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. I develop a simple comparative static test to distinguish collusion from standard forms of imperfect competition, showing that firm-specific demand shocks predict opposite employment effects at *unshocked* competitors operating independently (↓ employment) versus firms that were previously colluding but whose collusion breaks due to the shock (↑ employment). Next, I argue that large employers in the garment industry organize into industry associations to pay workers exactly the local minimum wage. Small demand shocks leave wages and employment at association members unchanged, suggesting that firms are willing to forego opportunities to sustain collusion. However, 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 rejects oligopsony in favor of the breakdown of collusion. Collusion spurs substantial losses even compared to firms exercising their independent but not 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, evidence of collusion remains scarce. This lack of evidence represents a significant blind spot for antitrust policy in developed and developing countries alike, which have, thus far, focused almost exclusively on regulating product markets. Evidence of collusion among employers would, however, provide a compelling rationale for extending antitrust intervention to the labor market.

This paper examines collusion among employers in the Indian textile and clothing manufacturing industry. The industry is among the largest employers in developing countries, with 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. Neighboring firms that compete perfectly, collude, or independently exercise 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 firm-specific demand shocks to distinguish collusion from standard forms of imperfect competition. Its main insight is 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 firms that were colluding but whose collusion is dismantled by the shock (↑ employment). Importantly, the test enables diagnosing collusion without making strong structural assumptions or estimating structural objects, which is the tradition in the literature. Its contribution, then, is a simple, "reduced form" test of collusion applicable across wide-ranging structures and assumptions.

The paper proceeds in four steps. First, I derive the test. Second, I provide motivating evidence that large employers in the Indian garment industry organize into industry associations, which coordinate to pay workers exactly the state- and industry-specific minimum wage. In effect, associations use the minimum wage as a focal point for collusion, effectively rendering it a maximum wage in the sector. Associations employ over half of India's garment workers and ostensibly lobby for members' interests in the product market. For instance, the most prominent association in India's main garment manufacturing hub, the Tirupur Exporters' Association, recently lobbied for free trade agreements with the United States and the UK. Third, I implement the comparative static test and "full-IO" approach to show collusion among industry association members. Finally, I quantify the wage and employment losses from collusion and examine the role of minimum wage policy as a new tool of antitrust.

My analysis links 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 and states for all industries, and (iv) establishment-level exports from customs records.

Test I begin by deriving the test. I show that, for very general labor supply and production structures—where demand (weakly) slopes down and higher competitor wages reduce labor supply to oneself—spillovers from firm-specific demand shocks predict opposite employment effects under non-cooperative competition versus collusion breakdown.[1] Unshocked firms that operate independently, such as under monopsony, Cournot oligopsony, or Bertrand oligopsony, will respond by raising wages and *reducing* employment. This occurs because higher wages at shocked competitors rotate an unshocked firm's labor supply curve left, moving her up the demand curve to increase wages and reduce employment.[2] In contrast, shocks that dismantle collusion prompt unshocked colluders to increase both wages *and* employment. This is because colluding firms internalize the negative impact of higher wages on fellow members of their cartel, suppressing both wages and employment below independently optimal levels. Dismantling collusion raises both. The test covers all collusive arrangements where at least some firms earn higher profits with collusion than without it.[3,4]

That unshocked competitors unambiguously reduce employment under oligopsony is not obvious. Specifically, spillovers exert competing forces on employment, 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, compelling higher pay to retain workers. On the one

[1] I assume (i) invertible labor supply, i.e., employers are not perfect substitutes, (ii) employers are connected substitutes, 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. Berger, Herkenhoff and Mongey 2022), discrete-choice logit (e.g. Card et al. 2018), nested logit, mixed logit with connected substitutes, linear, Kimball, translog, and others. Section 2.

[2] The contribution is showing that firm-specific shocks unambiguously rotate an unshocked, non-cooperative firm's labor supply left for assumptions (i)-(iii).

[3] Beyond the profit condition, the test requires no stance on the exact game in which firms interact. For example, it covers two standard forms of collusion: at a single wage or internalizing others' profits.

[4] Former colluders increase employment for demand shocks "small enough" to spur an equilibrium "close" to the counterfactual absent collusion. Very large demand shocks could, however, also reduce employment at unshocked colluders (e.g., if the shocked firm seeks to employ its entire labor market). The test nonetheless shows that non-cooperative competition *never* predicts higher employment at unshocked competitors for assumptions (i) - (iii) whereas collusion can (either due to breakdown or other collusive schemes). Appendix B.1 derives the maximum shock size below which unshocked colluders increase employment and confirms the studied shock is smaller. In a structural test of conduct, the full breakdown of collusion from a focal point rejects both non-collusive models (monopsony, oligopsony) and collusive arrangements sans breakdown, like a new collusive wage or joint profit maximization.

hand, the unshocked competitor wants to reduce employment to raise marginal product. On the other hand, she wants to grow large enough again to pay a smaller markdown (rotate labor supply back). I show that the first force unambiguously dominates and employment unambiguously declines.

Motivating Evidence Step two presents four facts to motivate the notion that garment industry associations use the minimum wage as a focal point for collusion. Each Indian state sets its own minimum wage for garment workers. Large employers in the industry also organize into local industry associations to advance interests in the product market. My analysis centers on Tirupur, which produces 60% of India's garment exports and employs 30% of workers. Tirupur's largest association is the Tirupur Exporters' Association (TEA).[5]

First, members of associations disproportionately cluster from above at local minimum wages whereas non-members typically pay below it. Social security records show that 30% of garment workers earn exactly the minimum wage, 55% earn below, and only 15% earn above. Association members almost entirely drive this bunching: 43% of their workers earn exactly the minimum wage compared to only 15% at non-members, where most workers (71%) earn below the minimum wage.[6] Second, associations expel members who deviate above the minimum wage. TEA members must complete two-year probationary terms before qualifying for permanent status; exceeding the minimum wage reduces promotion by 38pp.

Third, associations track increases in the minimum wage without reducing employment, indicating imperfect competition in the labor market. Finally, I examine how members respond to small demand shocks, defined as temporary price increases of 5 to 15% at an establishment's main importer (e.g., Zara USA, Gap USA). A DiD event study comparing shocked establishments to themselves in unshocked seasons shows that non-members cater to small shocks by increasing wages and employment. However, association members forego small export opportunities to stick to the minimum wage—they do not change wages, employment, or exports.

Test of collusion The main test of collusion examines the spillover effects of a large, firm-specific demand shock that led affected association members to raise wages. The shock originated due to labor audits in Vietnam that uncovered severe labor law violations and compelled twenty-six prominent brands to temporarily shift production to India. Within a month, prices at affected Indian exporters grew 24.5% over unaffected counterparts. Relocation thus precipitated a positive demand shock at employers exporting to affected brands,

[5]Two motivating facts hold for all associations, not just the TEA: bunching at the minimum wage and tracking increases without reducing employment.

[6]The proposed model of collusion is one where large, productive firms form a cartel to pay exactly the minimum wage while less productive fringe firms pay less.

but not exporters to other brands. The shock impacted 15% of establishments in Tirupur and 13% of TEA members. Affected and unaffected employers closely resembled each other in baseline characteristics.

Unlike small demand shocks, the large price shock led affected TEA members to raise wages and employment above the minimum wage. Employing a DiD event study to compare establishments in the shocked season to themselves in unshocked seasons, I find a 9% increase in wages and 8% increase in employment at affected members.

Unaffected non-members responded as in oligopsony, by increasing wages but reducing employment. However, unaffected members of the association responded as if the shock dismantled their collusion, increasing both wages *and* employment. Four months post-shock, the average wage at unaffected non-members grew by 5% and employment declined 6%. In contrast, unaffected members' wages rose 6.5% and employment *increased* 8.5%.

Could the above findings be driven by factors other than the breakdown of collusion? I rule out four key concerns. I rule out subcontracting within the association by showing that unaffected members' new exports fully account for their higher workforce, leaving little room to fill sub-contracts. Second, to rule out correlated demand shocks, or that affected members sub-contract "worse" export orders to unaffected counterparts, I show no price change at unaffected members. Only price shocks can compel oligopsonistic or monopsonistic firms to increase employment, since only they raise the *mrpl*.[7] Additionally, while affected members' profits increased by 16%, consistent with receiving positive demand shocks, profits of unaffected members declined by 5%, consistent with losing access to higher collusive profits. Together these results reveal that higher wages and employment among unaffected members reflected not a positive demand shock, but, rather, higher export *supply* when some members' deviations from the minimum wage made collusion untenable. Third, TFP or cost shocks common to association members could increase labor demand and employment. Disparate impacts on prices and profits suggest disparate, not a common, source of shocks. Finally, several tests rule out violations of weakly downward-sloping demand or labor supply declines when competitors raise wages as driving higher employment at unaffected members.[8]

Although the simple test is appealing in its minimal structure, a full structural approach enables quantifying the relative fit of different models of conduct. Under assumed labor supply (three-nested logit where workers choose across locations, industries, and employers) and value-added production function (Cobb-Douglas in capital and labor), I augment the approach of Backus, Conlon, & Sinkinson (2021) to test for *changes* in conduct. Collusion

[7]Only price or TFP shocks can raise the *mrpl*.

[8]In other words, unshocked members do not increase employment by virtue of competing in an oligopsony that violates weakly diminishing *mrpl* or connected substitutes (section 4.3).

breakdown from the minimum wage rejects both non-collusive and other collusive models.

Quantification: losses and minimum wage hikes I conclude by quantifying losses from collusion and studying how minimum wage policy can mitigate them. Quantifying losses entails calculating counterfactual wages and employment under Cournot competition, which itself requires three ingredients. First, I assume a Cobb-Douglas value-added production function in capital and labor with a Hicks-neutral productivity shock, whose distribution I estimate. Second, I estimate the three-nested logit labor supply system. Finally, I infer a simple punishment strategy from data to determine cartel membership, where deviations above the minimum wage trigger a breakdown to oligopsony for six months.[9] The cartel evolves to only comprise firms that profit from colluding at the minimum wage.

Collusion induces substantial wage and employment losses, even compared to a world where firms exercise their independent but not collective market power, reducing the average garment worker's wage by 9.7% and employment by 17%.

Since paying the minimum wage is entirely legal, antitrust authorities have limited legal recourse available for tackling the collusion evidenced in this paper. However, policies to raise the minimum wage could potentially mitigate the losses from collusion by catalyzing coordination at higher wages. An important institution of the garment industry renders such coordination likely, namely, that foreign buyers enforce compliance with the minimum wage.

I therefore conclude by studying the impact of three minimum wage hikes on wages and employment. The first two increase the monthly minimum wage of Rs.8170 in Tirupur's garment industry by 10% and 50%. A third policy aligns with global advocacy for a "living wage" in the garment sector, raising the minimum wage to a monthly living wage of Rs.33,920 proposed by the NGO Asia Wage Floor Foundation. Both 10% and 50% minimum wage hikes increase wages and employment. Since colluders were previously the most productive firms in the economy, their expansion also raises productive efficiency (Baqaee and Farhi 2020). Finally, the proposed living wage cannot sustain collusion.

Literature To my knowledge, this paper is the first to evidence employer collusion in a contemporary labor market setting, contributing to a large and growing literature on labor market power (reviewed in Azar and Marinescu 2024, Card 2022, Manning 2011, Manning 2021, Kline 2025, and Sokolova and Sorensen 2021). The closest related work by Delabastita & Rubens (2024) uses a structural approach to uncover collusion in the Belgian coal cartel of the 1870s. It estimates production functions to estimate wage markdowns, estimates input supply curves, and uncovers the degree to which employers internalizing others' profits would justify estimated markdowns. Roussille & Scuderi (2024) extend the work of BCS,

[9] Members reverted to paying the minimum wage six to eight months after the large shock.

2021 to test conduct on an online recruitment platform for high-wage engineers in the US. For estimated labor supply and production functions, the correct model of conduct implies productivity shocks uncorrelated with instruments that only shift markdowns. They find that employers behave as monopsonists rather than strategic oligopsonists.

In addition to providing the first (to my knowledge) evidence of employer collusion in a contemporary labor market setting, the paper makes three contributions. First, I develop a simple comparative static test valid for very general labor supply and production structures, which diagnoses collusion without needing to estimate several structural objects (the traditional approach, e.g., BCS 2021, Berry & Haile 2014). The key innovation is showing that *firm-specific* shocks cleanly predict opposite quantity responses at unshocked firms under non-collusive models versus the breakdown of collusion.[10] Second, I diagnose collusion at a focal point wage. Many real world forces push towards a focal point over models where employers collude by partly or fully internalizing others' profits.[11] Focal points are easy to observe and monitor. The garment industry also faces transitory shocks difficult to publicly observe.[12] Finally, foreign buyers enforce compliance with the minimum wage, rendering it a reasonable target for collusion. My third contribution is detecting collusion in an important industrial setting in a developing country. The garment industry is among the largest employers in developing countries, employing over 90 million workers overall.

While minimum wages typically bind from below (e.g, Cengiz et al. 2018 for the US, and Derenoncourt et al. 2021 for Brazil), this paper shows that they can serve as focal points for collusion even when non-binding. Higher minimum wages could mitigate losses from collusion by shifting coordination to a higher wage.

Outline Section 2 derives the simple test of collusion. Section 3 describes the data and setting, and presents motivating evidence that industry associations use the minimum wage as a focal point. Section 4 implements the comparative static test of collusion. Section 5 implements a full-IO structural test of conduct to compare the fit of the breakdown of collusion, oligopsony, and other models. Section 6 calculates losses from collusion and evaluates the impact of minimum wage policy in mitigating them. Section 7 concludes.

[10] Several seminal studies use aggregate shocks to detect price wars (e.g., Porter 1983, Ellison 1984 studying the railroad cartel in the Unites States). However, since all models predict that aggregate shocks simultaneously shift prices, they must impose structure on demand, marginal costs, and the collusive arrangement to distinguish between models. In contrast, the proposed test is non-parametric and "reduced form", not requiring knowledge of cartel operations.

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

[12] 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.

2 Test

This section demonstrates that under quite general labor supply and production structures—where demand weakly slopes down and higher wages at competitors reduce labor supply to oneself—spillovers from a positive firm-specific demand shock produce opposite employment effects at unshocked firms operating independently ($\downarrow$ employment) versus former colluders whose collusion dismantles due to the shock ($\uparrow$ employment). The test nests perfect competition, monopsony, Bertrand, and Cournot oligopsony. It covers all collusive schemes where at least some cartel members earn higher profits with collusion than without it, without requiring a stance on the exact game in which firms interact.[13]

The main point is that, for broad conditions, non-cooperative competition *never* predicts higher employment at unshocked competitors. Therefore, if unshocked firms increase employment they must have colluded before and collusive breakdown predicts this response. Section 4 implements the spillover test separately by industry association membership. Section 5 adds structure to statistically arbitrate between various models of conduct.[14]

2.1 Setup

The economy has a continuum of firms with finite subset $\mathbf{J}$ competing in a market. Discrete time is indexed by t. Labor supply is invertible, meaning that employers are imperfect substitutes in workers' eyes, yielding upward-sloping labor supply to individual firms. Firm j's labor supply depends on its wage w_{jt}, competitor wages $\mathbf{w_{-jt}}$, and non-wage amenities $\mathbf{a_t}$: $n_{jt} = f(w_{jt}, \mathbf{w_{-jt}}, \mathbf{a_t})$. Dependence on competitor wages introduces the potential for spillovers. Spillovers occur when a shock to w_j rotates labor supply to j', prompting j' to respond by adjusting its own wage and employment. Invertibility is a small technical requirement ensuring a unique distribution of workers across firms paying a common wage, which is a hallmark of imperfect competition.[15] Invertibility nests both standard and non-standard labor supply systems including nested CES (e.g., Berger et al. 2022), discrete-choice logit (e.g., Card et al. 2018), nested logit, mixed logit, linear, Kimball, translog, and others.

The key labor supply assumption which nests invertibility is that employers are connected substitutes (Berry, Gandhi and Haile 2013). Employers are weak substitutes in that a higher

[13] The exact number of unshocked cartel firms that will raise employment depends on the magnitude of the shock. Appendix B.1 derives a simple condition under which the typical unshocked member increases employment.

[14] In Section 5, the breakdown of collusion from a focal point wage rejects Cournot oligopsony, Bertrand oligopsony, monopsony, and collusion without breakdown, like shifting to a new collusive wage or joint profit maximization.

[15] Invertibility accommodates arbitrarily large but finite substitution elasticities which approximates well the case of perfect substitutes (Kucheryavyy 2012).

wage at one employer weakly reduces labor supply to others with sufficient strict substitution to warrant treating employers within a common labor supply system.

The connected substitutes condition enables a non-parametric test of collusion while allowing for substantially more flexible substitution patterns than standard models. It ensures that positive shocks to j rotate j' 's labor supply left without imposing functional forms, smoothness restrictions, or strong domain restrictions. While connected substitutes nests nested CES and nested logit preferences, unlike these systems, it does not impose symmetry (i.e., that a firm's significance is summarized by its market share). It also nests job ladder models where higher wages or amenities move employers up the ladder (e.g., Sorkin 2018).

Assumption 1. (Connected substitutes) Employers are weak substitutes where all else equal, a higher w_j weakly reduces labor supply to others $\frac{\partial lnn_{j'}}{\partial lnw_j} \leq 0 \forall\ j'! = j$. Additionally, define the directed graph of a matrix to represent substitution among employers $\chi(w)$ whose elements are $\chi_{j+1,k+1=} \begin{cases} 1\{employer\ j\ substitutes\ to\ employer\ k\ at\ x\} \\ 0 \end{cases}$. For all w the directed graph of $\chi(w)$ has from each node $k! = 0$ a directed path to 0.

While connected substitutes is natural to assume in a labor market setting, some violations exist. For instance, some types of non-homothetic preferences may violate the connected substitutes condition if workers' preferences for non-wage amenities grow with worker wealth. Higher wages at j could then *increase* rather than decrease labor supply to some unshocked high-amenity employer j', rotating j''s labor supply right instead of left and increasing employment even under non-cooperative competition. Section 4.3 rules out three mutually exclusive and exhaustive violations of connected substitutes as driving results.

Firms post wages. Each firm operates a revenue function $f_j(z_{jt}, n_{jt}, k_{jt}, x_{jt})$ that uses inputs of capital k_{jt}, labor n_{jt}, and intermediates x_{jt} and is twice differentiable in labor. The second assumption underlying conclusions is:

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

Assumption 2 accommodates both product market power, which itself generates downward-sloping demand for labor, or diminishing *mpl* with price-taking behavior. It additionally encompasses horizontal demand, such as if firms possess excess capacity or face credit constraints.

Firm j experiences a positive demand shock $dlnz_{jt} > 0$. Below we characterize wage and employment responses at $j'! = j$ for different forms of conduct. Under non-collusive conduct, firms maximize profits by choosing the number of workers to hire or wage to set, taking as given competitors' employment decisions (Cournot oligopsony), wages (Bertrand oligopsony), considering themselves atomistic (monopsony), or being atomistic (perfect competition). Colluders adhere to a collusive scheme satisfying Assumption 3 described below, while fringe firms operate independently taking others' behavior as given.

Perfect competition Firm-specific demand shocks do not affect wages under perfect competition. Firms face flat labor supply curves and shocked firms increase employment until marginal product equals the market wage again. Market-level positive shocks increase the market wage and reduce employment at unshocked employers.

Oligopsony or Monopsony

Proposition 1: For oligopsonistic or monopsonistic conduct, any invertible labor supply system, and Assumption 2, a positive demand shock to j $dlnz_{jt} > 0$ causes unshocked competitors j' in its labor market to weakly increase wages 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 when employers are connected substitutes.

Proof Appendix A.1.

Proposition 1 demonstrates that under Assumptions 1 and 2 spillovers will never lead unshocked employers operating independently to increase employment. Figure 1 illustrates the basic intuition for a Bertrand oligopsony where employer j' faces upward-sloping labor supply and downward-sloping demand. A positive shock to j that raises j's wage draws workers away from j' whenever the two are substitutes, including via connections. Unshocked competitor j''s labor supply curve rotates leftward; she moves up her demand curve, increasing her wage and reducing employment.

While it is clear why spillovers increase wages, their negative impact on employment is less apparent. Spillovers exert competing forces on employment, best illustrated via the first order condition, $w_{j'} = \mu_{j'} mrpl_{j'}$, where $mrpl_{j'}$ is marginal revenue product of labor and $\mu_{j'}$ the markdown. The shock raises the optimal markdown for unshocked competitor j', who must raise pay to retain workers.[16] On the one hand, j' wants to decrease employment to raise marginal product. On the other hand, she wants to grow large enough again to pay workers a smaller markdown (rotate the labor supply curve back). I show that the first force unambiguously wins under the two assumptions and employment unambiguously declines.

[16]Step 1 of Proof or Proposition 1 establishes the existence of such an optimal markdown for any non-cooperative competition structure and invertible labor supply system.

Finally, spillovers also reduce employment under monopsony. This is because spillovers occur by changing the curvature of labor supply, which can depend on competitor wages even absent strategic motives for wage setting.[17] If yes, spillovers unambiguously reduce employment for monopsonists.

Binding minimum wage, other markets (product, input, capital) Appendix A.1 demonstrates that under monopsonistic or oligopsonistic competition with a binding minimum wage, firm-specific demand shocks still predict weak employment declines at unshocked competitors. Left rotations still reduce employment. On other markets, Proposition 1 holds whenever labor supply exhibits connected substitutability and revenue weakly diminishing *mrpl* regardless of competition in product, capital, or other input markets. Product market power itself generates diminishing *mrpl*. Standard assumptions in other factor markets also predict weakly downward-sloping labor demand (see Appendix A.1). Section 4.3 rules out unusual features of other markets that could violate diminishing *mrpl*.

Violations of assumption 1 or 2 In sum, together Assumptions 1 and 2 imply that wages under oligopsonistic or monopsonistic competition exhibit strategic complementarity and employment exhibits strategic substitutability. As noted, these assumptions cover all standard labor supply systems including nested CES, nested logit, mixed logit with connected substitutes, (and non-standard systems like linear, Kimball, translog), job ladder models, and horizontal demand (binding minimum wage, credit constraints, excess capacity). Nonetheless, there exist some violations. For instance, non-homothetic preferences that rotate unshocked competitors' labor supply right instead of left could violate assumption 1. Section 4.3 rules out three mutually exclusive and exhaustive violations of connected substitutes as driving results. I either show analytically that violations continue to predict strategic substitutability in employment or establish conditions under which they yield strategic complementarity and empirically eliminate these possibilities. I also rule out violations of assumption 2. Proposition 1 is proven absent exit, which is easily relaxed. If employer exit rotates labor supply right instead of left, unshocked oligopsonistic competitors only increase employment if wages fall (Appendix A.1). In contrast, I find wage increases at unshocked association members.

Breakdown of collusion

[17] 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, which is zero under monopsony. However, the first term can still depend on competitor wages for some labor supply structures. Write to me to discuss this useful point.

Assumption 3. (Current collusive profits exceed counterfactual profits for some members) At least some cartel members earn higher profits with collusion than without it. This condition ensures that the shock does not occur when each member sacrifices higher non-cooperative profits today for the promise of higher collusive profits in the future. Thus, the test requires no stance on the exact game in which firms interact (the collusive scheme) and instead applies to all schemes satisfying assumptions 1 through 3.[18]

Proposition 2: For any labor supply system where employers are connected substitutes, if a positive demand shock to firm j ($dlnz_{jt} > 0$) causes collusion satisfying assumption 3 to break down such that firms go to the counterfactual without collusion, then $\exists\ j' \in \{\text{cartel}\backslash j\}$ for which $\frac{dlnn_{j't}}{dlnz_{jt}} > 0$.

Proof Appendix A.1

The core intuition behind Proposition 2 is simple: in order for collusion to be profitable, at least some firms must depress both wages and employment relative to independent operation. While my focus is coordination at a focal point wage, the logic is clearest for the case of joint profit maximization. Colluding firms that internalize the negative effect of each firm's higher wage on the labor supply available to competitors will depress both wages and employment below independently optimal levels (similar motives inspire other types of collusion). Dismantling collusion increases both.[19]

Proposition 2 covers all collusive schemes satisfying assumption 3, including collusion at a single wage or by partly or fully internalizing others' profits. It additionally covers any equilibrium emerging post-breakdown, including monopsony, Cournot oligopsony, Bertrand oligopsony, or another outcome, subject to the next paragraph.

Former colluders (unshocked) increase employment as long as the demand shock is small enough to spur an equilibrium "close" to the counterfactual absent collusion. In contrast, very large demand shocks that drive equilibria far from this original counterfactual can also decrease employment at unshocked cartel members, for e.g., if the shocked firm seeks to employ its entire labor market. The test nonetheless demonstrates that under the two assumptions unshocked non-colluding firms *never* increase employment in response to a rival's positive demand shock, whereas colluding firms do. Appendix B.1 derives a simple condition governing the maximum shock size below which unshocked cartel members (or the representative

[18] Assumption 3 matters for the proof since no cartel member needs to depress wages and employment if no one benefits from collusion.

[19] Coordination in the garment industry resembles coordination at the minimum wage rather than internalizing others' profits. In fact, joint profit maximization would predict wage dispersion at differently productive employers. Many forces in the real world push towards a focal point. First, it is easy to observe and monitor. Second, the garment industry faces transitory shocks difficult to observe. Finally, foreign buyers enforce compliance with the minimum wage, rendering it a reasonable target for collusion.

member) will increase employment and confirms the studied shock was smaller.

2.2 Discussion

This section has shown that spillovers from a positive firm-specific demand shock will never lead unshocked competitors operating independently to increase employment (Proposition 1). Thus, if unshocked firms increase employment they must have been colluding before and a breakdown of collusion predicts this behavior (Proposition 2). Importantly, my goal is not to argue that one firm's deviation from its collusive wage will necessarily dismantle collusion. Such a claim would be false—the Folk Theorem shows that multiple alternative collusive schemes sans breakdown are sustainable for sufficiently patient firms. For instance, the cartel might allow positively shocked members to expand production while asking unshocked members to cut back, reversing these roles when the shocks reverse. Collusion without breakdown does not unambiguously predict higher employment at unshocked cartel members. Rather, my goal is to show that, under very general labor supply and production structures, unshocked firms competing non-cooperatively will *never* increase employment but colluding firms can—either due to breakdown or other collusive schemes. Section 5 demonstrates that the breakdown of collusion from a focal point wage rejects both non-collusive models (monopsony, oligopsony, perfect competition) and collusion without breakdown.

3 Data, Setting, and Motivating Evidence

3.1 Data Sources

My analysis links four new datasets spanning the period between 2014 and 2018. I track worker outcomes using employer-employee linked social security data from India's Employees' Provident Fund Organization (EPFO). The EPFO collects pension contributions for all workers with monthly earnings below Rs.15,000. For each employment spell, it reports a worker's monthly earnings, tenure, age, gender, and employer characteristics like six-digit NAICS code and location. Second, I identify industry association membership by scraping member lists from the five largest industry associations in the five major hubs of garment manufacturing in India—Tirupur (Tamil Nadu), Bangalore (Karnataka), Gurgaon (Haryana), Faridabad (Haryana), and Noida (Uttar Pradesh). Together these sites employ 63% of all garment workers in India, with the average association having 555 members.

Third, I construct a panel dataset of state- and industry-specific minimum wages using state government announcements of minimum wage hikes. Finally, I measure demand shocks using establishment-level customs records digitized by the organization Panjiva. For each shipment exported by an establishment, the data report its value, six-digit product code, and destination. Product codes reveal both article type and material, e.g., "women's or girls' track suits of cotton" or "men's or boys' shirts of man-made fibers". I link datasets to each other by matching exporter names and zip codes using a combination of the Jaro-Winkler and Levenshtein minimum distance algorithms and manual matching. Overall, I match 82% of exporters to social security records.

3.2 Institutional Setting

This paper argues that two important institutional features underlie collusion in the Indian garment manufacturing industry. First, large employers organize into local industry associations ostensibly to coordinate their actions in the product market. Second, each state establishes a separate minimum wage for the garment industry. I argue that members of industry associations coordinate to pay workers exactly this state- and industry-specific minimum wage, although they would pay more if instead operating independently.

Industry associations Nearly half of all workers in the Indian garment industry work for members of industry associations. Associations advance members' interests in policy, and offer perks like training programs and access to trade fairs. While the criteria for membership varies across locations, membership is typically restricted to large and prosperous factories. Below I detail the benefits of participating in and membership criteria for the Tirupur Exporters' Association.

Table 1 describes summary statistics comparing members of industry associations to non-members. Members are typically among the largest and most productive firms in the sector, employing on average 152 workers compared to 101 at non-members. Members are more likely to export (71% compared to 52% of non-members) and, conditional on exporting, export a greater number of products (2.2 versus 2.1) and higher dollar value (3 million USD versus 2.6 million) than non-members. The average member pays workers a monthly wage of 371 USD adjusted for PPP compared to $257 outside the association.

While the bunching results reported below apply to associations in all five of the major garment-producing hubs of India, the spillover test of collusion focuses on Tirupur, which employs over a third of garment workers and produces sixty percent of exports.

Minimum wage Each state in India establishes a daily minimum wage for 105 different scheduled employments—roughly, two-digit industries.[20] Examples include garment manufacturing, biscuit manufacturing, and tobacco processing. This minimum wage is designed to

[20]The number of schedules depends on worker populations—industries with over 1000 workers can have distinct minimum wages, with a median of 105 across states.

cover basic living expenses for a family of four members and is benchmarked to local prices. For instance, the minimum wage in Karnataka aims to cover a very precisely defined set of items: "food items providing 2,400 calories, $\geq$ 50 gm of protein, and $\geq$ 30 gm fats per person per day", "essential non-food items like clothing, fuel, rent, education, healthcare, footwear and transport equal to the median class' expenditure", and "other non-food items equal to the sixth fractile of household expenditure". States typically gather price information from multiple markets before revising the minimum wage, for instance, Karnataka surveys sixteen different markets.

State governments must revise the minimum wage once every five years and adjust it for inflation every six months. However, revisions are infrequent in practice, with the average state only revising its minimum wage for the garment sector four times during 2014 to 2018. Minimum wages are set at three different levels for unskilled, semi-skilled, and skilled workers. In the garment industry, examples of skilled roles include designers, cutting machine operators, and grade I tailors; semi-skilled roles include grade II tailors and buttonhole machine operators, and unskilled roles include helpers and packers. All results in this paper use the semi-skilled wage, since over 65% of workers inhabit this category.

Table 2 summarizes the state of state-level minimum wages in the garment industry as of July 2016. The monthly minimum wage for unskilled workers ranged between Rs. 4390 and Rs. 9568, with an average value of Rs. 6962 (361 USD adjusted for PPP). The semi-skilled wage ranged from Rs. 4700 to Rs. 10582 with an average of Rs. 7439 (387 USD), and skilled wage ranged from Rs. 5171 to Rs. 11622 with an average of Rs. 8034 (418 USD).

Minimum wages are highly imperfectly enforced. Both the central and state governments are tasked with enforcement through labor inspections, and any employer found in violation faces fines of up to Rs.10,000 and imprisonment up to five years (Shyam Sundar 2010). However, both data and NGO investigations reveal large non-compliance with local minimum wages. For instance, the NGO Workers' Rights Consortium found thousands of factories in Karnataka as flouting minimum wage laws in 2021 (WRC 2021). In social security records, I show that over half of all formal workers in the garment industry earn below the minimum wage. This non-compliance reflects a combination of factors: imperfect enforcement, the small monetary penalty for violations (worth one worker's monthly salary), and no information sharing between the social security administration and Labor Ministry.

Tirupur and the Tirupur Exporters' Association The main spillover test of collusion in Section 4.2 focuses on Tirupur, which employs 30% of garment workers in India and produces 56% of exports. Tirupur's primary industry association, the Tirupur Exporters' Association (TEA), offers several benefits to its members, including organizing regular trade fairs to advertise products to international buyers—a benefit that would otherwise cost

$1500—and networking events where members can learn about new technologies and production methods (TEA 2024b, c). The TEA also disseminates information about accessing government schemes and subsidies to its members. On the policy front, the TEA recently lobbied the central government to enact free trade agreements with the United States and UK (Srinivasan 2024, TBS 2023, TEA 2024). Finally, even beyond its professional benefits, many core members of the association are friends.

TEA membership is restricted to large and prosperous factories. To qualify, factories must maintain annual revenues of at least Rs. 50 lakh over the past three years (worth 1.3 million USD in PPP terms), be endorsed by two existing members of the association, and undergo a two-year-long probationary term before becoming eligible for permanent membership. The TEA currently has 1076 permanent members and 155 probationary members, up from 931 permanent and 155 probationers in 2018.

Although a key advantage of the spillover test developed in Section 2 is that it enables diagnosing collusion without requiring a stance on the exact game in which firms interact, institutional features in Tirupur suggest that collusion is tacit. Members of the TEA realize that paying above the minimum wage risks being expelled from the association (shown in Fact 3 below), or moving to the punishment stage of the game (Section 4.2).

Wage observability Factories in Tirupur publicly post wages outside their premises, making collusion, and punishing deviators, feasible (see Figure A1). Public posting implies that (i) wages are posted, (ii) workers with the same skill are paid identical wages, and (iii) deviations from the minimum wage are easily detectable.

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

I begin by presenting five facts which show that members of industry associations disproportionately cluster to pay exactly the local minimum wage, while non-members typically pay below the minimum wage. The resulting model of collusion I propose is one where large and productive firms organize a cartel to pay workers exactly the minimum wage (the industry association), while less productive firms pay below the minimum wage (the fringe).

Fact 1: Wages bunch from above at the state- and industry-specific minimum wage Figure 2 (Panel a) plots the monthly earnings of all formal employees in the garment industry, averaged over January to July 2015. Wages disproportionately bunch from above at the state-specific minimum wage: over 29% of workers earn within 7.5% (2 days) of the minimum wage, 54.7% earn below the minimum wage, and only 16.1% earn above the minimum wage. Figure 3 demonstrates similar bunching patterns across all four of the major garment-producing states of India—Tamil Nadu, Karnataka, Uttar Pradesh, and Haryana. Together the figures demonstrate that minimum wages effectively serve as a maximum wages in the garment industry.

Two potential caveats impede this interpretation. First, earnings below the minimum wage might reflect part-time work instead of underpayment. I evaluate this concern by plotting the distribution of modal earnings across establishments, which likely represent the wage of full-time workers, since over 95% of garment workers in India work full-time (Primary Labor Force Survey, 2021). Modal earnings exhibit bunching akin to the average: nearly half of all modal workers earn below the minimum wage, with 30% clustered right at the minimum. A second concern is reporting bias. Since reported wages determine social security contributions, employers might falsely report paying exactly the minimum wage to shield higher earnings from social security deductions. I assess this concern by plotting the distribution of self-reported wages from the Primary Labor Force Survey (PLFS), a representative household survey. Although self-reported earnings do not impact social security contributions, they still exhibit bunching akin to social security records (Figure A2). Finally, beyond administrative and survey records, numerous qualitative accounts also highlight the prevalence of the minimum wage. For instance, Adhvaryu et al. (2019) evaluate a worker voice intervention at India's largest garment exporter that empowered workers to express disappointment with a low minimum wage hike, operating off the premise that these workers expected to earn exactly the new, disappointing, minimum wage. Garment workers across several contexts routinely protest for minimum wage hikes (Figure A3 offers Bangalore and Bangladesh as two examples).[21]

Fact 2: Members of industry associations disproportionately bunch from above at the minimum wage Over 42.8% of workers employed by members earn within 7.5% of the minimum wage, 38.7% earn below the minimum wage, and 18% earn above it. By contrast, most workers employed by non-members earn below the minimum wage (71.4%) and only 15.1% earn close to the minimum wage (Figures 2b and 3).

Fact 3: Members who deviate above the minimum wage are expunged from the association The Tirupur Exporters' Association requires a two-year probationary term before new members become eligible for permanent status. A third motivating investigation explores how promotion rates vary by members' deviations above the minimum wage during probation. Consistent with the association excluding members for raising pay above

[21] Several interviews I conducted with garment workers, factory owners, industry heads, and nonprofit organizations across different parts of India consistently point to workers earning exactly the minimum wage.

the minimum wage, I find that deviating members are 38pp less likely to be promoted to permanency relative to a baseline rate of 75% (Table 3).

Fact 4: Members of industry associations track increases in the minimum wage, without reducing employment To study the effect of minimum wage hikes, I identify nine large state-level minimum wage increases of at least 7.5% between 2015 and 2018. I use a stacked event study to compare employers in states that increased the minimum wage to other states separately by industry association membership.

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

The two outcomes are: an indicator equal to one if an establishment's modal wage is within two days of the new minimum wage and employment. y_{jst} is the outcome for establishment j in state s in month t relative to the event, $Treat_{st}$ is an indicator equal to one in states that increased the minimum wage in $t = 0$, and zero for states that never or were yet to increase their minimum wage. A_j is an indicator for industry association membership. The three sets of fixed effects are: establishment α_j, month around event λ_t, and calendar month η_{month}. β_t are the coefficients of interest with $\beta_{t=-1}$ omitted. I cluster standard errors by establishment. Conclusions are unchanged when using the de Chaisemartin and d'Haultfoeuille (2020) procedure to account for heterogeneous effects across cohorts and time.

Association members are substantially more likely than non-members to track increases in the minimum wage without reducing employment (Figure 4). Two months after a hike, members of associations are 21pp more likely to raise wages to exactly match the new minimum wage compared to 10pp for non-members (Panel A). This wage gap grows over time and, after eight months, members are 35pp more likely to pay exactly the new minimum wage compared to 10pp among non-members. However, higher wages do not come at the expense of employment among either members or non-members (Panel B). I find a small positive effect on employment at members (4pp). That employers can increase wages without reducing employment indicates imperfect competition in the labor market.

Taking stock Section 4.1 presents a final motivating investigation showing that members and non-members respond differently to small firm-specific demand shocks. While non-members respond like non-cooperative firms facing upward-sloping labor supply curves—increasing wages and employment to meet demand—members forego small export opportunities to stick to the minimum wage (Fact 5). Together, Facts 1 to 5 motivate the notion that industry associations in the garment industry use the minimum wage as a focal point for coordination.

I therefore implement the test of collusion separately by association membership.

4 Empirical Results

This section studies employer responses to firm-specific demand shocks separately by association membership. Section 4.1 provides motivating evidence that members forego small export opportunities to stick to the minimum wage. Section 4.2 implements the main test of collusion by examining the spillover effects of a large, firm-specific demand shock that led affected members to raise wages. I focus on Tirupur, which employs 31% of garment workers in India and produces half of all exports.

4.1 Small shocks

Fact 5: Members of the industry association forego export opportunities from small positive demand (price) shocks, whereas non-members raise wages, employment, and exports Small demand shocks should lead independently operating firms facing upward-sloping labor supply curves to raise wages and employment but may elicit no response if employers abide by the minimum wage.[22] For example, members of a cartel that punishes deviations above the minimum wage with a punishment profit Π_{punish} for T periods will stick to the minimum wage as long as: $\sum_{T+1} \delta^t \Pi_{coll,mw} > \Pi_{dev} + \sum_T \delta^t \Pi_{punish}$. Small shocks may not increase Π_{dev} enough to trigger a deviation.

I compute small demand shocks by leveraging two features of the garment industry. First, demand is highly transitory, reflecting idiosyncratic fashion trends like the introduction of a new fashion line or special seasons sales. Second, export relationships are recurrent, i.e., establishments export to the same importer over time. I define an establishment's *chief importer* as the entity to which it exported the most in dollar value during its previous export season, e.g., Zara USA or Nike Brazil (exports peak twice a year, demarcating two seasons, before winter holidays in November and summer sales in July).[23] I define an establishment as receiving a small demand shock if the average unit price of imports to its chief importer, excluding imports from its own state, grew by 5 to 15% between two export seasons. Units correspond to volume, twenty foot equivalents, but results are invariant to using quantities instead. The shock measure excludes imports from one's own state to isolate demand-side variation in prices rather than supply shocks to TFP or costs commonly

[22] Colluding members will only forego export opportunities to stick to the minimum wage if labor supply slopes up at the minimum wage, which is confirmed by elasticity estimates in Section 6.

[23] The average establishment exports 69% of value to its *chief importer*, which remains unchanged for over 80% of establishments between 2016 and 2018.

affecting establishments statewide. The idea is that prices paid by importer i to exporters *outside* state s capture demand shocks common to i rather than supply shocks common to s. Table A2 confirms that price shocks reflect price changes rather than changes in product composition (six-digit codes).

Figure A4 shows a strong first stage effect of small shocks on prices: affected establishments witness an 8% increase in their export price. A DiD event study examines member and non-member responses to small shocks, comparing shocked establishments to themselves in unshocked export seasons by including establishment-time-around-the-start-of-the-export-season fixed effects (α_{jt}). To do this, I construct a panel dataset that tracks each establishment experiencing a small shock between 2014 and 2018 for all its export seasons (both shocked and unshocked), from months $t = -4$ to $t = 6$ around the start of the season. The regression is:[24]

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

Y_{jtk} is the outcome of interest for employer j in month t relative to the start of season k. A_j is an indicator for industry association membership, and $Sshock_{jk}$ equals 1 in small-shocked seasons. β_t are the coefficients of interest with $\beta_{t=-1}$ omitted. β_t track the average employer's trajectory of outcomes relative to $t = -1$ in shocked versus unshocked seasons. Standard errors are clustered by chief importer. Since small demand shocks affect fewer than 5% of establishments in any season, results reveal how employers respond to firm-specific shocks.

The identifying assumption is a parallel evolution of outcomes in shocked and unshocked seasons absent the shock. Parallel pre-trends and a placebo check demonstrate the plausibility of this assumption: randomly picking an unshocked season for each establishment, I find that outcomes indeed evolve in parallel to other unshocked seasons (Figure A5).

Figures 5 and 6 report results. Non-members cater to small demand shocks by raising wages and employment (Figure 5). Four months after a shock, the average wage at affected non-members rises by 8% and employment grows 7%. In contrast, members of the association forego small export opportunities to stick to the minimum wage—they do not increase wages, do not raise employment, and do not expand exports (Figure 6). I successfully reject small increases in both employment and exports, exceeding 1%, with 95% confidence.

That association members forego small export opportunities instead of raising wages

[24] An alternative specification controlling for a common average trend around the start of export season (as opposed to establishment-specific trend) yields similar results: $\alpha_j + \sum_{t=-4}^{t=6} \lambda_{1,t} A_j 1_t + \sum_{t=-4}^{t=6} \lambda_{2,t}(1 - A_j)1_t + \sum_{t=-4}^{t=6} \beta_{1,t} Shock_{jk} A_j 1_t + \sum_{t=-4}^{t=6} \beta_{2,t} Shock_{jk}(1 - A_j)1_t + \epsilon_{jt}$. Here λ_t captures the average outcome relative to $t = -1$ during unshocked seasons and β_t captures the differential effect during shocked seasons.

suggests they are adhering to the minimum wage. One possible caveat to this interpretation is that members' lower responsiveness could reflect differences from non-members (e.g., lower excess capacity) or smaller shocks. Here, I first note that Fact 5 is primarily motivational, showing that association members disproportionately pay the minimum wage. The main test of collusion instead studies the spillover effects of firm-specific demand shocks (Section 4.2). Nevertheless, several findings counter the notion that members' lower responsiveness reflects different characteristics or shocks. First, results hold when comparing observably similar members and non-members, controlling for employer size, product exported, and importer (Table A1).[25] Second, the first-stage effect on prices is remarkably similar for similar-sized members and non-members, suggesting similar-sized shocks. Together these findings indicate that TEA members forego small export opportunities to stick to the minimum wage.

Two key points Two key points are worth noting before implementing the spillover test of collusion. First, the true boundary of the cartel may be smaller than the full association. Evidence suggests that permanent members—82% of all members—likely define the relevant boundary, since they disproportionately cluster to pay exactly the minimum wage and apparently enforce compliance with it by expelling probationary members who exceed the minimum wage during probation (Fact 3). Nonetheless, the above facts show that the association forms a reasonable boundary across which to separately apply the spillover test. Second, the spillover test requires no stance on the exact game in which firms interact, i.e., it does not require knowing how the association enforces collusion (Proposition 2). This makes it a useful diagnostic tool for detecting collusion even without knowledge of cartel operations. The test applies to all collusive schemes satisfying assumption 3, although I use it to study collusion at a focal point wage.

4.2 Test of collusion: Large shock

The main test of collusion studies the spillover effects of an exceptionally large, firm-specific demand shock that increased export prices in Tirupur by 24.5% between 2016 and 2017, and affected 14% of employers. The shock originated due to labor audits in Vietnam that uncovered severe labor law violations and compelled 26 major fashion brands to temporarily relocate production operations from Vietnam to India.[26] The brands included Zara USA, Macy's USA, Nike, and Gap (Figure 7). Conducted by the NGO Worker Rights Consor-

[25]Non-members may respond more to small demand shocks if they possess higher excess capacity or face more elastic labor supply. However, controlling for employer size—which proxies for excess capacity and determines labor supply elasticities in standard systems like nested CES or logit—leaves conclusions unchanged.

[26]The audits were conducted at the behest of universities sourcing merchandise from these factories.

tium, audits accused Vietnamese factories producing for these brands of wage theft, unjust overtime practices, pregnancy discrimination, and safety infractions, among other violations (Figure 7). Affected brands tapped their existing exporters in Tirupur for higher exports.

The relocation shock thus constitutes a positive, firm-specific demand shock to employers in Tirupur exporting to affected brands, but not employers exporting to other brands. Figure 8 shows a strong first-stage effect on prices: prices at affected exporters grew 24.5% over their unaffected counterparts.

The ideal shock for studying the spillover effects of firm-specific shocks on unaffected firms is firm-specific, rather than aggregate.[27] Correlated demand or supply shocks—such as through subcontracting, or correlated shocks to prices, labor supply, TFP, or input costs—could instead simultaneously increase labor demand at all firms, making it difficult to disentangle the effect of a direct shock from spillovers. In this case, I confirm the large demand shock was firm-specific. The shock impacted 14% of employers in the garment industry and 13% of TEA members. Importantly, affected and unaffected members closely resembled each other in baseline characteristics, including zip codes, six-digit products, firm size, and workforce composition (age, female share of employment, and share of local workers, Figure 9), suggesting an absence of correlated supply shocks. Section 4.3 further rules out correlated demand shocks (such as through subcontracting) or other supply shocks (such as to TFP or costs) as driving results.

A specification identical to equation 2 studies the direct effect on affected employers; as before, the labor demand shock occurs three months before exports. To study spillovers on unaffected employers, I run a similar specification exclusively for unshocked firms:

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

I compare unshocked establishments to themselves in other export seasons—without the Vietnam relocation shock—through establishment-time-around-start-of-the-export-season fixed effects, α_{jt}. $SS_k = 1$ (shocked season equals one) during the relocation shock and 0 in other seasons. Other variables are defined as in 2. The identifying assumption is that wages and employment would evolve in parallel to other seasons absent relocation. Parallel pre-trends and a placebo check demonstrate the plausibility of this assumption: randomly picking an unshocked season for each establishment, outcomes indeed evolve in parallel to other unshocked seasons (Figure A5).

[27] While I focus on firm-specific demand shocks, the test also works with firm-specific supply shocks.

Results Spillovers from firm-specific demand shocks should lead unshocked employers competing non-cooperatively to increase wages and *reduce* employment. In contrast, spillovers that lead unshocked firms to increase employment evidence collusion (Section 2).

The relocation shock provided scope for spillovers by leading both affected non-members and members to increase wages and employment. Like small shocks, non-members catered to higher demand by increasing wages to attract workers (Figure 10). Four months after the shock, non-members' wages grew by 10.3% and employment increased 9.8%, remaining elevated for six months. However, unlike small demand shocks, affected *members* of the association also responded to the large demand shock by increasing wages to expand employment (Figure 11). Four months later, affected members were 63pp more likely to pay above the minimum wage; their wages increased by 10% and employment grew 9.9%. Members' responsiveness to this large shock but not smaller shocks in 4.1 is consistent with the 24.5% price increase raising deviation profits more than the 5 to 15% increases studied above.

Next, I study spillovers onto unaffected employers. The shock prompted unaffected non-members to respond non-cooperatively, by raising wages and reducing employment (Figure 12). Four months post-shock, the average wage at unaffected non-members grew by 5% and employment *declined* 6%. Higher wages at affected firms drew workers away from unshocked non-members, rotating their labor supply curves left. Like oligopsonists facing heightened competition for workers, unshocked non-members responded by raising wages, but could retain fewer workers than before.

However, unlike the reduction in employment found for non-members, unaffected members increased both wages *and* employment. The average wage at unaffected members grew by 6.3% and employment *increased* 8.6% (Figure 13). This positive spillover effect on employment contrasts with all non-cooperative models of competition satisfying assumptions 1 and 2, including perfect competition, monopsony, Cournot oligopsony, and Bertrand oligopsony (Proposition 1). Instead, higher employment at unshocked members evidences collusion. When the large demand shock increased members' incentives to deviate, shocked members broke collusion, leading unshocked members to also increase employment despite no shock to themselves (Proposition 2). Note that other collusive schemes sans breakdown can also predict higher employment at unshocked firms. Below I rule out violations of assumptions 1 and 2 that may lead unshocked members to increase employment even absent collusion. In a structural test of conduct, the full breakdown of collusion from a focal point wage best fits the data, rejecting both oligopsony and monopsony, as well as moving to a new collusive scheme like a new focal point or joint profit maximization (Section 5).

Institutionally, collusion fully broke down because the tacit nature of collusion in Tirupur made it difficult to quickly establish a new focal point. While members recognize that undercutting the minimum wage, detectable on public factory displays (Figure A1), risks precipitating a punishment breakdown or expulsion from the association, factories do not explicitly discuss the wage. Employers rely on individual contractors to recruit enough workers to meet production targets. Once affected members had committed to increasing exports, agents had to offer whatever wages workers were willing to accept and there was no time for a new tacit collusive arrangement (or focal point) to emerge. About half the new recruits came from factories within Tirupur and the rest came from elsewhere.

A final point worth noting is that identifying collusion requires demonstrating higher wages and employment not at the average firm, but the *same* firm. Proposition 2 shows that spillovers will lead *at least some* former colluders to increase employment if the demand shock triggers an oligopsony equilibrium close to the counterfactual absent collusion. To align empirics to theory, I derive a simple condition on the maximum shock size satisfying this size condition and confirm the relocation shock was smaller (Appendix B.1). Second, as predicted, I find that the *same* unshocked members increased both wages and employment, evidencing collusion (Figure A6).

4.3 Robustness

Four explanations could lead unaffected members to increase employment even without collusion. Proposition 1 shows that spillovers cannot lead unshocked firms operating non-cooperatively to increase employment as long as: (i) the shock is firm-specific, (ii) employers are connected substitutes (assumption 1), and (iii) demand exhibits weakly diminishing marginal product of labor (assumption 2). Conversely, violations of these conditions could increase employment at unshocked members even without collusion. A new, higher wage imposed by foreign brands or the association could also raise employment (operating like a new minimum wage).[28] I evaluate and rule out each explanation in turn.

Correlated demand shocks Unaffected members may not be truly unaffected. Affected members might subcontract export orders to unaffected members, or offload "worse" orders. Higher employment at unaffected members would then reflect higher demand and not collusion. Four findings contradict this explanation. First, unaffected members expanded employment by increasing exports to their own chief importers rather than affected brands

[28] Visualizing a monopsony 101 setup helps identify the universe of cases where unshocked employers could increase employment even absent collusion. Employers face upward-sloping labor supply, downward-sloping demand, and potentially a binding minimum wage. Per Proposition 1, spillovers trigger a left rotation of an unshocked competitor's labor supply curve, raising wages and reducing employment. However, unshocked oligopsonists could increase employment if other aspects of the picture shift: demand increases (correlated demand or supply shocks), no left rotation of labor supply (violation of connected substitutes), or imposing a higher wage (a new "minimum wage").

(Table 4).[29] Per a simple calculation, higher exports fully accounted for the new workers, leaving little room to fill sub-contracts.[30] Second, large unaffected members, employing over one hundred workers, also raised employment, who do not accept subcontracts (Table 5).

Third and importantly, I find no detectable impact on prices at unaffected members (Figure A7). Product composition remains stable, implying no change in effective prices (Table A2). Only demand shocks that raise prices can lead oligopsonistic or monopsonistic firms to produce more by moving up the labor supply curve, since only they increase the *mrpl*. (For example, affected members' prices rose by 24.5%, consistent with receiving positive demand shocks.) In contrast, the lack of price changes at unaffected members suggests their export expansion reflected higher export *supply* when no longer bound by the minimum wage, rather than higher demand.

Finally, I study the relocation shock's effect on profits. Positive demand shocks should raise profits while shocks that prevent employers from accessing (higher) collusive profits should lower them. Profits data is sourced from Prowess and covers 24% of sample establishments.[31] Consistent with *affected* members experiencing a positive demand shock, I find a 16.2% increase in profits (SE 0.081, Table 6). In contrast, the profits of unaffected members declined by 5.3% (SE 0.012), consistent with them no longer accessing collusive profits. This profit decline closely resembles the implied increase in wage costs at unaffected members.[32]

Profits could decline under oligopsony even as employment rises if unaffected members experienced a positive shock alongside relocation (e.g., higher demand, TFP, or lower costs), causing profits to decline *less* than without the shock. The demand curve shifts right even as labor supply rotates left. I rule out TFP and cost shocks below, and find no source of positive demand shocks for unaffected members. Measured and effective prices are unchanged, rejecting small increases with high confidence (Figure A7, Table A2). Although quantity shocks don't raise the MRPL, appendix A.1 still investigates and finds they do not drive results.

Together these findings show that higher employment at unaffected members did not reflect correlated demand shocks. Rather, association members had previously suppressed both wages and employment to sustain higher collusive profits. When the shock made collusion untenable, they raised both.

[29] Capacity constraints compel 40% of Indian garment exporters to turn away export orders, explaining how unaffected members could rapidly expand exports when not bound to the minimum wage (ILO 2016).

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

[31] Prowess compiles financial performance data of Indian companies from annual reports, stock exchanges, and regulatory filings. It covers 40,000 companies, including all publicly listed firms and a sample of others.

[32] The average unaffected member pays 6.3% more to 8.6% more workers, implying a 6.8% decline in profits.

Correlated supply shocks: e.g. TFP or cost shocks Second, relocation may coincide with correlated supply shocks to members' TFP or input costs, increasing labor demand and employment even absent collusion. Three facts point against this explanation. First, relocation disparately impacted the prices and profits of affected and unaffected members (Figure 8, Figure A7), suggesting a distinct and not common source of shocks. Second, common TFP or cost shocks should drive simultaneous wage and employment changes at affected and unaffected members, but I find systematic differences. While affected members raised wages and employment immediately upon receiving relocation orders in $t = 0$, unaffected members adjusted two months later, in $t = 2$, suggesting that collusion ceased once unaffected members noticed affected members' deviations from the minimum wage. Finally, the conduct test in Section 5 imposes no input shock restrictions, so its conclusion deeming collusive breakdown the best-fitting model holds despite any common TFP or cost shocks.

Non-homothetic preferences Non-homothetic preferences for amenities could violate the connected substitutes condition, raising employment through a labor supply channel if unaffected members' amenities surpass those of non-members. Higher wages at affected employers that raise worker wealth could *increase* (not decrease) labor supply to high amenity employers, rotating labor supply right rather than left. I mitigate this concern by controlling for three amenity measures. Non-homothetic preferences should similarly shift labor supply to unshocked members and non-members with identical amenities—not produce opposite employment effects. First, I leverage foreign buyer enforcement of common amenities through audit agencies (documented in Boudreau 2024, Alfaro-Urena et al. 2022, my summer 2023 interviews in Tirupur). I control for common labor supply changes to exporters of brand c via importer-specific time trends in the shocked season ($\alpha_{ct\times shocked}$):

$$Y_{jtk} = \alpha_{jt} + \alpha_{ct\times shocked} + \sum_{t=-4}^{t=6} \beta_{t,1} SS_k A_j 1_{month=t} + \sum_{t=-4}^{t=6} \beta_{t,2} SS_k (1 - A_j) 1_{month=t} + \epsilon_{jt} \quad (4)$$

Table 5 still finds opposite employment effects at unshocked members and non-members, whose residual labor supply should change similarly. Controlling for other observed amenities, including establishment size, location, female share of workers, local worker share, and product (production process) also produces opposite employment effects (Figure A8).

Other violations of Assumption 1 (connected substitutes) and Assumption 2 (weakly diminishing marginal revenue product) Together Assumptions 1 and 2 yield strategic substitutability in employment under non-cooperative competition. Violations of these assumptions could instead lead employment to exhibit strategic complementarity even without collusion. Recall that connected substitutes implies that higher wages at one's competitor reduce labor supply to oneself (Assumption 1). Non-homothetic preferences or some types of worker heterogeneity may violate this assumption if, for example, higher wages elsewhere draw away one's most elastic workers, who highly value wages relative to amenities, and leave behind inelastic workers.[33] The differential retention of inelastic workers would reduce rather than raising j''s optimal markdown, $\mu_{j't}$.

Appendix A.1 characterizes and eliminates three mutually exclusive and exhaustive violations of connected substitutes as driving results. Connected substitutes implies that the optimal markdown declines with an employer's wage: good (high-wage) employers can pay workers a smaller fraction of marginal product. First, I show that for violations of connected substitutes where the markdown still declines in the wage, employment under oligopsony can only exhibit strategic complementarity if wages are strategic substitutes (i.e., employment rises only if wages decline).[34] In contrast, unshocked members' wages rise. Second, when the optimal markdown increases with the wage, wages and employment must either both exhibit strategic substitutability or strategic complementarity. Typical worker heterogeneity inhabits case one, i.e., both are strategic substitutes. An unshocked competitor who loses elastic workers can pay remaining inelastic workers less, but must nonetheless reduce employment since she would have to raise wages to attract workers back. Analytically, employment remains a strategic substitute. Alternatively, wages and employment could both be strategic complements if the shock reshapes the worker pool to unaffected members.[35] I rule this out by showing that unaffected members' new and old workers had similar characteristics predicting preferences: age, gender, and origin (Table A3). Moreover, unshocked members and non-members with similar amenities, whose residual labor supply should change similarly, show opposite employment effects (Table 5). In sum, higher employment at unaffected members does not reflect a violation of connected substitutes.

Downward-sloping demand may be violated or demand may shift right if the shock prompts the TEA to negotiate cheaper input contracts for all its members. However, cheaper costs contrast with the profit decline found for unshocked members, which instead suggest a loss of access to collusive profits. Several interviews also point against the association negotiating common input contracts for members. Finally, neither the association nor foreign

[33]Say the utility of worker i at employer j' is $\beta_i log w_{j'} + log a_{j'} + \epsilon_{ij}$. Higher valuation of wages relative to amenities (high β_i) would increase the wage elasticity of labor supply to j'. Higher wages elsewhere would draw away workers with high β_i, reducing the elasticity to j' and markdown $\mu_{j't}$ (share of mp paid).

[34]Labor supply rotates right instead of left. Non-homotheticity or competitor exit may spur right rotations.

[35]The new pool differs in its residual labor supply curve to the firm for example by rotating it at the point of intersection with demand. It's hard to think of a concrete example since traditional violations inhabit the other two cases, but could occur if new workers greatly value wages over amenities and have a higher reservation wage.

buyers imposed a new wage (for example, I find wage dispersion in the post period and opposite employment effects when comparing unaffected members and non-members exporting to the same foreign buyer, Figures A8, A9). Appendix A.1 comprehensively describes and rules out these violations that could lead unshocked members to increase employment even without collusion. In sum, the fact that unaffected members increased employment while reducing profits stands in contrast to all forms of non-cooperative competition and instead evidences collusion.

5 Test of conduct

While the comparative static test of collusion is appealing in its minimal structure a full structural approach enables statistically adjudicating between models of conduct. I extend the approach of Backus, Conlon, and Sinkinson (2021) to test for *changes* in conduct. I make two comparisons. First, I compare Cournot oligopsony and monopsony throughout to the breakdown of collusion from a single wage. Second, I compare breakdown to other collusive arrangements. Although used in this section, labor supply and production are estimated in Section 6 (counterfactuals).

5.1 Summary

The BCS approach arbitrates between models of conduct by leveraging the exclusion restriction that the true model predicts productivity shocks uncorrelated with instruments that only shift markdowns. Given observed wages, BCS impose specific labor supply and production structures to infer the productivity shock implied under each model (z_{jt}). The moment condition requires z_{jt} to be uncorrelated with instruments shifting only markdowns (μ_{jt}). Comparing any two models, the null hypothesis assumes equally good fit; the model rejecting this null "fits" better (Rivers and Vuong 2002).

I modify the BCS approach to instead identify *changes* in conduct following the large demand shock. The correctly specified change will imply dz_{jt} uncorrelated with instruments shifting only μ_{jt}. My instrument is a weighted average of demand shocks affecting other firms $j'! = j$. I assume a Cobb-Douglas value-added production function in capital and labor with a Hicks-neutral productivity shock: $\tilde{z_{jt}} n_{jt}^{\tilde{\alpha}}$, where z_{jt} equals the product of TFP and price for employer j at time t, $\tilde{z}_{jt}$ is its modified value plugging in optimal capital demand (capital is supplied competitively in a rental market), and n_{jt} is labor. Production in the garment industry is commonly modeled in this way, representing a Leontief production process in materials (e.g., Cajal et al. 2019, Atkin et al. 2019). To compute $dln\mu_{jt}$ across models, I assume a three-nested logit labor supply system where workers sequentially choose locations, industries, and employers. Section 6 estimates production and labor supply.

Under non-cooperative competition, wage and employment changes are governed by firm j's best response wage: $w_{jt} = \mu_{jt} mrpl_{jt}$.[36] Totally differentiating this best response function following any change to firms in the market yields $dlnz_{jt}$:

$$dlnw_{jt} = dln\mu_{jt} + dln\tilde{z_{jt}} + (\tilde{\alpha} - 1) dlnn_{jt} \tag{5}$$

I recover $dlnz_{jt}$ by calculating $dlnn_{jt}$ and $dlnw_{jt}$ in data, and $dln\mu_{jt}$ implied by conduct.

Under collusive breakdown, conduct shifts from collusion at the minimum wage to a Cournot oligopsony due to shocked firms' deviations above the minimum wage. The test remains agnostic regarding the exact Nash strategy played to precipitate breakdown. For unshocked firms, $dlnz_{jt}$ is randomly drawn from a distribution governing shocks to z_{jt}, and conduct shifts from collusion to oligopsony due to breakdown.[37] The moment condition is:

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

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 large demand shock summed over all employers excluding j.[38] Appendix B.2 formally justifies this instrument. I generate empirical analogs of the moment condition and formulate a pairwise test statistic to compare the fit of model 1 versus 2 (as in Rivers and Vuong 2002, BCS 2021):

$$t_{1,2} := \frac{(\hat{M}_1 - \hat{M}_2)}{\frac{\hat{\sigma}_{1,2}}{\sqrt{n}}}$$

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

Two comparisons test for changes in conduct among unshocked members of the industry association. First, I assess Cournot oligopsony throughout (and monopsony throughout)

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

[37] The random component of shocks to z_{jt} is calibrated to small shocks, where a random 14% of firms receive price changes uniformly distributed between -10 to 10%.

[38] The one-time relocation shock furnishes sufficient variation since the instrument's value differs with employer size. Intuitively, large employers' markdowns are more responsive to others' shocks since they have more room to adjust, captured by the $1 - s_{jt}$ term in the denominator (Amiti et al. 2019, Sharma 2023).

against switching from coordination at the minimum wage to a breakdown to Cournot oligopsony following the shock. Second, the shock could conceivably push firms closer to joint profit maximization, where heterogeneously productive firms pay different wages rather than the same wage, for example, if the shock made the association realize its inefficiency.[39] I thus compare shifting from coordination at the minimum wage to oligopsony versus shifting to joint profit maximization. I do not test for collusion at a new wage, since post-shock wages among association members exhibit substantial dispersion (Figure A9).

The key intuition underlying results is that, under oligopsony or monopsony, $dlnw_{jt} > 0$ and $dlnn_{jt} > 0$ only if $dln\tilde{z_{jt}} > 0$. The observed changes therefore predict $dln\tilde{z_{jt}}$ correlated with the instrument, as firms will only raise both wages and employment if shocked themselves. In contrast, a breakdown of collusion predicts higher wages and employment due to the collapse of collusion (even if firms do not directly experience a shock themselves).

Change in markdown Conduct predicts changes in the optimal markdown $dln\mu_{jt}$. For oligopsony throughout, $dln\mu_{jt}$ inhabits three possible categories. For employers not previously paying the minimum wage, $dln\mu_{jt} = \sum_{j'} \frac{\partial ln\mu_{jt}}{\partial lnw_{j't}} dlnw_{j't}$, whose analytical expression is derived in Appendix B.4. For employers previously bound by the minimum wage whose wage changes after the shock, $dln\mu_{jt} = ln\mu_{j,t+1}^{oligopsony}(\mathbf{s_{t+1}}) - ln\mu_{j,t}^{olig,mw}$ where $\mu_{j,t+1}^{oligopsony}$ is the Cournot oligopsony markdown implied by post-shock market shares. The pre-period markdown is $ln\mu_{jt}^{olig,mw} = lnmw - lnz_{jt} - (\tilde{\alpha} - 1)lnn_{jt}$. Monopsonistic firms operate as if $\eta = \theta = \lambda$ and set constant markdowns $(\frac{\eta}{\eta+1})$, implying $dln\mu_{jt} = 0$. Finally, firms competing in a Bertrand oligopsony use elasticities $\eta + (\theta - \eta)s_{jt} + (\lambda - \theta)s_{jt}s_{kt}$ to set markdowns and $dln\mu_{jt}$ follows three categories similar to Cournot competition. Given the implied markdown changes under different models, I calculate implied productivity $dlnz_{jt}$, compute the moment, and evaluate fit using the Rivers and Vuong (2002) test of model equivalence.

5.2 Results

Table 7 reports results. A positive value indicates that the column model fits better than the row. I find that switching from collusion at the minimum wage to Cournot oligopsony fits better than continued Cournot oligopsony, continued monopsony, or switching to joint profit maximization. Collusive breakdown also rejects Bertrand oligopsony with results available upon request. Although Table 7 shows that collusion breaking down to oligopsony fits best, it does not quantify the model's absolute goodness of fit. To assess this, I plot the correlation between $dlnz_{jt}$ and the instrument, which should be zero over the instrument's

[39] Collusion at the minimum wage sacrifices efficiency over joint profit maximization because wages and worker allocations do not reflect productivity.

full support not just in expectation. Reassuringly, the correlation is zero, confirming absolute fit (Figure A10). Figure A10 also importantly demonstrates that the oligopsony model fits poorly—the instrument is strongly positively correlated with implied productivity shocks.

6 Counterfactuals

I develop a simple model to generate ballpark estimates on two topics: (i) the wage and employment losses due to collusion, and (ii) the effectiveness of the minimum wage as a prospective tool of anti-trust policy. Appendix B.3 provides full derivations.

6.1 Model

Set-up A continuum of geographies $r \in [0, 1]$ host a discrete number of industries $k \in 1, ..., M_r$, each with firms $j \in 1, ..., J_m$. Firms demand labor under two possible competition structures: (i) collusion, where a cartel colludes to pay the minimum wage while fringe firms choose employment to maximize profits taking other firms' employment decisions and the cartel's behavior as given, (ii) a Cournot oligopsony, where firms set employment to maximize profits taking others' employment as given. Time is discrete and indexed by t.

Labor Supply A unit measure of workers possess three-nested logit preferences over employers, sequentially choosing across locations, industries, and employers. Worker i obtains the following utility from working at employer j: $u_{ijkrt} = lnw_{jt} + lna_{jt} + lna_k + \epsilon_{ijk}$, where w_{jt} is the wage at j in t, a_k denote industry-specific amenities, and a_{jt} is j's deviation from the industry norm. The idiosyncratic term ϵ_{ijk} has a nested Type I extreme value distribution, with variance governed by three parameters: η (within-industry correlation), θ (cross-industry), and λ (cross-location). i must earn income $y_i \sim F(y)$, where $y_i = w_j h_{ij}$ and h_{ij} are hours. Aggregating nested logit probabilities across workers yields the upward-sloping labor supply curve to employer j:

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

Here $\bar{W_{krt}} = (\sum_{j \in k} a_{jkrt} {w_{jkrt}}^{1+\eta_g})^{\frac{1}{1+\eta_g}}$ denotes the amenity-adjusted wage index for industry k in region r, $\bar{W_{rt}}$ the wage index of r, and $\bar{W_t}$ the aggregate wage index, with bars indicating that the expressions also include amenities. N_t is aggregate labor supply. Good employers—offering relatively high wages and amenities—attract more workers. Since counterfactuals consider a Cournot solution concept where firms choose employment given their inverse labor supply, I define it here: $w_{jkrt} = \left(\frac{n_{jkrt}}{N_{krt}}\right)^{\frac{1}{\eta}} \left(\frac{N_{krt}}{N_{rt}}\right)^{\frac{1}{\theta}} \left(\frac{N_{rt}}{N_t}\right)^{\frac{1}{\lambda}} \bar{W_t}$.

Production A value-added production function combines capital k_{jt} and labor n_{jt}: $y_{jt} = Zz_{jt}(k_{jt}^{1-\gamma}n_{jt}^{\gamma})^{\alpha}$, $\gamma \in$(0,1) , α<1. z_{jt} is a product of TFP and price for j and Z is a sectoral productivity shifter. Counterfactuals abstract from product market power (although this is not assumed in the spillover test). Capital is rented competitively at rate R_t, implying that for any labor choice optimal capital demand depends just on n, z, and parameters. Redefining production in terms of labor alone: $\tilde{y}_{jt} = \tilde{z}_{jt}\tilde{n}_{jt}^{\tilde{\alpha}}$.

Labor Demand: Cournot Oligopsony A Cournot oligopsonist's first order condition is: $\frac{\partial y_{jt}}{\partial n_{jt}} = w_{jt}\left(1+\frac{1}{e_{jt}}\right)$. e_{jt} denotes the elasticity of residual labor supply and depends on a firm's payroll share s_{jkrt} and industry share s_{krt} in r: $e_{jt} = \left[\frac{1}{\eta} + \left(\frac{1}{\theta} - \frac{1}{\eta}\right)s_{jkrt} + \left(\frac{1}{\lambda} - \frac{1}{\theta}\right)s_{jkrt}s_{krt}\right]^{-1}$.

Labor Demand: Collusion Under collusion, a cartel emerges to pay the minimum wage. The cartel plays a two-period Bertrand game, each spanning six months, where deviations from the minimum wage in period one are punished with oligopsony in period two. In other words, a cartel firm's strategy is to pay the minimum wage in period two if all members complied with it in period one, and, otherwise, to pay oligopsony wages. I infer this punishment strategy from the fact that association members reverted to paying the minimum wage six to eight months after the shock. The cartel endogenously evolves to only comprise firms that benefit from collusion, i.e., whose collusive profits exceed both oligopsony profits ($\Pi_{mw} > \Pi_{olig}$) and the gain from deviation ($2\Pi_{mw} > \Pi_{dev} + \Pi_{olig}$), with profits determined in equilibrium. Firms outside the cartel comprise the fringe and set employment to maximize own profits. Cartel members employ as many workers as are willing to accept the minimum wage. Thus, the cartel suppresses both wages and employment to boost profits.

Three caveats are worth noting. First, the Folk Theorem posits that alternative collusive schemes are feasible for patient firms. Section 6.3 discusses how alternative punishment strategies impact results. 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 no other wage. This reflects a key institutional feature of the garment industry, namely, that foreign buyers enforce compliance with the minimum wage through audits.[40] Foreign-buyer-induced enforcement yields interesting implications for minimum wage policy, discussed in Section 6.3.

[40]Foreign brands use audit agencies like SEDEX to enforce compliance with labor regulation including the minimum wage. Estimates reveal that the single collusive wage maximizing the joint sum of profits lies below the minimum wage. However, foreign buyers' enforcement justifies using the minimum wage as a focal point.

6.2 Estimation and Mechanics

Determining counterfactual wages and employment requires four key ingredients: the labor supply system; the underlying distribution of productivity across firms (z_{jt}); labor demand determined by the equilibrium concept; and other parameters in the production function (α,γ) and upper-level labor supply (Frisch elasticity φ); Table 8 summarizes each.

Labor Supply I estimate labor supply using standard techniques (Berry, Levinsohn, Pakes 1995, Nevo 2001). Worker utility is: $u_{ijkrt} = lnw_{jt} + lna_j + lna_k + lna_{jt} + \epsilon_{ijk}$. The shares of workers choosing employer j and industry k are respectively:

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

Instrument-induced variation in s_{jkrt} and s_{krt} estimates 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.

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

Instruments for the wage include importer-induced demand shocks from Section 4 and state- and industry-specific minimum wage hikes (denoted $\mathbf{z_{jt}}$). The identifying assumption assumes that these shocks are orthogonal to time-varying amenities a_{jt} (a standard assumption in the literature estimating labor supply elasticities, e.g., Lamadon, Mogstad, Setzler 2022, Berger et al. 2022, Felix 2022, Sharma 2023), yielding the moment condition: $E[a_{jt}\mathbf{z_{jt}}] = 0$. I achieve estimation by inverting observed shares and imposing the exclusion restriction. In other words, for candidate 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 $lns_{jt,implied}$. Estimates $(\hat{\eta}, \hat{a_j}, \hat{\theta}, a_k)$ minimize the empirical analog of moment conditions: $\hat{\mathbf{G}} = \frac{1}{N_{jt}} \sum_{j,t} \hat{a_{jt}} \mathbf{z^D_{jt}}$.

Table 8 reports estimates. I estimate $\hat{\eta}$ equal to 3.51, $\hat{\theta}$ equal to 0.9, and calibrate the cross-location elasticity $\hat{\lambda} = 0.04$ from Sharma (2023).[41] I obtain very similar estimates using a more standard-to-labor instrumental variables strategy (Sharma 2023).

[41] The low estimate of λ accords with several studies which find limited geographic mobility even in the face of large adverse shocks to a geography (e.g., Autor et al. 2013, Dix-Carneiro & Kovak 2013, Sharma 2023).

Productivity distribution I estimate the productivity distribution using indirect inference (Berger et al. 2022). Specifically, assuming z_{jt} follows a log-normal distribution with mean 1 and standard deviation σ, and the large shock fully dismantles collusion to a Cournot oligopsony, I calibrate σ as the productivity distribution that would rationalize the post-large-shock concentration in the garment industry in Tirupur. Running the oligopsony model for candidate values, the estimate $\hat{\sigma}$ best matches the post-period wage bill Herfindahl Hirschmann Index HHI_{kr}. One caveat to indirect inference is that post-period market shares reflect the shock in addition to pre-period productivity. To recover productivity alone, I replicate the empirical shock by assuming that 13% of firms experience a 24.5% price shock at random, and subtract it off. Indirect inference also assumes a full breakdown of collusion, which may be too strong. However, the conduct test supports this assumption, and a second approach using firm-specific demand shocks to uncover productivity, which requires no stance on breakdown, yields similar estimates.[42]

Other parameters Appendix B.5 describes the calibration of other necessary parameters. Decreasing returns to scale α and Frisch elasticity φ are calibrated to Berger et al. (2022). φ governs the disutility of hours worked. I calibrate the exponent γ to match the capital share. A closed form solution of the model shows that productivity shifter Z normalizes wage units (Berger et al. 2022, Appendix E.6). I therefore calibrate it to match the post-period average wage. As a diagnostic statistic, the calibrated model closely replicates the share of workers paid the minimum wage, 41% in the model compared to 46% in data.

Mechanics For each counterfactual, I compute its impact on the average wage and total employment in Tirupur's garment industry. I solve for two fixed points: an upper-level industry share and lower-level within-industry share. I quantify losses from collusion by simulating cartel members switching to Cournot competition. Garment wages rise both because former cartel members raise pay above the minimum wage, and because this exerts upward wage pressure on fringe firms paying below the minimum wage.[43] Higher wages in the garment industry attract workers away from other industries (governed by θ), geographies (governed by λ) and unemployment (governed by φ). Workers substituting to higher-paying members lowers non-member shares, increasing labor supply elasticities and wages (lower-level fixed point). Industry wage indices and upper-level shares change (upper-level fixed point). Overall, garment wages and employment rise. I make one simplifying assumption:

[42] Analogous to Carrillo et al. (2024), the approach relies on a first order Taylor expansion around the production function. It uses firm-specific demand shocks to uncover the distribution of marginal products across firms without imposing conduct or labor supply. Results upon request.

[43] Some members, those least productive to begin with, slightly lower wages, but increases dominate by far.

assuming away non-time-varying establishment-specific amenity deviations from industry norms a_j.[44]

6.3 Results

Figure 14 reports results, which all pertain to Tirupur. First, I quantify the losses from collusion. Collusion at the minimum wage induces substantial wage and employment losses even compared to firms exercising their individual but not collective market power. Switching to Cournot oligopsony increases the average garment worker's wage by 9.6%. Cartel members drive two-thirds of the effect while the rest reflects higher wages at fringe firms. Higher wages in the garment sector attract workers away from other industries and unemployment. Overall, employment in the garment sector increases 17%, of which a fifth comprise transitions from unemployment. Since colluding firms were originally the most productive in the economy, their expansion increases productive efficiency—defined as the ratio of actual to potential output if employers do not exercise market power—by 4.3% (Baqaee and Farhi 2020).

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 increase the minimum wage could limit the ill-effects of collusion by catalyzing coordination at higher wages. An important institution renders such coordination likely, namely, that foreign buyers enforce the minimum wage.

I thus conclude by studying the impact of three minimum wage hikes on wages and employment. The first two increase the monthly minimum wage of Rs.8170 in Tirupur's garment industry by 10% and 50%. A third policy aligns with global advocacy for a "living wage" in the garment sector and increases the monthly minimum wage to a living wage of Rs.33,920 proposed by the NGO Asia Wage Floor Foundation. Both 10% and 50% minimum wage hikes raise wages and employment. Surprisingly, the 50% hike outperforms oligopsony on both measures as, when highly productive firms lower wages to join the cartel, less productive firms can raise pay and employment above a more-competitive oligopsony. The second force outweighs the first and the average garment worker's wage increases by 32%; employment rises 23%. Finally, I find that the proposed living wage cannot sustain collusion.

The conclusions of this section rely on three assumptions. First, the cartel punishes deviations above the minimum wage with oligopsony for six months. A stricter (weaker) punishment strategy would instead increase (decrease) losses from collusion. For instance, a better enforced cartel could more severely punish deviators (e.g., by expelling members), making collusion easier to sustain and exacerbating losses. Second, the minimum wage

[44] Estimation of η, θ still includes employer fixed-effects; I simply do not use a_j for counterfactuals s.t. labor supply depends just on w_j and industry amenities.

serves primarily as a focal point and is otherwise imperfectly enforced (evidenced by Figure 2). Third, employers coordinate only at the minimum wage and at no other wage; as noted, foreign buyer enforcement rationalizes using the minimum wage as a focal point.[45] Major brands like Zara and Nike regularly audit their suppliers for compliance with labor regulation, including minimum wages (Boudreau 2024, Tirupur interviews 2023). Indeed, labor violations in Vietnam are what triggered the large demand shock to begin with. Foreign buyer enforcement yields competing implications for minimum wage policy. On the one hand, if establishments can only access lucrative export opportunities by paying the minimum wage, policy can sustain even higher minimum wages than my estimates suggest, as fewer firms would exit the cartel when minimum wages rise. However, if import demand is elastic, raising the minimum wage could shift production to non-compliant, less productive factories or even offshore. Understanding the implications of these competing forces for optimal minimum wage policy remains a promising avenue for future research.

7 Conclusion

This paper shows evidence of collusion among employers in the Indian textile and clothing manufacturing industry. I show that the largest industry association in the main garment-producing hub coordinates to pay workers exactly the local minimum wage, effectively rendering it a maximum wage in the sector.[46] I diagnose collusion by developing a new comparative static test that studies the spillover effects of firm-specific demand shocks: while unshocked firms competing for labor should lose workers to shocked firms and *reduce* employment, unshocked colluders whose collusion unravels should expand. Small demand shocks leave wages and employment at members of the association unchanged, suggesting that firms are willing to forego opportunities to maintain collusion. However, when a large firm-specific demand shock led affected members to raise wages, unshocked non-members responded as in oligopsony, by increasing wages but reducing employment, whereas unshocked members responded as if their collusion collapsed, raising both wages *and* employment. Collusion induces substantial losses even relative to firms exercising their individual but not collective market power. It reduces the average worker's wage by 9.6% and employment by 17%.

The findings of this paper yield four key implications for policy and research. First, they underscore the need to extend antitrust intervention to the labor market beyond its current focus on product markets. To date, the Indian anti-trust authority has not prosecuted a

[45] Estimates imply that the single collusive wage that maximizes the joint sum of profits lies below the minimum wage.

[46] Association members employ half of all workers in Tirupur, which itself employs 30% of the garment workforce in India.

single case of employer collusion, yet this paper offers a clear case where such enforcement would be warranted. Second, I introduce a new method for detecting collusion by analyzing quantity responses at unshocked firms. This spillover test also applies to product markets and future work can use it to identify the boundaries of a cartel if enough shocks disrupt collusion over time, developing statistical guarantees around a firm's participation (for example, using tools developed in Kline & Walters 2021).

Third, the findings show that higher minimum wages can mitigate losses from collusion by catalyzing coordination at higher wages, even beyond their standard role in monopsony models. Finally, this paper highlights how the weak enforcement of worker and consumer protections in developing countries can interact with strong firm coordination—here through industry associations—to produce market power. Much more work remains to identify and tackle other instances where such forces interact to generate collusion.

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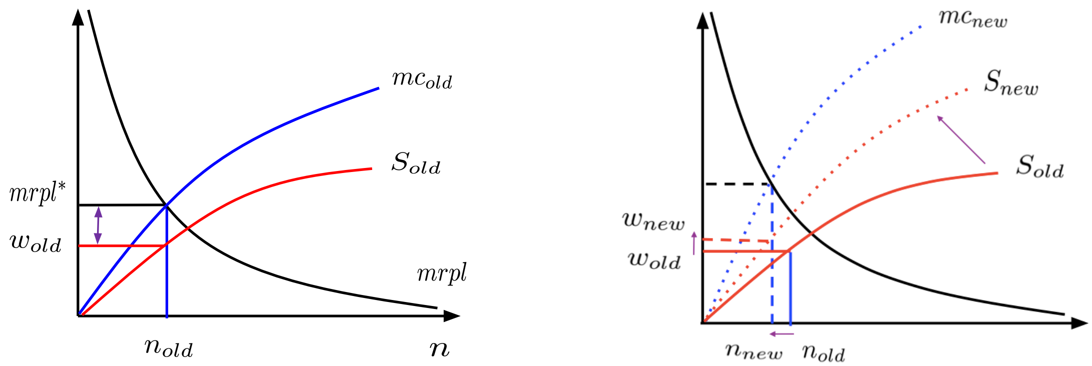
Figures

Figure 1: Spillover Test

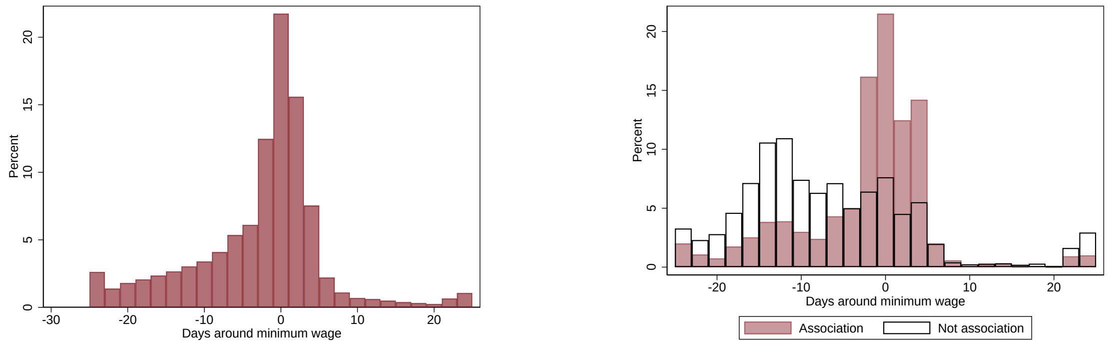
(a) Firm optimization in oligopsony/monopsony (b) Spillover, left rotation of labor supply



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.

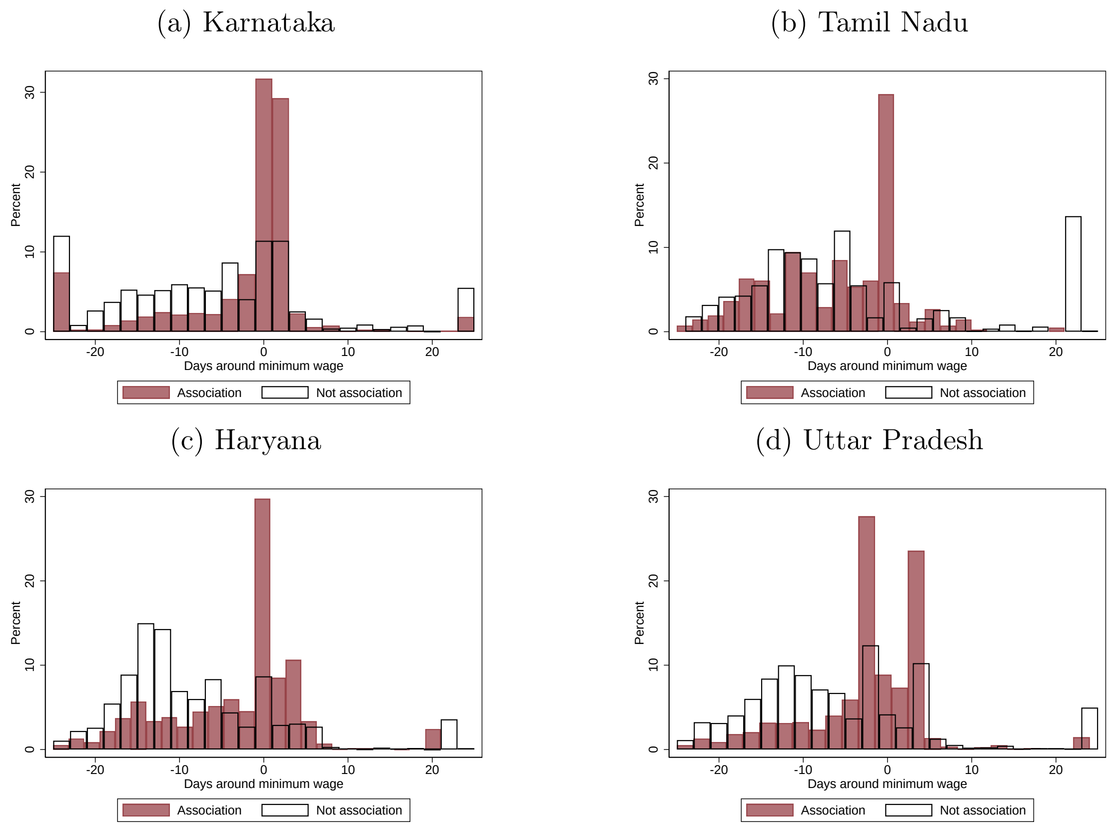
Figure 2: Bunching at the minimum wage

(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.

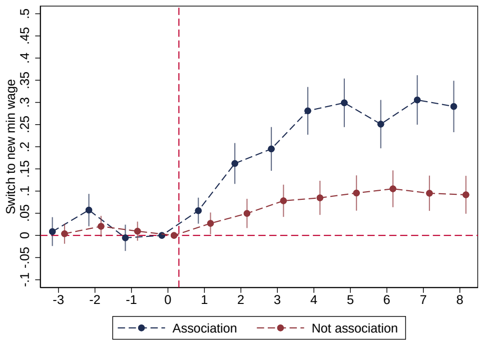
Figure 3: Bunching at the minimum wage across locations



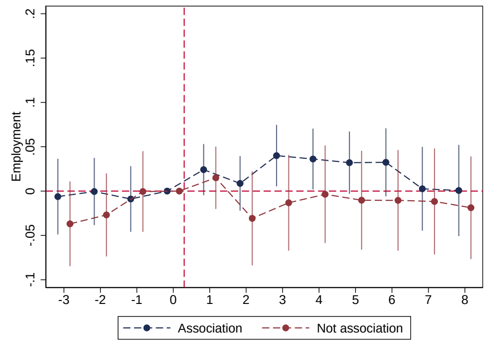
Notes: This figure plots the distribution of wages for formal workers in the garment industry across four large centers of garment manufacturing in India: Karnataka, Tamil Nadu, Haryana, and Uttar Pradesh. Together these states account for 63% of employment in the Indian garment industry. This figure 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



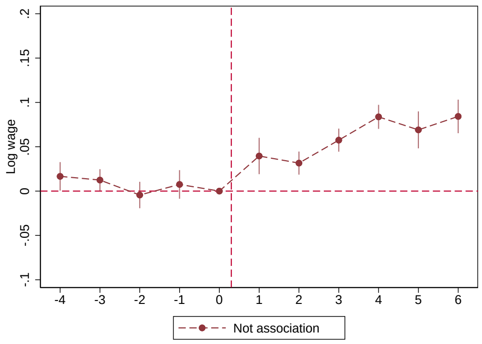
(b) Log employment



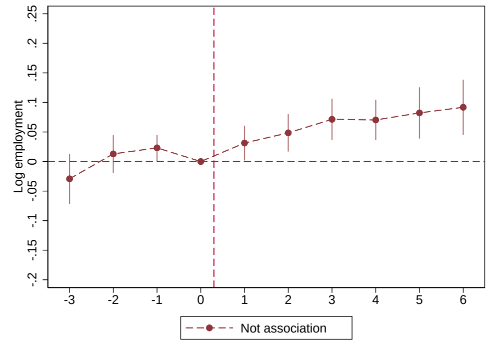
Notes: This figure plots results from the stacked event study specification described in equation (2). It plots estimates of the β_k coefficients for $k \in [-3, 8]$ (with $k = -1$ omitted. Each event corresponds with a large increase in the minimum wage, of at least 7.5% (or 2 days) over its previous 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



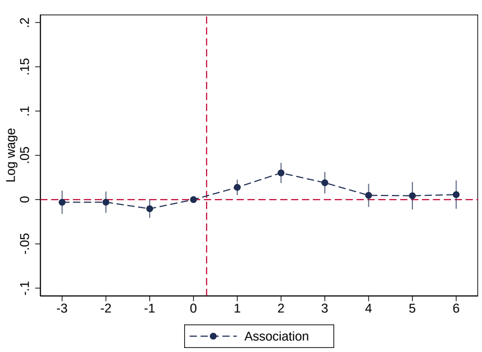
(b) Log employment



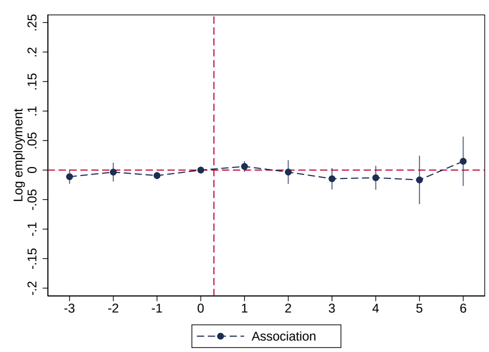
Notes: This figure plots the effect of routine firm-specific demand shocks on the log wage and employment of establishments that are not members of industry associations. It plots estimates of the β_k coefficients for $k \in [-4, 6]$ months around the shock (with $k = -1$ omitted). A firm-specific demand 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**

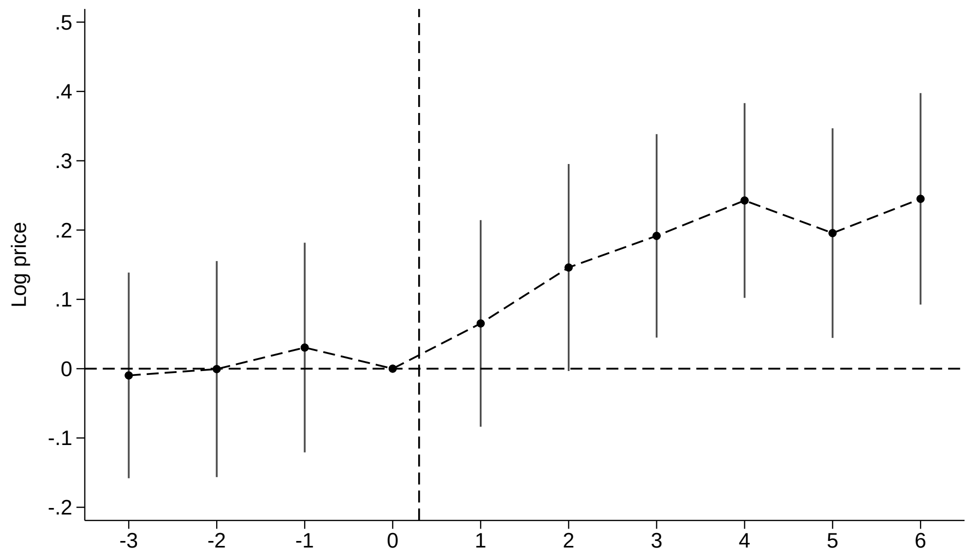
Affected brands

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

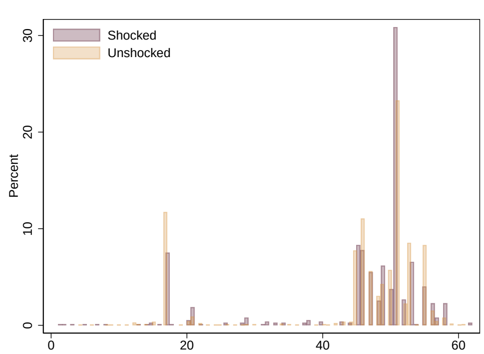
(a) Log price



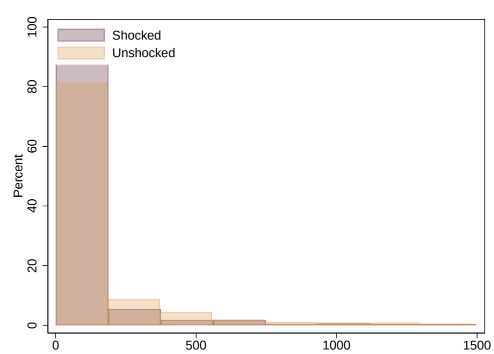
Notes: This figure plots the effect of the relocation shock from Vietnam – which led several prominent brands to temporarily relocate production to India – on the prices of affected and unaffected exporters. Affected exporters are those whose largest volume of exports was to one of the affected brands. 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



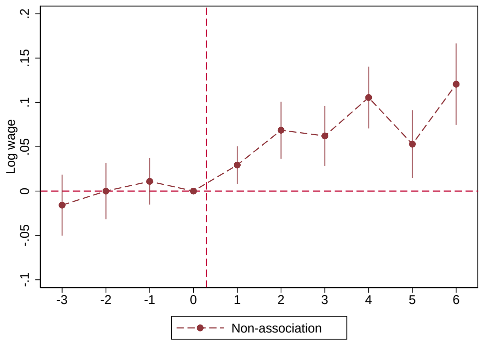
(b) Size



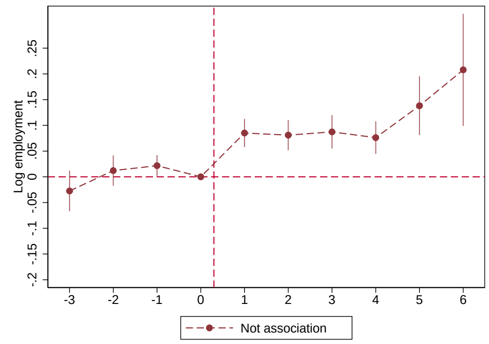
Notes: Panel A plots the distribution of the main 6-digit HS code product exported by affected and unaffected members of the industry association at baseline. The main export is defined as the highest value exported product. Panel B plots the distribution of establishment sizes for the two sets of employers.

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

(a) Log wage



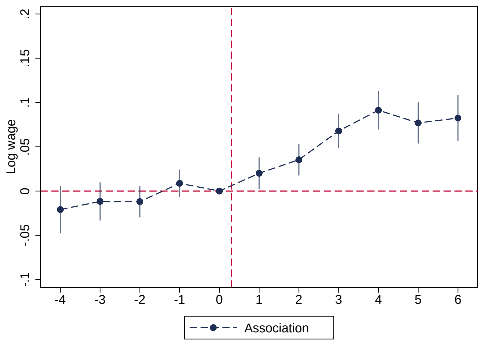
(b) Log employment



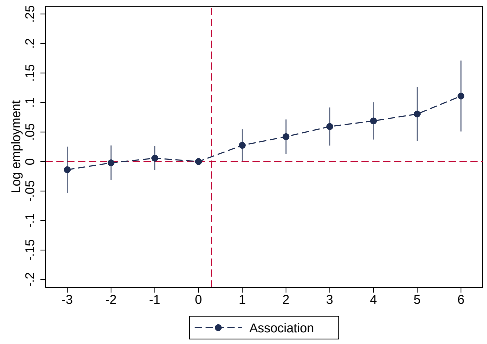
Notes: This figure plots the effect of a relocation demand shock on the log wages and employment of affected employers outside the industry association. The shock led several leading brands to temporarily relocate production to Indian manufacturers. The shock affected 14% of employers in total, and 13% 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

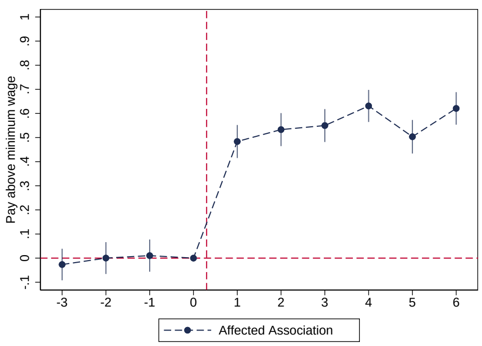
(a) Log wage



(b) Log employment



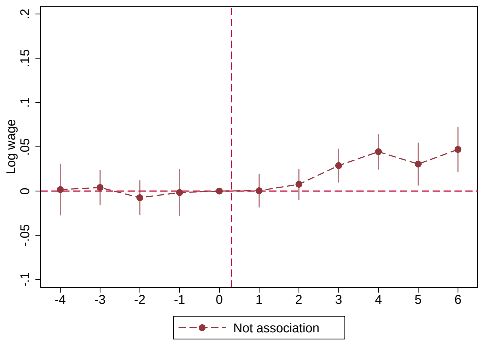
(c) Pay above the minimum wage (indicator)



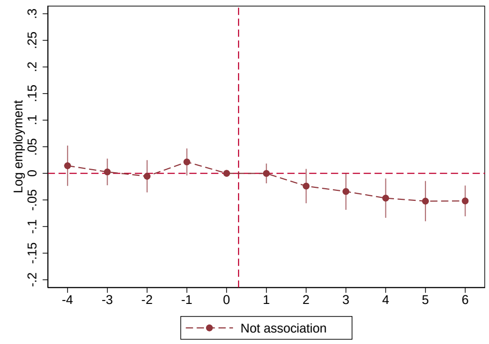
Notes: This figure plots the effect of a relocation demand shock on the log wages and employment of affected members of the industry association. The shock led several leading brands to temporarily relocate production to Indian manufacturers. The shock affected 14% of employers in total, and 13% of members 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



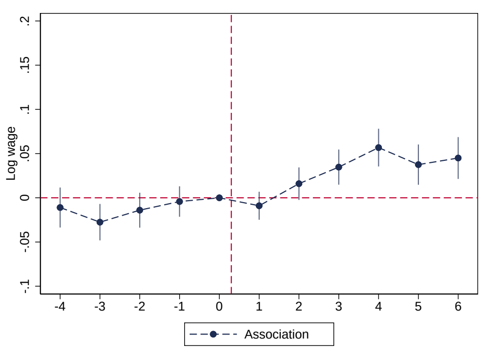
(b) Log employment



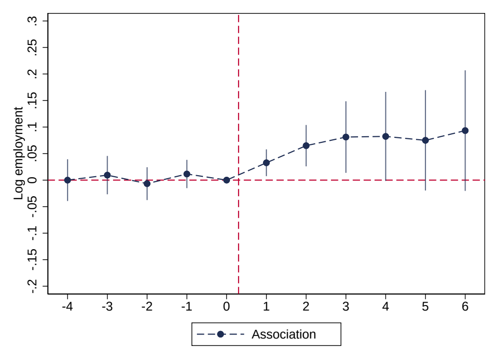
Notes: This figure shows spillover effects on unaffected employers outside the industry association. These employers respond in ways consistent with oligopsony–by increasing their wage and reducing employment. The figure plots estimates of the β_k coefficients in equation 2 for $k \in [-4, 6]$ months 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)	371	257
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 differences in the rate of promoting probationary members to permanent members based on whether they deviate above the minimum wage during probation.

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 using a specification identical to (3), but aggregated to two time periods (pre and post-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: Controlling for differences between unaffected members and non-members

	Compare within:						
	> 100 workers	Size-importer	Importer	Size	Female share	Zip code	Product (6 digit)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Non-member x post	-0.049**	-0.085**	-0.090**	-0.096*	-0.082*	-0.095**	-0.084**
	(0.023)	(4.366)	(4.274)	(5.969)	(4.696)	(4.060)	(4.152)
Member x post	0.095**	0.133**	0.163**	0.169*	0.158	0.143*	0.117
	(0.042)	(0.062)	(0.079)	(0.102)	(0.112)	(0.091)	(0.085)
Observations	5822	18945	18945	18945	18945	15197	14959

Notes: This table compares effects of the relocation shock on employment at unaffected members and non-members with similar characteristics. Column 1 restricts the sample to establishments employing over 100 workers at baseline. Columns (2) through (7) implement equation 4, controlling for time-varying fixed effects by employer characteristic in the shocked season. For example, column (3) compares unaffected members and non-members exporting to the same importer by controlling for importer x time fixed effects in the shocked season (controls for common changes to the labor supply of all exporters to the importer). Column (6) compares employers in the same zip code. Female share and establishment size are divided into quartile bins. Standard errors are clustered by establishment.

Table 6: 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. I aggregate profits to two periods: the year before and after the shock.

Table 7: Test of conduct

	Cournot Oligopsony	Collusion at min wage → joint profit max
Breakdown of collusion from min wage	7.585	13.52

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 8: 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).

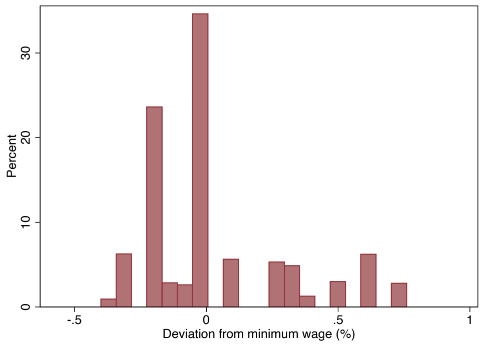
Appendix Figures

Figure A1: Wages posted outside factories

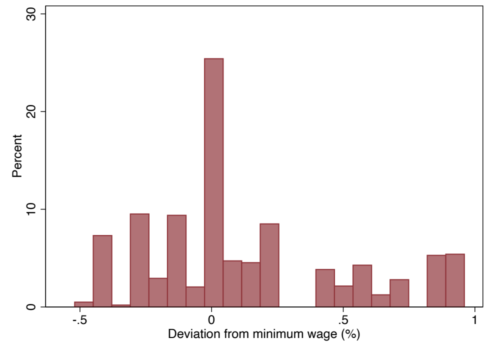
Notes: Factories publicly post wages visible to workers (or other employers) outside their premises. The three levels of the minimum wage are unskilled, semi-skilled, skilled, and most workers are semi-skilled tailors. The ranges here reflect the potential for overtime work, although most workers earn exactly the same wage, e.g. 60% earn the establishment mode. Photos: Tirupur 2024.

Figure A2: Bunching at the minimum wage, survey data

(a) Karnataka



(b) Tamil Nadu



Notes: This figure plots the distribution of wages across formal workers in the garment industry in Karnataka and Tamil Nadu using survey data from the Primary Labor Force Survey (PLFS) between 2017 and 2018. The PLFS is a nationally representative labor force survey. The x-axis is denominated in deviations from the semi-skilled minimum wage in percentage terms. Workers at zero are paid exactly the state-specific semi-skilled minimum wage for the garment industry. Formal workers are defined as working at establishments with 10 or more employees. The figure for Karnataka is based on 68 observations and for Tamil Nadu is based on 131 observations (weighted using survey weights). Workers earning slightly above the semi-skilled minimum wage could be earning the skilled minimum wage. For all workers in the first visit between 2017 and 2018, I calculate and plot their monthly earnings from the last month.

Figure A3: Relevance of the minimum wage

(a) Bangalore

Bengaluru garment workers seek minimum wage of ₹478 per day

The State government withdrew the revised minimum wages notification for garments workers in March 2019, leading to several protests.

Updated - September 13, 2019 09:53 am IST - Bengaluru

STAFF REPORTER

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Members of the Garment and Textile Workers' Union protesting in front of the Labour office in Bengaluru on Thursday.

(b) Bangladesh

Bangladesh hikes minimum wage for garment workers after protests

Reuters

November 7, 2023 8:10 PM EST · Updated 4 days ago

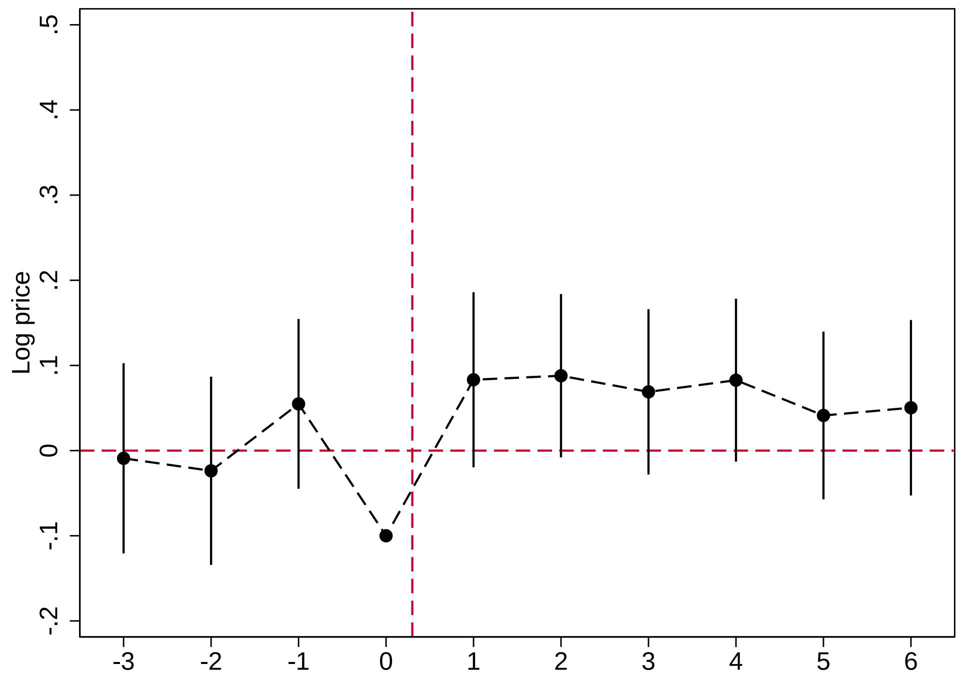
Aa

File photo: Employees work between polythene sheets, as a safety measure to reduce the spread of coronavirus disease (COVID-19), at The Civil Engineering Limited garment factory in Dhaka, Bangladesh, August 17, 2021. REUTERS/Mohammad Ponir Hossain/File photo *Acquire Licensing Rights*

Notes: Garment workers across many developing contexts expect to earn exactly the minimum wage, and thus protest for hikes. The left panel shows protesters in Bangalore demanding a daily minimum wage of $8. The right panel reports a historic hike, where Bangladesh raised its monthly minimum wage for the first time in over a decade (by 56%, to $113).

Figure A4: Effect of small shocks on prices

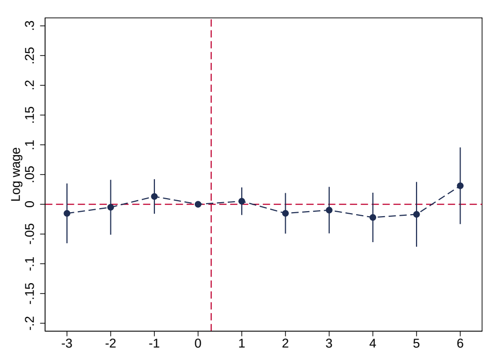
(a) Log price



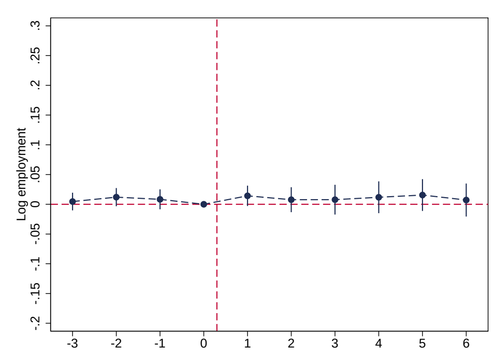
Notes: This figure plots the first stage effect of small price shocks on export prices. Section 4.1 defines the shocks. I plot an establishment-level DiD event study, comparing the log price of exports at affected versus unaffected exporters. Confidence intervals at a 95% level are reported.

Figure A5: Placebo check: parallel trends

(a) Log wage

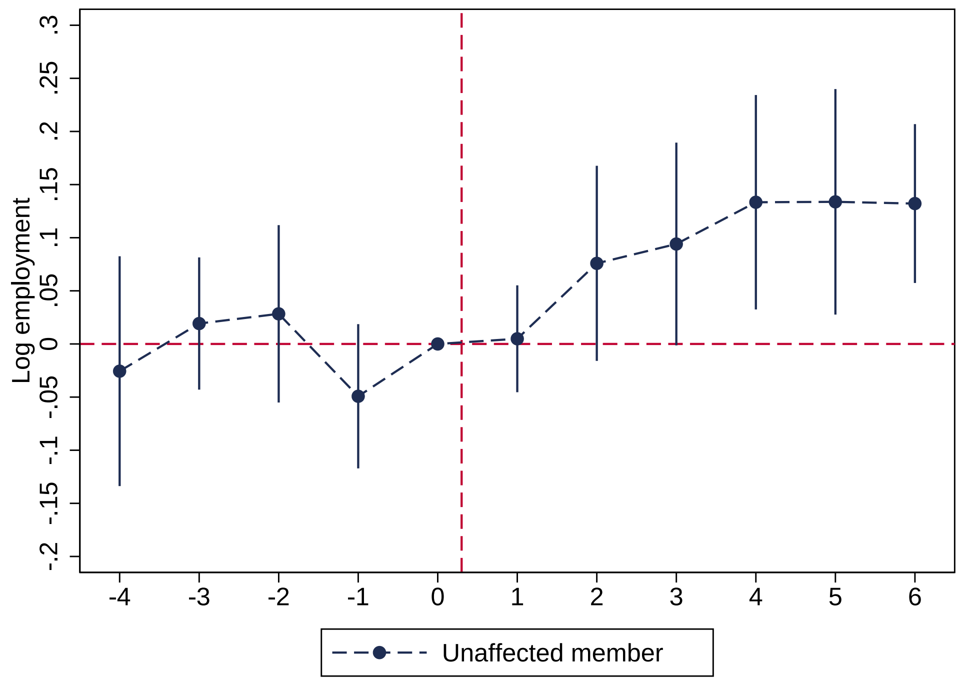


(b) Log employment



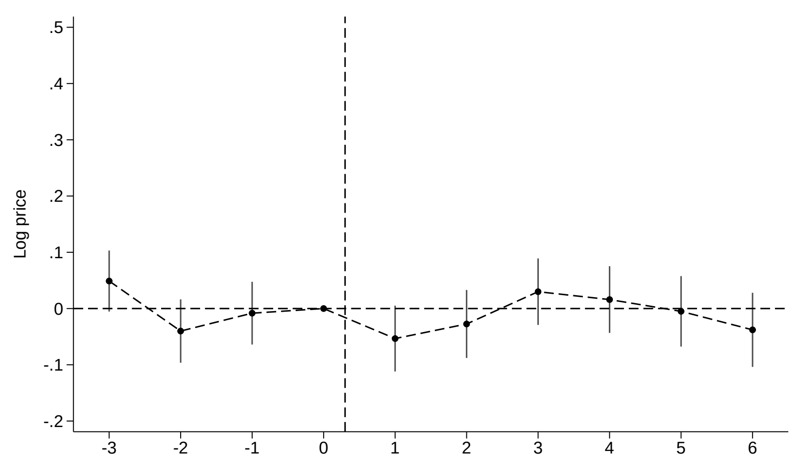
Notes: This figure performs a placebo check, picking a random unshocked season for each establishment. Using the empirical strategy outlined in equation (3), where SS now equals 1 in the placebo season, I show that outcomes in the randomly picked unshocked season indeed evolve in parallel to other unshocked export seasons. Standard errors are clustered by establishment.

Figure A6: Same unaffected members increase wages, employment



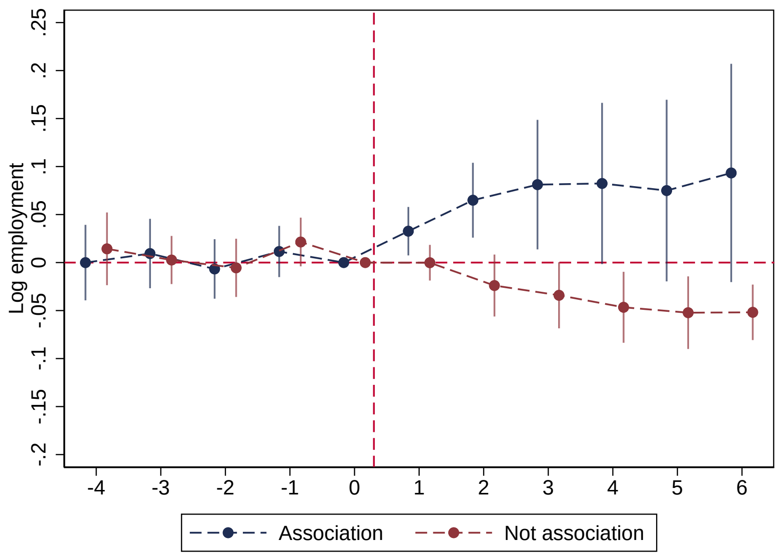
Notes: This figure plots the effect on employment for those unaffected members who raise modal pay between t=-1 and t=4. Effects look similar if instead using t=5 or t=6 as the terminal period.

Figure A7: Prices of unaffected exporters



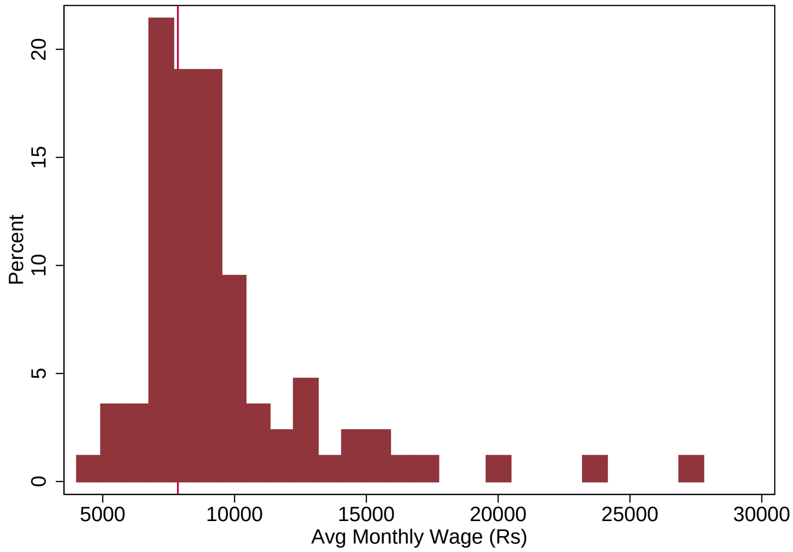
Notes: This figure plots the event study estimates of the effect of the relocation shock on prices at unaffected exporters. The outcome is unit prices, where units correspond to volume (a twenty foot equivalent or TEU). Table A2 shows no effect on product composition, indicating no change in effective prices.

Figure A8: Effect on employment at unaffected members and non-members, controlling for importer



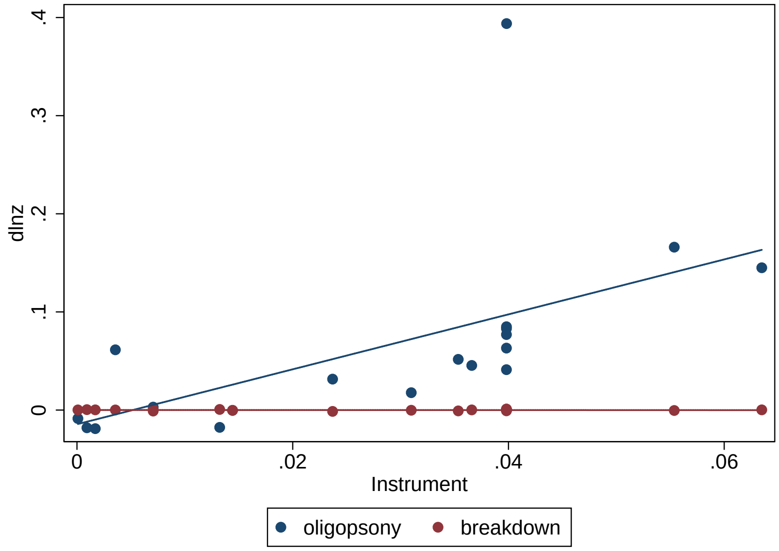
Notes: This figure plots the effect on unaffected employers' employment, controlling for importer-time trends in the shocked period, using the regression specification described in equation (4).

Figure A9: Post-shock wage distribution at members



Notes: This figure plots the post-shock distribution of wages at association members in month $t = 5$. The red line marks the minimum wage.

Figure A10: Test of conduct



Notes: This figure plots the correlation between implied *dlnz* and the instrument under the Cournot oligopsony model and the breakdown of collusion from the minimum wage.

Appendix Tables

Table A1: Small shock effects: control for differences between members and non-members

	Compare within:		
	Importer	Size	Product (6-digit)
	(1)	(2)	(3)
Non-member x post	0.089*	0.103**	0.145**
	(0.045)	(0.036)	(0.057)
Member x post	0.010	-0.025	-0.018
	(0.031)	(0.060)	(0.064)
Observations	19127	19127	19127

Notes: This table compares effects of small shocks on employment at members and non-members with similar characteristics. I implement the equivalent of equation 4 for small shocks, controlling for time-varying fixed effects in the shocked season. Column (1) compares unaffected members and non-members controlling for common changes to the employment of exporters to the same importer, column (2) compares employers in the same quartile size bin, and column (3) compares employers exporting the same 6-digit product.

Table A2: Effect on product composition (6-digit HS Code)

	Different from baseline product (1)	Number (2)
Non-member x post	0.007	0.0741
	(0.007)	(0.113)
Member x post	0.026	0.082
	(0.016)	(0.217)
Observations	18001	10983

Notes: This table assesses changes to product composition following the large shock. Column (1) reports the effect on exporting a product different from t=-1, and column (2) reports it on the number of exported products. The regression specification is identical to equation equation (2), but pools together months t=1 to t=6 into a single post indicator. Standard errors are clustered by establishment.

Table A3: Effect on worker composition at unaffected members

	Age (1)	Gender (2)
New worker	0.032	-0.011
	(0.482)	(0.018)
Baseline value	34.308	0.443
Observations	2092	2092

Notes: This table assesses the large shock's effect on worker composition at unaffected members. I regress the average worker characteristic at an employer on a dummy variable equal to one in the post period. In this regression, each unaffected member has two observations, one describing the average characteristic of old workers, and another the average characteristic of new workers hired after the shock.

A 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 $\chi_{j+1,k+1} = \begin{cases} 1\{employer\ j\ substitutes\ to\ k\ at\ x\} \\ 0 \end{cases}$. 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 of labor) 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 the following fixed point problem for any wage vector at competitors $\mathbf{w_{-jt}}$: $ln\tilde{w_{jt}} = lnmrpl_{jt} + \Lambda_j(\tilde{w_{jt}}, \mathbf{w_{-jt}}, \mathbf{a_t})$.

A.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 when 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.[47]

Step 1: For any non-cooperative 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 $\mathbf{w_{-jt}}$:

$$ln\tilde{w_{jt}} = lnmrpl_{jt} + \Lambda_j(\tilde{w_{jt}}, \mathbf{w_{-jt}}, \mathbf{a_t}) \tag{6}$$

Proof. This proof derives closely from Amiti et al. (2019). See Proposition 3 of Sharma (2023) on page 86 for the labor market derivation. The optimal markdown function Λ_j is endogenous to the supply and competition structures, i.e., changes functional form from one structure to another. The chief implication of Step 1 is that across all structural models, for invertible labor supply, competitor wages $\mathbf{w_{-jt}}$ form a sufficient statistic for firm j's wage decision and, conditional on $\mathbf{w_{-jt}}$, firm behavior does not depend on competitors' marginal products $mrpl_{kt}|_{k!=j}$.

Step 2: When $dlnz_{jt} > 0$ for some j and $dlnz_{j't} = 0$ for $j'! = j$, 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[48]:

$$dlnw_{1t} = \frac{\partial lnm_{1t}}{\partial lnz_1} dlnz_{1t} + \frac{\partial lnm_{1t}}{\partial lnn_1} dlnn_1 + \sum_{j'} \frac{\partial ln\mu_1}{\partial lnw_{j'}} dlnw_{j'} \tag{7}$$

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

[47] This is innocuous, see discussion on "Amenities" below.

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

$$
\begin{aligned}
\frac{dlnw_{1t}}{dlnz_{jt}} &= \frac{\partial lnm_{1t}}{\partial lnn_1}\frac{\partial lnn_1}{\partial lnw_1}\frac{dlnw_1}{dlnz_{jt}} + \sum_{j'!=1}\frac{\partial lnm_{1t}}{\partial lnn_1}\frac{\partial lnn_1}{\partial lnw_{j'}}\frac{dlnw_{j'}}{dlnz_{jt}} \\
&+ \frac{\partial ln\mu_1}{\partial lnw_1}\frac{dlnw_1}{dlnz_{jt}} + \sum_{j'!=1}\frac{\partial ln\mu_1}{\partial lnw_{j'}}\frac{dlnw_{j'}}{dlnz_{jt}} \qquad (8)
\end{aligned}
$$

$$
\left[1 - \frac{\partial lnm_{1t}}{\partial lnn_1}\frac{\partial lnn_1}{\partial lnw_1} - \frac{\partial ln\mu_1}{\partial lnw_1}\right]\frac{dlnw_{1t}}{dlnz_{jt}} = \sum_{j'!=1}\frac{\partial lnm_{1t}}{\partial lnn_1}\frac{\partial lnn_1}{\partial lnw_{j'}}\frac{dlnw_{j'}}{dlnz_{jt}} + \sum_{j'!=1}\frac{\partial ln\mu_1}{\partial lnn_1}\frac{\partial lnn_1}{\partial lnw_{j'}}\frac{dlnw_{j'}}{dlnz_j}
$$

$$
\left[1 - \left(\frac{\partial lnm_{1t}}{\partial lnn_1} + \frac{\partial ln\mu_1}{\partial lnn_1}\right)\frac{\partial lnn_1}{\partial lnw_1}\right]\frac{dlnw_{1t}}{dlnz_{jt}} = \left[\frac{\partial lnm_{1t}}{\partial lnn_1} + \frac{\partial ln\mu_1}{\partial lnn_1}\right]\sum_{j'!=1}\frac{\partial lnn_1}{\partial lnw_{j'}}\frac{dlnw_{j'}}{dlnz_j}
$$

$$
\left[1 - a_1\frac{\partial lnn_{1t}}{\partial lnw_{1t}}\right]\frac{dlnw_{1t}}{dlnz_{jt}} = a_1\sum_{j'!=1}\frac{\partial lnn_{1t}}{\partial lnw_{j't}}\frac{dlnw_{j't}}{dlnz_{jt}} \qquad (9)
$$

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[49]:

$$
\frac{dlnn_{1t}}{dlnz_{jt}} = \frac{\partial lnn_{1t}}{\partial lnw_{1t}}\frac{dlnw_{1t}}{dlnz_{jt}} + \sum_{j'!=1}\frac{\partial lnn_{1t}}{\partial lnw_{j't}}\frac{dlnw_{j't}}{dlnz_{jt}} \qquad (10)
$$

Substituting from (9) and given assumed $\frac{dlnw_{1t}}{dlnz_{jt}} < 0$:

$$
\begin{aligned}
\frac{dlnn_{1t}}{dlnz_{jt}} &= \frac{\partial lnn_{1t}}{\partial lnw_{1t}}\frac{dlnw_{1t}}{dlnz_{jt}} + \frac{\left[1 - a_1\frac{\partial lnn_{1t}}{\partial lnw_{1t}}\right]}{a_1}\frac{dlnw_{1t}}{dlnz_{jt}} \\
\frac{dlnn_{1t}}{dlnz_{jt}} &= \frac{\frac{dlnw_{1t}}{dlnz_{jt}}}{a_1} > 0 \qquad (11)
\end{aligned}
$$

Equation (11) reveals that any unshocked firm whose optimal response is to decrease (increase) its wage must increase (reduce) 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 10). This statement must hold for each employer

[49] Assuming that no firm rations employment is equivalent to assuming that firms inhabit 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. I show below that, even with a binding minimum wage, oligopsonistic or monopsonistic competition never predicts higher employment at unshocked competitors under Assumptions 1, 2, and 3.

with declining wages. However, if all firms whose wage declines gain workers exclusively from other firms that also lower wages, at least one must lose workers on net. This is impossible if the said firm's optimal wage response is negative (equation 11). 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., $\frac{dlnw_{j't}}{dlnz_{jt}} > 0 \ \forall$ unshocked 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 increasing her wage $\frac{dlnw_{jt}}{dlnz_{jt}} > 0$. This is easily seen from best response equation 7, where all other employers weakly increase wages and $dlnz_{jt} > 0$. Given this, returning to equation 9 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). The proof applies as-is to unshocked firms if multiple other firms receive positive shocks not just j.

Binding minimum wage Given Assumptions 1, 2, and 3 spillovers firm-specific demand shocks still predict employment declines at unshocked employers in monopsony or oligopsony models with a binding minimum wage. Minimum wages that bind from below push firms onto their labor supply curve instead of first order condition. A left rotation to labor supply due to a firm-specific shock to other firms may leave an unshocked firm's wage unchanged at the minimum wage, $dlnw_1 = 0$, but nonetheless reduces employment since fewer workers are willing to supply labor at the old wage (captured by the second term of equation 10).

The minimum wage may alternatively bind from above if set too high. Labor supply exceeds demand and employment is rationed. Spillovers nonetheless weakly raise an unshocked employer's wage and reduce employment. A left rotation to labor supply may leave wages and employment unchanged if the minimum wage remains too high—the unshocked competitor stays on her labor demand curve. However, large rotations will prompt higher wages and lower employment. In sum, even oligopsonistic or monopsonistic models with a binding minimum wage predict (weak) employment declines at unshocked employers.

Visual framework Visualizing a monopsony 101 setup helps identify the universe of cases for which unshocked employers could increase employment even absent collusion. The typical setup features upward-sloping labor supply, downward-sloping demand, and potentially a binding minimum wage. Per Proposition 1, spillovers rotate an unshocked competitor's labor supply curve left, raising wages and reducing employment. Unshocked oligopsonists might instead increase employment if other aspects of the picture shift: (i) demand increases (e.g., due to correlated demand or supply shocks), (ii) labor supply does not rotate leftward (violation of connected substitutes), or (iii) external entities impose a higher wage (a new "minimum wage", which does not occur, see Section 4.3).

The product market, capital market, and other factor markets (materials) Proposition 1 holds whenever labor supply satisfies the connected substitutes property and revenue function exhibits weakly diminishing marginal revenue product of labor, regardless of competition in the product, capital, or other input markets. Product market power itself generates diminishing *mrpl*. Standard assumptions in other input markets also predict downward-sloping demand (provided declining physical *mpl*): (i) perfect competition in other factor markets, the standard assumption in studies of labor market power (e.g., Delabastita & Rubens, Yeh et al. 2022), or (ii) a Leontief production structure in materials and a capital-labor aggregate, which is realistic for the garment industry where labor and materials are not substitutes. In capital markets, results hold whether capital is supplied competitively in a rental market or firms face credit constraints. Credit constraints render labor demand horizontal (*mrpl* is constant), but Proposition 1 still holds. Spillovers that rotate an unshocked firm's labor supply left reduce employment.

Unusual and non-standard features of other input markets could, by increasing labor demand, overturn Proposition 1 and prompt unshocked oligopsonists to increase employment, for example if they seek to expand market power in other input markets to offset profit declines (profits would decline *more* without higher market power). Alternatively, the shock could prompt the association to negotiate cheaper input contracts, increasing labor demand at unaffected members. Section 4.3 empirically eliminates violations of downward-sloping demand as driving results.

Violations of connected substitutes (Assumption 1) Connected substitutes implies that wages under oligopsony are strategic complements and employment is strategic substitutes. I characterize and rule out three mutually exclusive and exhaustive violations of the connected substitutes condition as driving higher employment at unshocked members. I either show analytically that violations continue to predict strategic substitutability in employment, or establish conditions under which they yield strategic complementarity and empirically eliminate these possibilities. First, for violations where Assumption 3 holds (Case 1), employment can only exhibit strategic complementarity under oligopsony or monopsony if wages are strategic substitutes, i.e., employment can only rise if wages decline (equation 11).[50] Labor supply rotates right instead of left. In contrast, I find wage increases among

[50] Note that equation (11) *does not* rely on the connected substitutes assumption. Instead, it assumes invertible labor supply, optimization (that we can totally differentiate the optimal wage condition as in equation

unshocked members. Second, when both assumptions 1 and 3 fail, wages and employment must either both exhibit strategic substitutability or both exhibit strategic complementarity (equation 11). For instance, some types of worker heterogeneity may violate both assumptions if higher wages elsewhere draw away an unshocked competitor's most elastic workers, who highly value wages relative to amenities, leaving behind inelastic workers.[51] The differential retention of inelastic workers would reduce rather than raising j''s optimal markdown $\mu_{j't}$ $\left(\frac{\partial ln\mu_{jt}}{\partial lnw_{jt}}|_{\{w_j,\mathbf{w_{-j}}\}} > 0\right)$. Now $a_1 > 0$ in eq(11) and both wages and employment either exhibit strategic substitutability (Case 2) or strategic complementarity (Case 3). Typical worker heterogeneity inhabits case 2, where the unshocked competitor can pay her remaining inelastic workers a lower wage, but must reduce employment because she would have to raise wages to attract workers back. Analytically, employment remains a strategic substitute. Alternatively, case 3 arises if the shock changes the worker pool available to unshocked members.[52] I rule this out by showing that unaffected members' new workers closely resembled old ones in characteristics predicting preferences: age, gender, and origin (Table A3). Moreover, I find opposite employment effects at unshocked members and non-members with similar amenities, whose residual labor supply should change similarly (Table 5). In sum, higher employment at unaffected members does not reflect a violation of connected substitutes and instead evidences collusion.

Firm exit The proof assumes oligopsonistic employers occupy their first order condition. The shock may instead lead some firms to exit, rotating labor supply to unshocked firms right. However, akin to some violations of connected substitutes that may also rotate labor supply right (discussed above), oligopsonistic employment can only increase if wages decline. I instead find wage increases at unaffected members of the association.

Worker heterogeneity Worker heterogeneity could overturn Proposition 1 by violating connected substitutes or diminishing *mrpl*. Preference heterogeneity, which could violate connected substitutes, is discussed and ruled out above (footnote XX)—new and old workers are virtually identical, and I find opposite employment effects at unaffected members and non-members with similar amenities, who should experience similar changes in residual labor supply. Even if workers differ in productivity, unshocked employers will reduce employment

7), that firms inhabit their labor supply curve (equation 10), and Assumption 3.

[51] Say the utility of worker i at employer j is $\beta_i logw_j + loga_j + \epsilon_{ij}$. Higher valuation of wages relative to amenities (high β_i) would increase the elasticity of labor supply to j, and higher wages elsewhere would draw away workers with higher β_i, leaving behind wage-inelastic workers.

[52] The new pool differs in its residual labor supply curve to the firm, e.g., rotates it at the point of intersection with demand. It's hard to think of a concrete example, but case 3 could arise if an employer's old workers leave to work elsewhere, and the new pool she accesses is more elastic (e.g., greatly values wages over amenities) with higher reservation wages.

for any group whose labor supply curve rotates left due to higher demand elsewhere, provided the demand curve remains unchanged. Production "scales down" as employers hire both fewer tailors and packers. However, if the shock disproportionately increases demand for highly productive workers, unshocked employers may substitute toward less productive workers, shifting demand right even as labor supply rotates left. This could increase employment as more unproductive workers are needed to replace productive ones. Section 4.3 rules out such rightward shifts in demand, showing no change in worker composition. I also find no effect on wage variance at unaffected members which could signal changing composition.

Amenities Allowing employers to adjust both wages and amenities following shocks leaves conclusions unchanged if the connected substitutes condition holds. Unshocked, non-cooperative competitors will not increase employment if positively shocked firms raise wages or amenities, as higher utility elsewhere still draws workers away. Such amenity changes would also appear in equation (10). Only preferences that violate connected substitutes can lead unshocked competitors to raise employment under oligopsony (discussed above).

Quantity shocks Although quantity shocks do not raise the *mrpl*, I nonetheless investigate and find they cannot explain results. First, unaffected members exported more to their chief importer rather than affected brands or via subcontracting (Table 4).[53] However, nonmembers of similar sizes exporting to the same importers *reduced* employment, indicating no positive quantity shock to the brand (Table 5, column 2; similar size proxies for comparable excess capacity). Moreover, it is unlikely that unaffected members responded to quantity shocks without price gains from the same brands from which they historically rejected price increases of 5 to 15pp (see small shocks).

Assumption 4 (Current collusive profits exceed counterfactual profits for some cartel members) Proposition 2 covers all collusive arrangements where at least some unshocked cartel members earn higher profits with collusion than without it. This regularity condition ensures that the shock does not arrive when each unshocked cartel member earns lower profits today for the promise of higher future profits, or is compensated via transfers.[54] Importantly, the result requires no assumption on the exact game in which firms interact (the

[53]Unaffected members' higher exporters to their original chief importer would entirely account for greater employment, leaving little room for subcontracts.

[54]For example, Assumption 4 rules out collusion among firms with widely varying productivity whose less productive members are compensated for participation via transfers, ***and*** where the shock disproportionately affects highly productive firms. Empirically, the industry association does not make transfers. In addition, the shock as-if-randomly affected members of the industry association as evidenced by similar baseline characteristics. The estimated productivity distribution satisfies assumption 4 when breakdown precipitates a Cournot oligopsony.

collusive scheme), and instead applies to all schemes satisfying assumption 4. It additionally does not require assuming which counterfactual equilibrium emerges after the breakdown of collusion and instead covers monopsony, Cournot oligopsony, Bertrand oligopsony, or another outcome. However, I term the counterfactual "oligopsony" for ease of exposition. Proposition 2 thus covers all collusive arrangements satisfying assumptions 1 through 4, including collusion at a single wage or partly or fully internalizing others' profits.

Proposition 2: For any labor supply system where employers are connected substitutes if a positive demand shock to firm j ($dlnz_{jt} > 0$) causes collusion satisfying assumption 4 to break down such that firms go to the counterfactual without collusion, then $\exists\ j' \in \{\textbf{cartel}\backslash j\}$ for which $\frac{dlnn_{j't}}{dlnz_{jt}} > 0$.

Proof. I consider a labor market featuring both a cartel ($\mathbf{J_{cartel}} \in \mathbf{J}$) and a fringe that does not collude ($\mathbf{J_{fringe}} \in \mathbf{J} \setminus \mathbf{J_{cartel}}$). Fringe firms independently maximize profits taking the cartel's behavior as given, choosing either quantities or wages. The punishment strategy of the cartel entails collusion breaking down at some point. A positive demand shock to firm j causes collusion to dismantle. I assume the shock is small, such that unshocked firms revert to outcomes "close" to the original counterfactual that would prevail without collusion. I show that among the subset of cartel members whose current collusive profits exceed counterfactual profits absent collusion (i.e., the set of firms for which $\Pi_{coll,t} > \Pi_{count,t}$), $\exists\ j' \in \{\textbf{cartel}\backslash j\}$ who increases employment $\left(\frac{dlnn_{j't}}{dlnz_{jt}} > 0\right)$.

As previously noted, the test does not require assuming which counterfactual equilibrium emerges after collusion breaks down, covering monopsony, Cournot oligopsony, Bertrand oligopsony, or another outcome. I term the counterfactual "oligopsony" for ease of exposition. I proceed by considering three cases.

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

First consider a world without a fringe. I prove the result by contradiction. Say to the contrary that $n_{j',count} \leq n_{j',coll}\ \forall j' \in \mathbf{J_{cartel}} \setminus j$. If breakdown leads every cartel member to reduce wages, an arbitrary member j' would find it profitable to increase its wage from $w_{j',count}$ 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, $f(n) - nw_{coll} > f(n_{coll}) - n_{coll}w_{coll}$. Breakdown enables j' to hire strictly more workers at the old collusive wage since every other firm's wage declines (we're in Case I), and employers are connected substitutes. That j' can hire more workers at $w_{j',coll}$ is easily seen by taking the total derivative of labor supply:

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

However, the arbitrary firm j''s profits after breakdown must then exceed collusive profits, contradicting assumption 4. We arrive at a contradiction and it cannot be that $n_{j',count} \leq n_{j',coll}\ \forall j' \in \mathbf{J_{cartel}} \setminus j$ if $w_{j',olig} < w_{j',coll} \forall j' \in \mathbf{J_{cartel}}$. Thus, $\exists\ j' \in \{\mathbf{cartel} \backslash j\}$ s.t. $n_{j',count} > n_{j',coll}$, 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 unshocked fringe firms cannot raise wages if $w_{j',count} < w_{j',coll} \forall j' \in \mathbf{J_{cartel}}$. Consider an arbitrary fringe employer 1. Since fringe firms inhabit their FOC, equation (9) 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 this is already true if all other employers (cartel + fringe) lower wages. Say, however, to the contrary, that $\frac{dlnw_{1t}}{dlnz_{jt}} > 0$. Equation (11) 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 if every firm raising wages loses workers exclusively to wage-increasing firms. However, the said firm cannot gain workers if its optimal wage response is positive (equation (11)). We arrive at a contradiction and $w_{j'',count} < w_{j'',coll}\ \forall\ j'' \in \mathbf{J_{fringe}}$ if $w_{j',count} < w_{j',coll} \forall j' \in \mathbf{J_{cartel}}$, where $w_{j'',coll}$ is the pre-shock wage at j'' and $w_{j'',count}$ is the post-shock wage. As shown, this implies that $\exists\ j' \in \{\mathbf{cartel} \backslash j\}$ s.t. $n_{j',count} > n_{j',coll}$, and $\frac{dlnn_{j't}}{dlnz_{jt}} > 0$. In sum, if $w_{j',count} < w_{j',coll} \forall j' \in \mathbf{J_{cartel}}$ then $\exists\ j' \in \{\mathbf{cartel} \backslash j\}$ s.t. $n_{j',count} > n_{j',coll}$ and $\frac{dlnn_{j't}}{dlnz_{jt}} > 0$.

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

First, consider the case without a fringe. Say, to the contrary, that $n_{j',count} < n_{j',coll} \forall j' \in \mathbf{J_{cartel}} \setminus j$. Given upward-sloping labor supply to the market, it is impossible for every employer to pay higher wages to hire fewer workers. Thus, counterfactual employment must exceed collusive employment for at least one member of the cartel and $\exists\ j' \in \{\mathbf{cartel} \backslash j\}$ for which $n_{j',count} > n_{j',coll}$. A shock precipitating breakdown to *count* therefore spurs $\frac{dlnn_{j't}}{dlnz_{jt}} > 0$.

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 11). Therefore, if fringe employers increase wages, at least one former cartel member must increase employment, completing the proof.

I argue that unshocked fringe employers cannot reduce wages when $w_{j',count} > w_{j',coll} \forall j' \in \mathbf{J_{cartel}}$. Say, to the contrary, that some arbitrary fringe employer lowers wages $\frac{dlnw_{1t}}{dlnz_{jt}} < 0$. They must 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 more (since $\sum_{j' \in \mathbf{J_{cartel}}} \frac{\partial lnn_1}{\partial lnw_j} dlnw_{j'} < 0$ when $dlnw_{j'} > 0 \forall j'$, we're in Case II). 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 firms that lower wages—but the said firm cannot lose workers on net if its optimal wage response is negative (equation (11)). We arrive 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 $w_{j',count} > w_{j',coll} \forall j' \in \mathbf{J_{cartel}} \setminus j$ then $\exists$ at least one firm $j' \in \{\mathbf{cartel} \setminus \mathbf{j}\}$ for which $\frac{dlnn_{j't}}{dlnz_{jt}} > 0$.

Case III: $w_{j',count} > w_{j',coll}$ **for some firms** $\mathbf{J_{sub1}} \in \mathbf{J_{cartel}} \setminus j$ **and** $w_{j',count} < w_{j',coll}$ **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.

B Appendix: Other Derivations

B.1 Do colluding firms increase employment?

One can determine if a demand shock is "small enough" to prompt firms whose collusion dismantles to increase employment by examining the labor supply curve:

$$\frac{dlnn_{1t}}{dlnz_{jt}} = \frac{\partial lnn_{1t}}{\partial lnw_{1t}} \frac{dlnw_{1t}}{dlnz_{jt}} + \sum_{j'!=1} \frac{\partial lnn_{1t}}{\partial lnw_{j't}} \frac{dlnw_{j't}}{dlnz_{jt}} \tag{12}$$

Under three assumptions, empirically estimated wage changes from the shock reveal whether any given unaffected member or the representative member increases employment. Let lnx_t denote the log industry expenditure function, defined in the standard way.[55] Assume that (i) the log expenditure function is a sufficient statistic for competitor wages, i.e., labor supply

[55] Formally, $lnx_t = \{\log \max_{\{n_{jt}\}} \sum_{j \in \mathbf{J}} w_{jt} n_{jt} | U(n_{it}; N_t) = 1\}$, where $U(.)$ is the preference aggregator which defines the industry labor supply aggregator N_t. In a three-nested labor supply system, where workers choose in turn across locations, industries, and employers, lnx_t is the the log wage index of the industry.

can be expressed as $n_j(w_{jt}, lnx_t; \mathbf{a_t})$,[56] (ii) amenities $\mathbf{a_t}$ stay constant around the time of the shock, and (iii) firms inhabit the labor supply curve. Employer 1 increases employment if:

$$dlnn_{1t} = \left[\frac{\partial lnn_{1t}}{\partial lnw_{1t}} - \frac{\partial lnn_{1t}}{\partial lnx_t}\frac{\partial lnx_t}{\partial lnw_{1t}}\right] dlnw_{1t} + \frac{\partial lnn_{1t}}{\partial lnx_t}\sum_{j' \in \mathbf{J}} s_{j'} dlnw_{j't} > 0$$

which uses Shephard's lemma for the log expenditure function $\partial lnx_t/\partial lnw_{jt} = s_{jt}$. I assume three-nested logit preferences. Thus, unaffected member 1 increases employment if her wage increases more than the industry's wage index (the demand shock is "small enough"):

$$dlnn_{1t} = \eta dlnw_{1t} + ((\theta - \eta) + (\lambda - \theta)s_k)\sum_{j' \in \mathbf{J}} s_{j'} dlnw_{j't} > 0$$

Where (η, θ, λ) are the elasticities of substitution across employers, industries, and locations, and s_k is the wage index-weighted share of employment in industry k (garments) in the location. The representative—payroll share-weighted—unaffected member increases employment if:

$$\underbrace{\sum_{um} s_{um} dlnn_{um,t}}_{(a)} = \eta \underbrace{\sum_{um} s_{um} dlnw_{um,t}}_{(b)} + \underbrace{((\theta - \eta) + (\lambda - \theta)s_k)\sum_{um} s_{um}}_{(c)} \underbrace{\sum_{j' \in \mathbf{J}} s_{j'} dlnw_{j't}}_{(d)} > 0$$

I estimate (b) and (d) for the large shock using weighted versions of the regressions estimating average effects and substitute estimates $(\hat{\eta}, \hat{\theta}, \hat{\lambda})$ and s_{um}. The right hand side exceeds zero, indicating the representative unshocked colluder should increase employment. In other settings, a similar calculation can determine whether a shock that breaks collusion will increase output at unaffected cartel members.

B.2 Conduct test instrument

I argue that the instrument $\sum_{j'!=j} \frac{s_{j't}}{1-s_{jt}} 1_{shocked,j'}$ is relevant in shifting markdowns. The instrument, a share-weighted sum of indicators of being affected by the large demand shock summed over employers $j'! = j$, should be uncorrelated with j's own productivity z_{jt}.

Step 1 For any non-cooperative 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 $\mathbf{w_{-jt}}$: $ln\tilde{w_{jt}} = lnmrpl_{jt} + \Lambda_j(\tilde{w_{jt}}, \mathbf{w_{-jt}}, \mathbf{a_t})$.

[56] For example, nested CES and nested logit labor supply exhibit this property.

Proof. Sharma (2023) Proposition 3 on p.86.

Step 2 A competitor wage index $dlnw_{-jt} = \sum_{j'!=j} \omega_{-j't} dlnw_{j't}$ links competitor wages to j's markdown with $\omega_{-j't}$ being weights. If the log expenditure function lnx_t is a sufficient statistic for competitor wages, i.e., labor supply can be expressed as $n_j(w_{jt}, lnx_t; \mathbf{a_t})$, then the weights in the competitor wage index are proportional to wage bill market shares $s_{j't}$ for $j'! = j$ and given by $\omega_{jj't} = \frac{s_{j't}}{1-s_{jt}}$. The competitor wage index thus simplifies to: $\sum_{j'!=j} \frac{s_{j't}}{1-s_{jt}} dw_{j't}$. I instrument it with $\sum_{j'!=j} \frac{s_{j't}}{1-s_{jt}} 1_{shocked,j'}$.

Proof. Sharma (2023) Proposition 4 on p.88. Nested-logit labor supply satisfies the log expenditure function property.

B.3 Model derivations

Environment A continuum of geographies (states) $r \in [0, 1]$ host a discrete number of industries $k \in 1, ..., M_r$, each with firms $j \in 1, ..., J_m$. A unit measure of workers possess heterogeneous preferences over employers. Firms can demand labor under two competition structures: (i) collusion, where a cartel colludes to pay the minimum wage while fringe firms choose employment to maximize profits taking other firms' employment and the cartel's behavior as given, (ii) a Cournot oligopsony, where firms set employment to maximize profits taking others' employment decisions as given. Time is discrete and indexed by t.

Labor Supply Workers possess heterogeneous preferences over employers. Worker i chooses to work at her highest utility employer, and exhibits three-nested preferences, choosing in turn across locations, industries, and employer in 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 j's wage and amenity and an idiosyncratic preference shock specific to each employment relationship:

$$u_{ijkrt} = lnw_{jt} + lna_{jt} + lna_k + \epsilon_{ijk} \tag{13}$$

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 with variance 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.

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

The probability of choosing employer j is (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 probabilities over the unit measure of workers yields the upward-sloping labor supply curve to employer j:

$$\begin{aligned}
n_{jkrt} &= \int_0^1 p_{jkrt}h_{ijkr}dF(y_i),\ h_{ijkr} = \frac{y_i}{w_{jkrt}} \\
n_{jkrt} &= \frac{(w_{jkrt})^{\eta}}{\sum_{j'\in k}(a_{j't}w_{j't})^{1+\eta}} \frac{((\sum_{j'\in k}(a_{j'}w_{j'})^{1+\eta}))^{\frac{1+\theta}{1+\eta}}}{\sum_{k'\in r} a_{k'}^{1+\theta}(\sum_{j''\in k'}(a_{j''}w_{j''})^{1+\eta})^{\frac{1+\theta}{1+\eta}}} \times \\
&\frac{\left(\sum_{k'\in r} a_{k'}^{1+\theta}(\sum_{j''\in k'}(a_{j''t}w_{j''t})^{1+\eta})^{\frac{1+\theta}{1+\eta}}\right)^{\frac{1+\lambda}{1+\theta}}}{\sum_r \left(\sum_{k''\in r} a_{k''}^{1+\theta}(\sum_{j'''\in k''}(a_{j'''t}w_{j'''t})^{1+\eta})^{\frac{1+\theta}{1+\eta}}\right)^{\frac{1+\lambda}{1+\theta}}} (a_{jkrt})^{1+\eta}a_k^{1+\theta} \underbrace{\int_0^1 y_i dF(y_i)}_{:=Y_t}
\end{aligned}$$

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

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

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 labor supply to an employer, I plug these expressions back into the labor supply curve expression above, yielding nested logit labor supply to j:

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

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:

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

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 to j:

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

Labor Supply Elasticity I obtain the inverse elasticity of residual labor supply to employer j by taking the derivative of its log wage with respect to 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 curves of j and $j' \in k, r$), thus proving the lemma.

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

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

Expressing production in terms of labor alone When capital is supplied competitively at rate R_t, optimal capital demand can be plugged into the production function to obtain it in terms of labor alone. The value-added production function is $y_{jt} = z_{jt}(k_{jt}^{1-\gamma} n_{jt}^{\gamma})^{\alpha}$. The optimal choice of capital solves:

$$k_{jt}^*(z_{jt}, n_{jt}, R) = \arg\max_{k_{jt}} z_{jt}(k_{jt}^{1-\gamma} n_{jt}^{\gamma})^{\alpha} - R k_{jt}$$

This yields: $k^*_{jt} = \left(\frac{(1-\gamma)\alpha z_{jt}}{R}\right)^{\frac{1}{1-(1-\gamma)\alpha}} n_{jt}^{\frac{\gamma\alpha}{1-(1-\gamma)\alpha}}$, with output re-written as: $\tilde{y_{jt}} = \tilde{z_{jt}} n_{jt}^{\tilde{\alpha}}$. In terms of factor payment shares, capital is competitively priced, which will be used to calibrate γ: $R_t k_{jt} = \alpha(1-\gamma)y_{jt}$. Aggregating across garment employers: $RK = \alpha(1-\gamma)Y_k$.

B.4 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 the elasticity:

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

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

$$\begin{aligned}
\frac{\partial ln\mu_{jt}}{\partial lnw_{jt}} &= \frac{w_{jt}}{e_{jt}}\frac{\partial e_{jt}}{\partial w_{jt}} - \frac{1}{1+e_{jt}} w_{jt} \frac{\partial e_{jt}}{\partial w_{jt}} \\
&= \frac{w_{jt}}{e_{jt}(1+e_{jt})}\left[e_{jt}^2 \frac{\partial\left(\frac{1}{\eta} + \left(\frac{1}{\theta} - \frac{1}{\eta}\right) s_{jt} + \left(\frac{1}{\lambda} - \frac{1}{\theta}\right) s_{jt} s_{kt}\right)}{\partial w_j}\right] \\
&= \frac{e_{jt}}{1+e_{jt}}\left[\left(\frac{1}{\theta} - \frac{1}{\eta}\right) s_{jt}((1-s_{jt})) + \left(\frac{1}{\lambda} - \frac{1}{\theta}\right) s_{kt} s_{jt}(1-s_{jt})\right] \\
&+ \frac{e_{jt}}{1+e_{jt}}\left[\left(\frac{1}{\lambda} - \frac{1}{\theta}\right) s_{jt}^2 (1-s_{kt})\right]
\end{aligned} \tag{14}$$

Amiti et al. (2019) show that $\sum_{j'!=j} \frac{\partial ln\mu_{jt}}{\partial lnw_{j't}} dlnw_{j't}$ can be written as:

$$\underbrace{\sum_{j'!=j} \frac{\partial ln\mu_{jt}}{\partial lnw_{j't}}}_{\tau_{j'}} \sum_{j'!=j} \underbrace{\frac{\partial ln\mu_j / \partial lnw_{j'}}{\sum_{j'!=j} \frac{\partial ln\mu_{jt}}{\partial lnw_{j't}}}}_{\omega_{jj't}} dlnw_{j't} \tag{15}$$

They show that for nested CES preferences: $\tau_{j'} = -\frac{\partial ln\mu_{jt}}{\partial lnw_{jt}}$ and weights $\omega_{jj't} = \frac{s_{j't}}{1-s_{jt}}$. Combining equations 14 and 15 yields the derivative of the optimal markdown under Cournot oligopsony. I derive the Bertrand oligopsony markdown given elasticity of labor supply: $\eta + (\theta - \eta)s_{jt} + (\lambda - \theta)s_{jt}s_{kt}$.

B.5 Calibration

Decreasing returns to scale α and Frisch elasticity φ are calibrated to Berger et al. (2022). The Frisch elasticity φ governs the disutility of hours worked and is the elasticity of aggregate labor wrt aggregate wage holding wealth effects constant. I calibrate the exponent γ to match the capital share (see final paragraph of Appendix B.3), calibrated to the tradeable sector in Barkai (2020). A closed form solution of the model shows that the productivity shifter Z normalizes units of wages (Berger et al. 2022, Appendix E.6). I thus calibrate Z to match the post-shock average wage after subtracting off the shock itself, akin to the productivity distribution. As a diagnostic check, the calibrated model closely replicates the share of workers paid the minimum wage, 41% in the model compared to 46% in data.