Collusion Among Employers in India

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Abstract

This paper evidences collusion among employers in the textile and clothing manufacturing industry in India. First, I develop a simple comparative static test to distinguish standard forms of imperfect competition from collusion. I show that, for general labor supply and production structures, spillovers from 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 manufacturing industry organize into industry associations to pay workers exactly the state-industry-specific minimum wage, using it as a focal point for collusion. Members of associations are much more likely than non-members to bunch from above at the minimum wage, and track increases without reducing employment. I show that non-members cater to small export demand shocks by increasing wages and employment (standard imperfect competition), but members forego small export opportunities to stick to the minimum wage. 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. I conclude that collusion spurs substantial losses even compared to a world where firms exercise 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). Economists have long suspected that employers conspire to pay workers below their worth, yet evidence of collusion to date remains scarce. This lack of evidence represents an important blind spot for antitrust policy in developed and developing countries alike, which have so far focused almost exclusively on regulating product markets. Evidence of collusion among employers would, however, provide a compelling rationale for extending antitrust intervention also in the labor market.

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

The key challenge with detecting collusion is that collusive and non-collusive models of the labor market often make identical predictions. For instance, neighboring firms that compete perfectly, collude, or that 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 structures of labor supply and production, the spillover effects of firm-specific demand shocks predict opposite employment effects at unshocked competitors who operate independently (↓ employment), versus employers who were previously colluding but whose collusion dismantles due to the shock (↑ employment). Importantly, the test enables diagnosing collusion without making strong structural assumptions or estimating many structural objects, which is the tradition in the literature. To quantify the relative fit of various models, I complement the comparative static test with a "full IO" approach, imposing specific structures of labor supply and production to identify the model of conduct best satisfying exclusion restrictions.

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

My analysis relies on linking 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. Its main insight is that, for very general labor supply and production structures—where demand (weakly) slopes down, and higher competitor wages reduce labor supply to oneself—the spillover effects of firm-specific demand shocks predict opposite employment effects under non-cooperative models of competition vs. the breakdown of collusion.[1] When firms operate independently, such as under monopsony, Cournot oligopsony, or Bertrand oligopsony, a positive demand shock to some firms leads unshocked competitors to raise wages and *reduce* employment. Intuitively, shocked firms raise wages to attract new workers, drawing them away from unshocked competitors. Unshocked competitors best respond by raising their own wage. However, to ensure optimality again, they must shed workers to raise marginal product. Spillovers thus unambiguously reduce employment.[2] In contrast, a firm-specific demand shock that dismantles collusion prompts unshocked employers to raise both wages *and* employment. This occurs because colluding firms internalize the negative impact of higher wages on fellow cartel members, suppressing both wages and employment below independently optimal levels. Dismantling collusion raises both. The test covers any collusive scheme 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 her to raise wages to retain workers. On the one hand, she wants to reduce employment to raise marginal product. On the other hand, she wants to grow large enough again to pay a smaller markdown. I show that the first force unambiguously dominates the second, and employment unambiguously declines.

[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.

[2] Figure 1 illustrates the intuition: higher wages at shocked firms rotate an unshocked competitor's labor supply curve left for assumptions (i)-(iii); she moves up the demand curve, increasing wage and reducing employment.

[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 by partly or fully internalizing others' profits.

[4] Former colluders increase employment for demand shocks "small enough" to spur an equilibrium "close" to the counterfactual that would prevail 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 can *never* predict higher employment at unshocked competitors for assumptions (i) - (iii), whereas a breakdown of collusion does (as could other collusive schemes sans breakdown). The appendix derives the maximum shock size for which unshocked colluders will raise employment, and confirms the studied shock is smaller. In a structural test of conduct, the full breakdown of collusion from a focal point rejects monopsony, oligopsony, or shifting to a new collusive scheme, like a new wage or joint profit maximization.

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

First, I find that members of industry associations disproportionately bunch from above at the local minimum wage, while non-members typically pay below it. Social security records reveal that 30% of garment workers earn exactly the minimum wage, 55% earn below it, and 15% earn above. Industry associations almost entirely account for this bunching from above at the minimum wage: 43% of their workers earn exactly the minimum wage, compared to only 15% among non-members, where the majority (71%) earn below the minimum wage.[5] Second, industry associations expel members who deviate to paying wages above the minimum wage. In Tirupur, which employs 30% of India's garment workers and produces 60% of exports, the Tirupur Exporters' Association features a two-year probationary term before members can become permanent. I find that probationary members who raise pay above the minimum wage are 38pp less likely to be promoted to permanency compared to never-deviators.

Third, industry associations track increases in the minimum wage without reducing employment, indicating imperfect competition in the labor market. Finally, I examine how members and non-members respond to routine demand shocks, defined as temporary price increases of 5 to 15pp at an establishment's main importer (e.g., Zara USA, Gap USA). Using a DiD event study comparing shocked establishments to themselves in unshocked seasons, I find that non-members cater to small demand shocks as imperfect competitors facing upward-sloping labor supply curves, by increasing wages to hire more workers. However, members forego these small export opportunities to stick to the minimum wage—they do not increase wages, do not expand employment, and do not export more. Together, these facts suggest that industry associations coordinate to pay workers exactly the minimum wage.

Test of collusion: empirics In the main empirical test for collusion, I study the spillover effects of a large, firm-specific demand shock that led affected members of the industry association to deviate to paying wages above the minimum. The shock originated as a result of labor audits in Vietnam, which uncovered severe labor law violations and compelled twenty six prominent brands to temporarily relocate production operations from Vietnam to India. In a single month, prices at affected Indian exporters grew 24.5pp above their unaffected counterparts. The relocation shock thus constitutes a positive demand shock to the subset of establishments previously exporting to affected brands (but not exporters to other brands). I study its impact in Tirupur, which employs 30% of India's garment workers and produces most exports. The shock impacted 15% of establishments in Tirupur and 13% of TEA members. Affected and unaffected members (and non-members) closely resembled each other in baseline characteristics.

[5] The resulting model of collusion I propose is one where large and productive firms form a cartel to pay exactly the minimum wage, while less productive fringe firms pay below the minimum.

Unlike routine demand shocks, the relocation shock led affected TEA members to raise wages and employment above the minimum wage. Employing a DiD event study to compare establishments in shocked seasons to their unshocked selves in previous seasons, I find that the shock raised wages at affected members by 9pp, and employment by 8pp.[6]

Spillovers onto unaffected non-members manifested as in oligopsony, by increasing wages and reducing employment. In contrast, spillovers onto unaffected members of the industry association occurred as if the shock dismantled their collusion, by leading to higher wages *and* employment. Four months after the shock, the average wage at unaffected non-members grew by 5pp and employment declined 6pp. In contrast, unaffected members' wages rose 6.5pp, and employment *increased* 8.5pp.

Could the above findings be driven by factors other than a breakdown of collusion? I rule out four sets of concerns. I rule out subcontracting within the association by showing that unaffected members' new exports fully account for their higher workforce, leaving little scope to fill sub-contracts. Second, to rule out correlated demand shocks, or that affected members sub-contract out "worse" export orders to unaffected counterparts, I show that the price of unaffected members' exports is unchanged. Only demand shocks that increase prices can compel oligopsonistic or monopsonistic firms to raise employment.[7] In addition, while affected members' profits increased by 16%, consistent with them receiving positive demand shocks, profits at unaffected members declined by 5%, consistent with them no longer accessing higher collusive profits. Together, these results reveal that the wage and employment increase among unaffected members reflected not a positive demand shock, but, rather, a greater *supply* of exports when some members' deviations from the minimum wage rendered the old collusive scheme untenable. Third, common TFP or cost shocks that affect association members concurrently with relocation could increase labor demand, and, hence, employment. Disparate impacts on prices and profits suggest disparate, and not a common, source of shocks.[8] Finally, a host of other tests rule out violations of weakly downward sloping demand or a reduction in labor supply when competitors raise wages as driving higher employment at unaffected members.[9]

Although the simple test is appealing due to its minimal structure, a full structural approach enables quantifying the relative fit of different models of conduct. Under assumed models of labor supply (a three-nested CES where workers choose across locations, industries, and employers within the industry) and 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. I reject oligopsony in favor of a breakdown of collusion from the minimum wage.[10]

Quantification: losses and minimum wage policy I conclude by quantifying the wage and employment losses that accrue due to collusion, and assess the role of minimum wage policy as a new tool of anti-trust. To quantify losses, I calculate the counterfactual wages and employment

[6]A host of tests validate the parallel trends identifying assumption, sections 4.1 and 4.2.

[7]Only price or TFP shocks lead monopsonists or oligopsonists to raise employment since only they raise the *mrpl*.

[8]The timing of changes also closely aligns with a breakdown of collusion: affected members' wages rise immediately following the relocation shock whereas unaffected members' wages rise two months later.

[9]In other words, unaffected members did not increase employment by virtue of competing in an oligopsony that violates these assumptions (see section 4.3).

[10]I additionally reject collusion at a new wage or moving toward joint profit maximization.

that would prevail if employers instead competed Cournot. I impose structure to solve the model. I assume a Cobb-Douglas value-added production function in capital and labor with a Hicks-neutral productivity shock, whose distribution I estimate. I estimate the three-nested logit labor supply system (locations, industries, employers). Finally, I infer a simple punishment strategy from the data, where the cartel punishes deviations from the minimum wage by switching to oligopsony for six months. The cartel endogenously evolves to only comprise firms that profit from colluding at the minimum wage.

Collusion at the minimum wage induces substantial wage and employment losses, even compared to a world where firms exercises their own, but not their collective, market power. Switching from collusion to Cournot oligopsony increases the average garment worker's wage by 9.6pp. Wages rise both because former cartel members raise pay above the minimum wage, and because this exerts upward wage pressure on fringe employers paying below the minimum. Higher wages in the garment industry attract workers from other industries and unemployment. Overall, employment in the garment sector rises 17pp, of which a fifth come from unemployment.

Since paying the minimum wage is entirely legal, antitrust authorities have limited legal recourse available for tackling the type of collusion evidenced in this paper. However, policies to raise the minimum wage can mitigate the ill effects of collusion by catalyzing coordination at a higher wage. An important institutional feature of the garment industry renders such coordination highly likely, namely, that foreign buyers enforce compliance with the minimum wage.

I therefore conclude by studying the impact of three different minimum wage hikes on wages and employment. The first two 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 industry, raising 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 because, when highly productive firms lower their wages to join the cartel, less productive firms can raise wages and employment above a more-competitive oligopsony. The second force outweighs the first, and the average garment worker's wage rises 32pp; employment rises 23pp. Since colluders were previously the most productive firms in the economy, their expansion raises productive efficiency (Baqaee and Farhi 2020). Finally, I find that the proposed living wage cannot sustain collusion.

Related literature This paper is, to my knowledge, 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 Manning 2011, Sokolova and Sorensen 2021, Manning 2021, and Card 2022). The closest related work is Delabastita & Rubens (2022), which employs a structural approach to uncover collusion in the Belgian coal cartel of the 1870s. The authors estimate production functions to estimate wage markdowns, estimate input supply curves, and uncover the degree to which employers internalizing others' profits would justify estimated markdowns. Roussille & Scuderi (2022) augment the structural approach of Backus, Conlon, and Sinkinson (BCS, 2021) to test for conduct on an online recruitment platform for high wage engineers in the US. The idea is that, under estimated labor supply and production functions, the correct model of conduct will imply productivity shocks uncorrelated with instruments that only shift markdowns. They find that employers behave as independent monopsonists rather than oligopsonists who strategically interact.

To the best of my knowledge, this paper is the first to evidence employer collusion in a contemporary labor market setting. It makes three additional contributions. First, I develop a simple, comparative static test of collusion valid for very general labor supply and production structures. In so doing, I diagnose collusion without needing to estimate several structural objects (e.g. BCS 2021, Berry & Haile 2014). The key innovation is showing that *firm-specific* demand shocks cleanly predict opposite employment effects at unshocked competitors under non-cooperative competition versus the breakdown of collusion.[11] Second, I diagnose collusion at a focal point wage. Many forces in the real world push towards such a focal point over models where employers collude perfectly, or by internalizing others' profits.[12] A focal point is easy to observe and monitor. The garment industry also faces transitory shocks that are difficult to publicly observe.[13] Finally, foreign buyers enforce compliance with the minimum wage, rendering it a reasonable target for collusion. The paper's third contribution is to detect collusion in an important industrial setting in a developing country context. The garment industry is among the largest employers in developing countries, employing over 90 million workers overall.

The paper adds to a large literature on minimum wages. While the minimum wage typically binds from below (e.g in the US as in Cengiz et al. 2018, and Brazil in Derenoncourt et al. 2021), I show that it can serve as a focal point for collusion even when non-binding.[14] My findings demonstrate that higher minimum wages can successfully mitigate the effects of collusion by catalyzing coordination at a higher wage.

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

[11]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, my test offers a nonparametric, "reduced form" test of collusion not requiring knowledge of the exact game in which firms interact.

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

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

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

2 Test

This section demonstrates that, under quite general labor supply and production structures—where demand weakly slopes down and higher wages at a competitor reduce one's labor supply—spillovers from a positive, firm-specific demand shock produce opposite employment effects at unshocked firms operating independently (↓ employment), versus former colluders whose collusion dismantles due to the shock (↑ employment). The test nests perfect competition, monopsony, Bertrand, and Cournot oligopsony. It additionally covers all collusive schemes where at least some cartel members earn higher profits with than without collusion.[15] For example, the test covers standard forms of collusion, like at a single wage or by partly or fully internalizing others' profits, without requiring a stance on the exact game in which firms interact.

The main point is that, under fairly general conditions, non-cooperative competition *never* predicts higher employment at unshocked competitors. Thus, if unshocked firms raise employment they must be colluding before, and collusive breakdown predicts this response. Section 4 tests for collusion by examining spillovers from firm-specific demand shocks separately by industry association membership. Section 5 adds more structure to statistically arbitrate between various models of conduct.[16]

2.1 Setup

The economy has a continuum of firms, with a finite subset $\mathbf{J}$ competing in a labor market. Time is discrete and indexed by t. I outline three, easily testable conditions under which non-cooperative competition cannot predict higher employment at unshocked competitors.

Labor supply is invertible, meaning employers are imperfect substitutes in workers' eyes. Imperfect substitutability yields upward-sloping labor supply curves to individual employers, which depend on a firm j's wage w_{jt}, a vector of 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 strategic interactions, or spillovers. Spillovers occur when a firm-specific shock to j's wage rotates labor supply to j', causing j' to best respond by changing its own wage and employment. Invertibility is a small, technical requirement ensuring a unique distribution of workers across employers paying a common wage, a defining feature of imperfect competition.[17] Invertibility nests both common and uncommon 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 main assumption regarding labor supply, which nests invertibility, is that employers are connected substitutes (Berry, Gandhi and Haile 2013). Employers are weak substitutes, where a higher wage at one employer weakly reduces labor supply to others, with sufficient strict substitution

[15] The number of unshocked cartel members that increase employment depends on the magnitude of the shock. The appendix derives a simple condition under which a typical unshocked member increases employment.

[16] In Section 5, the full breakdown of collusion from a focal point wage rejects oligopsony (Cournot and Bertrand), monopsony, and collusion sans breakdown, like shifting to a new collusive wage or joint profit maximization.

[17] Invertibility accommodates arbitrarily large but finite substitution elasticities, which approximates perfect substitutes well (Kucheryavyy 2012).

to warrant treating employers within a common labor supply system. Connected substitutes ensures that positive shocks to to j rotate j''s labor supply left.

The connected substitutes condition enables a non-parametric test while allowing substantially more flexible patterns of substitution across employers than standard. For instance, while connected substitutes nests nested CES and nested logit preferences, unlike these systems, it does not impose symmetry (i.e., that the significance of any firm is summarized by its market share). It also nests job ladder models where higher wages/amenities elevate employers up the ladder (e.g., Sorkin 2018). In sum, connected substitutes ensures that a positive shock to j rotates competitors' labor supply left, without requiring specific functional forms, smoothness restrictions, or strong domain restrictions.

Assumption 1. (Connected substitutes) Employers are weak substitutes where, all else equal, a higher w_j weakly reduces labor supply to other employers $\frac{\partial lnn_{j'}}{\partial lnw_j} \leq 0 \forall\ j'! = j$. 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, reasonable violations exist. For instance, non-homothetic preferences may violate the connected substitutes condition if workers' preference for non-wage amenities grows with wealth. Higher wages at j could then *increase*, rather than decrease, labor supply to an unshocked, high-amenity employer j', rotating labor supply right and increasing employment even under oligopsony/monopsony. Section 4.3 characterizes and rules out three mutually exclusive and exhaustive violations of the connected substitutes condition as driving results.

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

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

Assumption 2 applies both when firms possess product market power, which itself generates downward-sloping demand, or not. It additionally encompasses horizontal demand, e.g. when firms possess excess capacity or are credit constrained.

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), by considering themselves atomistic (monopsony), or being atomistic (perfect competition). Collusive firms adhere to the collusive scheme, while fringe firms choose employment or wages taking as given other firms' decisions and the cartel's behavior.

Perfect competition Firm-specific demand shocks do not affect any employer's wage under perfect competition. Firms face flat labor supply curves, leading the shocked firm to increase employment until marginal product equals the market wage again. Market-level positive demand shocks raise the market wage and reduce employment at unshocked competitors.

Oligopsony or Monopsony

Proposition 1: For oligopsonistic or monopsonistic conduct, any invertible labor supply system, and Assumption 2, a positive demand shock to firm 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 See Appendix.

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: consider a Bertrand oligopsony. Employer j' faces upward-sloping labor supply (imperfect competition) and downward-sloping demand (Assumption 2). A positive demand 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 left; she moves up her demand curve, increasing wages and reducing employment.

While the rationale behind positive wage spillovers is obvious, an unambiguous decline in employment is not. Spillovers exert competing forces on employment, best illustrated via the first order condition, $w_{j'} = \mu_{j'} mrpl_{j'}$, where $mrpl_{j'}$ is the marginal revenue product of labor and $\mu_{j'}$ the markdown. The shock increases unshocked competitor j''s optimal markdown $\mu_{j'}$, since she must raise pay to retain workers.[18] 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 her labor supply curve back). Under assumptions one and two, I show that the first force unambiguously wins, and employment unambiguously declines.

Finally, spillovers also reduce employment under monopsony. This is because spillovers manifest by changing the curvature of labor supply, which can depend on competitor wages even absent strategic motives for wage setting.[19] If yes, spillovers unambiguously reduce employment.

Binding minimum wage, other markets (product, input, capital) The appendix demonstrates that under monopsonistic or oligopsonistic competition with a binding minimum wage, firm-specific demand shocks continue to predict (weak) employment declines at unshocked competi-

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

[19]Formally, the curvature or perceived elasticity of labor supply is defined $\sigma_{jt} = \frac{dlnn_{jt}}{dlnw_{jt}} = \frac{\partial lnn_{jt}(w_{jt}, w_{-jt}, a_t)}{\partial lnw_{jt}} + \sum_{j'!=j} \frac{\partial lnn_{jt}(w_{jt}, w_{-jt}, a_t)}{\partial lnw_{j't}} \frac{dlnw_{j't}}{dlnw_{jt}}$. 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.

tors—left rotations of labor supply still reduce employment. On other markets, Proposition 1 holds whenever labor supply exhibits connected substitutability and revenue exhibits weakly diminishing *mrpl*, regardless of competition in the 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 8.1). The appendix and section 4.3 rule out unusual features of other markets that 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 previously noted, these assumptions cover all standard labor supply systems including nested CES, nested logit, mixed logit with connected substitutes, common job ladder, and extend to cases with horizontal demand (binding minimum wage, credit constraints, excess capacity). Nonetheless, there exist reasonable violations. For instance, assumption 1 could be violated by non-homothetic preferences that rotate an unshocked firm's labor supply curve right instead of left. The appendix characterizes and rules out three mutually exclusive and exhaustive violations of connected substitutes as driving results (also Section 4.3). 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 additionally rules out violations of assumption 2 as driving results. Proposition 1 is proven absent exit, but this is easily relaxed. If other employers' exit rotates an unshocked competitor's labor supply right instead of left, then employment can only increase under oligopsony if wages decline (akin to some violations of the connected substitutes condition, Appendix). In contrast, I find higher wages at unshocked members of the industry association.

Breakdown of collusion

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 mild condition ensures that the shock does not occur when each member sacrifices higher counterfactual profits today for 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.[20]

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 $\exists$ $j' \in \{\textbf{cartel} \backslash j\}$ for which $\frac{dlnn_{j't}}{dlnz_{jt}} > 0$.

Proof See Appendix.

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

A simple intuition underlies the proof—for collusion to be profitable, at least some firms must suppress both wages and employment relative to independent operation. Although I study firms coordinating at a focal point wage, the intuition for why wage and employment suppression is mutually beneficial is clearest for the case of joint profit maximization. Jointly profit-maximizing firms internalize the negative impact of each firm's higher wage on the labor supply available to competitors, thereby suppressing both wages and employment below individually optimal levels. Similar motives inspire other forms of collusion (like at a focal point), and a breakdown of collusion leads unshocked colluders to increase both wages and employment.[21]

A key advantage is that Proposition 2 enables diagnosing collusion without taking a stance on the exact game in which firms interact (the collusive scheme) or which equilibrium emerges after breakdown. Instead, the test covers all collusive arrangements satisfying assumption 3, and any equilibrium post-breakdown (e.g. monopsony, Cournot oligopsony, Bertrand oligopsony, or another outcome). Thus, Proposition 2 covers both common collusive schemes, at a single wage or partly or full internalizing others' profits, and more complex arrangements satisfying assumption 3.

Former colluders increase employment when the demand shock is small enough to spur an equilibrium "close" to the counterfactual absent collusion. In contrast, very large demand shocks, driving equilibria far from this original counterfactual, could also reduce employment at unshocked cartel members, e.g. if the shocked firm seeks to employ its whole labor market. The test nonetheless demonstrates that, under the two assumptions, non-cooperative competition *never* predicts higher employment at unshocked competitors, whereas a breakdown of collusion can. Appendix 9.1 derives a simple condition governing the maximum shock size below which unshocked cartel members (or the representative member) will increase employment and confirms the studied shock was smaller.

2.2 Discussion

This section shows 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 be 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 should dismantle collusion. Such an argument is incorrect—the Folk Theorem shows that several alternative collusive schemes (sans breakdown) are sustainable for sufficiently patient firms. For instance, the cartel might allow members receiving positive shocks to expand production while asking unshocked members to cut back, reversing roles when shocks reverse. This scheme 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, non-cooperative unshocked firms will *never* increase employment, whereas colluding firms can. Section 5 shows that

[21] Coordination in the garment industry resembles coordination at the minimum wage rather than firms internalizing others' profits. In fact, joint profit maximization would predict wage dispersion at differently productive employers (distinct z_j's). 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 that are hard to observe. Finally, foreign buyers enforce compliance with the minimum wage, rendering it a reasonable target for collusion.

the breakdown of collusion from a focal point wage rejects not just non-cooperative competition (monopsony, oligopsony, perfect competition), but also collusion sans breakdown.

3 Data, Setting, and Motivating Evidence

3.1 Data Sources

The analysis links four new datasets, each spanning the period between 2014 and 2018. First, I track worker outcomes using linked employer-employee social security records from India's Employees' Provident Fund Organization (EPFO). The EPFO collects pension contributions for all workers with monthly earnings below Rs.15,000. The data track workers across employers. For each employment spell, they report a worker's monthly earnings, tenure, age, gender, and employer characteristics like location (city or district) and six-digit industry. Second, to capture industry association membership, I identify the largest association in each of five major garment manufacturing hubs—Tirupur (Tamil Nadu), Bangalore (Karnataka), Gurgaon (Haryana), Faridabad (Haryana), and Noida (Uttar Pradesh)—which together employ 63% of garment workers. I scrape member lists from each association's website, with the average association comprising 555 establishments.

Third, I construct a panel of state- and industry-specific minimum wages using state government announcements of minimum wage hikes. The data cover 105 industries, including "biscuit manufacturing", "tobacco processing", and "garments and tailoring". Finally, I measure demand shocks using establishment-level export data from customs records, digitized by the organization Panjiva. The data provide annual export values, product codes (six-digit), and destinations for each establishment. Product codes encode information about both article type and material, for example "women's or girls' track suits of cotton" or "men's or boys' shirts of man-made fibers". I link datasets by matching exporter names and zip codes using the Jaro-Winkler and Levenshtein minimum distance algorithms, and manual matching. In total, I match 82% of exporters to social security records.

3.2 Institutional Setting

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

Industry associations Nearly half of all workers in the Indian garment industry work at 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 association membership varies by location, membership is typically restricted to large and prosperous factories. Benefits and membership criteria are detailed below.

I identify the most prominent industry association in each of the five main hubs of garment manufacturing—Tirupur, Bangalore, Gurgaon, Faridabad, and Noida. The bunching results reported below apply to all associations. However, the spillover test in Section 4 focuses on Tirupur, which employs a third of garment workers and produces most exports.

Table 1 describes summary statistics comparing members of industry associations to non-members. Members of industry associations are among the largest and most productive firms in the economy. They employ on average 152 workers, compared to 101 workers at firms outside the association. 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 value in dollars (3 million USD versus 2.6 million). The average member of an industry association pays a monthly wage of $371 (USD adjusted for PPP), compared to $257 outside the association. Below I describe the membership criteria for, and perks of participating in, the Tirupur Exporters' Association (TEA).

Minimum wage Each state in India establishes a daily minimum wage for each of 105 scheduled employments (roughly, two-digit industries).[22] Examples include garment manufacturing, biscuit manufacturing, and tobacco processing. The minimum wage is designed to cover basic living expenses for a family of four members and is benchmarked to local prices. For instance, the minimum wage for Karnataka aims cover "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 expenditure". States gather price information from multiple markets before revising the minimum wage. For instance, Karnataka gathers prices from sixteen markets.

State governments must revise each industry's minimum wage once every five years and adjust it for inflation every six months. However, in practice revisions are infrequent: the average state only revised its minimum wage for the garment industry four times between 2014 and 2018. Within each industry, minimum wages are set at three levels for unskilled, semi-skilled, and skilled workers. The semi-skilled wage is typically 5.9% above the unskilled wage, and skilled wage is 14.3% higher. Examples of skilled roles in the garment industry include designers, cutting machine operators, and master or grade I tailors. Semi-skilled roles include grade II tailors, buttonhole machine operators, and stitchers, and unskilled roles include helpers and packers. All results use the semi-skilled wage, since over 70% of workers belong to this category.

Table 2 reports summary statistics on minimum wages in the garment industry in July 2016. Across states, 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 value Rs. 7439 (387 USD), and the skilled wage ranged from Rs. 5171 to Rs. 11622, with an average Rs. 8034 (418 USD). Of the total value of the minimum wage, 90.6% typically comprised a basic salary to cover living expenses at the time of setting, and 9.4% comprised a "variable dearness allowance" (VDA) denoting adjustments for inflation.

[22]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.

The minimum wage is highly imperfectly enforced. Both the central and state governments are tasked with enforcement, which typically occurs through labor inspections. Inspections are usually random but sometimes based on complaints (Shyam Sundar 2010). Any employer found violating the minimum wage faces a fine of up to Rs.10,000 and imprisonment up to five years. However, both data and NGO investigations show large non-compliance with local minimum wages. For instance, the NGO Workers' Rights Consortium found thousands of factories in Karnataka as being non-compliant in 2021 (WRC 2021). In data, I will show below that over half of all workers employed at formal establishments in India, and who show up in social security records, earn below the minimum wage. Non-compliance with the minimum wage reflects a combination of imperfect enforcement, the small monetary penalty for violations (worth only 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 test of collusion in Section 4 focuses on Tirupur, which is the main center of garment manufacturing in India and employs over 30% of workers. Tirupur's primary industry association, the Tirupur Exporters' Association, offers several benefits to members. It organizes regular trade fairs for members 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 (e.g.. TEA 2024b, c). The TEA also disseminates information about accessing government schemes. On the policy front, the TEA recently lobbied the central government to enact free trade agreements with the United States and the UK (Srinivasan 2024, TBS 2023, TEA 2024). Even beyond these professional benefits, however, 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 (1.3 million USD in PPP terms). New members must be endorsed by two existing members. They undergo a two-year probationary term before becoming eligible for permanent membership. Currently, the TEA 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 above is that it enables diagnosing collusion without requiring a stance on the exact game in which firms interact, institutional features of Tirupur point to tacit collusion among members of the industry association. Members realize that paying above the minimum wage risks expulsion from the association (Fact 3 below), or moving to the punishment stage of the game (Large shock).

Wage observability Factories in Tirupur publicly post wages outside their premises, which makes collusion feasible (Figure A1). Public posting means that deviations from the minimum wage are easy to detect, which is critical for monitoring compliance and administering punishment. Moreover, public posting implies that (i) wages are posted, and (ii) workers with the same skill are paid identical wages.

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

Five facts demonstrate 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 into a cartel to pay 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 wage distribution for all formal employees in the garment industry, plotting each worker's average monthly earnings between January and July 2015. Wages in the industry disproportionately cluster from above at the state-specific minimum wage: over 29% of workers earn within 7.5% of the minimum wage, 54.7% earn below the minimum wage, and only 16.1% of workers earn above the minimum wage. Figure 3 presents similar bunching patterns across the four major garment-producing states of India—Tamil Nadu, Karnataka, Uttar Pradesh, and Haryana—which together employ 63% of garment workers. Together, these figures show that state-specific minimum wages effectively serve as maximum wages in the garment industry.

There are two potential caveats to this interpretation. First, earnings below the minimum wage might reflect part-time work instead of underpayment. To evaluate this concern, I plot the distribution of modal earnings across establishments, which likely represent the wages of full-time workers, as most garment workers in India work full-time (Primary Labor Force Survey, 2021). As shown in Figure 3, modal earnings resemble the distribution of individual earnings: nearly half of all modal workers earn below the minimum wage, with 30% clustered directly at the minimum wage. A second concern is reporting bias. Since reported wages are used to calculate social security contributions, employers might falsely report paying exactly the minimum wage while actually paying more under the table. To assess this, I plot the distribution of self-reported wages from the Primary Labor Force Survey (PLFS), a representative household survey. Self-reported wages are immune from reporting bias since they do not affect social security contributions. Even so, self-reported earnings show similar bunching to social security records (Figure A2). Finally, even beyond administrative and survey records, numerous qualitative accounts suggest that many garment workers earn exactly the minimum wage.[23] For instance, Adhvaryu et al. (2019) evaluate a worker voice intervention at India's largest garment exporter, which empowered workers to express disappointment with a low minimum wage hike, based on the premise that these workers expected to earn exactly the new, disappointing minimum wage. Garment workers across the developing world (including Bangalore and Bangladesh) routinely protest for higher minimum wages (Figure A3).

Fact 2: Members of industry associations disproportionately bunch from above at the minimum wage Members of industry associations disproportionately bunch from above at the

[23]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.

minimum wage (Figure 2b), and this is true across the four major garment producing states of India (Figure 3). At members, 42.8% of workers 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 at non-members earn below the minimum wage (71.4%), with only 15.1% earning close to the minimum wage.

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 can be elected to permanent membership. In a third motivating investigation, I explore how promotion rates vary by members' deviations above the minimum wage during their period of probation. Consistent with the association excluding members for raising pay above the minimum wage, I find that deviating members are significantly less likely to be promoted to permanency compared to never-deviators: a 38pp decline 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 increase the minimum wage to other states, separately by industry association membership. I track employers for twelve months around each event:

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

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. I include three sets of fixed effects: establishment α_j, month around time of reform λ_t, and calendar month η_{month}. β_t denote the coefficients of interest, with $\beta_{t=-1}$ normalized to 0. I cluster standard errors by establishment. Conclusions are unchanged when using the de Chaisemartin and d'Haultfoeuille (2020) procedure to account for heterogeneous treatment effects across cohorts and time.

I find that members of industry associations are substantially more likely than non-members to track increases in the minimum wage without reducing employment (Figure 4). Two months following a wage hike, members of industry associations are 21pp more likely to increase their wage to exactly match the new minimum wage compared to 10pp for non-members (Panel A). This gap grows over time: eight months later, 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 for either members or non-members (Panel B). If anything, I find a small increase in employment at members (4pp).

Summary Section 4.1 presents a final motivating investigation which shows that members and non-members respond differently to routine (small) demand shocks: while non-members act as non-cooperative firms facing upward-sloping labor supply curves (raising wages and employment), 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 of the association forego small export opportunities to stick to the minimum wage. Section 4.2 implements the main empirical test of collusion from Section 2, by studying the spillover effects of a large, firm-specific demand shock that led affected industry association members to deviate to paying wages above the minimum wage. I focus on Tirupur, which employs 31% of garment workers in India and produces over half of exports. Tirupur's main industry association is the Tirupur Exporters' Association (TEA).

4.1 Small shock

Fact 5: Members of industry associations forego export opportunities from small positive (price) shocks to demand, whereas non-members respond by raising wages, employment, and exports In a final motivating investigation, I study how members and non-members respond to routine demand shocks (small price shocks). Small demand shocks should elicit the standard imperfectly competitive response from independently operating employers facing upward-sloping labor supply curves (higher wages and employment), but may elicit no response if employers abide by the minimum wage.[24] For instance, if a cartel punishes members who raise pay above the minimum wage with a punishment profit of Π_{punish} for T periods, members will stick to paying the minimum wage as long as $\sum_{T+1} \delta^t \Pi_{coll,mw} > \Pi_{dev} + \sum_T \delta^t \Pi_{punish}$. Small price shocks may not raise Π_{dev} enough to inspire deviation.

I leverage two features of the garment manufacturing industry to compute routine demand shocks. First, demand is highly transitory, which reflects idiosyncratic fashion trends such as 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.[25] Exports in the garment industry peak twice a year, before the holiday season in November and before summer sales in July. For each establishment, I define its *chief importer* as the entity to which it exported the most in dollar value

[24]Members colluding to pay the minimum wage would only forego export opportunities to stick to the minimum wage if labor supply slopes upward at the minimum wage. In other words, they only need to forego exports if they cannot attract more workers while paying the minimum wage. Labor supply elasticity estimates from Section 6 confirm that employers indeed face upward-sloping labor supply at the minimum wage.

[25]The average establishments in my sample exports 69% of value to one importer, and over 80% of establishments have the same chief importer between 2016 and 2018.

during the previous peak export season. Chief importers typically constitute a brand-and-location, such as Zara USA or Nike Brazil.

For each establishment in state s, I define it as receiving a routine demand shock if the average unit price of imports to its chief importer grows 5 to 15pp between two peak export seasons, leaving out imports from own state s. Units correspond to volume (a twenty foot equivalent or TEU), but results are invariant to using quantities instead. I exclude imports from an establishment's own state to isolate demand-side variation in prices rather than supply shocks commonly affecting establishments statewide (e.g. TFP or cost shocks). The idea is that prices paid by brand i to exporters *outside* state s will reflect demand shocks common to i, rather than supply shocks to i's exporters in state s (or all exporters in s, since the prices are calculated outside the state). To confirm that price shocks reflect changes in price rather than product composition, I show no impact on the modal six-digit exported product (Table A2).[26] Demand shocks to one's chief importer are potent: the average establishment exports 69% of value to this importer. Figure 3 shows a strong first stage effect of the shock on export prices received by affected establishments: a 10% increase in the leave-state-out price of imports to one's chief importer increases an establishment's own export price by 7pp (with similar magnitudes for members and non-members of the industry association).[27]

I employ a DiD event study design to study the effect of routine demand shocks on wages and employment, comparing establishments in shocked seasons to themselves in unshocked seasons. To do so, I construct a panel dataset that tracks each establishment experiencing a routine demand shock between 2014 and 2018, in each of its export seasons (both shocked and unshocked) between months $t = -4$ to $t = 6$ relative to the start of the season. The following regression estimates effects separately for members and non-members of the industry association[28]:

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

Y_{jtk} is the outcome of interest for employer j in month t relative to the start of season k. I compare shocked establishments to their unshocked selves in other seasons by including establishment-time-around-start-of-export-season fixed effects (α_{jt}). A_j is an indicator for industry association membership. β_t are the coefficients of interest, with $\beta_{t,1=-1}$ and $\beta_{t,2=-1}$ omitted. For the average employer, β_t track the trajectory of outcomes relative to $t = -1$ values, in seasons during which an establishment experiences a routine shock relative to unshocked seasons. I cluster standard errors by chief importer. Since routine demand shocks affect fewer than 5% of establishments in any export season, the results reveal employer responses to firm-specific rather than aggregate demand shocks.[29]

[26] Both the average and median establishment exports two six-digit products.

[27] The average price is calculated using all exports, not just those to the chief importer.

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

[29] The firm-specific nature of small shocks is not germane to the main point of Fact 5, which is that small price

The identifying assumption is that, absent the shock, outcomes at shocked establishments would evolve in parallel to unshocked seasons. Both parallel pre-trends and a placebo check demonstrate the plausibility of this assumption. In the placebo, randomly picking an unshocked season for each establishment, outcomes indeed evolve in parallel to unshocked seasons (Figures 5, 6, A4).

Turning to the effects of routine demand shocks on members and non-members of the association, I find that non-members respond to small shocks as independently operating employers facing upward-sloping labor supply curves, by raising wages to hire more workers (Figure 5). Four months after the shock, the average wage at affected non-members is 10.3pp higher relative to unshocked seasons, and employment grows 9.8pp. In contrast, members of the industry association forego small export opportunities presented by routine demand shocks to stick to the minimum wage—they do not increase wages, do not raise employment, and do not expand exports (Figure 6). I can reject small increases in employment, exceeding 1%, with 95% confidence.

The fact that association members forego small export opportunities instead of raising wages above the minimum suggests that they are adhering to the minimum wage. One possible caveat to this interpretation is that members' lower responsiveness to small shocks could reflect differences from non-members (e.g., lower excess capacity), or smaller shocks. Here, I first note that Fact 5 is primarily motivational: it shows that members of the association disproportionately pay the minimum wage. The paper's main test of collusion instead studies the spillover effects of firm-specific demand shocks (Section 4.2). Nevertheless, several pieces of evidence counter the notion that members' lower responsiveness to small demand shocks reflects different characteristics or shocks. First, results hold when comparing observably similar members and non-members, controlling for employer size, product exported, or importer identity (Table A1).[30] Second, the first stage effect on prices is remarkably similar for both members and non-members, even after controlling for employer size, suggesting similarly-sized shocks. Together, these findings suggest that members of the industry association forego small export opportunities to stick to the minimum wage.

Two key points Two key points are worth noting before implementing the spillover test. First, the true boundary of the cartel may be smaller than the full association. Evidence suggests that permanent members—who comprise 82% of all members—likely define the relevant boundary, since they disproportionately cluster to pay exactly the minimum wage, and appear to enforce compliance with the minimum wage by expelling employers who deviate above this wage during their probationary term. Nonetheless, the facts presented here indicate that the industry association is a reasonable boundary for separately applying the spillover test.[31] Second, the spillover test does not require a stance on the exact game in which firms interact—that is, it does not depend on knowing exactly how the association enforces collusion (see section 2). This makes it a useful diagnostic tool for

increases lead non-members to increase wages and employment while members stick to the minimum wage.

[30]Non-members may be more responsive to routine demand shocks if they possess more 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 nested logit—leaves conclusions unchanged.

[31]The spillover test can serve as diagnostic tool to identify the boundary of a cartel over longer time horizons and multiple shocks. When several shocks dismantle collusion or shift the collusive scheme, one can generate statistical guarantees around the likelihood that an unshocked employer increases employment.

detecting collusion, even without knowledge of cartel operations.

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 24.5pp between 2016 and 2017, and affected 14% of employers. The shock originated following labor audits in Vietnam that uncovered severe labor law violations across several large factories. Conducted by the NGO Worker Rights Consortium, the audits accused these factories of wage theft, unjust overtime practices, pregnancy discrimination, and health and safety infractions, among other violations (Figure 7, Panel A).[32] They compelled twenty six prominent fashion brands—including Zara USA, Macy's USA, Nike, and Gap—to temporarily relocate their production operations from Vietnam to India (Figure 7, Panel B), tapping existing exporters in Tirupur to meet the higher demand.

The relocation shock thus constitutes a positive, firm-specific demand shock to the subset of employers in Tirupur exporting to brands implicated in Vietnamese audits (affected employers), but not exporters to unaffected brands. Figure 8 shows a strong first-stage effect of the shock on export prices: shortly after the shock, prices at affected exporters grew 24.5pp above those at unaffected counterparts.

The ideal shock for studying the spillover effects of firm-specific shocks on unaffected firms is firm-specific, rather than aggregate.[33] However, correlated demand or supply shocks—such as through subcontracting, or correlated shocks to prices, labor supply, TFP, or input costs—could simultaneously increase labor demand at all firms, making it difficult to disentangle the direct effects of a shock from spillovers. In this case, I confirm that the relocation shock in Tirupur was indeed firm-specific. It impacted 14% of employers in the garment industry and 13% of members of the industry association. 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 confirms the firm-specific nature of the shock and rules out correlated demand (e.g, subcontracting) or supply shocks (e.g., cost changes) as driving results.

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

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

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

[33] While I focus on firm-specific demand shocks, one could instead use firm-specific supply shocks.

I compare establishments to themselves in other export seasons—seasons without the Vietnam relocation shock—by including establishment-time-around-start-of-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 in (2). The identifying assumption is that wages and employment would have evolved in parallel to unshocked seasons absent the shock (identical to the assumption in small shocks). As previously noted, a placebo check demonstrates the plausibility of this assumption: randomly picking an unshocked season for each establishment, outcomes indeed evolve in parallel to other unshocked seasons (Figure A4). Parallel pre-trends further evidence the identifying assumption.

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

To determine if the relocation shock provided scope for spillovers, I first examine its direct effect on affected employers. Just like routine demand shocks, non-members outside the industry association responded to the large demand shock by raising wages to attract new workers (Figure 10). Four months after the shock, the average wage at affected non-members grew 8pp above trend, and employment increased 8pp. Both remained higher for six months. However, unlike routine demand shocks, affected *members* of the association also responded to the large demand shock by raising wages to increase employment and exports (Figure 11). Four months after the shock, affected members were nearly 60pp more likely to pay above the minimum wage. Their wages grew 9pp, and employment increased 8pp.

The finding that affected members increased wages above the minimum wage following the large price shock, but not after smaller shocks, aligns with a model where colluding firms stick to the minimum wage until the gains from deviating outweigh the benefits of continued coordination. The relocation shock likely increased deviation incentives more than routine shocks by triggering a larger price increase, of 24.5pp, compared to 5 to 15pp during routine shocks.

I next implement the main test of collusion by examining the spillover effects on employment at unaffected members and non-members. The shock prompted unaffected non-members outside the association to respond in non-cooperative ways, by increasing wages and reducing employment (Figure 12). Four months post-shock, the average wage at unaffected members increased 5pp and employment *declined* 6pp. Tracking workers across firms, I find that higher wages at affected firms drew workers away from unaffected non-members. Akin to oligopsonists facing heightened competition for workers, unaffected non-members responded by increasing wages, but were able to retain fewer workers than before.

However, unlike the reduction in employment found for non-members, unaffected members of the association responded by increasing both wages and employment. The average wage at unaffected members grew 6.3pp within four months of the shock, and employment *increased* 8.6pp (Figure 13). This positive spillover effect on employment contrasts with all non-cooperative models of competition where firms face weakly downward sloping demand and upward-sloping supply with connected substitutes, including perfect competition, monopsony, Cournot oligopsony, and Bertrand oligopsony (Proposition 1). Instead, higher employment at unshocked members aligns with a model where colluding association members were depressing both wages and employment to stick to the minimum wage, but affected members' deviation from the minimum wage either dismantled collusion altogether (Proposition 2), or spurred a different collusive scheme. Below I rule out violations that could lead unshocked members to increase employment even absent collusion. In a structural test of conduct, I find that the full breakdown of collusion from a focal point wage fits the data best: rejecting oligopsony, monopsony, as well as moving to a different collusive scheme, including a new collusive wage or joint profit maximization (Section 5).

In sum, while spillovers led unaffected non-members to react with standard non-cooperative behavior, raising wages and reducing employment, unaffected members responded as if freed from a collusive agreement to pay the minimum wage, increasing both wages and employment. Institutionally, collusion fully broke down here because employers use contractors to recruit enough workers to meet production targets. Each factory has its own agent, and once affected members had committed to increasing exports, agents had to offer whatever wages workers were willing to accept, leaving no time for a new collusive arrangement to emerge. Given the tacit nature of collusion in this setting—where members recognize that deviating from the minimum wage risks a punishment breakdown or expulsion from the association (see motivating fact 3)—a new focal point could not be quickly established. About half the new recruits came from factories within Tirupur, while the rest came from elsewhere.

A final point worth noting is that identifying collusion requires demonstrating higher wages and employment not at the *average* unshocked 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 had firms not been colluding. To align empirics to theory, I first derive a simple condition on the maximum shock size satisfying this condition and confirm the relocation shock was smaller (Appendix 9.1). Second, as predicted, I find that the *same* unshocked firms increased both wages and employment, evidencing collusion (Figure A5).

4.3 Robustness

Four explanations could lead unaffected members to increase employment even absent collusion. Proposition 1 shows that spillovers from a firm-specific demand shock cannot lead unshocked firms acting independently 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 even without collusion.[34] Additionally, unaffected members could increase employment if

[34] Visualizing a monopsony 101 setup helps identify the universe of cases where 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. However, unshocked oligopsonists might increase employment if other aspects of the picture shift: demand increases (correlated demand or supply shocks), labor supply does not rotate left (violation of connected substitutes), or external entities impose a higher wage (a new "minimum wage").

forced to pay higher wages by foreign brands or the association (akin to a new minimum wage). I evaluate and rule out each explanation in turn.

Correlated demand shocks Unaffected members may not be truly unaffected. For instance, affected members could subcontract new export orders to unaffected members, or offload "worse" orders. Unaffected members could then increase employment due to higher demand instead of collusion. Four findings contradict explanation. First, I find that unaffected members expanded employment by exporting more to their own chief importers and not affected brands (Table 4).[35] A simple back-of-the-envelope calculation reveals that higher exports would fully account for their new workers, leaving little room to fill sub-contracts.[36] Second, I find that large unaffected members, employing over one hundred workers, also increased employment, who do not accept subcontracts (Table 5, column 1).

Third, and importantly, I find no detectable impact on unaffected members' prices (Figure A6). Product composition remains stable, implying no change in effective prices (Table A2). Only demand shocks that increase prices can lead oligopsonistic or monopsonistic firms to produce more by moving up the labor supply curve, since only price shocks raise the marginal revenue product of labor. (For example, the relocation shock increased affected members' prices by 24.5pp, consistent with them receiving a positive demand shock.) In contrast, the lack of price changes at unaffected members suggests that their export expansion reflected a greater *supply* of exports when they no longer had to abide by the minimum wage, rather than higher demand.

Finally, I examine the relocation shock's effect on profits. Positive demand shocks should increase profits, while shocks that prevent employers from accessing (higher) collusive profits should lower profits. Profits data is sourced from the Prowess database and covers 24% of establishments in my sample.[37] Table 6 reports results. Consistent with *affected* members receiving a positive demand shock, I find that their profits rose 16.2% (SE 0.081). In contrast, profits of unaffected members declined 5.3% (SE 0.012), consistent with them no longer accessing higher collusive profits.[38]

Profits could decline under oligopsony even as employment rises if unaffected members experienced a positive shock alongside relocation (e.g., higher demand, higher TFP, or lower input 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. Both measured and effective prices are unchanged, and I reject small increases with high confidence (Figure A6, Table A2). Although quantity shocks don't raise

[35]Capacity constraints force forty percent of Indian garment exporters to regularly turn away export orders, explaining the rapid export expansion among unaffected members when no longer bound to the minimum wage (ILO 2016, in a survey of 116 large exporters).

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

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

[38]The magnitude of the profit decline closely resembles the predicted increase in wage costs—the average unaffected member pays 6.3% more to an 8.6% larger workforce, implying a 6.8% decline in profits.

the MRPL, I nonetheless investigate and find that they cannot explain the results. First, unaffected members exported more to their chief importer, not to affected brands or via subcontracting (Table 4).[39] However, similar-sized non-members 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 where they previously rejected price increases of 5 to 15pp (see small shocks).

Together, these findings indicate that higher employment at unaffected members did not reflect correlated demand shocks. Rather, the absence of price changes and declining profits imply that association members were previously suppressing both wages and employment to earn higher collusive profits, and increased both when the shock rendered collusion untenable.

Correlated supply shocks: e.g. TFP or cost shocks Second, relocation may coincide with correlated supply shocks to members such as to TFP or input costs. Such shocks would raise labor demand and employment even absent collusion.[40] Three facts mitigate the concern that common TFP or cost shocks drove higher employment at unaffected members. First, affected and unaffected members varied systematically in their price of new exports (Figure 8, Figure A6). While affected members' prices rose 24.5pp, I find no detectable impact on the prices of unaffected members. Disparate price and profit patterns indicate disparate, and not a common, source of shocks. Second, common TFP or cost shocks simultaneously affecting all association members would predict simultaneous changes in wages and employment. However, I find systematic differences. Whereas affected members increased wages and employment immediately after relocation orders arrived in $t = 0$, unaffected members adjusted wages and employment two months later, in $t = 2$. The timing differences do not accord with simultaneous shocks. Instead, they suggest that collusion ceased when unaffected members noticed affected members' deviations from the minimum wage. Finally, the test of conduct in Section 5, which quantifies the relative fit of the oligopsony model vs. the breakdown of collusion from a focal point wage, imposes no restrictions on TFP shocks. Its conclusions are thus robust to TFP or cost shocks that commonly affect members.

Non-homothetic preferences As discussed in Section 2, 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 could increase worker wealth, leading workers to *increase* (as opposed to reduce) labor supply to high amenity employers. To mitigate this concern, I control for three measures of workplace amenities, comparing unshocked members and non-members with identical amenities. Non-homothetic preferences should similarly change labor supply to the two sets of employers (and not opposite employment effects). First, I leverage the fact that foreign buyers often enforce common amenities through audit agencies like SEDEX (e.g. as in Boudreau 2021, Alfaro-Ureña et al. 2022,

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

[40]For example, if gross output is Leontief in materials, declining materials prices could increase labor demand.

interviews in Tirupur, summer 2023). Comparing members and non-members exporting to the same entity thus controls for common amenities enforced by the importer. I employ a modified version of equation (2):

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

As before, this regression compares unaffected members to themselves in other export seasons (non-Vietnam shock), and unaffected non-members to themselves in other seasons, controlling for common changes to labor supply of exporters to brand c (via importer-specific time trends in the shocked season, $\alpha_{ct \times shocked}$). Additional analyses control for observed amenities like establishment size, location, share of women workers, share of local workers, and product (proxying for the production process facing workers). Even after including controls, the shock produces opposite employment effects at unaffected members and non-members, whose residual labor supply should change similarly (Table 5, Figure A7). Thus, non-homotheticity does not drive higher employment at unaffected members, as it would predict similar and not opposite employment effects.

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. Conversely, violations of either could 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 a competitor's most elastic workers, who highly value wages relative to amenities, leaving behind inelastic workers.[41] The differential retention of inelastic workers would reduce, rather than raise, j''s optimal markdown, $\mu_{j't}$.

I show that higher employment at unaffected members does not reflect violations of connected substitutes. The appendix characterizes and eliminates three mutually exclusive and exhaustive violations. Connected substitutes implies that the optimal markdown declines in an employer's wage: good (high wage) employers can pay workers a smaller fraction of marginal product. First, I show that when employers are not connected substitutes, but the optimal markdown still declines in the wage, employment can only exhibit strategic complementarity under oligopsony if wages are strategic substitutes (i.e., employment can only rise if wages fall).[42] In contrast, I find an increase in unshocked members' wages. Second, when employers are not connected substitutes, and the optimal markdown increases in the wage, then wages and employment must either both exhibit strategic substitutability or strategic complementarity. Typical worker heterogeneity inhabits case

[41] 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 elasticity of labor supply to j, and higher wages elsewhere would draw away workers with higher β_i.

[42] The labor supply curve rotates right instead of left. Non-homotheticity inhabits case 1.

one, i.e., both are strategic substitutes. An unshocked competitor who loses elastic workers can pay the remaining inelastic workers a lower wage, but must nonetheless reduce employment because she would have to raise wages to attract workers back. Analytically, employment remains a strategic substitute. Alternatively, both wages and employment could be strategic complements if the shock changes the worker pool of unaffected members.[43] However, I rule this out by showing that unaffected members' new workers closely resembled old ones in characteristics predicting preferences: age, gender, 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.

Downward-sloping demand may be violated, or demand may shift right. For instance, the shock could prompt shocked and unshocked members of the TEA to collaborate to negotiate cheaper input contracts and shift labor demand right. However, such a shift is inconsistent with the observed decrease in profits found for unshocked members, who could have retained their old export opportunities by maintaining lower wages and employment to earn higher profits. Instead, the decline in profits suggests lost access to previously higher collusive profits. Additionally, several qualitative accounts indicate that the association does not negotiate common input contracts (interviews). Finally, neither the association nor foreign 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 a common foreign buyer). In sum, the finding 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

Although the comparative static test of collusion is appealing in its minimal structure, a full structural approach enables statistically adjudicating between various models of conduct. I employ and augment the approach developed by BCS 2021 to test for *changes* in conduct. I make two comparisons. First, I test continued oligopsony versus the breakdown of collusion from a single wage. Second, I compare the breakdown of collusion from a single wage versus switching to joint profit maximization. Although used in this section, labor supply and production are estimated in Section 6 (counterfactuals).

5.1 Summary

The BCS approach arbitrates between various models of conduct by employing the idea that the true model best satisfies the following exclusion restriction: productivity shocks are uncorrelated with instruments that only alter markdowns. Imposing specific structures of labor supply and production,

[43]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 since traditional violations fall under the other two cases, but it could occur if new workers greatly value wages over amenities and have a higher reservation wage.

given the observed wage, BCS back out the implied productivity shock under each model of conduct (z_{jt}). This implied productivity shock should be uncorrelated with any instrument that alters markdowns but not marginal product. Employing the Rivers and Vuong (2002) test to evaluate the null hypothesis of equally well-fitting models, BCS identify the model rejecting this null hypothesis as the best fitting model.

I modify the BCS approach to instead uncover *changes* in conduct following the large demand shock from Section 4 (relocation from Vietnam). Under the correctly specified change, the implied change in productivity will be uncorrelated with an instrument that only alters markdowns. For this shock, the instrument shifting j's markdown (μ_{jt}) but not marginal product (z_{jt}) is a weighted average of demand shocks affecting employers $j'! = j$. I assume a Cobb-Douglas value-added production function using inputs of capital and labor (described in section 6): $\tilde{z_{jt}} n_{jt}^{\alpha_2}$, where z_{jt} is a product of TFP and price for employer j at time t, $\tilde{z}_{jt}$ is its modified value plugging in optimal capital demand (capital is supplied competitively in a rental market), and n_{jt} is labor. To calculate the change in markdown implied by various models, I assume a three-nested CES labor supply system, where workers choose in turn across locations, industries, and employers within an industry. Section 6 describes estimation. A firm j's best response wage is given by[44]:

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

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

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

Under the true model, $dlnz_{jt}$ is uncorrelated with an instrument that only alters markdowns:

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

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

Here $1_{shocked,j'}$ is an indicator equal to one for establishments affected by the relocation shock, and s_j is employer j 's baseline wage bill market share. The instrument is a share-weighted sum of indicators for exporting to brands affected by the Vietnam relocation shock, summed over employers excluding j.[45] Observing $dlnn_{jt}$ and $dlnw_{jt}$, and calculating $dln\mu_{jt}$ implied by the conduct change recovers $dlnz_{jt}$.

I generate empirical analogs of the moment condition, and formulate pairwise test statistics to

[44] 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.

[45] 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 (Amiti et al. 2019, Sharma 2023).

assess the relative fit of any two models 1 and 2 (as in Rivers and Vuong 2002, BCS 2021):

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

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

Tests I conduct two pairwise comparisons to test for changes in conduct among unshocked members of the industry association. First, I test between oligopsony throughout vs. switching from coordination at the minimum wage to oligopsony due to the shock. Second, the shock could conceivably push employers closer to joint profit maximization (jointly profit maximizing firms with heterogenous productivity would pay different wages rather than a single wage, and the shock may lead the association to recognize this inefficiency). I thus test between switching from coordination at the minimum wage to oligopsony versus switching to joint profit maximization. I do not test for collusion at a new wage, since post-period wages among industry association members exhibit substantial dispersion.

Change in markdown Conduct determines the change in markdown ($dln\mu_{jt}$). For the continued oligopsony case, these changes fall into three categories. For employers who don't pay the minimum wage at baseline, the change in the optimal markdown is $dln\mu_{jt} = \sum_{j'} \frac{\partial ln\mu_{jt}}{\partial lnw_{j't}} dlnw_{j't}$. The appendix derives the analytical expressions for nested CES labor supply under Cournot oligopsony. For employers who previously paid a binding minimum wage, but whose wage changes after the shock, the change in the optimal markdown is $dln\mu_{jt} = ln\mu_{j,t+1}^{oligopsony}(\mathbf{s_{t+1}}) - ln\mu_{j,t}^{olig,mw} = ln\mu_{j,t+1}^{oligopsony}(\mathbf{s_{t+1}}) - 0$, where $\mu_{j,t+1}^{oligopsony}$ is the optimal Cournot oligopsony markdown implied by the post-period distribution of shares. The pre-period markdown with a binding minimum wage is simply one, i.e., workers are paid exactly their marginal product since binding minimum wages push employers onto the demand curve. For employers who continue paying the (binding) minimum wage, the optimal markdown does not change.

For the collusion to oligopsony case, the post-period markdown is simply the oligopsony markdown. The pre-period markdown is $ln\mu_{jt}^{coll,mw} = lnmw_{jt} - lnz_{jt} - (\alpha_2 - 1)lnn_{jt}$. Thus, $dln\mu_{jt} = ln\mu_{j,t+1}^{oligopsony}(\mathbf{s_{t+1}}) - ln\mu_{jt}^{coll,mw}$. I use a slightly modified version of the moment condition, where I additionally assume that the shock is uncorrelated with pre-period productivity, $E[(dlnz_{jt} - lnz_{jt})I_j] = 0$, with I_j as the instrument. The change in conduct now predicts $(dlnz_{jt} - lnz_{jt})$. Under the true model, the predicted value is uncorrelated with the instrument. The assumption that the relocation shock is uncorrelated with baseline productivity is substantiated by the fact that shocked and unshocked members of the industry association closely resemble each other in baseline characteristics (Figure 9).

5.2 Results

Table 7 reports results from the pairwise comparisons. A positive value indicates the column model fits better than the row. I find that switching from collusion at the minimum wage to oligopsony fits better than either the continued oligopsony model or switching from collusion to joint profit maximization. Although Table 7 reveals that switching from collusion to oligopsony is the best-fitting model, it does not quantify absolute goodness of fit. I evaluate the objective fit of the breakdown model by plotting the correlation between $dlnz_{jt}$ and the instrument. This correlation should be zero under the true model, not just zero in expectation. Reassuringly, I find no correlation between the two. Thus, switching from collusion at a focal point wage to oligopsony fits the data well.

6 Counterfactuals

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

6.1 Model

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

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

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

w_{jt} denotes the wage at employer j in period t, a_k denotes industry-specific amenities, and a_{jt} denotes the employer's deviation from the industry norm. ϵ_{ijk} has a nested Type I extreme value distribution, 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.

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

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

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

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

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

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

Good employers (with relatively high wages and amenities) attract more workers. Since the counterfactual considers a Cournot solution concept, where firms choose employment taking their inverse labor supply as given, I define it here,

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

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

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

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

Labor Demand: Cournot Oligopsony Firms that compete in a Cournot oligopsony maximize profits by choosing the number of workers to hire taking their competitors' employment decisions as given. The first order condition is: $\frac{\partial y_{jt}}{\partial n_{jt}} = w_{jt} \underbrace{\left(1 + \frac{1}{e_{jt}}\right)}_{\mu_{gjt}^{-1}}$, where e_{jt} is the elasticity of the firm's residual labor supply curve. Under nested logit preferences, e_{jt} depends on a firm's payroll share s_{jkrt} and the industry's share s_{krt} in each region r:

$$e_{jt} = \left[\frac{1}{\eta} + \left(\frac{1}{\theta} - \frac{1}{\eta}\right) s_{jkrt} + \left(\frac{1}{\lambda} - \frac{1}{\theta}\right) s_{jkrt} s_{krt}\right]^{-1} \tag{7}$$

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

Labor supply and firm profits are determined in equilibrium. Fringe firms have first order conditions akin to oligopsonists. By contrast, cartel members only hire as many workers as are willing to work at the minimum wage:

$$n_{jt|cartel} = \left(\frac{mw}{\bar{W}_{kt}}\right)^{\eta} \left(\frac{\bar{W}_{kt}}{\bar{W}_{rt}}\right)^{\theta} \left(\frac{\bar{W}_{rt}}{\bar{W}_{t}}\right)^{\lambda} N_t \tag{8}$$

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

Three caveats are worth highlighting. First, per the Folk Theorem, several alternative collusive schemes are feasible. Section 6.3 discusses the implications of different punishment strategies for conclusions. Second, I assume that the minimum wage only serves as a coordination device and is otherwise imperfectly enforced. That half of all workers in the garment industry earn below the minimum wage substantiates its imperfect enforcement (Figure 2). Still, Section 6.3 details the impact of enforcement on conclusions. Finally, I assume that the cartel only coordinates at the minimum wage and no other wage. This assumption reflects a key institutional feature of the garment industry, namely, that foreign buyers enforce compliance with the minimum wage (e.g. through audit agencies like SEDEX).[46] Foreign-buyer-induced enforcement of the minimum wage

[46] Interestingly, my estimates indicate that the single collusive wage that would maximize the joint sum of profits is

generates interesting implications for minimum wage policy, discussed in Section 6.3.

6.2 Estimation and Mechanics

I now study the wage and employment consequences of coordination, and the effect of counterfactual policies that raise the minimum wage. Determining the counterfactual distribution of wages and employment requires four key ingredients. First, I estimate the labor supply system, parameterized using the nested logit framework outlined in Section 6.1. Second, I estimate the underlying distribution of productivity across firms (z_{jt}). Third, labor demand is determined either by the collusive equilibrium concept or a Cournot oligopsony. Finally, I estimate or calibrate other necessary parameters in the production function (α,γ), and upper-level labor supply (φ,$\bar{\varphi}$). Table 8 summarizes requisite parameters.

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

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

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

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

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

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

below the minimum. However, foreign buyers' enforcement of the minimum justify its use as a focal point.

Table 8 reports estimates. I estimate $\hat{\eta}$ equal to 3.5, and $\hat{\theta}$ equal to 1.1. I calibrate the cross-location elasticity from Sharma (2023), $\hat{\lambda} = 0.03$.[47] Using a more standard instrumental variables strategy to estimate labor supply parameters yields very similar estimates to the BLP approach (see strategy in Sharma 2023).

Productivity distribution I employ indirect inference to obtain the underlying distribution of productivity across employers. In particular, I assume that productivity z_{jt} follows a log-normal distribution with mean 1 and standard deviation σ. I assume that the large shock fully dismantles collusion, and precipitates a Cournot oligopsony equilibrium. σ can then be calibrated as the productivity dispersion that rationalizes the post-large-shock concentration found in the textile industry, measured via the wage bill Herfindahl Hirschmann Index HHI_{kr}. Specifically, I run the oligopsony model for various candidate values of σ, and choose the one that best matches the observed post-shock HHI. One caveat to the indirect inference approach is that the post-period market shares of employers reflect not just their pre-period distribution of productivity, which I need for the counterfactuals, but, rather, this productivity plus the shock itself. I circumvent this issue by replicating the empirical shock in the model by randomly assigning 13% of firms with a 25pp price shock. I estimate σ to reflect the post-period distribution of productivity minus the shock. I calibrate the productivity shifter Z to match the average wage in the textile industry.

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

Other parameters I calibrate other necessary parameters. I calibrate decreasing returns to scale α to Berger et al. (2022). I calibrate the exponent on labor γ to match the labor share. The Frisch elasticity, φ, is calibrated to Berger et al. (2022). Finally, I calibrate the disutility of labor $\bar{\varphi}$ to match the average firm size in the market (described in the Appendix). As a diagnostic statistic, the calibrated model closely replicates the share of workers paid the minimum wage, 41% in model, compared to 46% in the data.

Mechanics I make a few simplifying assumptions. I assume away establishment-specific amenities a_j that deviate from industry norms, retaining only the time-varying component necessary for identification. I also limit counterfactuals to the five largest industries by employment: textiles

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

and clothing, food and beverages, metal products, machinery, and automobiles. Collectively, these industries employ over 15% of the formal labor force.

For each counterfactual, I quantify its effect on the average wage and total employment in the garment sector. Unlike estimation, counterfactuals require solving the model. I solve for two fixed points: an upper-level industry share and lower-level within-industry share. For the counterfactual quantifying the wage and employment losses due to collusion, I induce cartel members to independently maximize profits in a Cournot oligopsony, instead of coordinating at the minimum wage. The average wage rises for two reasons. As collusion dismantles, cartel members raise wages above the minimum wage. A few members, who were least productive to begin with, slightly reduce wages. On balance, the first effect far outweighs the second and the average garment wage rises. Higher wages in the cartel induce upward wage pressure on fringe employers. As workers substitute from non-members to wage-enhancing members, non-member shares decline and elasticity of labor supply increases. They raise wages and workers reallocate across garment employers (lower-level fixed point). This yields a new wage index for each industry and upper-level industry share; I solve until a fixed point in upper-level industry shares. Higher wages in the garment industry also increase employment, drawing workers away from other industries (governed by θ), other geographies (governed by λ), and from unemployment (governed by φ).

The second set of policy counterfactuals study the effect of increasing the monthly minimum wage in Tirupur, of Rs.8170, by 10%, 50%, and 100%. A final policy increases the monthly minimum wage to a living wage of Rs.33,920 per month proposed by the NGO Asia Floor Wage Alliance. As the minimum wage rises, new, productive members enter the cartel and less productive members exit. Employer and industry shares change and, as before, I solve for upper and lower level fixed points.

6.3 Results

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

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

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

A caveat to these conclusions is that I assume that the cartel punishes deviations in the first period with oligopsony for six months. Although the simple two-period model does not feature shocks, the punishment period is based on observing that association members return to paying the minimum wage six months later. A more (less) severe punishment strategy would, instead, imply larger (smaller) losses from collusion. For example, a better enforced cartel could reduce the deviation profit to $\Pi_{dev} + \Pi_{olig} - punishment$. More productive firms, with higher $\Pi_{dev} + \Pi_{olig}$, would now also enter the cartel, thereby reducing wages and employment more than in a world without *punishment*.

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

Minimum wage as a tool for anti-trust policy Given that paying the minimum wage is entirely legal, anti-trust policy has limited legal recourse for dismantling the type of collusion evidenced in this paper. For example, neither breaking up large firms nor targeting concentration would work. If anything, collusion implies lower concentration than oligopsony since collusive firms coordinate to pay the minimum wage, thereby compressing firm sizes more than if they were paying wages more commensurate with productivity (as under oligopsony).

However, my findings suggest that minimum wage hikes could potentially help combat market power by catalyzing coordination at a higher wage. I study four counterfactual minimum wage increases. The first three raise the current monthly minimum wage in Tirupur, of Rs.8170, by 10%, 50%, and 100%. A final policy aligns with demands for a living wage in the garment industry and raises the monthly minimum wage to a living wage of Rs.33,920 proposed by the NGO Asia Wage Floor Foundation.

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

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

Enforcement My conclusions rest on two assumptions. First, I assume that the minimum wage only serves as a coordination device and is otherwise imperfectly enforced. That half of all workers in the garment industry earn below the minimum substantiates its imperfect enforcement (Figure 2). Second, I assume that employers can only coordinate at the minimum and at no other wage.[48] This second assumption reflects an important institutional feature of the garment industry, namely, that foreign buyers enforce compliance with the minimum wage. Prominent brands such as Zara and Nike regularly audit their suppliers to enforce compliance with local labor regulation, including the minimum wage (e.g. via audit agencies like SEDEX). Indeed, non-compliance with labor regulations in Vietnam is exactly what precipitated the large demand shock studied in this paper (Section 4).

Foreign buyers' enforcement of the minimum wage yields competing implications for minimum wage policy. On the one hand, if establishments can only access lucrative export orders when they pay the minimum wage, policy can potentially sustain higher minimum wages than my estimates suggest (since fewer establishments leave the cartel when the wage increases). However, importers may instead exhibit elastic demand, such that increasing the minimum wage reallocates production from high-cost minimum wage factories to low-cost non-compliers. Studying the implications of these competing forces for minimum wage policy is a fruitful direction for future research.

7 Conclusion

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

[48] For example, I find that the "optimal" single collusive wage that maximizes the joint sum of profits lies below the minimum wage.

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

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

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

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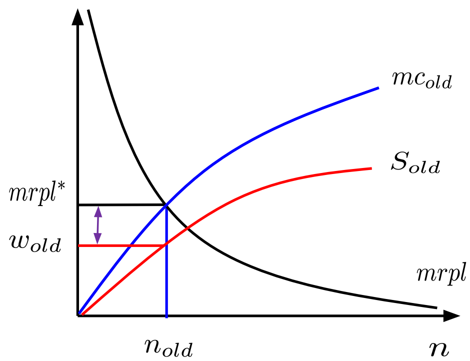
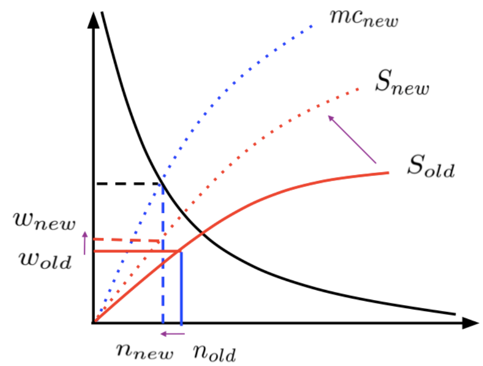
Figures

Figure 1: Spillover Test

(a) Firm optimization in oligopsony/monopsony



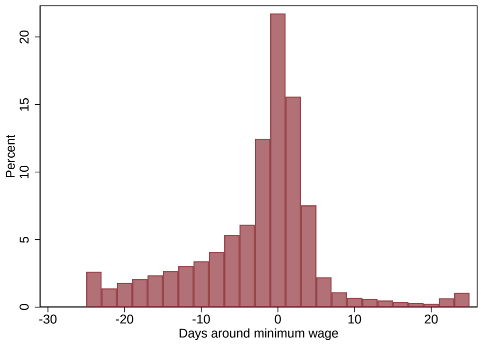
(b) Spillover, left rotation of labor supply



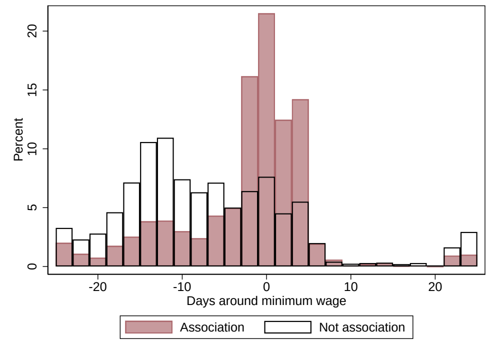
Notes: The left panel plots the optimization problem of an oligopsonistic or monopsonistic firm, and the right panel plots the spillover effect of a positive demand shock to its competitor. The shock reduces labor supply to the unshocked competitor, thereby rotating her labor supply curve left. She moves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

Figure 2: Bunching at the minimum wage

(a) Wage distribution in the garment industry



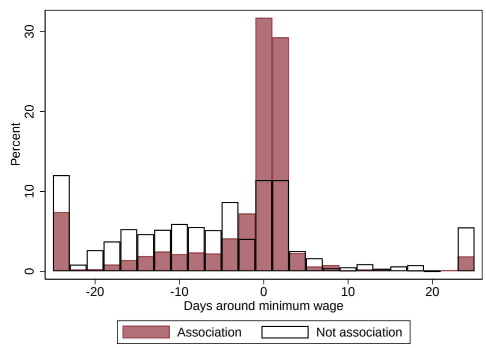
(b) Wage distribution, by association membership



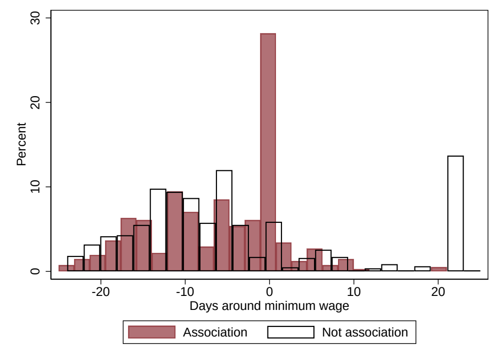
Notes: This figure plots the distribution of wages across all formal workers in the garment industry in India, calculated in denominations of days around the local semi-skilled minimum wage. For example, a value of one on the x-axis signifies that the worker is paid one day above the minimum wage for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

Figure 3: Bunching at the minimum wage across locations

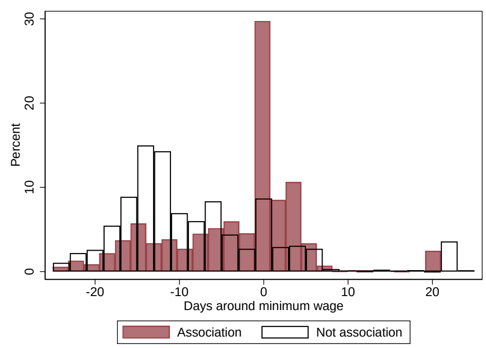
(a) Karnataka



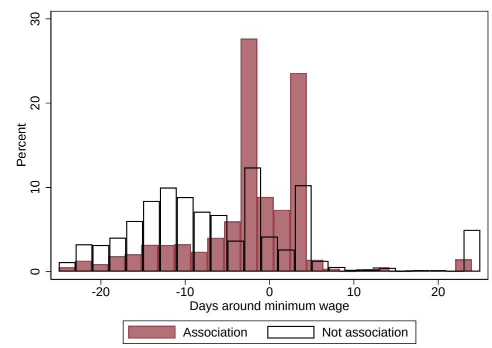
(b) Tamil Nadu



(c) Haryana



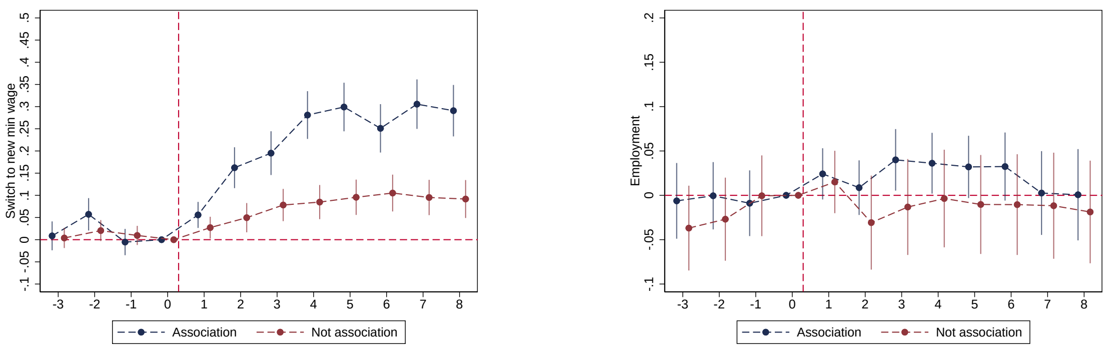
(d) Uttar Pradesh



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

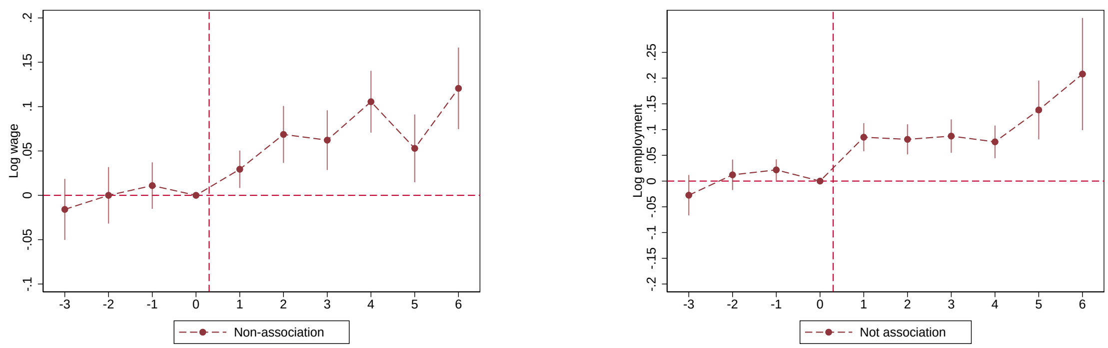
(a) Pay new minimum wage (b) Log employment



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

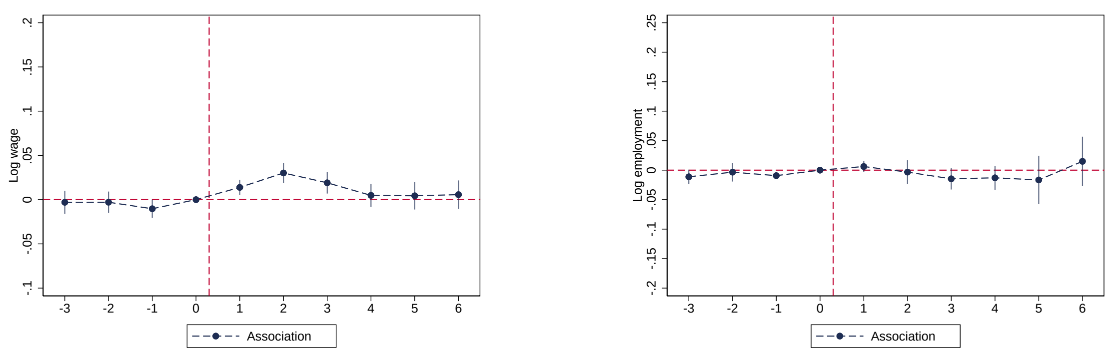
(a) Log wage (b) Log employment



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

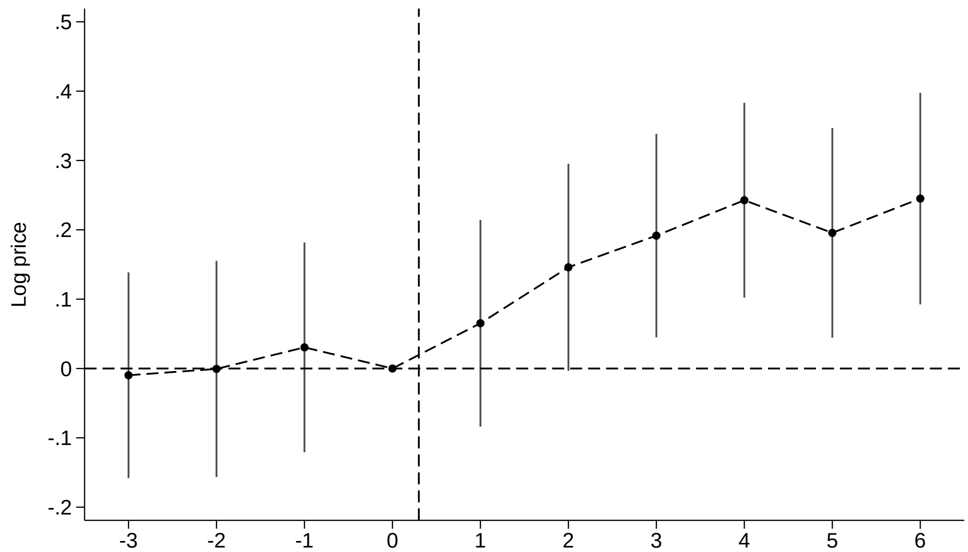
Affected brands

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

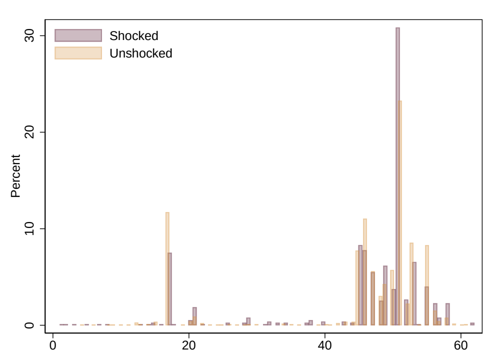
(a) Log price



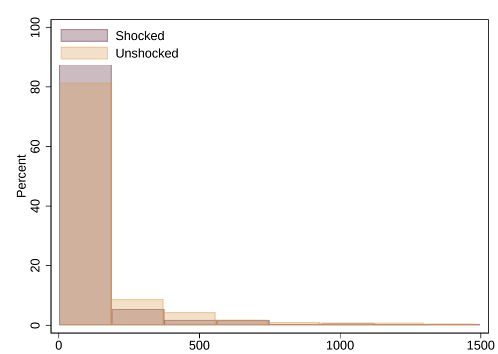
Notes: This figure plots the effect of the relocation shock from Vietnam – which led several prominent brands to temporarily relocate production to India – on the prices of affected and unaffected exporters. Affected exporters are those whose largest volume of exports was to one of the affected brands.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



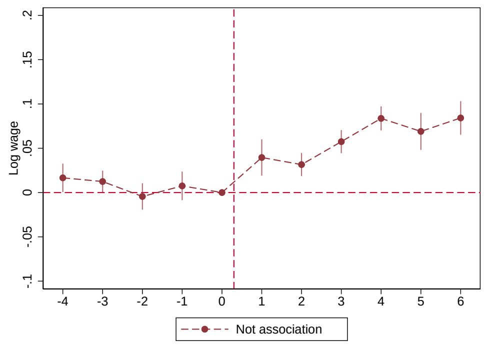
(b) Size



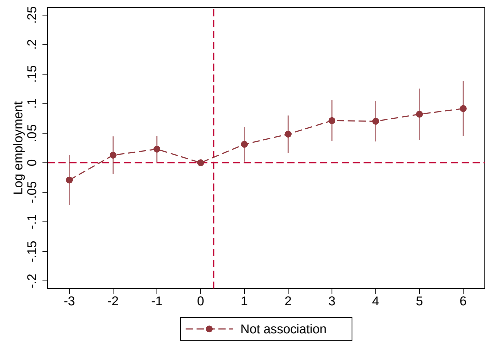
Notes: Panel A plots the distribution of the main 6-digit HS code product exported by affected and unaffected members of the industry association at baseline. The main export is defined as the highest value exported product. Panel B plots the distribution of establishment sizes for the two sets of employers.

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

(a) Log wage



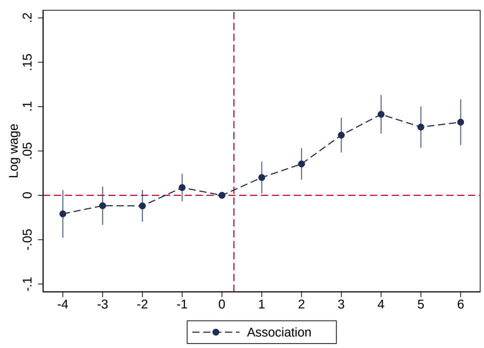
(b) Log employment



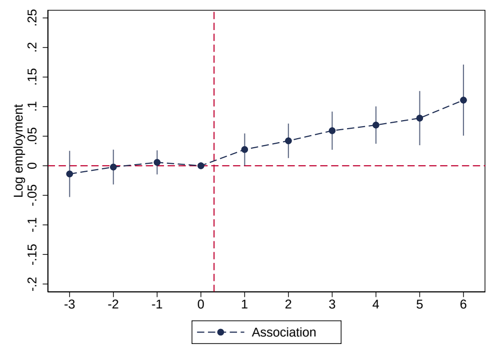
Notes: This figure plots the effect of a relocation demand shock on the log wages and employment of affected employers outside the industry association. The shock led several leading brands to temporarily relocate production to Indian manufacturers. The shock affected 14% of employers in total, and 13%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

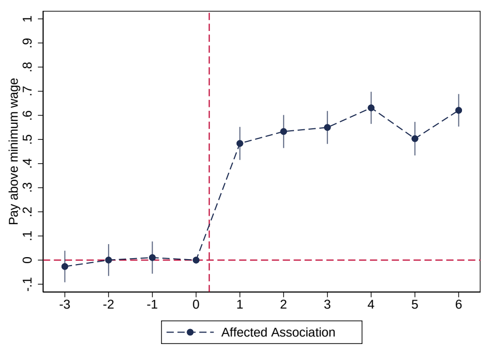
(a) Log wage



(b) Log employment



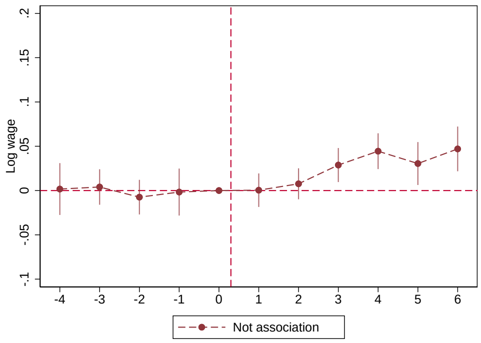
(c) Pay above the minimum wage (indicator)



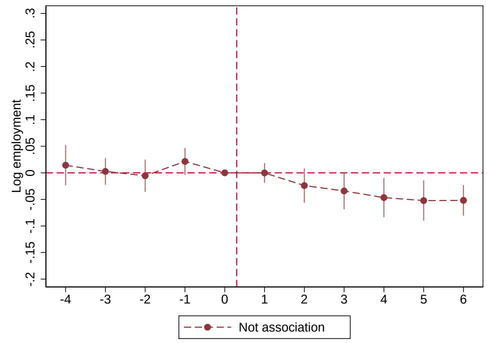
Notes: This figure plots the effect of a relocation demand shock on the log wages and employment of affected members of the industry association. The shock led several leading brands to temporarily relocate production to Indian manufacturers. The shock affected 14% of employers in total, and 13% of members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



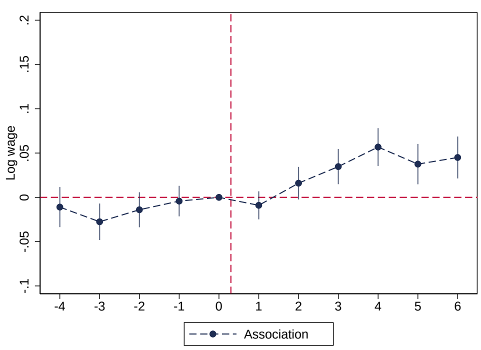
(b) Log employment



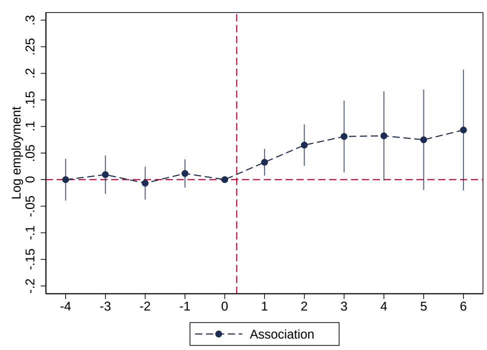
Notes: This figure shows spillover effects on unaffected employers outside the industry association. These employers respond in ways consistent with oligopsony–by increasing their wage and reducing employment. The figure plots estimates of the β_k coefficients in equation 2 for $k \in [-4, 6]$ months 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

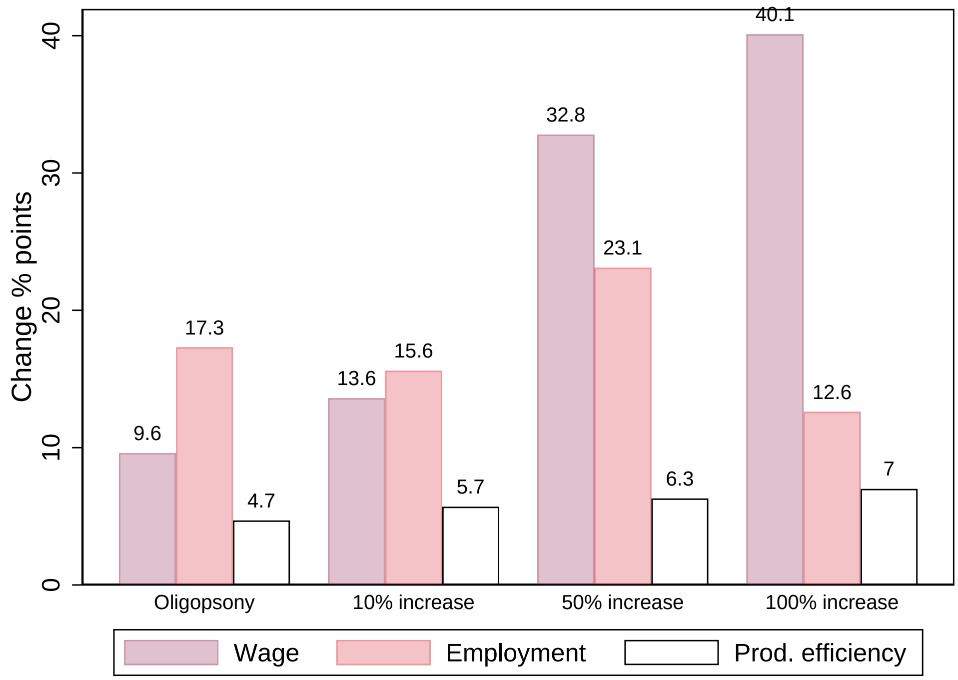


(b) Log employment



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	28.42	15.10

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

Table 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).

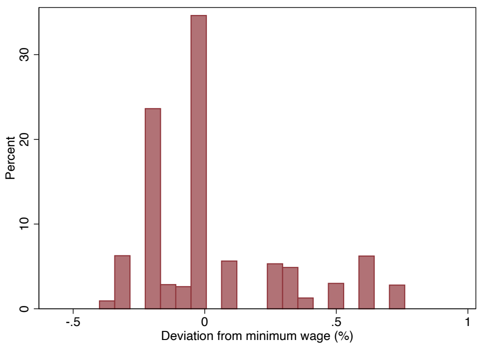
Appendix Figures

Figure A1: Wages posted outside factories

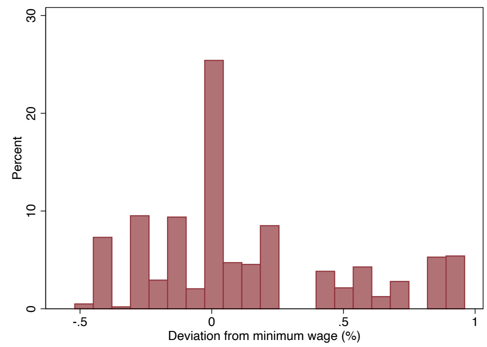
Notes: Factories publicly post wages visible to workers (or other employers) outside their premises. Public posting makes deviations easy to detect. The three levels of the minimum wage are unskilled, semi-skilled, skilled, and most workers are semi-skilled tailors. The ranges here reflect the potential 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

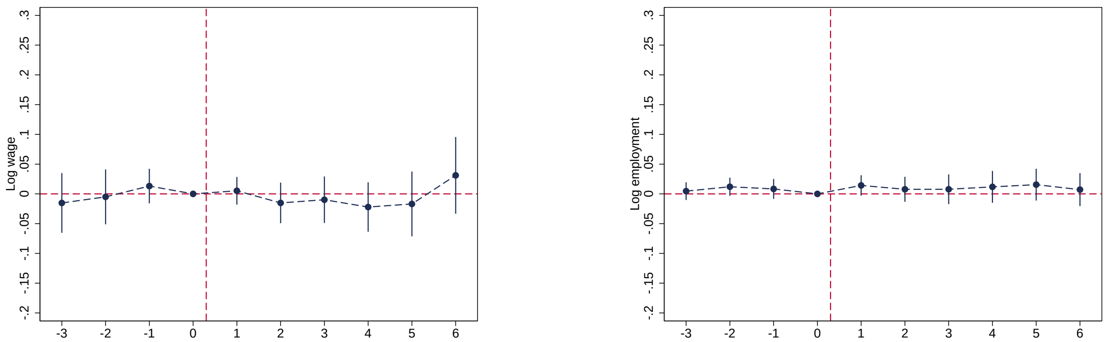
Aa

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).

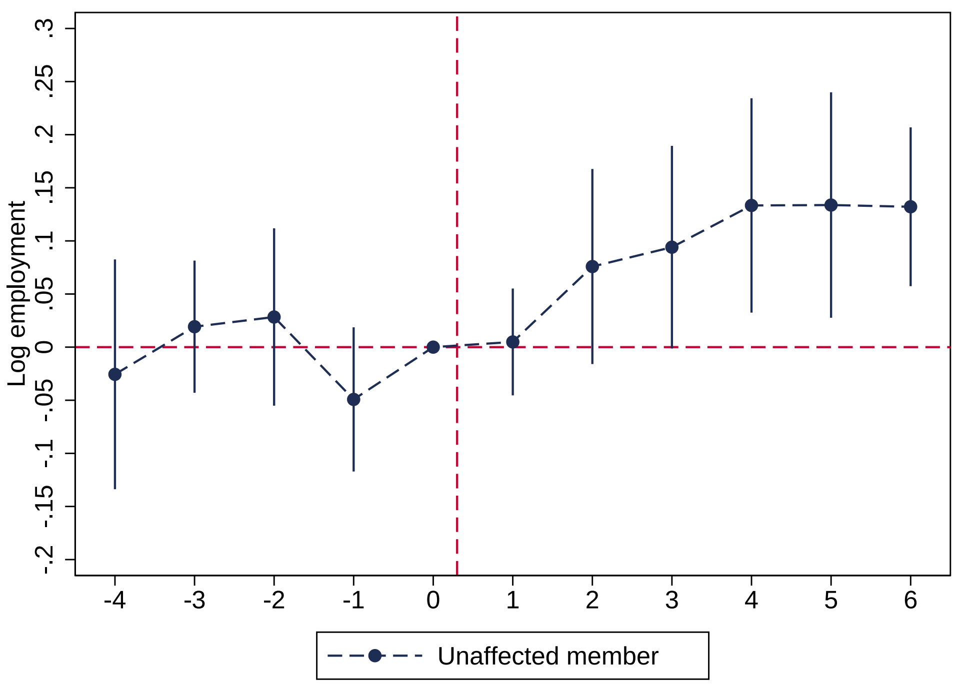
Figure A4: Placebo check: parallel trends

(a) Log wage (b) Log employment



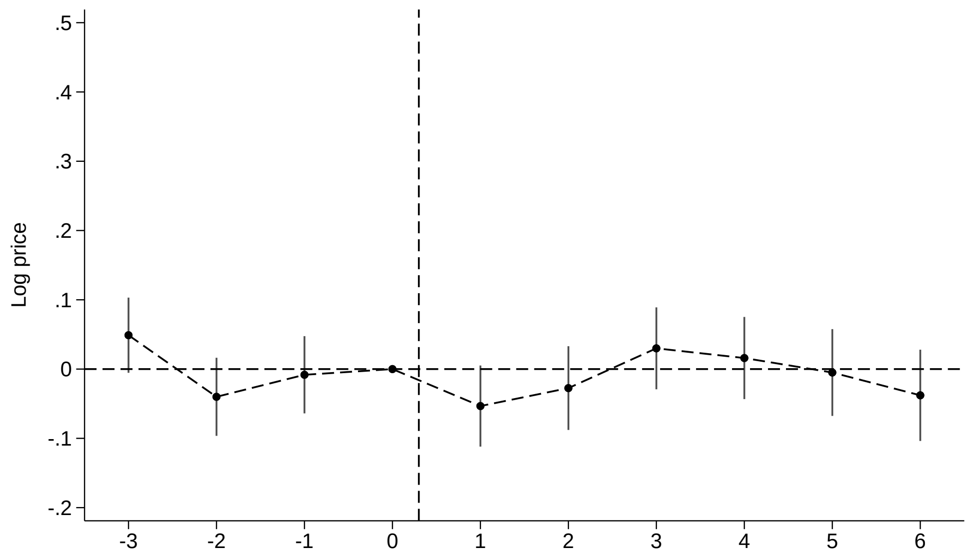
Notes: This figure performs a placebo check, picking a random unshocked season for each establishment. Using the empirical strategy outlined in equation (3), where SS now equals 1 in the placebo season, I show that outcomes in the randomly picked unshocked season indeed evolve in parallel to other unshocked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

Figure A5: Same unaffected members increase wages, employment



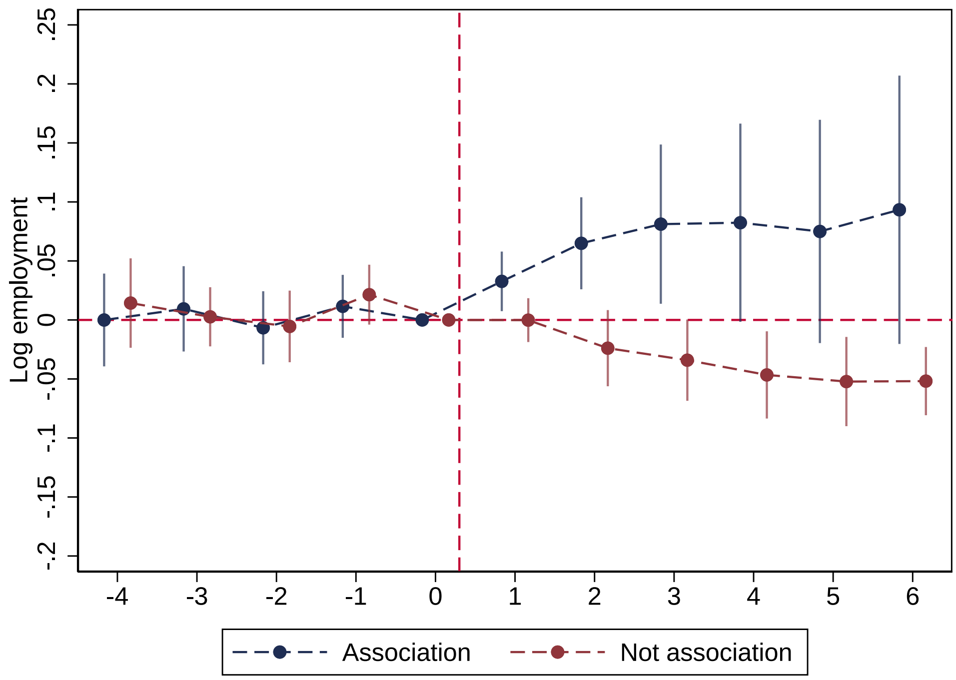
Notes: This figure plots the effect on employment for those unaffected members who raise modal pay between t=-1 and t=4. Effects look similar if instead using t=5 or t=6 as the terminal period.

Figure A6: 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 A7: 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).

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	Number
	(1)	(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	Gender
	(1)	(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.

8 Appendix: Proofs

I make the following assumptions.

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

8.1 Proofs of Propositions

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

Proof The proof proceeds in three steps. First, I show that for any competition structure and invertible labor supply system where employers are not perfect substitutes, $\exists$ a log markdown function $\Lambda_j(w_{jt}, \mathbf{w_{-jt}}, \mathbf{a_t})$ such that a firm's profit maximizing wage $\tilde{w_{jt}}$ is the solution to a fixed point problem for any wage vector at competitors $\mathbf{w_{-jt}}$, $ln\tilde{w_{jt}} = lnmrpl_{jt} + \Lambda_j(\tilde{w_{jt}}, \mathbf{w_{-jt}}, \mathbf{a_t})$. Next, I show that $\frac{dlnw_{j't}}{dlnz_{jt}} > 0 \forall j' \in \mathbf{J} \setminus j$, with strict inequality whenever $\frac{\partial lnn_{j'}}{\partial lnw_j} \leq 0 \; \forall \; j' \in \mathbf{J} \setminus j$. Finally, I show that $\frac{dlnn_{j't}}{dlnz_{jt}} < 0$ whenever $\frac{dlnw_{j't}}{dlnz_{jt}} > 0$. I assume throughout that firm-specific amenities remain unchanged.[49]

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

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 $\mathbf{w_{-jt}}$:

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

Proof. This proof derives closely from Amiti et al. (2019). See Appendix of Sharma (2023) for the labor market derivation. The optimal markdown function Λ_j is endogenous to the supply and competition structure, i.e., changes functional form from one structure of labor supply and competition to another. The chief implication of Step 1 is that, across all structural models, as long as labor supply is invertible, competitor wages $\mathbf{w_{-jt}}$ form a sufficient statistic for firm j's wage decision, and, 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 all $j'! = j$, then $\frac{dlnw_{j't}}{dlnz_{jt}} \geq 0 \ \forall \ j'! = j$, with strict inequality whenever $\frac{\partial lnn_{j'}}{\partial lnw_j} \leq 0 \ \forall \ j'! = j$.

Proof. Consider an arbitrary unshocked competitor $j' = 1$. Denote the log of the marginal revenue product of labor, $lnm_{j't} := lnmrpl_{j't} = ln\frac{\partial f_{j't}}{\partial n_{j't}}$. Totally differentiating the best response function following any change to firms in the market[50]:

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

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

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

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

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

We wish to show that the optimal wage response is weakly positive, i.e., $\frac{dlnw_{1t}}{dlnz_{jt}} \geq 0$. We will prove this by contradiction. Say, to the contrary, that $\frac{dlnw_{1t}}{dlnz_{jt}} < 0$. Since the labor market clears at each firm[51]:

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

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

$$\frac{dlnn_{1t}}{dlnz_{jt}} = \frac{\partial lnn_{1t}}{\partial lnw_{1t}}\frac{dlnw_{1t}}{dlnz_{jt}} + \frac{\left[1 - a_1\frac{\partial lnn_{1t}}{\partial lnw_{1t}}\right]}{a_1}\frac{dlnw_{1t}}{dlnz_{jt}}$$

$$\frac{dlnn_{1t}}{dlnz_{jt}} = \frac{\frac{dlnw_{1t}}{dlnz_{jt}}}{a_1} > 0 \tag{14}$$

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

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

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

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

Proof. The result follows from equation (14).

Binding minimum wage Under Assumptions 1, 2, and 3, the spillover effects of firm-specific demand shocks continue to predict negative employment effects in monopsony/oligopsony models

[51] Assuming that no firm rations employment is equivalent to assuming that firms are on their labor supply curve. Firms may instead ration employment if the minimum wage is too high and binds from above, i.e. more workers supply labor than demanded. 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 a binding minimum wage. Minimum wages that bind from below lead firms to inhabit their labor supply curve instead of first order condition. A left rotation to labor supply following a firm-specific demand shock to competitors may leave an unshocked firm's wage unchanged at the minimum wage, $dlnw_1 = 0$. It nonetheless reduces employment since fewer workers supply labor at the old wage (captured by the second term of equation 13).

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 competitor'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 the labor demand curve. However, large leftward 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 competitors.

Visual framework Visualizing a monopsony 101 setup helps identify the universe of cases where unshocked employers could increase employment even without 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. However, unshocked oligopsonists might instead increase employment if other aspects of the picture shift: (i) demand increases (e.g. 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 the 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 labor demand (provided physical production exhibits declining *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, the 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). 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 demand, overturn Proposition 1 and prompt unshocked, non-cooperative employers to raise employment. For instance, unshocked employers might expand input market power to offset profit declines from the shock (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 the connected substitutes condition (Assumption 1) Connected substitutes implies that wages under monopsony or 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, when connected substitutes is violated but Assumption 3 holds (Case 1), employment can only exhibit strategic complementarity under oligopsony/monopsony if wages are strategic substitutes, i.e., employment can only rise if wages decline (equation 14).[52] Labor supply rotates right instead of left. In contrast to the wage prediction of case 1, however, I find that unshocked members increase wages. Second, when both assumptions 1 and 3 fail, wages and employment must either both exhibit strategic substitutability or both exhibit strategic complementarity (equation 14). 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.[53] The differential retention of inelastic workers would reduce, rather than raise, 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(14), and both wages and employment must either exhibit strategic substitutability (Case 2), or strategic complementarity (Case 3). Typical worker heterogeneity inhabits case 2, where the unshocked competitor can pay 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 pool of workers available to unshocked members.[54] However, 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 the connected substitutes condition. Instead, it evidences collusion.

Worker heterogeneity Worker heterogeneity could overturn Proposition 1 if it violates connected substitutes or diminishing $mrpl$. Preference heterogeneity could violate connected substitutes, which I discuss and rule out above (see footnote 53)—new and old workers are virtually identical, and I find opposite employment effects at similar unaffected members and non-members, whose residual labor supply should change similarly. Even when workers differ in productivity, unshocked employers

[52] Note that equation (14) *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 10), that firms inhabit their labor supply curve (equation 13), and Assumption 3.

[53] 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 elasticity of labor supply to j, and higher wages elsewhere would draw away workers with higher β_i, leaving behind wage-inelastic workers.

[54] 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.

will reduce employment for any worker group whose labor supply rotates left due to higher demand elsewhere, provided the demand curve is unchanged. In this case, production "scales down", and employers hire both fewer tailors and fewer packers. However, if the shock disproportionately increases demand for highly productive workers, unshocked employers may substitute toward less productive workers, shifting their demand curve right even as labor supply rotates left. Employment may rise as more unproductive workers are needed to replace productive workers. Section 4.3 rules out such right shifts in demand, showing that worker composition is unchanged.

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 would draw workers away. Such amenity changes would also appear in equation (13). Only preferences that violate connected substitutes can lead unshocked competitors to raise employment under oligopsony (discussed above).

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 than without collusion. 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.[55] Importantly, the result requires no assumption on the exact game in which firms interact (the 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 (e.g. 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 by 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. The punishment strategy of the cartel entails the breakdown of collusion 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

[55] 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. Finally, the estimated productivity distribution satisfies assumption 4 for a Cournot oligopsony counterfactual.

would prevail had firms not initially colluded. I show that, among the subset of cartel members whose current collusive profits exceed their counterfactual profits absent collusion (i.e., the set of firms for which $\Pi_{coll,t} > \Pi_{count,t}$), $\exists\ j' \in \{\mathbf{cartel} \backslash j\}$ 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 the breakdown of collusion (e.g. monopsony, Cournot oligopsony, Bertrand oligopsony, or another outcome), albeit 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 (12) 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 (14) 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 other firm increasing wages loses workers exclusively to other wage-increasing firms. However, the said firm cannot gain workers if its optimal wage response is to increase its wage (equation (14)). 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 higher employment at a cartel member earning higher profits with than without collusion. 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. In other words, $\exists \; j' \in \{\mathbf{cartel} \backslash j\}$ for which $n_{j',count} > n_{j',coll}$. Since the shock takes firms close to the original counterfactual, it therefore follows that $\frac{dlnn_{j't}}{dlnz_{jt}} > 0$.

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

9 Appendix: Other Derivations

9.1 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:

$$\frac{dlnn_{1t}}{dlnz_{jt}} = \frac{\partial lnn_{1t}}{\partial lnw_{1t}}\frac{dlnw_{1t}}{dlnz_{jt}} + \sum_{j'!=1}\frac{\partial lnn_{1t}}{\partial lnw_{j't}}\frac{dlnw_{j't}}{dlnz_{jt}} \tag{15}$$

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.[56] Assume that (i) the log expenditure function is a sufficient statistic for competitor wages, i.e., labor supply can be expressed as $n_j(w_{jt}, lnx_t; \mathbf{a_t})$, (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:

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

which uses the 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 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; I substitute estimates $(\hat{\eta}, \hat{\theta}, \hat{\lambda})$ and s_{um}. The right hand side exceeds zero, indicating that the representative unshocked colluder will raise employment. In other settings, a similar calculation can determine whether a shock that breaks collusion will increase output at unaffected cartel members.

9.2 Model derivations

Environment The economy features a continuum of geographies $r \in [0,1]$ (districts). Each geography has a discrete number of industries, indexed by $k \in 1, ..., M_r$, and firms within the industry $j \in 1, ..., J_m$. A measure one of workers possess heterogeneous preferences over employers. Firms demand labor under one of two possible competition structures. The first is a collusive equilibrium,

[56] 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.

wherein a subset of firms (the "cartel") coordinates to pay the minimum wage, while firms outside the cartel (the "fringe") choose labor to maximize profits taking as given other firms' employment choices and the cartel's behavior. By contrast, in a cournot oligopsony, each firm chooses labor to maximize its own profits taking others' employment decisions as given. Time is discrete and indexed by t.

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

$$u_{ijkrt} = lnw_{jt} + lna_{jt} + lna_k + \epsilon_{ijk} \tag{16}$$

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

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

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

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

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

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

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

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

And the following employment indices:

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

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

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

I invert the labor supply curve in three steps:

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

Next:

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

Finally:

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

Together, these yield the inverse labor supply curve:

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

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

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

Before doing so, I prove a useful lemma:

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

Proof:

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

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

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

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

9.3 Test of conduct: change in optimal markdown

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

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

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

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