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

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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, 1773). Although economists have long suspected that employers conspire to pay workers below their worth, empirical evidence of collusion remains scarce. This lack of evidence constitutes a striking blind spot for antitrust policy in developing countries, which have until now focused almost exclusively on regulating the product market. Evidence of collusion among employers would, however, usher a strong rationale for anti-trust intervention also in the labor market.

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

The key challenge with detecting collusion is that collusive and non-collusive models of the labor market often yield identical predictions. For instance, neighboring firms that compete perfectly, collude, or that independently exercise their market power should all adjust their wages in tandem, regardless of the underlying model of competition. I overcome this diagnostic challenge by developing a simple test that distinguishes collusion from standard forms of imperfect competition. Its key insight is that, for very general structures of labor supply and production, the spillover effects of firm-specific demand shocks predict opposite employment responses at unshocked competitors who operate independently ($\downarrow$ employment), versus whose collusion dismantles due to the shock ($\uparrow$ employment). To quantify the relative fit of the models, I complement this simple comparative static test with a "full IO" approach, imposing specific structures of labor supply and production to identify the model of conduct best satisfying exclusion restrictions.

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

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

Test I begin by deriving the test. Its main insight is that, for very general labor supply and production structures, the spillover effects of firm-specific demand shocks predict opposite employment responses under non-cooperative models of competition vs. the breakdown of collusion.[1] When firms operate independently, such as in a monopsony, Cournot oligopsony, or Bertrand oligopsony, then a positive demand shock to some firms leads their unshocked competitors to raise their wages, and *reduce* employment. Intuitively, shocked firms pay more 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.[2] Spillovers thus predict an unambiguous decline in employment. In contrast, unshocked employers whose collusion dismantles due to the shock increase not only their wages, but also employment. This is because collusion requires employers to depress both wages and employment below their independently optimal levels. Colluding firms recognize the fact that raising their wage diminishes labor supply to their fellow colluders. Dismantling collusion thus leads unshocked competitors to raise both wages and employment. The test holds for two standard forms of collusion: at a single wage, or by partly or fully internalizing others' profits.[3]

The fact that spillovers unambiguously reduce unshocked competitors' employment under oligopsony is not obvious. In particular, spillovers spur competing forces that pull employment in two different directions. This is best understood via the first order condition, $w_j = \mu_j mrpl_j$. Higher wages at shocked firms lower an unshocked competitor's optimal markdown μ_j. On the one hand, the competitor must lower employment to raise marginal product. On the other hand, she wants to grow large enough again to pay workers a smaller markdown. For very general labor supply and production structures, it turns out that the first force unambiguously dominates the second, and employment unambiguously declines.

Motivating Evidence Step two documents three empirical facts to motivate the notion that industry associations in the garment industry coordinate to pay workers exactly the minimum wage,

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

[2] The appendix extends the logic of the test to non-cooperative models with a binding minimum wage. Spillovers under a binding minimum wage continue to predict weakly lower employment at unshocked competitors who operate independently. They never predict an increase in employment.

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

i.e., use the minimum wage as a focal point for coordination. Each state in India establishes a separate minimum wage for garment workers. The industry also features industry associations of large employers, typically organized to represent members' interests in the product market. Members of industry associations employ over half of all garment workers in India.

First, I find that members of industry associations exhibit substantial bunching from above at the state- and industry-specific minimum wage. In social security records, 29% of garment workers earn exactly their local minimum wage, 55% earn below the minimum wage, and 16% earn above the minimum wage. Members of industry associations almost entirely account for this bunching from above at the minimum wage—nearly 43% of their workers earn precisely the minimum wage, compared to only 15% among workers employed outside the association.

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

Although tracking increases in the minimum wage without reducing employment evidences imperfect competition in the labor market, it does not evidence coordination.[4] Thus, in a third motivating investigation, I study how members and non-members of the association respond to routine (small) demand shocks. Small positive shocks to demand should elicit the standard imperfectly competitive response among employers who face upward-sloping labor supply curves (higher wage and employment), but may elicit no response if employers abide by the minimum wage. I define routine demand shocks by exploiting both the transitory nature of export demand, and the repeat nature of export relationships. An establishment receives a routine demand shock if the average price of imports to its chief importer from the previous export season rises between 5 and 15pp in the current season. The chief importer is an establishment's largest importer (in value) from the previous export season (e.g. Zara USA, or Gap USA). To isolate shocks to labor demand as opposed to labor supply, the price shock measure leaves out exports from an establishment's own state. I employ a DiD event study to compare establishments in shocked seasons to their unshocked selves in other seasons.

Routine demand shocks elicit the standard imperfectly competitive response from non-members, who raise wages to hire more workers. By contrast, members of the industry association forego export opportunities from routine demand shocks. They do not deviate from paying the minimum wage, do not raise employment, and do not increase exports.

Test of collusion: empirics Next, I put the spillover theory to test by studying the effects of a large, firm-specific demand shock that led affected members of the industry association to deviate

[4] Ongoing descriptive analysis reveals that the industry associations expunges members who deviate from paying the minimum wage.

to wages above the minimum wage. The shock originated as a result of labor audits that uncovered severe labor law violations at large Vietnamese factories. As a result, twenty six prominent brands were compelled to temporarily relocate their production operations from Vietnam to India.[5] In a single season, export prices at affected Indian exporters grew 24.5pp more than unaffected exporters. The relocation shock thus constitutes a positive demand shock to the subset of establishments that were previously exporting to affected brands. I study its effect in Tirupur, which hosts 30% of garment workers in India and the majority of exports. Tirupur's main industry association is the Tirupur Exporters' Association (TEA). The shock impacted 15% of establishments in Tirupur and 13% of members of the TEA. Affected and unaffected members (and non-members) closely resembled each other in baseline characteristics.

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

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

Could the above findings be driven by factors other than a breakdown of collusion? I rule out three sets of concerns. First, common TFP or cost shocks that affect members of the association concurrently with the demand shock could increase their labor demand, and, thus, employment. I rule out common TFP and cost shocks by showing that affected and unaffected members vary systematically in their destination of new exports. While common TFP and cost shocks would predict similar patterns of export expansion among all members, I find that members who were affected by the relocation shock expanded their exports to affected brands, but unaffected members expanded exports to entirely new importers. In addition, I find that the timing of changes is most consistent with a breakdown of collusion. Affected members' wages rise immediately following the relocation shock, whereas unaffected members' wages rise two months later. 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. Finally, to rule out correlated demand shocks, or that affected members sub-contract out "worse" export orders to their unaffected counterparts, I show that the price of unaffected member exports remained unchanged. Only demand shocks that alter prices can compel oligopsonistic or monopsonistic employers to increase employment.[6] Together, these results suggest that export expansion among unaffected members reflects a greater

[5] Affected brands included Zara USA, Gap USA, and Nike.

[6] Only demand shocks that increase prices or TFP can compel imperfectly competitive (e.g. monopsonistic or oligopsonistic) firms to increase employment, since only these shocks raise workers' *mrpl*.

supply of exports rather than higher demand.

Although the simple test is appealing due to its minimal structure, a full structural approach enables me to quantify the relative fit of different models of conduct. Under assumed models of labor supply and production, I augment the approach of Backus, Conlon, & Sinkinson (2021) to test for *changes* in conduct. I reject the oligopsony model in favor of a breakdown of collusion at the minimum wage.

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

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

Since paying the minimum wage is entirely legal, antitrust authorities have limited legal recourse available for tackling the type of collusion evidenced in this paper. However, policies to raise the minimum wage could effectively mitigate the ill effects of collusion if employers continue to coordinate at the higher minimum wage. An important institutional feature of the garment industry renders such coordination highly likely, namely, that foreign buyers enforce compliance with the minimum wage.[7]

I therefore conclude by studying the impact of three different minimum wage hikes. The first two increase the current monthly minimum wage in Tirupur's garment industry, of Rs.8170 per month, by 10% and 50% of its present value. A third policy aligns with global advocacy for a 'living wage' in the garment industry, and raises the minimum wage to a monthly living wage of Rs.33,920 proposed by the NGO Asia Wage Floor Foundation. The cartel endogenously evolves to only comprise firms that profit from collusion at the proposed minimum wage.

I find that both the 10% and 50% hikes in the minimum wage increase wages and employment.

[7] Indeed, my estimates indicate that the optimal single collusive wage is below the minimum. Section 6 discusses the implications of foreign buyer enforcement for minimum wage policy.

Surprisingly, the 50% minimum wage hike outperforms oligopsony in its positive impact on both wages and employment. Intuitively, this occurs because highly productive firms now also profit from colluding at the higher minimum wage. Facing less intense competition from their productive counterparts, less productive firms raise wages and employment above a more-competitive oligopsony. The second force outweighs the first, and the average garment worker's wage rises 32pp; employment rises 23pp. Finally, I find that the proposed living wage cannot sustain collusion.

Related literature This paper contributes to a large and growing literature on labor market power (reviewed in Manning 2011, and more recently in Sokolova and Sorensen 2021, Manning 2021, and Card 2022). Although economists have long suspected that employers coordinate to set wages (Smith 1773), this paper is, to the best of my knowledge, the first to document employer collusion in a contemporary labor market setting. The closest paper is Delabastita & Rubens (2022), who employ a structural approach to uncover collusion in the Belgian coal cartel of the 1870s. The authors employ production function estimation to estimate wage markdowns, estimate input supply curves, and uncover the degree to which employers internalizing others' profits would justify the estimated markdowns. Roussille & Scuderi (2022) adopt and augment the structural approach developed in Backus, Conlon, and Sinkinson (BCS, 2021) to test for conduct on an online recruitment platform for high wage engineers in the US. In other words, under estimated labor supply and production functions, the "correct" model of conduct will imply productivity shocks that are uncorrelated with instruments that only shift markdowns. The authors find that employers behave as independent monopsonists as opposed to oligopsonists who strategically interact.

This paper is, to the best of my knowledge, the first to evidence employer collusion in a contemporary labor market setting. It makes three additional contributions. First, I develop and implement a simple comparative static test of collusion valid for very general structures of labor supply and production. In so doing, I diagnose collusion without needing to estimate several structural objects. Section 5 then complements this simple test to quantify the relative fit of various models, adapting and augmenting the BCS 2021 approach to test for changes in conduct. Second, I diagnose collusion at a focal point wage. Many forces in the real world push towards such a focal point, instead of models wherein employers collude perfectly or by internalizing others' profits.[8] A focal point wage is easy to observe and monitor. The garment industry faces transitory shocks that are hard to observe. Foreign buyers also enforce the minimum wage, rendering it a reasonable target for collusion. Finally, the paper detects collusion in an important industrial setting in a developing country context. The garment industry is among the largest employers in developing countries, employing over 90 million workers overall.

The paper adds to a large literature on minimum wages. While the minimum wage typically binds from below (e.g in the US as in Cengiz et al. 2018, and Brazil in Derenoncourt et al. 2021), I document that the minimum wage can serve as a focal point for collusion even when it is non-binding.[9] My findings show that higher minimum wages can successfully limit the ill effects of

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

[9]A seminal study by Knittel & Stango (2003) documents that state-specific interest rate ceilings serve as focal

collusion.

Outline The rest of the paper proceeds as follows. Section 2 presents the simple test to arbitrate between own profit maximization and the breakdown of collusion. Section 3 describes the data and setting. Section 4 presents the main empirical results, first the motivating evidence on routine demand shocks, and then the comparative static test of collusion. Section 5 employs the full-IO test of conduct to quantify the relative fit of the oligopsony model versus the breakdown of collusion from a focal point wage. Section 6 calculates the losses due to collusion, and evaluates the impact of minimum wage policy in mitigating them. Section 7 concludes.

2 Test

This section demonstrates that, under very general labor supply and production structures, spillovers from firm-specific demand shocks predict opposite employment responses under individual profit maximization versus the breakdown of collusion. The test holds for two standard forms of collusion: at a single wage, or by partly or fully internalizing others' profits. In models where firms maximize individual profits, such as perfect competition, monopsony, Bertrand oligopsony, or Cournot oligopsony, a firm-specific, positive demand shock that affects some employers always spills over onto unshocked competitors by causing them to increase their wage, and *reduce* employment.[10] In contrast, if employers were previously coordinating to pay collusive wages, and the demand shock dismantles collusion, then spillovers to unshocked members of the former cartel induce them to increase their wage and *increase* employment. Thus, spillovers predict opposite employment responses under individual optimization ($\downarrow$ employment), versus the breakdown of collusion from a focal point wage ($\uparrow$ employment), helping distinguish between the two.

Section 4 tests the reduced form implications of this theory, by studying the spillover effects of firm-specific demand shocks onto members and non-members of local industry associations. Section 5 adds more structure to formally arbitrate between different models of conduct.

2.1 Setup

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

Labor supply Labor supply is invertible, i.e., employers are not perfect substitutes in the eyes of workers. Labor supply to each firm depends on its own wage w_{jt}, a vector of wages at its competitors $\mathbf{w_{-jt}} = \{w_{1t}, ..., w_{j-1,t}, w_{j+1,t}...w_{Jt}\}$, and a vector of non-wage amenities offered by all employers $\mathbf{a_t}$. $n_{jt} = f(w_{jt}, \mathbf{w_{-jt}}, \mathbf{a_t})$ for $j \in 1, ..., J$. The fact that employers are imperfect substitutes generates imperfect competition in the labor market. The fact that n_j is potentially a function of competitor

points for tacit collusion in the US credit card market, albeit using a different empirical strategy.

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

$-\mathbf{j}$s' wages generates the prospect for strategic interactions, or, spillovers. Namely, spillovers only occur when a firm-specific demand shock to some firm $j_2 \in -\mathbf{j}$, that alters j_2's wage, in turn rotates labor supply to employer j, and causes j to best respond by altering its own wage and/or employment.

The assumption of invertibility is a small, technical requirement that ensures a unique distribution of workers across employers who all pay a common wage.[11] Invertibility nests most popular (and unpopular) labor supply systems in use today. For example, it nests popular structures such as nested CES (e.g. as in Berger, Herkenhoff and Mongey 2022), discrete-choice logit (e.g. as in Card et al. 2018), nested logit, mixed logit, linear, Kimball, translog, and many others.

I make one additional assumption: that employers are connected substitutes (Berry, Gandhi & Haile 2013). In other words, that they are weak substitutes, with sufficient strict substitution to warrant treating employers in a single supply system. The weak substitutes condition is that, all else equal, a higher wage w_j weakly lowers labor supply to all other employers. The connected substitutes condition is defined in Assumption 1.

Although not fully general (as described below), connected substitutes is a fairly natural assumption in a labor market setting. Its main role is to ensure the occurrence of spillovers, i.e. that a higher wage at j reduces labor supply to j', in turn raising j''s optimal wage. While nesting most standard labor supply systems, connected substitutes enables substantially more flexible patterns of substitution across employers. For example, although both nested CES and nested logit supply satisfy the connected substitutes condition, unlike these systems, I do not impose symmetric preferences.[12] Connected substitutes also nests models wherein workers climb a common job ladder, and, where, all else equal, higher wages or amenities push employers up this ladder (e.g. as in Sorkin 2018).

While assuming connected substitutes is natural for a labor market setting, it may be violated if workers possess non-homothetic preferences. For instance, if richer workers disproportionately value employer amenities, then an increase in some employer j's wage, that increases wealth among j's employees, could lead these workers to supply more—as opposed to less—labor to a different high amenity employer j'. Section 4.4 empirically rules out non-homotheticity as driving my results.[13] To summarize the main assumption about labor supply:

Assumption 1. (Connected substitutes) Employers are weak substitutes in that, all else equal, an increase in w_j weakly lowers labor supply to all other employers $\frac{\partial ln n_{j'}}{\partial ln w_j} \leq 0 \forall\, j' \in \mathbf{J} \setminus j$.

[11] This unique distribution is a key feature of imperfectly competitive labor markets where market power arises from workers' heterogeneous preferences/constraints across employers (e.g. Berger et al. 2022, Card et al. 2018, Sharma 2023).

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

[13] My main empirical finding is that a large, firm-specific demand shock that affected some employers spilled over to unshocked employers unaffiliated with the industry association as under oligopsony (by $\uparrow$ their wage and $\downarrow$ employment), but onto members of the association as after a breakdown of collusion (by $\uparrow$ their wage and $\uparrow$ employment). Section 4.4 shows that the opposite employment responses also occur when comparing members and non-members who offered the same amenities at baseline. By contrast, non-homothetic preferences would predict similar employment changes at the two sets of firms, and, thus, cannot explain the finding.

In addition, define the directed graph of a matrix to represent substitution among employers $\chi(w)$ whose elements are $\chi_{j+1,k+1}= \begin{cases} 1\{good\ j\ substitutes\ to\ employer\ k\ at\ x\} \\ 0 \end{cases}$. For all possible w, the directed graph of $\chi(w)$ has, from every node $k = 0$, a directed path to node 0.

Firms Firms post wages. Depending on the model conduct, they maximize profits by choosing the number of workers to hire or wage to set, taking as given their competitors' employment decisions (under Cournot oligopsony), wages (under Bertrand oligopsony), or by considering themselves atomistic (monopsonistic competition). In the collusive equilibrium, a cartel coordinates to pay the focal point wage, whereas fringe employers choose the number of workers to hire taking as given their competitors' employment decisions and the cartel's behavior.[14]

Each firm operates a production function of the form $z_{jt}f_j(n_{jt}, k_{jt})$, that uses inputs of capital k_{jt} and labor n_{jt}, and is twice differentiable and concave in both. Here z_{jt} is a product of TFP and price. Firms are price-takers in the product market.[15] Capital is supplied in a competitive market at rate R_t. Therefore, I can substitute in optimal capital demand into the production function to express it in terms of labor alone, $y_{jt} = \tilde{z_{jt}}\tilde{f_j}(n_{jt})$. Here $\tilde{z_{jt}}$ is a function of z_{jt}, R_t, and primitives. The second assumption underlying conclusions is:

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

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

2.2 Perfect competition

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

2.3 Oligopsony or Monopsony

Proposition 1: For oligopsonistic or monopsonistic conduct, any invertible labor supply system, and Assumption 2, a positive demand shock to one firm j ($dlnz_{jt} > 0$), causes

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

[15] Assuming price-taking in the product market is reasonable for the highly-traded textile and clothing manufacturing industry. However, all qualitative predictions remain unchanged if firms instead possess product market power, as long as the production function exhibits diminishing marginal revenue product of labor (Assumption 2).

unshocked competitors j' in its labor market to weakly increase their wage and reduce employment, with strict inequality under Assumption 1. In other words, $\frac{dlnw_{j't}}{dlnz_{jt}} \geq 0 \; \forall \; j' \in \mathbf{J} \setminus j$ and $\frac{dlnn_{j't}}{dlnz_{jt}} \leq 0 \; \forall \; j' \in \mathbf{J} \setminus j$, with strict inequality whenever employers are connected substitutes.[16]

Proof The proof proceeds in three steps. First, I show that $\forall$ competition structures and invertible labor supply systems, $\exists$ a log markdown function $\Lambda_j(w_{jt}, \mathbf{w_{-jt}}, \mathbf{a_t})$ such that the firm's profit maximizing wage $\tilde{w}_{jt}$ is the solution to the following fixed point problem for any wage vector at its 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 $\frac{dlnw_{jt'}}{dlnz_{jt}} \geq 0 \forall j' \in \{\mathbf{J} \setminus \mathbf{j}\}$, with strict inequality whenever $\frac{\partial lnn_{j't}}{\partial lnw_{jt}} \leq 0 \; \forall \; j' \in \mathbf{J} \setminus j$. Finally, I show that $\frac{dlnn_{j't}}{dlnz_{jt}} < 0$ whenever $\frac{dlnw_{j't}}{dlnz_{jt}} > 0$. The connected substitutes condition, which is sufficient for spillovers to occur, requires that workers exhibit some degree of substitution (via connections) between the shocked employer j, and each other employer $j' \in \mathbf{J} \setminus \mathbf{j}$. Its main role is to ensure that a wage increase at j reduces labor supply to j', in turn increasing j''s optimal wage.

Proposition 1 demonstrates that spillovers under monopsony or oligopsony always manifest by causing competitors to (weakly) increase their wage and reduce employment. For employers that maximize their own profits, thus, spillovers never predict higher employment.

To understand the intuition underlying this result, consider a Bertrand oligopsony. A positive demand shock to j increases j's labor demand, causing j to raise its wage in order to attract more workers (given upward sloping labor supply, $\frac{\partial lnn_{jt}}{\partial lnw_{jt}} > 0$). This higher wage attracts workers away from competitor j' whenever workers can substitute from j' to j (including via connections). This creates upward wage pressure at j', causing j' to also increase its wage.

While the rationale behind positive wage spillovers is obvious, that behind the unambiguous reduction of employment is not. In particular, spillovers exert competing forces on employment. This is best illustrated via the first order condition $w_j = \mu_j mrpl_j$ where μ_j is the markdown and $mrpl_j$ is the marginal revenue product of labor. On the one hand, unshocked employers wish to decrease employment to raise marginal product. On the other hand, they wish to grow large enough again to pay workers a lower markdown. It turns out that, for any production function with declining marginal product, and any labor supply system where employers are connected substitutes, the first force dominates the second. Spillovers unambiguously reduce employment at unshocked competitors.

Finally, spillovers also lower employment when employers are monopsonistic instead of oligopsonistic. This is because spillovers manifest by changing the curvature of labor supply. Even when an employer faces no strategic motives for wage setting (as in monopsony), the curvature of her labor supply can be a function of competitors' wages.[17] If yes, spillovers unambiguously reduce

[16] I show below that qualitative conclusions are unchanged when firms maximize profits subject to a binding minimum wage.

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

employment under monopsonistic competition.

Binding minimum wage The spillover effects of firm-specific demand shocks also predict negative employment effects in monopsony/oligopsony models with a binding minimum wage. This is best visualized via monopsony 101 graphs with downward-sloping demand and upward-sloping labor supply. When the minimum wage binds from below, firms are on their labor supply curve instead of the first order condition, i.e., the optimal monopsony wage that equates marginal product to marginal costs is lower than the minimum wage. A leftward rotation to labor supply nonetheless induces unshocked competitors to reduce employment. They may either continue to pay the minimum wage but employ fewer workers, since fewer workers are now willing to supply labor at the minimum wage. Alternatively, they may raise their wage (if the rotation pushes them onto their first order condition), which also reduces employment.

The minimum wage may alternatively bind from above. More workers supply labor than demanded, and firms are on their labor demand curve. Spillovers that induce a leftward rotation to labor supply nonetheless lead unshocked competitors to weakly reduce employment. Unshocked competitors may either not change wages and employment, if the minimum wage continues to bind from above. For a large enough rotation to supply, however, an unshocked competitor will raise her wage and reduce employment.

2.4 Breakdown of collusion

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

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

Proofs See Appendix.

A simple intuition underlies the proof—in order for collusion to be profitable, at least some firms (and, under some conditions, many firms) must depress both wages and employment to collude at the minimum wage, compared to oligopsony. Although I study firms' coordination at a focal point wage, the intuition for why mutual wage suppression is mutually beneficial is most apparent when considering the case of "perfect" collusion, or, joint profit maximization. Jointly profit-maximizing firms fully internalize the negative effect of their higher wages on their competitors' labor supply, and, thus, suppress wages and employment below the individually optimal level. Similar motives

competition, $\frac{dlnw_{j't}}{dlnw_{jt}} = 0$. However, the first term can still depend on competitor wages.

lead firms to collude at a focal point wage, by suppressing both their wages and employment.[18] A breakdown of collusion that causes unshocked firms to revert to oligopsony then predicts higher wages and employment at firms that were previously coordinating.

Former colluders raise employment as long as the demand shock is "small enough" to spur an oligopsony equilibrium close to the one that would originally prevail if colluders did not collude. Very large demand shocks, that spur transitions to equilibria far from this original counterfactual, would, however, also predict lower employment among unshocked colluders. For example, consider the extreme where a shocked firm wishes to employ its entire labor market. The test nonetheless demonstrates that non-cooperative models of competition can *never* predict higher employment at unshocked competitors, whereas a breakdown of collusion can.

2.5 Discussion

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

My goal is not to argue that a single firm's deviation from the collusive strategy must necessarily dismantle collusion. Indeed, such an argument would be false—the Folk Theorem postulates that several alternative collusive strategies are sustainable for sufficiently patient firms. For instance, a cartel could temporarily allow members who receive positive demand shocks to increase production while asking unshocked members to cut back. It could reverse these roles when the shocks reverse. Rather, the aim of the theory is to demonstrate that, under very general structures of labor supply and production, a breakdown of collusion *can* predict higher employment at unshocked competitors, for any punishment strategy leading to breakdown. In contrast, independent profit maximization can *never* predict higher employment at unshocked competitors.

Section 4 tests the reduced form implications of this theory. Section 6 quantifies the relative fit of different models of conduct, and demonstrates that the collusion plus breakdown model best fits the data.

3 Data and Setting

3.1 Data Sources

My analysis links four new sources of data: (i) wages and worker outcomes from linked employer-employee social security records covering the universe of formal workers in India, (ii) establishment-level membership in local industry associations, scraped from their websites, (iii) minimum wage lev-

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

els and changes over time for all states and industries in India, and (iv) exports at the establishment-level from customs records.

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

For information on membership in local industry associations, I first identify the largest industry association in each of five main centers of garment manufacturing in India, each in a different city—Tirupur (Tamil Nadu), Bangalore (Karnataka), Gurgaon (Haryana), Faridabad (Haryana), and Noida (Uttar Pradesh). Together these cities employ 63% of all workers in the garment industry. Appendix Table 1 lists the most prominent industry association in each city. I scrape member lists for these associations from their websites. Industry associations have an average membership of 555 employers.

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

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

3.2 Institutional Setting

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

Industry associations Nearly half of all workers in India's textile and garment manufacturing industries work at factories that belong to local industry associations. The ostensible purpose of these associations is to coordinate member actions in the product market, and to advance their interests in policy. For instance, industry associations regularly lobby the government for perks—the most prominent association in India's largest garment manufacturing hub, the Tirupur Exporters' Association, recently extensively lobbied the central government to enact free-trade agreements that would boost India's exports to Australia and the UK, and lobbied against an agreement that increased imports from Bangladesh. Industry associations also regularly organize networking events where members learn about each others' production processes, and trade fairs to showcase members' goods to foreign buyers.

I identify the most prominent industry association in each of five main centers of garment manufacturing in India—Tirupur (Tamil Nadu), Bangalore (Karnataka), Gurgaon (Haryana), Faridabad (Haryana), and Noida (Uttar Pradesh). The bunching results reported below apply to all associations[19]. However, the empirical analysis in Section 4 focuses on the Tirupur Exporters' Association (TEA). Tirupur employs 31% of garment workers in India and accounts for a majority of exports.

Membership in the TEA is restricted to large and prosperous factories. In order to be eligible for membership, factories must have a minimum turnover of Rs. 50 lakh over the past three years (1.3 million USD in PPP terms). They must additionally be endorsed by two existing members. Prospective members of the TEA first undergo a trial period as "associate" members of the association before they can be inducted in as permanent "lifetime" members. In total, the association has 1076 lifetime members and 155 associate members. By way of comparison, in 2018 it had 931 lifetime members and 155 associates.

Some nuance is in order when defining the boundaries of the cartel. Although I define the cartel as the industry association, the true cartel is potentially smaller than the full association. Ongoing descriptive analysis reveals that permanent members of the association (82% of the total) may constitute a more likely boundary of the cartel. I find that the association appears to enforce compliance with the minimum wage among probationary members by expunging members who deviate from paying the minimum wage. Probationary members who deviate to paying a wage higher than the minimum during their period of probation are less likely to be inducted as permanent members compared to those who never deviate. Evidence in Section 4 nonetheless reveals that the industry association can be considered a loose definition of the cartel.

Minimum wage Each state in India establishes a daily minimum wage for each of 105 scheduled employments (roughly, two-digit industries).[20] This wage is intended to cover basic living expenses for a family of four members. While states vary somewhat in their precise definition of "basic living expenses", these definitions are consistently detailed; for instance, the national government proposes the following, very specific basket of goods that a reasonable minimum wage should enable

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

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

households to afford[21]: "food items amounting to the level of 2,400 calories, along with proteins $\geq$ 50 gm and fats $\geq$ 30 gm per day per person", "essential non-food items, such as clothing, fuel and light, house rent, education, medical expenses, footwear and transport equal to the median class' expenditure as per the NSSO-CES 2011/12 survey data", and "expenditure on any other non-food items equivalent to the sixth fractile (25-30 per cent) of the household expenditure distribution." States typically comply with these requirements by gathering price information from several different locations before adjusting the minimum wage. For example, Karnataka collects prices across 16 urban and rural centers.

In principle, the law requires state governments to revise each industry's minimum wage every five years, and to adjust it for inflation every six months. In practice, however, revisions are uncommon. During the five year period spanning 2014 to 2018, the average state only revised its minimum wage for the garment sector 4 times.

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

Table 1 describes key characteristics of the minimum wage in the garment industry in July 2016. The daily minimum wage for unskilled workers ranged between Rs. 4390 and Rs. 9568 across states, with an average value of Rs. 6962. For semi-skilled workers, this daily minimum wage ranged from Rs. 4700 to Rs. 10582, with an average value of 7439. Finally, the minimum wage for skilled workers ranged from Rs. 5171 to Rs. 11622, with an average of 8034. These average wages corresponded with monthly earnings of \$361, \$387, \$418 respectively when converted to USD adjusted for purchasing power parity. Of the total value of the minimum wage, 9.4% typically comprised a basic wage that covered basic living expenses at the original time of setting the wage. The remaining 90.6% comprised a "variable dearness allowance" (VDA) that constitutes periodic adjustments to the minimum wage for inflation.

Both the central and state governments are tasked with enforcing the minimum wage, but, as I will show below, its enforcement is highly imperfect. Enforcement typically takes the form of labor inspections. Inspectors located in different geographic zones within a state inspect establishments that lie within their jurisdictions, either randomly or, in rare cases, based on complaints (Shyam Sundar 2010). Inspections assess an employer's compliance with all local labor regulation, not just the minimum wage. Any employer found in violation of the minimum wage law faces a fine of up to Rs.10,000 and imprisonment of up to five years. However, as I will show below, over half of all workers employed at formal establishments in India, and who show up in social security records,

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

earn less than the minimum wage. This reflects both the government's highly imperfect enforcement of the minimum, and virtually no sharing of information between the social security administration and Ministry of Labor.

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

My analysis begins by documenting three facts describing the distribution of wages in the Indian garment industry.

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

A potential concern with the documented pattern is reporting bias. Since social security contributions are calculated using a worker's reported wage, employers may falsely report paying workers the low, legally mandated, minimum wage when in fact paying workers a premium above this minimum wage under the table. To allay concerns of reporting bias, Appendix Figure 1 instead plots the distribution of self-reported wages from the Primary Labor Force Survey. Self-reports are less prone to reporting bias, since they are not used to calculate social security contributions. In self-reported earnings too, I find bunching from above at the minimum wage. In addition to survey evidence, abundant qualitative evidence substantiates the claim that workers in garment manufacturing factories receive exactly the minimum wage.[22] For example, Adhvaryu et al. (2019) evaluate the impact of a worker voice intervention at India's largest garment exporter, which empowered workers to voice their discontentment after a dissappointing minimum wage hike. The voice intervention was based on the premise that garment workers earn exactly the new (disappointing) minimum wage.

Fact 2: Industry association members disproportionately bunch from above at the minimum wage As a second fact, I document that, across locations, members of industry associations are disproportionately more likely to bunch from above at the local minimum wage compared to

[22] For instance, the fact that garment workers earn exactly the minimum wage emerged during several of this authors' qualitative interviews with garment workers, owners of large garment factories, heads of industry associations, and non-profit organizations advocating on behalf of garment workers across many locations in India.

employers who are not members of the association. Figure 2 plots the distribution of wages separately for members and non-members. At members of the local industry association, 42.8% of workers earn within two days of the minimum wage, 38.7% earn below the minimum wage, and 18% of workers earn above the minimum wage. By contrast, employers who are unaffiliated with the association exhibit substantially less bunching at the minimum, paying a large share of workers below the minimum wage (71.4%), and only 15.1% within two days of the minimum.

Fact 3: Members of industry associations track any increase in their local minimum wage, without reducing employment To study the effect of minimum wage hikes, I first identify fifteen large increases in the minimum wage between 2015 and 2018, wherein a state government increased the garment sector's minimum wage by over 7.5% (or two days) of its previous value. I employ a stacked event study design to evaluate the effect of these hikes on wages and employment, separately for members and non-members of industry associations. To this end, I generate a panel dataset that tracks establishments affected by the increase, i.e. located in the state that raises its minimum wage, and comparison establishments in other states, that do not hike their minimum wage, for 12 months around the time of each event. The empirical specification is:

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

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

I find that members of industry associations are disproportionately more likely to track the higher minimum wage compared to non-members, without reducing employment. Figure 3, Panels A and B, plot the coefficients β_t for the two outcomes. I find that two months after a minimum wage hike, members of industry associations in treated states are nearly 21pp more likely to pay the new, higher minimum wage compared to 6pp of employers outside the state (Panel A). By contrast, employers outside the industry association are only around 10pp more likely to pay the new minimum wage. The differential switch of members to the new minimum remains true over time – eight months following the increase, members of industry associations are nearly 35pp more likely to pay workers the new minimum wage, compared to only around 10pp among non-members. Panel B plots the average treatment effect on employment at the two sets of employers. Eight months after a minimum wage hike, there is no statistically significant treatment effect on employment at either members or non-members. If anything, members of industry associations, who are more likely to pay the higher minimum wage, experience a small positive treatment effect on employment (4pp) three to six months after the hike.

The fact that members track increases in the minimum wage without reducing employment indicates the presence of imperfect competition in the labor market. However, it does not sufficiently evidence coordination. Thus, in a third motivating investigation, I study how members and non-members of the association respond to routine (small) demand shocks. Small positive shocks to demand should elicit the standard imperfectly competitive response among employers who face upward-sloping labor supply curves (higher wage and employment), but may elicit no response if employers abide by the minimum wage.

4 Empirical Results

This section presents the main empirical results on members and non-members' responses to demand shocks. First, I present motivating evidence that members of the industry association forego lucrative export opportunities from small positive shocks to demand whereas non-members do not. Second, in the chief empirical exercise of the paper, I take the comparative static test outlined in Section 2 to the data. Specifically, I assess the spillover effects of a large firm-specific demand shock that caused affected members of the industry association to deviate from the minimum wage, onto unshocked employers within versus outside the industry association. All results in this section pertain to the city of Tirupur, which employs 31% of India's garment workers, and accounts for a majority of garment exports. Tirupur's main industry association is the Tirupur Exporters' Association (TEA).

4.1 Routine (small) shocks

Fact 4: Members of industry associations forego export opportunities from small positive (price) shocks to demand, whereas non-members respond by raising wages, employment, and exports Before exploring the spillover effects of firm-specific demand shocks onto unaffected employers, I first examine employers' responses to their own small demand shocks (small in price). Specifically, I ask whether employers unaffiliated with the industry association cater to routine demand shocks as individual profit maximizers who face upward-sloping labor supply curves, by raising wages, employment, and exports, whereas members forego the opportunity and stick to paying the minimum wage. Imperfectly competitive firms that maximize private profits, and face upward-sloping labor supply curves, would cater to higher demand by increasing their wage to hire more workers. By contrast, colluding firms that face upward-sloping labor supply curves may forego the export opportunity in order to continue to coordinate at the minimum wage, unless the gains from deviating exceed the benefits of continued collusion. Formally, say that members of a cartel who deviate to paying a wage higher than the minimum wage receive a punishment profit of Π_{punish} for T periods. Members would continue to coordinate as long as $\sum_{T+1} \delta^t \Pi_{coll} > \Pi_{dev} + \sum_T \delta^t \Pi_{punish}$. Small price shocks may not raise Π_{dev} enough.

I leverage two features of the garment industry to generate a measure of routine (small) demand shocks. First, demand is highly transitory, which reflects idiosyncratic fashion trends such as the introduction of a new line, or new sales. Second, export relationships are recurrent—i.e., establishments routinely export to the same importer across seasons. For each establishment in state s, I define a small, routine shock to occur if the average price of imports to its chief importer, leaving out imports from its own state s, grows 5 to 15pp between any two peak export seasons. Exports peak twice a year, prior to the holiday season in November, and prior to the commencement of summer sales in July. The labor demand shock occurs three months prior to the export shock, since export contracts typically award three months of lead time. An establishment's chief importer is defined as the entity to which it exported the most, in dollar value, during the previous peak export season. For establishments that don't export in the previous season, I define the chief importer using the last observed season. Chief importers typically constitute a brand-location combination, such as Zara USA or Nike Brazil. Formally, an establishment j with chief importer c in state s experiences a small demand shock in season k if:

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

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

I employ a DiD event study to study the shock's effect on wages and employment, comparing an establishment's trajectory of outcomes during seasons in which it experiences a small demand shock, to its own trajectory during unshocked seasons. To do so, I construct a panel dataset that tracks outcomes for all establishments experiencing at least one routine demand shock between 2014 and 2018, for all months between $t = -4$ and $t = 6$ relative to the start of any peak export season. In particular the sample includes both shocked and unshocked seasons for establishments that ever receive a routine demand shock. The following regression then evaluates the shock's effect on members and non-members of the industry association[23]:

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

where Y_{jtk} is the outcome of interest (modal wage or total employment) for employer j in month

[23] 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.

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

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

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

I next turn to main results. Figure 4 shows the effect of a routine demand shock on the modal wage and employment of non-members, i.e., employers unaffiliated with the association. If these employers are maximizing profits and face upward-sloping labor supply curves, then a positive demand shock should cause them to raise wages and employment. As predicted, non-members who experience a positive demand shock increase their wage by 10.5pp more in seasons during which they experience the shock compared to seasons without a shock (Panel A, month 4). They increase employment by 10pp (Panel B).

Figure 5 shows the effect of a routine demand shock on members of the industry association. If these employers are coordinating to pay the minimum wage, then we should not expect routine demand shocks to affect their wages, employment, or exports. As predicted, I find that members of industry associations remain unresponsive to routine demand shocks. Panel A shows no average effect on their modal wage in seasons during which they experience a shock compared to seasons without one (point estimate 0.004 95% CI (-.008, .017)). Similarly, Panel B shows no average effect on the number of workers employed in seasons with versus without a shock.

Note that members would only forego export opportunities, as I find, if they face upward-sloping labor supply curves when paying the minimum wage. In other words, if they must raise their wage above the minimum to hire more workers, but are unable to do so due to coordination. Section 6 microfounds such upward-sloping labor supply curves using heterogenous preferences across employers. Estimates there also suggest that labor supply is indeed upward-sloping at the minimum wage.

One may expect these different responses among members and non-members even absent collusion if the shocks to members are on average "smaller". However, as previously discussed, routine demand shocks have a remarkably similar first stage effect on the export price at members and non-members. This suggests that the different wage/employment effects between these two employers are driven not by different shocks, but, rather, by different responses to similar shocks.

The results of this section suggest that members of industry associations forego export opportunities in order to stick to the minimum wage. Non-members outside the association cater to routine, positive demand shocks by raising their wage to hire more workers, as predicted for individual optimizers who face upward-sloping labor supply curves. In contrast, members of the association stick to paying the minimum wage, do not raise employment, and do not increase exports.

4.2 Large shock

Next, to put the theory in Section 2 to test, I study the spillover effect of an exceptionally large, positive demand shock, that affected over 13% of exporters in Tirupur, and increased their export prices by 24.5pp between 2016 and 2017. The shock originated as a result of labor audits in Vietnam that revealed severe labor law violations among several large factories. Conducted by NGO Worker Rights Consortium, the audits accused these factories of wage theft, unjust overtime practices, pregnancy discrimination, and health and safety infractions, among others (Figure 6, Panel A).[24] The audits prompted twenty six prominent fashion brands, including Zara USA, Macy's, Nike, and Gap, to temporarily relocate their production operations away from Vietnam (Figure 6, Panel B). Many of these factories' existing suppliers, tasked with filling extra export orders, were located in Tirupur, India.

The Vietnam relocation shock thus serves as a positive demand shock to employers in Tirupur that were already exporting to the affected brands (affected employers), but not to employers who were exporting to other brands (unaffected employers). Figure 7 shows a strong first stage effect of the shock on export prices received by affected versus unaffected employers. For six months following the shock, between July and December 2017, the export price for affected employers grew 20 to 30pp above unaffected employers.

The relocation shock impacted 14% of employers outside the association and 13% within the association.

In order to deliver the effects of a demand instead of supply shock, the ideal exogenous, as-if-randomly-assigned, shock to a firm's demand would be uncorrelated with changes to the firm's labor supply, TFP, or input costs. Figure 8 shows that affected and unaffected employers within the association, and those outside the association, closely resembled each other in baseline characteristics. In other words, affected and unaffected employers within the association were similar and affected and unaffected employers outside the association were similar. Specifically, the two sets of employers exported similar products (HS 6 digit codes) and had similar baseline distributions of firm size. The similarity in baseline characteristics among affected and unaffected employers within (and outside)

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

the association suggests that the shock constitutes an exogenous shock to demand, uncorrelated with changes to the firm's labor supply, TFP, and input costs. Section 4.3 explicitly rules out common TFP shocks as driving results.

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

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

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

Results Figure 9 reports the impact of the relocation shock on the modal wage and employment of affected non-members (employers outside the industry association). Similar to routine demand shocks, non-members respond to the larger demand shock by increasing their wage and employment. Four months after the shock, the wage at affected non-members is 8pp higher relative to trend (Panel A), and employment is 8pp higher (Panel B). Both the wage and employment increase persists for six months.

Figure 10 reports the impact of the relocation shock on members of the TEA. Unlike with routine demand shocks, affected members also respond to the Vietnam shock by increasing their wage and employment. In particular, affected members deviate to paying a wage that is higher than the minimum wage. Four months after the shock, affected members pay 9pp higher wages compared to trend (Panel A). They also hire more workers, increasing employment by 8pp (Panel B).

The fact that affected members of the industry association shift to paying a wage higher than the minimum following the large relocation shock, but not after routine demand shocks, is consistent with a model in which a cartel member pays the minimum wage until her benefit from deviating outweighs the benefit of continued collusion. Because the relocation shock led to a substantially higher increase in export prices than routine demand shocks—24pp relative to 5 to 15pp during a routine shock—it conceivably increased the benefit of deviating more than the typical shock.

Given that the relocation shock inspired affected members to deviate away from the minimum wage, I can perform the comparative static test outline in Section 3. Specifically, I ask whether the shock's spillover effects are consistent with a model of individually profit maximizing firms (with unshocked competitors $\uparrow$ their wage and $\downarrow$ employment), or the breakdown of collusion from a focal point wage (with unshocked competitors $\uparrow$ their wage and $\uparrow$ employment).

Figure 11 reports the spillover effect of the relocation shock on non-members. As predicted by individual profit maximization, spillovers lead unaffected employers to increase their wage and reduce employment. Four months after the relocation shock, the wage at unaffected non-members is 5pp higher than trend (Panel A). Employment is 6pp lower.

By contrast, unshocked members of the association respond as if collusion breaks down from a focal point wage (Figure 12). In particular, they increase both wages and employment. Four months after the shock, the wage at unaffected members is 6.5pp higher than trend (Panel A). Employment is 8.5pp higher (Panel B). As illustrated in Section 3, this positive spillover effect onto employment is inconsistent with all models in which firms maximize their own profits (Proposition 1). Instead, it is consistent with a model in which members of the industry association were previously coordinating to depress both wages and employment, to pay the minimum wage, but where the positive demand shock dismanteld their collusion (Proposition 2).

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

Boundaries of the cartel Some nuance is in order when defining the boundaries of the cartel. Although I define the cartel as the industry association, the true cartel is potentially smaller than the full association. Two ongoing descriptive analyses reveal that permanent members of the association (82% of the total) may constitute a more likely boundary of the cartel. First, I find that permanent members are more likely to bunch from above at the minimum wage. Second, I show that the association appears to enforce compliance with the minimum wage among probationary members by expunging members who deviate from paying the minimum. Probationary members who deviate to paying a wage higher than the minimum wage during their period of probation are less likely to be inducted as permanent members compared to those who never deviate. The industry association can nonetheless be considered a loose definition of the cartel.

4.3 Robustness

At least three alternative explanations could lead unaffected members of the industry association to increase employment even absent a breakdown of collusion. I evaluate and furnish evidence inconsistent with each in turn.

TFP/cost shocks to association members First, common TFP or cost shocks that affect all members of the industry association, but not non-members, could increase labor demand, and, hence, employment among members compared to non-members. The observed effect could then reflect these common labor demand shocks due to changes in TFP or costs, instead of a breakdown of collusion. For example, if members of the association share the same input suppliers, then any reduction in the price from these suppliers could simultaneously increase demand among members.[25]

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

Three facts mitigate the concern that common TFP or cost shocks drive the empirical findings. First, I find that affected and unaffected members vary systematically in the destination of their new exports (Appendix Figure A2). Whereas shocked members export more to exactly those affected brands to which they were already exporting, unshocked members increase exports to entirely new importers. Four to seven months after the relocation event, unaffected members are nearly 15pp more likely to export to a new importer compared to at baseline. Affected members, by contrast, are no more likely to add importers. Common TFP or cost shocks may have predicted similar patterns of exports. Thus, spillovers to unaffected members of the TEA appear to be driven by a breakdown of collusion—which allowed these employers to deepen exports by hiring more workers at higher wages.

Second, common TFP or cost shocks to members should cause their wages and employment to change at the same time. However, I find systematic differences in the timing of wage and employment changes at affected and unaffected members. Affected members increase their wage and employment immediately after $t = 0$. In contrast, unaffected members do not raise their wage until two months into the shock, in $t = 2$. The differential timing of changes is inconsistent with simultaneous shocks to TFP or costs. Rather, they appear to reflect a breakdown of collusion. Finally, the test of conduct in Section 5, which quantifies the relative fit of the oligopsony model vs breakdown of coordination from the minimum wage imposes no restrictions on TFP shocks. Its conclusions are thus robust to common TFP/cost shocks affecting all members.

Sub-contracting within the association A second possible explanation for higher employment at unaffected members is that affected members simply subcontracted production to their unaffected counterparts within the TEA, thereby generating a positive demand shock at the latter. The positive spillover effect on employment could then reflect this positive demand shock as opposed to a breakdown of collusion. Two findings point against this explanation. First, as documented above, unaffected members increase their own exports to entities to which they were not exporting previously (Appendix Figure A2). According to a simple back of the envelope calculation, the magnitude of this increase in exports can, by itself, account for higher employment at these firms.[26]

Nonetheless, higher exports at unaffected members may still reflect affected members handing over "worse" exports to unaffected members of the association. However, Appendix Figure A1 shows that unaffected members' prices remained unchanged. Any demand shock must precipitate a price increase in order to compel an oligopsonistic firm to produce more. Thus, higher exports at unaffected members of the association do not reflect a positive shock to these members either by virtue of receiving orders from the affected brands or by taking over "worse" orders from affected members. This suggests that the positive spillover effect on employment (and exports) among unaffected members reflects the breakdown of collusion, which raised export supply from these members.

for labor.

[26]Specifically, for the average firm, $\Delta export = mp \times \Delta n$. Here $\Delta n = \bar{n}\Delta lnn$ where $\bar{n}$ indicates the average firm size and $\Delta lnn = 0.065$.

Non-homothetic preferences Finally, as discussed in Section 2, non-homothetic preferences for amenities could also lead unaffected members to increase employment through a labor supply channel, if member amenities exceed those at unaffected non-members. While I do not directly observe amenities at each establishment, I leverage the observation that foreign buyers commonly enforce these amenities on all their exporters (e.g. as in Boudreau 2021, Alfaro-Ureña et al. 2022). For example, brands frequently employ audit agencies like SEDEX to ensure compliance with local labor regulation. Thus, comparing members and non-members that export to the same importer controls for common amenities enforced by the importer, and, thus, for non-homotheticity. I control for importer-time fixed effects in the following modified version of the regression from (2):

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

Appendix Figure A3 shows that, even after controlling for a common change in labor supply to exporters to brand c, the shock spurs opposite employment effects among members and non-members.

Section 5 quantifies the relative fit of different models of conduct. Section 6 quantifies the losses due to collusion and the role of the minimum wage in remedying them.

5 Test of conduct

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

5.1 Summary

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

I modify the BCS approach to instead uncover changes in conduct due to the large demand shock studied in Section 4. Under the correctly specified change in conduct, the implied change in productivity should be uncorrelated with an instrument that only alters markdowns but not marginal product. In my case, the instrument for employer j is a weighted average of the demand shock at employers excluding j. The instrument only affects j's markdown by rotating its labor supply, without directing impacting j's own productivity (z_{jt}). I assume the production function described in detail in section 6: $\tilde{z_{jt}} n_{jt}^{\alpha_2}$. Where z_{jt} is a product of TFP and price for employer j in time t and n_{jt} is labor. To uncover the implied change in markdowns under different models of conduct, I assume a three-nested CES labor supply system where workers choose across locations, industries, and then employers within an industry. Section 6 describes estimation in detail.

A firm j's best response wage is given by[27]:

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

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

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

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

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

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

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.[28]

I generate an empirical analog of the moment condition. Different shifts in conduct predict different $dln\mu_{jt}$ among unshocked employers. I observe $dlnn_{jt}$ and $dlnw_{jt}$. I thus recover the implied change in productivity $dlnz_{jt}$ for each employer.

I formulate a pairwise test statistic for testing between any two models 1 and 2 (as in Rivers and Vuong 2002, and BCS 2021):

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

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

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

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

Tests I conduct two pairwise comparisons to test for changes in conduct among unshocked members of the industry association. First, I test between oligopsony throughout vs. switching from coordination at the minimum wage to oligopsony due to the shock. Second, the shock could conceivably shift employers closer to their optimally collusive scheme. For example, the cartel may decide that the shock makes it worthwhile to incur the fixed cost of transporting workers in from a neighboring state. I thus test between switching from coordination at the minimum wage to oligopsony vs. switching from coordination at the minimum wage to joint profit maximization. I do not test for coordination at a new collusive wage since I find substantial dispersion in post-period wages among members of the industry association (both shocked and unshocked).

Change in markdown Conduct determines the change in markdown ($dln\mu_{jt}$). For the continued oligopsony case, these changes fall into three categories. For employers who do not pay the minimum wage at baseline, the change in the optimal markdown is $dln\mu_{jt} = \sum_{j'} \frac{\partial ln\mu_{jt}}{\partial lnw_{j't}} dlnw_{j't}$ (Appendix derives the analytical expressions when labor supply is nested CES and employers compete in a Cournot oligopsony). For employers who previously paid a binding minimum wage, but whose wage changes following the shock, the change in the optimal markdown is $dln\mu_{jt} = ln\mu_{j,t+1}^{oligopsony}(\mathbf{s_{t+1}}) - ln\mu_{j,t}^{olig,mw} = ln\mu_{j,t+1}^{oligopsony}(\mathbf{s_{t+1}}) - 0$, where $\mu_{j,t+1}^{oligopsony}$ is the optimal Cournot oligopsony markdown implied by the post-period distribution of shares. The pre-period markdown with a binding minimum wage is simply one, i.e., workers are paid exactly their marginal product.[29] For employers who continue to pay a binding minimum wage, the difference in the optimal markdown is zero.

For the collusion to oligopsony case, the post-period markdown is simply the oligopsony 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 8).

5.2 Results

Table 4 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

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

fits better than either the continued oligopsony model or switching from collusion to the optimal collusive scheme.

Although Table 4 reveals the switching from collusion to oligopsony is the best-fitting model, it does not reveal how well the breakdown model fits the data. Appendix Figure X thus evaluates the objective fit of the breakdown model by plotting the correlation between $dlnz_{jt}$ and the instrument. This correlation should be flat under the true model, not just zero in expectation. Reassuringly, I find no correlation between the two $dlnz_{jt}$ and the instrument. The switching from collusion to oligopsony model thus fits the data well.

6 Counterfactuals

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

6.1 Model

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

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

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

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

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

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

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

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

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

Relatively high wages and amenity employers attract more workers—labor supply to an employer is increasing in its wage and amenity relative to the industry, and in the industry's wage index relative to the geography.

Since the counterfactuals consider a Cournot solution concept, where firms choose employment taking their inverse labor supply curves as given, I define it here,

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

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

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

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

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

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

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

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

Labor Demand: Collusion Under collusion, a cartel emerges to pay the minimum wage. I consider a two period world where each period spans six months. The cartel rewards members for paying the minimum wage in the first period by also sticking to the minimum wage in the second period. By contrast, it punishes any deviations away from the minimum wage by switching to oligopsony in the second period. A firm then colludes iff collusion is profitable, $2\Pi_{mw} > \Pi_{dev} + \Pi_{olig}$ (where profits are determined in equilibrium).

Any firm not in the cartel is in the fringe. Fringe firms maximize their own profits, by choosing the number of workers to hire taking both the cartel's behavior and other firms' employment decisions as given.

Labor supply and firm profits are then determined in equilibrium. Fringe firms have first order conditions that resemble equation (6). By contrast, cartel members only hire as many workers as are willing to work there at the minimum wage:

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

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

Three caveats are worth highlighting. First, per the Folk Theorem, several alternative punishment strategies 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 1). Still, Section 6.3 details the impact of enforcement on conclusions. Finally, I assume that the cartel only coordinates at the minimum and at no other wage. This assumption reflects a key institutional feature of the garment industry—that foreign buyers enforce the minimum wage. Foreign-buyer-induced enforcement of the minimum wage generates interesting implications for minimum wage policy, which are discussed in Section 6.3 below.

6.2 Estimation and Mechanics

I now turn to studying the wage and employment consequences of coordination, and policy counterfactuals. Running counterfactuals requires four key ingredients. First, I estimate the labor supply system, which is parameterized using the nested logit framework outlined in equation (1). Second, I estimate the underlying distribution of productivity (z_{jt}) across firms. Third, labor demand is determined either by the collusive or oligopsony equilibrium concept. Finally, I estimate or calibrate other necessary parameters in the production function (α,γ), and upper-level labor supply (φ,$\bar{\varphi}$). Table 3 summarizes all requisite parameters.

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

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

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

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

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 importer-induced demand shocks described in Section 4 and local industry-specific minimum wage changes as instruments. These shocks are assumed to be uncorrelated with a_{jt}. The moment condition is, thus, $E[a_{jt}\mathbf{z_{jt}}] = 0$, 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 moment conditions:

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

Table 3 reports estimates. I estimate $\hat{\eta}$ equal to 3.5, and $\hat{\theta}$ equal to 1.1. I calibrate the cross-location elasticity, $\hat{\lambda} = 0.03$, from Sharma (2023).[30] Using a more standard instrumental variables strategy to estimate labor supply parameters yields very similar estimates to the BLP approach (Sharma 2023).

Productivity distribution I employ indirect inference to obtain the underlying productivity distribution. In particular, I calibrate productivity dispersion to match the post-shock concentration, the Herfindahl Hirschmann Index, HHI_{kr} in the textile sector. I assume that productivity z_{jt} follows a log-normal distribution with mean 1 and standard deviation σ. I then run the oligopsony model for various candidate values of σ, and choose the one that best matches the observed post-shock HHI. One caveat to this indirect inference approach is that the post-period market shares of employers reflect not just their pre-period productivity distribution, which I need, but this productivity plus the shock itself. To mitigate this concern, I replicate the empirical shock in the model by randomly assigning 13% of firms with a 25pp price shock. I then estimate σ to reflect post-period productivity minus this shock. I calibrate the productivity shifter Z to match the average wage in the textile industry (described in Appendix).

In ongoing work I employ a different approach to back out productivity—that does not rely on assuming that the large shock leads to a full breakdown of collusion. Specifically, I employ an approach analogous to Carillo et al., using the demand shock to back out the distribution of marginal product, and, hence, productivity. The approach relies only on taking a first order Taylor expansion around the production function, without imposing pre or post-period conduct 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 Appendix).

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

Mechanics I make a few simplifying assumptions. I assume away establishment-specific amenities a_j that deviate from industry norms. I restrict counterfactuals to the five major industries that employ the largest number of workers: the manufacturing of textiles and clothing, food and beverage products, metal products, machinery, and automobiles. Together these industries employ over 10.3% of the formal labor force (7.6% of women and 10.4% of men).

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

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

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

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

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

6.3 Results

Collusion versus oligopsony To study the wage and employment losses due to collusion, I calculate their counterfactual values if employers instead operated in a Cournot oligopsony. I find that switching from collusion to oligopsony increases the average garment worker's wage by 9.6pp (Figure 13). 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 were previously benefiting from wage suppression at highly productive firms. Facing limited 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 xpp more. Higher wages in the cartel also induce upward wage pressure on other, fringe employers. Overall, the average garment worker earns 9.6pp more under oligopsony relative to collusion.

Employment in the garment sector also increases by 17pp. 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, ypp represents workers transitioning 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 4.3pp.

A caveat to these conclusions is that I assume that the cartel punishes any deviation in the first period with oligopsony for six months. This is based on observing that a large fraction of firms return to paying the minimum wage six months following the relocation shock. A more (less) severe punishment strategy would, instead, imply larger (smaller) losses from collusion. For example, a better enforced cartel could reduce the deviation profit to $\Pi_{dev} + \Pi_{olig} - punishment$. More productive firms, with higher $\Pi_{dev} + \Pi_{olig}$, would now also enter the cartel, thereby reducing wages and employment more than in a world without *punishment*.

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

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

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

Figure 13 reports results. I find that a 10% increase in the minimum wage increases the average garment worker's wage by 13.6pp. It increases employment by 15.6pp. As previously noted, the increases reflect gains among both members and fringe employers.

Interestingly, I find that a 50% minimum wage hike outperforms oligopsony. The average garment worker now earns 32pp more than before. Employment increases by 23pp. The intuition underlying this result is that more productive firms now also find it profitable to coordinate at the minimum wage, thereby suppressing their wages and employment. Facing less intense competition from highly productive counterparts, less productive firms can raise wages and employment above a more-competitive oligopsony. On balance, the second effect outweighs the first, leading to an overall rise in wages and employment. The gains from raising the minimum wage, do, however, taper off for larger minimum wage hikes, and a 100% increase does worse than oligopsony. While it raises the average worker's wage by 40pp, it only raises employment by 12pp.

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

Enforcement My conclusions rest on two assumptions. First, I assume that the minimum wage only serves as a coordination device and is otherwise imperfectly enforced. That half of all workers in the garment industry earn below the minimum substantiates its imperfect enforcement (Figure 1). Second, I assume that employers can only coordinate at the minimum and at no other wage.[31] This second assumption reflects an important institutional feature of the garment industry, namely, that foreign buyers enforce compliance with the minimum wage. Prominent brands such as Zara and Nike regularly audit their suppliers to enforce compliance with local labor regulation, including the minimum wage (e.g. via audit agencies like SEDEX). Indeed, non-compliance with labor regulations in Vietnam is exactly what precipitated the large demand shock studied in this paper (Section 4).

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

7 Conclusion

This paper evidences collusion among employers in the Indian textile and clothing manufacturing industry. I show that local industry associations in the sector operate as cartels, coordinating to pay workers exactly the minimum wage. Its use as a focal point essentially renders the minimum wage a "maximum wage" in the garment industry. I find that while routine positive demand shocks elicit no response among members of the industry association, consistent with their continued coordination,

[31] For example, I find that the "optimal" collusive wage, which maximizes the sum of profits of employers who coordinate at it is lower than the minimum wage.

they lead non-members to raise their wages to hire more workers, consistent with non-cooperative models of market power. Further, a large demand shock that leads affected industry association members to raise wages, spills over onto unshocked non-members as under oligopsony (by leading them to ↑ their wage and ↓ employment), but onto unshocked members as when dismantling collusion (by ↑ their wage and ↑ employment).

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

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, suppressing their wages and employment. 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 payment of the minimum wage. Enforcement by foreign buyers yields two competing policy implications. On the one hand, policy could sustain a higher minimum wage if firms can only access lucrative export opportunities if paying the minimum wage (since fewer firms would drop out of the cartel when the minimum wage rises). On the other hand, policy may be able to sustain a lower minimum wage if export demand is elastic, and 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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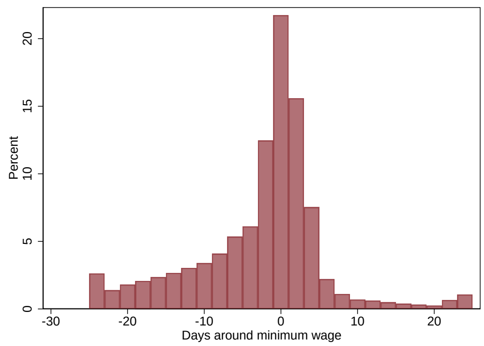
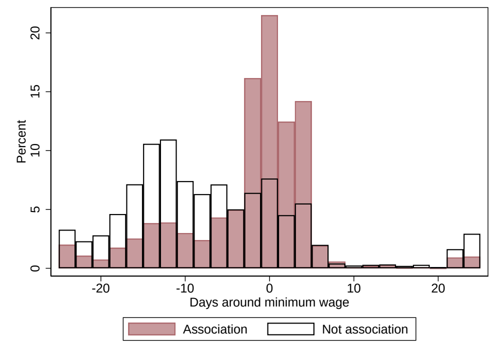
Figures

Figure 1: Bunching at the minimum wage

(a) Wage distribution in the garment industry

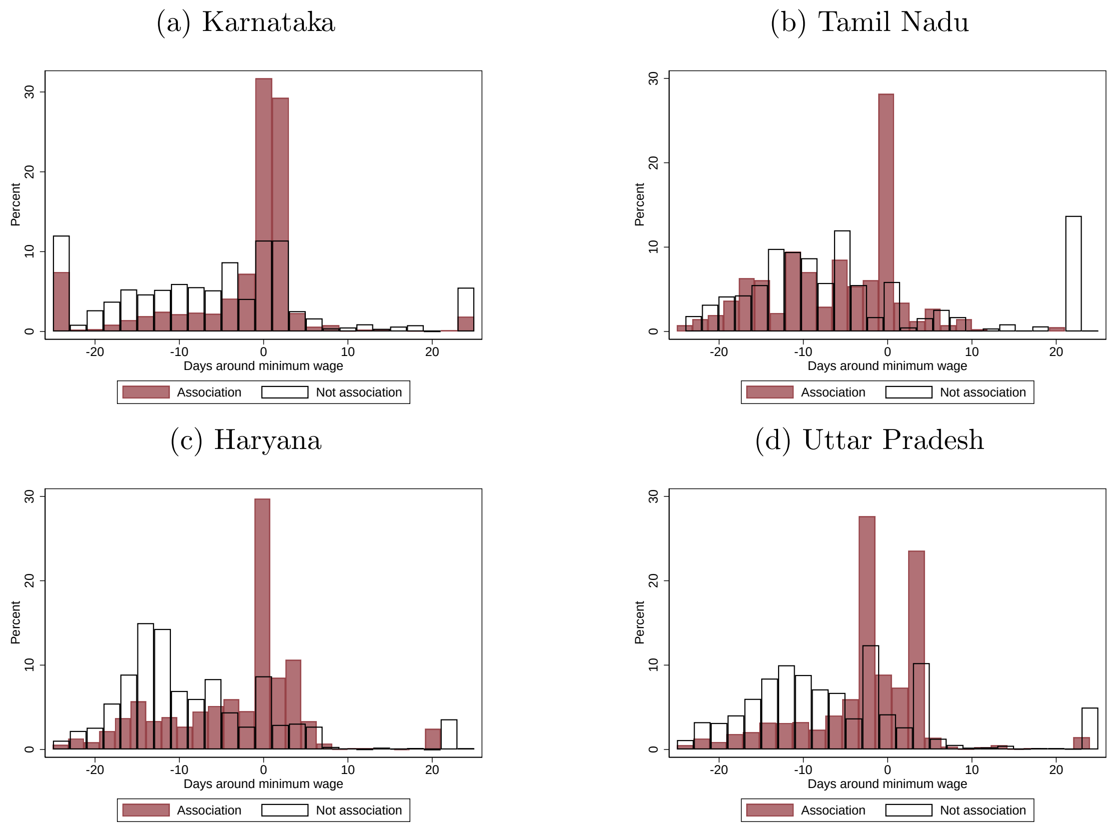


(b) Wage distribution, by association membership



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.

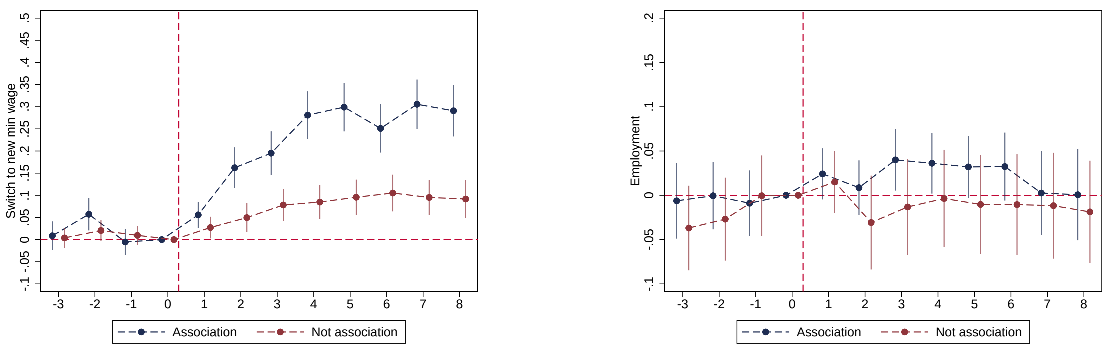
Figure 2: Bunching at the minimum wage across locations



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

Figure 3: Effect of minimum wage increases on wages and employment

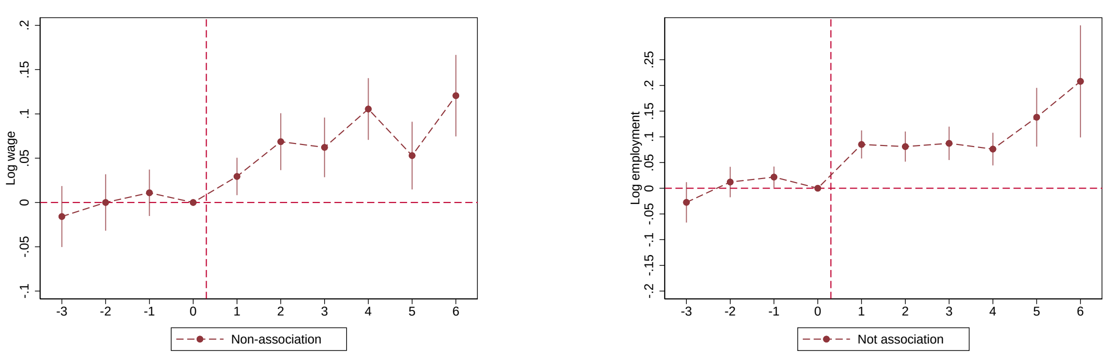
(a) Pay new minimum wage (b) Log employment



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

(a) Log wage (b) Log employment

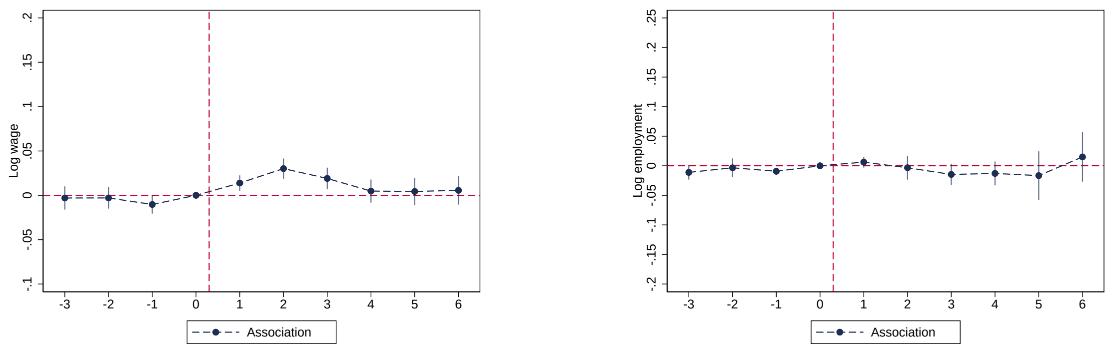


Notes: This figure plots the effect of routine firm-specific demand shocks on the log wage and employment of establishments that are not members of industry associations. It plots estimates of the β_k coefficients for $k \in [-4, 6]$ months around the shock (with $k = -1$ omitted). A firm-specific demand 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 5: 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 6: 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**

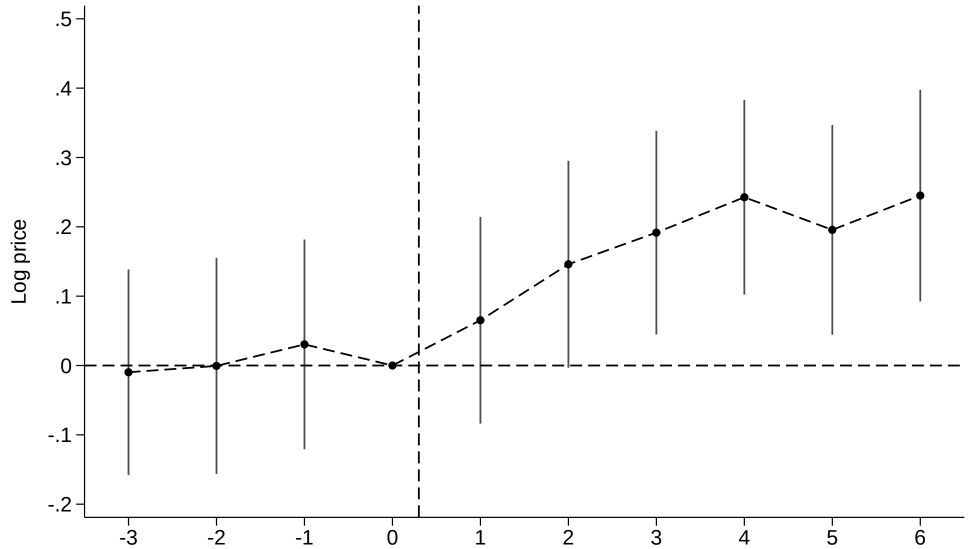
Affected brands

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 7: Effect of large relocation shock on prices

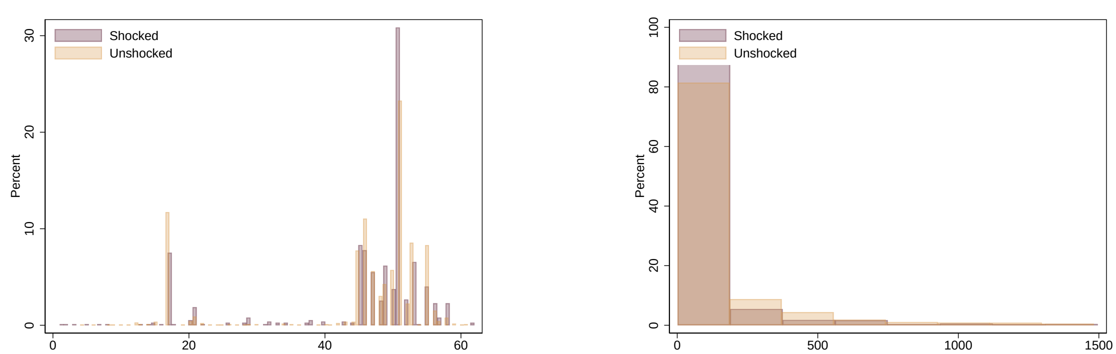
(a) Log price



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 8: Baseline characteristics of affected and unaffected industry association members

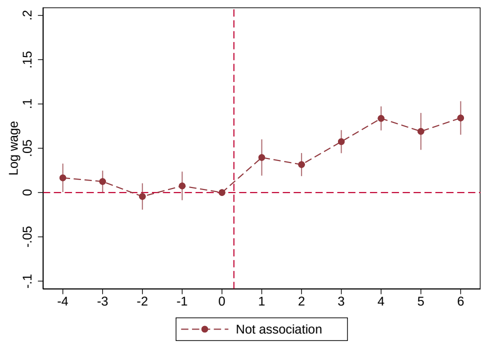
(a) HS-6 code of main export (b) Size



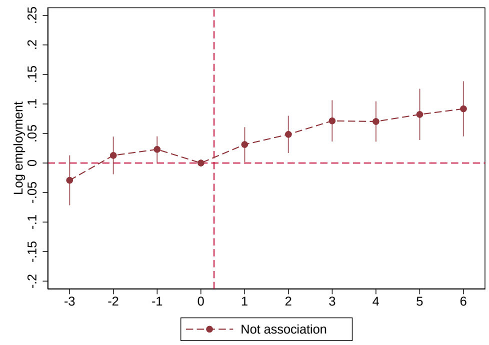
Notes: Panel A plots the distribution of the main 6-digit HS code product exported by affected and unaffected members of the industry association at baseline. The main export is defined as the highest value exported product. Panel B plots the distribution of establishment sizes for the two sets of employers.

Figure 9: Effect of large shock on affected non-members

(a) Log wage



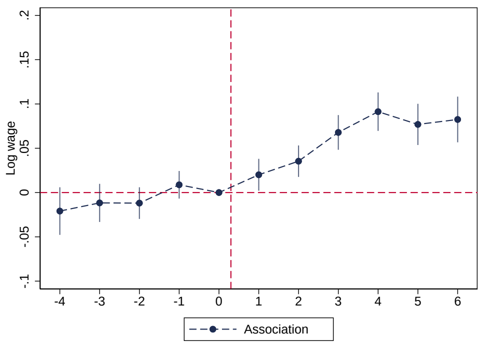
(b) Log employment



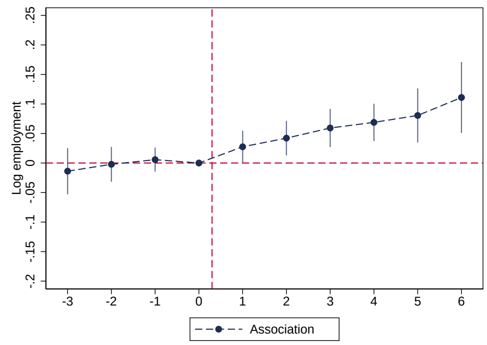
Notes: This figure plots the effect of a relocation demand shock on the log wages and employment of affected employers outside the industry association. The shock led several leading brands to temporarily relocate production to Indian manufacturers. The shock affected 14% of employers in total, and 13% of members of the industry association. The figure plots estimates of the β_k coefficients in equation X 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 10: Effect of large shock on affected industry association members

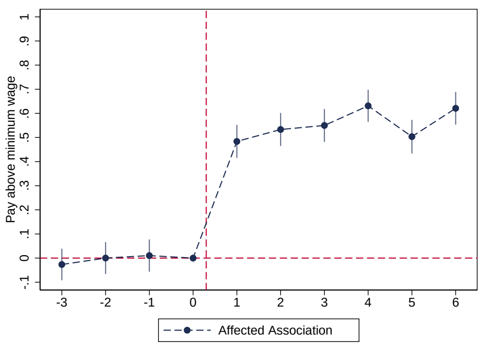
(a) Log wage



(b) Log employment



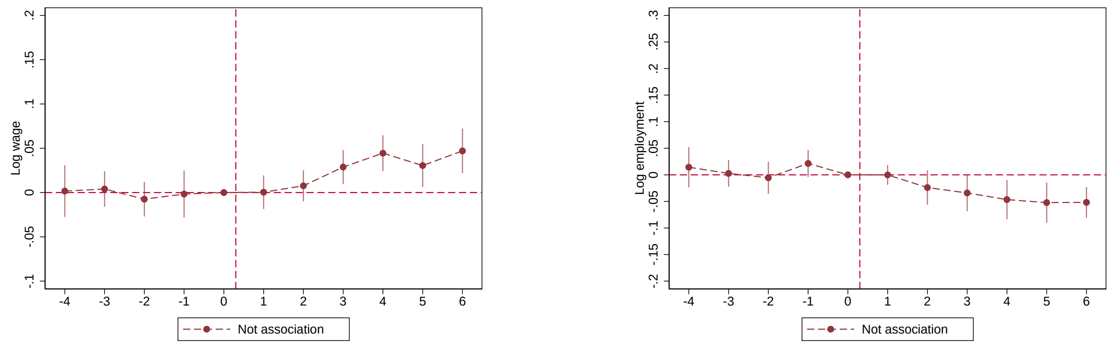
(c) Pay above the minimum wage (indicator)



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 X 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 11: Spillover effects on unaffected non-members

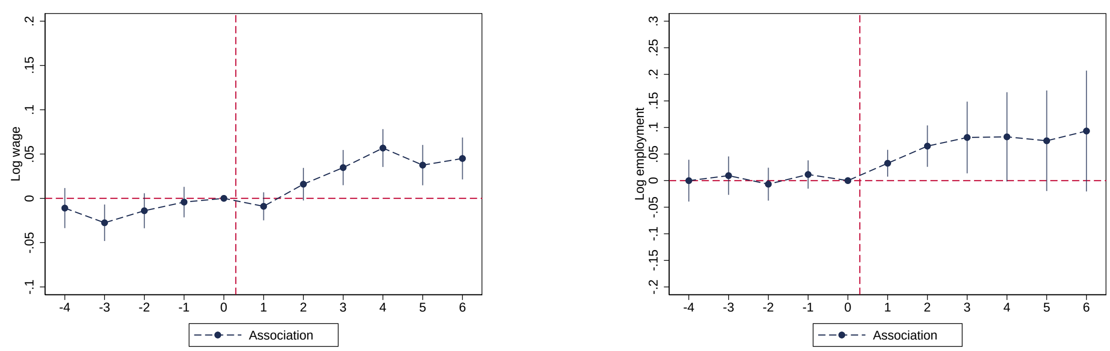
(a) Log wage (b) Log employment



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 X 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.

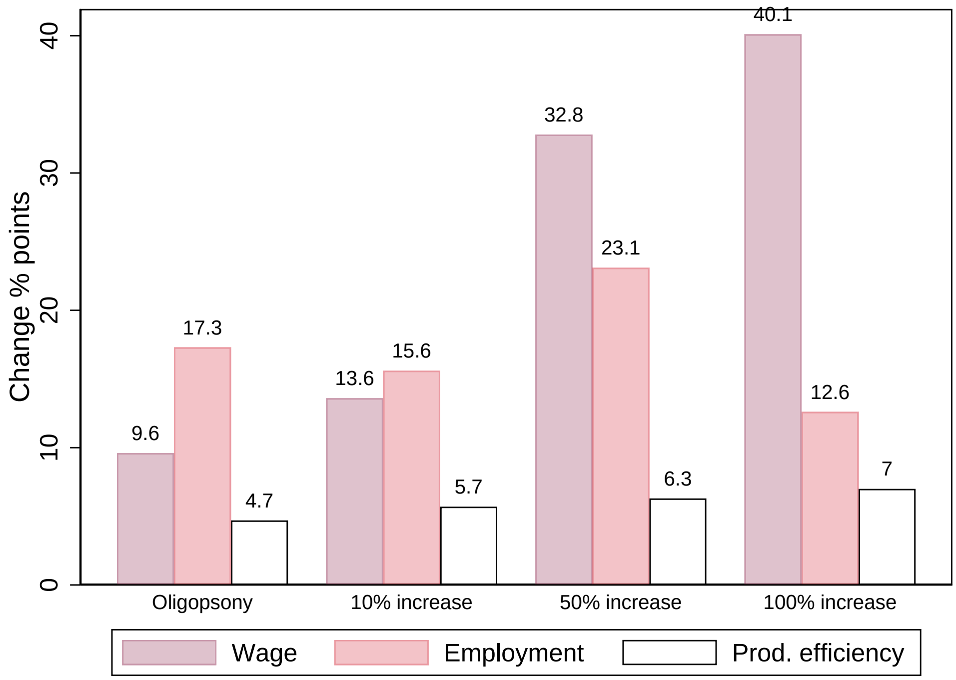
Figure 12: Spillover effects on unaffected members of the industry association

(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 X 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: Counterfactual results



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

Tables

Table 1: 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 2: Characteristics of industry associations

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

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

Table 3: Test of conduct

	Cournot Oligopsony	Collusion at min wage $\rightarrow$ optimal collusion
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.

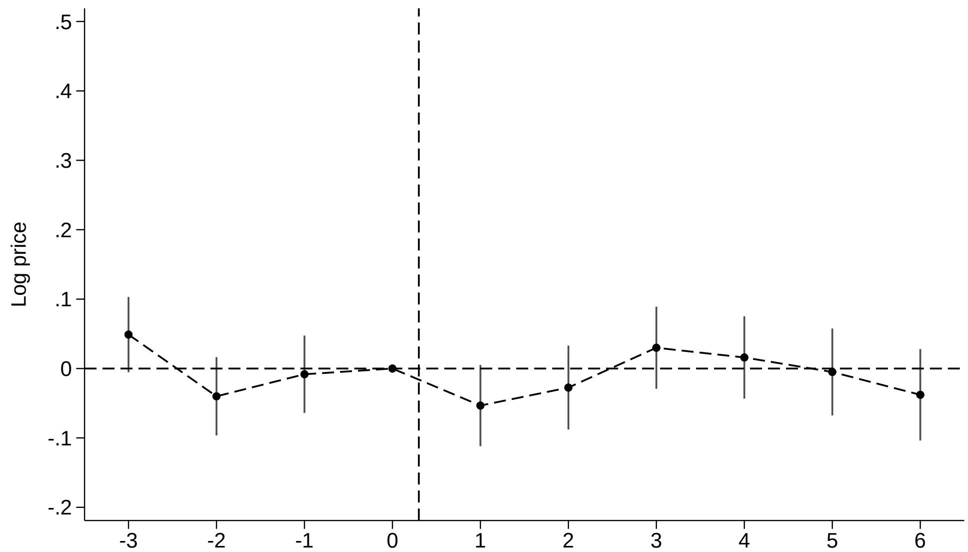
Table 4: Model parameters for counterfactuals

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).

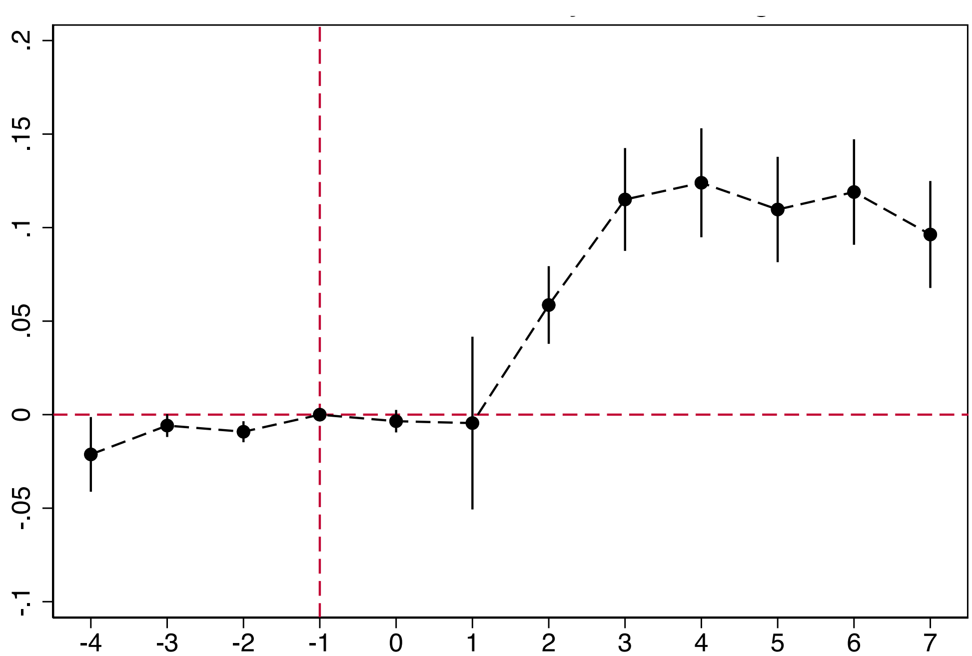
Appendix Figures

Figure A1: Prices of unaffected exporters



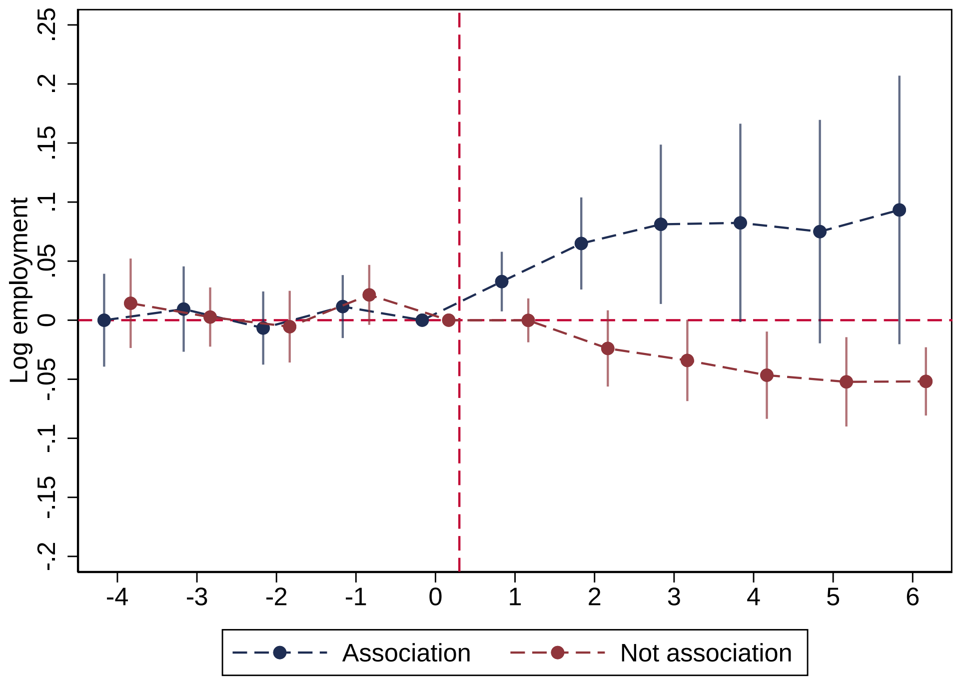
Notes: This figure plots the event study estimates of the effect of the relocation shock on prices at unaffected exporters.

Figure A2: Effect on adding new importer, non-members



Notes: This figure plots the effect on a dummy variable for adding a new importer.

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



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

8 Appendix: Proofs

I make the following assumptions.

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

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

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

8.1 Proofs of Propositions

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

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

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

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

Proof. This proof derives closely from Amiti et al. (2019).

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[32]:

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

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

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

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[33]:

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

[33] Assuming that no firm rations employment is equivalent to assuming that firms are on their labor supply curve. Firms may instead ration employment if the minimum wage is too high and binds from above, i.e. more workers supply labor than demanded. Nonetheless, under Assumptions 1, 2, and 3, oligopsony or monopsony would never predict a positive spillover effect on employment. When the minimum wage binds from above, spillovers weakly increase wages

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

Substituting from (3), and given $\frac{dlnw_{1t}}{dlnz_{jt}} < 0$:

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

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

Equation (6) 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 5). But this statement must hold for each employer with declining wages. However, if all firms whose wages decline gain workers exclusively from other firms that also lower wages, then at least one of these firms must lose workers on net. But this is impossible if the said firm's optimal wage response is negative (equation 6). 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, $\frac{dlnw_{j't}}{dlnz_{jt}} > 0 \ \forall j' \in \mathbf{J} \setminus j$ if $\frac{\partial lnn_{j'}}{\partial lnw_j} \leq 0 \ \forall \ j' \in \mathbf{J} \setminus j$. Consider the shocked employer j. Her optimal response is to increase her wage $\frac{dlnw_{jt}}{dlnz_{jt}} > 0$—this is easily seen from equation 2, where all other employers weakly increase their wage and $dlnz_{jt} > 0$. Given this, returning to equation 4 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 (6).

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

and weakly reduce employment at competitor 1. A rotation to labor supply following a firm-specific demand shock to j that induces j to raise wages, may leave competitor 1's wage and employment unchanged, if the minimum wage continues to be too high, keeping 1 on its labor demand curve. For a large enough rotation to supply, 1 will increase her wage and reduce employment.

since fewer workers now supply labor to 1 at the same wage (mathematically, the second term in equation 5 captures this effect).

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

Other factor markets (materials), and the product market The results hold when other factor markets are perfectly competitive (the standard assumption in the literature on labor market power, e.g. Delabastita & Rubens 2023, Yeh et al. 2022), or when production is Leontief in materials. The latter is a natural assumption for the garment industry. The results also remain true when the product market is perfectly competitive, or when, regardless of the nature of competition, the revenue function exhibits diminishing marginal product. Perfect competition in the product market is a natural assumption for the highly traded garment industry, where each factory is a tiny player in the global market.

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

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

Proof. I consider a labor market featuring both a cartel that coordinates to pay a focal point wage ($\mathbf{J_{cartel}} \in \mathbf{J}$), and a fringe that does not collude ($\mathbf{J_{fringe}} \in \mathbf{J} \setminus \mathbf{J_{cartel}}$). Fringe firms optimize individual profits by taking the cartel's behavior as given. The collusive strategy is to pay the focal point wage until some fraction of members, x, deviate from the focal point wage, and, upon deviation, to switch to oligopsony for T periods. The precise values of x and T are immaterial to the proof; as is the choice of Bertrand or Cournot oligopsony. A firm colludes if $\sum_{T+1} \Pi_{collusion} > \Pi_{deviation} + \sum_{T} \Pi_{oligopsony}$ (where the profits are determined in equilibrium). For simplicity, I consider productivity for (unshocked) firms to be determinate. Thus, $\Pi_{collusion}$ and $\Pi_{oligopsony}$ are identical across periods for each firm. Given $\Pi_{deviation} > 0$, a firm can only collude if $\Pi_{collusion} > \Pi_{oligopsony}$.

Consider a positive, demand shock to firm $j \in \mathbf{J}_{cartel}$ ($dlnz_j > 0$) that causes collusion to break down. I assume a small shock, such that $j' \in \mathbf{J}_{cartel} \setminus j$ revert to outcomes "close" to the original oligopsony.[34] I aim to show that $\exists\ j' \in \mathbf{J_{cartel}} \backslash j$ for which $\frac{dlnn_{j'}}{dlnz_j} > 0$. I proceed by considering three cases.

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

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

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

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

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

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

I aim to show $\frac{dlnw_{1t}}{dlnz_{jt}} < 0$. The above equation shows that this is already true if all other employers (cartel + fringe) reduce their wage. Say, though, to the contrary, that $\frac{dlnw_{1t}}{dlnz_{jt}} > 0$. Following the argument from Proposition 1, 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 lose workers on net if other firms with higher wages gain workers exclusively from other firms that also increase their wage — but it is impossible for the said firm to gain workers on net if it increaseses its wage (equation (6)). We have arrived at a contradiction, and $w_{j'',olig} < w_{j'',coll}\ \forall\ j' \in \mathbf{J_{fringe}}$ if $w_{j',olig} < w_{j',coll} \forall j' \in \mathbf{J_{cartel}}$. As shown, this implies higher employment at some cartel member.

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

[34] The empirical shock I study satisfies formal conditions of a "small enough" shock. Formalism soon added.

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

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

First consider the case without a fringe. Say, to the contrary, that $n_{j',olig} < n_{j',coll} \forall j' \in \mathbf{J_{cartel}} \setminus j$. Given upward-sloping labor supply to the market, it is impossible for each employer to pay higher wages to hire fewer workers. Thus, $\exists$ at least one firm $j' \in \{\mathbf{cartel} \setminus j\}$ s.t. $n_{j',olig} > n_{j',coll}$, and $\frac{dlnn_{j't}}{dlnz_{jt}} > 0$.

Now consider the addition of a fringe. Per the argument above, if the optimal wage response of a fringe member 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. Therefore, if fringe employers increase wages, then at least one former cartel member must increase employment $n > n_{j',coll}$.

I argue that it is impossible for unshocked fringe employers to reduce wages when $w_{j',olig} > w_{j',coll} \forall j' \in \mathbf{J_{cartel}}$. Say, to the contrary that, $\frac{dlnw_{1t}}{dlnz_{jt}} < 0$. These employers must then be gaining workers on net from other firms that reduce their wage. The connected substitutes property implies that fringe firms cannot poach workers from cartel members who now pay higher wages (since $\sum_{j' \in \mathbf{J_{cartel}}} \frac{\partial lnn_1}{\partial lnw_j} dlnw_{j'} < 0$ 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 other firms that also reduce their wage — but it is impossible for the said firm to lose workers on net if it reduces its wage (equation (6)). We have arrived at a contradiction, and fringe firms must increase wages. As shown, the desired result is implied.

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

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

9 Appendix: Other Derivations

9.1 Model derivations

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

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

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

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

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

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

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

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

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

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

$$\bar{W}_{krt} = (\sum_{j' \in k,r} (a_{j't} w_{j't})^{1+\eta})^{\frac{1}{1+\eta}}$$

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

$$\bar{W}_t = (\sum_r \bar{W}_r^{1+\lambda})^{\frac{1}{1+\lambda}}$$

And the following employment indices:

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

$$N_{rt} = (\sum_{k \in r} (a_k^{-1} N_{krt})^{\frac{1+\theta}{\theta}})^{\frac{\theta}{1+\theta}}$$

$$N_t = (\sum_r N_{rt}^{\frac{1+\lambda}{\lambda}})^{\frac{\lambda}{1+\lambda}}$$

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

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

I invert the labor supply curve in three steps:

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

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

Next:

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

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

Finally:

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

Together, these yield the inverse labor supply curve:

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

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

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

Before doing so, I prove a useful lemma:

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

Proof:

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

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

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

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

9.2 Test of conduct: change in optimal markdown

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

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

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

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