt}} = lnmrpl_{jt} + \Lambda_j(\tilde{w_{jt}}, \mathbf{w_{-jt}}, \mathbf{a_t})$.

8.1 Proofs of Propositions

Proposition 1: For oligopsonistic or monopsonistic conduct, any invertible labor supply system, and Assumptions 2 and 3, a positive demand shock to one firm j ($dlnz_{jt} > 0$), causes unshocked firms j' in its labor market to weakly increase their wage and reduce employment, with strict inequality under Assumption 1. In other words, $\frac{dlnw_{j't}}{dlnz_{jt}} \geq 0 \ \forall j'! = j$ and $\frac{dlnn_{j't}}{dlnz_{jt}} \leq 0 \ \forall j'! = j$, with strict inequality whenever employers are connected substitutes.

Proof The proof proceeds in three steps. First, I show that for any competition structure and invertible labor supply system where employers are not perfect substitutes, $\exists$ a log markdown function $\Lambda_j(w_{jt}, \mathbf{w_{-jt}}, \mathbf{a_t})$ such that a firm's profit maximizing wage $\tilde{w_{jt}}$ is the solution to a fixed point problem for any wage vector at competitors $\mathbf{w_{-jt}}$, $ln\tilde{w_{jt}} = lnmrpl_{jt} + \Lambda_j(\tilde{w_{jt}}, \mathbf{w_{-jt}}, \mathbf{a_t})$. Next, I show that $\frac{dlnw_{j't}}{dlnz_{jt}} > 0 \forall j' \in \mathbf{J} \setminus j$, with strict inequality whenever $\frac{\partial lnn_{j'}}{\partial lnw_j} \leq 0 \ \forall \ j' \in \mathbf{J} \setminus j$. Finally, I show that $\frac{dlnn_{j't}}{dlnz_{jt}} < 0$ whenever $\frac{dlnw_{j't}}{dlnz_{jt}} > 0$. I assume throughout that firm-specific amenities remain unchanged.

Step 1: For any competition structure and invertible labor supply system where employers are not perfect substitutes, $\exists$ a log markdown function $\Lambda_j(w_{jt}, \mathbf{w_{-jt}}, \mathbf{a_t})$ such that a firm's profit maximizing wage $\tilde{w}_{jt}$ is the solution to a fixed point problem for any wage vector at competitors $\mathbf{w_{-jt}}$:

$$ln\tilde{w_{jt}} = lnmrpl_{jt} + \Lambda_j(\tilde{w_{jt}}, \mathbf{w_{-jt}}, \mathbf{a_t}) \tag{9}$$

Proof. This proof derives closely from Amiti et al. (2019). See Appendix of Sharma (2023) for the labor market derivation. The optimal markdown function Λ_j is endogenous to the supply and competition structure, that is, its specific functional form changes from one structure of labor supply and competition to another. The chief implication of Step 1 is that, across all these structural models, as long as labor supply is invertible, competitor wages $\mathbf{w_{-jt}}$ form a sufficient statistic for firm j's wage decision, and that, conditional on $\mathbf{w_{-jt}}$, the firm's behavior does not depend on its competitors' marginal products $mrpl_{kt}|_{k!=j}$.

Step 2: When $dlnz_{jt} > 0$ for some j, and $dlnz_{j't} = 0$ for all $j'! = j$, then $\frac{dlnw_{j't}}{dlnz_{jt}} \geq 0 \;\forall\; j'! = j$, with strict inequality whenever $\frac{\partial lnn_{j'}}{\partial lnw_j} \leq 0 \;\forall\; j'! = j$.

Proof. Consider an arbitrary unshocked competitor $j' = 1$. Denote the log of the marginal revenue product of labor, $lnm_{j't} := lnmrpl_{j't} = ln\frac{\partial f_{j't}}{\partial n_{j't}}$. Totally differentiating the best response function following any change to firms in the market[41]:

$$dlnw_{1t} = \frac{\partial lnm_{1t}}{\partial lnz_1} dlnz_{1t} + \frac{\partial lnm_{1t}}{\partial lnn_1} dlnn_1 + \sum_{j'} \frac{\partial ln\mu_1}{\partial lnw_{j'}} dlnw_{j'} \tag{10}$$

Re-arranging, substituting in $dlnz_{1t} = 0$, and substituting in the labor supply function $n_1(w_{1t}, \mathbf{w_{-1t}}, \mathbf{a_t})$:

$$\begin{aligned}
\frac{dlnw_{1t}}{dlnz_{jt}} &= \frac{\partial lnm_{1t}}{\partial lnn_1}\frac{\partial lnn_1}{\partial lnw_1}\frac{dlnw_1}{dlnz_{jt}} + \sum_{j'!=1}\frac{\partial lnm_{1t}}{\partial lnn_1}\frac{\partial lnn_1}{\partial lnw_{j'}}\frac{dlnw_{j'}}{dlnz_{jt}} \\
&\quad + \frac{\partial ln\mu_1}{\partial lnw_1}\frac{dlnw_1}{dlnz_{jt}} + \sum_{j'!=1}\frac{\partial ln\mu_1}{\partial lnw_{j'}}\frac{dlnw_{j'}}{dlnz_{jt}} \qquad (11)\\
\left[1 - \frac{\partial lnm_{1t}}{\partial lnn_1}\frac{\partial lnn_1}{\partial lnw_1} - \frac{\partial ln\mu_1}{\partial lnw_1}\right]\frac{dlnw_{1t}}{dlnz_{jt}} &= \sum_{j'!=1}\frac{\partial lnm_{1t}}{\partial lnn_1}\frac{\partial lnn_1}{\partial lnw_{j'}}\frac{dlnw_{j'}}{dlnz_{jt}} + \sum_{j'!=1}\frac{\partial ln\mu_1}{\partial lnn_1}\frac{\partial lnn_1}{\partial lnw_{j'}}\frac{dlnw_{j'}}{dlnz_j} \\
\left[1 - \left(\frac{\partial lnm_{1t}}{\partial lnn_1} + \frac{\partial ln\mu_1}{\partial lnn_1}\right)\frac{\partial lnn_1}{\partial lnw_1}\right]\frac{dlnw_{1t}}{dlnz_{jt}} &= \left[\frac{\partial lnm_{1t}}{\partial lnn_1} + \frac{\partial ln\mu_1}{\partial lnn_1}\right]\sum_{j'!=1}\frac{\partial lnn_1}{\partial lnw_{j'}}\frac{dlnw_{j'}}{dlnz_j} \\
\left[1 - a_1\frac{\partial lnn_{1t}}{\partial lnw_{1t}}\right]\frac{dlnw_{1t}}{dlnz_{jt}} &= a_1\sum_{j'!=1}\frac{\partial lnn_{1t}}{\partial lnw_{j't}}\frac{dlnw_{j't}}{dlnz_{jt}} \qquad (12)
\end{aligned}$$

[41] I additionally assume a small shock such that a first-order approximation is enough.

where $a_1 := \left(\frac{\partial lnm_{1t}}{\partial lnn_1} + \frac{\partial ln\mu_1}{\partial lnw_1}\right) < 0$ (Assumptions 2 and 3).

We wish to show that the optimal wage response is weakly positive, i.e., $\frac{dlnw_{1t}}{dlnz_{jt}} \geq 0$. We will prove this by contradiction. Say, to the contrary, that $\frac{dlnw_{1t}}{dlnz_{jt}} < 0$. Since the labor market clears at each firm[42]:

$$\frac{dlnn_{1t}}{dlnz_{jt}} = \frac{\partial lnn_{1t}}{\partial lnw_{1t}}\frac{dlnw_{1t}}{dlnz_{jt}} + \sum_{j'!=1}\frac{\partial lnn_{1t}}{\partial lnw_{j't}}\frac{dlnw_{j't}}{dlnz_{jt}} \tag{13}$$

Substituting from (12), and given $\frac{dlnw_{1t}}{dlnz_{jt}} < 0$:

$$\begin{aligned}\frac{dlnn_{1t}}{dlnz_{jt}} &= \frac{\partial lnn_{1t}}{\partial lnw_{1t}}\frac{dlnw_{1t}}{dlnz_{jt}} + \frac{\left[1 - a_1\frac{\partial lnn_{1t}}{\partial lnw_{1t}}\right]}{a_1}\frac{dlnw_{1t}}{dlnz_{jt}}\\ \frac{dlnn_{1t}}{dlnz_{jt}} &= \frac{\frac{dlnw_{1t}}{dlnz_{jt}}}{a_1} > 0 \end{aligned} \tag{14}$$

Equation (14) reveals that any unshocked firm whose optimal response is to increase (decrease) its wage must reduce (increase) employment.

Characterizing the source of new workers at employer 1, under connected substitutes (Assumption 1), these workers must exclusively be drawn from other employers who also reduce their wage (second term in equation 13). But, this statement must hold for each employer with declining wages. However, if all firms whose wages decline gain workers exclusively from other firms that also lower wages, then at least one of these firms must lose workers on net. But this is impossible if the said firm's optimal wage response is negative (equation 14). We arrive at a contradiction, and it cannot be that $\frac{dlnw_{1t}}{dlnz_{jt}} < 0$. Thus, $\frac{dlnw_{j't}}{dlnz_{jt}} \geq 0 \ \forall \ j' \in \mathbf{J} \setminus j$.

I now show that the inequality is strict under Assumption 1, i.e., that $\frac{dlnw_{j't}}{dlnz_{jt}} > 0 \ \forall j' \in \mathbf{J} \setminus j$ if $\frac{\partial lnn_{j'}}{\partial lnw_j} \leq 0 \ \forall \ j' \in \mathbf{J} \setminus j$. Consider the shocked employer j. Her optimal response is to increase her wage $\frac{dlnw_{jt}}{dlnz_{jt}} > 0$. This is easily seen from equation 10, where all other employers weakly increase their wage and $dlnz_{jt} > 0$. Given this, returning to equation 12 for the unshocked competitor, $\frac{dlnw_{j't}}{dlnz_{jt}} > 0$ if $\frac{\partial lnn_{j'}}{\partial lnw_j} \leq 0 \ \forall \ j' \in \mathbf{J} \setminus j$.

Step 3: $\frac{dlnn_{j't}}{dlnz_{jt}} \leq 0 \ \forall j'! = j$, with strict inequality whenever $\frac{dlnw_{-jt}}{dlnz_{jt}} > 0$.

Proof. The result follows from equation (14).

[42] Assuming that no firm rations employment is equivalent to assuming that firms are on their labor supply curve. Firms may instead ration employment if the minimum wage is too high and binds from above, i.e. more workers supply labor than demanded. Nonetheless, under Assumptions 1, 2, and 3, oligopsony or monopsony would never predict a positive spillover effect on employment. When the minimum wage binds from above, spillovers weakly increase wages and weakly reduce employment at competitor 1. A rotation to labor supply following a firm-specific demand shock to j that induces j to raise wages, may leave competitor 1's wage and employment unchanged, if the minimum wage continues to be too high, keeping firm 1 on its labor demand curve. For a large enough rotation to supply, firm 1 will increase her wage and reduce employment.

Binding minimum wage I now show that under Assumptions 1, 2, and 3, the spillover effects of firm-specific demand shocks also predict negative employment effects in monopsony/oligopsony models with a binding minimum wage. A minimum wage that binds from below leads firms to be on their labor supply curve, instead of their first order condition. A rotation to labor supply following a competitor's firm-specific demand shock that induces the competitor to raise her wage may still leave $1'$'s wage unchanged at the minimum, $dlnw_1 = 0$. It will nonetheless reduce employment $dlnn_1 < 0$ since fewer workers now supply labor to 1 at the same wage (mathematically, this effect is captured by the second term in equation 13).

The minimum wage may alternatively be too high and bind from above. More workers supply labor than demanded, leading firms to ration employment. Nonetheless, spillovers weakly increase wages and weakly reduce employment at unshocked competitors. A rotation to labor supply following a competitor's firm-specific demand shock that induces the competitor to raise its wage, may leave 1's wage and employment unchanged, if the minimum wage continues to be too high. Employer 1 remains on her labor demand curve. For a large enough rotation to supply, however, 1 will increase her wage and reduce employment. In sum, in cases where the minimum wage binds from above or from below, oligoopsonistic or monopsonistic unshocked competitors will weakly reduce employment.

Other factor markets (materials) and the product market The results hold when other factor markets are perfectly competitive (the standard assumption in the literature on labor market power, e.g. Delabastita & Rubens 2023, Yeh et al. 2022), or when production is Leontief in materials. The latter is a natural assumption for the garment industry, where labor and materials are not substitutes. The results also remain true when the product market is perfectly competitive, or, when, regardless of the nature of competition, the revenue function exhibits diminishing marginal revenue product. Therefore, Proposition 1 is fully consistent with the presence of product market power, which itself is a source of downward sloping demand curves.

Capital market All results remain true if capital is supplied competitively in a rental market. In this case, Proposition 1 holds after plugging in optimal capital demand into the first order condition for labor. Credit constraints that are alleviated by a positive demand shock combined with excess capacity might predict higher employment at shocked firms. They could only predict higher employment at unshocked members of the association under oligopsony if these employers are not truly unshocked, i.e., if they also receive a positive demand shock such as due to subcontracting. However, as argued in Section 5, the results cannot be explained by correlated demand shocks at members of the industry association. First, I find that profits at unshocked members of the association decline, whereas a positive demand shock would lead to higher profits at affected employers.[43] Second, I also find an increase in employment among large unshocked members of the association, defined as establishments employing over 100 or over 500 workers prior to the shock, who do not accept

[43]By contrast, consistent with the affected members of the industry association experiencing a positive demand shock, their profits increase. Affected members are those that were exporting to a brand affected by labor audits in Vietnam.

subcontracts. Since these large firms do not accept subcontracts, the increase in their employment cannot be explained by subcontracting. Finally, I show that members of the association forego small export demand opportunities to stick to the minimum wage. It would be strange for unaffected members to respond to subcontract opportunities but not to their own demand shocks. Together these findings reveal that the increase in employment among unshocked members of the association is most consistent with collusion in the pre-period as opposed to correlated demand shocks that alleviate credit constraints.

Violation of the connected substitutes condition (Assumption 1) One implication of the connected substitutes condition is that wages under monopsony or oligopsony are strategic complements, and employment is strategic substitutes. I characterizes and rule out three mutually exclusive and exhaustive violations of the connected substitutes condition as driving my results. I either show analytically that violations continue to predict strategic substitutability in employment, or, establish conditions under which violations could yield strategic complementarity, and empirically eliminate these possibilities. Case 1 is if connected substitutes is violated but Assumption 3 remains true. Then, employment can only exhibit strategic complementarity under oligopsony/monopsony if wages are strategic substitutes (equation 14). Note that equation (14) *does not* rely on the connected substitutes assumption. It only relies on the invertibility of labor supply, optimization (that we can totally differentiate the optimal wage condition as in equation 10), that firms are on their labor supply curve (equation 13), and Assumption 3. In other words, if Assumption 1 is violated, but Assumption 3 remains true, then unshocked monopsonistic or oligopsonistic competitors will only increase employment if they lower wages. In contrast, I find that the large shock raises wages at unaffected members of the industry association. Thus, their higher employment cannot be rationalized in an oligopsony/monopsony framework that violates the connected substitutes condition, since, in order to do so, wages would have had to decline.

Violation of both Assumption 1 and Assumption 3 Alternatively, Assumptions 1 and 3 could both fail, such that $\frac{\partial ln\mu_{jt}}{\partial lnw_{jt}}|_{\{w_j,\mathbf{w_{-j}}\}} \geq 0$. For example, this could occur in a cream-skimming world where a higher wage at employer j draws away its competitor j''s least tethered workers , such that the most inelastic workers remain at j' (for example, due to a strong idiosyncratic preference for j'). In this case, $a_1 > 0$, and both wages and employment must either exhibit strategic substitutability (Case 2), or strategic complementarity (Case 3). The standard cream-skimming story inhabits case 2, where an unshocked competitor pays her remaining inelastic workers a lower wage, but nonetheless reduces employment. This is because she must otherwise raise wages to attract workers back. Employment remains analytically strategic substitutes. Alternatively, case 3 could occur if the shock alters the pool of workers accessible to unshocked members. This is largely ruled out by the observed decline in profits among unshocked members — since they increase employment by expanding exports to their existing importers, they could, in principle, have retained their old export opportunities by maintaining lower wages and employment to earn higher profits. Instead, the decline in profits suggests a loss of access to previously higher collusive profits.

Profits could decline if unshocked members no longer access their old, lower (wage, employment) combination. I rule this out by showing that unshocked members' new workers closely resemble old workers in observed characteristics. Moreover, to rationalize the opposite employment effects found for unshocked members and non-members of the association as both reflecting oligopsonistic competition, the available pool of workers would have to differentially change for unshocked members, which seems implausible.

Assumption 4 (Current collusive profits exceed oligopsony profits for some members) Proposition 2 applies to collusive schemes where some subset of cartel members earn collusive profits that exceed the counterfactual oligopsony profits that would prevail if collusion broke down. This regularity condition ensures that the shock does not arrive during a period where each cartel member earns lower profits today, for the promise of higher collusive profits in the future.[44]

Although I consider two cases below, the proof applies to all collusive schemes satisfying Assumptions 1 to 4.

Proposition 2 (a): For any labor supply system where employers are connected substitutes, if a positive, demand shock to some firm j ($dlnz_{jt} > 0$) causes collusion at a focal point wage to break down, and firms go to oligopsony, then $\exists\ j' \in \{\mathbf{cartel} \backslash j\}$ for which $\frac{dlnn_{j't}}{dlnz_{jt}} > 0$.

Proposition 2 (b): For any labor supply system where employers are connected substitutes, if a positive, demand shock to some firm j ($dlnz_{jt} > 0$) causes collusion by partly or full internalizing others' profits to break down, and firms go to oligopsony, then $\exists$ $j' \in \{\mathbf{cartel} \backslash j\}$ for which $\frac{dlnn_{j't}}{dlnz_{jt}} > 0$.

Proof. I consider a labor market featuring both a cartel that either coordinates to pay a focal point wage (case a), or internalizes others' profits (case b) ($\mathbf{J_{cartel}} \in \mathbf{J}$), and a fringe that does not collude ($\mathbf{J_{fringe}} \in \mathbf{J} \setminus \mathbf{J_{cartel}}$). Fringe firms maximize individual profits by taking the cartel's behavior as given. The punishment strategy of the cartel entails the breakdown of collusion at some point. The proof applies regardless of whether the breakdown precipitates a Cournot or a Bertrand oligopsony equilibrium.

Consider a positive, demand shock to some firm j that causes collusion to dismantle. I assume a small shock, such that $j' \in \mathbf{J}_{cartel} \setminus j$ revert to outcomes "close" to the original oligopsony that would prevail had firms not initially colluded. I show that, from the subset of cartel members whose current collusive profits exceed the counterfactual oligopsony profits that would prevail if collusion

[44] Assumption 4 also rules out schemes where every unshocked member of the cartel earns collusive profits below oligopsony that are compensated by transfers. This effectively rules out collusive schemes among firms with widely varying productivity, whose less productive members are compensated for their participation via transfers, and where the shock disproportionately affects high productivity firms. Empirically, the industry association does not make transfers. Moreover, the estimated productivity distribution satisfies assumption 4. Finally, the shock as-if-randomly affected members of industry associations.

dismantled (i.e., the set of firms for which $\Pi_{coll,t} > \Pi_{olig,t}$), $\exists\ j' \in \{\textbf{cartel}\backslash j\}$ for which $\frac{dlnn_{j't}}{dlnz_{jt}} > 0$. I proceed by considering three cases.

Case I: $w_{j',olig} < w_{j',coll} \forall j' \in \mathbf{J_{cartel}}$

First consider a world with no fringe. I prove the result by contradiction. Say, to the contrary, that $n_{j',olig} \leq n_{j',coll}\ \forall j' \in \mathbf{J_{cartel}} \setminus j$. If all of an arbitrary firm j''s competitors reduce their wage, then j' would find it profitable to raise its wage from $w_{j',olig}$ to $w_{j',coll}$, hire strictly more workers than $n_{j',coll}$ ($n > n_{j',coll}$), produce strictly more than under collusion ($f(n) > f(n_{coll})$), and earn higher than collusive profits, $f(n) - nw_{coll} > f(n_{coll}) - n_{coll}w_{coll}$. j' could hire strictly more workers at its old, collusive wage, since all its competitors lower wages and employers are connected substitutes. This is seen by taking the total derivative of labor supply:

$$\underbrace{dlnn_{j'}}_{>0} = \frac{\partial lnn_{j't}}{\partial lnw_{j't}} \underbrace{dlnw_{j't}}_{0} + \underbrace{\sum_{j''!=j'} \frac{\partial lnn_{jt}}{\partial lnw_{j''t}} \underbrace{dlnw_{j''t}}_{<0}}_{>0}$$

However, this implies that oligopsony profits must exceed collusive profits, and collusion would be unprofitable for j' at the outset. We arrive at a contradiction, and it cannot be that $n_{j',olig} \leq n_{j',coll}$ $\forall j' \in \mathbf{J_{cartel}} \setminus j$ if $w_{j',olig} < w_{j',coll} \forall j' \in \mathbf{J_{cartel}}$. Thus, $\exists\ j' \in \{\textbf{cartel}\backslash j\}$ s.t. $n_{j',olig} > n_{j',coll}$, and $\frac{dlnn_{j't}}{dlnz_{jt}} > 0$.

Now consider the addition of a fringe. If all fringe firms reduce wages, the above argument holds as is. I show that it is impossible for unshocked fringe firms to raise wages if $w_{j',olig} < w_{j',coll} \forall j' \in \mathbf{J_{cartel}}$. Consider an arbitrary fringe employer 1. Since fringe firms are on their FOC, equation (3) from Proposition 1 governs changes in their best response wage:

$$\left[1 - a_1 \frac{\partial lnn_{1t}}{\partial lnw_{1t}}\right] \frac{dlnw_{1t}}{dlnz_{jt}} = a_1 \sum_{j'!=1} \frac{\partial lnn_{1t}}{\partial lnw_{j't}} \frac{dlnw_{j't}}{dlnz_{jt}}\ ,\ a_1 < 0$$

I aim to show $\frac{dlnw_{1t}}{dlnz_{jt}} < 0$. The above equation shows that this is already true if all other employers (cartel + fringe) reduce their wage. Say, though, to the contrary, that $\frac{dlnw_{1t}}{dlnz_{jt}} > 0$. Proposition 1 shows that its optimal employment response is $\frac{dlnn_{1t}}{dlnz_{jt}} < 0$. Firm 1 loses workers to other fringe employers who increase their wage. This statement holds for all fringe employers whose optimal wage response is positive. However, at least one firm whose optimal wage response is positive must gain workers on net, if all other firms that raise wages lose workers exclusively to other wage-increasing firms. However, it is impossible for the said firm to gain workers on net if it increases its wage (equation (14)). We have arrived at a contradiction, and $w_{j'',olig} < w_{j'',coll}\ \forall\ j'' \in \mathbf{J_{fringe}}$ if $w_{j',olig} < w_{j',coll} \forall j' \in \mathbf{J_{cartel}}$, where $w_{j'',coll}$ is the pre-shock wage at j'' and $w_{j'',olig}$ is the post-shock wage. As shown, this implies higher employment at a cartel member whose collusive profits exceed oligopsony profits.

In sum, if $w_{j',olig} < w_{j',coll} \forall j' \in \mathbf{J_{cartel}}$ then $\exists\ j' \in \{\textbf{cartel}\backslash j\}$ s.t. $n_{j',olig} > n_{j',coll}$, and

$\frac{dlnn_{j't}}{dlnz_{jt}} > 0$.

Case II: $w_{j',olig} > w_{j',coll} \forall j' \in \mathbf{J_{cartel}}$

First, consider the case without a fringe. Say, to the contrary, that $n_{j',olig} < n_{j',coll} \forall j' \in \mathbf{J_{cartel}} \setminus j$. Given upward-sloping labor supply to the market, it is impossible for every employer to pay higher wages to hire fewer workers. Thus, oligopsony employment must exceed collusive employment for at least one member of the cartel. In other words, $\exists\ j' \in \{\mathbf{cartel} \setminus j\}$ for which $n_{j',olig} > n_{j',coll}$. Since the shock takes firms close to the original oligopsony, it therefore follows that $\frac{dlnn_{j't}}{dlnz_{jt}} > 0$.

Now consider the addition of a fringe. Per the argument above, if the optimal wage response of a fringe employer is positive then it must lose workers on net to other firms that increase their wage. It cannot be the optimal response for any other fringe employer to increase both its wage and employment (given equation 14). Therefore, if fringe employers increase wages, then at least one former cartel member must increase employment $\frac{dlnn_{j't}}{dlnz_{jt}} > 0$.

I argue that it is impossible for unshocked fringe employers to reduce wages when $w_{j',olig} > w_{j',coll} \forall j' \in \mathbf{J_{cartel}}$. Say, to the contrary, that $\frac{dlnw_{1t}}{dlnz_{jt}} < 0$. These employers must then gain workers on net from other firms that lower wages. The connected substitutes property implies that fringe firms cannot poach workers from cartel members who now pay higher wages (since $\sum_{j' \in \mathbf{J_{cartel}}} \frac{\partial ln n_1}{\partial lnw_j} dlnw_{j'} < 0$ when $dlnw_{j'} > 0 \forall j'$). Thus, at least one fringe firm whose optimal wage response is negative must lose workers on net if other firms with lower wages gain workers exclusively from other firms that also reduce their wage — but it is impossible for the said firm to lose workers on net if it reduces its wage (equation (14)). We have arrived at a contradiction, and unshocked fringe firms must raise wages. As shown, this implies that at least one cartel member increases employment.

In sum, if $w_{j',olig} > w_{j',coll} \forall j' \in \mathbf{J_{cartel}} \setminus j$ then $\exists$ at least one firm $j' \in \{\mathbf{cartel} \setminus \mathbf{j}\}$ for which $\frac{dlnn_{j't}}{dlnz_{jt}} > 0$.

Case III: $w_{j',olig} > w_{j',coll}$ **for some firms** $\mathbf{J_{sub1}} \in \mathbf{J_{cartel}} \setminus j$**, and** $w_{j',olig} < w_{j',coll}$ **for other firms** $\mathbf{J_{sub2}} \in \mathbf{J_{cartel}} \setminus \mathbf{J_{sub1}}, j$**.** Per the arguments in Cases I and II, at least one former member of the cartel that raises its wage ($j' \in \mathbf{J_{sub1}}$) must also increase employment.

9 Appendix: Other Derivations

9.1 Model derivations

Environment The economy features a continuum of geographies $r \in [0,1]$ (districts). Each geography has a discrete number of industries, indexed by $k \in 1, ..., M_r$, and firms within the industry $j \in 1, ..., J_m$. A measure one of workers possess heterogeneous preferences over employers. Firms demand labor under one of two possible competition structures. The first is a collusive equilibrium, wherein a subset of firms (the "cartel") coordinates to pay the minimum wage, while firms outside the cartel (the "fringe") choose labor to maximize profits taking as given other firms' employment choices and the cartel's behavior. By contrast, in a cournot oligopsony, each firm chooses labor to maximize its own profits taking others' employment decisions as given. Time is discrete and indexed by t.

Labor Supply Workers possess heterogeneous preferences over employers. Each worker i chooses to work at her highest utility employer, and exhibits three-nested preferences. She first chooses a location, then an industry within the location, and finally an employer with the industry. Each worker must earn income $y_i \sim F(y)$ which is a product of hours and wages $y_i = w_j h_{ij}$. A worker's utility from working at employer j comprises a common component, rising in the wage and amenity at employer j, and an idiosyncratic preference shock specific to each employment relationship:

$$u_{ijkrt} = lnw_{jt} + lna_{jt} + lna_k + \epsilon_{ijk} \tag{15}$$

w_{jt} denotes the wage at employer j in period t, a_k denotes industry-specific amenities, and a_{jt} denotes the employer's deviation from the industry norm. ϵ_{ijk} has a nested Type I extreme value distribution. Its variance is governed by three dispersion parameters that determine the correlation of idiosyncratic draws across employers within an industry, η, across industries, θ, and across locations, λ.

$$F(\epsilon_{i1}, ..., \epsilon_{NJ}) = \exp\left[-\sum_r(\sum_{k=1}^{M}(\sum_{j=1}^{J_m} e^{-(1+\eta)\epsilon_{igjk}})^{\frac{1+\theta}{1+\eta}})^{\frac{1+\lambda}{1+\theta}}\right]$$

I obtain labor supply by aggregating the preferences of individual workers. The probability of choosing employer j is, as in nested logit \citep{mcfadden1978modelling}:

$$p_{jt} = \underbrace{\frac{(a_{jt}w_{jt})^{1+\eta}}{\sum_{j'\in k}(a_{j't}w_{j't})^{1+\eta}}}_{prob\ of\ choosing\ firm\ j\ in\ industry\ k} \times \underbrace{\frac{a_k^{1+\theta}\left(\sum_{j\in k}(a_{jt}w_{jt})^{1+\eta}\right)^{\frac{1+\theta}{1+\eta}}}{\sum_{k'\in R} a_{k'}^{1+\theta}\left(\sum_{j\in k'}(a_{jt}w_{jt})^{1+\eta}\right)^{\frac{1+\theta}{1+\eta}}}}_{prob\ of\ choosing\ industry\ k} \times \underbrace{\frac{\bar{W}_{rt}^{1+\lambda}}{\sum_{R'}\bar{W}_{rt'}^{1+\lambda}}}_{prob\ of\ choosing\ region\ r}$$

Aggregating these probabilities over workers yields the labor supply curve to employer j:

$$n_{jkrt} = \int p_{jkrt}h_{ijkr}dF(y_i),\ h_{ijkr} = \frac{y_i}{w_{jkrt}}n_{jkrt} = \frac{(w_{jkrt})^{\eta}}{\sum_{j'\in k}(a_{j't}w_{j't})^{1+\eta}} \frac{((\sum_{j'\in k}(a_{j'}w_{j'})^{1+\eta}))^{\frac{1+\theta}{1+\eta}}}{\sum_{k'\in r} a_{k'}^{1+\theta}(\sum_{j''\in k'}(a_{j''}w_{j''})^{1+\eta})^{\frac{1+\theta}{1+\eta}}} \times$$
$$\frac{\left(\sum_{k'\in r} a_{k'}^{1+\theta}(\sum_{j''\in k'}(a_{j''t}w_{j''t})^{1+\eta})^{\frac{1+\theta}{1+\eta}}\right)^{\frac{1+\lambda}{1+\theta}}}{\sum_r\left(\sum_{k''\in r} a_{k''}^{1+\theta}(\sum_{j'''\in k''}(a_{j'''t}w_{j'''t})^{1+\eta})^{\frac{1+\theta}{1+\eta}}\right)^{\frac{1+\lambda}{1+\theta}}}(a_{jkrt})^{1+\eta}a_k^{1+\theta}Y_t$$

where $Y_t = \sum_n w_{nt} n_{nt}$ denotes the total labor income of the group summed over all employers in the economy. I define the following wage indices at the industry-region, region, and group levels:

$$\bar{W}_{krt} = (\sum_{j' \in k,r} (a_{j't} w_{j't})^{1+\eta})^{\frac{1}{1+\eta}}$$
$$\bar{W}_{rt} = (\sum_{k' \in r} a_k^{1+\theta} (\sum_{j' \in k} (a_{j't} w_{j't})^{1+\eta})^{\frac{1+\theta}{1+\eta}})^{\frac{1}{1+\theta}}$$
$$\bar{W}_t = (\sum_r \bar{W}_r^{1+\lambda})^{\frac{1}{1+\lambda}}$$

And the following employment indices:

$$N_{krt} = (\sum_{j' \in k,r} (a_{j't}^{-1} n_{j't})^{\frac{1+\eta}{\eta}})^{\frac{\eta}{1+\eta}}$$
$$N_{rt} = (\sum_{k \in r} (a_k^{-1} N_{krt})^{\frac{1+\theta}{\theta}})^{\frac{\theta}{1+\theta}}$$
$$N_t = (\sum_r N_{rt}^{\frac{1+\lambda}{\lambda}})^{\frac{\lambda}{1+\lambda}}$$

These indices imply $W_t N_t = Y_t$. To obtain the labor supply to an employer I plug these expressions back into the labor supply curve expression above, yielding the nested CES labor supply curve to j:

$$n_{jkrt} = \left(\frac{w_{jkrt}^{\alpha}}{\bar{W}_{krt}}\right)^{\eta} \left(\frac{\bar{W}_{krt}}{\bar{W}_{rt}}\right)^{\theta} \left(\frac{\bar{W}_{rt}}{\bar{W}_t}\right)^{\lambda} a_{jkrt}^{1+\eta} a_k^{1+\theta} N_t$$

I invert the labor supply curve in three steps:

$$N_{rt} = \left(\frac{\bar{W}_{rt}}{\bar{W}_t}\right)^{\lambda} N_t$$
$$\bar{W}_{rt} = \left(\frac{N_{rt}}{N_t}\right)^{\frac{1}{\lambda}} W_t$$

Next:

$$N_{krt} = \left(\frac{\bar{W}_{krt}}{\bar{W}_{rt}}\right)^{\theta} \left(\frac{\bar{W}_{rt}}{\bar{W}_t}\right)^{\lambda} a_k^{1+\theta} N_t$$
$$\bar{W}_{krt} = \left(\frac{N_{krt}}{N_{rt}}\right)^{\frac{1}{\theta}} a_k^{-(\frac{1+\theta}{\theta})} \bar{W}_{rt}$$

Finally:

$$n_{jkrt} = \left(\frac{w_{jkrt}}{\bar{W_{krt}}}\right)^{\eta} n_{krt} a_{jkrt}^{1+\eta}$$

$$w_{jkrt} = \left(\frac{n_{jkrt}}{n_{krt}}\right) a_{jkrt}^{-\left(\frac{1+\eta}{\eta}\right)} \bar{W_{krt}}$$

Together, these yield the inverse labor supply curve:

$$w_{jkrt} = \left(\frac{n_{jkrt}}{N_{krt}}\right)^{\frac{1}{\eta}} \left(\frac{N_{krt}}{N_{rt}}\right)^{\frac{1}{\theta}} \left(\frac{N_{rt}}{N_t}\right)^{\frac{1}{\lambda}} \bar{W}_t$$

Labor Supply Elasticity I obtain the inverse elasticity of residual labor supply to a single employer j by taking the derivative of its log wage wrt log employment:

$$lnw_{jkrt} = \frac{1}{\eta} lnn_{jkrt} + \left(\frac{1}{\theta} - \frac{1}{\eta}\right) lnN_{krt} + \left(\frac{1}{\lambda} - \frac{1}{\theta}\right) lnN_{rt} + Aggregates + Amenities$$

Before doing so, I prove a useful lemma:

Lemma 1: $\frac{\partial lnN_{krt}}{\partial lnn_{jkrt}} = s_{jt}$

Proof:

$$\frac{\partial lnN_{krt}}{\partial lnn_{jkrt}} = \frac{\eta}{1+\eta} \frac{\partial ln(\sum_{j' \in k,r} (a_{j't}^{-1} n_{j't})^{\frac{1+\eta}{\eta}})}{\partial n_{jt}} n_{jt}$$

$$\frac{\partial lnN_{krt}}{\partial lnn_{jkrt}} = \frac{(a_{j't}^{-1} n_{jkrt})^{\frac{1+\eta}{\eta}}}{\sum_{j' \in k,r} (a_{j't}^{-1} n_{j't})^{\frac{1+\eta}{\eta}}}$$

By definition, $s_{jkrt} := \frac{w_{jkrt} n_{jkrt}}{\sum_{j' \in k,r} w_{j't} n_{j't}} = \frac{(a_{j't}^{-1} n_{jkrt})^{\frac{1+\eta}{\eta}}}{\sum_{j' \in k,r} (a_{j't}^{-1} n_{j't})^{\frac{1+\eta}{\eta}}}$ (plugging in the inverse labor supply to j and $j' \in k, r$), thus proving the lemma.

By a similar argument, $\frac{\partial lnN_{rt}}{\partial lnn_{jkrt}} = \frac{\partial lnN_{rt}}{\partial lnN_{krt}} \frac{\partial lnN_{krt}}{\partial lnn_{jkrt}} = s_{kt} s_{jt}$. Therefore, the elasticity of residual labor supply to employer j in industry k in region r is:

$$e_{jt} = \left(\frac{\partial lnw_{jt}}{\partial lnn_{jt}}\right)^{-1} = \left[\frac{1}{\eta} + \left(\frac{1}{\theta} - \frac{1}{\eta}\right) s_{jt} + \left(\frac{1}{\lambda} - \frac{1}{\theta}\right) s_{jt} s_{kt}\right]^{-1}$$

9.2 Test of conduct: change in optimal markdown

Here I derive $dln\mu_{jt} := \sum_{j'} \frac{\partial ln\mu_{jt}}{\partial lnw_{j't}} dlnw_{j't}$ for a Cournot oligopsony with three-nested CES labor supply. Recall that the elasticity is:

$$e_{jt} = \left[\frac{1}{\eta_g} + \left(\frac{1}{\theta_g} - \frac{1}{\eta_g}\right) s_{jt} + \left(\frac{1}{\theta_g} - \frac{1}{\eta_g}\right) s_{jt} s_{kt}\right]^{-1}$$

The markdown $\mu_{jt} = \frac{e_{jt}}{1+e_{jt}}$; $ln\mu_{jt} = lne_{jt} - ln(1+e_{jt})$. The derivative of the optimal markdown is:

$$\begin{aligned}
\frac{\partial ln\mu_{jt}}{\partial lnw_{jt}} &= \frac{w_{jt}}{e_{jt}} \frac{\partial e_{jt}}{\partial w_{jt}} - \frac{1}{1+e_{jt}} w_{jt} \frac{\partial e_{jt}}{\partial w_{jt}} \\
&= \frac{w_{jt}}{e_{jt}(1+e_{jt})} \left[e_{jt}^2 \frac{\partial \left(\frac{1}{\eta_g} + \left(\frac{1}{\theta_g} - \frac{1}{\eta_g}\right) s_{jt} + \left(\frac{1}{\theta_g} - \frac{1}{\eta_g}\right) s_{jt} s_{kt} \right)}{\partial w_j} \right] \\
&= \frac{e_{jt}}{1+e_{jt}} \left[\left(\frac{1}{\theta_g} - \frac{1}{\eta_g}\right) s_{jt}(\eta_g(1-s_{jt}) - s_{jt}) + \left(\frac{1}{\lambda_g} - \frac{1}{\theta_g}\right) s_{kt} s_{jt}(\eta_g(1-s_{jt}) - s_{jt}) \right] \\
&+ \frac{e_{jt}}{1+e_{jt}} \left[\theta_g \left(\frac{1}{\lambda_g} - \frac{1}{\theta_g}\right) s_{jt}^2 s_{kt} \right]
\end{aligned}$$